Technical Service Information

BMW, AUDI, PORSCHE
Technicians Guide

INDEX

AUTOMATIC TRANSMISSION SERVICE GROUP

INTRODUCTION
BMW, AUDI, PORSCHE

Published
September, 2003

This booklet contains information that has not normally been available in most OEM repair manuals and can be used by the technician to diagnose electrical concerns, identify the location and direction of the valves, springs, retainers and bore plugs in the valve body. This information has been prepared from actual valve bodies and in some cases may vary from one model to another, but is invalueable when the need arises to diagnose and repair electrical and valve body concerns.

This Manual covers the following models:

- ***ZF-4HP-18FLE/FLA Transaxle, found in Audi and Porsche.***
- ***ZF-4HP-22/24 Series, Model "E7", "5 Solenoid" Valve Body found in various vehicles.***
- ***ZF-4HP-22/24 Series, Model "E9", "4 Solenoid" Valve Body found in various vehicles.***
- ***ZF-5HP-18 Series, found in various BMW models.***
- ***ZF-5HP-19FL Transaxle, found in various BMW models.***
- ***ZF-5HP-24 Series, found in various BMW models.***
- ***ZF-5HP-30 Series, found in various BMW models and Rolls Royce.***

The information and part numbers contained in this booklet have been carefully compiled from industry sources known for their reliability, but ATSG does not guarantee its accuracy.

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We wish to thank the following for supplying the actual valve bodies that have made these illustrations possible.

ZF-4HP-18FLE AND ZF-4HP-18FLA
DIAGNOSTIC INFORMATION

The ZF-4HP-18FLE is mounted longitudinal in the front of the vehicle, and was produced in 2 Wheel Drive models (FLE) and All Wheel Drive (FLA) models, as shown in Figure 1. This unit is totally electronic controlled and is totally different than any 4-HP-18 unit that you are currently familiar with.

ZF-4HP-18FLE And ZF-4HP-18FLA Is Found In The Following Vehicles;

Audi - - - 100 Quatro, A6 1991-1997
Audi - - - A8 1994-1996
Porsche - - - 944 1991-1994

There has been very little pertinent information published on these units. The information in this bulletin has been prepared from an actual transaxle and valve body, and has been formulated to provide you with the preliminary information needed to diagnose and repair electrical and valve body concerns.

Refer to Figure 1 for illustrations of both the 4-HP-18FLE (2WD) and 4-HP-18FLA (AWD) models.

Refer to Figure 2 for internal component resistance charts and connector pin identification.

Refer to Figure 3 for complete wiring schematic with computer terminal identification and transaxle terminal identification, which makes it easier for electrical diagnosis.

Refer to Figure 4 for the solenoid application chart and component application chart.

Refer to Figure 5 for illustration of the complete valve body assembly.

Refer to Figure 6 for exploded view of oil filter and oil filter transfer plate.

Refer to Figure 7 for exploded view of the manual valve body.

Refer to Figure 8 for exploded view of the solenoid body, and notice that it provides you with the factory setting for the adjustment on the pressure regulator valve for EDS-1 solenoid. The Legend for Figure 8 which identifies the solenoid body components and solenoids is found on Page 13.

Refer to Figure 9 for exploded view of the valve body assembly components.

Refer to Figure 10 for exploded detail view of the "Rear Side" of the main valve body. The Legend for Figure 10 which identifies the main valve body components is found on Page 16.

Continued on Page 5

SPECIAL NOTE:
All nomenclatures in this booklet are ATSG interpretations, not Audi's nor ZF.

Continued from Page 4.

Refer to Figure 11 for exploded detail view of the "Front Side" of the main valve body.

Refer to Figure 12 for valve body spring specifications. The spring dimensions listed in Figure 12 were "Observations" from only one valve body, and may vary from one model to another.

Refer to Figure 13 for Solenoid Body screen and retainer locations, and to Figure 14 for the Manual Valve Body retainer locations.

Refer to Figure 15 for the Main Valve Body "Top Side" retainer locations, check valve and checkball locations, and the locations of the small flat disc orifices.

Refer to Figure 16 for the Main Valve Body "Bottom Side" check valve location, and the location of the small flat disc orifices.

Refer to Figure 17 for location of the small flat disc orifices in the channel plate.

Refer to Figure 18 for the two pressure tap locations on the back of case.

Refer to Page 22 for explanation of Safety Mode Valve operation.

Refer to Page 23 for complete color hydraulic schematic.

SPECIAL NOTE:
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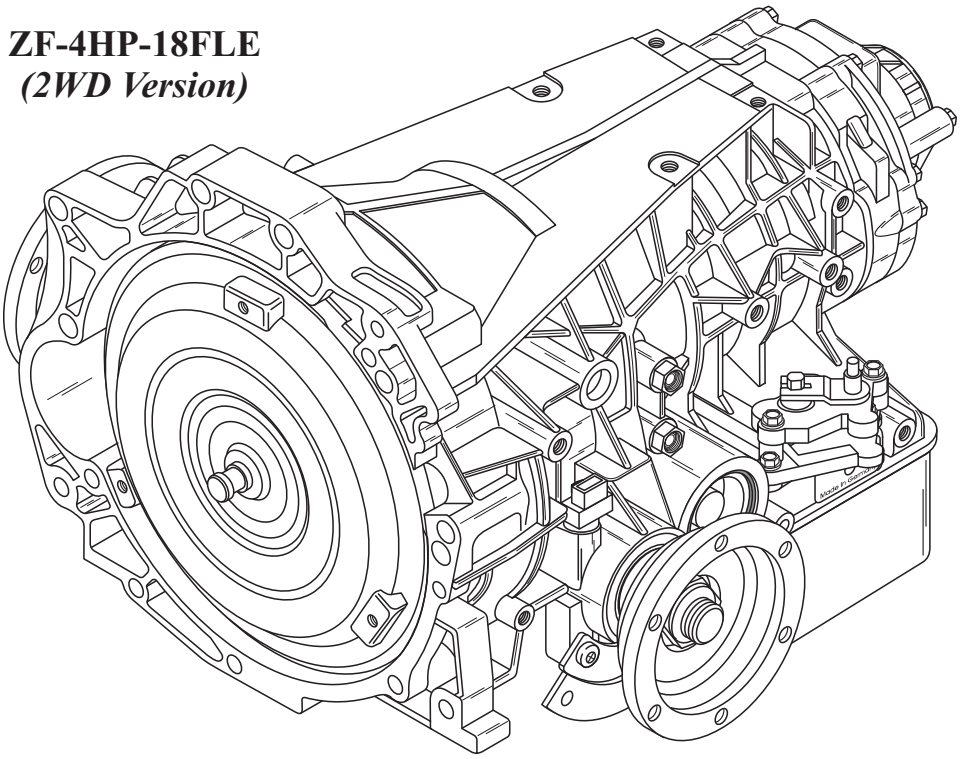
ZF-4HP-18FLE
(2WD Version)



ZF-4HP-18FLA
(A*WD Version)*

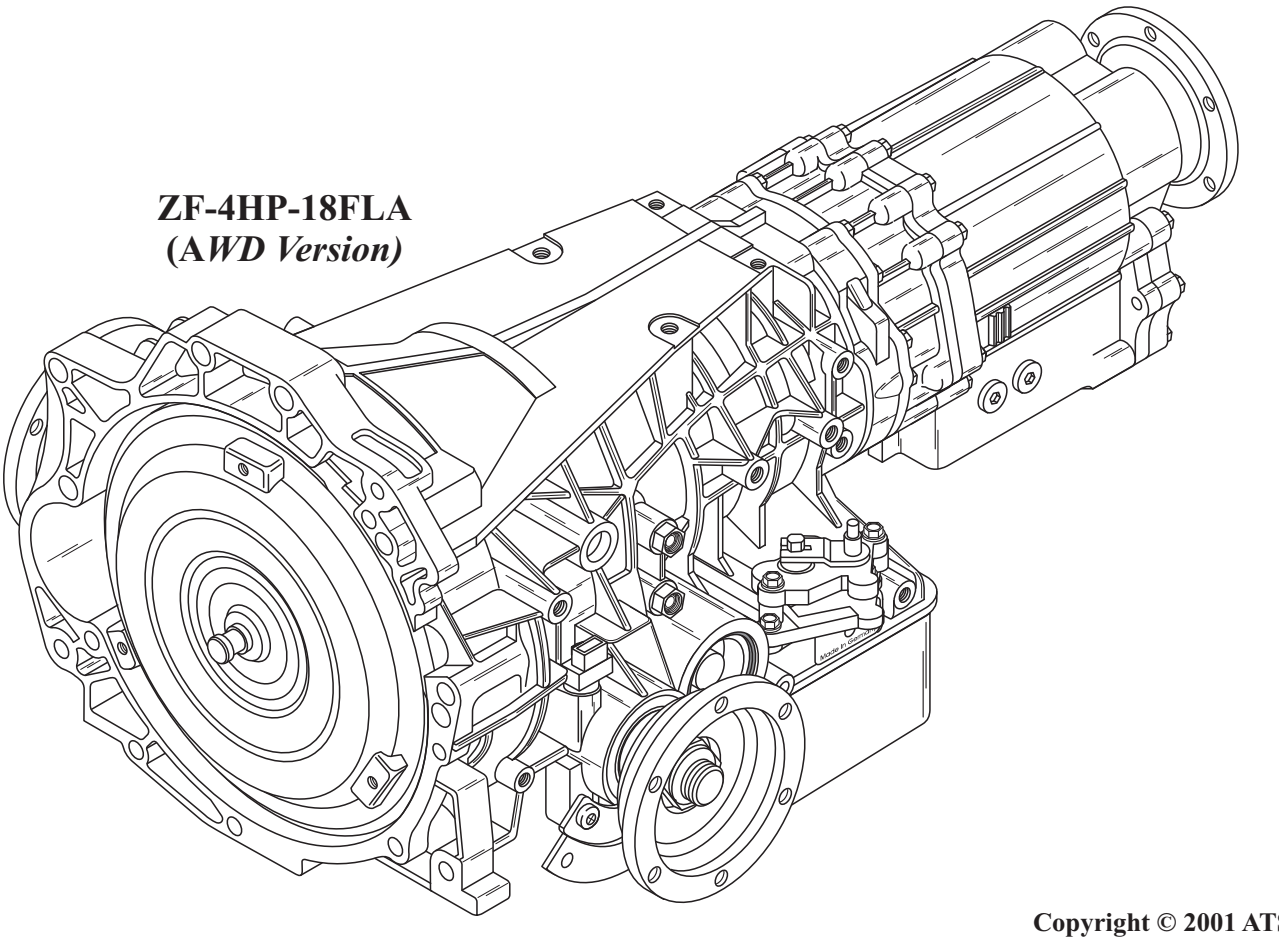
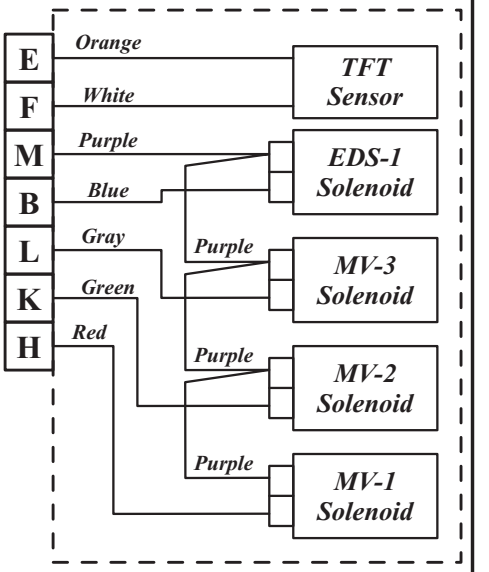


Figure 1

RESISTANCE CHARTS AND TERMINAL IDENTIFICATION

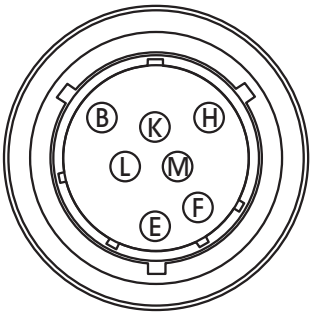
Internal Component	Connector Terminals	Resistance In Ohms
MV-1 Solenoid	M & H	30-40 Ohms @ 68°F (20°C)
MV-2 Solenoid	M & K	30-40 Ohms @ 68°F (20°C)
MV-3 Solenoid	M & L	30-40 Ohms @ 68°F (20°C)
EDS-1 Solenoid	M & B	5-8 Ohms @ 68°F (20°C)
TFT Sensor	E & F	920-960 Ohms @ 68°F (20°C)

SPECIAL NOTE:
Solenoid nomenclatures are ATSG interpretations, not Audi's nor ZF.

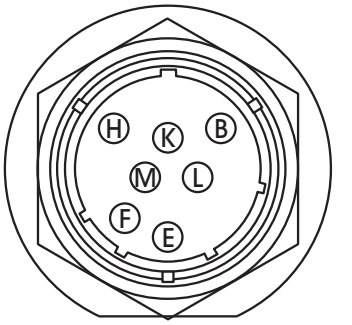


TRANSAXLE SOLENOID CONNECTOR TERMINAL IDENTIFICATION

View Looking Into Vehicle Harness Connector

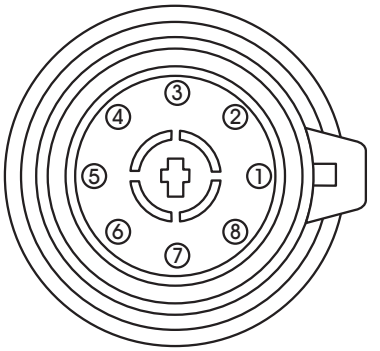


View Looking Into Transaxle Case Connector



TRANSAXLE RANGE SWITCH CONNECTOR TERMINAL IDENTIFICATION

View Looking Into Transaxle Range Switch Vehicle Harness Connector



View Looking Into Transaxle Range Switch Connector

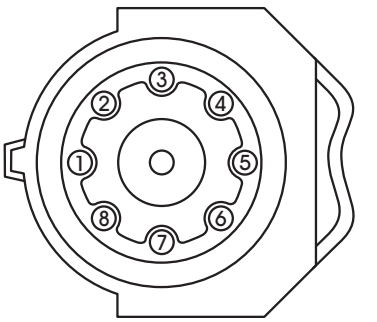


Figure 2

WIRING SCHEMATIC

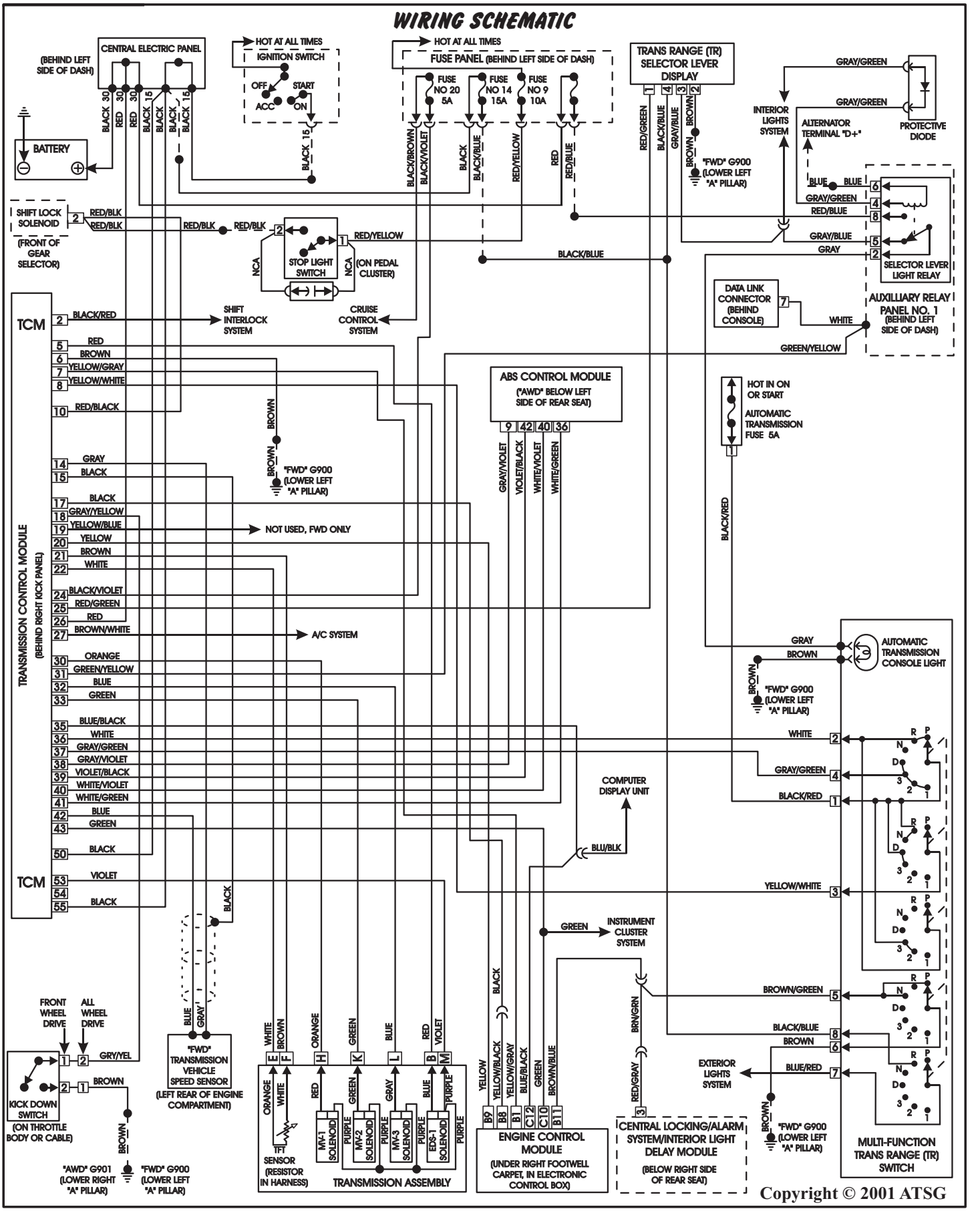


Figure 3

ZF-4HP-18FLE SOLENOID AND COMPONENT APPLICATION CHART										
RANGE	*MV-1 Sol.*	*MV-2 Sol.*	*MV-3 Sol.*	*EDS-1 Sol.*	*"A" Clutch*	*"B" Clutch*	*2-4 Band*	*"C" Clutch*	*"D" Clutch*	"E" Clutch
Park/Neut		*ON*	*ON*	**						
Reverse		*ON*	*	**		*ON*			*ON*	
Drive-1st			*ON*	**	*ON*					
Drive-2nd	*ON*		*ON*	**	*ON*		*ON*	*ON*		
Drive-3rd	*ON*			**	*ON*			*ON*		*ON*
Drive-4th				**			*ON*	*ON*		*ON*
Manual-1st			*ON*	**	*ON*				*ON*	
*"Failsafe" *****				*Max.*	*ON*		*ON*	*ON*		

* *ON For Reverse Inhibit Feature.*

** *Pressure Regulating.*

*** *Electrical failure while in 4th gear, vehicle remains in 4th gear until engine is turned off. When vehicle is once again started, transaxle will be in "Failsafe" 2nd gear. Refer to Page 22 for complete explanation of Safety Mode Valve Operation.*

SPECIAL NOTE:

Solenoid and Clutch nomenclature are ATSG interpretations, not Audi's nor ZF.

Figure 4

ZF-4HP-18FLA/E VALVE BODY COMPLETE

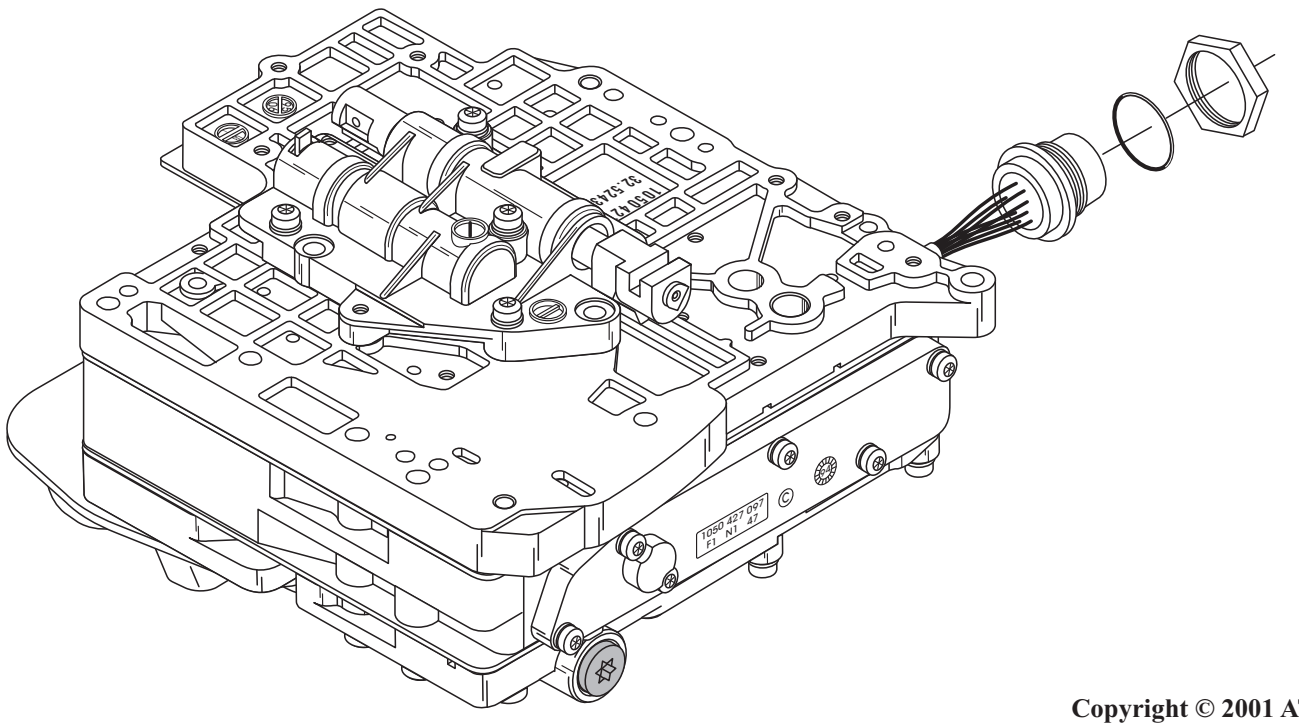
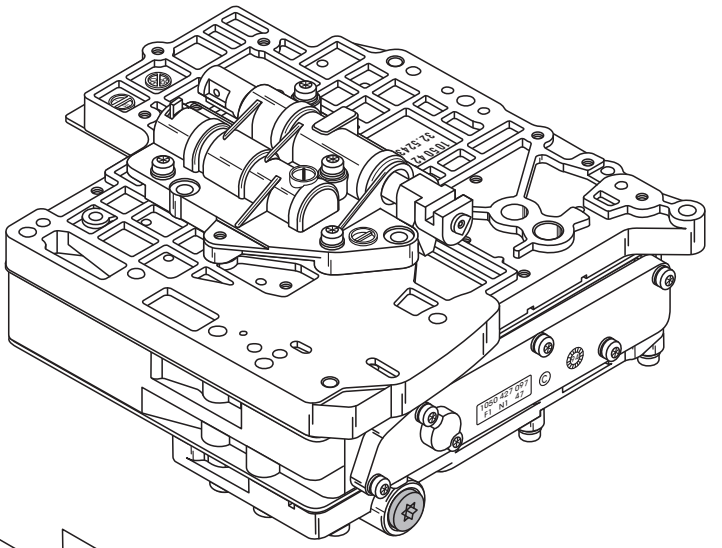
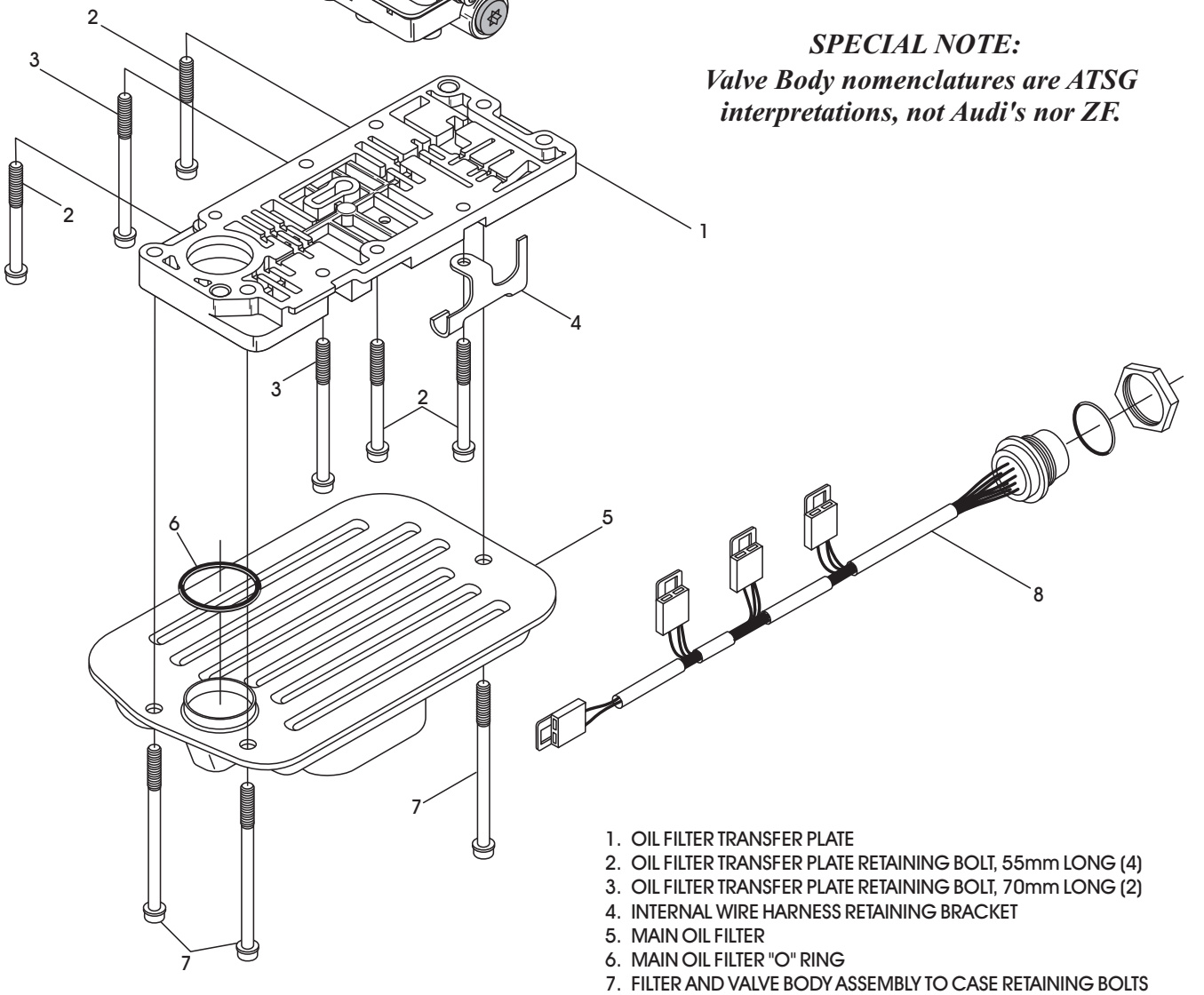


Figure 5

ZF-4HP-18FLA/E OIL FILTER AND FILTER TRANSFER PLATE



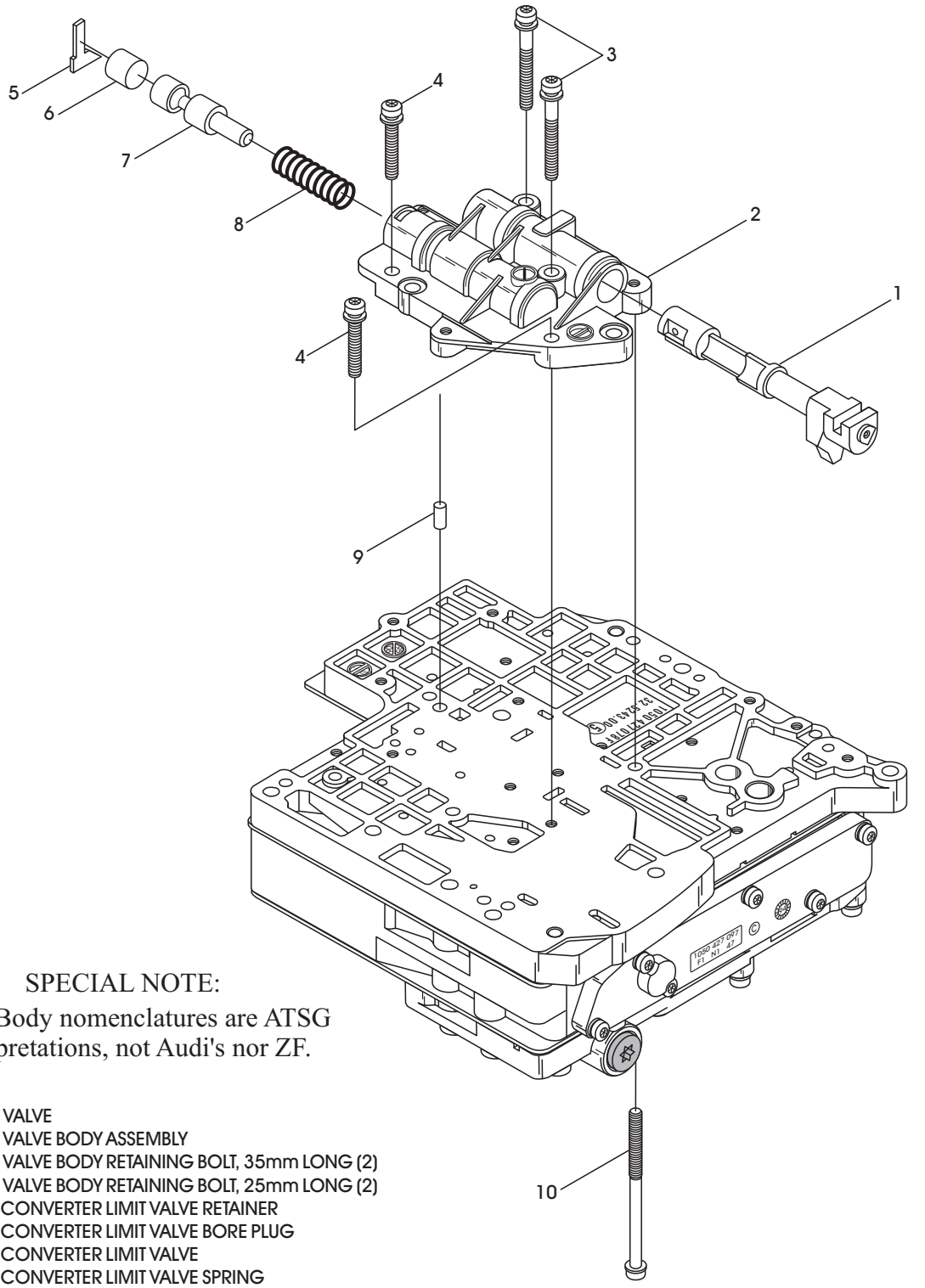


SPECIAL NOTE:
Valve Body nomenclatures are ATSG interpretations, not Audi's nor ZF.

1. OIL FILTER TRANSFER PLATE
2. OIL FILTER TRANSFER PLATE RETAINING BOLT, 55mm LONG (4)
3. OIL FILTER TRANSFER PLATE RETAINING BOLT, 70mm LONG (2)
4. INTERNAL WIRE HARNESS RETAINING BRACKET
5. MAIN OIL FILTER
6. MAIN OIL FILTER "O" RING
7. FILTER AND VALVE BODY ASSEMBLY TO CASE RETAINING BOLTS

Figure 6

ZF-4HP-18FLA/E MANUAL VALVE BODY



SPECIAL NOTE:
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1. MANUAL VALVE
2. MANUAL VALVE BODY ASSEMBLY
3. MANUAL VALVE BODY RETAINING BOLT, 35mm LONG (2)
4. MANUAL VALVE BODY RETAINING BOLT, 25mm LONG (2)
5. TORQUE CONVERTER LIMIT VALVE RETAINER
6. TORQUE CONVERTER LIMIT VALVE BORE PLUG
7. TORQUE CONVERTER LIMIT VALVE
8. TORQUE CONVERTER LIMIT VALVE SPRING
9. ALIGNMENT DOWEL PIN, .235" DIAMETER, .612" LONG
10. LOWER PLATE/MANUAL VALVE BODY BOLT, 65mm LONG (1)

Figure 7

ZF-4HP-18FLA/E SOLENOID VALVE BODY

SPECIAL NOTE:
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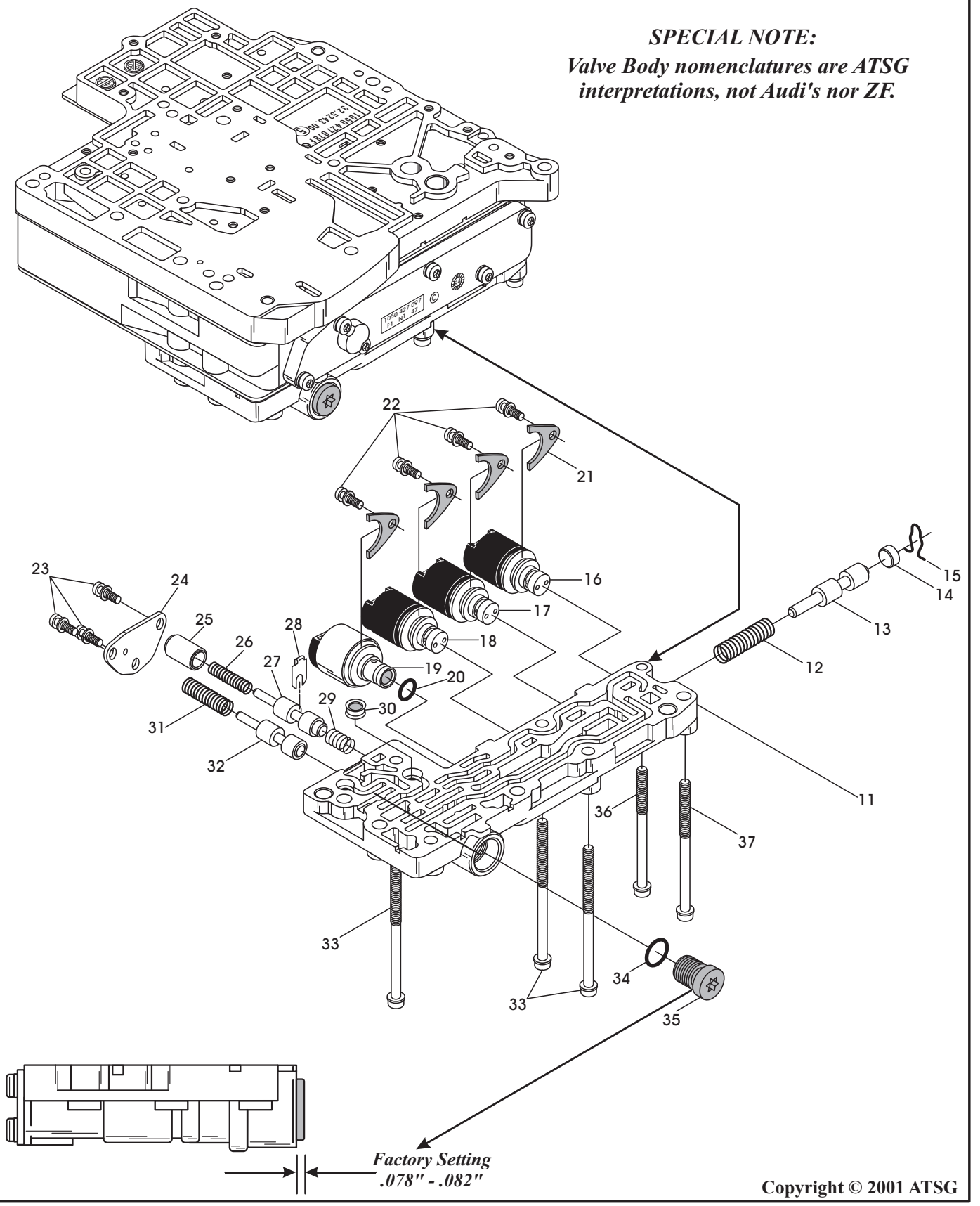


Figure 8

11. SOLENOID VALVE BODY CASTING
12. PRESSURE REGULATOR VALVE SPRING, MV-1 THRU MV-3 SOLENOIDS
13. PRESSURE REGULATOR VALVE, MV-1 THRU MV-3 SOLENOIDS
14. PRESSURE REGULATOR VALVE BORE PLUG, MV-1 THRU MV-3 SOLENOIDS
15. PRESSURE REGULATOR VALVE RETAINING CLIP, MV-1 THRU MV-3 SOLENOIDS
16. MV-1 SOLENOID, OEM PART NUMBER 0501 313 500 (SHIFT CONTROL)
17. MV-2 SOLENOID, OEM PART NUMBER 0501 313 500 (SHIFT CONTROL)
18. MV-3 SOLENOID, OEM PART NUMBER 0501 313 500 (SHIFT CONTROL)
19. EDS-1 SOLENOID, OEM PART NUMBER 0501 311 843 (LINE PRESSURE)
20. EDS-1 SOLENOID "O" RING
21. SOLENOID RETAINING BRACKET (4 REQUIRED)
22. SOLENOID RETAINING BRACKET BOLT, 12mm LONG (4 REQUIRED)
23. RETAINING PLATE BOLT, 12mm LONG (3 REQUIRED)
24. SOLENOID BODY RETAINING PLATE
25. MODULATING VALVE PLUNGER
26. MODULATING VALVE SPRING
27. MODULATING VALVE
28. MODULATING VALVE RETAINING CLIP
29. MODULATING VALVE BALANCE SPRING
30. EDS-1 SOLENOID SCREEN
31. PRESSURE REGULATOR VALVE SPRING, FOR EDS-1 SOLENOID
32. PRESSURE REGULATOR VALVE, FOR EDS-1 SOLENOID
33. SOLENOID VALVE BODY RETAINING BOLT, 70mm LONG (3 REQUIRED)
34. MODULATING VALVE ADJUSTING SCREW "O" RING
35. MODULATING VALVE ADJUSTING SCREW
36. SOLENOID VALVE BODY RETAINING BOLT, 60mm LONG (1 REQUIRED)
37. SOLENOID VALVE BODY RETAINING BOLT, 65mm LONG (1 REQUIRED)

SPECIAL NOTE:
Valve Body nomenclatures are ATSG interpretations, not Audi's nor ZF.

Figure 8 LEGEND

ZF-4HP-18FLA/E COMPONENT ASSEMBLY

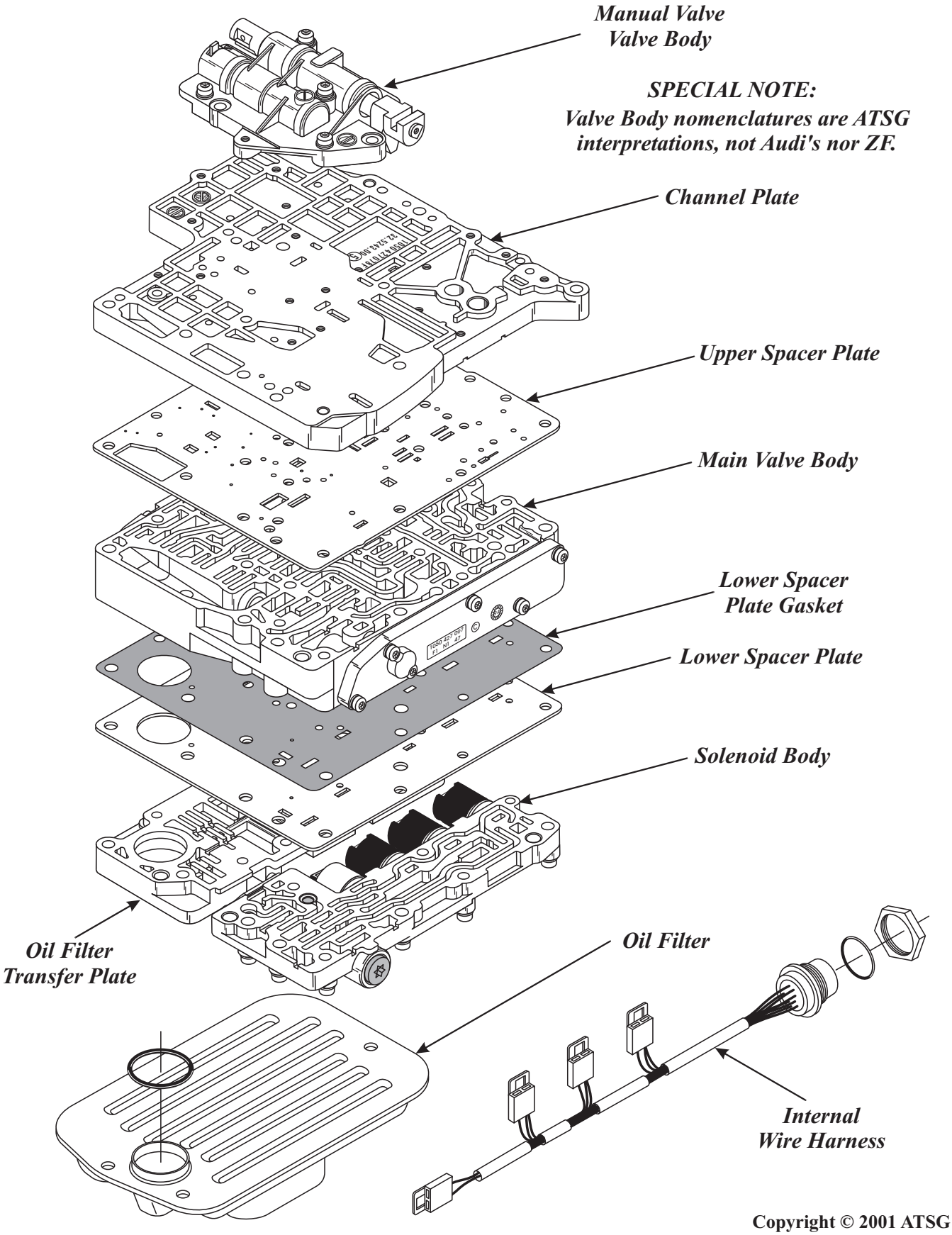
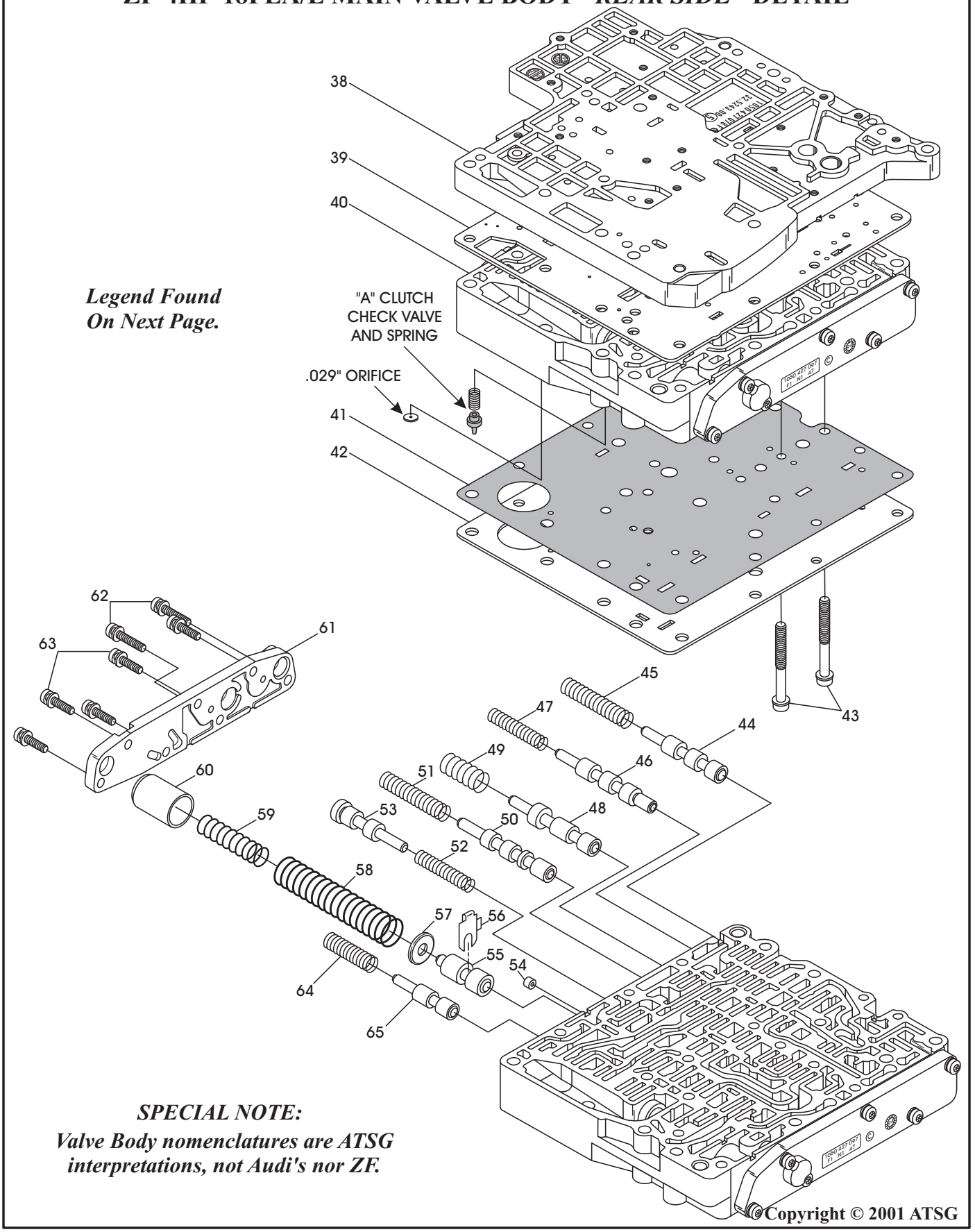


Figure 9

ZF-4HP-18FLA/E MAIN VALVE BODY *"REAR SIDE"* DETAIL

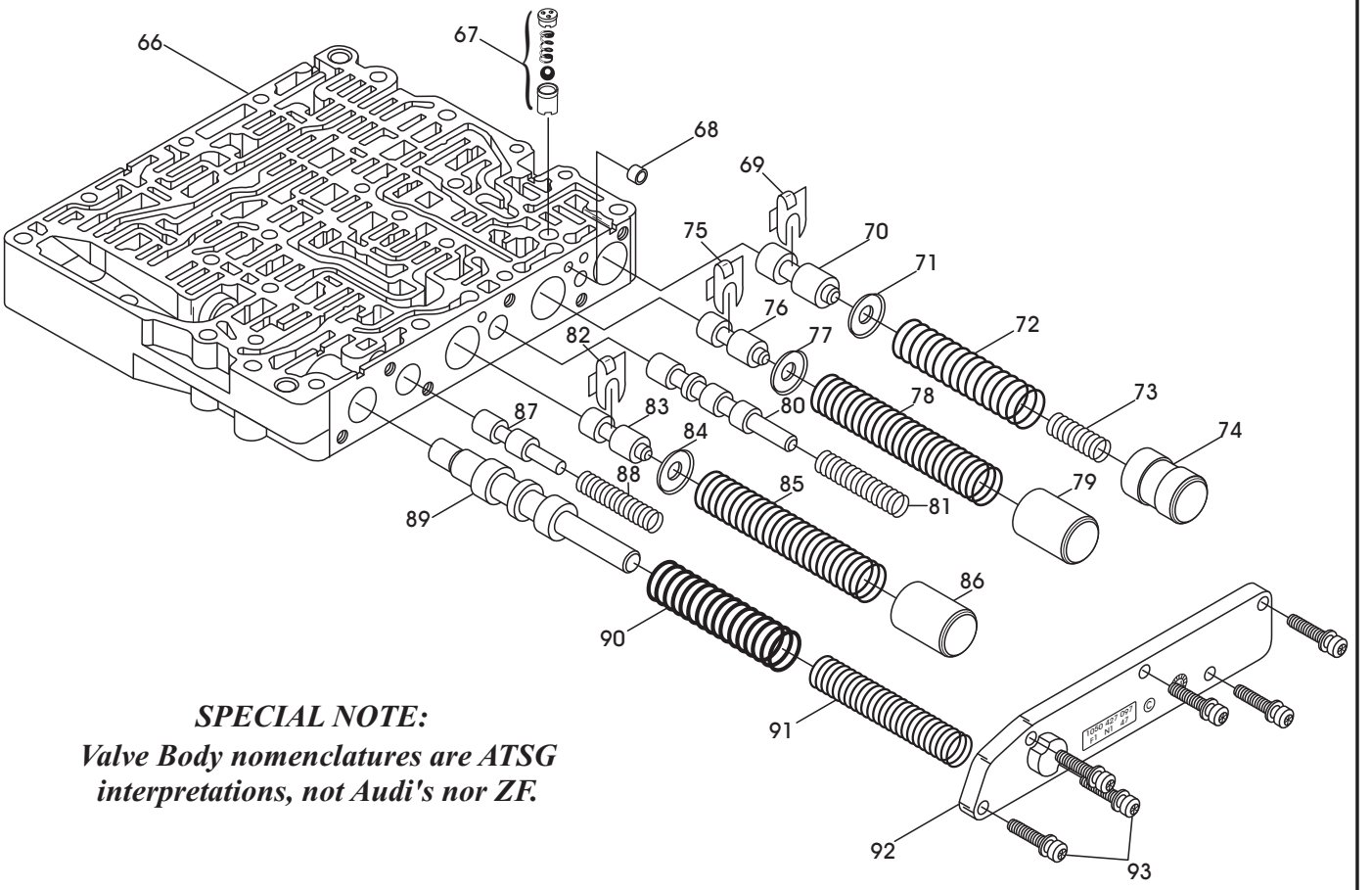


Legend Found On Next Page.

SPECIAL NOTE:
Valve Body nomenclatures are ATSG interpretations, not Audi's nor ZF.

Figure 10

ZF-4HP-18FLA/E MAIN VALVE BODY *"FRONT SIDE"* DETAIL



SPECIAL NOTE:
Valve Body nomenclatures are ATSG interpretations, not Audi's nor ZF.

FIGURE 10 LEGEND
38. CHANNEL PLATE ASSEMBLY
39. UPPER SPACER PLATE
40. MAIN VALVE BODY ASSEMBLY
41. MAIN VALVE BODY TO LOWER SPACER PLATE GASKET
42. LOWER SPACER PLATE
43. SPACER PLATE TO CHANNEL PLATE BOLT, 50mm LONG (2)
44. SHIFT VALVE NUMBER ONE
45. SHIFT VALVE NUMBER ONE SPRING
46. SHIFT VALVE NUMBER TWO
47. SHIFT VALVE NUMBER TWO SPRING
48. SAFETY MODE VALVE
49. SAFETY MODE VALVE SPRING
50. SHIFT VALVE NUMBER THREE
51. SHIFT VALVE NUMBER THREE SPRING
52. 3-4 TRACTION VALVE SPRING
53. 3-4 TRACTION VALVE
54. .060" ORIFICED CUP PLUG IN VALVE BODY CASTING
55. "A" CLUTCH ACCUMULATOR VALVE
56. "A" CLUTCH ACCUMULATOR VALVE RETAINER
57. "A" CLUTCH ACCUMULATOR VALVE SPRING SEAT
58. "A" CLUTCH ACCUMULATOR OUTER SPRING
59. "A" CLUTCH ACCUMULATOR INNER SPRING
60. "A" CLUTCH ACCUMULATOR PLUNGER
61. REAR SIDE VALVE RETAINING COVER
62. REAR SIDE COVER RETAINING SCREWS, 22mm LONG (2)
63. REAR SIDE COVER RETAINING SCREWS, 18mm LONG (5)
64. "C" CLUTCH TRACTION VALVE SPRING
65. "C" CLUTCH TRACTION VALVE

FIGURE 11 LEGEND
66. MAIN VALVE BODY CASTING
67. "D" CLUTCH ONE-WAY CHECK VALVE, (.020" ORIFICE)
68. .070" ORIFICED CUP PLUG IN VALVE BODY CASTING
69. "D" CLUTCH ACCUMULATOR VALVE RETAINER
70. "D" CLUTCH ACCUMULATOR VALVE
71. "D" CLUTCH ACCUMULATOR VALVE SPRING SEAT
72. "D" CLUTCH ACCUMULATOR OUTER SPRING
73. "D" CLUTCH ACCUMULATOR INNER SPRING
74. "D" CLUTCH ACCUMULATOR PLUNGER
75. "C" CLUTCH ACCUMULATOR VALVE RETAINER
76. "C" CLUTCH ACCUMULATOR VALVE
77. "C" CLUTCH ACCUMULATOR VALVE SPRING SEAT
78. "C" CLUTCH ACCUMULATOR SPRING
79. "C" CLUTCH ACCUMULATOR PLUNGER
80. 1ST AND REVERSE VALVE
81. 1ST AND REVERSE VALVE SPRING
82. "E" CLUTCH ACCUMULATOR VALVE RETAINER
83. "E" CLUTCH ACCUMULATOR VALVE
84. "E" CLUTCH ACCUMULATOR VALVE SPRING SEAT
85. "E" CLUTCH ACCUMULATOR SPRING
86. "E" CLUTCH ACCUMULATOR PLUNGER
87. 4-3 TRACTION VALVE
88. 4-3 TRACTION VALVE SPRING
89. MAIN LINE PRESSURE REGULATOR VALVE
90. MAIN LINE PRESSURE REGULATOR VALVE OUTER SPRING
91. MAIN LINE PRESSURE REGULATOR VALVE INNER SPRING
92. FRONT SIDE VALVE RETAINING COVER
93. FRONT SIDE COVER RETAINING SCREWS, 18mm LONG (6)

Figure 11

ZF 4HP-18FLA/E SPRING SPECIFICATIONS

Manual Valve Body	*Solenoid Valve Body*	*Main Valve Body* "Back Side"	*Main Valve Body* "Front Side"
SPRING ILLUSTRATION NO. 8 FREE LENGTH = 1.618" SPRING DIAMETER = .495" WIRE DIAMETER = .062"	SPRING ILLUSTRATION NO. 12 FREE LENGTH = 1.688" SPRING DIAMETER = .375" WIRE DIAMETER = .042"	SPRING ILLUSTRATION NO. 45: FREE LENGTH = 1.865" SPRING DIAMETER = .382" WIRE DIAMETER = .035"	SPRING ILLUSTRATION NO. 72: FREE LENGTH = 2.860" SPRING DIAMETER = .612" WIRE DIAMETER = .048"
	SPRING ILLUSTRATION NO. 26 FREE LENGTH = 1.475" SPRING DIAMETER = .320" WIRE DIAMETER = .042"	SPRING ILLUSTRATION NO. 47: FREE LENGTH = 1.595" SPRING DIAMETER = .365" WIRE DIAMETER = .031"	SPRING ILLUSTRATION NO. 73: FREE LENGTH = 1.589" SPRING DIAMETER = .429" WIRE DIAMETER = .035"
	SPRING ILLUSTRATION NO. 29 FREE LENGTH = .760" SPRING DIAMETER = .370" WIRE DIAMETER = .028"	SPRING ILLUSTRATION NO. 49: FREE LENGTH = 1.194" SPRING DIAMETER = .443" WIRE DIAMETER = .031"	SPRING ILLUSTRATION NO. 78: FREE LENGTH = 3.530" SPRING DIAMETER = .575" WIRE DIAMETER = .039"
	SPRING ILLUSTRATION NO. 31 FREE LENGTH = 1.530" SPRING DIAMETER = .340" WIRE DIAMETER = .042"	SPRING ILLUSTRATION NO. 51: FREE LENGTH = 1.832" SPRING DIAMETER = .364" WIRE DIAMETER = .031"	SPRING ILLUSTRATION NO. 81: FREE LENGTH = 1.815" SPRING DIAMETER = .365" WIRE DIAMETER = .031"
		SPRING ILLUSTRATION NO. 52: FREE LENGTH = 1.289" SPRING DIAMETER = .298" WIRE DIAMETER = .027"	SPRING ILLUSTRATION NO. 85: FREE LENGTH = 3.530" SPRING DIAMETER = .575" WIRE DIAMETER = .039"
		SPRING ILLUSTRATION NO. 58: FREE LENGTH = 3.216" SPRING DIAMETER = .590" WIRE DIAMETER = .042"	SPRING ILLUSTRATION NO. 88: FREE LENGTH = 1.712" SPRING DIAMETER = .361" WIRE DIAMETER = .031"
		SPRING ILLUSTRATION NO. 59: FREE LENGTH = 1.592" SPRING DIAMETER = .432" WIRE DIAMETER = .035"	SPRING ILLUSTRATION NO. 90: FREE LENGTH = 2.909" SPRING DIAMETER = .605" WIRE DIAMETER = .066"
		SPRING ILLUSTRATION NO. 64: FREE LENGTH = 1.514" SPRING DIAMETER = .363" WIRE DIAMETER = .038"	SPRING ILLUSTRATION NO. 91: FREE LENGTH = 3.612" SPRING DIAMETER = .445" WIRE DIAMETER = .042"

Special Note:

The spring dimensions listed above were "Observations" from only one valve body, and may vary from one model to another.

Figure 12

ZF-4HP-18FLE/FLA
SOLENOID BODY RETAINER AND SCREEN LOCATIONS

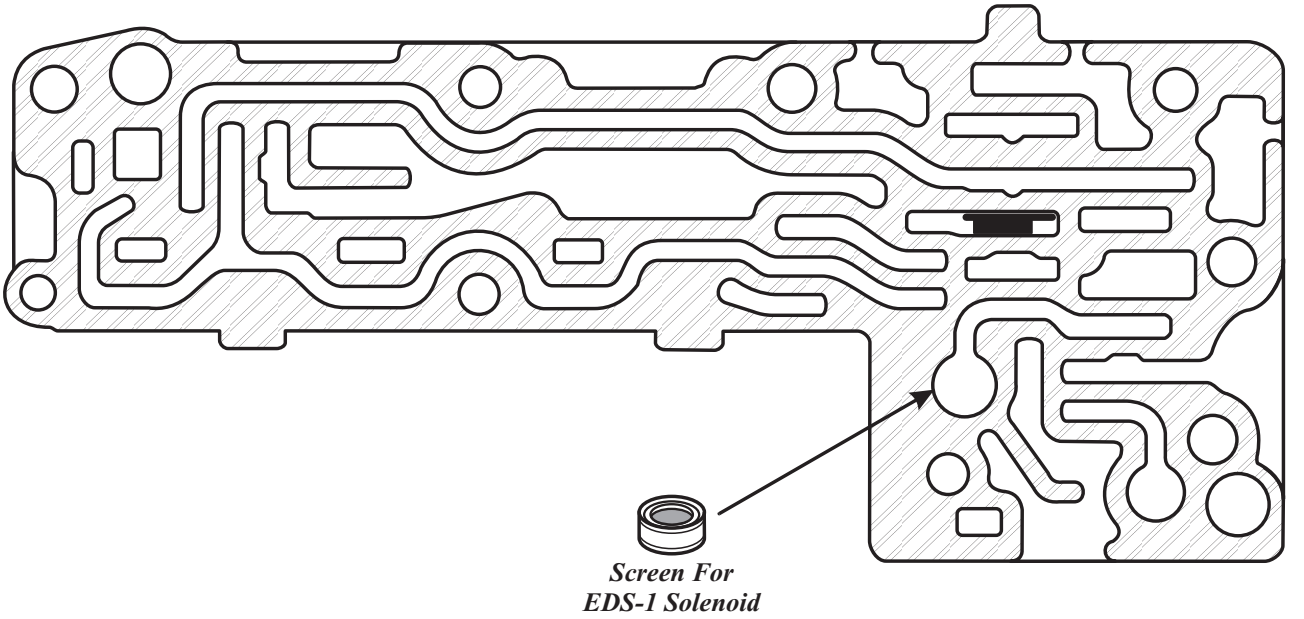


Figure 13

ZF-4HP-18FLE/FLA
MANUAL VALVE BODY RETAINER LOCATIONS

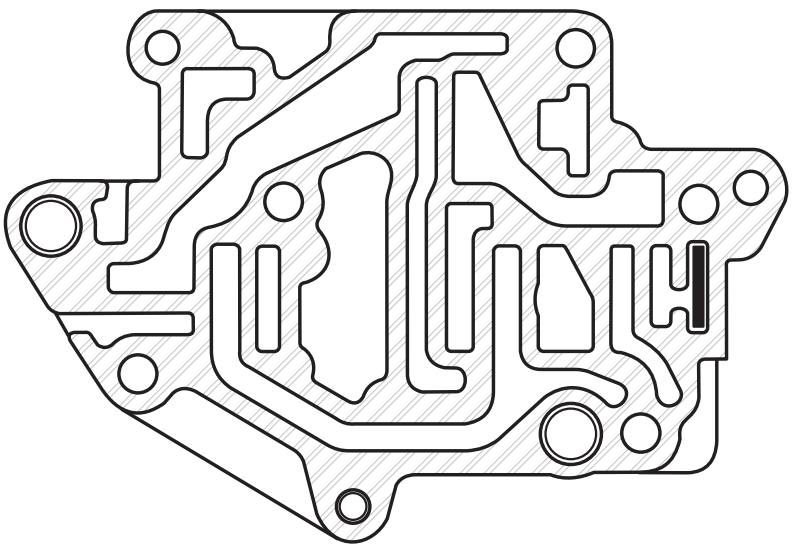


Figure 14

ZF-4HP-18FLE/FLA

MAIN VALVE BODY BODY *"TOP SIDE"* RETAINER AND ORIFICE LOCATIONS

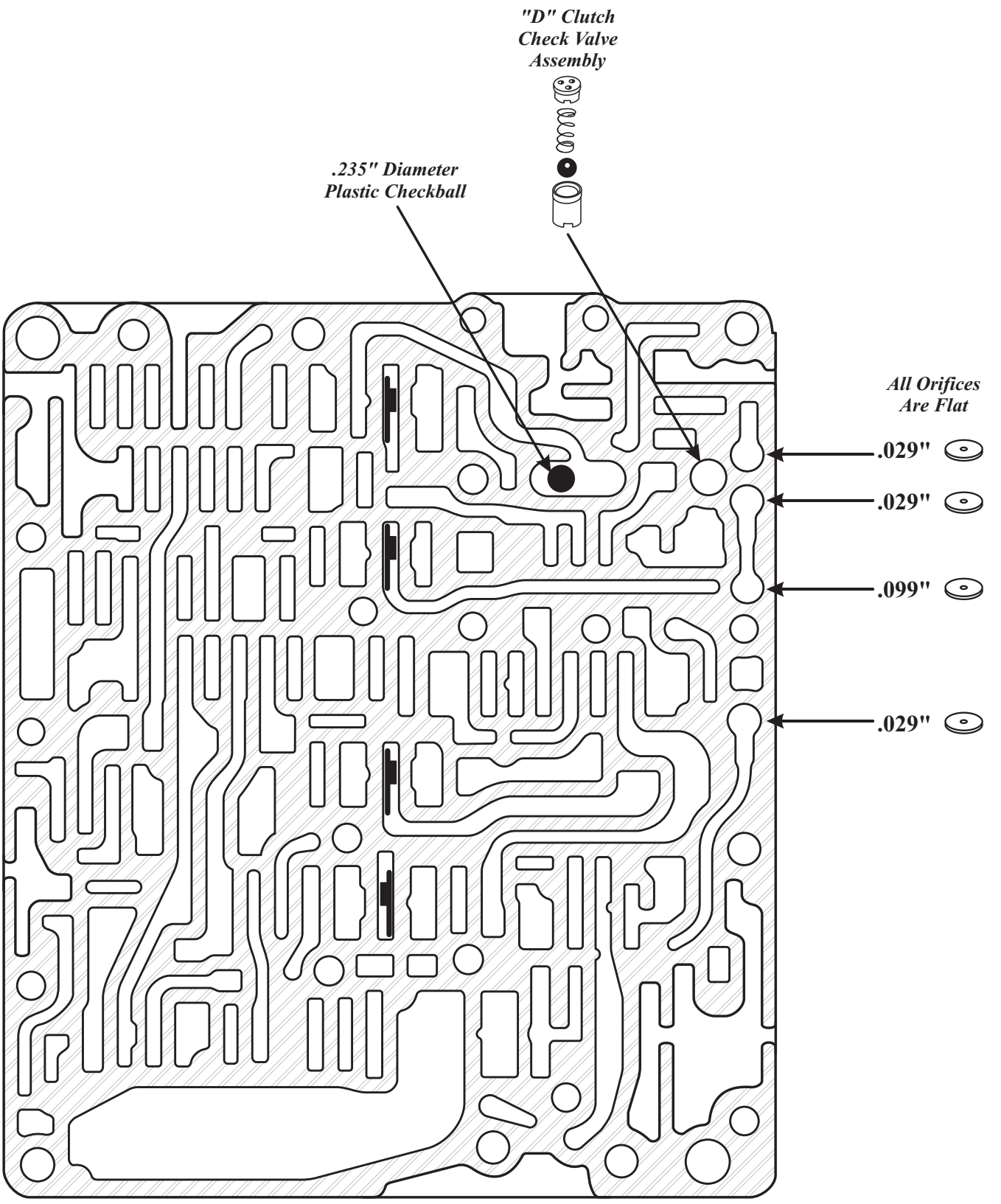


Figure 15

ZF-4HP-18FLE/FLA

MAIN VALVE BODY BODY *"BOTTOM SIDE"* VALVE AND ORIFICE LOCATIONS

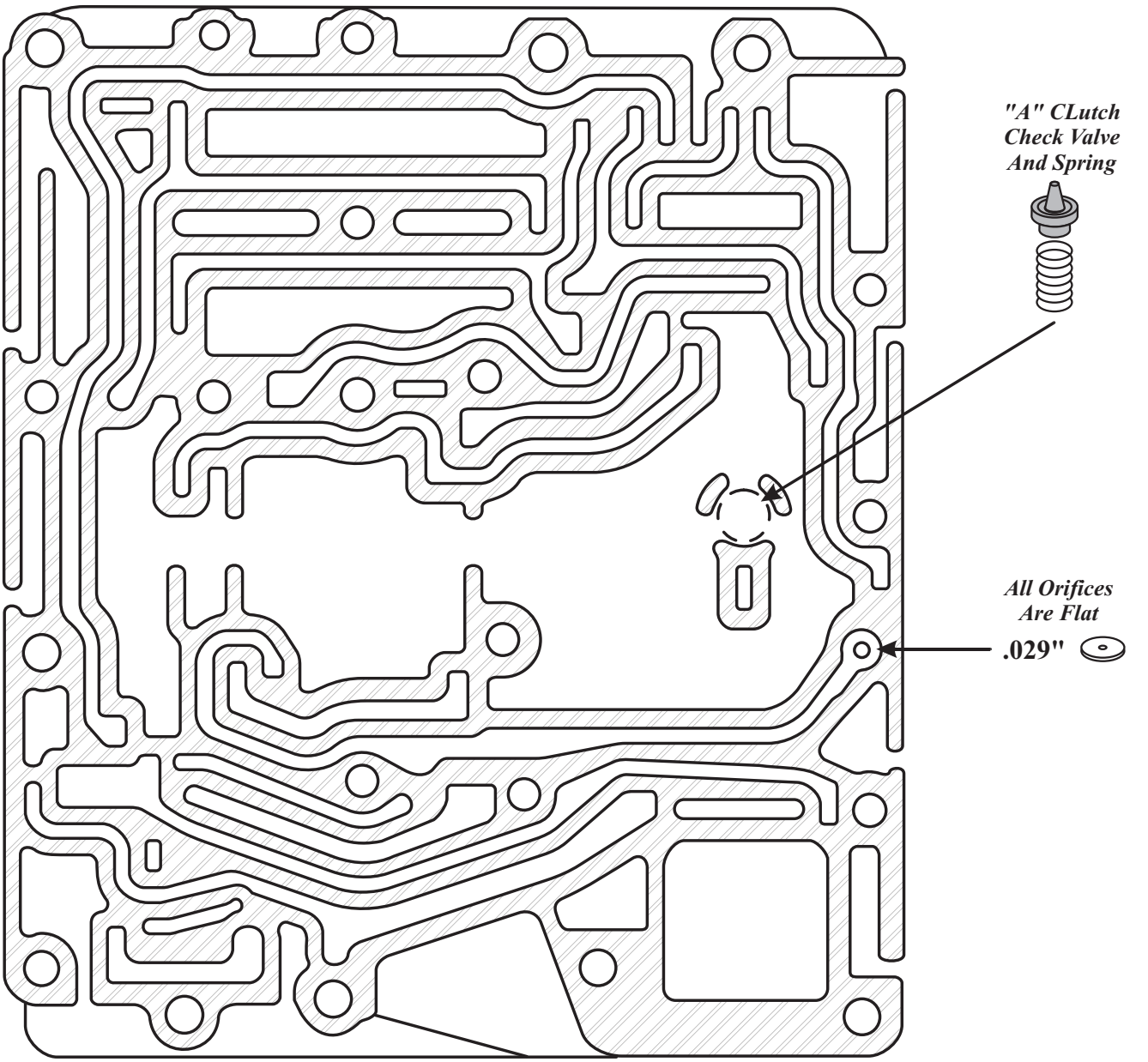


Figure 16

ZF-4HP-18FLE/FLA

CHANNEL PLATE ORIFICE LOCATIONS

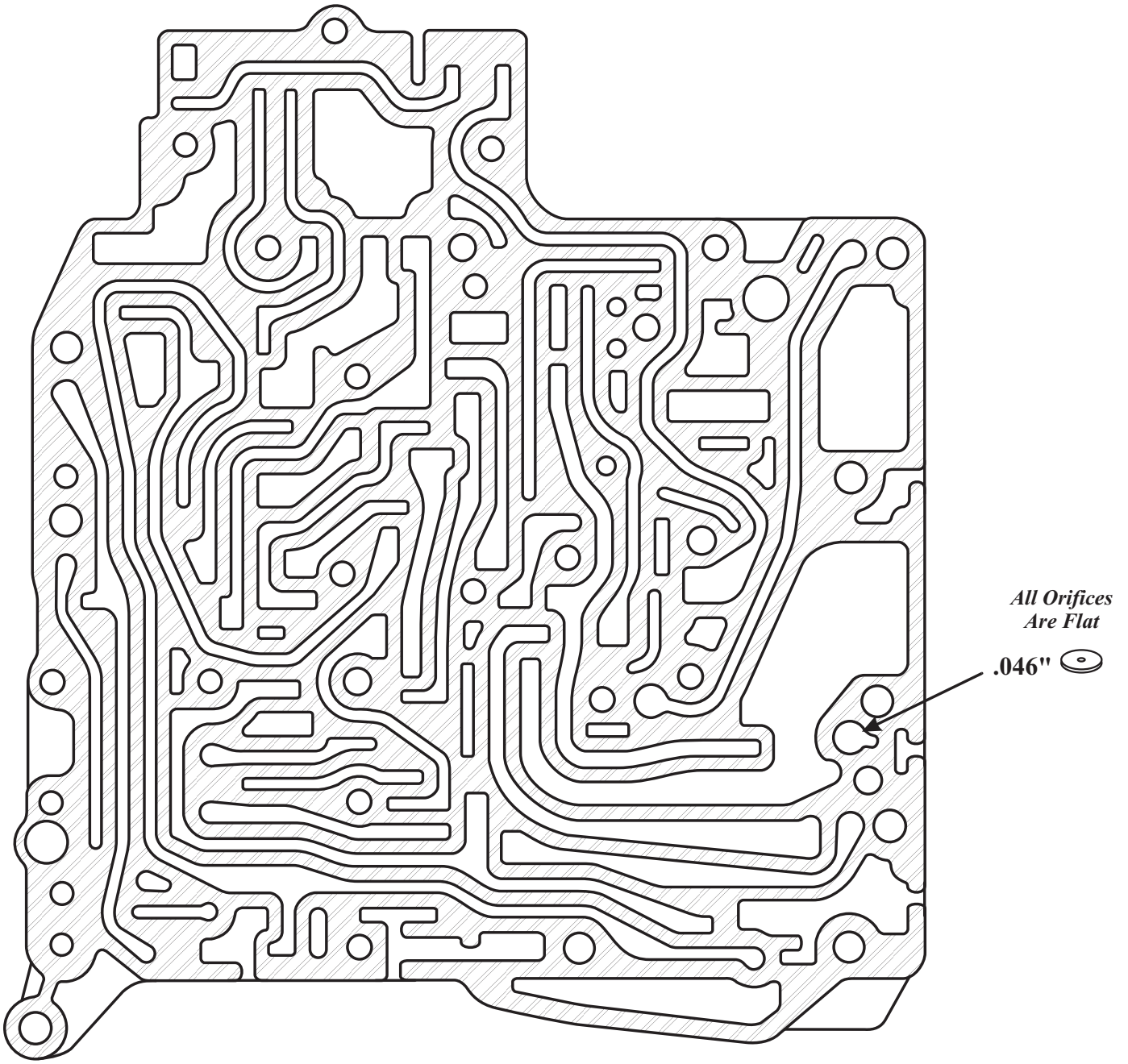
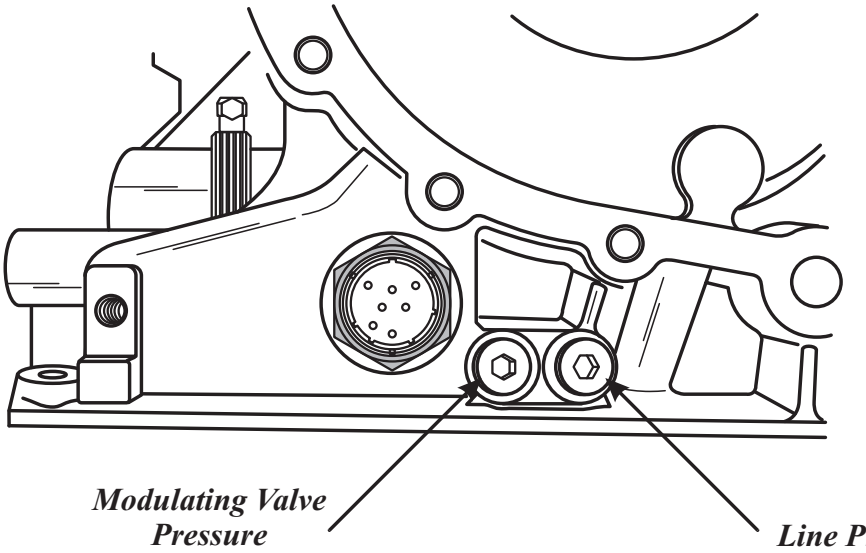
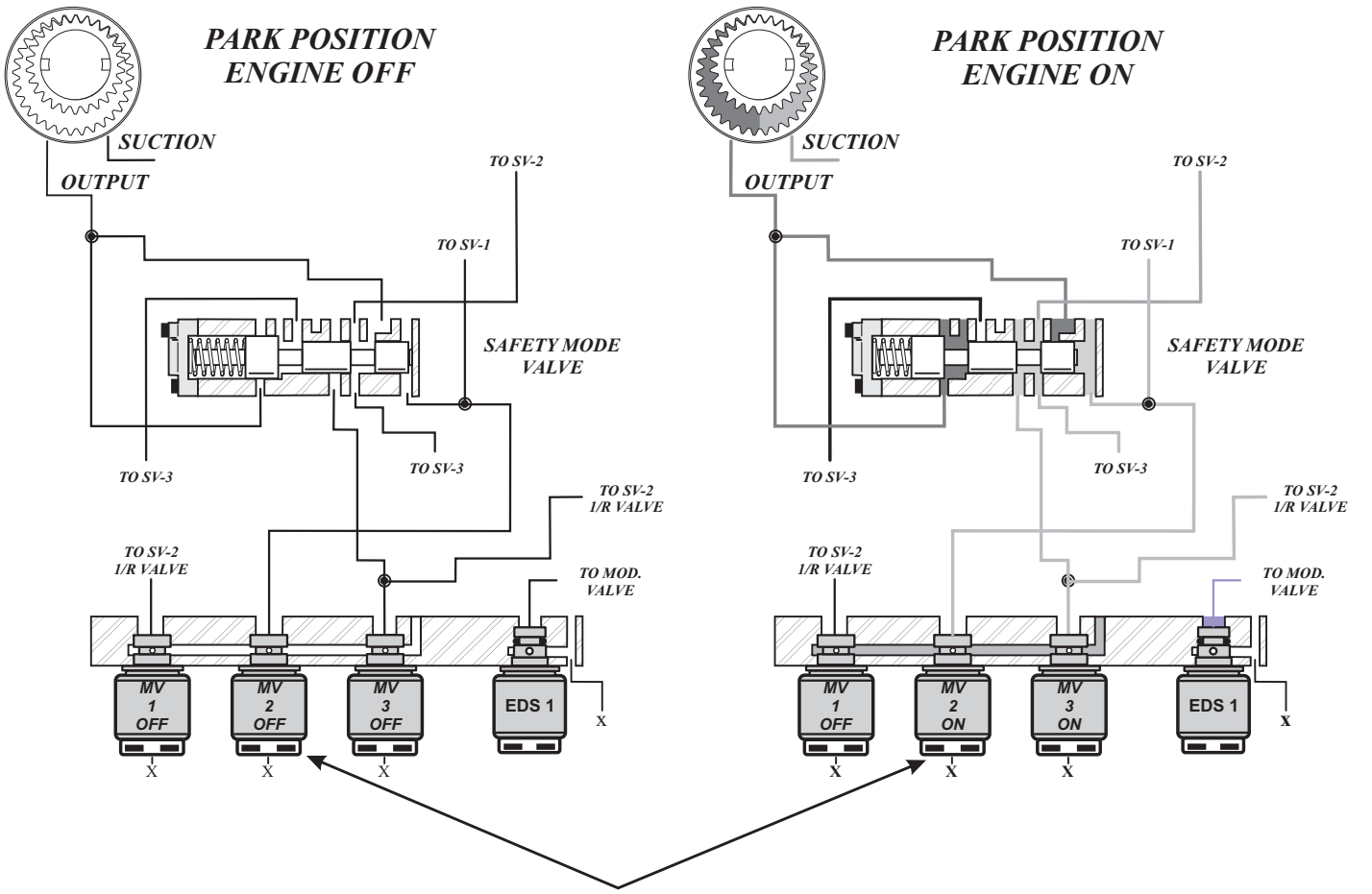


Figure 17

ZF-4HP-18FLE/FLA
PRESSURE TAP LOCATIONS



SAFETY MODE VALVE OPERATION



MV-2 IS TURNED "ON", ONLY TO STROKE THE SAFETY MODE VALVE. PUMP PRESSURE WILL KEEP THE SAFETY MODE VALVE STROKED, AS LONG AS THE ENGINE IS RUNNING

Figure 18

INDEX

COLOR HYDRAULIC SCHEMATIC
(FOLD OUT) ON THIS PAGE.

TO CONVERTER (LUBRICATION)

SUCTION

OUTPUT

TORQUE CONVERTER LIMIT VALVE

.030" .030"

MANUAL VALVE

PRND321

MAIN LINE CHECK PORT

SV-1

SV-2

SAFETY MODE VALVE *

SV-3

3-4 TRACTION

.030" .020" .068" .050" .030"

"A" ACCUM-ULATOR

.047" ORIFICE

.040" .050"

"C" CLUTCH TRACTION VALVE

"A" CLUTCH CHECK VALVE

FILTER

SUMP

MV 1 OFF

MV 2 ON

MV 3 ON

EDS 1

"D" ACCUMULATOR

.068" .050"

"D" CLUTCH ONE-WAY CHECK VALVE .020" ORIFICE

C' ACCUMULATOR

.068" 470U .047" ORIFICE

1st & REVERSE VALVE

"E" ACCUMULATOR

.068"

4-3 TRACTION VALVE

.050"

MAIN REGULATOR VALVE

.030" .030"

.030" .025" .030" .030"

EDS1 SCREEN

PRESSURE REDUCING VALVE FOR MV1-3

PRESSURE REDUCING VALVE FOR EDS1

MODULATING VALVE

MODULATING PRESSURE PORT

"C" CLUTCH

"B" CLUTCH

C' BAND 2-4 BAND

"A" CLUTCH

"E" CLUTCH

"D" CLUTCH

	LEGEND
	MODULATING PRESSURE
	MAIN LINE PRESSURE
	PUMP SUCTION
	CONVERTER PRESSURE
	CUTBACK PRESSURE
	EDS1 PRESSURE
	MV1-3 REDUCING PRESSURE
	CONNECTED CIRCUIT
	"A" CLUTCH PREFILL

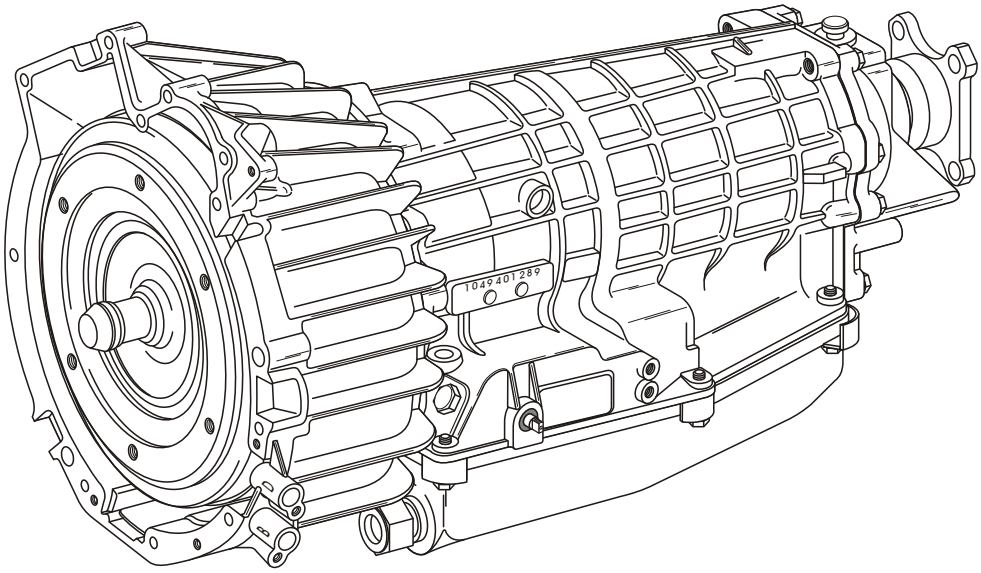
	ORIFICE I.D.
Ⓐ	.046"
Ⓑ	.029"
Ⓒ	.029"
Ⓓ	.029"
Ⓔ	.099"
Ⓕ	.029"

* NOTE: MV2 IS INITIALLY ENERGIZED IN PARK/NEUTRAL TO STROKE THE SAFETY MODE VALVE

PARK OR NEUTRAL
4HP-18 FLE/FLA

INDEX

ZF 4HP-22/24 SERIES
DIAGNOSTIC INFORMATION



The Electronic Control system was first introduced in 1986 and was incorporated into the totaly hydraulic 4HP-22 unit produced by ZF. It combines the hydraulic control of forward and reverse gear engagement, with electronic control for automatic upshifts from 1st thru 4th and automatic downshifts from 4th thru 1st gears. Three different versions of valve bodies have been used on BMW vehicles, with minor differences between them

The 1st version, ***designated Early "E-7"***, has ***5 solenoids*** on the valve body, was introduced in 1986 and used up thru 1989. This version includes a solenoid for reverse lockout.

The 2nd version, ***designated Late "E-7"***, has ***5 solenoids*** on the valve body, was introduced in 1988 and used up thru Mid-1989. This version includes a solenoid for reverse lockout.

The 3rd version, ***designated "E-9"***, has ***4 solenoids*** on the valve body, was introduced in Mid-1989 and used up thru 1994. This version uses a shift solenoid for the reverse lockout function.

MODEL YEAR USAGE CHART

Valve Body Models	*Model Year*								
	86	87	88	89	90	91	92	93	94
1st Version, Early "E-7", 5 Solenoid									
2nd Version, Late "E-7", 5 Solenoid									
3rd Version, "E-9", 4 Solenoid									

Figure 19

FOR ZF 4HP-22/24 SERIES VEHICLES

Refer to Figure 19 for model year usage of the "E7", 5 Solenoid and "E9", 4 Solenoid valve bodies.

Refer to Figure 20 for internal component application chart for all models.

Refer to Figure 21 for shift quadrant and mode switch differences between the different models.

FOR MODEL "E7", "5 SOLENOID" VALVE BODY

Refer to Figure 22 for identification, location and function of the 5 solenoids, along with the shift solenoid firing order for the "E7" 5 solenoid models.

Refer to Figure 23 for internal wire schematic and case connector terminal identification, along with a resistance chart to check the internal electronic components.

Refer to Figure 24 for individual solenoid operation.

Refer to Figure 25 for valve body assembly exploded view.

Refer to Figure 26 for Lower Front Valve Body exploded view, with valve identification, and individual spring specifications, as observed in a used valve body.

Refer to Figure 27 for Lower Rear Valve Body exploded view, with valve identification, and individual spring specifications, as observed in a used valve body.

Refer to Figure 28 for MV-1 and MV-2 Shift Solenoid Body exploded view, with valve identification, and spring specifications, as observed in a used valve body.

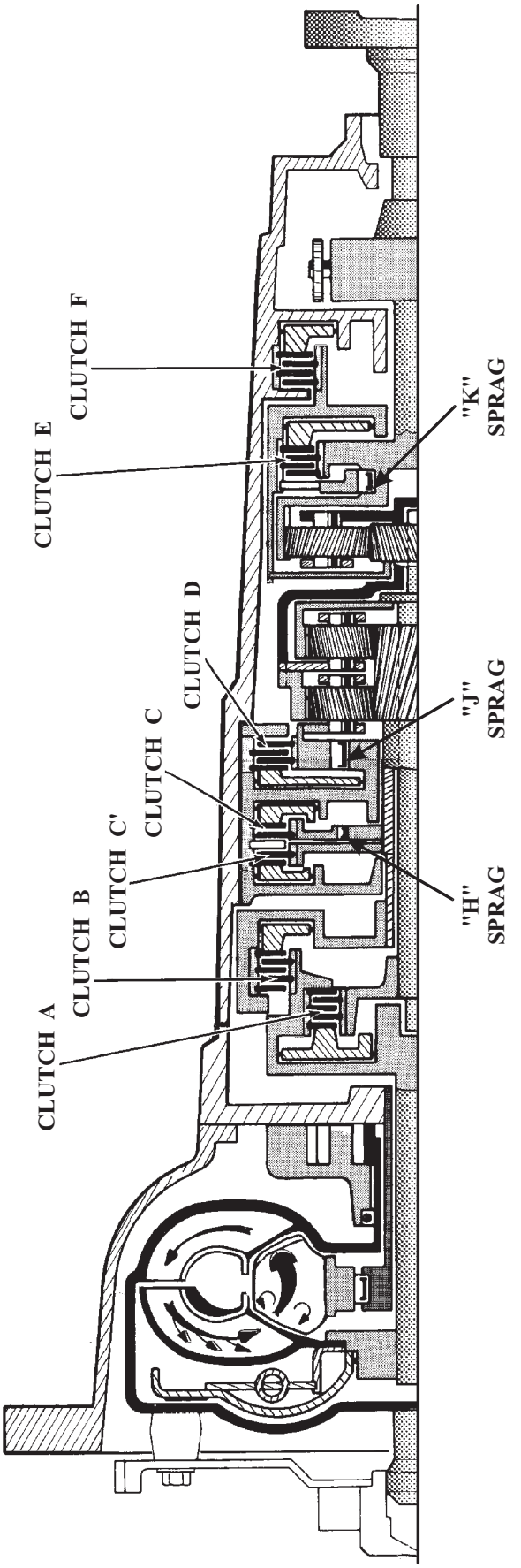
Refer to Figure 29 for Pressure Control Solenoid Body exploded view, with solenoid identifications.

Refer to Figure 30 for Reverse Lockout Solenoid Body exploded view, with valve identifications, and spring specifications, as observed in a used valve body.

Refer to Figures 31, 32, 33, 34 for retainer, checkball, orifice and check valve and spring locations.

FOR MODEL "E9", "4 SOLENOID" VALVE BODY
REFER TO PAGE 43 IN THIS MANUAL

COMPONENT APPLICATION CHART FOR ZF 4HP-22/24 SERIES



RANGE	"A" Clutch	"B" Clutch	"C' " Clutch	"C" Clutch	"D" Clutch	"E" Clutch	"F" Clutch	"H" Sprag	"J" Sprag	"K" Sprag
Park										
Reverse		ON			ON	ON				Hold
Neutral										
"D"-1st	ON					ON			Hold	Hold
"D"-2nd	ON		ON	ON		ON		Hold		Hold
"D"-3rd	ON	ON		ON		ON				Hold
"D"-4th	ON	ON		ON			ON			
"3"	Same as above, Automatic Shift 1st thru 3rd, 4th gear is inhibited.									
"2"	Same as above, Automatic Shift 1st thru 2nd, 3rd and 4th gear are inhibited.									
"1"	Same as above, except "D" Clutch is applied for engine braking									

Figure 20

SHIFT QUADRANTS FOR ZF 4HP-22/24 SERIES

Early "E-7" Models Only (5 Solenoid)

(P) = Parking Pawl Engaged

(R) = Reverse Gear

(N) = Neutral

(D) = Automatic Shifts 1st thru 4th Gears

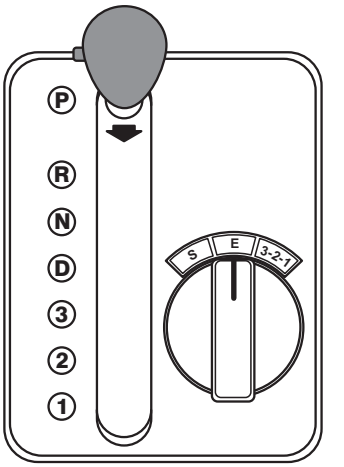
(3) = Automatic Shifts 1st thru 3rd Gears. 4th Gear is locked out.

(2) = Automatic Shifts 1st thru 2nd Gears. 3rd and 4th Gear is locked out.

(1) = 1st Gear Only. 2nd, 3rd and 4th Gear is locked out.

Mode Switch Description

A ***rotary*** switch with three fixed positions and an indicator light in the instrument cluster for the 3-2-1 (M) mode when selected



Late "E-7" Models Only (5 Solenoid)

(P) = Parking Pawl Engaged

(R) = Reverse Gear

(N) = Neutral

(D) = Automatic Shifts 1st thru 4th Gears

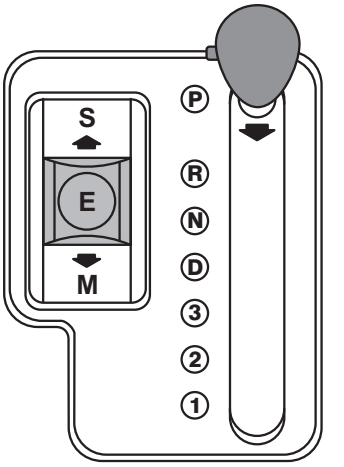
(3) = Automatic Shifts 1st thru 3rd Gears. 4th Gear is locked out.

(2) = Automatic Shifts 1st thru 2nd Gears. 3rd and 4th Gear is locked out.

(1) = 1st Gear Only. 2nd, 3rd and 4th Gear is locked out.

Mode Switch Description

A ***three*** position slide switch with Digital display of the three individual positions in instrument cluster (E-S-M). The switch is a momentary contact and spring loaded to a neutral position.



"E-9" Models Only (4 Solenoid)

(P) = Parking Pawl Engaged

(R) = Reverse Gear

(N) = Neutral

(D) = Automatic Shifts 1st thru 4th Gears

(3) = Automatic Shifts 1st thru 3rd Gears. 4th Gear is locked out.

(2) = Automatic Shifts 1st thru 2nd Gears. 3rd and 4th Gear is locked out.

(1) = 1st Gear Only. 2nd, 3rd and 4th Gear is locked out.

Mode Switch Description

A ***two*** position slide switch for the "A" mode (Economy and "M" mode (Manual). The Sport mode is selected with the range selector in position 3, 2, or 1 and "A" mode selected. The switch is a momentary contact and spring loaded to a neutral position.

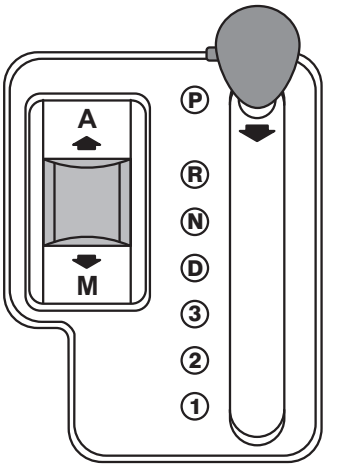
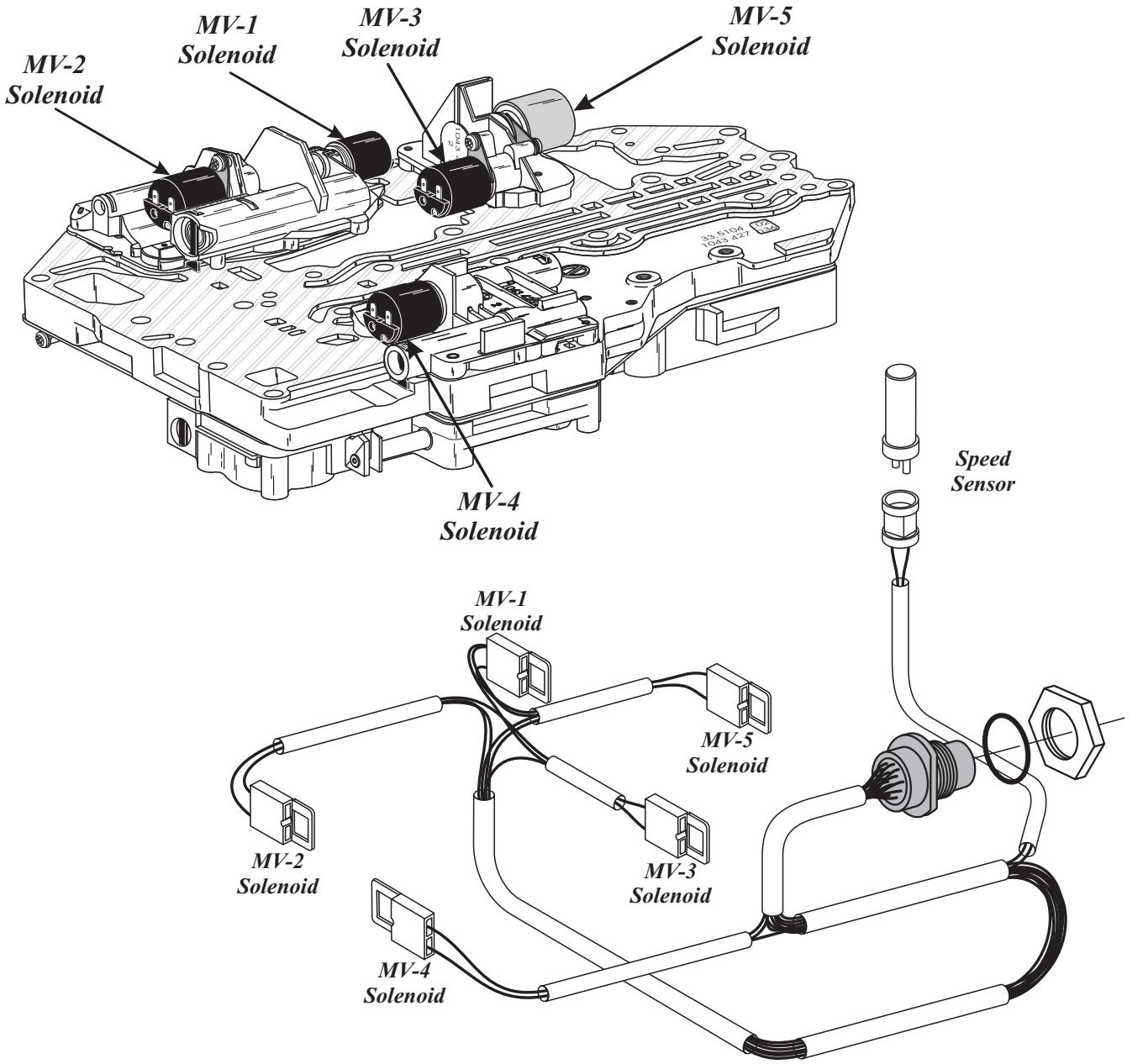


Figure 21

ZF-4HP-22/24 MODEL "E-7", "5 SOLENOID" IDENTIFICATION, LOCATION AND FUNCTION

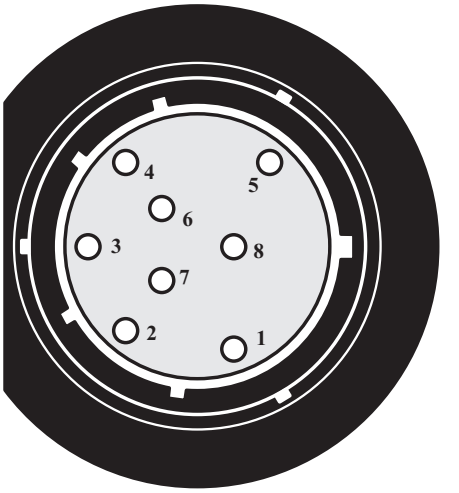


Solenoid	Function	Gear	MV-1	MV-2
MV-1	Shift Control	1st	ON	ON
MV-2	Shift Control	2nd	OFF	ON
		3rd	OFF	OFF
		4th	ON	OFF
MV-3	Lock-Up Control			
MV-4	Reverse Lockout			
MV-5	Line Pressure Control			

Figure 22

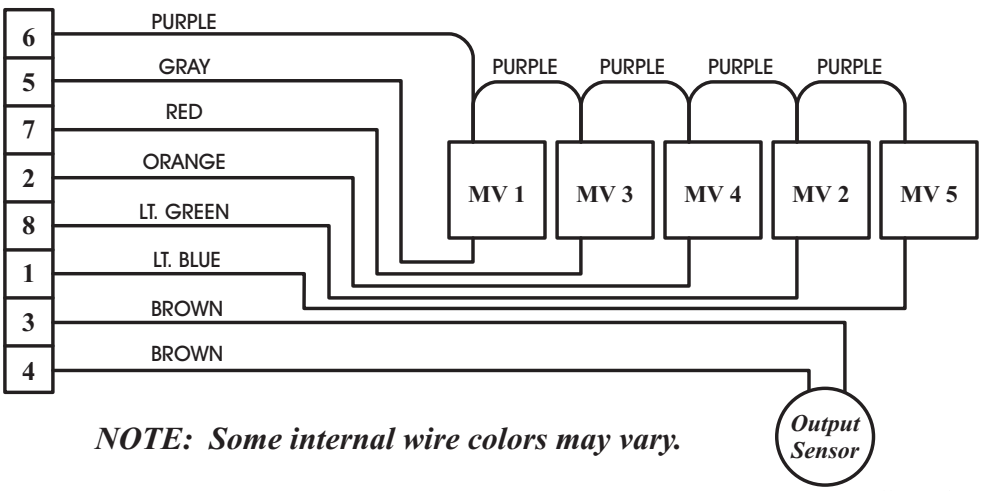
ZF-4HP-22/24 MODEL "E-7", "5 SOLENOID" INTERNAL WIRE SCHEMATIC AND CONNECTOR TERMINAL IDENTIFICATION

Note: The case connector on this unit is not numbered on connector for identification. ATSG has chosen the numbers you see so that you can use the chart below to do a resistance check on internal components.



View Looking Into Case Connector

COMPONENT	*TERMINALS*	*RESISTANCE*	*PART NUMBER*
MV 1 Solenoid	*5 And 6*	*30 - 34 Ohms*	*0501 307 869*
MV 2 Solenoid	*8 And 6*	*30 - 34 Ohms*	*0501 307 869*
MV 3 Solenoid	*7 And 6*	*30 - 34 Ohms*	*0501 307 869*
MV 4 Solenoid	*2 And 6*	*30 - 34 Ohms*	*0501 307 869*
MV 5 Solenoid	*1 And 6*	*2.5 - 4.5 Ohms*	*0501 206 997*
Output Speed Sensor	*3 And 4*	*265 Ohms (72° F)*	*0501 311 086*

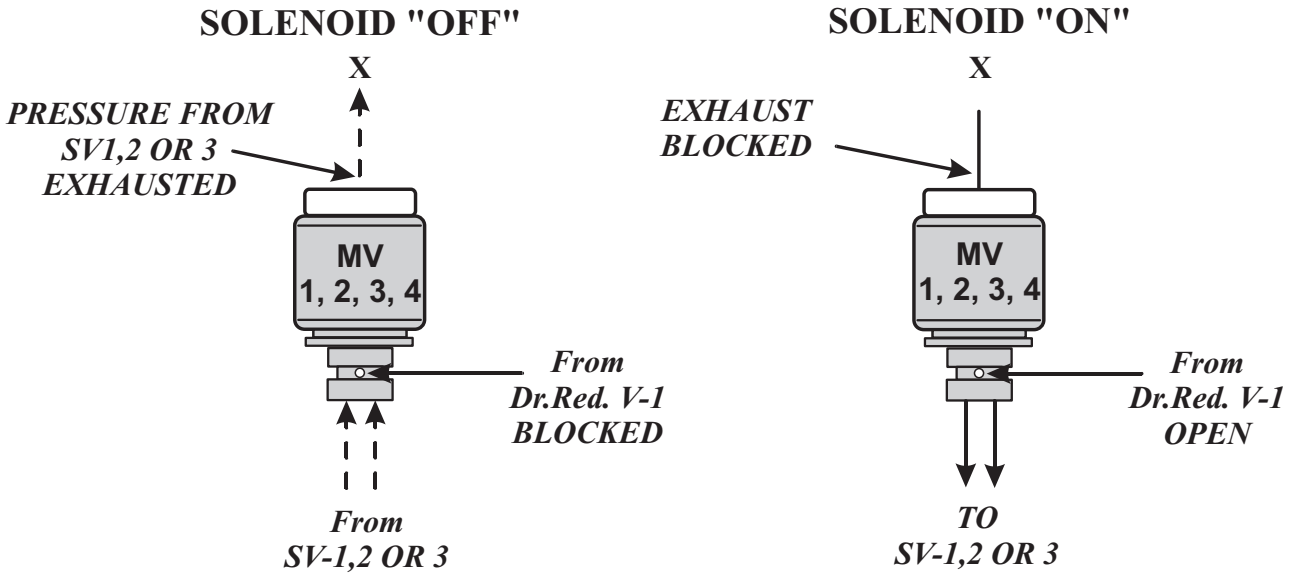


NOTE: Some internal wire colors may vary.

Figure 23

ZF-4HP-22 MODEL "E7", "5 SOLENOID" VALVE BODY, SOLENOID OPERATION

MV1, 2, 3 AND 4 OPERATION

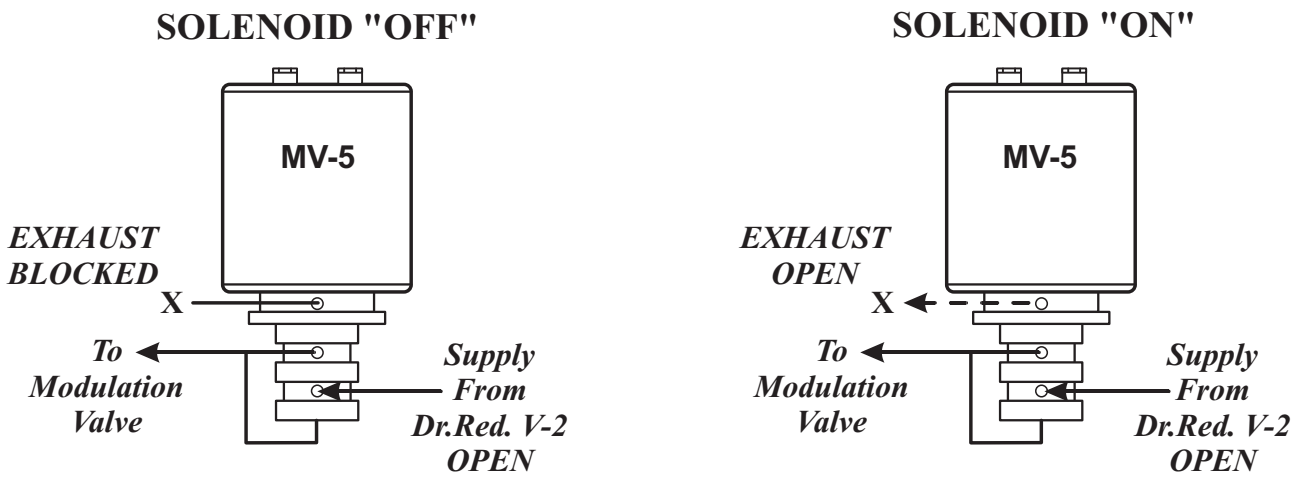


SUMMARY:

When MV 1, 2, 3 or 4 is "OFF" Solenoid reducing pressure, from Dr.Red. V-1, is blocked by the solenoid and oil pressure from SV 1, 2 or 3 is exhausted at the rear of the solenoid.

When MV 1, 2, 3 or 4 is "ON" Solenoid reducing pressure, From Dr.Red. V-1, is open through the solenoid and is applied to SV 1, 2 or 3. The exhaust at the rear of the solenoid is closed.

MV-5 OPERATION
(Line Pressure Solenoid)



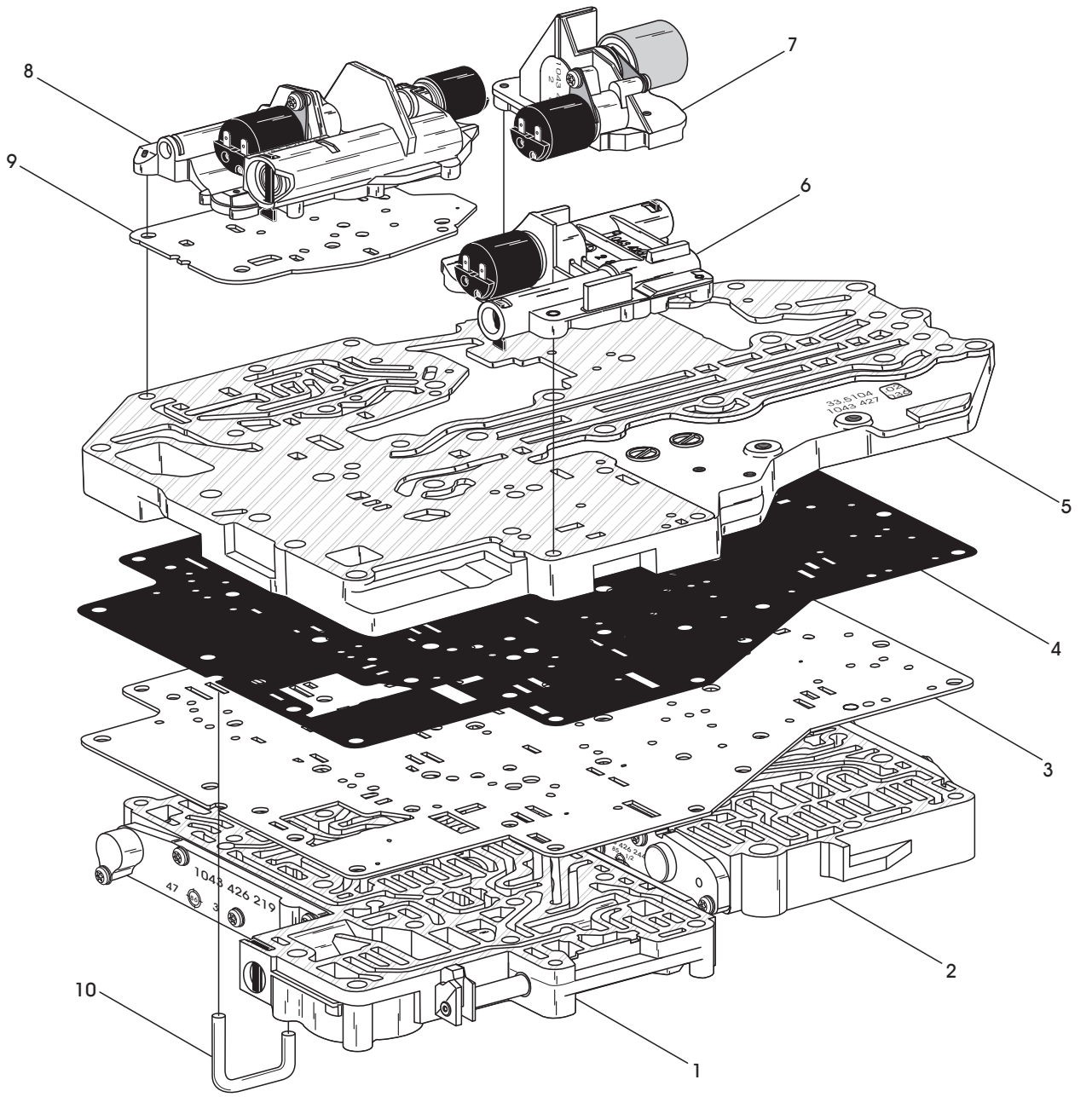
SUMMARY:

When MV-5 solenoid is "OFF," solenoid reducing pressure, from Dr. Red. V-2, is high to MOD-V valve which creates high line pressure.

When MV-5 solenoid is "ON," solenoid reducing pressure, from Dr. Red. V-2, is low to MOD-V valve which creates low line pressure.

Figure 24

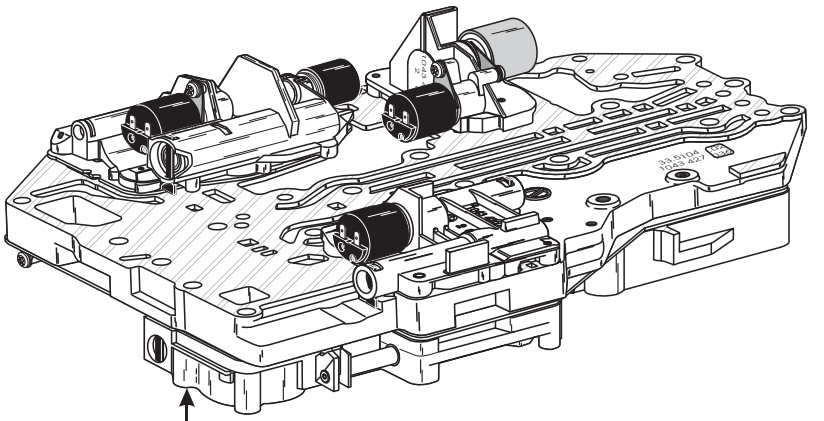
ZF-4HP-22/24 MODEL "E-7", "5 SOLENOID" VALVE BODY ASSEMBLY



1 LOWER FRONT VALVE BODY ASSEMBLY
2 LOWER REAR VALVE BODY ASSEMBLY
3 VALVE BODY SPACER PLATE
4 SPACER PLATE TO CHANNEL PLATE GASKET
5 CHANNEL PLATE ASSEMBLY
6 MV-4 SOLENOID BODY ASSEMBLY
7 MV-3 AND MV-5 SOLENOID BODY ASSEMBLY
8 MV-1 AND MV-2 SOLENOID BODY ASSEMBLY
9 MV-1/MV-2 SOLENOID BODY TO CHANNEL PLATE SPACER PLATE
10 OIL PIPE, LOWER FRONT VALVE BODY TO CHANNEL PLATE

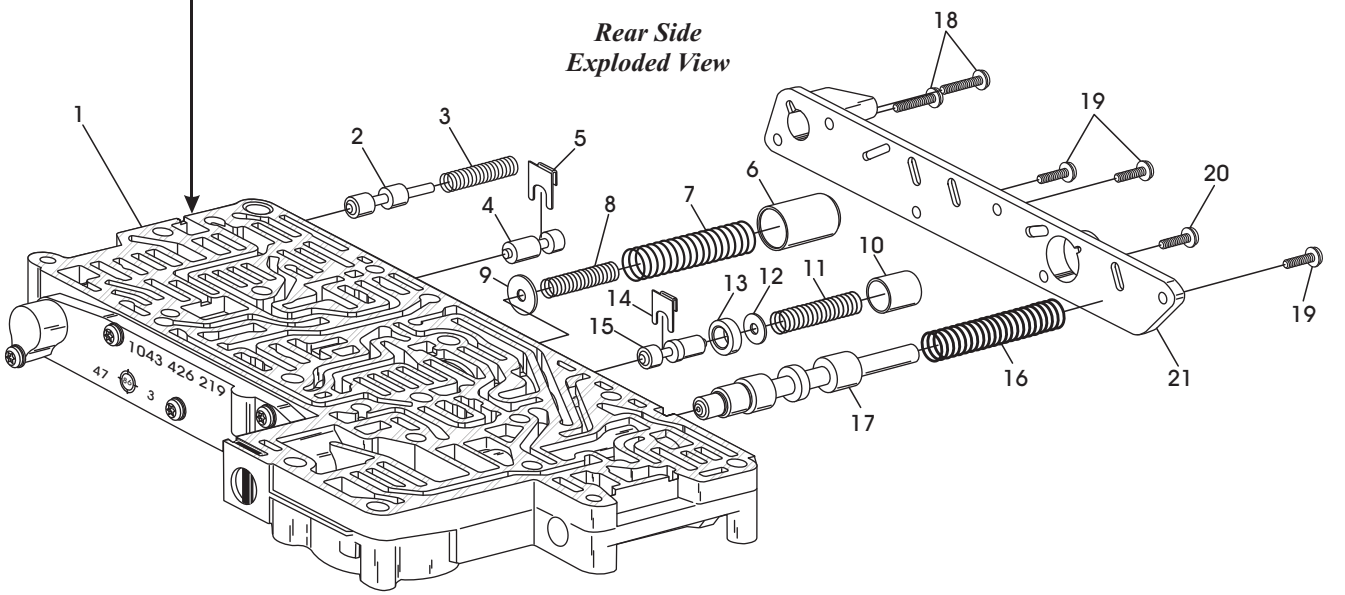
Figure 25

ZF-4HP-22/24 MODEL "E-7", "5 SOLENOID"
LOWER "FRONT" VALVE BODY



Legend And Spring Specifications Found On Page 33.

Rear Side Exploded View



Front Side Exploded View

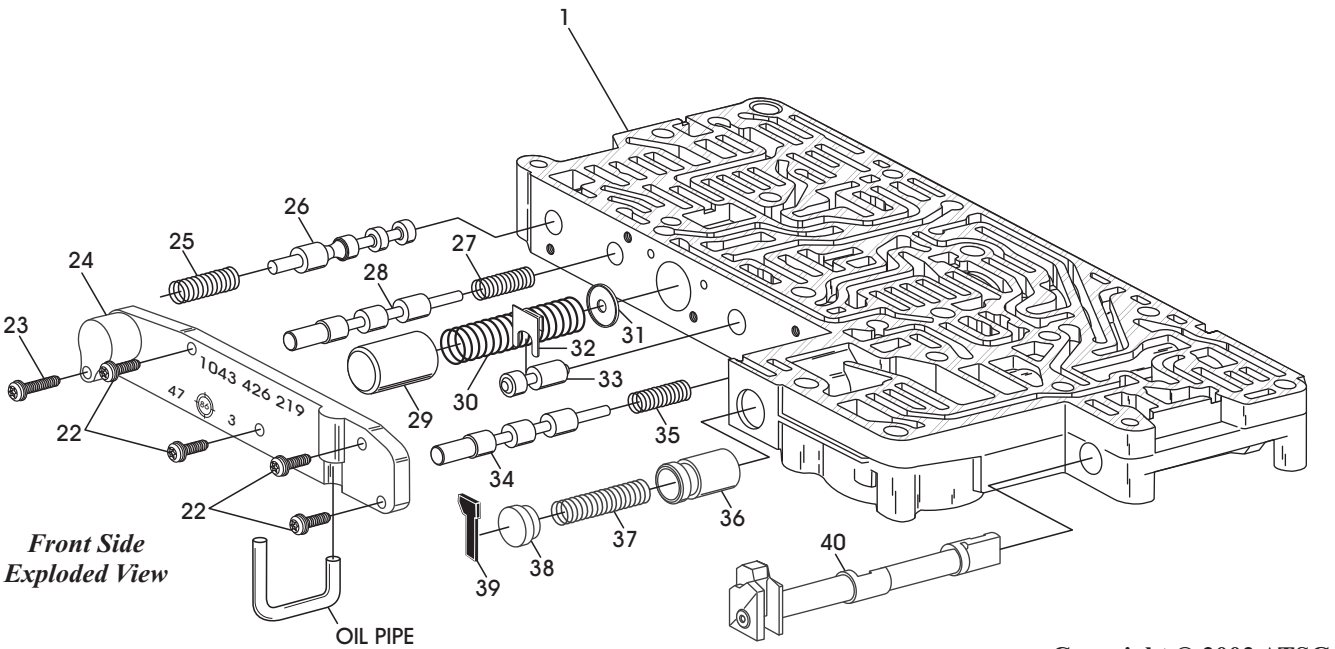


Figure 26

FIGURE 26 LEGEND AND SPRING SPECIFICATIONS

1 LOWER FRONT VALVE BODY CASTING
2 "C' " CLUTCH VALVE
3 "C' " CLUTCH VALVE SPRING
4 "C" CLUTCH VALVE
5 "C" CLUTCH VALVE RETAINER
6 "B" CLUTCH DAMPER PISTON
7 "B" CLUTCH DAMPER PISTON OUTER SPRING
8 "B" CLUTCH DAMPER PISTON INNER SPRING
9 "B" CLUTCH DAMPER PISTON SPRING SEAT
10 "D" CLUTCH DAMPER PISTON
11 "D" CLUTCH DAMPER PISTON SPRING
12 "D" CLUTCH DAMPER PISTON SPRING SEAT
13 "D" CLUTCH VALVE SLEEVE
14 "D" CLUTCH VALVE RETAINER
15 "D" CLUTCH VALVE
16 PRESSURE REGULATOR VALVE SPRING
17 PRESSURE REGULATOR VALVE
18 REAR SIDE COVER RETAINING BOLT, 34 mm LENGTH (2)
19 REAR SIDE COVER RETAINING BOLT, 17 mm LENGTH (3)
20 REAR SIDE COVER RETAINING BOLT, 21 mm LENGTH (1)
21 REAR SIDE COVER
22 FRONT SIDE COVER RETAINING BOLT, 17 mm LENGTH (4)
23 FRONT SIDE COVER RETAINING BOLT, 29 mm LENGTH (1)
24 FRONT SIDE COVER
25 TORQUE CONVERTER LOCK-UP VALVE SPRING
26 TORQUE CONVERTER LOCK-UP VALVE
27 2-3 SHIFT VALVE SPRING
28 2-3 SHIFT VALVE
29 "C" CLUTCH DAMPER PISTON
30 "C" CLUTCH DAMPER PISTON SPRING
31 "C" CLUTCH DAMPER PISTON SPRING SEAT
32 "B" CLUTCH REGULATOR VALVE RETAINER
33 "B" CLUTCH REGULATOR VALVE
34 1-2 SHIFT VALVE
35 1-2 SHIFT VALVE SPRING
36 "A" CLUTCH DAMPER PISTON
37 "A" CLUTCH DAMPER SPRING
38 "A" CLUTCH DAMPER PISTON SPRING SEAT
39 "A" CLUTCH DAMPER SPRING SEAT RETAINER
40 MANUAL SHIFT VALVE

SPRING ILLUSTRATION NO. 3:
FREE LENGTH = 1.495"
SPRING DIAMETER = .360"
WIRE DIAMETER = .035"

SPRING ILLUSTRATION NO. 7:
FREE LENGTH = 3.160"
SPRING DIAMETER = .595"
WIRE DIAMETER = .044"

SPRING ILLUSTRATION NO. 8:
FREE LENGTH = 1.560"
SPRING DIAMETER = .430"
WIRE DIAMETER = .040"

SPRING ILLUSTRATION NO. 11:
FREE LENGTH = 1.653"
SPRING DIAMETER = .550"
WIRE DIAMETER = .044"

SPRING ILLUSTRATION NO. 16:
FREE LENGTH = 3.575"
SPRING DIAMETER = .600"
WIRE DIAMETER = .080"

SPRING ILLUSTRATION NO. 25:
FREE LENGTH = 1.830"
SPRING DIAMETER = .435"
WIRE DIAMETER = .040"

SPRING ILLUSTRATION NO. 27:
FREE LENGTH = 1.660"
SPRING DIAMETER = .360"
WIRE DIAMETER = .036"

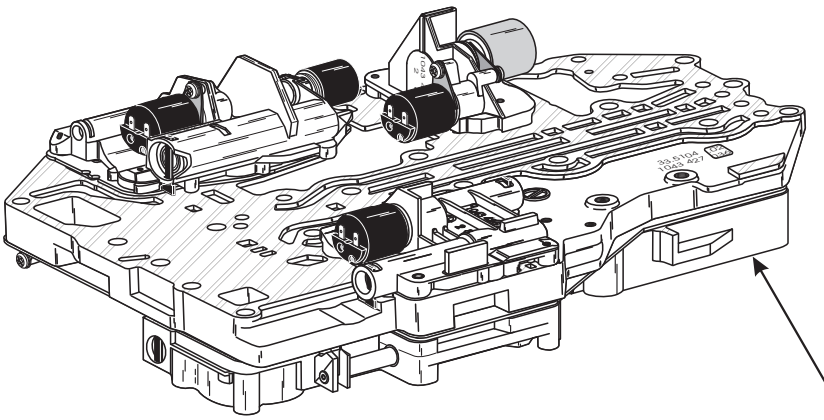
SPRING ILLUSTRATION NO. 30:
FREE LENGTH = 3.160"
SPRING DIAMETER = .595"
WIRE DIAMETER = .044"

SPRING ILLUSTRATION NO. 35:
FREE LENGTH = 1.660"
SPRING DIAMETER = .360"
WIRE DIAMETER = .036"

SPRING ILLUSTRATION NO. 37:
FREE LENGTH = 2.515"
SPRING DIAMETER = .410"
WIRE DIAMETER = .050"

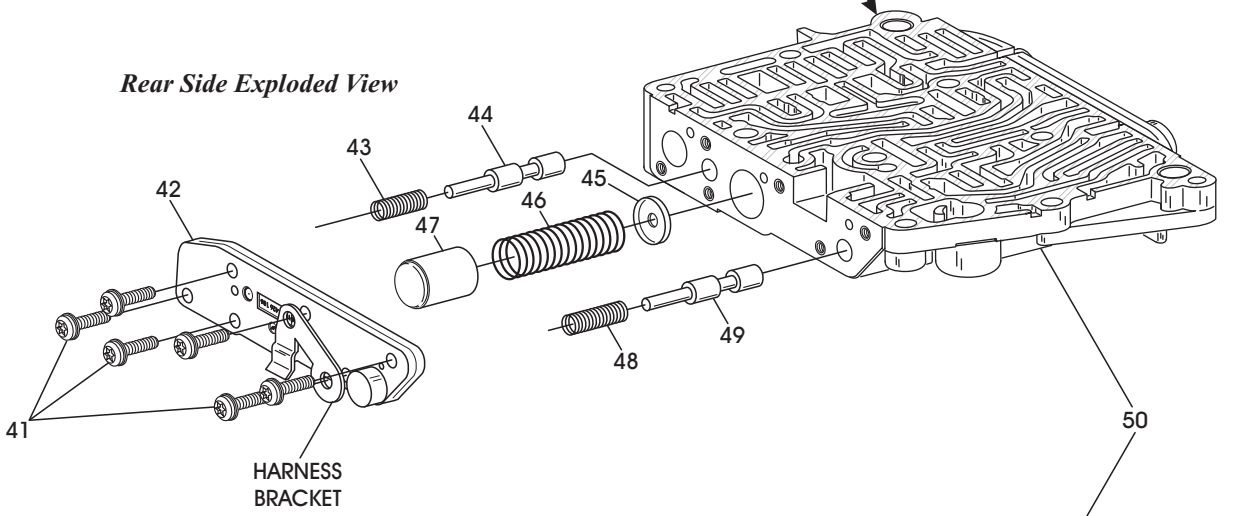
Figure 26 Legend

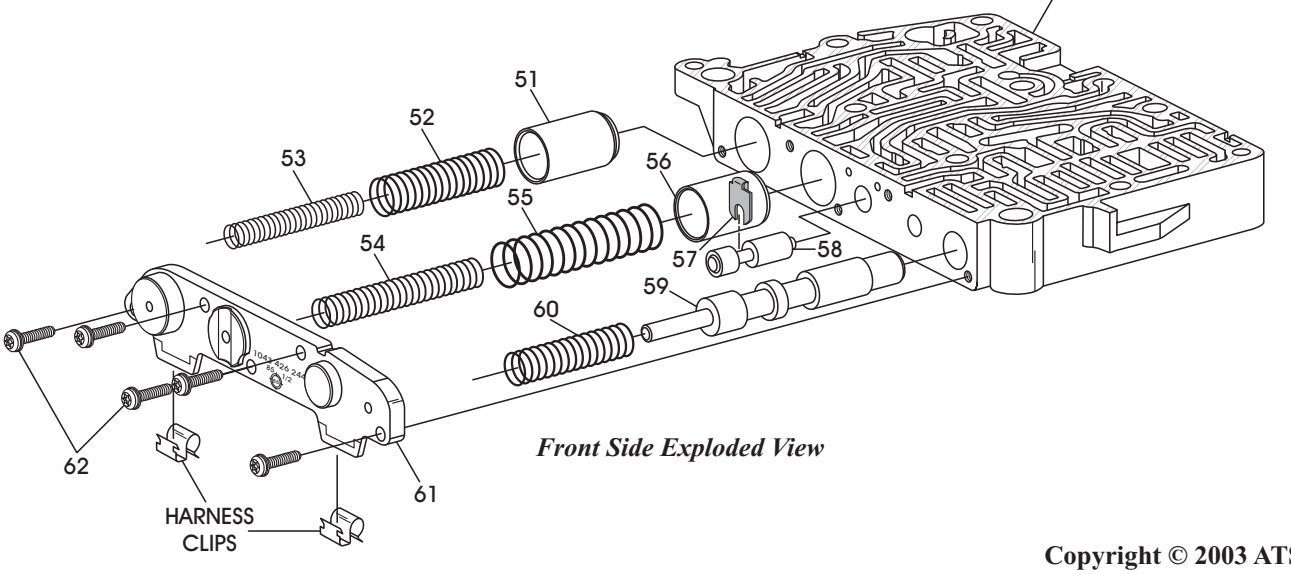
ZF-4HP-22/24 MODEL "E-7", "5 SOLENOID"
LOWER "REAR" VALVE BODY



Legend And Spring Specifications Found On Page 35.

Rear Side Exploded View





Front Side Exploded View

Figure 27

FIGURE 27 LEGEND AND SPRING SPECIFICATIONS

41 REAR SIDE COVER RETAINING BOLTS, 17 mm LENGTH (6)
42 REAR SIDE COVER
43 PRESSURE REDUCING VALVE "2" SPRING
44 PRESSURE REDUCING VALVE "2"
45 "F" CLUTCH DAMPER PISTON SPRING SEAT
46 "F" CLUTCH DAMPER PISTON SPRING
47 "F" CLUTCH DAMPER PISTON
48 PRESSURE REDUCING VALVE "1" SPRING
49 PRESSURE REDUCING VALVE "1"
50 LOWER REAR VALVE BODY CASTING
51 "C' " CLUTCH DAMPER PISTON
52 "C' " CLUTCH DAMPER PISTON OUTER SPRING
53 "C' " CLUTCH DAMPER PISTON INNER SPRING
54 "E" CLUTCH DAMPER PISTON INNER SPRING
55 "E" CLUTCH DAMPER PISTON OUTER SPRING
56 "E" CLUTCH DAMPER PISTON
57 "F" CLUTCH VALVE RETAINER
58 "F" CLUTCH VALVE
59 3-4 SHIFT VALVE
60 3-4 SHIFT VALVE SPRING
61 FRONT SIDE COVER
62 FRONT SIDE COVER RETAINING BOLTS, 17 mm LENGTH (5)

SPRING ILLUSTRATION NO. 43:
FREE LENGTH = 1.365"
SPRING DIAMETER = .355"
WIRE DIAMETER = .044"

SPRING ILLUSTRATION NO. 46:
FREE LENGTH = 3.290"
SPRING DIAMETER = .600"
WIRE DIAMETER = .043"

SPRING ILLUSTRATION NO. 48:
FREE LENGTH = 1.535"
SPRING DIAMETER = .365"
WIRE DIAMETER = .044"

SPRING ILLUSTRATION NO. 52:
FREE LENGTH = 2.945"
SPRING DIAMETER = .600"
WIRE DIAMETER = .066"

SPRING ILLUSTRATION NO. 53:
FREE LENGTH = 3.511"
SPRING DIAMETER = .405"
WIRE DIAMETER = .049"

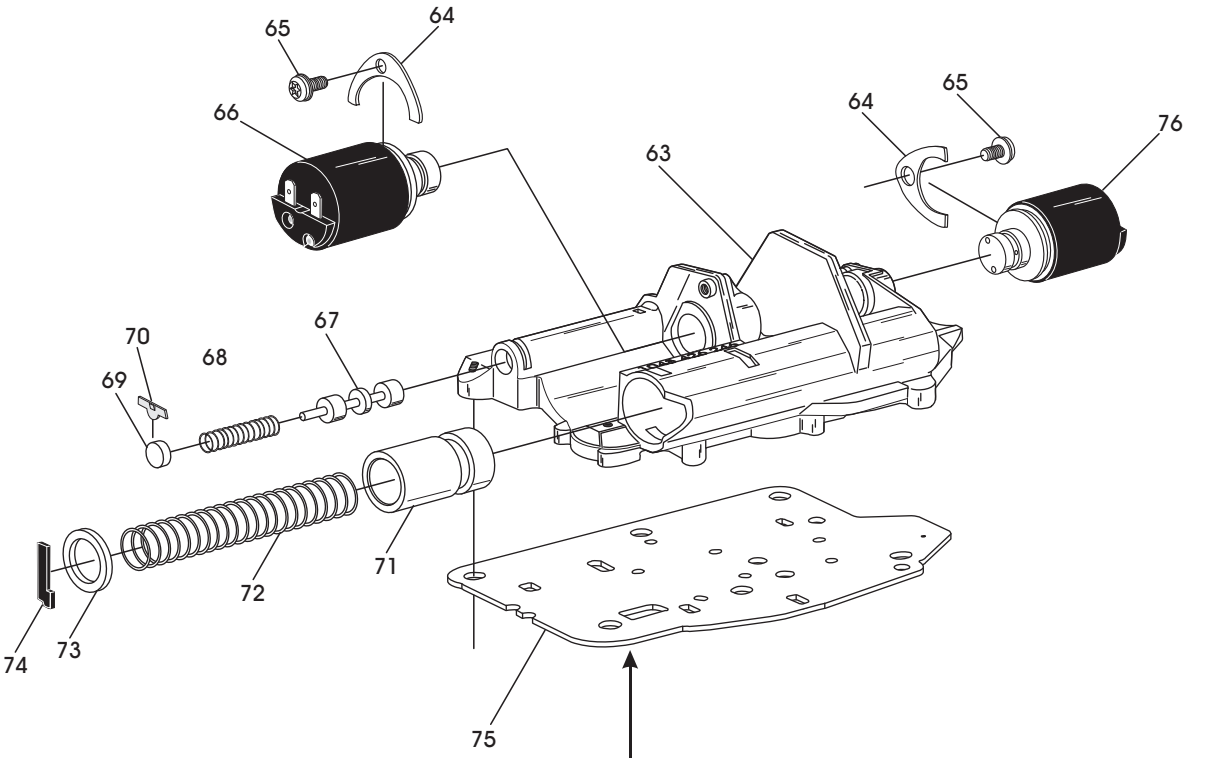
SPRING ILLUSTRATION NO. 54:
FREE LENGTH = 4.556"
SPRING DIAMETER = .510"
WIRE DIAMETER = .037"

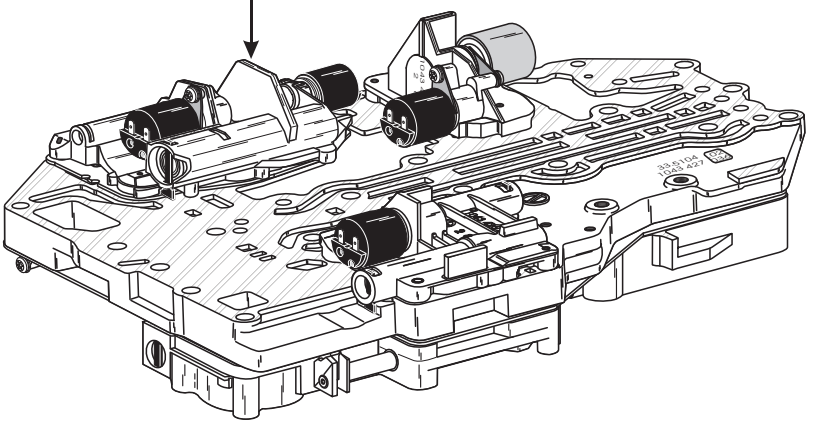
SPRING ILLUSTRATION NO. 55:
FREE LENGTH = 3.330"
SPRING DIAMETER = .685"
WIRE DIAMETER = .070"

SPRING ILLUSTRATION NO. 60:
FREE LENGTH = 2.445"
SPRING DIAMETER = .472"
WIRE DIAMETER = .040"

Figure 27 Legend

ZF-4HP-22/24 MODEL "E-7", "5 SOLENOID"
SHIFT SOLENOID BODY





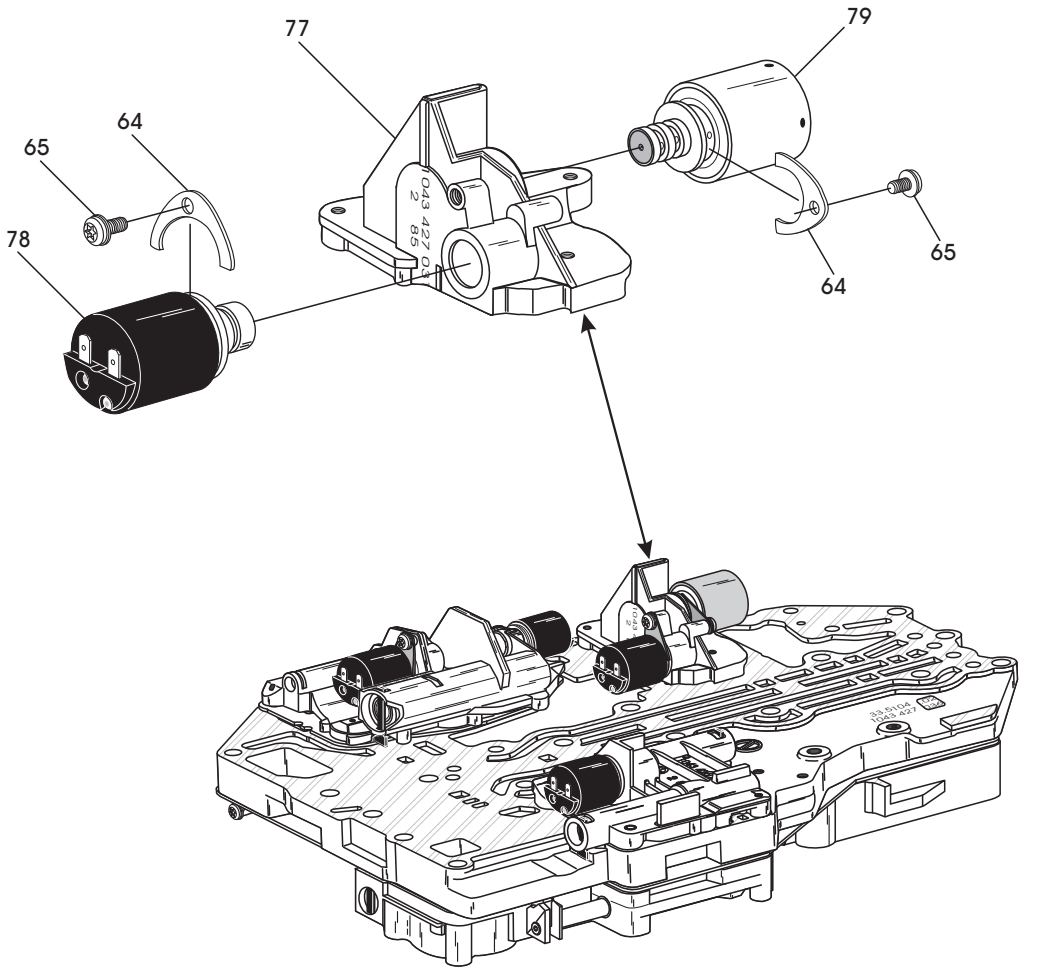
63 SHIFT SOLENOID BODY CASTING
64 SOLENOID RETAINING BRACKET
65 SOLENOID RETAINING BOLT, 11 mm LENGTH
66 MV-2 SHIFT SOLENOID ASSEMBLY
67 1-2 AND 3-4 SHIFT CONTROL VALVE
68 1-2 AND 3-4 SHIFT CONTROL VALVE SPRING
69 1-2 AND 3-4 SHIFT CONTROL VALVE BORE PLUG
70 1-2 AND 3-4 SHIFT CONTROL BORE PLUG RETAINER
71 T.C.C. LOCK-UP DAMPER PISTON
72 T.C.C. LOCK-UP DAMPER PISTON SPRING
73 T.C.C. LOCK-UP DAMPER PISTON SPRING SEAT
74 T.C.C. LOCK-UP DAMPER PISTON SPRING SEAT RETAINER
75 SOLENOID BODY TO CHANNEL PLATE SPACER PLATE
76 MV-1 SHIFT SOLENOID ASSEMBLY

SPRING ILLUSTRATION NO. 68:
FREE LENGTH = 1.542"
SPRING DIAMETER = .372"
WIRE DIAMETER = .035"

SPRING ILLUSTRATION NO. 72:
FREE LENGTH = 3.622"
SPRING DIAMETER = .422"
WIRE DIAMETER = .044"

Figure 28

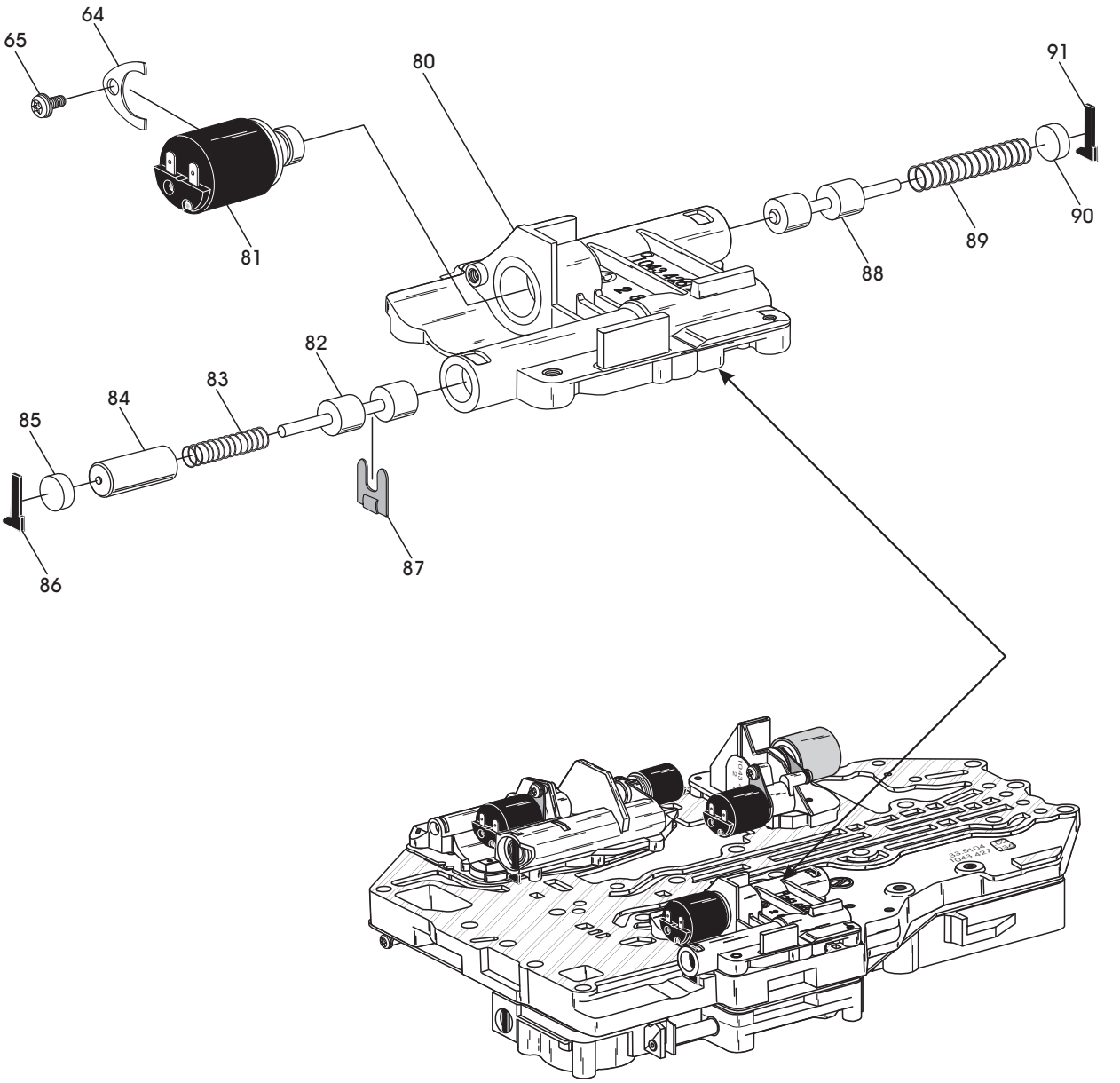
ZF-4HP-22/24 MODEL "E-7", "5 SOLENOID"
PRESSURE CONTROL SOLENOID BODY



64 SOLENOID RETAINING BRACKET
65 SOLENOID RETAINING BOLT, 11 mm LENGTH
77 PRESSURE CONTROL SOLENOID BODY CASTING
78 MV-3 LOCK-UP CONTROL SOLENOID ASSEMBLY
79 MV-5 PRESSURE CONTROL SOLENOID ASSEMBLY

Figure 29

ZF-4HP-22/24 MODEL "E-7", "5 SOLENOID"
REVERSE LOCKOUT SOLENOID BODY



64 SOLENOID RETAINING BRACKET
65 SOLENOID RETAINING BOLT, 11 mm LENGTH
80 REVERSE LOCKOUT SOLENOID BODY CASTING
81 MV-4 REVERSE LOCKOUT SOLENOID ASSEMBLY
82 MODULATION VALVE
83 MODULATION VALVE SPRING
84 MODULATION VALVE SLEEVE
85 MODULATION VALVE BORE PLUG
86 MODULATION VALVE BORE PLUG RETAINER
87 MODULATION VALVE RETAINER
88 REVERSE LOCKOUT VALVE
89 REVERSE LOCKOUT VALVE SPRING
90 REVERSE LOCKOUT VALVE SPRING SEAT
91 REVERSE LOCKOUT SPRING SEAT RETAINER

SPRING ILLUSTRATION NO. 83:
FREE LENGTH = 1.480"
SPRING DIAMETER = .310"
WIRE DIAMETER = .035"

SPRING ILLUSTRATION NO. 89:
FREE LENGTH = 1.870"
SPRING DIAMETER = .380"
WIRE DIAMETER = .035"

Figure 30

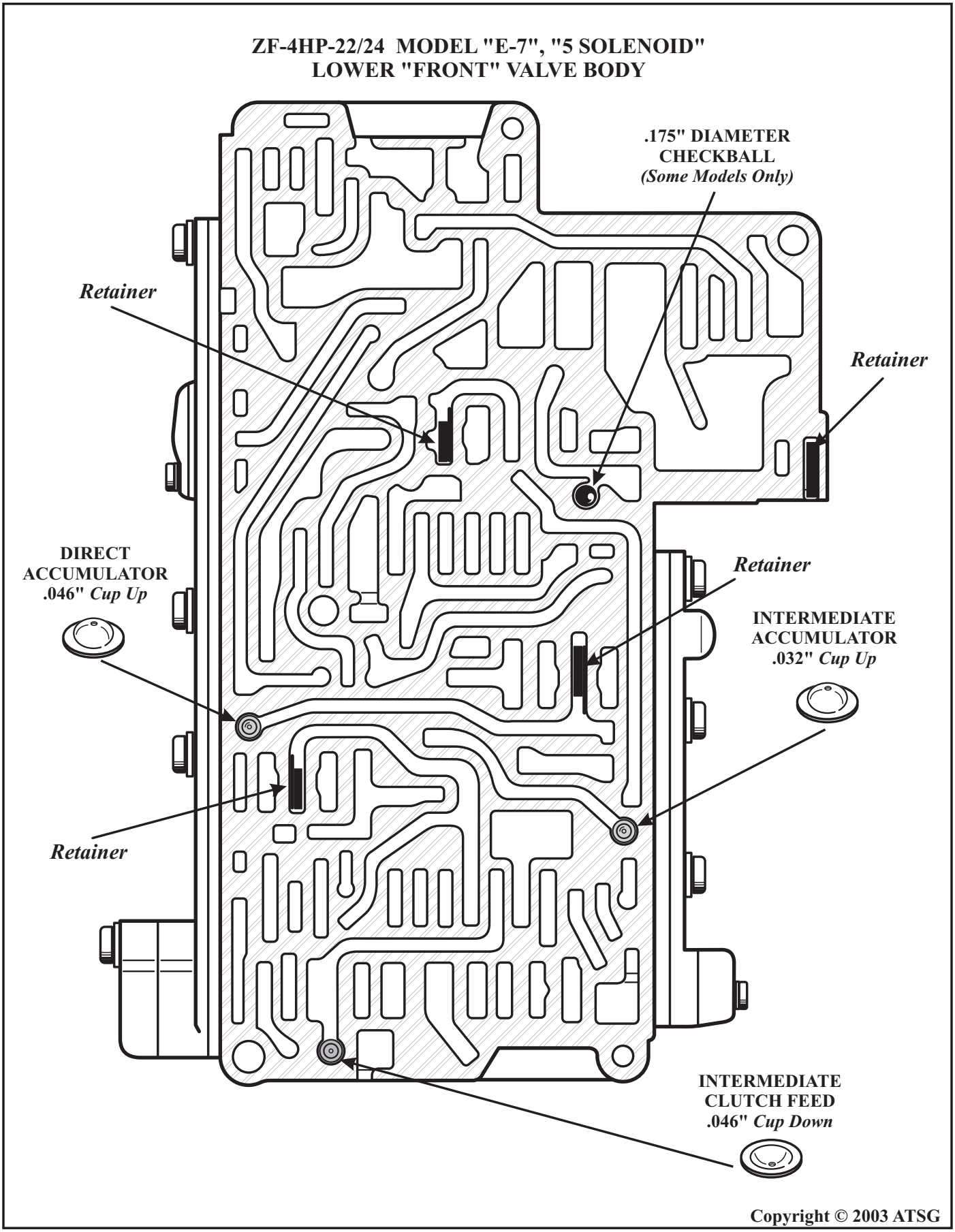

ZF-4HP-22/24 MODEL "E-7", "5 SOLENOID"
LOWER "FRONT" VALVE BODY
.175" DIAMETER
CHECKBALL
(Some Models Only)
Retainer
Retainer
Retainer
DIRECT
ACCUMULATOR
.046" Cup Up
INTERMEDIATE
ACCUMULATOR
.032" Cup Up
Retainer
INTERMEDIATE
CLUTCH FEED
.046" Cup Down
Copyright © 2003 ATSG

Figure 31

ZF-4HP-22/24 MODEL "E-7", "5 SOLENOID"
LOWER "REAR" VALVE BODY

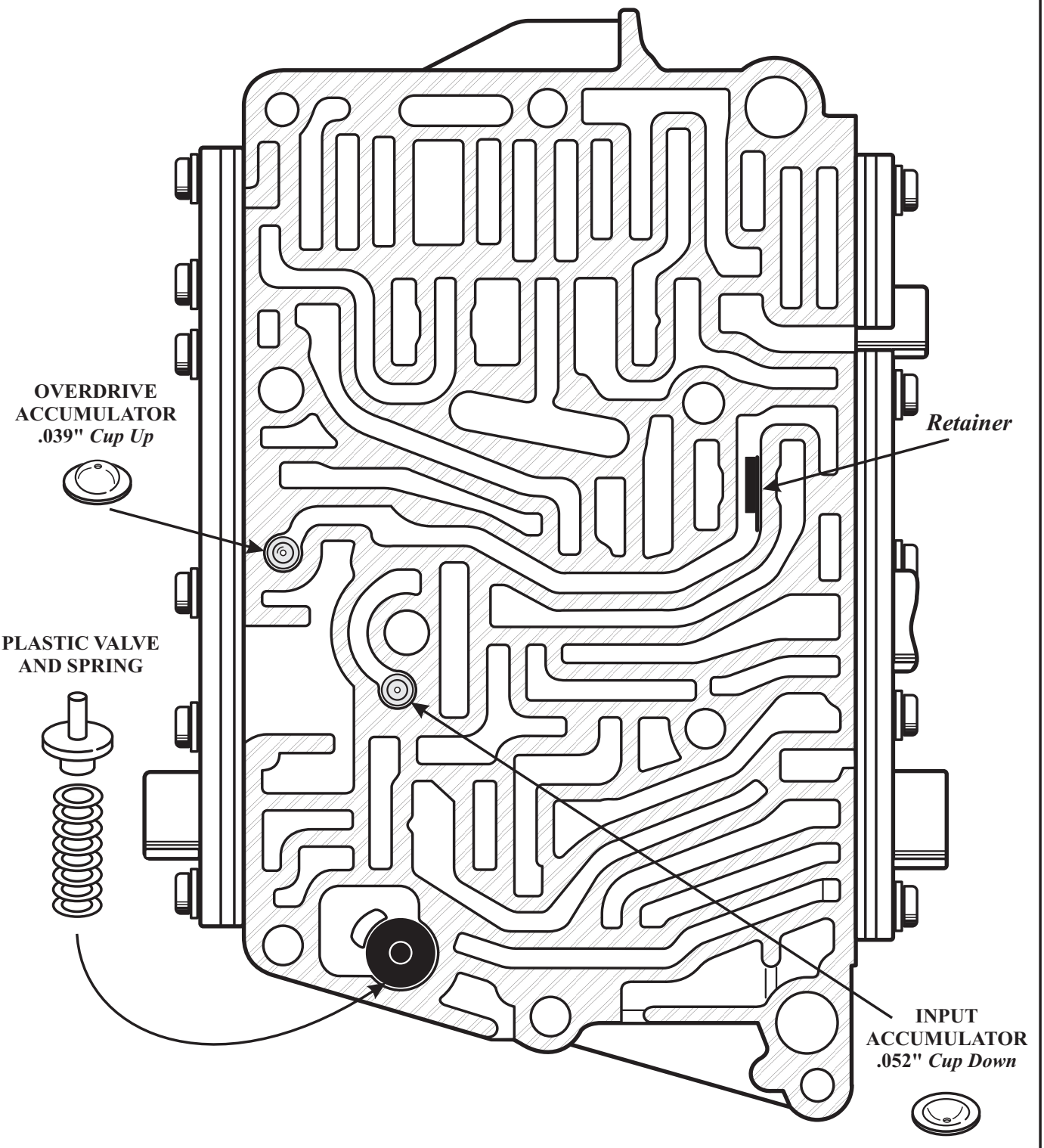


Figure 32

ZF-4HP-22/24 MODEL "E-7", "5 SOLENOID"
CHANNEL PLATE

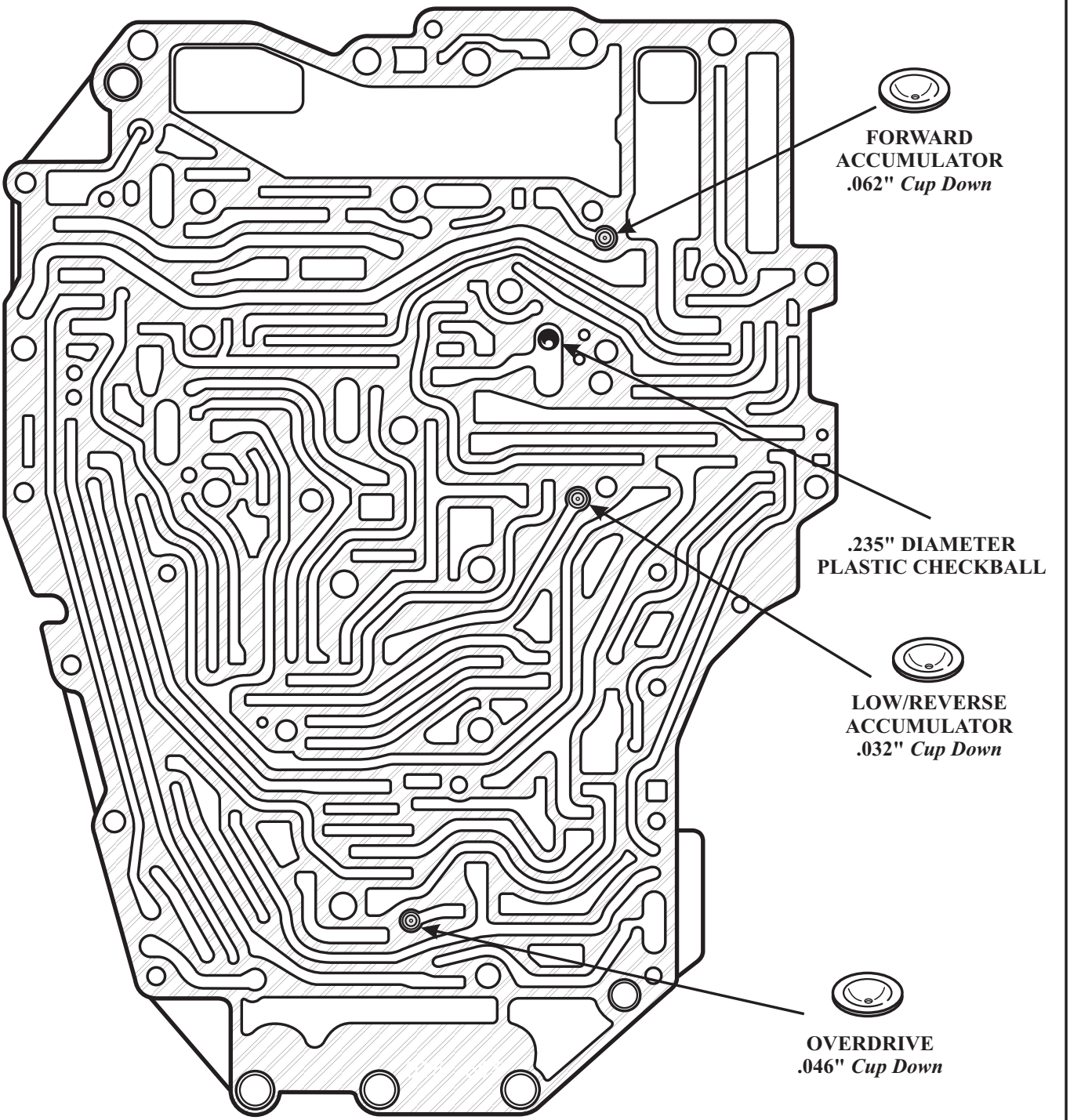


Figure 33

ZF-4HP-22/24 MODEL "E-7", "5 SOLENOID"
ALL SOLENOID BODIES

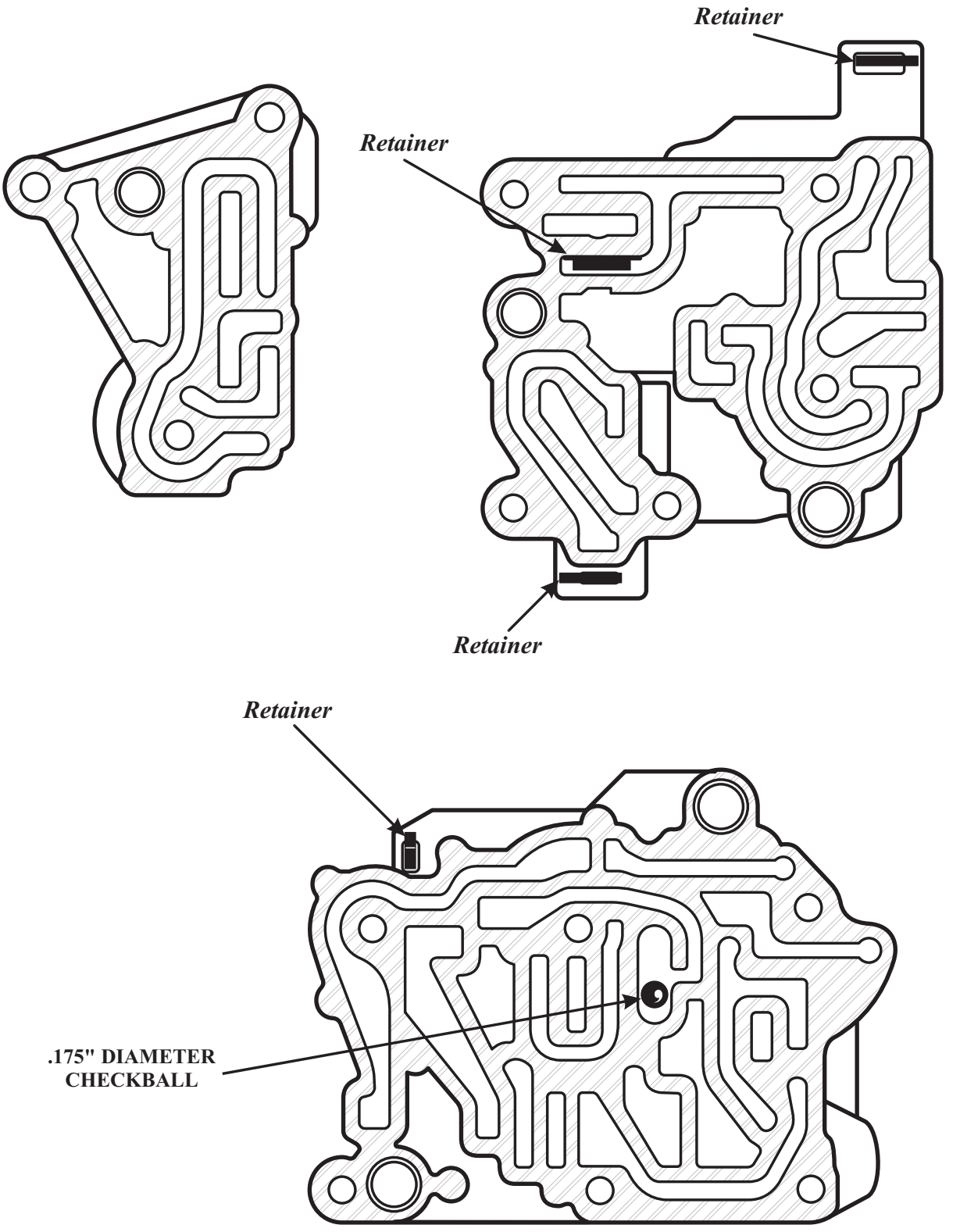


Figure 34

ZF 4HP-22/24 SERIES

DIAGNOSTIC INFORMATION

FOR MODEL "E9", "4 SOLENOID" VALVE BODY

Refer to Figure 36 for identification, location and function of the 5 solenoids, along with the shift solenoid firing order for the "E9" 4 solenoid models.

Refer to Figure 37 for internal wire schematic and case connector terminal identification, along with a resistance chart to check the internal electronic components.

Refer to Figure 38 for individual solenoid operation.

Refer to Figure 39 for Complete Valve Body Assembly exploded view.

Refer to Figure 40 for Lower Front Valve Body exploded view, with valve identifications.

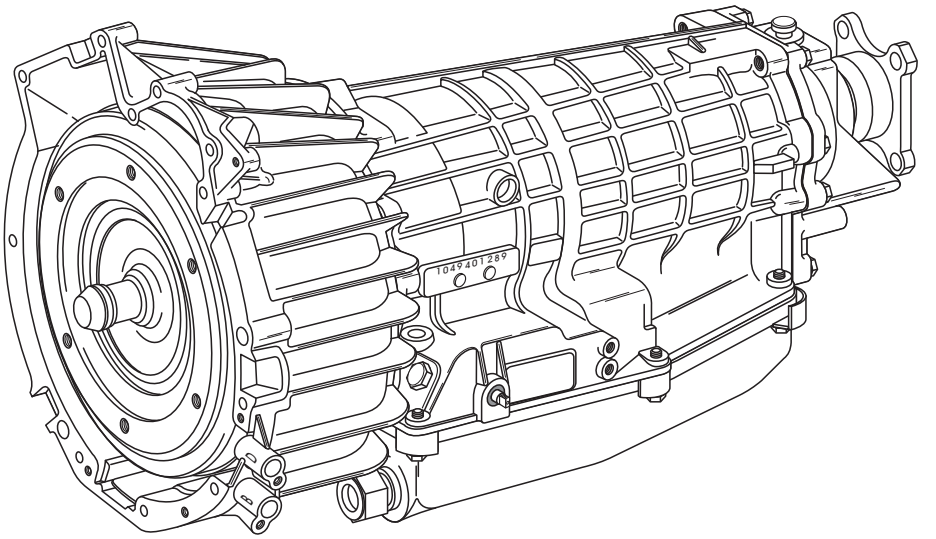
Refer to Figure 41 for Lower Rear Valve Body exploded view, with valve identifications.

Refer to Figure 42 for MV-5 Solenoid Body exploded view, with valve identifications.

Refer to Figure 43 for MV-1 and MV-2 Solenoid Body exploded view, with valve identifications.

Refer to Figure 44 for MV-3 Lock-Up Solenoid Body exploded view, with identifications.

Refer to Figures 45, 46, 47 and 48 for retainer, checkball, and orifice locations.

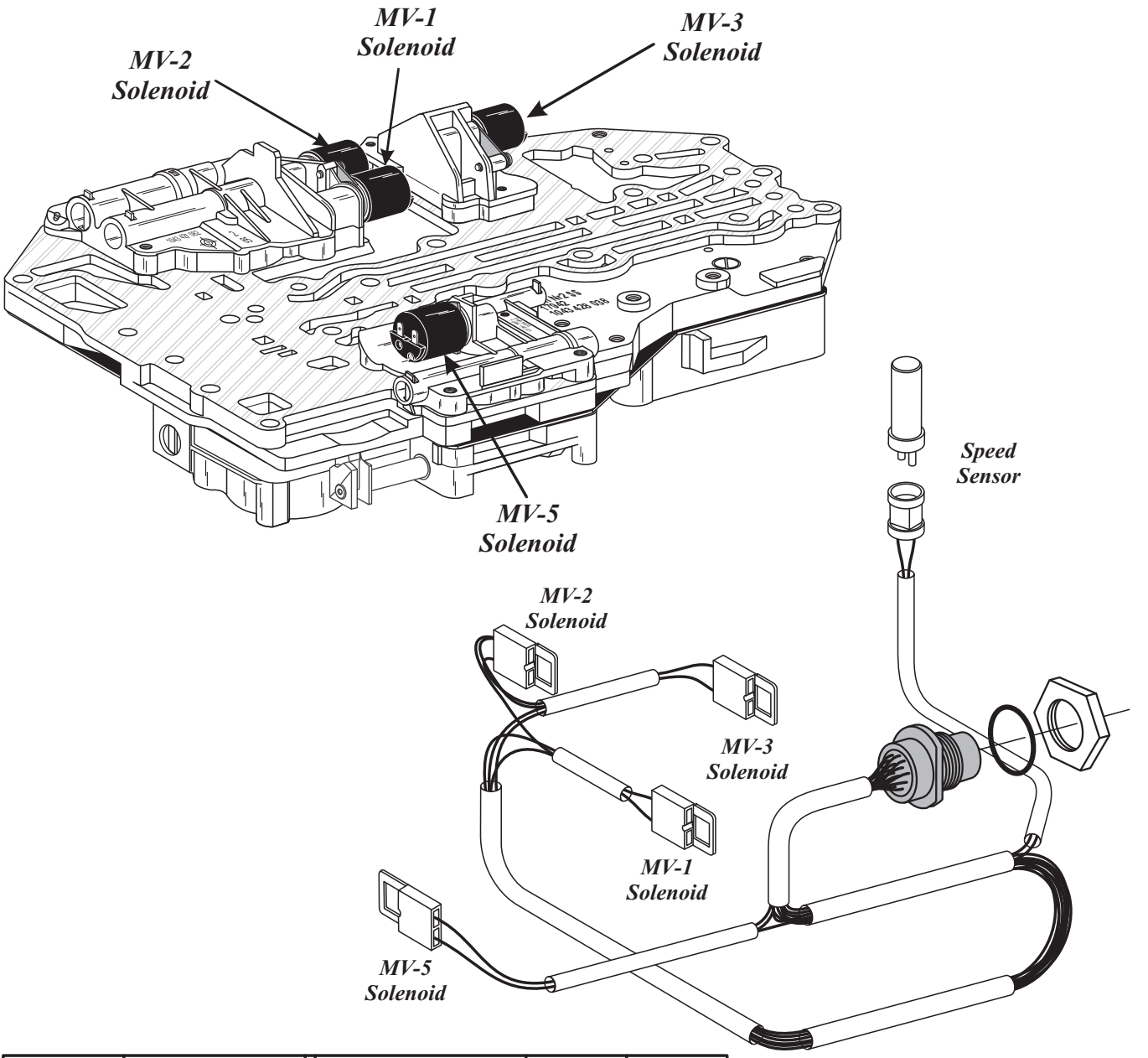


MODEL YEAR USAGE CHART

Valve Body Models	*Model Year*								
	86	87	88	89	90	91	92	93	94
1st Version, Early "E-7", 5 Solenoid									
2nd Version, Late "E-7", 5 Solenoid									
3rd Version, "E-9", 4 Solenoid									

Figure 35

ZF-4HP-22/24 MODEL "E-9", "4 SOLENOID" IDENTIFICATION, LOCATION AND FUNCTION

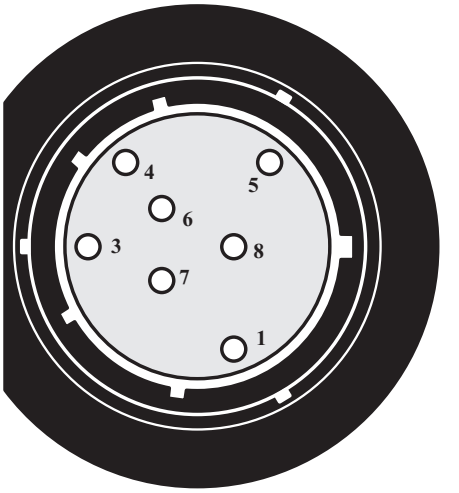


Solenoid	Function	Gear	MV-1	MV-2
MV-1	Shift Control	1st	OFF	ON
MV-2	Shift Control	2nd	ON	ON
		3rd	ON	OFF
		4th	OFF	OFF
		Rev 0 mph	ON	OFF
		Rev Above 3 mph	OFF	ON
MV-3	Lock-Up Control			
MV-5	Line Pressure Control			

Figure 36

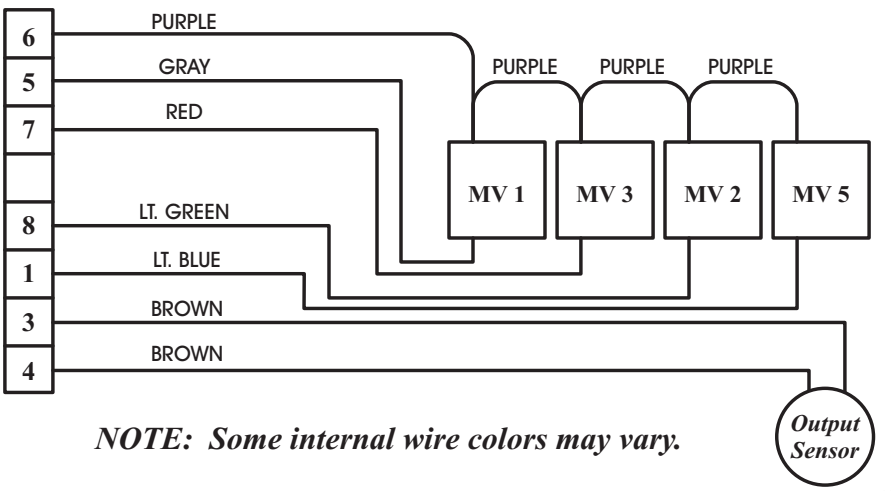
ZF-4HP-22/24 MODEL "E-9", "4 SOLENOID" INTERNAL WIRE SCHEMATIC AND CONNECTOR TERMINAL IDENTIFICATION

Note: The case connector on this unit is not numbered on connector for identification. ATSG has chosen the numbers you see so that you can use the chart below to do a resistance check on internal components.



View Looking Into Case Connector

COMPONENT	*TERMINALS*	*RESISTANCE*	*PART NUMBER*
MV 1 Solenoid	*5 And 6*	*30 - 34 Ohms*	*0501 310 967*
MV 2 Solenoid	*8 And 6*	*30 - 34 Ohms*	*0501 310 967*
MV 3 Solenoid	*7 And 6*	*30 - 34 Ohms*	*0501 310 967*
MV 5 Solenoid	*1 And 6*	*4.5 - 6.5 Ohms*	*0501 311 500*
Output Speed Sensor	*3 And 4*	*265 Ohms (72° F)*	*0501 311 086*

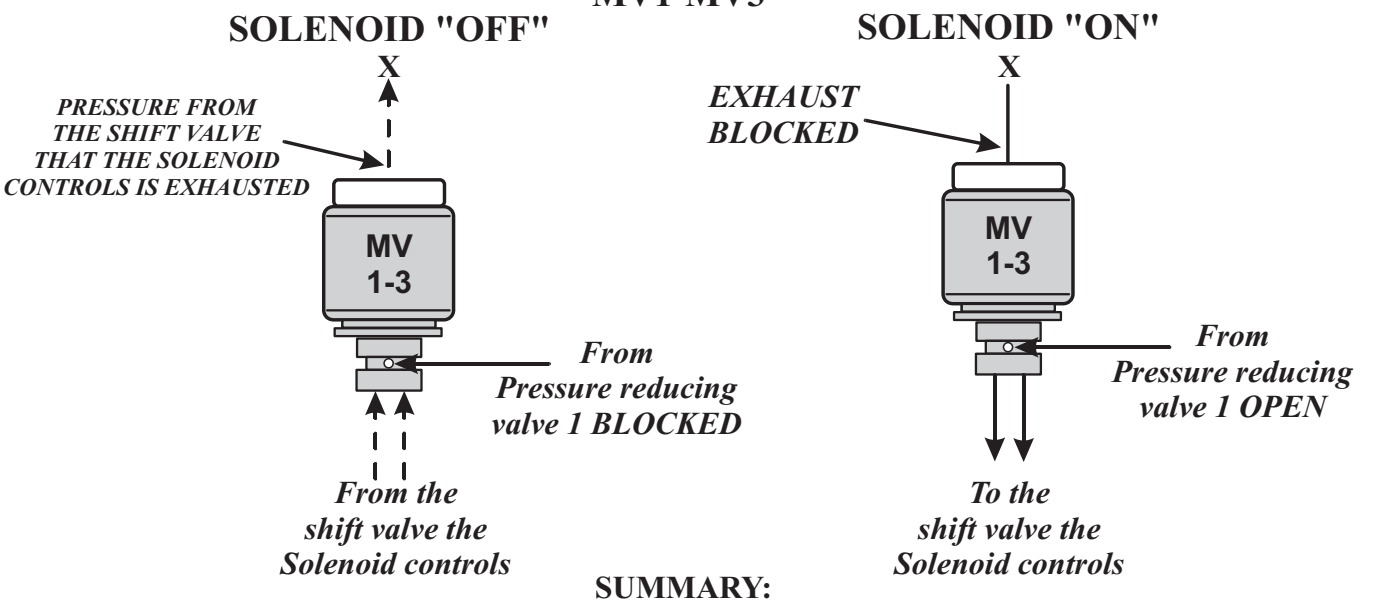


NOTE: Some internal wire colors may vary.

Figure 37

ZF-4HP-22/24 MODEL "E-9", "4 SOLENOID" VALVE BODY, SOLENOID OPERATION

MV1-MV3

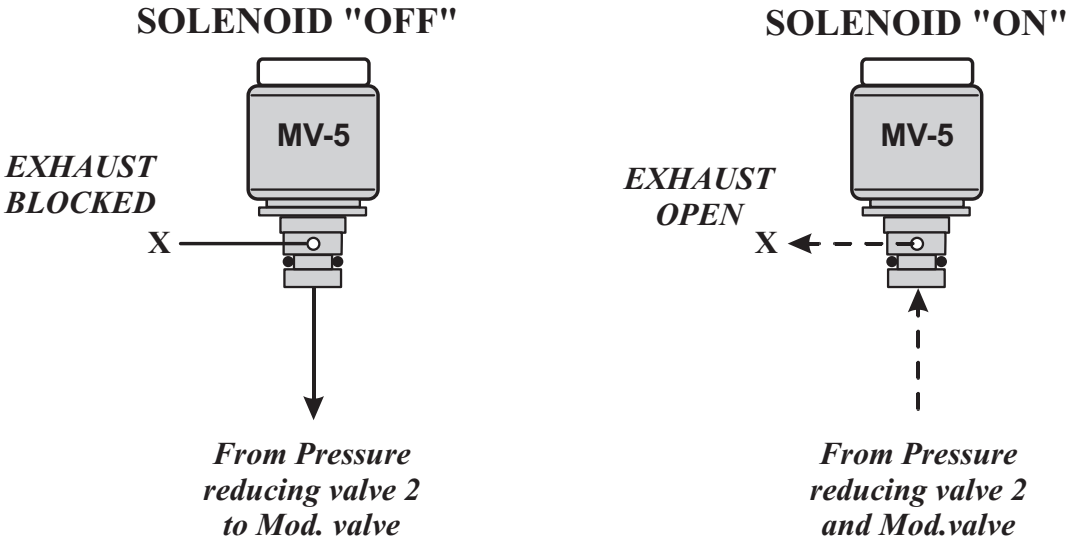


SUMMARY:

When MV 1 thru 3 is in the "OFF" state, Solenoid reducing pressure, from Pressure reducing valve 1, is blocked by the solenoid and oil pressure from the valve that the solenoid controls is exhausted at the rear of the solenoid.
When MV 1 thru 3 is in the "ON"state, Solenoid reducing pressure, from Pressure reducing valve 1, is open through the solenoid and is applied to the valve that the solenoid controls. The exhaust at the rear of the solenoid is closed.

MV-5

(Line Pressure Solenoid)

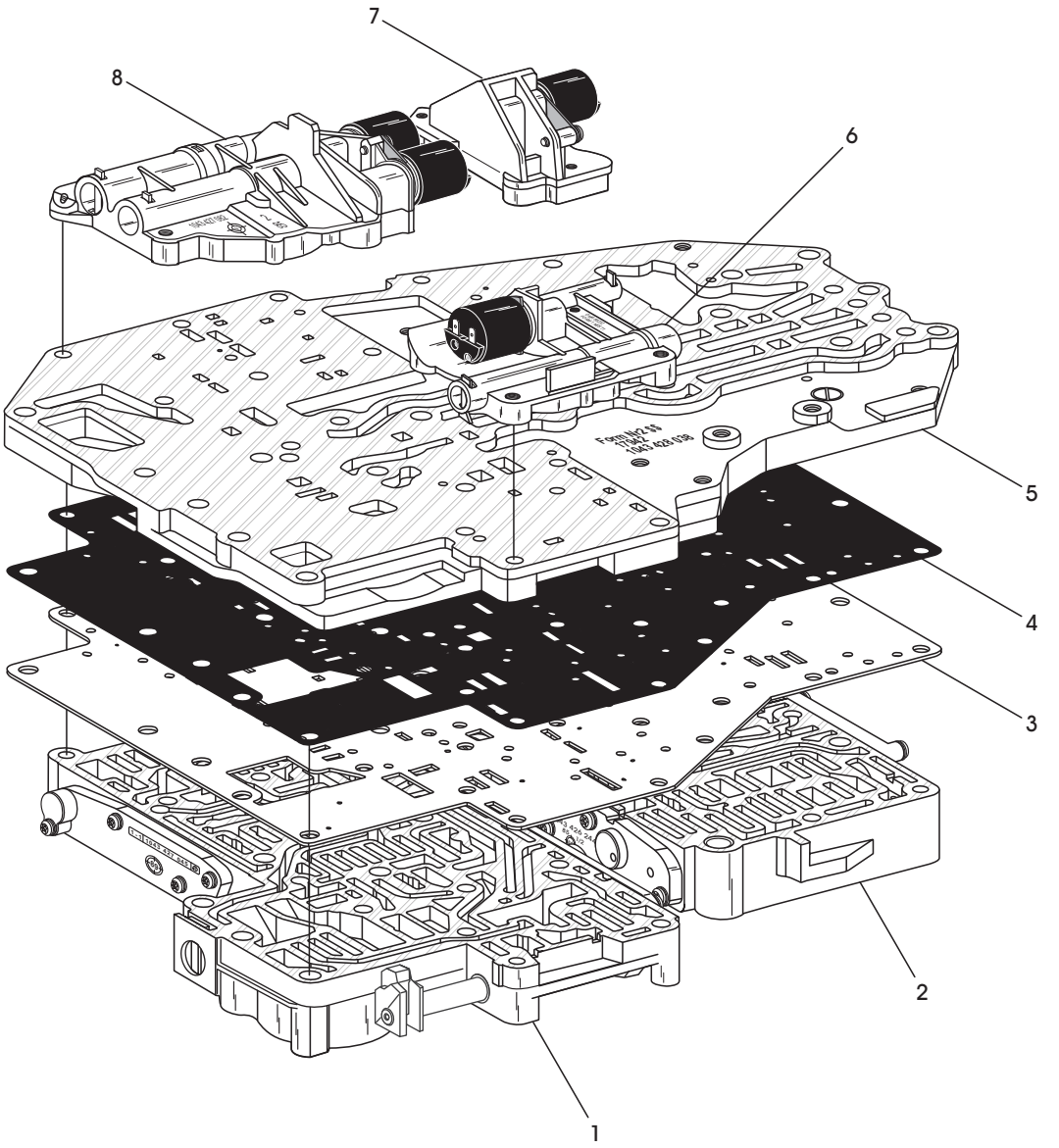


SUMMARY:

When MV-5 solenoid is "OFF," solenoid reducing pressure, from Pressure reducing valve 2, is high to the Modulating valve which creates high line pressure.
When MV-5 solenoid is "ON," solenoid reducing pressure, from Pressure reducing valve 2, is low to the Modulating valve which creates low line pressure.

Figure 38

ZF-4HP-22/24 MODEL "E-9", "4 SOLENOID"
VALVE BODY ASSEMBLY



1 LOWER FRONT VALVE BODY ASSEMBLY
2 LOWER REAR VALVE BODY ASSEMBLY
3 VALVE BODY SPACER PLATE
4 SPACER PLATE TO CHANNEL PLATE GASKET
5 CHANNEL PLATE ASSEMBLY
6 MV-5 SOLENOID BODY ASSEMBLY
7 MV-3 SOLENOID BODY ASSEMBLY
8 MV-1 AND MV-2 SOLENOID BODY ASSEMBLY

Figure 39

ZF-4HP-22/24 MODEL "E-9", "4 SOLENOID"
LOWER "FRONT" VALVE BODY

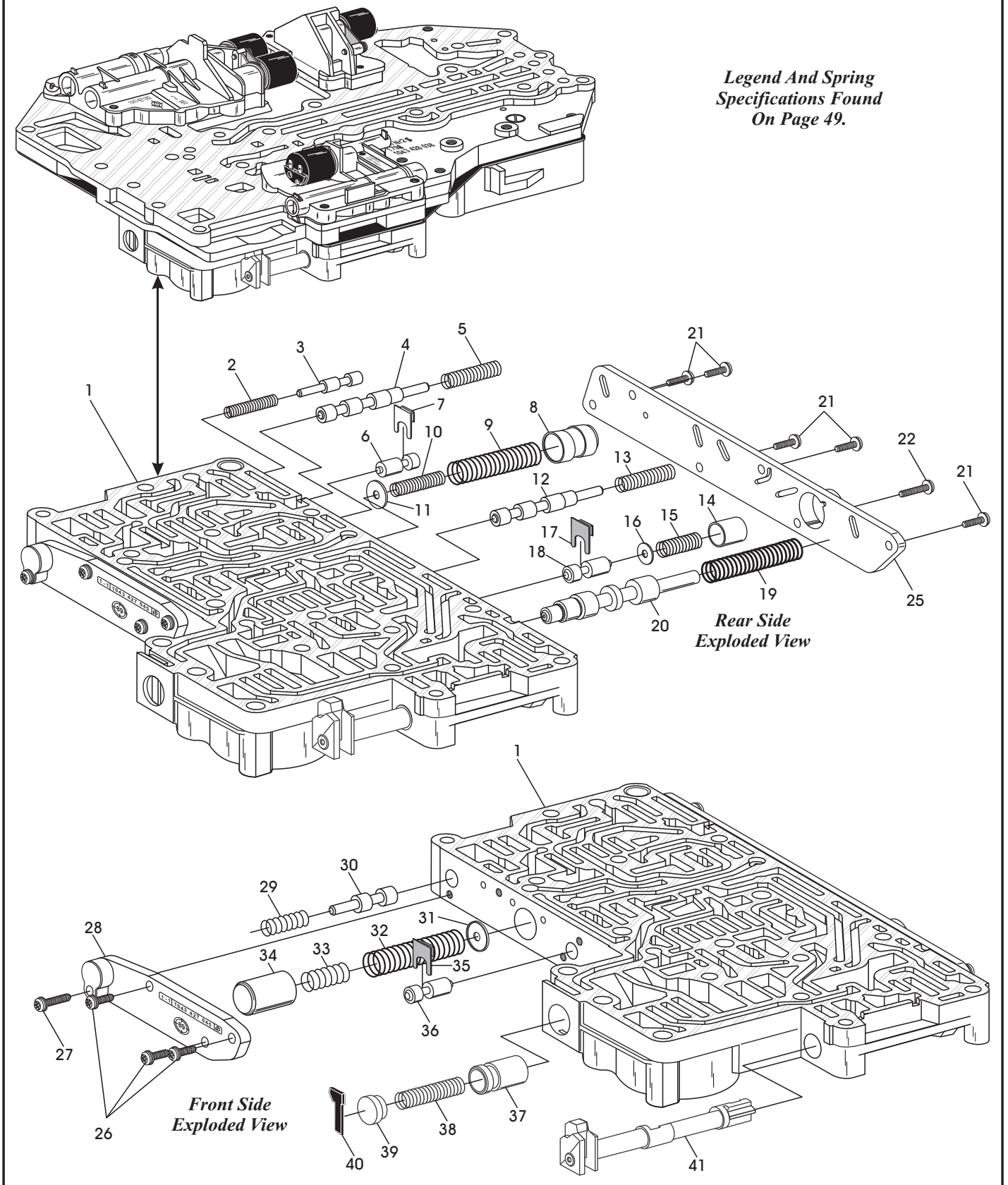


Figure 40

FIGURE 40 LEGEND AND SPRING SPECIFICATIONS

1 LOWER FRONT VALVE BODY CASTING
2 "C' " CLUTCH VALVE SPRING
3 "C' " CLUTCH VALVE
4 2-3 SHIFT VALVE
5 2-3 SHIFT VALVE SPRING
6 "C" CLUTCH VALVE
7 "C" CLUTCH VALVE RETAINER
8 "B" CLUTCH DAMPER PISTON
9 "B" CLUTCH DAMPER PISTON OUTER SPRING
10 "B" CLUTCH DAMPER PISTON INNER SPRING
11 "B" CLUTCH DAMPER PISTON SPRING SEAT
12 1-2 SHIFT VALVE
13 1-2 SHIFT VALVE SPRING
14 "D" CLUTCH DAMPER PISTON
15 "D" CLUTCH DAMPER PISTON SPRING
16 "D" CLUTCH DAMPER PISTON SPRING SEAT
17 "D" CLUTCH VALVE RETAINER
18 "D" CLUTCH VALVE
19 PRESSURE REGULATOR VALVE SPRING
20 PRESSURE REGULATOR VALVE
21 REAR SIDE COVER RETAINING BOLT, 17 mm LENGTH (5)
22 REAR SIDE COVER RETAINING BOLT, 24 mm LENGTH (1)
25 REAR SIDE COVER
26 FRONT SIDE COVER RETAINING BOLT, 17 mm LENGTH (3)
27 FRONT SIDE COVER RETAINING BOLT, 29 mm LENGTH (1)
28 FRONT SIDE COVER
29 TORQUE CONVERTER LOCK-UP VALVE SPRING
30 TORQUE CONVERTER LOCK-UP VALVE
31 "C" CLUTCH DAMPER PISTON SPRING SEAT
32 "C" CLUTCH DAMPER PISTON OUTER SPRING
33 "C" CLUTCH DAMPER PISTON INNER SPRING
34 "C" CLUTCH DAMPER PISTON
35 "B" CLUTCH REGULATOR VALVE RETAINER
36 "B" CLUTCH REGULATOR VALVE
37 "A" CLUTCH DAMPER PISTON
38 "A" CLUTCH DAMPER SPRING
39 "A" CLUTCH DAMPER PISTON SPRING SEAT
40 "A" CLUTCH DAMPER SPRING SEAT RETAINER
41 MANUAL SHIFT VALVE

SPRING ILLUSTRATION NO. 2:
FREE LENGTH = 1.075"
SPRING DIAMETER = .280"
WIRE DIAMETER = .033"

SPRING ILLUSTRATION NO. 5:
FREE LENGTH = 1.925"
SPRING DIAMETER = .363"
WIRE DIAMETER = .033"

SPRING ILLUSTRATION NO. 9:
FREE LENGTH = 2.900"
SPRING DIAMETER = .594"
WIRE DIAMETER = .040"

SPRING ILLUSTRATION NO. 10:
FREE LENGTH = 1.580"
SPRING DIAMETER = .432"
WIRE DIAMETER = .040"

SPRING ILLUSTRATION NO. 13:
FREE LENGTH = 1.880"
SPRING DIAMETER = .367"
WIRE DIAMETER = .032"

SPRING ILLUSTRATION NO. 15:
FREE LENGTH = 1.655"
SPRING DIAMETER = .560"
WIRE DIAMETER = .045"

SPRING ILLUSTRATION NO. 19:
FREE LENGTH = 3.625"
SPRING DIAMETER = .600"
WIRE DIAMETER = .080"

SPRING ILLUSTRATION NO. 29:
FREE LENGTH = 1.690"
SPRING DIAMETER = .443"
WIRE DIAMETER = .032"

SPRING ILLUSTRATION NO. 32:
FREE LENGTH = 3.310"
SPRING DIAMETER = .585"
WIRE DIAMETER = .045"

SPRING ILLUSTRATION NO. 33:
FREE LENGTH = 1.590"
SPRING DIAMETER = .442"
WIRE DIAMETER = .032"

SPRING ILLUSTRATION NO. 38:
FREE LENGTH = 2.727"
SPRING DIAMETER = .400"
WIRE DIAMETER = .050"

Figure 40 Legend

ZF-4HP-22/24 MODEL "E-9", "4 SOLENOID"
LOWER "REAR" VALVE BODY

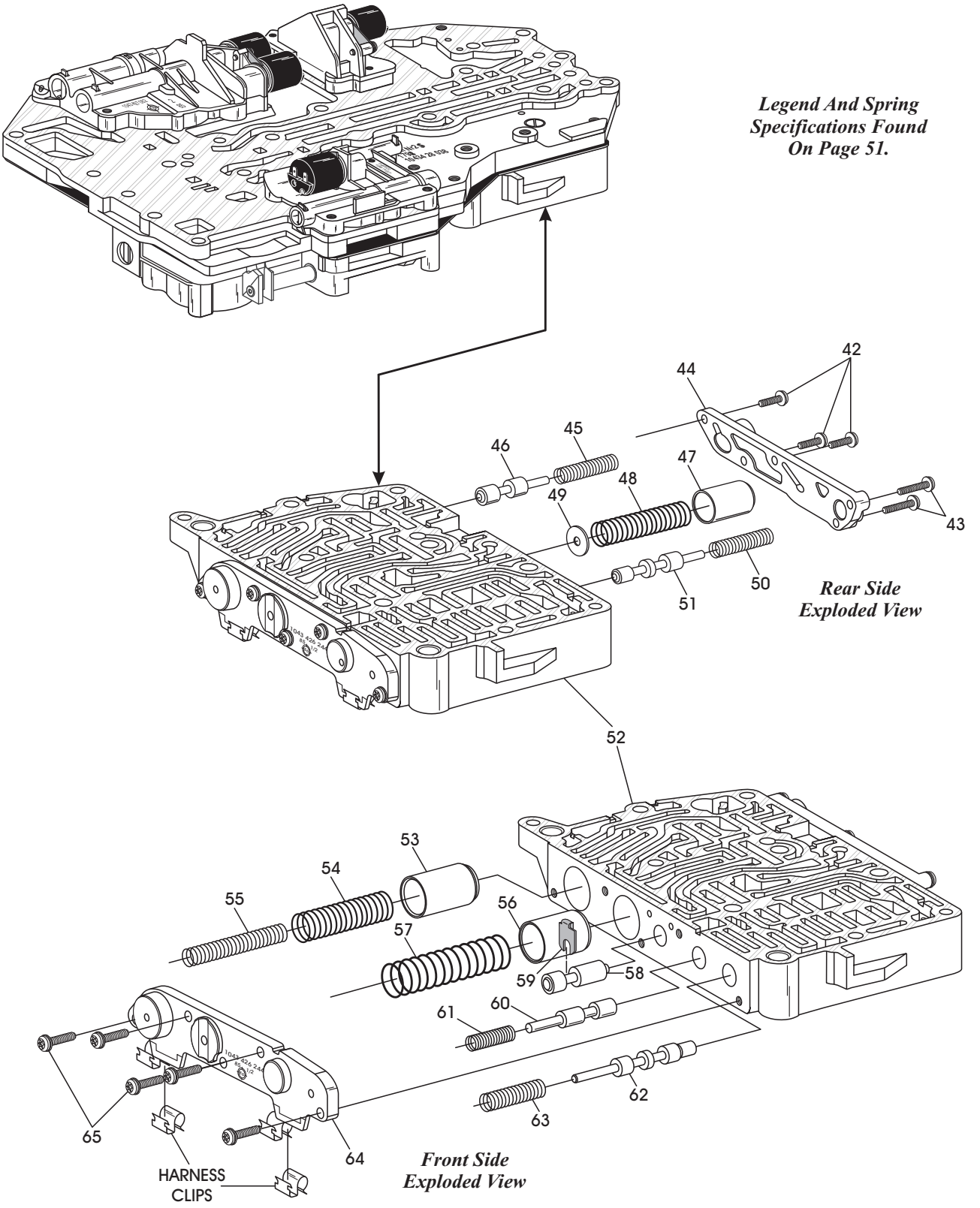


Figure 41

FIGURE 41 LEGEND AND SPRING SPECIFICATIONS

42 REAR SIDE COVER RETAINING BOLTS, 17 mm LENGTH (3)
43 REAR SIDE COVER RETAINING BOLTS, 21 mm LENGTH (2)
44 REAR SIDE COVER
45 PRESSURE REDUCING VALVE "1" SPRING
46 PRESSURE REDUCING VALVE "1"
47 "F" CLUTCH DAMPER PISTON
48 "F" CLUTCH DAMPER PISTON SPRING
49 "F" CLUTCH DAMPER PISTON SPRING SEAT
50 SAFETY VALVE SPRING
51 SAFETY VALVE
52 LOWER REAR VALVE BODY CASTING
53 "C' " CLUTCH DAMPER PISTON
54 "C' " CLUTCH DAMPER PISTON OUTER SPRING
55 "C' " CLUTCH DAMPER PISTON INNER SPRING
56 "E" CLUTCH DAMPER PISTON
57 "E" CLUTCH DAMPER PISTON SPRING
58 "F" CLUTCH VALVE
59 "F" CLUTCH VALVE RETAINER
60 PRESSURE REDUCING VALVE "2"
61 PRESSURE REDUCING VALVE "2" SPRING
62 3-4 SHIFT VALVE
63 3-4 SHIFT VALVE SPRING
64 FRONT SIDE COVER
65 FRONT SIDE COVER RETAINING BOLTS, 17 mm LENGTH (5)

SPRING ILLUSTRATION NO. 45:
FREE LENGTH = 1.395"
SPRING DIAMETER = .305"
WIRE DIAMETER = .040"

SPRING ILLUSTRATION NO. 48:
FREE LENGTH = 3.160"
SPRING DIAMETER = .690"
WIRE DIAMETER = .044"

SPRING ILLUSTRATION NO. 50:
FREE LENGTH = 1.267"
SPRING DIAMETER = .315"
WIRE DIAMETER = .025"

SPRING ILLUSTRATION NO. 54:
FREE LENGTH = 2.900"
SPRING DIAMETER = .603"
WIRE DIAMETER = .065"

SPRING ILLUSTRATION NO. 55:
FREE LENGTH = 3.490"
SPRING DIAMETER = .408"
WIRE DIAMETER = .045"

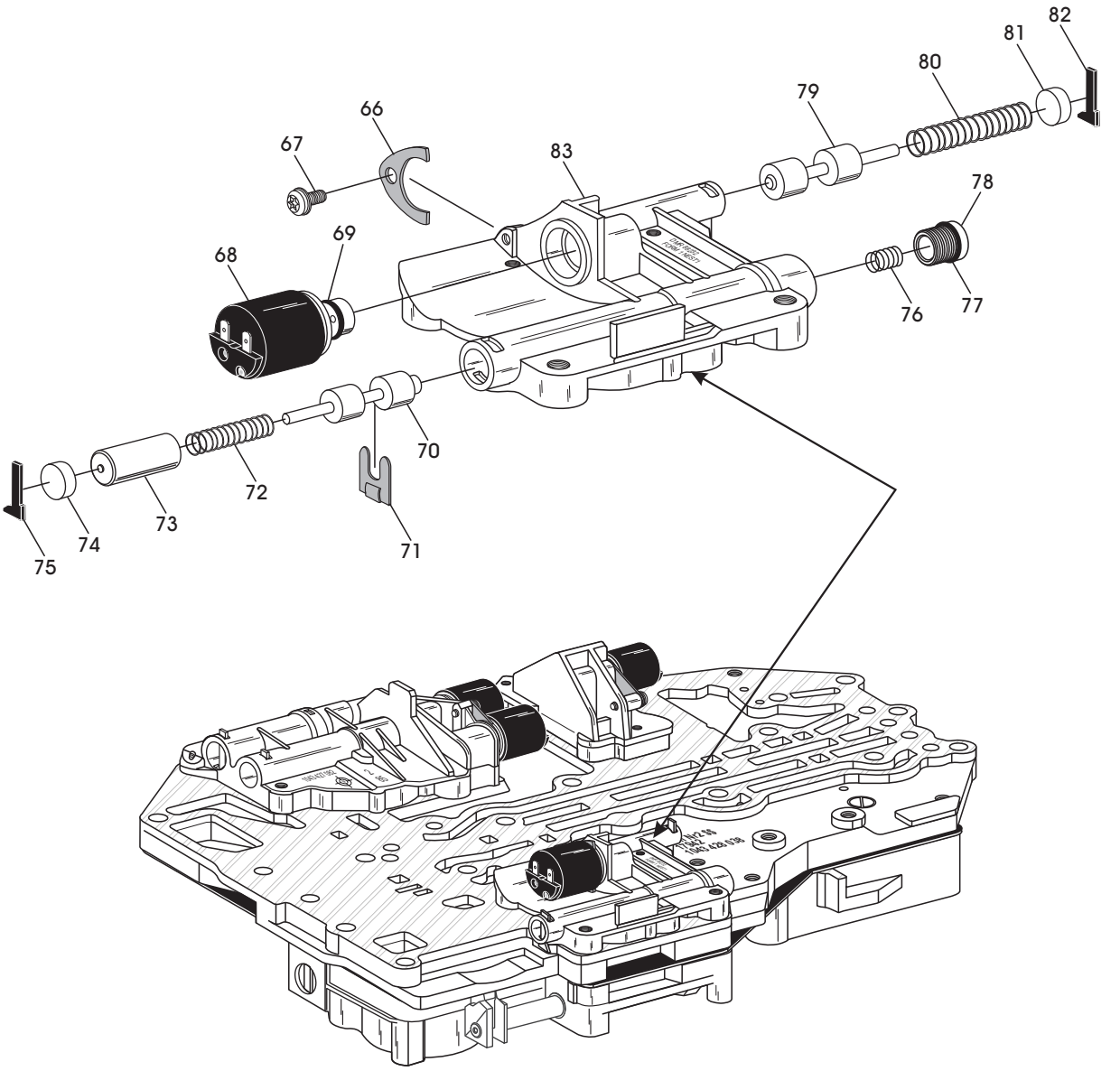
SPRING ILLUSTRATION NO. 57:
FREE LENGTH = 2.905"
SPRING DIAMETER = .614"
WIRE DIAMETER = .065"

SPRING ILLUSTRATION NO. 61:
FREE LENGTH = 1.515"
SPRING DIAMETER = .339"
WIRE DIAMETER = .045"

SPRING ILLUSTRATION NO. 63:
FREE LENGTH = 1.595"
SPRING DIAMETER = .67"
WIRE DIAMETER = .032"

Figure 41 Legend

ZF-4HP-22/24 MODEL "E-9", "4 SOLENOID"
MV-5 SOLENOID BODY



66 SOLENOID RETAINING BRACKET
67 SOLENOID RETAINING BOLT, 11 mm LENGTH
68 MV-5 LINE PRESSURE SOLENOID ASSEMBLY
69 MV-5 LINE PRESSURE SOLENOID "O" RING
70 MODULATION VALVE
71 MODULATION VALVE RETAINER
72 MODULATION VALVE SPRING
73 MODULATION VALVE SPRING SLEEVE
74 MODULATION VALVE BORE PLUG
75 MODULATION VALVE BORE PLUG RETAINER
76 MODULATION VALVE BALANCE SPRING
77 MODULATION VALVE ADJUSTING PLUG "O" RING
78 MODULATION VALVE ADJUSTING PLUG
79 REVERSE LOCKOUT VALVE
80 REVERSE LOCKOUT VALVE SPRING
81 REVERSE LOCKOUT VALVE BORE PLUG
82 REVERSE LOCKOUT VALVE BORE PLUG RETAINER
83 MV-5 SOLENOID BODY CASTING

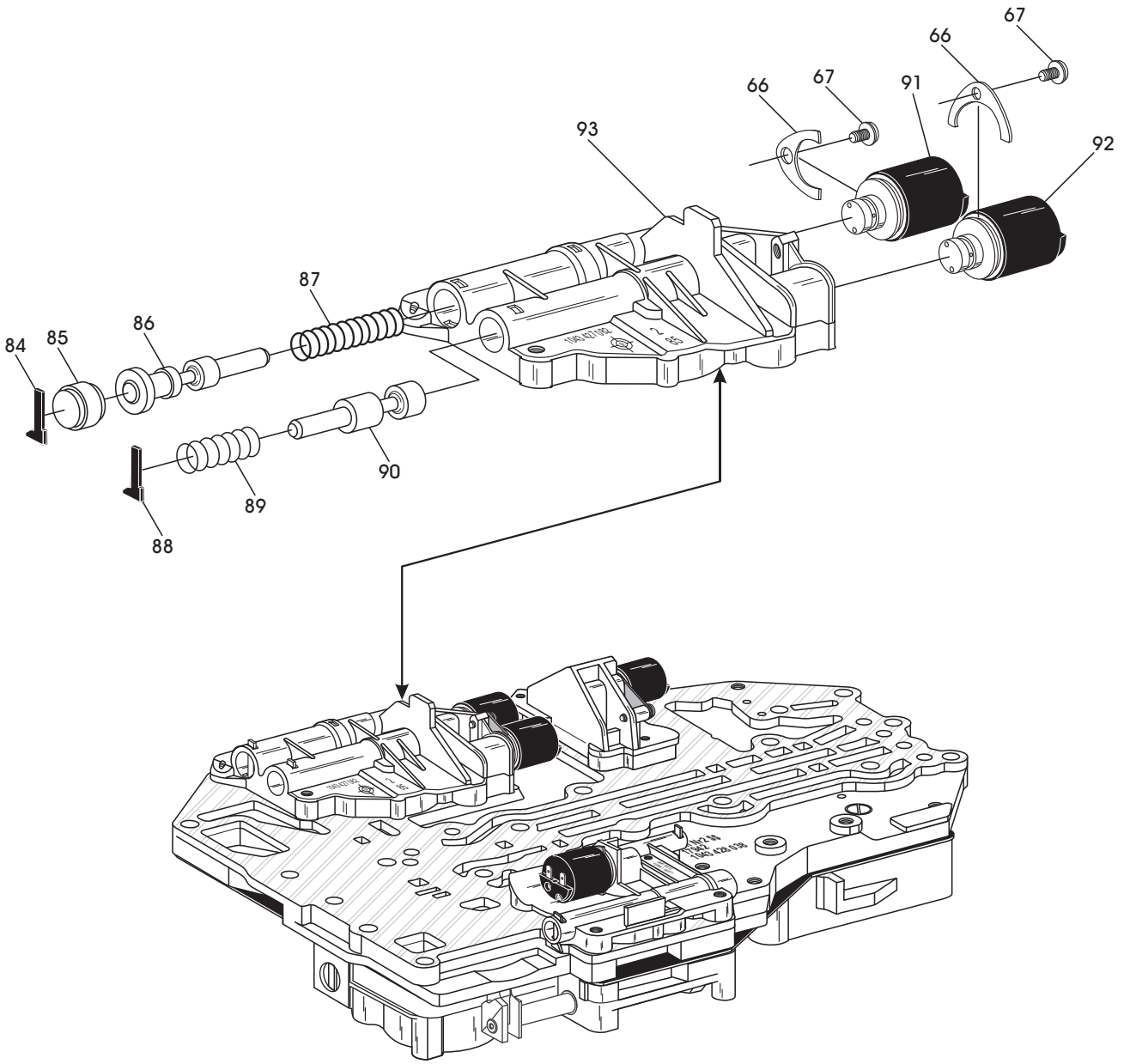
SPRING ILLUSTRATION NO. 72:
FREE LENGTH = 1.245"
SPRING DIAMETER = .302"
WIRE DIAMETER = .039"

SPRING ILLUSTRATION NO. 76:
FREE LENGTH = .770"
SPRING DIAMETER = .377"
WIRE DIAMETER = .027"

SPRING ILLUSTRATION NO. 80:
FREE LENGTH = 1.835"
SPRING DIAMETER = .380"
WIRE DIAMETER = .035"

Figure 42

ZF-4HP-22/24 MODEL "E-9", "4 SOLENOID"
MV-1 AND MV-2 SOLENOID BODY



66 SOLENOID RETAINING BRACKET
67 SOLENOID RETAINING BOLT, 11 mm LENGTH
84 T.C.C. VALVE BORE PLUG RETAINER
85 T.C.C. VALVE BORE PLUG
86 TORQUE CONVERTER CLUTCH VALVE
87 TORQUE CONVERTER CLUTCH VALVE SPRING
88 LUBRICATION VALVE SPRING RETAINER
89 LUBRICATION VALVE SPRING
90 LUBRICATION VALVE
91 MV-2 SHIFT SOLENOID ASSEMBLY
92 MV-1 SHIFT SOLENOID ASSEMBLY
93 SHIFT SOLENOID BODY CASTING

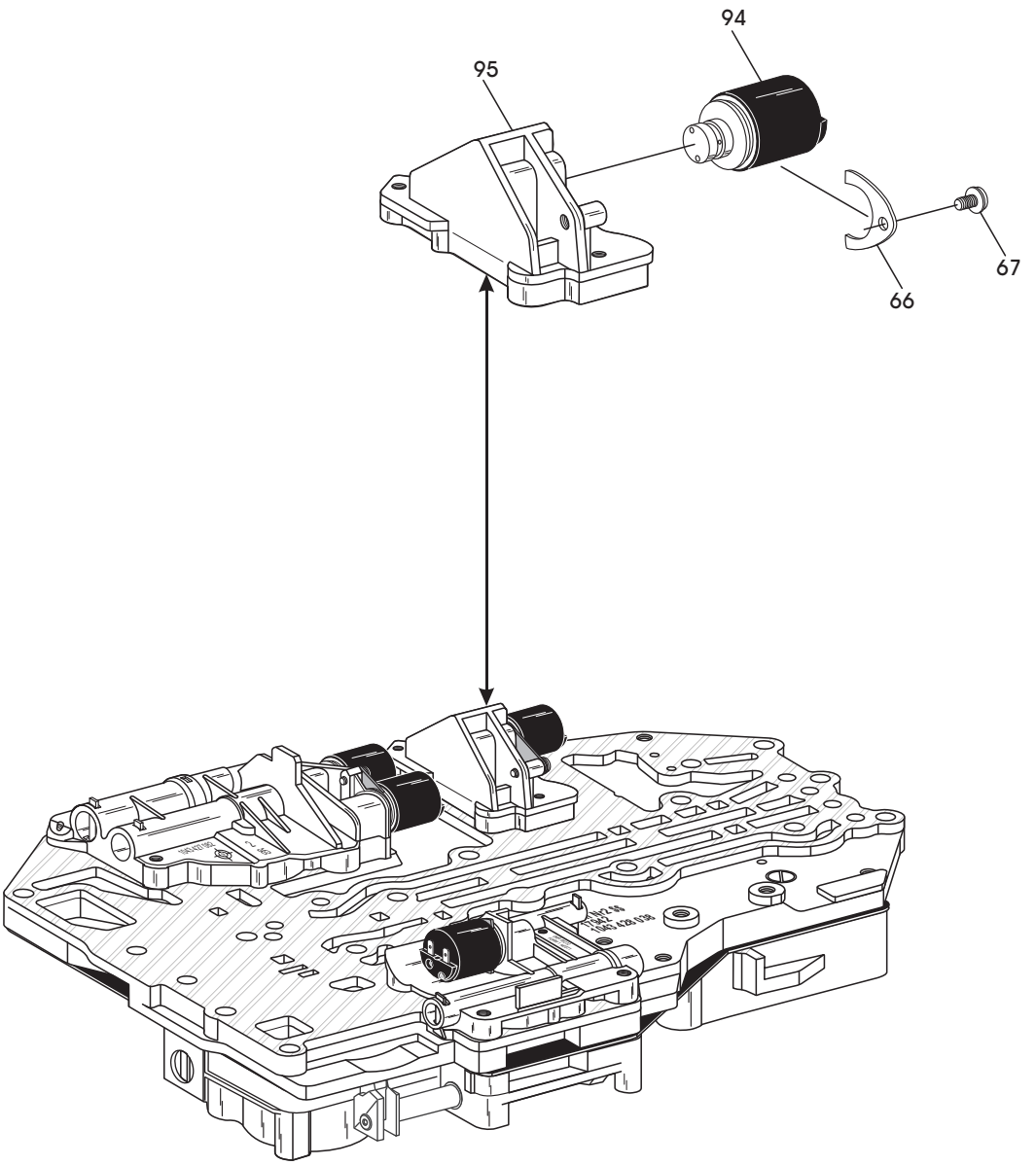
SPRING ILLUSTRATION NO. 87:
FREE LENGTH = 1.570"
SPRING DIAMETER = .430"
WIRE DIAMETER = .039"

SPRING ILLUSTRATION NO. 89:
FREE LENGTH = 1.545"
SPRING DIAMETER = .440"
WIRE DIAMETER = .031"

Figure 43

INDEX

ZF-4HP-22/24 MODEL "E-9", "4 SOLENOID"
MV-3 SOLENOID BODY



66 SOLENOID RETAINING BRACKET
67 SOLENOID RETAINING BOLT, 11 mm LENGTH
94 MV-3 LOCK-UP SOLENOID ASSEMBLY
95 MV-3 SOLENOID BODY CASTING

Figure 44

ZF-4HP-22/24 MODEL "E-9", "4 SOLENOID"
LOWER "FRONT" VALVE BODY

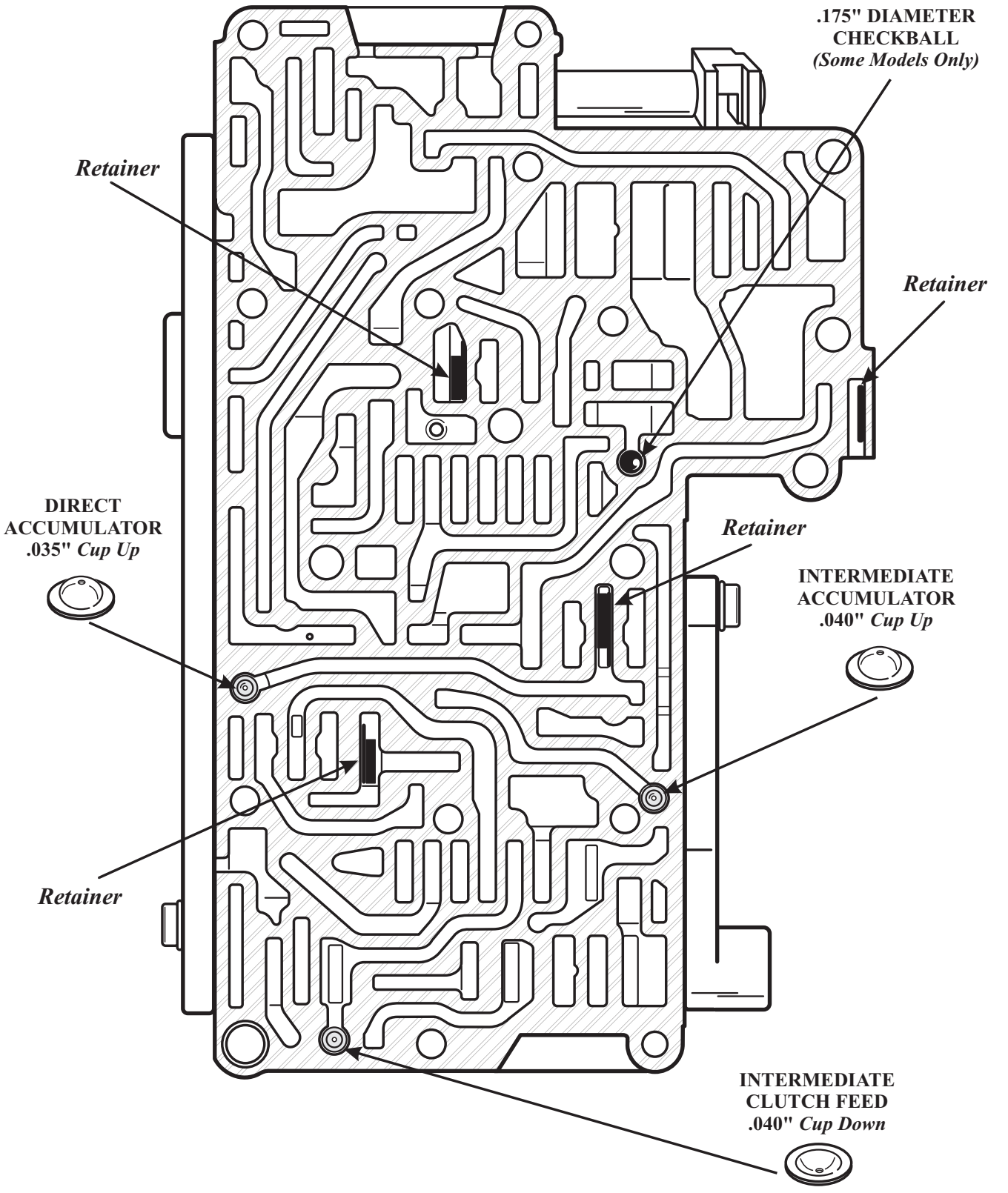


Figure 45

ZF-4HP-22/24 MODEL "E-9", "4 SOLENOID"
LOWER "REAR" VALVE BODY

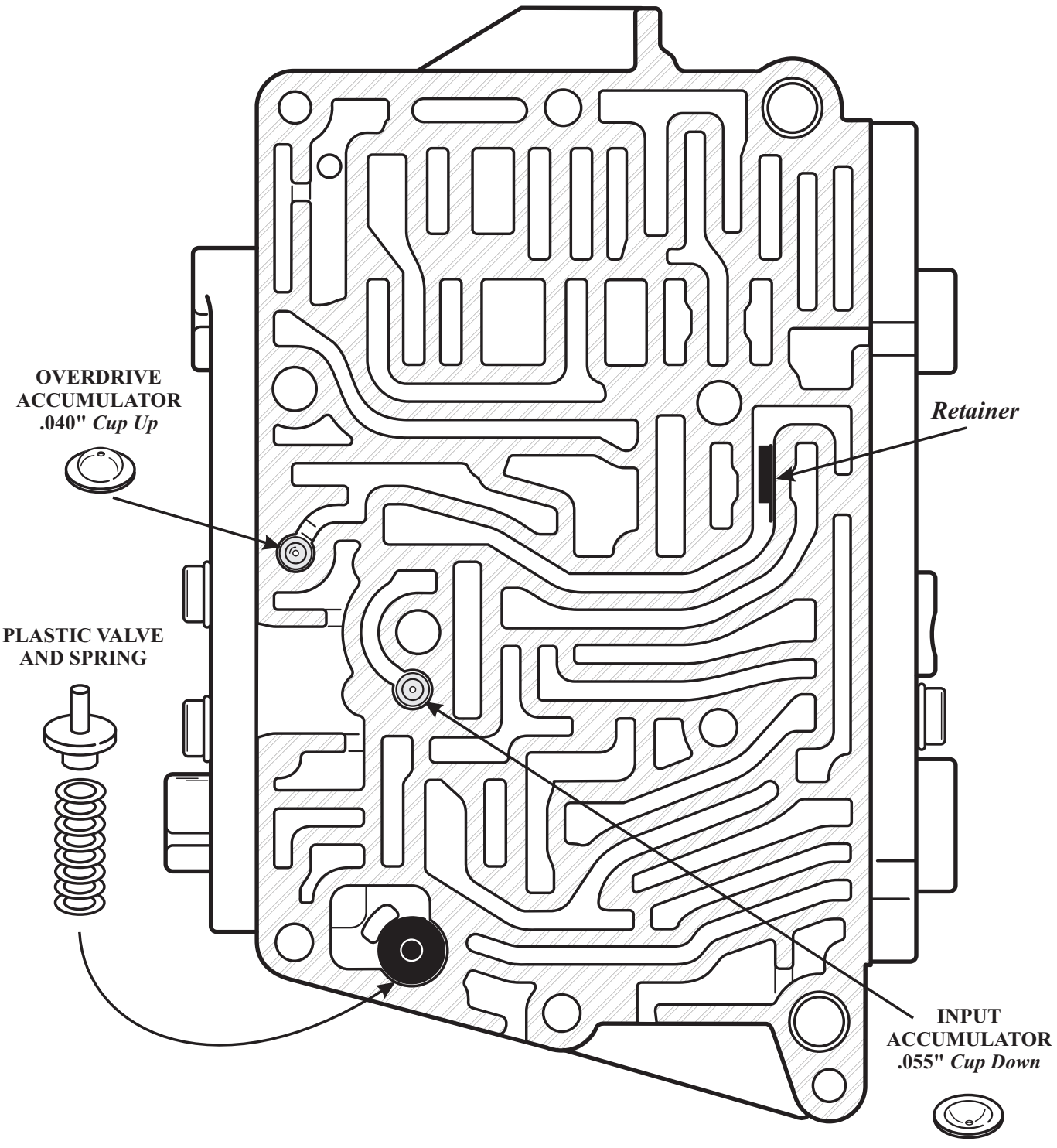


Figure 46

ZF-4HP-22/24 MODEL "E-9", "4 SOLENOID"
CHANNEL PLATE

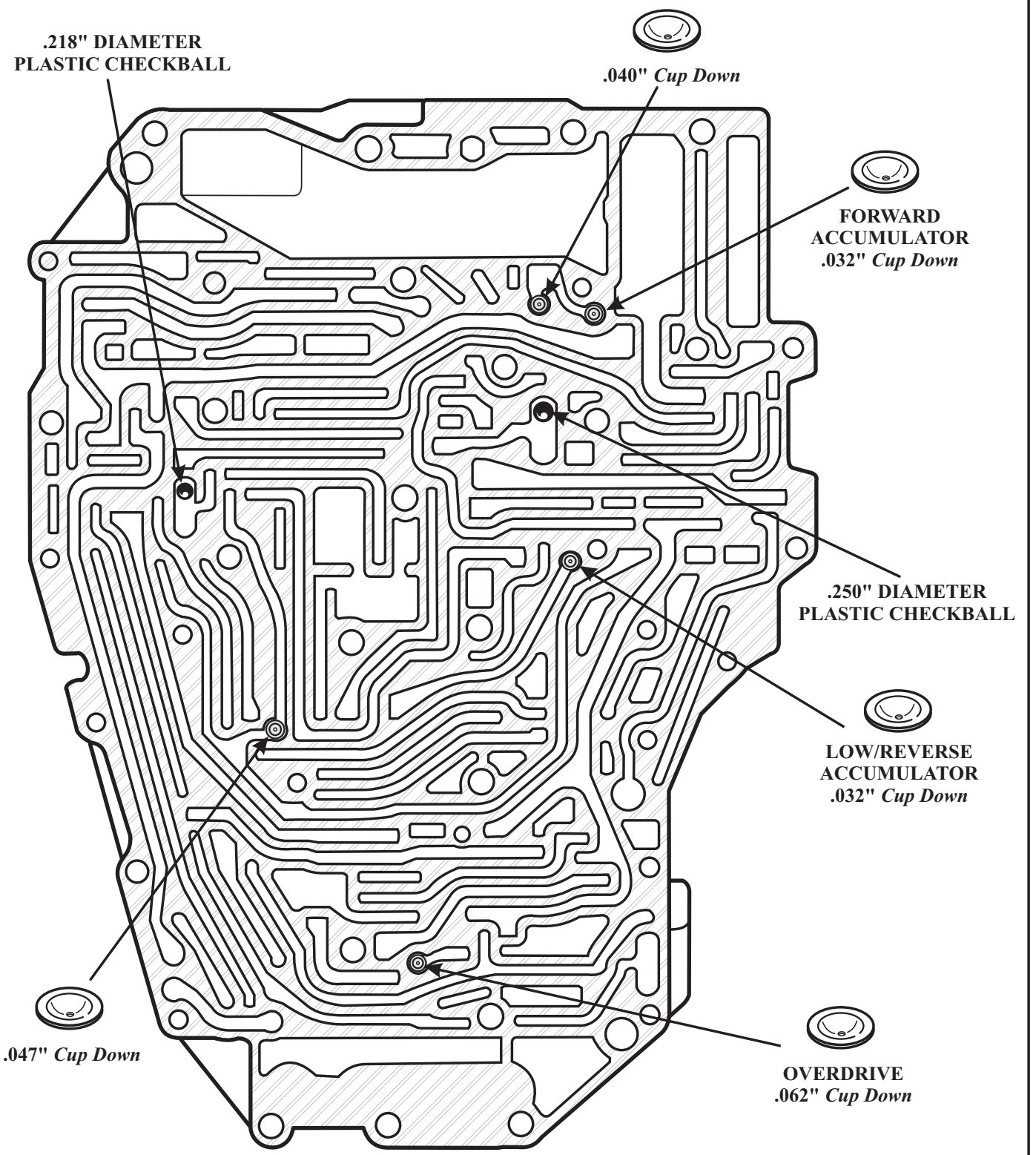
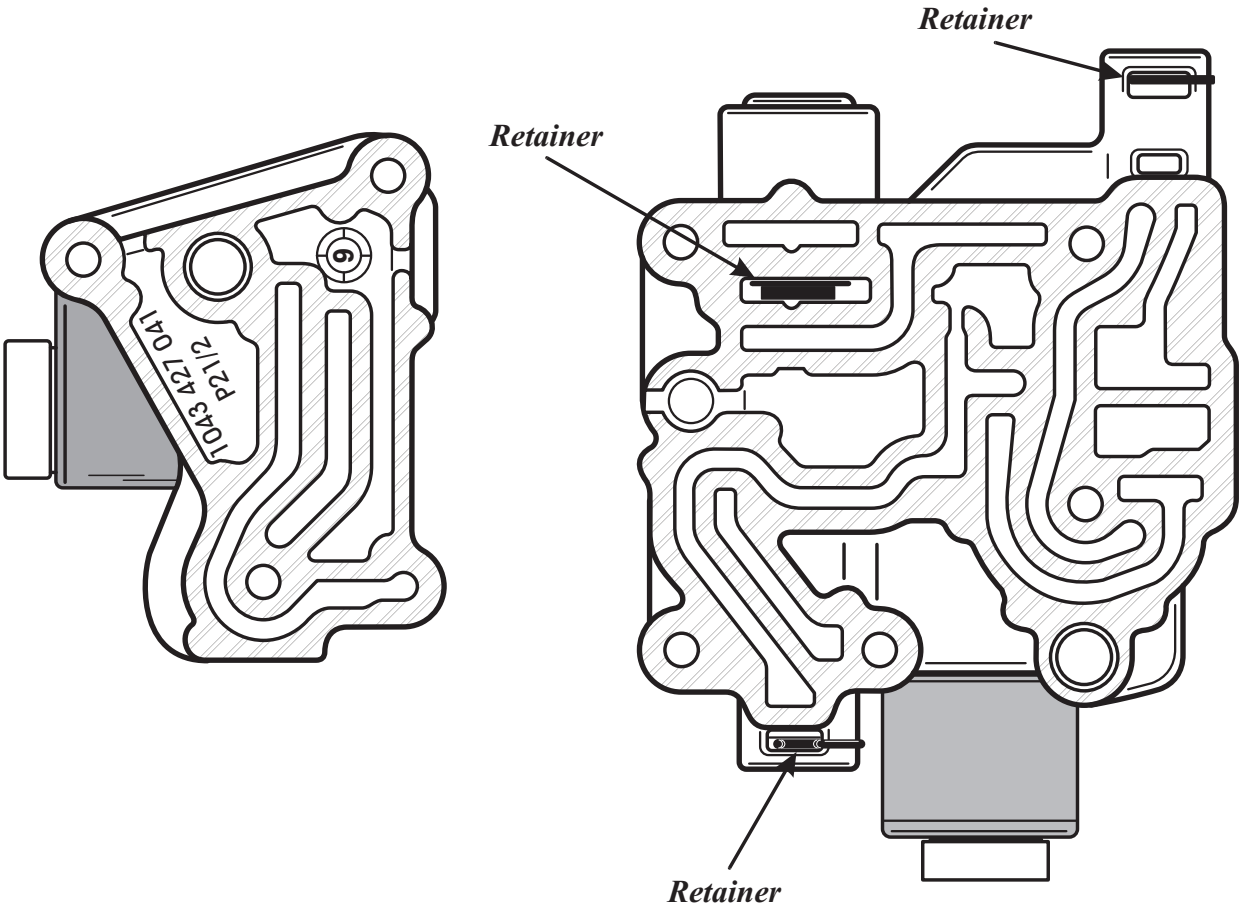


Figure 47

ZF-4HP-22/24 MODEL "E-9", "4 SOLENOID"
ALL SOLENOID BODIES



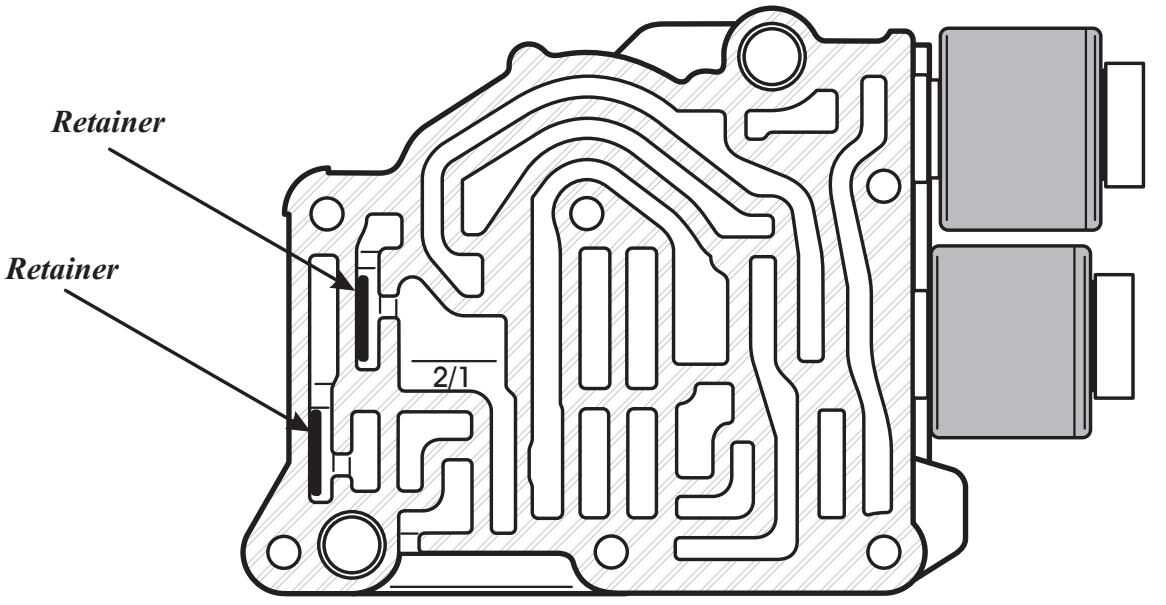
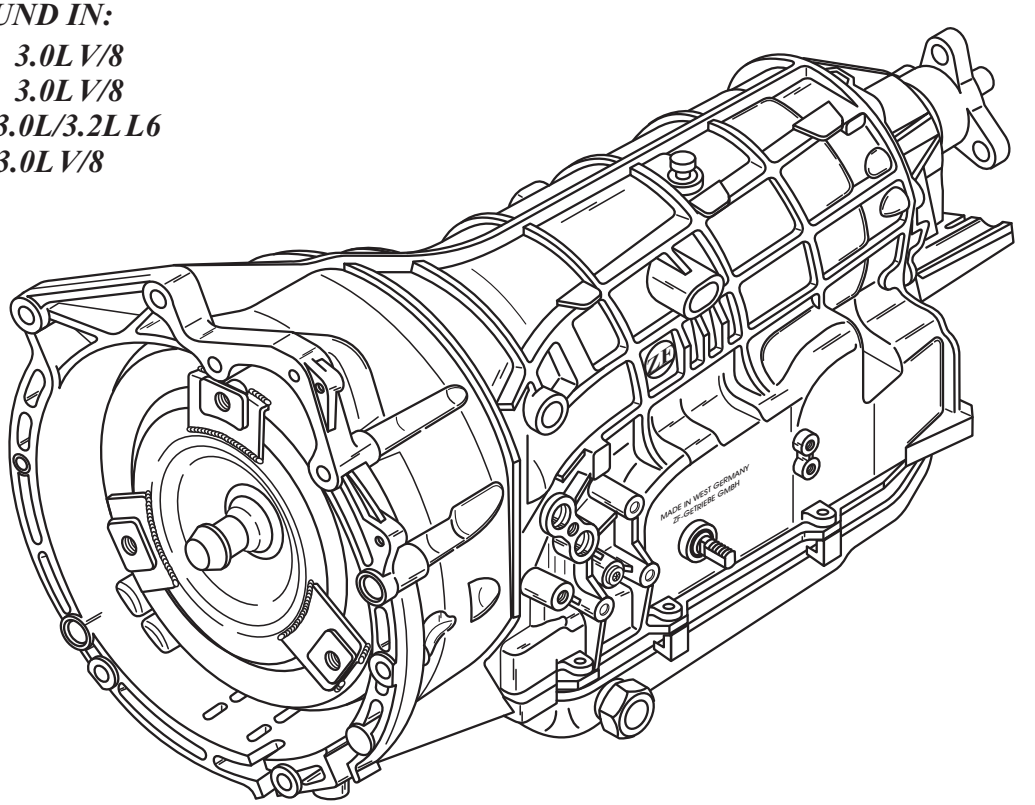


Figure 48

BMW ZF-5HP-18
DIAGNOSTIC INFORMATION

FOUND IN:
93-94 320i 3.0L V/8
93-95 530i 3.0L V/8
95-98 M3 3.0L/3.2L L6
730 3.0L V/8



This transmission is manufactured in Germany by ZF and carries the BMW designation A5S 310Z.

The A5S 310Z (ZF-5HP-18) is an electronically controlled, five speed automatic transmission with a lock-up clutch type torque converter. Two planetary gear sets, one Ravingneaux gear set and one standard planetary gear set on the output side, four rotating multiple disc clutches, three multiple disc brake clutches, one brake band, and two sprag clutches (Freewheels) are used to provide the five forward speeds and reverse.

Key to designation:

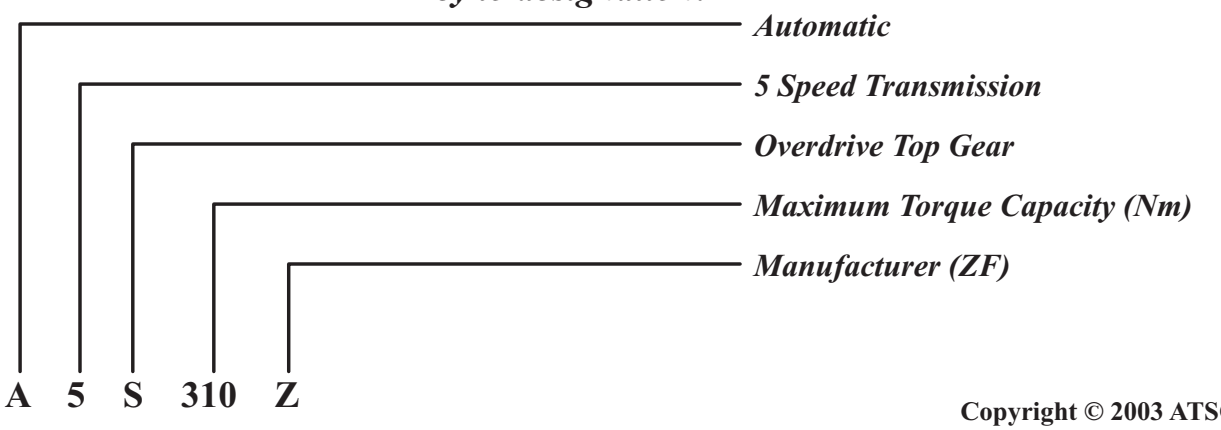


Figure 49

Refer to Figure 50 for Clutch and Band Application Chart.

Refer to Figure 51 for Manual Shift Lever Operation, Mode Switch Operation and location, and Failsafe Operation.

Refer to Figure 52 for both MV Solenoid Operation and EDS Solenoid Operation and Tests.

Refer to Figure 53 for Shift Solenoid Application chart and their locations. Notice that the MV 6 Solenoid is used only for Converter Clutch application and that it is identified by a White connector on the solenoid, where all the others are Black. Notice also that EDS 1 Solenoid is used for line pressure control. MV 4 and MV 5 Solenoids are used only for downshifts.

Refer to Figure 54 for wiring harness identification, internal wiring schematic, and transmission case connector pin identification and functions.

Refer to Figure 55 for identification and internal component resistance chart.

Refer to Figure 56 and 57 for retrieving trouble codes and the Trouble Code charts.

Refer to Figure 58 for Solenoid and Sensor resistance chart with the pins identified for both the case connector and the Transmission Control Unit connector.

Refer to Figure 59 for case passage identification to air check this unit before installation of the valve body assembly.

Refer to Figure 60 for pressure tap locations on the case, and notice that some cases you must drill and tap for access to a particular pressure.

Refer to Figure 61 for exploded view of the Upper Front Valve Body with valves identified.

Refer to Figure 62 for speed sensor locations on the channel plate.

Refer to Figure 63 for exploded view of the Solenoid Valve Body with valves identified. Notice that there is an "O" ring on the adjustment screw that goes in the groove.

Refer to Figure 64 for exploded view of the Lower Rear Valve Body with the valves identified.

Refer to Figure 65 for exploded view of the Lower Front Valve Body with the valves identified.

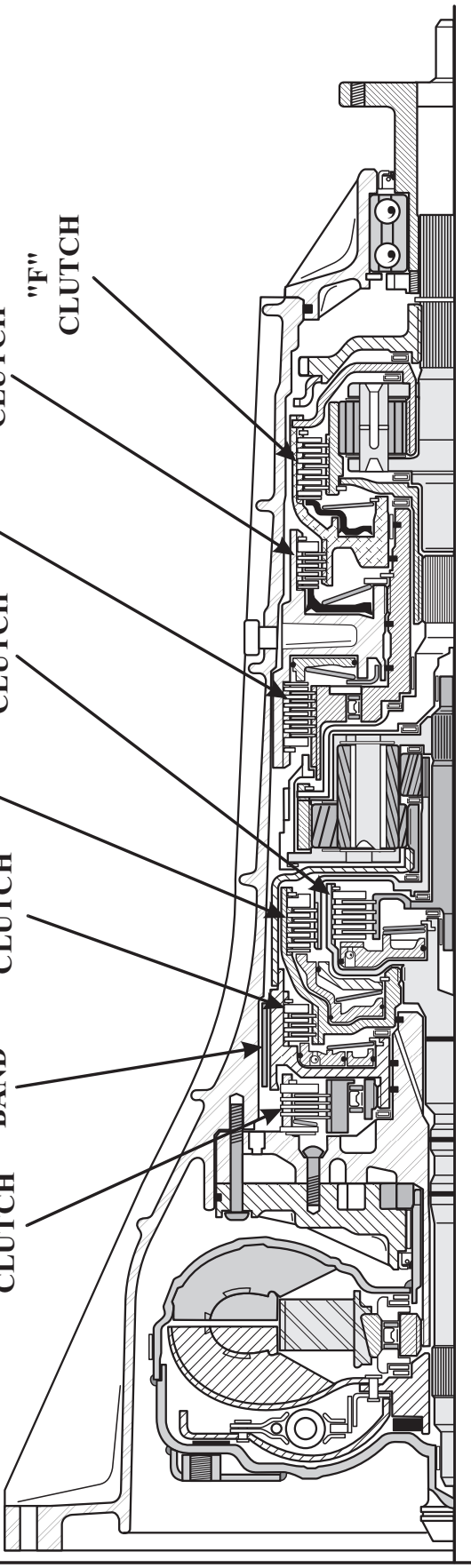
Refer to Figures 66 thru 69 for the retaining clip locations in the various valve bodies.

Refer to Figure 70 for the locations of the orifices, checkballs, screens, and the check valves and springs that are located in the channel plate.

Refer to Figure 71 for all valve body spring specifications, as observed in a used valve body.

Refer to Page 83 for "No Movement Or Delayed Engagement", and Refer to Page 86 for a "Bind-Up In 1st Gear, With Selector Lever In Manual 2 Position".

CLUTCH AND BAND APPLICATION CHART



RANGE	"A" CLUT	"B" CLUT	"C1" CLUT	"C2" BAND	"INT" SPRAG	"D" CLUT	"LOW" SPRAG	"E" CLUT	"F" CLUT	"G" CLUT	CONV CLUT	GEAR RATIO
Park										ON		
Reverse		ON				ON				ON		4.08
Neutral										ON		
"D"-1st	ON						HOLD			ON		3.66
"D"-2nd	ON		ON	ON	HOLD					ON		1.99
"D"-3rd	ON		ON	ON	HOLD				ON		*	1.40
"D"-4th	ON		ON					ON	ON		*	1.00
"D"-5th			ON	ON				ON	ON		*	0.74
"4"	*Same as above, Automatic Shift 1st thru 4th, 5th gear is inhibited.*										*	
"3"	*Same as above, Automatic Shift 1st thru 3rd, 4th and 5th gear are inhibited.*										*	
"2"	*Same as above, Automatic Shift 1st thru 2nd, 3rd, 4th and 5th gear are inhibited.*											

∗Converter Clutch may be ON or OFF depending on vehicle speed and throttle position.

Figure 50

SELECTOR LEVER

P = Park

R = Reverse

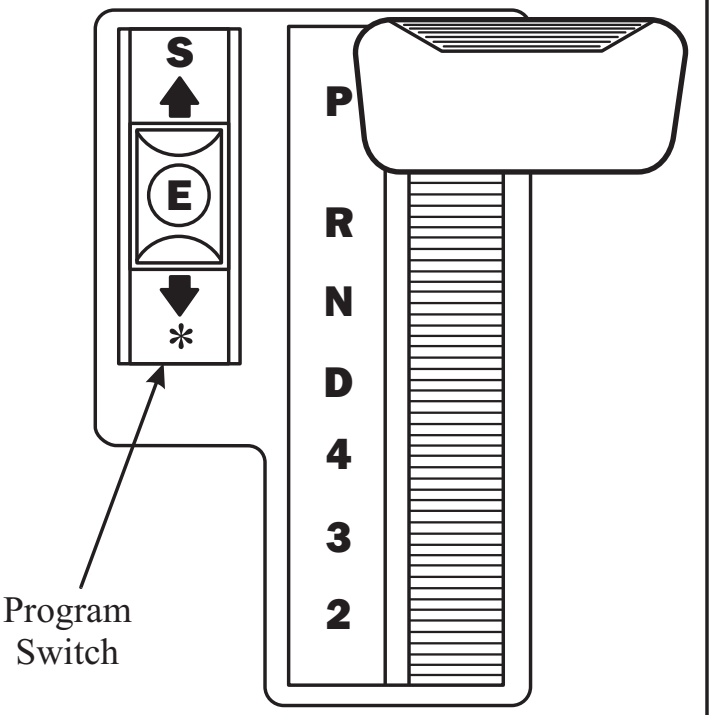
N = Neutral

D = Automatic Shift 1st thru 5th gear.

4 = Automatic Shift 1st thru 4th gear.
5th gear is locked out.

3 = Automatic Shift 1st thru 3rd gear.
4th and 5th gear are locked out.

2 = Automatic Shift 1st thru 2nd gear.
3rd, 4th and 5th gear are locked out.



The "Program Switch" can be used to select one of three programs.

E = ***ECONOMY*** **(Fuel Efficient Driving Style)**
The ***"E"*** program is activated every time the engine is started. Once the engine has been started, either Sport or Winter programs can be selected with the Program Switch. The transmission changes automatically from 1st thru 5th gear in any throttle position up to full throttle. When throttle position is in the kick-down range, the transmission changes automatically from 1st thru 4th gears. The change into 5th gear is a forced upshift and occurs just before engine speed reaches the upper limit for controlled cut-back.

S = ***SPORT*** **(Full Exploitation of Engine Performance)**
The ***"S"*** program is performance oriented and must be re-selected every time the engine is started. The transmission changes automatically from 1st thru 4th gear regardless of throttle position. The change into 5th gear is a forced upshift and occurs just before engine speed reaches the upper limit for controlled cut-back.

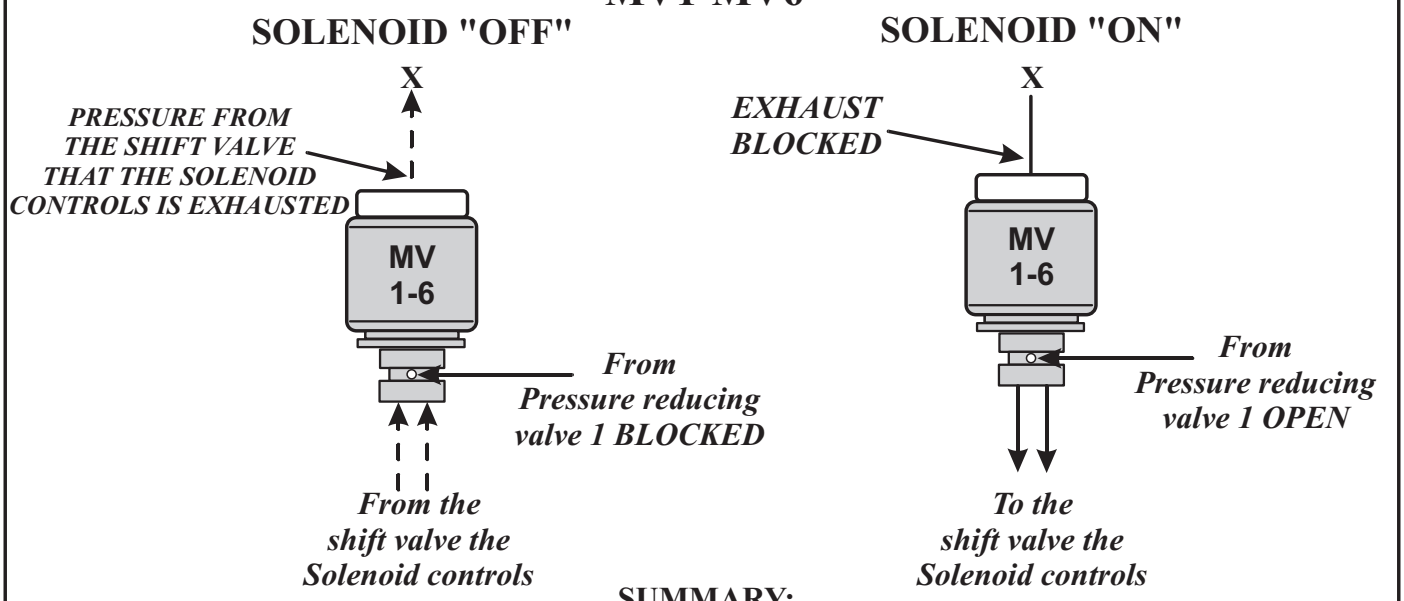
***** = ***WINTER*** **(Manual Shifts)**
The ***"Winter"*** program provides manual shifts and is designed for situations of driving on snow or ice, driving on mountain roads or towing a trailer. The driver has the same free choice of gears as with a manual transmission, as the transmission remains in the gear selected with the selector lever. This makes it possible to utilize the engines full braking power. The transmission never changes into 1st or 5th gears in the "Winter" mode.

FAILSAFE OPERATION:
When a system fault is detected which would impair normal reliable operation, the transmission control module interrupts the power supply to Pin 13 at the transmission case connector. The transmission control module also alerts the driver of any faults by signaling the vehicles "Check Control" system. To enable the vehicle to be driven to a repair shop, the following manual gear selections are permitted:

Selector Lever Position	**P R N D 4 3 2**
Actual Gear Obtained	**P R N 4 4 4 4**

Figure 51

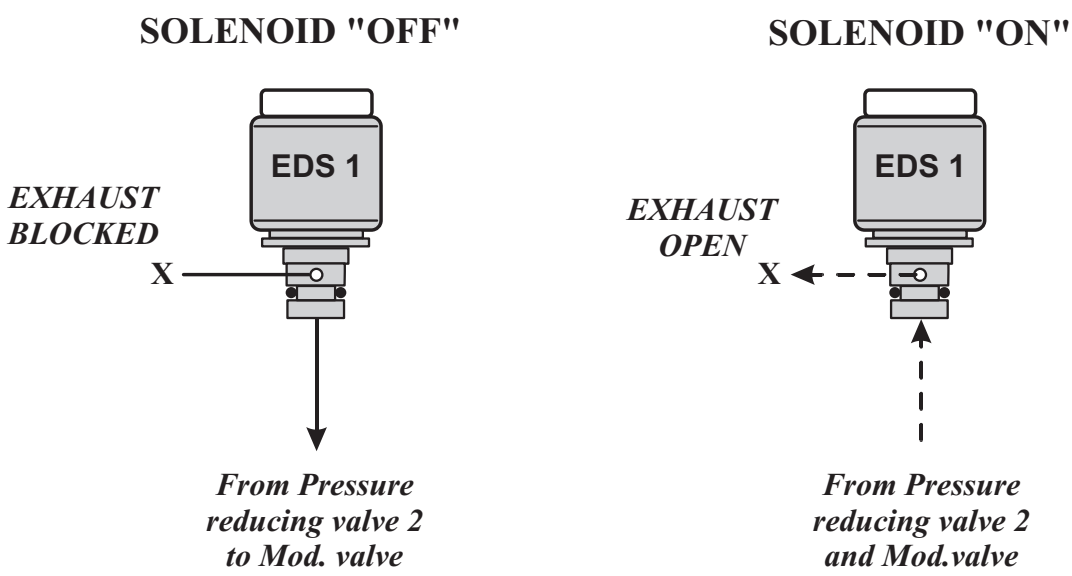
MV1-MV6



SUMMARY:

When MV 1 thru 6 is in the "OFF" state, Solenoid reducing pressure, from Pressure reducing valve 1, is blocked by the solenoid and oil pressure from the valve that the solenoid controls is exhausted at the rear of the solenoid.
When MV 1 thru 6 is in the "ON"state, Solenoid reducing pressure, from Pressure reducing valve 1, is open through the solenoid and is applied to the valve that the solenoid controls. The exhaust at the rear of the solenoid is closed.

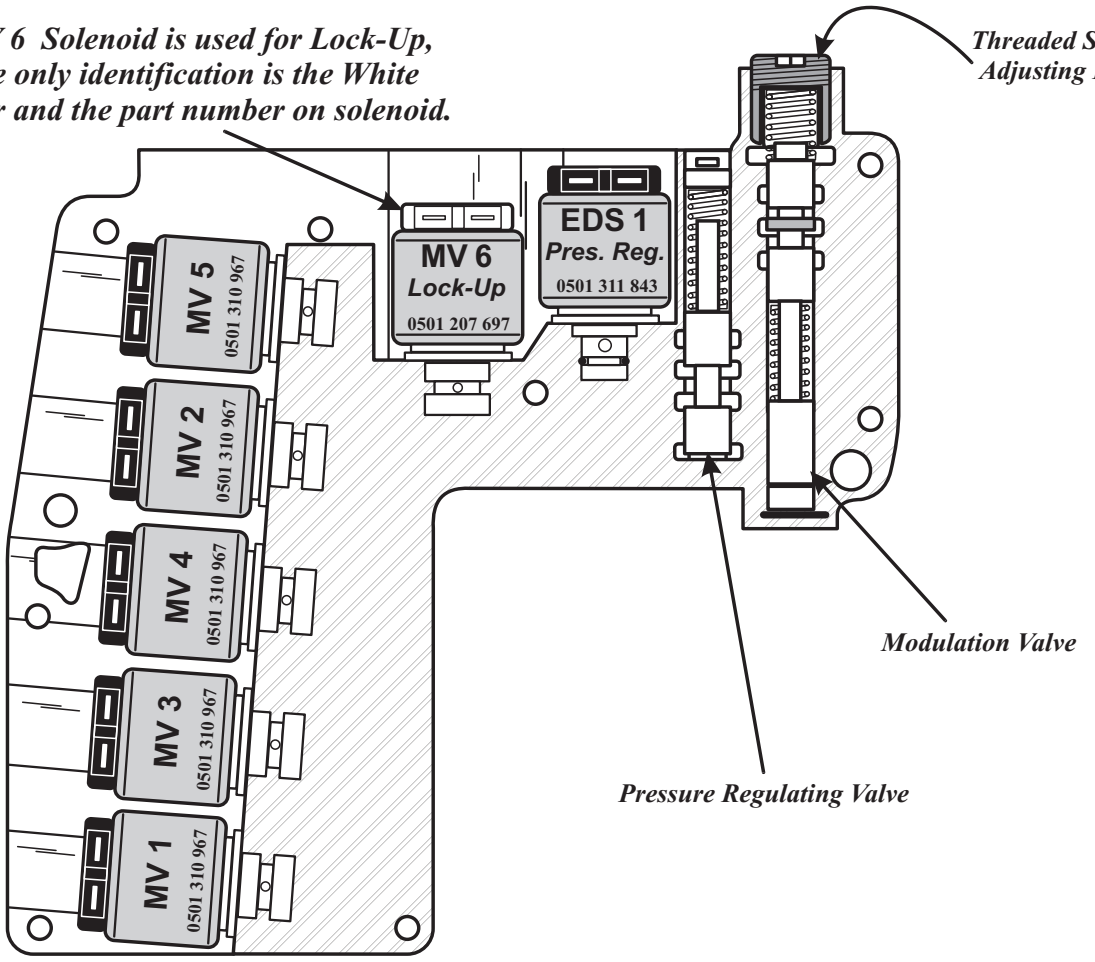
EDS 1



SUMMARY:

When EDS 1 solenoid is "OFF," solenoid reducing pressure, from Pressure reducing valve 2, is high to the Modulating valve which creates high line pressure.
When EDS 1 solenoid is "ON," solenoid reducing pressure, from Pressure reducing valve 2, is low to the Modulating valve which creates low line pressure.

Figure 52



	SHIFT SOLENOID APPLICATION CHART							
RANGE	MV 1	MV 2	MV 3	MV 4	MV 5	MV 6	EDS 1	RATIO
Park	ON	ON	ON				**	
Reverse	ON	ON					**	4.08
Neutral	ON	ON	ON				**	
"D"-1st	ON	ON	ON				**	3.66
"D"-2nd		ON	ON				**	1.99
"D"-3rd			ON			*	**	1.40
"D"-4th						*	**	1.00
"D"-5th	ON					*	**	0.74
"D", 3-2				ON			**	
"D", 5-4					ON		**	
"Failsafe"	OFF	OFF	OFF	OFF	OFF	OFF	OFF	1.00

** Converter Clutch may be ON or OFF depending on vehicle speed and throttle position.*

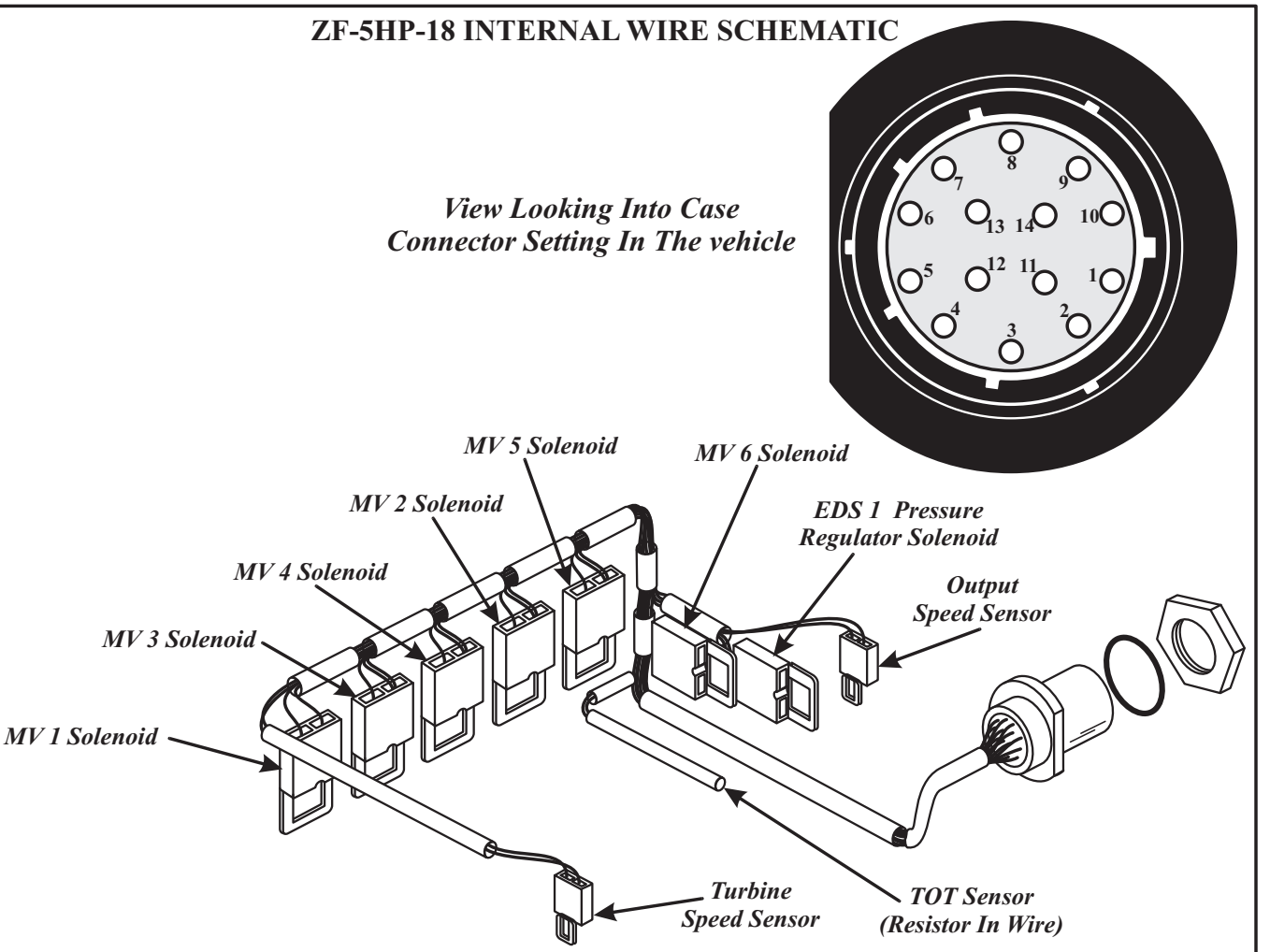
*** Line Pressure is Modulating, depending on vehicle speed and throttle position.*

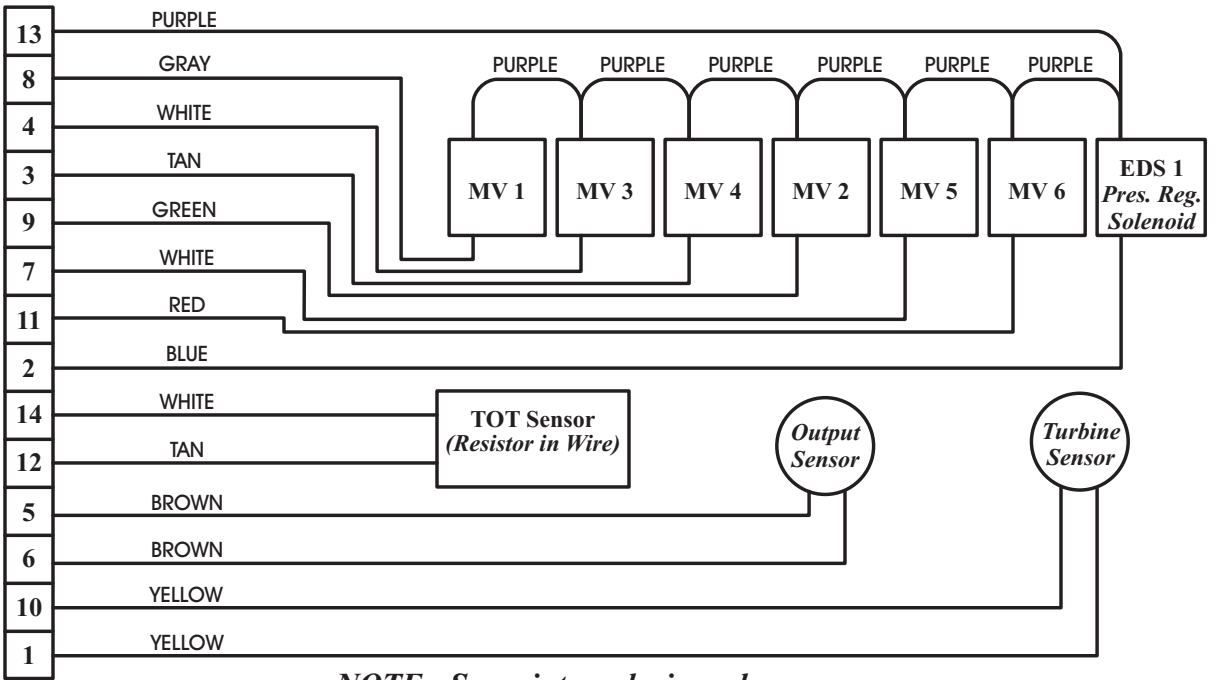
Note: MV 4 and MV 5 are used only on downshifts.

Figure 53

INDEX

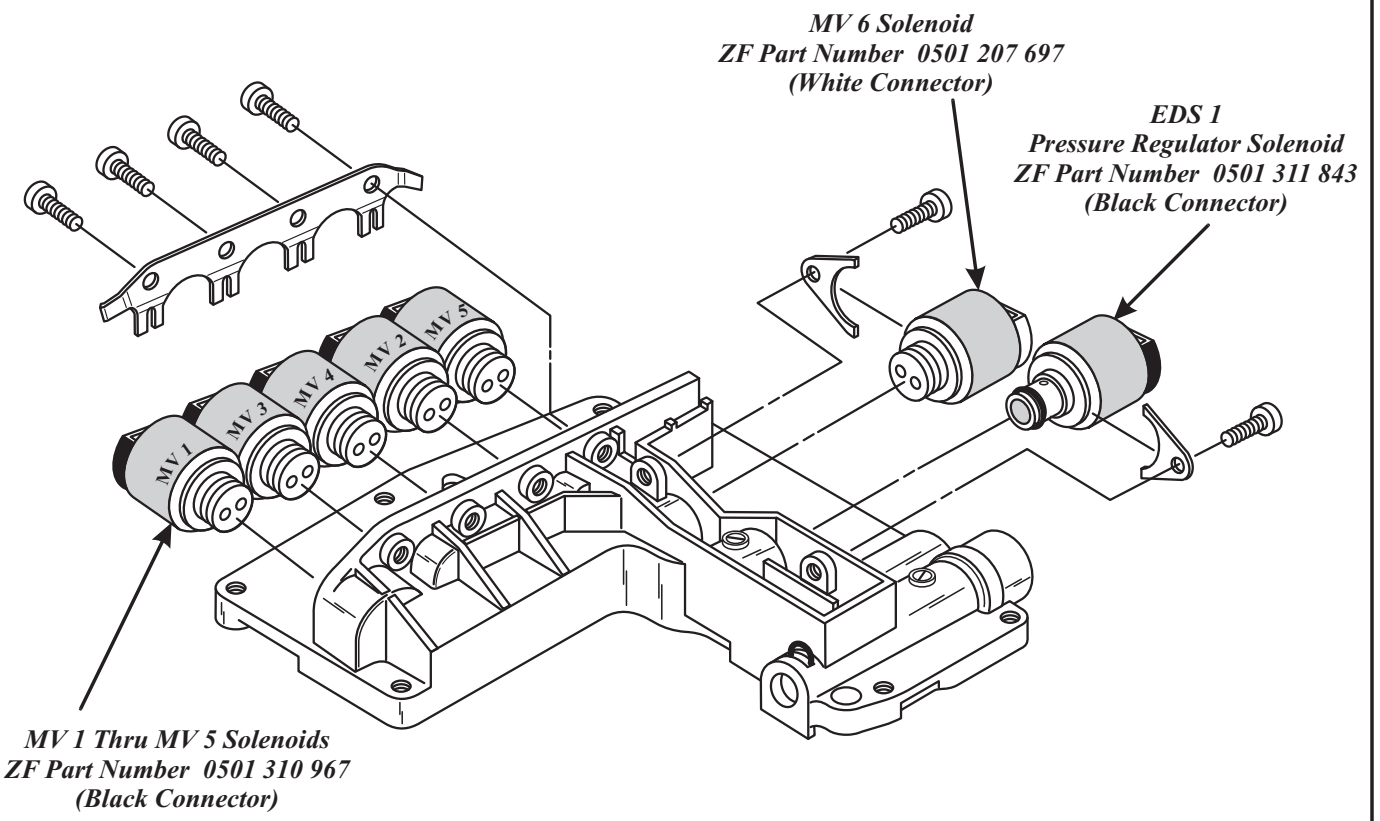
ZF-5HP-18 INTERNAL WIRE SCHEMATIC





NOTE: Some internal wire colors may vary.

Figure 54



COMPONENT	RESISTANCE	PART NUMBER
MV 1 Solenoid	30 - 34 Ohms	0501 310 967
MV 2 Solenoid	30 - 34 Ohms	0501 310 967
MV 3 Solenoid	30 - 34 Ohms	0501 310 967
MV 4 Solenoid	30 - 34 Ohms	0501 310 967
MV 5 Solenoid	30 - 34 Ohms	0501 310 967
MV 6 Solenoid	30 - 34 Ohms	0501 207 697
EDS 1 Pres Reg Solenoid	5.2 - 6.8 Ohms	0501 311 843
Input Speed Sensor	265 Ohms (72° F)	0501 311 086
Output Speed Sensor	265 Ohms (72° F)	0501 311 086
Trans Temp Sensor	970 Ohms (72° F)	N/A

Figure 55

RETREIVING FAULT CODES

The BMW Diagnostic Tool is ***required*** to retrieve the fault codes that are stored in the control unit. The diagnostic tool has the ability to retrieve codes, clear codes and activate individual components, and is adaptable to 3 Series, 5 Series, 7 Series and 8 Series vehicles equipped with 4HP-22/24, 4L30-E, 5HP-18, 5HP-19, and 5HP-30.

BMW ZF-5HP-18 FAULT CODE CHART

Code	*Description (Pin No's Refer To TCM)*	*Possible Causes*
02	Park-Neutral Lock Solenoid - Pin 2	Break or short in wiring, or defective solenoid
03	MV 5 Solenoid - Pin 3	Break or short in wiring, or defective solenoid
04	MV 6 Solenoid (Lock-Up) - Pin 4	Break or short in wiring, or defective solenoid
05	EDS 1 Solenoid (Pres. Reg.) - Pin 5	Break or short in wiring, or defective solenoid
08	Selector Lever Position L2 - Pin 8	Vehicle acceleration detected while selector lever in P or N position, or engine has been started even though trans control unit has not detected a selector lever position of P or N
09	Selector Lever Position L3/L4 - Pins 37 and 9	Engine has been started even though trans control unit has not detected a selector lever position of P or N
0C	Program Selector Switch - Pins 12, 13 and 45	Short in wiring, or more than one program selector switch input is applied to ground
10	Turbine Shaft Speed Sensor, Pins 16 and 44	No input, or incorrect engine speed information
12	Kickdown Switch - Pin 18	Shorted to Ground
13	ASC Monitoring - Pin 19	ASC operation has been detected while selector lever was in Park or Neutral position
16	TOT Sensor - Pins 21 and 22	Resistance of TOT Sensor not within permissible range
1A	Battery Voltage Supply - Pin 26	Break in wiring
1E	MV 1 Solenoid - Pin 30	Break or short in wiring, or defective winding in solenoid
1F	MV 4 Solenoid - Pin 31	Break or short in wiring, or defective winding in solenoid
20	MV 3 Solenoid - Pin 32	Break or short in wiring, or defective winding in solenoid
21	MV 2 Solenoid - Pin 33	Break or short in wiring, or defective winding in solenoid
23	Throttle Position Sensor - Pin 35	Break or short in wiring, or defective sensor
24	Selector Lever Position L1 - Pin 36	Break or short in wiring, or defective sensor
2A	Output Speed Sensor signal - Pins 13 and 42	No input, or incorrect output speed information
2b	Engine Speed Signal - Pin 43	Questionable signal, or break or short in wiring
35	Power Supply to transmission - Pin 52	Break or short in wiring, or defective TCU

Figure 56

BMW ZF-5HP-18 FAULT CODE CHART

Code	*Description (Pin No's Refer To TCM)*	*Possible Causes*
36	Power Supply - Pin 54	Power Supply less than 9 volts at engine speeds greater than 1600 RPM
64	Speed Monitoring	Faulty Speed Sensor signal, or slip in Transmission
65	EPROM - Checksum	Program memory in Transmission Control Unit faulty
66	Incorrect Program Checksum	Program memory in Transmission Control Unit faulty
67	Transmission Relay - Pin 52	Pickup and dropout times too long
68	Engine Temp Sensor - Pin 35	Break or Short in wiring, or defective CTS
69	Throttle Position Sensor - Pin 35	TCU detected questionable TPS signal
6E	Basic Data Record	TCU has not been programmed
96	CAN Timeout 1	CAN signal not sent during initialization (Ignition On)
97	CAN Timeout 2	CAN signal not sent during operation
98	CAN Bus monitoring	Values in CAN RAM are not updated
99	CAN status fault	Control units with different CAN statuses are installed on CAN bus
9A	CAN throttle valve information	DME detects faulty throttle valve signal
9B	CAN load signal information	DME detects faulty load signal
9C	CAN engine intervention	DME cannot carry out reduction in engine torque desire by the EGS, or DME has different requirements compared to other CAN users
9D	CAN engine temperature info	DME detects faulty engine temperature signal
9E	CAN engine speed information	DME detects faulty engine speed signal

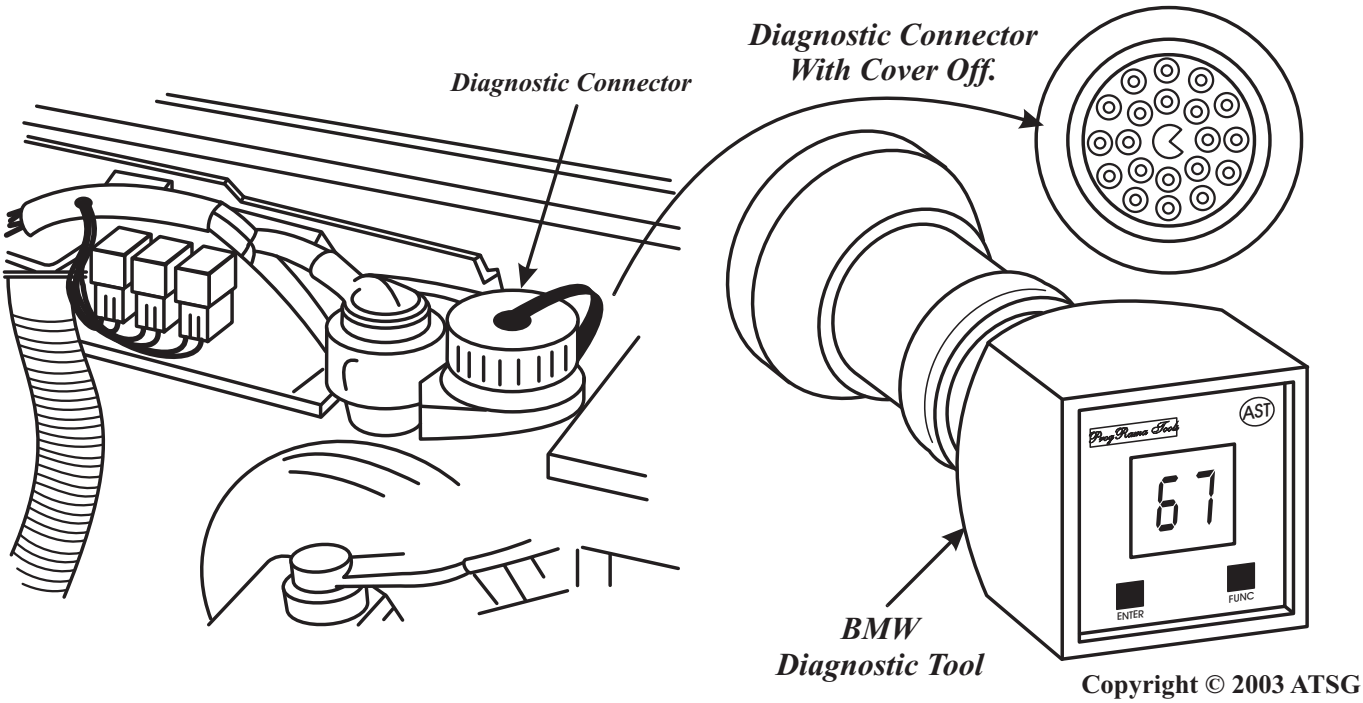
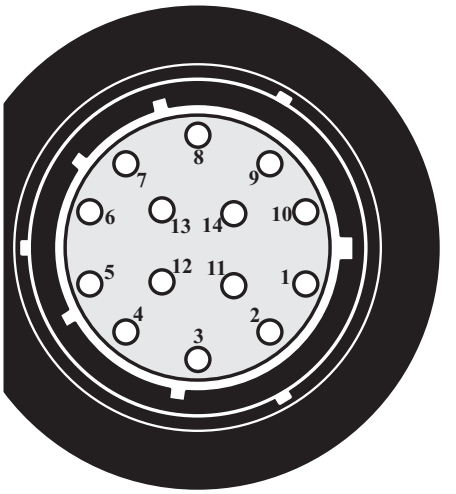


Figure 57

SOLENOID AND SENSOR RESISTANCE CHART

Solenoid	*Case Connector Pin Numbers* (− +)	*Control Unit Connector Pin Numbers* (− +)	*Resistance In Ohms*
MV 1	*8 and 13*	*30 and 52*	*30 - 34 Ω*
MV 2	*9 and 13*	*33 and 52*	*30 - 34 Ω*
MV 3	*4 and 13*	*32 and 52*	*30 - 34 Ω*
MV 4	*3 and 13*	*31 and 52*	*30 - 34 Ω*
MV 5	*7 and 13*	*3 and 52*	*30 - 34 Ω*
MV 6	*11 and 13*	*4 and 52*	*30 - 34 Ω*
EDS 1	*2 and 13*	*5 and 52*	*5.2 - 6.8 Ω*
TOT	*12 and 14*	*21 and 22*	*970 Ω at 72°F*
TSS	*1 and 10*	*44 and 16*	*265 Ω (72°F)*
OSS	*5 and 6*	*14 and 42*	*265 Ω (72°F)*

View Looking Into Case
Connector Setting In The vehicle



Electronic Control Unit Connector Pin Identification

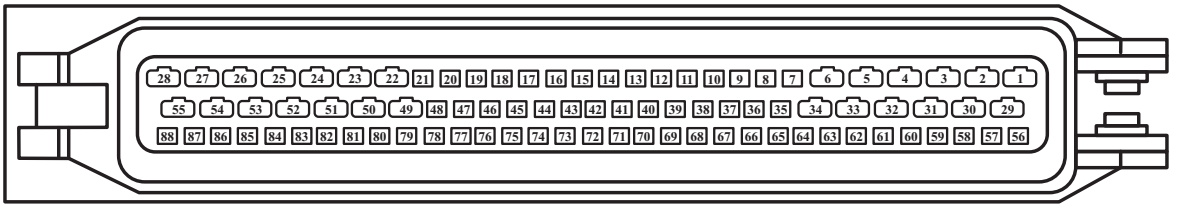


Figure 58

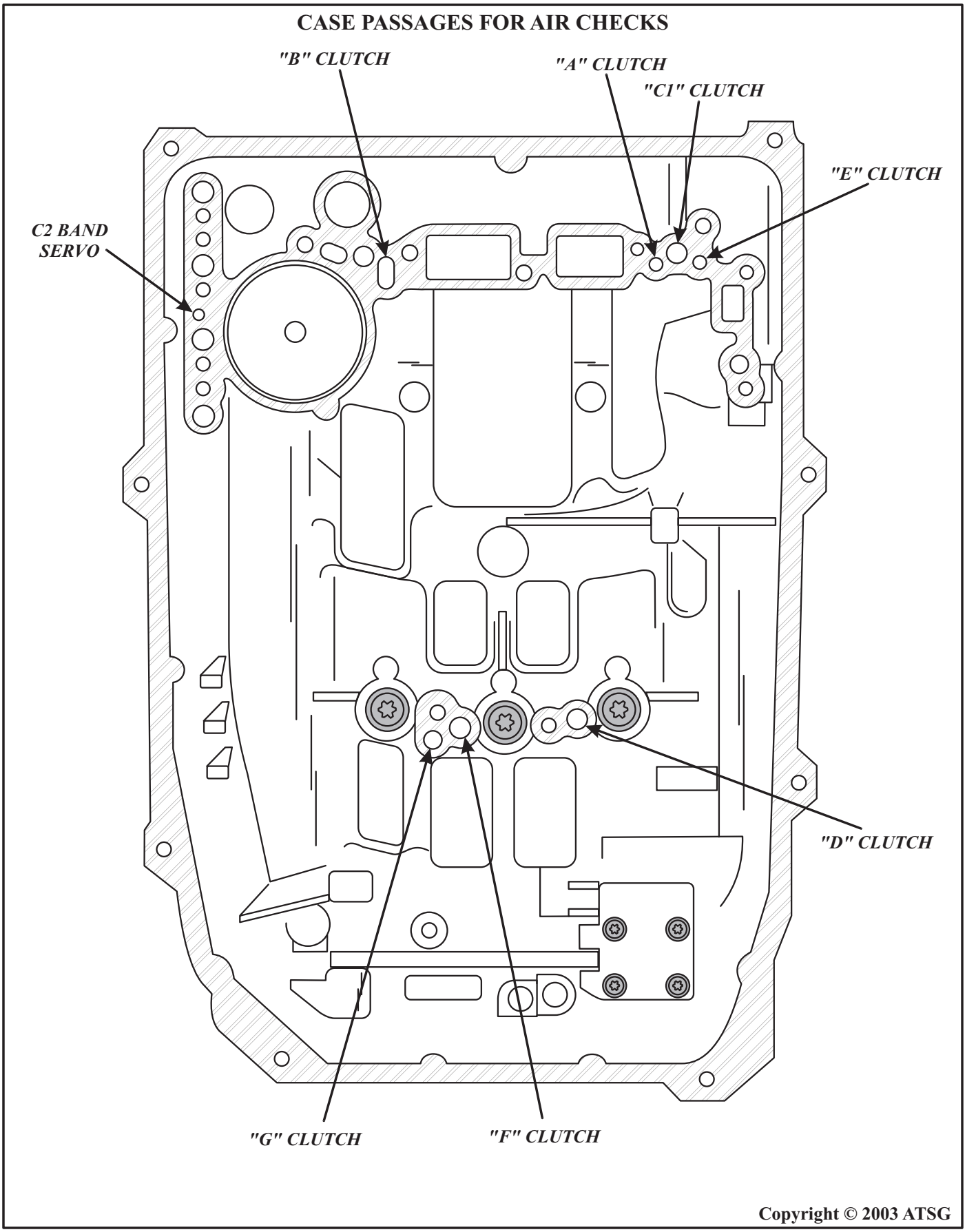

CASE PASSAGES FOR AIR CHECKS
"B" CLUTCH
"A" CLUTCH
"C1" CLUTCH
"E" CLUTCH
C2 BAND SERVO
"D" CLUTCH
"G" CLUTCH
"F" CLUTCH
Copyright © 2003 ATSG

Figure 59

PRESSURE TAP LOCATIONS

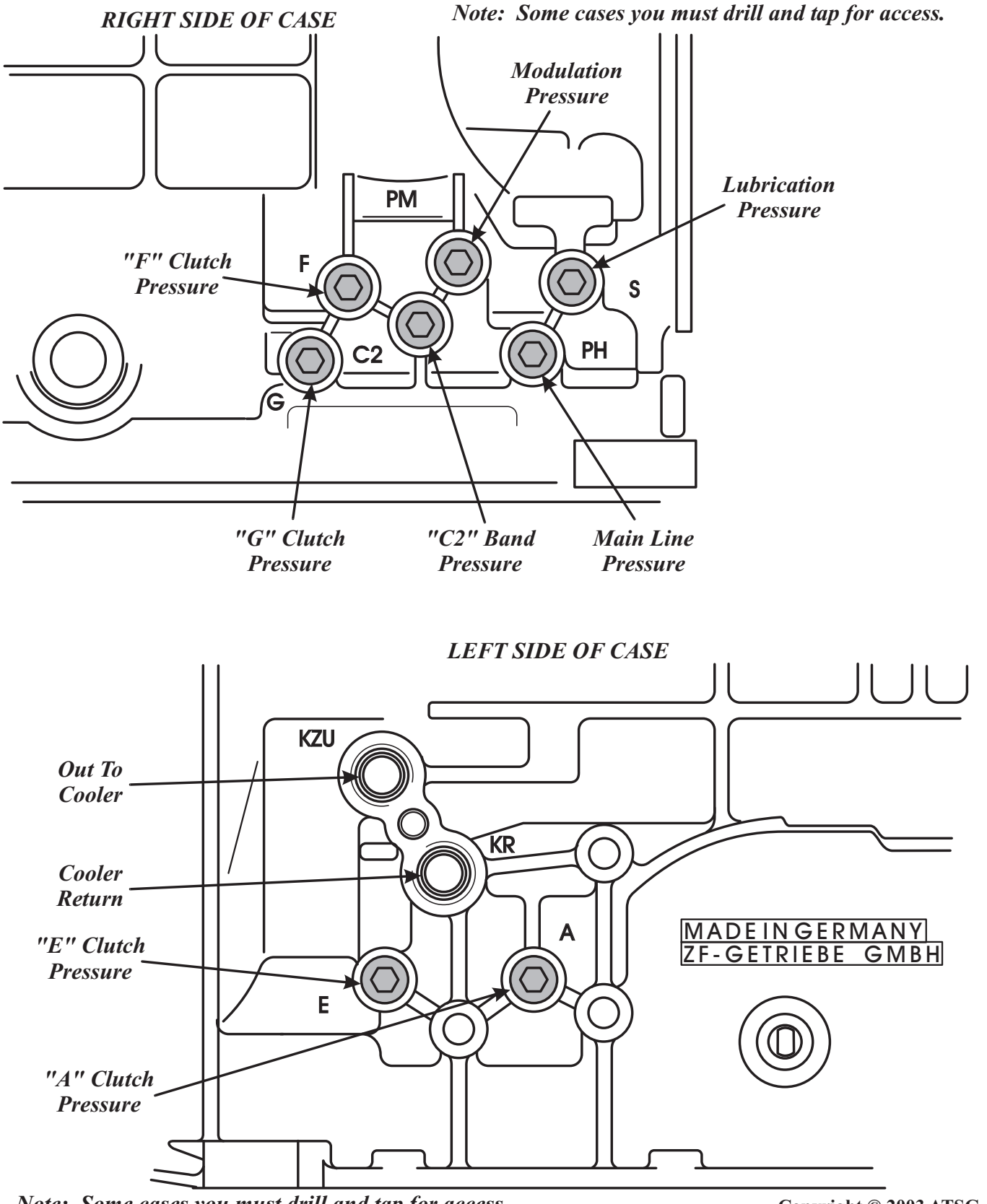


Figure 60

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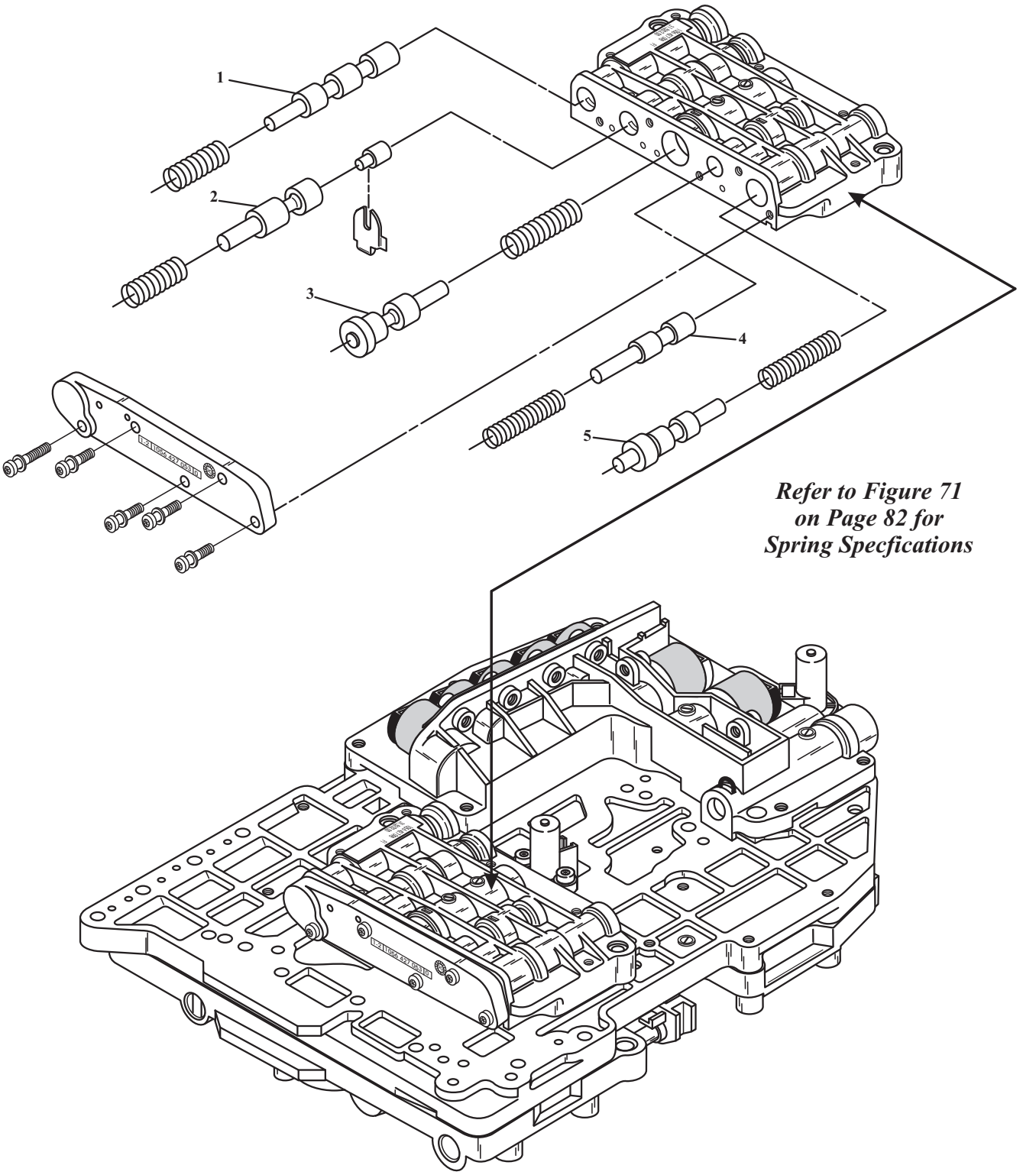
UPPER FRONT VALVE BODY



Refer to Figure 71 on Page 82 for Spring Specfications

1. Torque Converter Valve
2. Lubrication Valve Train
3. Lock-Up Control Valve
4. 5-4 Traction Valve

Figure 61

SOLENOID BODY, SPEED SENSORS AND CHANNEL PLATE

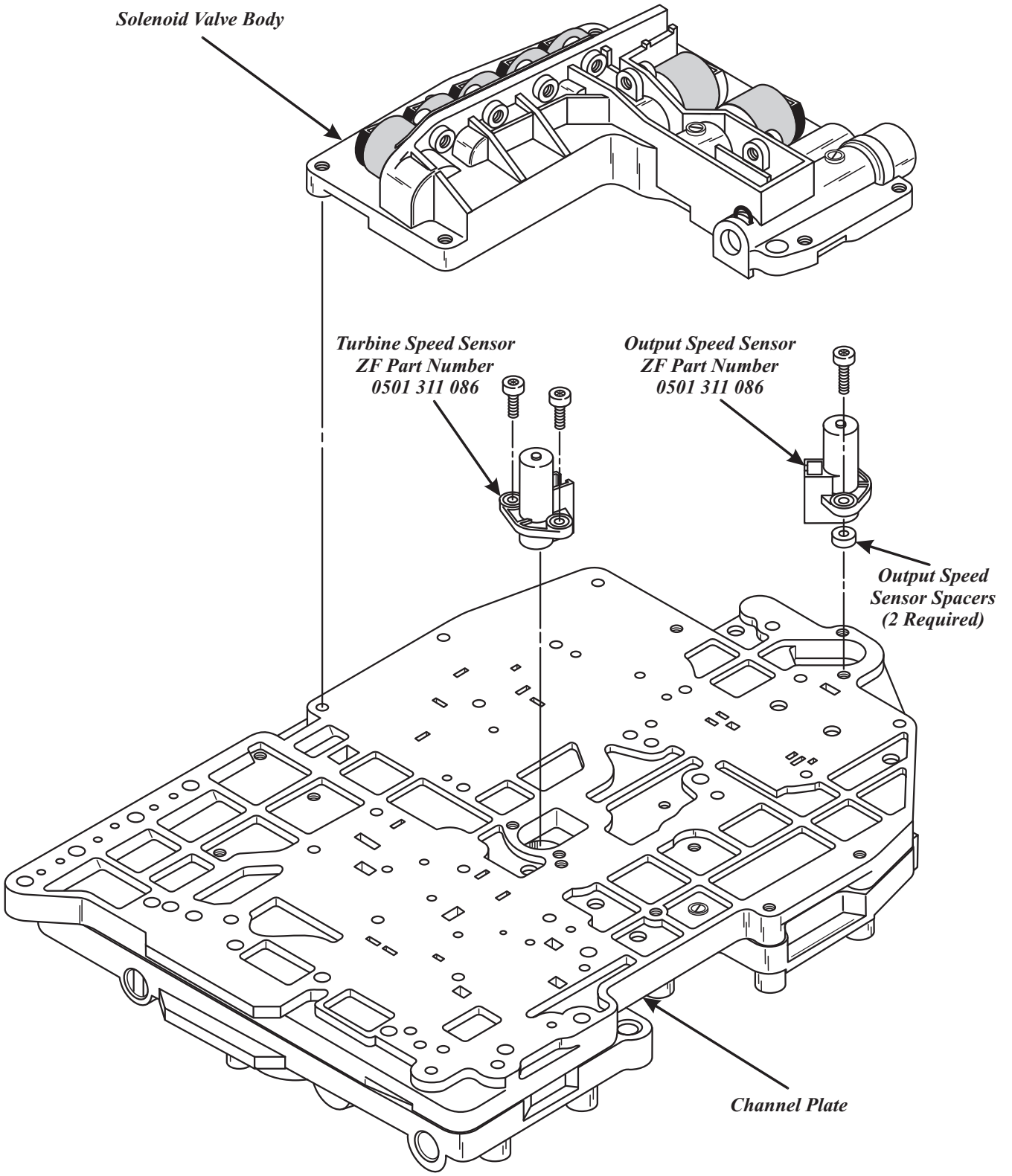


Figure 62

SOLENOID VALVE BODY

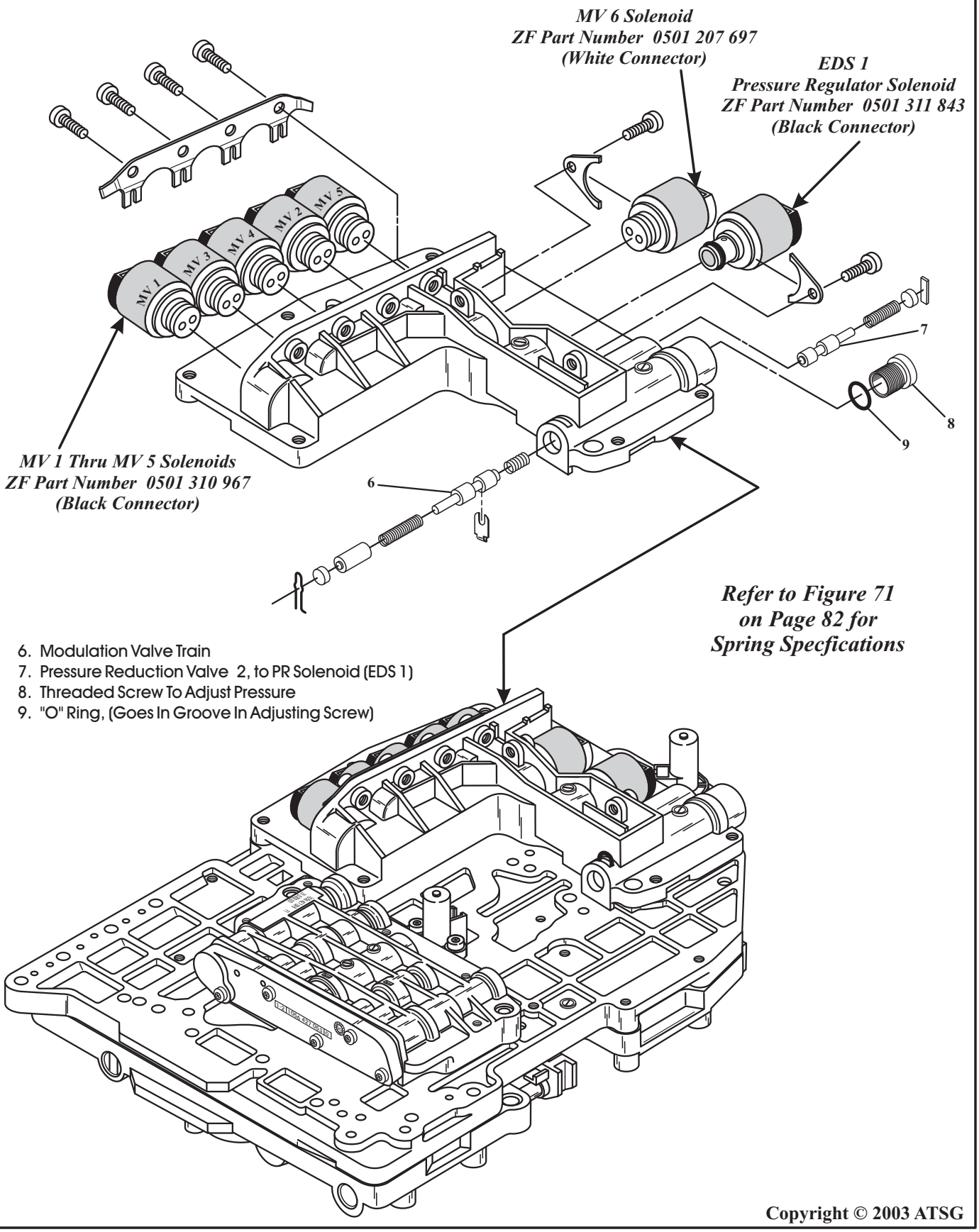
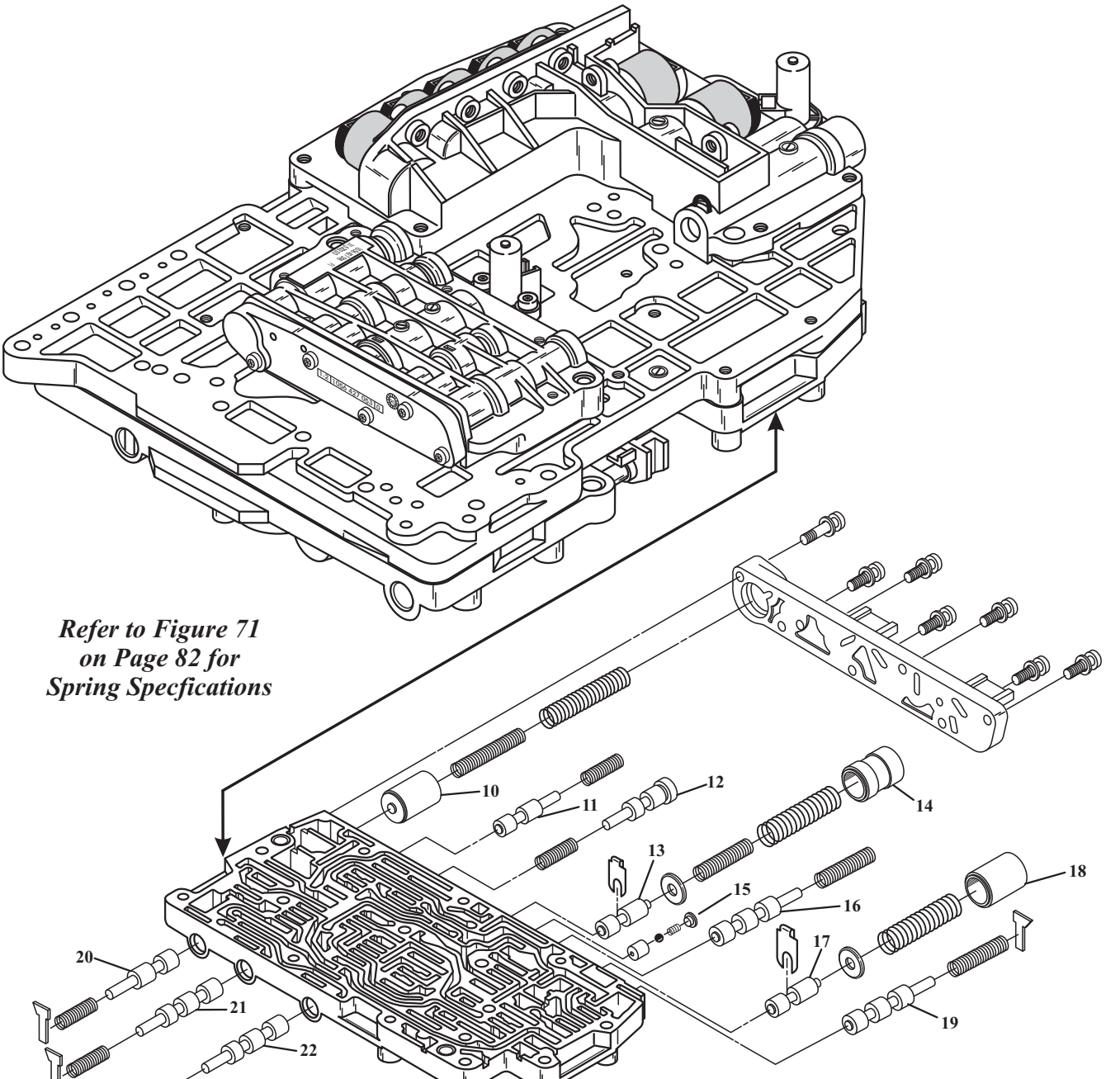


Figure 63

INDEX

LOWER REAR VALVE BODY



Refer to Figure 71 on Page 82 for Spring Specfications

10. "G" Clutch Damper Valve
11. 3-2 Traction Valve
12. 2-3 Traction Valve
13. "D" Clutch Accumulator Regulator Valve
14. "D" Clutch Damper Valve
15. "D" Clutch One-Way Check Valve Assembly
16. Reverse Lock-Out Valve
17. "F" Clutch Accumulator Regulator Valve
18. "F" Clutch Damper Valve
19. Shift Valve Number 2
20. Pressure Reduction Valve For MV 1 thru MV 6
21. Traction Coast Valve Number 2
22. Traction Coast Valve Number 1

Figure 64

INDEX

LOWER FRONT VALVE BODY

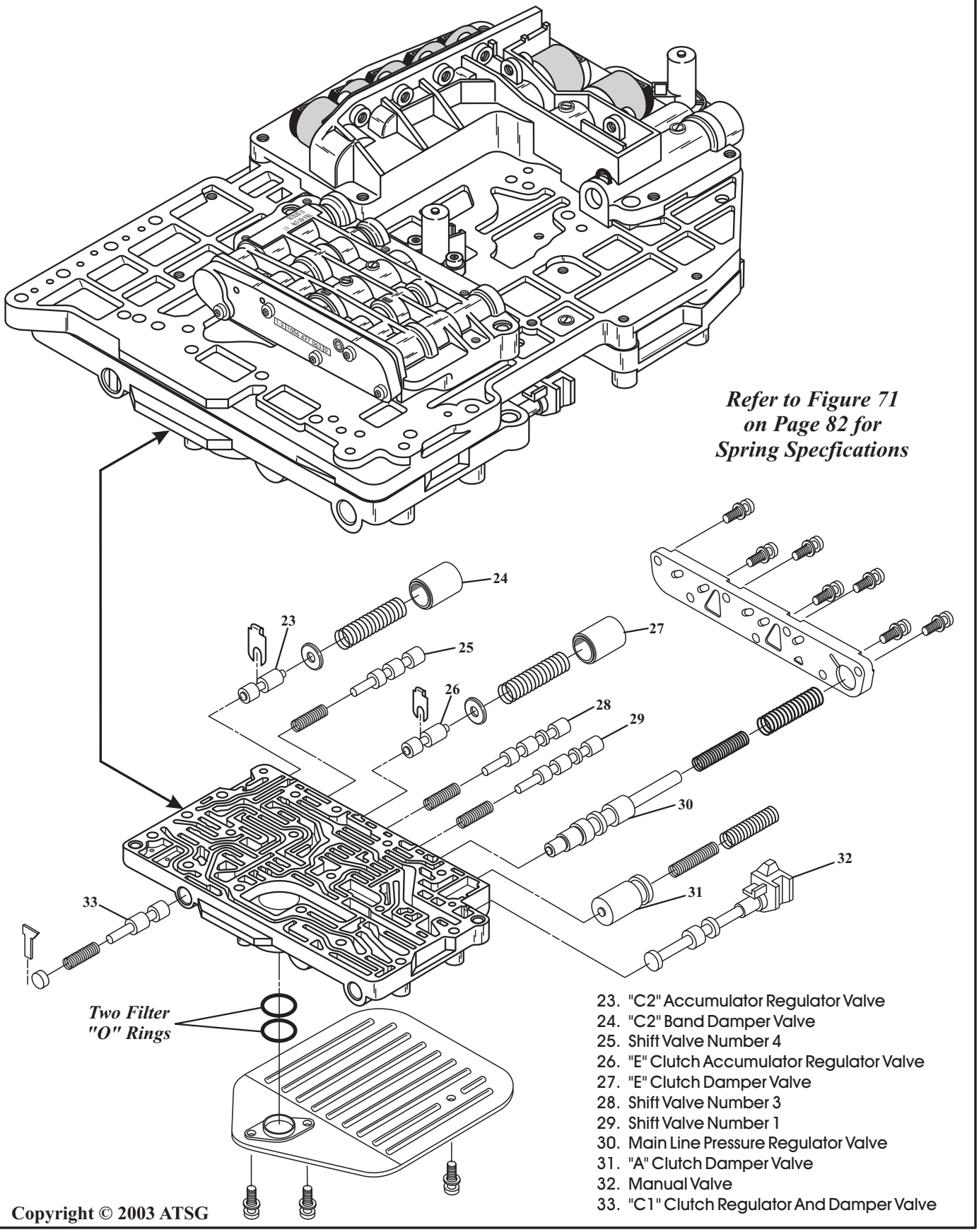


Figure 65

ZF 5HP-18
UPPER FRONT VALVE BODY CLIP LOCATIONS

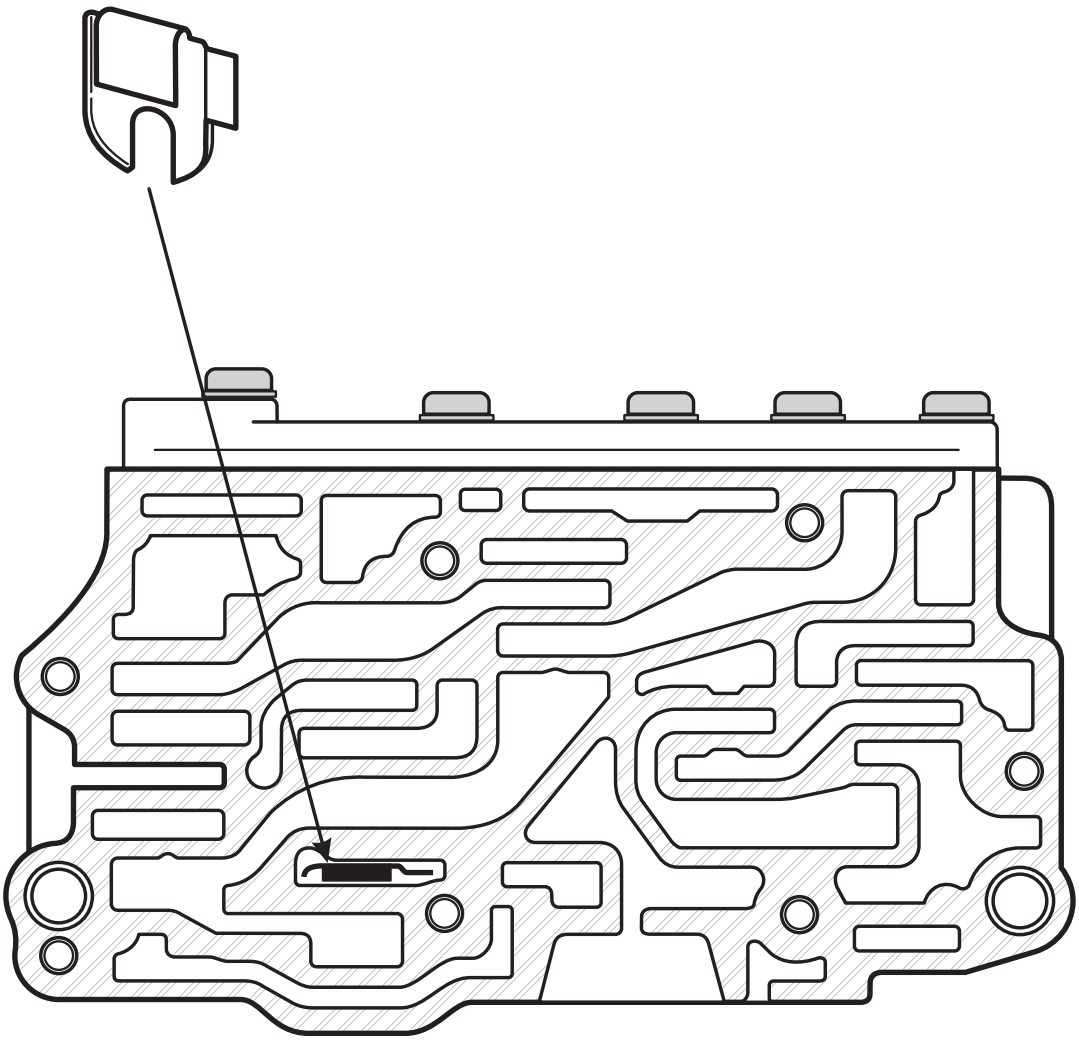


Figure 66

ZF 5HP-18
LOWER FRONT VALVE BODY CLIP LOCATIONS

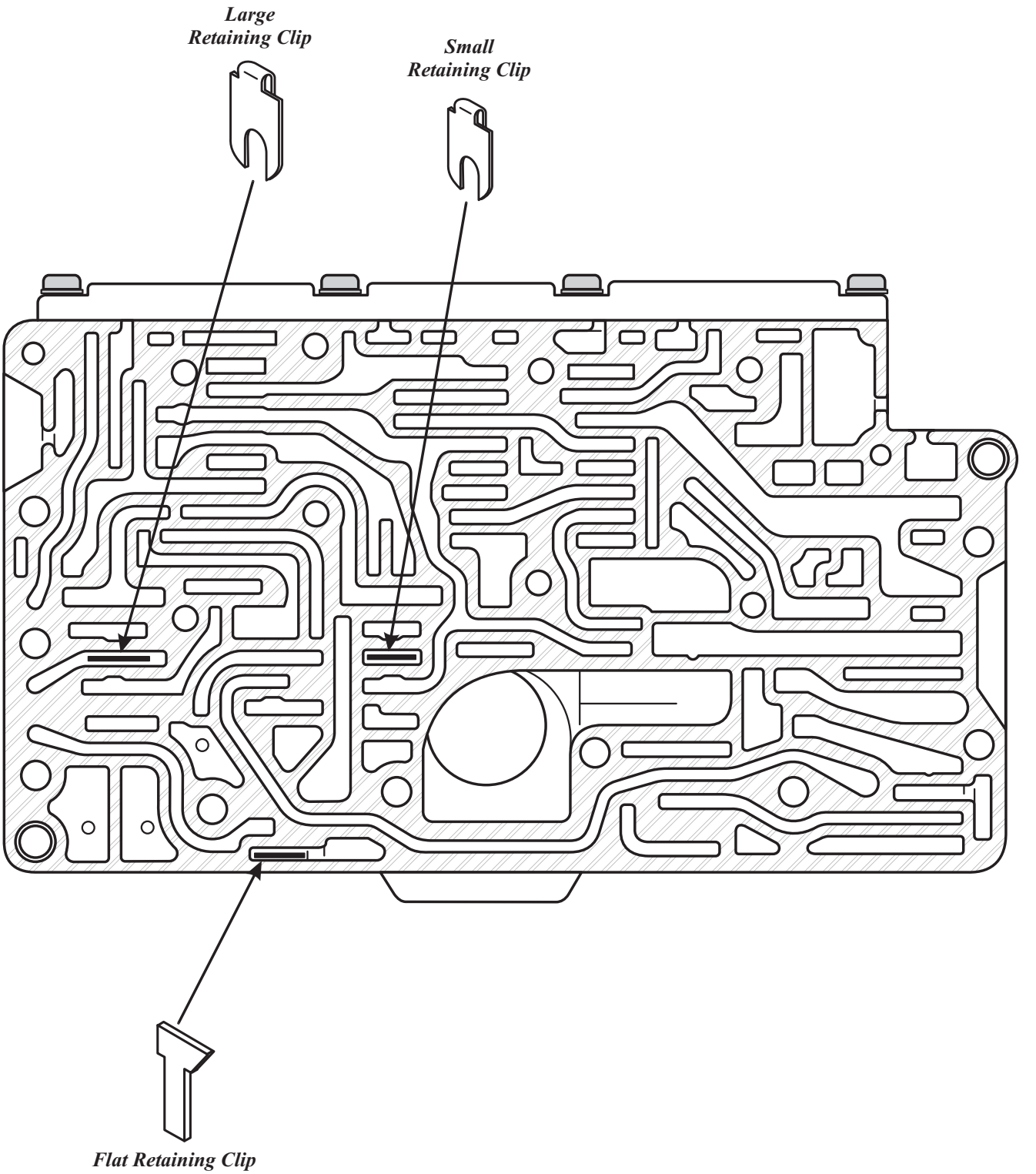


Figure 67

ZF 5HP-18
LOWER REAR VALVE BODY CLIP LOCATIONS

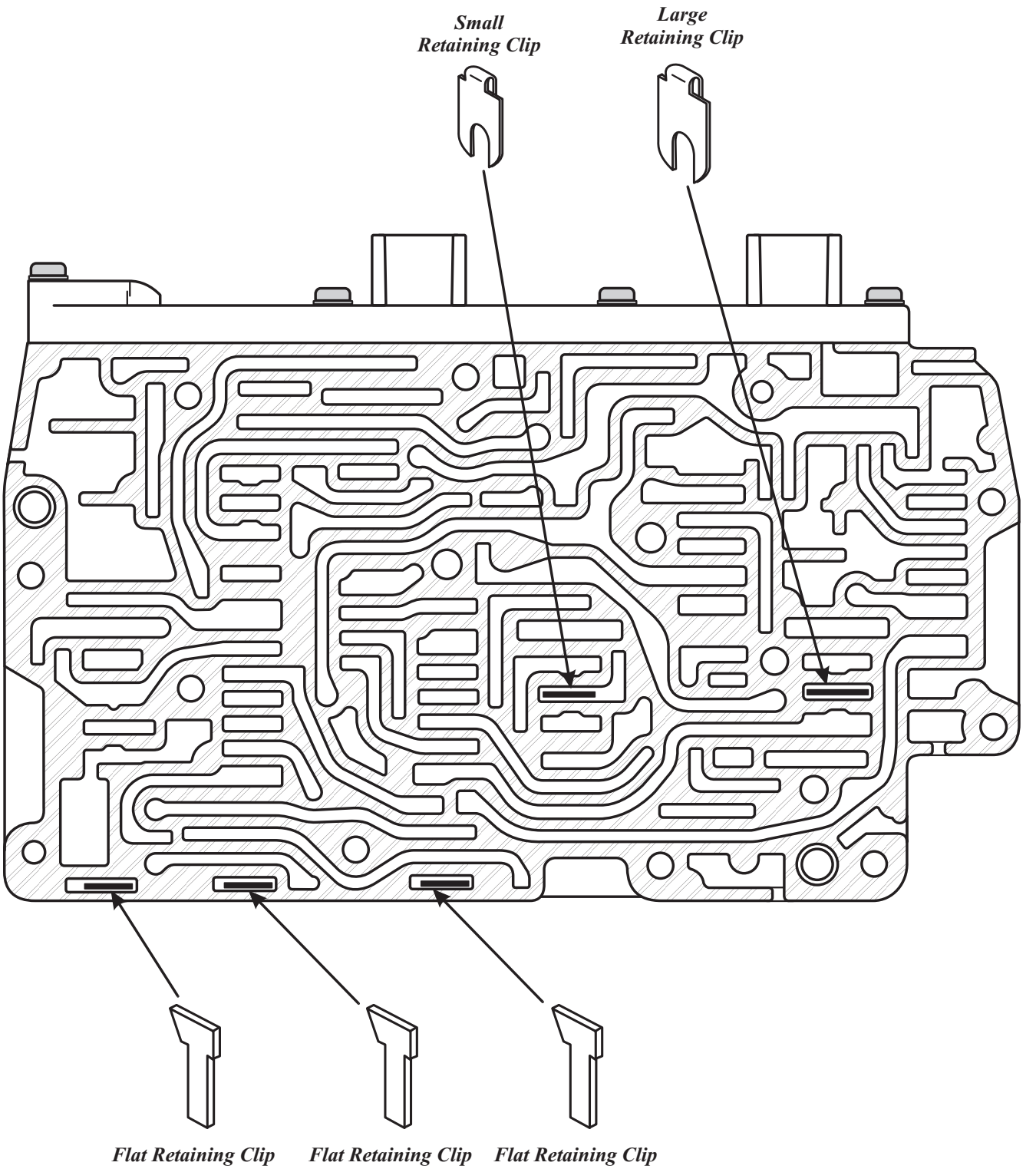


Figure 68

ZF 5HP-18
SOLENOID VALVE BODY CLIP LOCATIONS

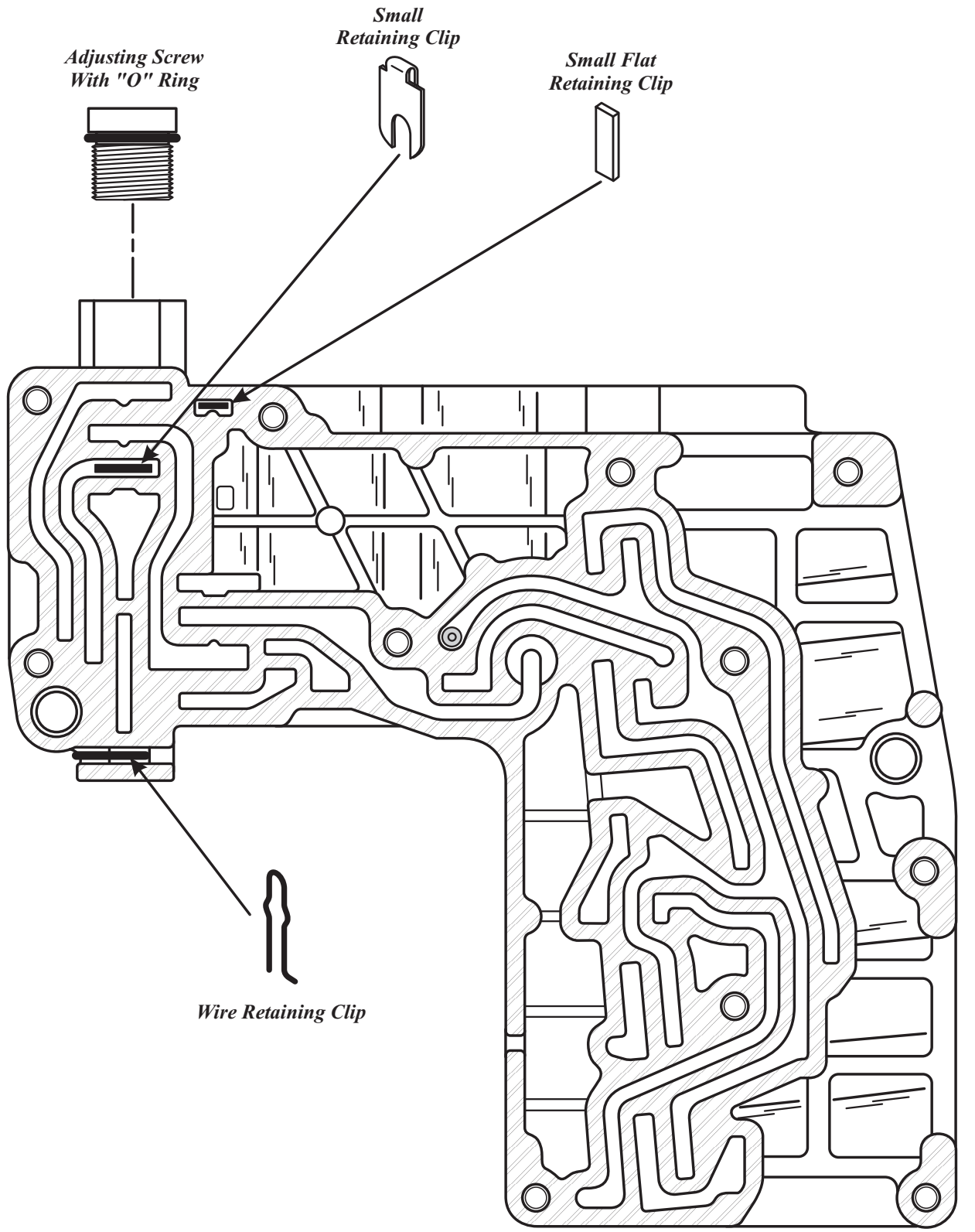


Figure 69

ZF 5HP-18
CHANNEL PLATE BALL AND ORIFICE LOCATIONS

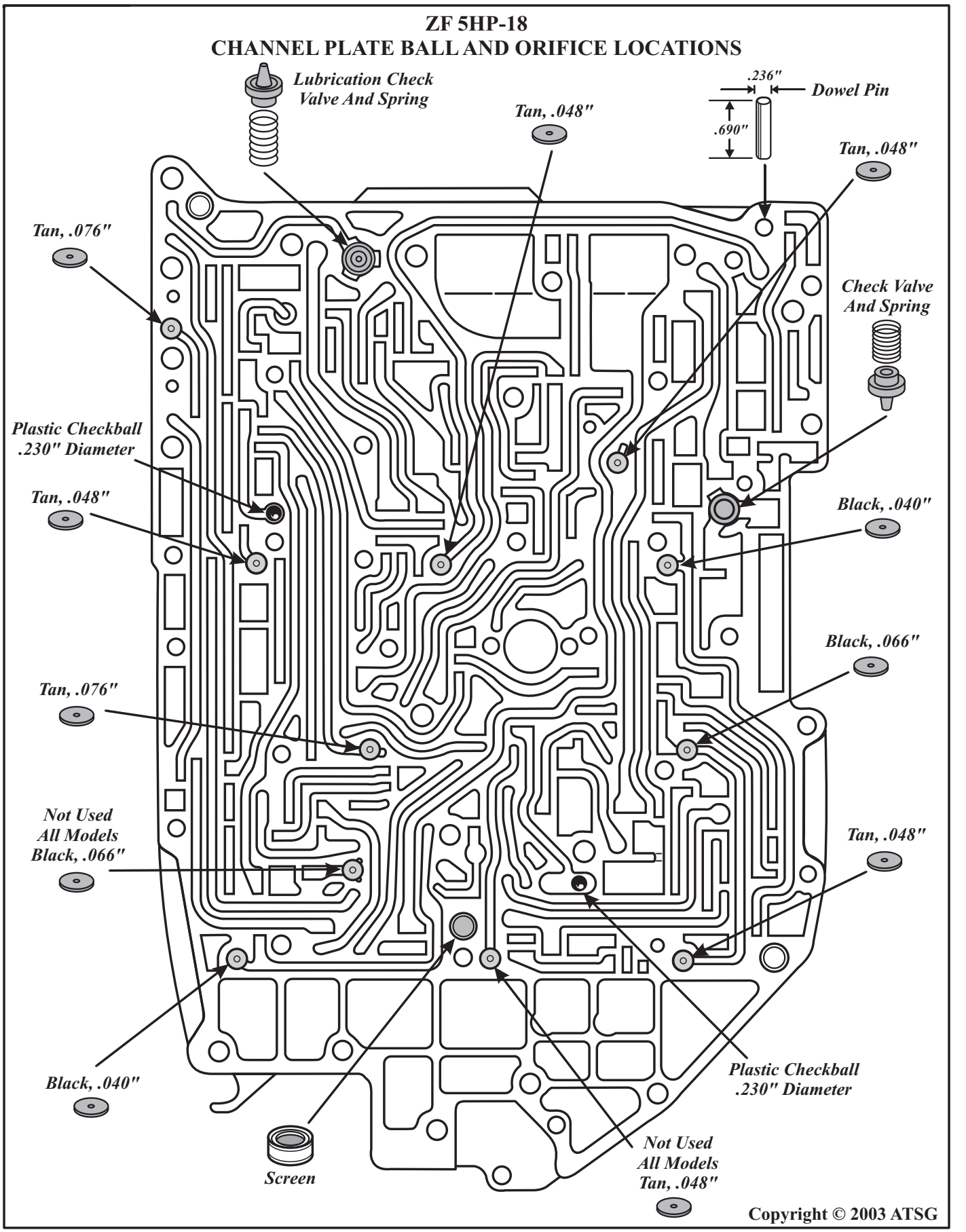


Figure 70

ZF 5HP-18FL SPRING SPECIFICATIONS

UPPER FRONT VALVE BODY

(1) TORQUE CONVERTER VALVE
FREE LENGTH = 1.710"
SPRING DIAMETER = .430"
WIRE DIAMETER = .030"

(2) LUBRICATION VALVE
FREE LENGTH = 1.774"
SPRING DIAMETER = .445"
WIRE DIAMETER = .043"

(3) LOCK-UP CONTROL VALVE
FREE LENGTH = 1.550"
SPRING DIAMETER = .430"
WIRE DIAMETER = .038"

(4) 5-4 TRACTION VALVE
FREE LENGTH = 1.900"
SPRING DIAMETER = .360"
WIRE DIAMETER = .030"

(5) 4-5 TRACTION VALVE
FREE LENGTH = 1.630"
SPRING DIAMETER = .360"
WIRE DIAMETER = .030"

SOLENOID VALVE BODY

(6) MODULATION VALVE
FREE LENGTH = 1.400"
SPRING DIAMETER = .305"
WIRE DIAMETER = .038"

(6) MOD. VALVE (ADJUST SIDE)
FREE LENGTH = .780"
SPRING DIAMETER = .305"
WIRE DIAMETER = .026"

(7) PRES REDUCING VALVE 2
FREE LENGTH = 1.560"
SPRING DIAMETER = .350"
WIRE DIAMETER = .043"

LOWER REAR VALVE BODY

(10) "G" DAMPER PIST (INNER)
FREE LENGTH = 3.900"
SPRING DIAMETER = .368"
WIRE DIAMETER = .028"

(10) "G" DAMPER PIST (OUTER)
FREE LENGTH = 4.120"
SPRING DIAMETER = .590"
WIRE DIAMETER = .042"

(11) 3-2 TRACTION VALVE
FREE LENGTH = 1.625"
SPRING DIAMETER = .373"
WIRE DIAMETER = .035"

(12) 2-3 TRACTION VALVE
FREE LENGTH = 1.770"
SPRING DIAMETER = .356"
WIRE DIAMETER = .023"

(14) "D" DAMPER PIST (INNER)
FREE LENGTH = 1.565"
SPRING DIAMETER = .430"
WIRE DIAMETER = .039"

(14) "D" DAMPER PIST (OUTER)
FREE LENGTH = 2.925"
SPRING DIAMETER = .592"
WIRE DIAMETER = .043"

(16) REVERSE LOCKOUT VALVE
FREE LENGTH = 1.820"
SPRING DIAMETER = .440"
WIRE DIAMETER = .039"

(18) "F" DAMPER PISTON
FREE LENGTH = 3.475"
SPRING DIAMETER = .568"
WIRE DIAMETER = .039"

(19) SHIFT VALVE 2
FREE LENGTH = 1.780"
SPRING DIAMETER = .365"
WIRE DIAMETER = .030"

(20) PRES REDUCING VALVE 1
FREE LENGTH = 1.470"
SPRING DIAMETER = .378"
WIRE DIAMETER = .043"

(21) TRACTION VALVE 2
FREE LENGTH = 1.780"
SPRING DIAMETER = .360"
WIRE DIAMETER = .031"

(22) TRACTION VALVE 1
FREE LENGTH = 1.780"
SPRING DIAMETER = .360"
WIRE DIAMETER = .031"

Note: The number in front of the name of the valve line-up is the illustration number in the ATSG illustrations in this manual.

Note: There is now available from ZF distributers a "Valve Body Kit" for the 5HP-18 that includes all new stock springs, all check balls, all orifices and screens. ZF part number "5HP-18 VBK".

LOWER FRONT VALVE BODY

(24) "C2" DAMPER PISTON
FREE LENGTH = 3.425"
SPRING DIAMETER = .585"
WIRE DIAMETER = .031"

(25) SHIFT VALVE 4
FREE LENGTH = 1.780"
SPRING DIAMETER = .366"
WIRE DIAMETER = .031"

(27) "E" DAMPER PISTON
FREE LENGTH = 3.500"
SPRING DIAMETER = .554"
WIRE DIAMETER = .040"

(28) SHIFT VALVE 3
FREE LENGTH = 1.776"
SPRING DIAMETER = .365"
WIRE DIAMETER = .031"

(29) SHIFT VALVE 1
FREE LENGTH = 1.766"
SPRING DIAMETER = .365"
WIRE DIAMETER = .031"

(30) PRESSURE REG (INNER)
FREE LENGTH = 3.150"
SPRING DIAMETER = .448"
WIRE DIAMETER = .048"

(30) PRESSURE REG (OUTER)
FREE LENGTH = 2.930"
SPRING DIAMETER = .600"
WIRE DIAMETER = .048"

(31) "A" DAMPER PIST (INNER)
FREE LENGTH = 2.880"
SPRING DIAMETER = .442"
WIRE DIAMETER = .048"

(31) "A" DAMPER PIST (OUTER)
FREE LENGTH = 3.078"
SPRING DIAMETER = .577"
WIRE DIAMETER = .042"

(33) "C1" REGULATOR VALVE
FREE LENGTH = 1.975"
SPRING DIAMETER = .380"
WIRE DIAMETER = .035"

Figure 71

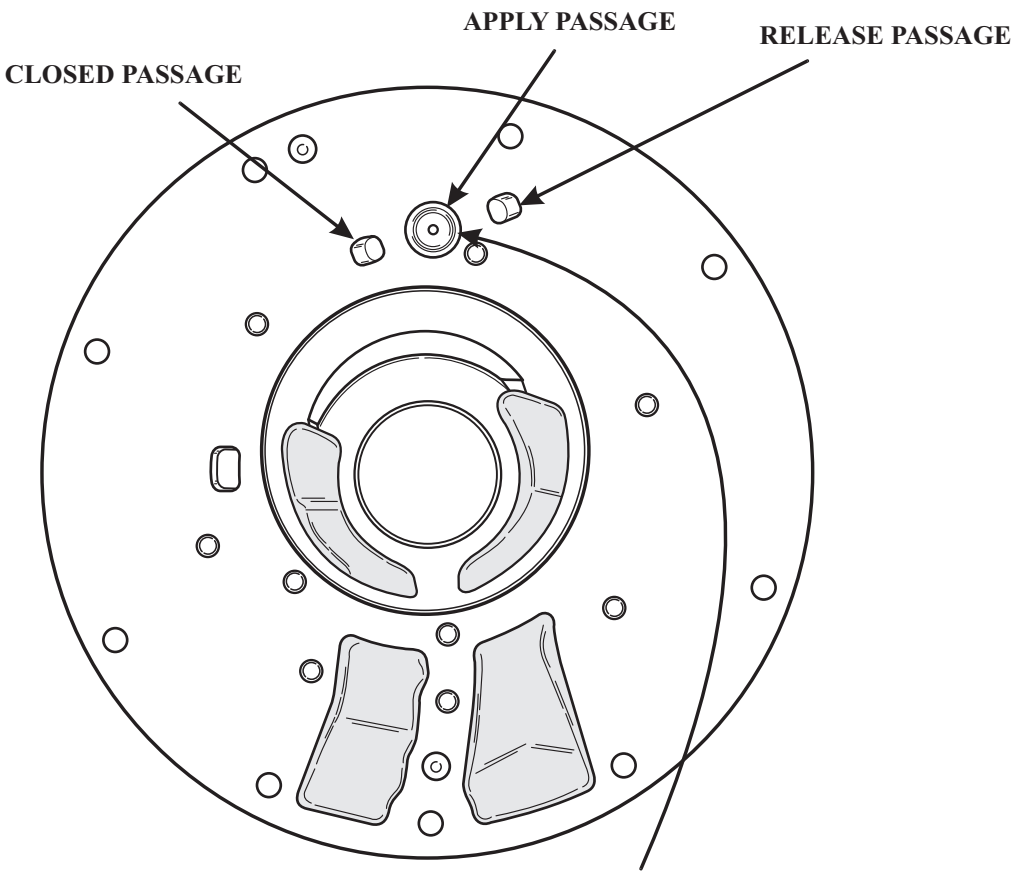
ZF-5HP-18
NO MOVE OR DELAYED ENGAGEMENT

COMPLAINT: Vehicles equipped with ZF5HP18 may exhibit a No movement or a delayed engagement condition, before or after overhaul.

CAUSE: The cause may be, that the "Bypass Ball," located in the pump as shown in Figure 72, may have shrunken down and traveled back through the pump passage leading to the Torque Convertor Valve, sticking the valve in the "stroked" position (See Figure 73). When this valve is stuck in this position it may cause the Torque Convertor to drain-back after sitting for a prolonged period of time. When the vehicle is started after sitting, it may take 10 to 15 minuites for the Torque Convertor to fill back up, and this all depends on the positioning of the stuck Torque Convertor Valve.

CORRECTION: Locate the Torque Convertor Valve, as shown in Figure 74, and free the valve up, removing the shrunken Bypass Ball from binding the valves movement. Replace the assembly in pump body with a new one from ZF, available under ZF part number 1056-210-143, ***if the capsule can be removed*** from the pump body.

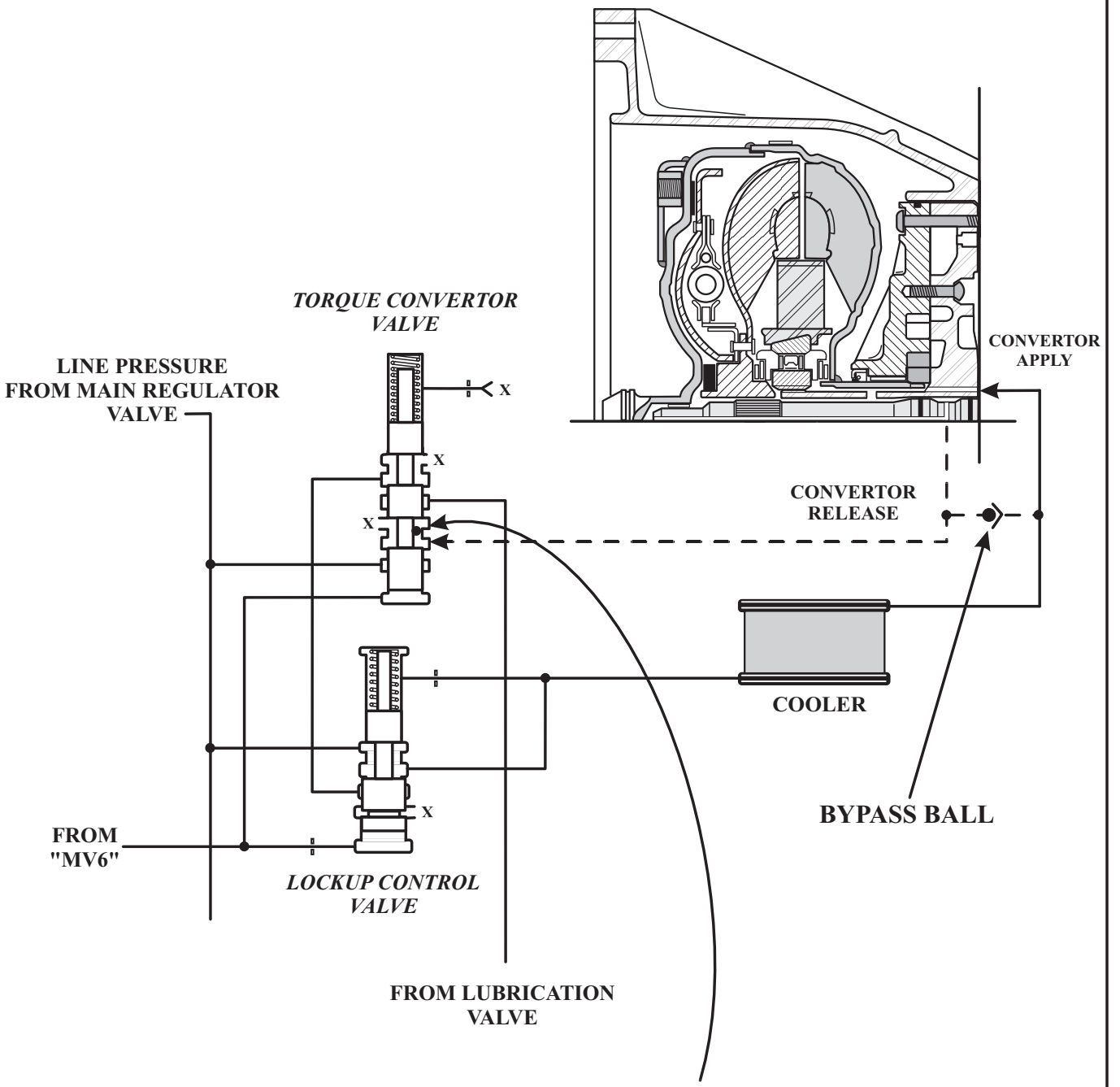
PUMP BODY



The Bypass Ball is located under a Capsule, in the Convertor Apply Circuit.

Figure 72

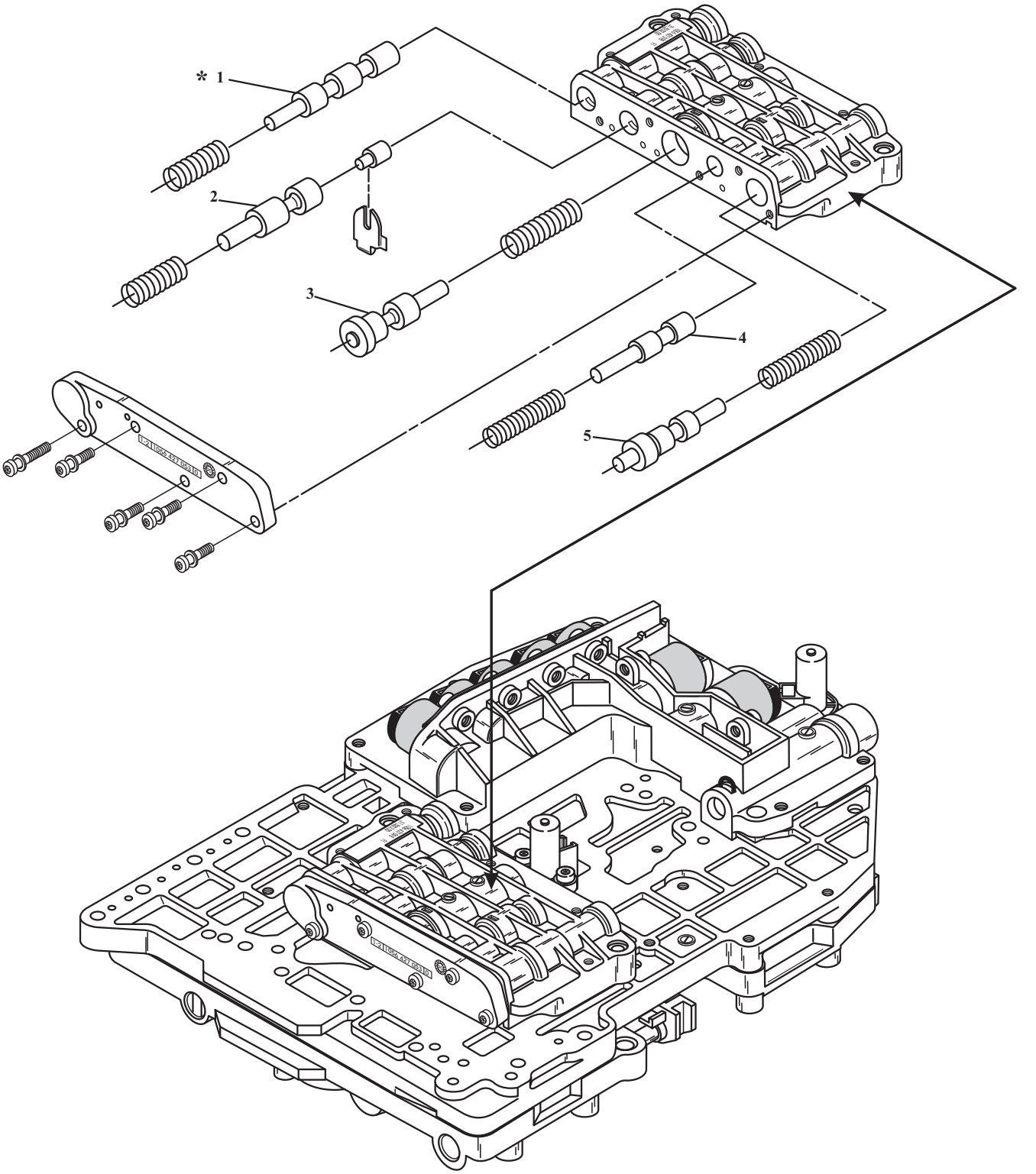
LOCKUP HYDRAULIC CIRCUIT



The "Bypass Ball" shrinks and travels back through to the Torque Convertor Valve and lodges itself in this passage, sticking the valve in this approximate position.

Figure 73

ZF-5HP-18 UPPER FRONT VALVE BODY



*1. Torque Converter Valve
2. Lubrication Valve Train
3. Lock-Up Control Valve
4. 5-4 Traction Valve

Figure 74

ZF-5HP-18
"BIND-UP" WITH SELECTOR IN MANUAL "2" POSITION, 1st GEAR

COMPLAINT: Before or after overhaul, vehicles equipped with ZF-5HP-18, may exhibit a "Bind-Up" condition in the Manual "2" position, 1st gear.

CAUSE: The cause may be, the plastic "D" Clutch One-way Check Valve assembly located in the Lower Rear valve body, shown in Figure 76, may be broken allowing the "B" Clutch (Reverse Input Clutch) to be on while the "D" Clutch (Low/Reverse Clutch) is on in 1st gear.

CORRECTION: Replace the "D" Clutch One-way Check Valve assembly , as shown in Figure 75, with a new assembly, part number 1043 226 028 from ZF, or a new "Aluminum" check valve assembly offered by Mario Aristides. Phone (305) 666-3544 or Fax (305) 666-8238.

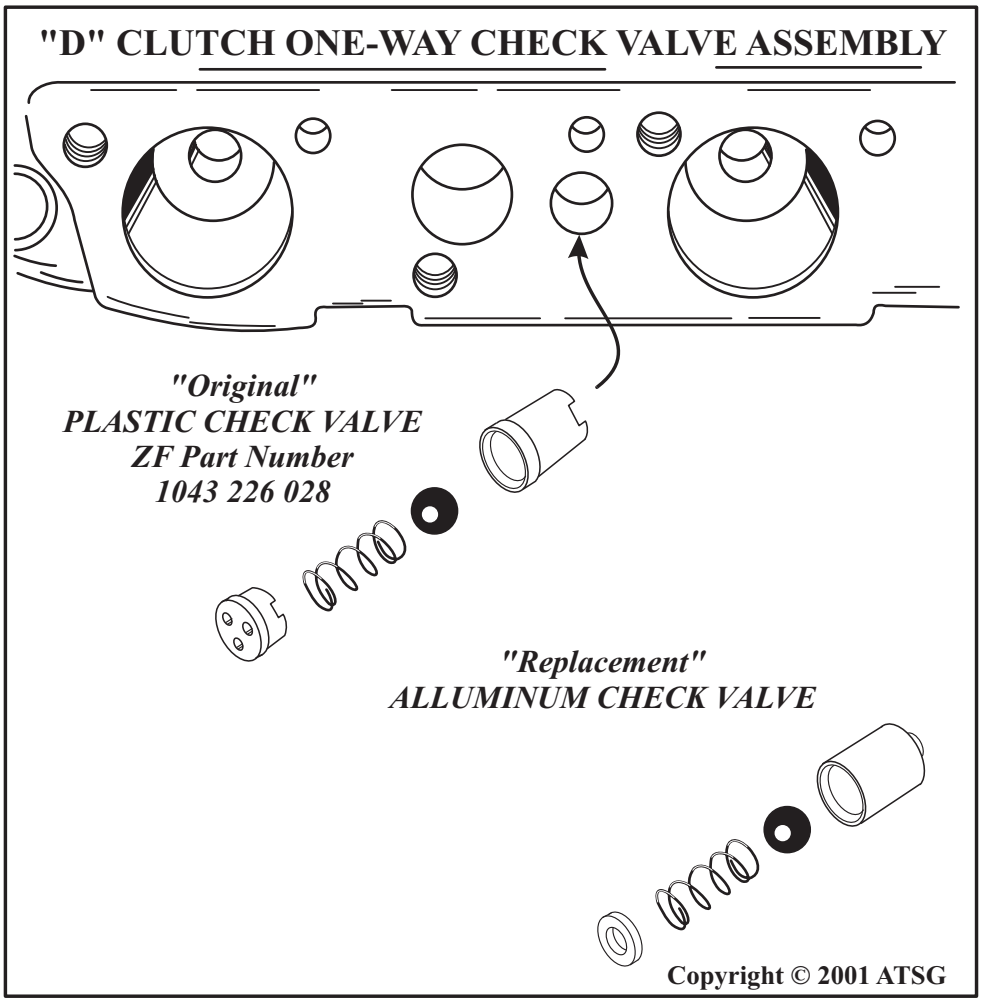
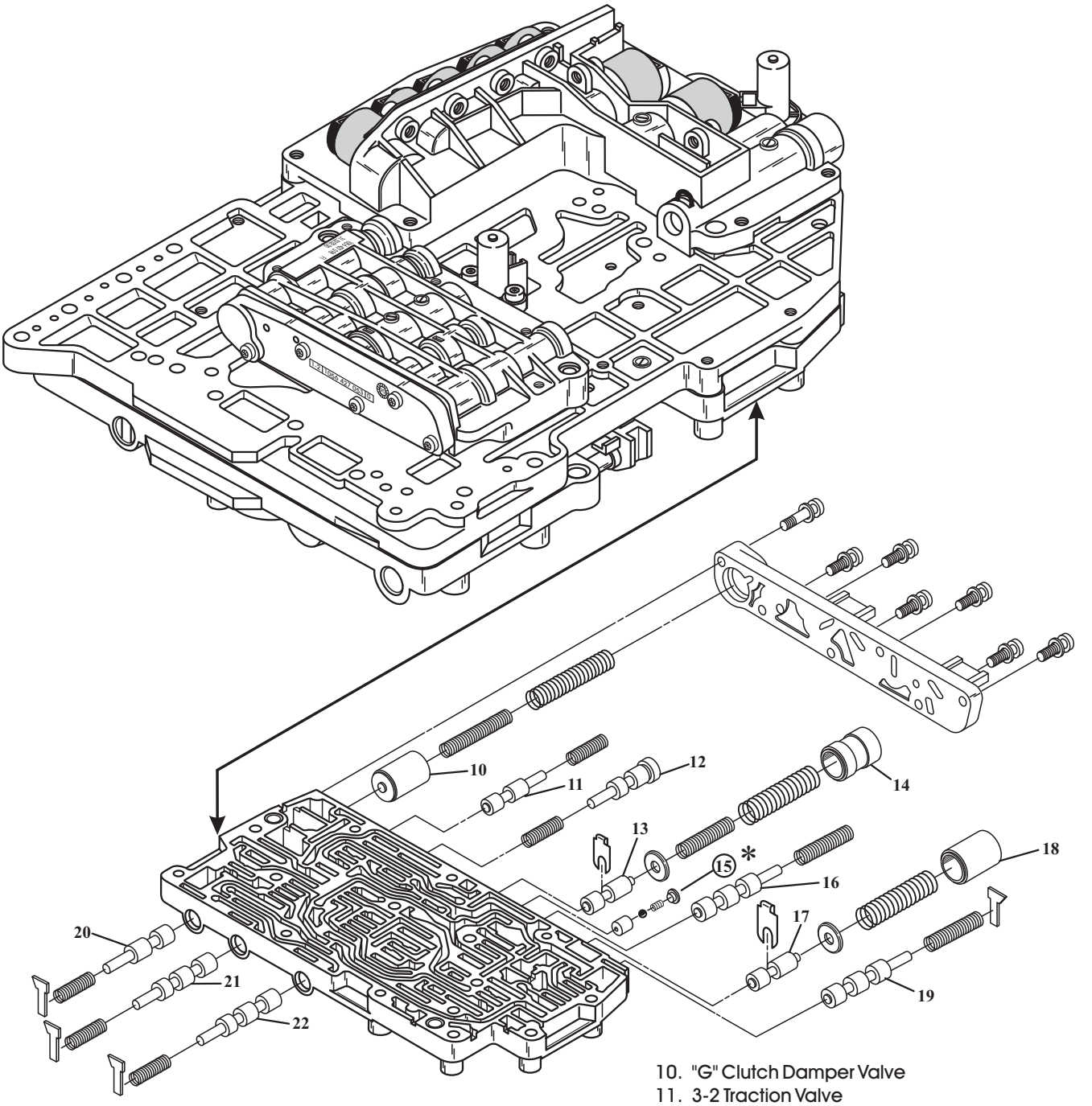


Figure 75

LOWER REAR VALVE BODY



10. "G" Clutch Damper Valve
11. 3-2 Traction Valve
12. 2-3 Traction Valve
13. "D" Clutch Accumulator Regulator Valve
14. "D" Clutch Damper Valve
* 15. "D" Clutch One-Way Check Valve Assembly
16. Reverse Lock-Out Valve
17. "F" Clutch Accumulator Regulator Valve
18. "F" Clutch Damper Valve
19. Shift Valve Number 2
20. Pressure Reduction Valve For MV 1 thru MV 6
21. Traction Coast Valve Number 2
22. Traction Coast Valve Number 1

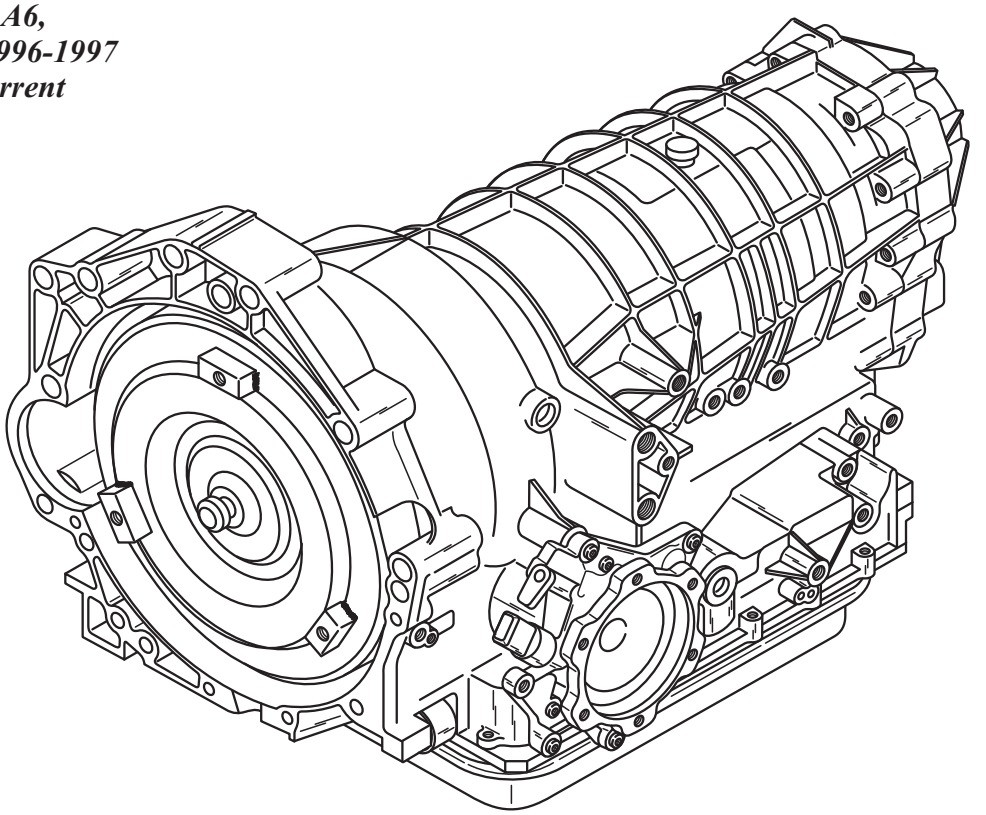
Figure 76

We wish to thank the following for supplying the actual valve bodies that have made these illustrations possible.

BMW ZF-5HP-19FL
DIAGNOSTIC INFORMATION

FOUND IN:

BMW 97-Current, 3 Series E46, 5 Series E39, 7 Series E38.
Audi 95-Current, A4, A8,
Audi 97-Current, A6,
Porsche Boxter 1996-1997
VW Passat 96-Current



This transmission is manufactured in Germany by ZF and carries the designation ZF-5HP-19..

The ZF-5HP-19 Series is an electronically controlled, five speed automatic transmission with a lock-up clutch type torque converter. Two planetary gear sets, one Ravingneaux gear set and one standard planetary gear set on the output side, four rotating multiple disc clutches, three multiple disc brake clutches, and one sprag clutch (Freewheel) are used to provide the five forward speeds and reverse.

Figure 77

Refer to Figure 78 for Clutch and Band Application Chart.

Refer to Figure 79 and 80 for Manual Shift Lever Operation, and Failsafe Operation.

Refer to Figures 81, 82, and 83 for Solenoid identification and both MV Solenoid Operation and EDS Solenoid Operation and Tests.

Refer to Figure 84 for wiring harness identification, internal wiring schematic, and transmission case connector pin identification and functions.

Refer to Figure 85 for Shift Solenoid Application chart. Notice that EDS 1 Solenoid is used for line pressure control, and EDS 4 is used for converter clutch.

Refer to Figure 86 for internal components resistance chart, with the pins identified for both the transmission case connector and the Electronic Control Unit.

Refer to Figure 87 for Upper Front Valve Body exploded view and identification of valves.

Refer to Figure 88 for Upper Rear Valve Body exploded view and identification of valves.

Refer to Figure 89 for Lower Front Valve Body exploded view and identification of valves.

Refer to Figure 90 for Lower Rear Valve Body exploded view and identification of valves.

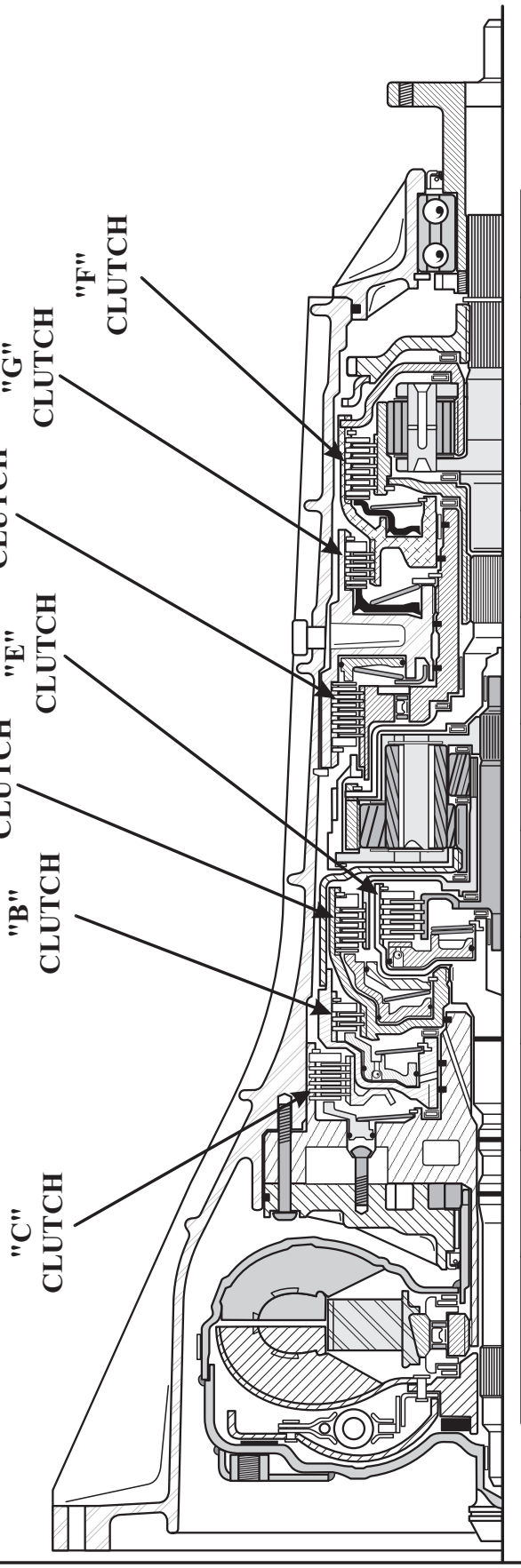
Refer to Figure 91 for Channel Plate exploded view and turbine speed sensor location on the channel plate.

Refer to Figures 92, 93, and 94 for valve body retainer locations in the various valve bodies.

Refer to Figure 95 for the locations of the orifices, checkballs, screens, and the check valves and springs that are located in the channel plate.

Refer to Figure 96 for all valve body spring specifications, as observed in a used valve body.

ZF-5HP-19 CLUTCH AND BAND APPLICATION CHART



RANGE	"A" CLUT	"B" CLUT	"C" CLUT	"D" CLUT	"LOW" SPRAG	"E" CLUT	"F" CLUT	"G" CLUT	GEAR RATIO	CONV CLUT
Park								ON		
Reverse		ON		ON				ON	4.08	
Neutral								ON		
"D"-1st	ON				HOLD			ON	3.66	
"D"-2nd	ON		ON					ON	1.99	
"D"-3rd	ON		ON				ON		1.40	*
"D"-4th	ON					ON	ON		1.00	*
"D"-5th			ON			ON	ON		0.74	*
"4"	*Same as above, Automatic Shift 1st thru 4th, 5th gear is inhibited.*									*
"3"	*Same as above, Automatic Shift 1st thru 3rd, 4th and 5th gear are inhibited.*									*
"2"	*Same as above, Automatic Shift 1st thru 2nd, 3rd, 4th and 5th gear are inhibited.*									

***Converter Clutch may be ON or OFF depending on vehicle speed and throttle position.**

Figure 78

SHIFT QUADRANT

Ⓟ = Parking Pawl Engaged

Ⓡ = Reverse Gear

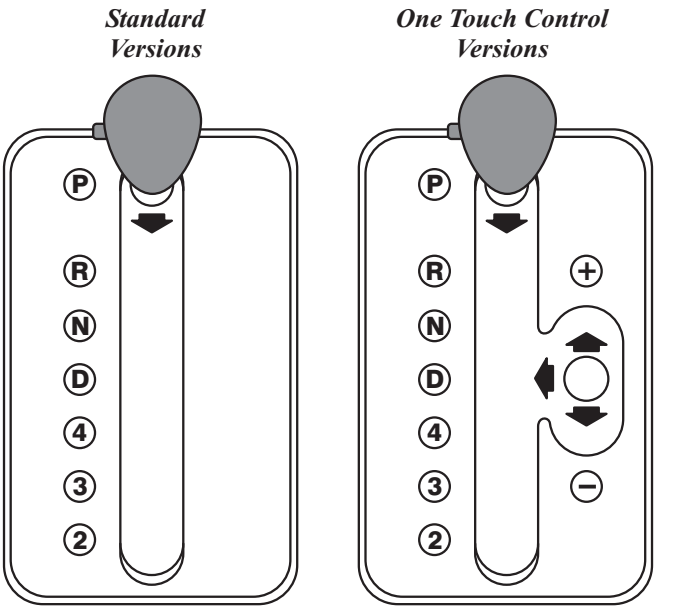
Ⓝ = Neutral

Ⓓ = Automatic Shifts 1st thru 5th Gears

④ = Automatic Shifts 1st thru 4th Gears. 5th Gear is locked out.

③ = Automatic Shifts 1st thru 3rd Gears. 4th and 5th Gear is locked out.

② = Automatic Shifts 1st thru 2nd Gears. 3rd, 4th and 5th Gear is locked out.



Note: 1st gear, which has an engine braking effect, is selected electronically, dependent on being in Manual Position 2 and at a suitable road speed.

ONE-TOUCH CONTROL VERSIONS

Standard versions have a shift quadrant using only the left gate as shown above. The versions that are equipped with One-Touch Control, supplied as an option and model dependent, have a two section shift quadrant, also shown above. Positions P, R, N, D, 4, 3, 2, can be selected in the left-hand gate and all shifts are automatic depending on which selection was made. When the selector lever is placed in the right-hand gate, the transmission can be up-shifted manually, by tapping the lever in the direction of the "Plus" symbol, or down-shifted manually by tapping the lever in the direction of the "Minus" symbol. The seperate program switch is no longer needed, as functions A and B have replaced it.

"A" Left-Hand Gate = DSP (Dynamic Shift Program)

With the selector lever in the left-hand gate, the Dynamic Shift Program (DSP) looks at the speed of accelerator pedal movement, engine speed, vehicle acceleration via output speed and other important parameters in the control unit.

The Electronic Control Unit (ECU) includes modules which will automatically modify the transmissions shift characteristics according to the driving style and the road conditions. These modules effectively replace the program switch.

If the engine temperature is below approximately 40°C (104°F) when it is started, the ECU control system enters a special warm-up program in order to shorten the catalytic converter's warming-up phase. This warm-up program is terminated after approximately 2 minutes of operation.

Continued on next Page

Figure 79

"A" Left-Hand Gate = DSP (Dynamic Shift Program) (Cont'd)

If the speed of the accelerator pedal movement is greatly varied, the shift points are modified for maximum fuel economy, or a more sporting driving style accordingly. There are three shift patterns for this purpose.

1. = Comfort Oriented, Economical Driving Style

2. = Average Driving Style

3. = Sports Oriented, High Performance Driving Style

When the vehicle is started cold, it moves off in shift pattern number one, provided that the transmission temperature is above 40°C (104°F). This shift pattern places the emphasis on maximum fuel economy. If a more enthusiastic driving style is required, detected by the accelerator opening and closing more rapidly, the ECU switches between the shift patterns and adopting shift pattern three where necessary.

If a calmer driving style is resumed, the ECU returns to the lower shift pattern, and will once again place the emphasis on fuel consumption.

"B" Right-Hand Gate = Manual Shift Program

When the selector lever is moved to the right-hand gate, the current gear is retained, and the transmission can be shifted to a lower or higher gear using the one-touch function.

There are engine speed limits for each gear, as in the transmission can only be shifted down if the maximum engine speed will not be exceeded by doing so. No mandatory upshifts will take place.

If the One-Touch feature is not used when the selector lever is in the right-hand gate, for durability concerns, the transmission is allowed to down-shift automatically to 1st gear.

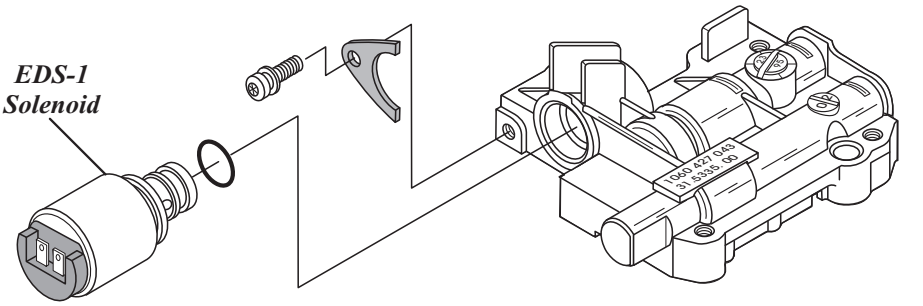
FAILSAFE OPERATION

When a system fault is detected which could impair normal reliable operation, the ECU module interrupts the power supply to Pin 12 at the transmission case connector. The ECU module also alerts the driver of any faults by signaling the vehicles "check control" system. To enable the vehicle to be driven to a repair shop, the following manual gear selections are permitted:

Selector Lever Position	***P R N D 4 3 2***
Actual Gear Obtained	***P R N 4 4 4 4***

Figure 80

ZF-5HP-19 SOLENOID IDENTIFICATION AND LOCATIONS



ZF Part Numbers	
EDS-1 Solenoid	0501 209 875
EDS-2, 3, 4, Solenoid	0501 208 562
MV-1, 2, 3, Solenoid	0501 313 506

SPECIAL NOTE:

EDS-1 Solenoid
.650" Snout Diameter
Requires Green "O" Ring

EDS-2, 3, 4 Solenoids
.670" Snout Diameter
Requires Black "O" Ring

MV-1, 2, 3 Solenoids
Use NO "O" Rings

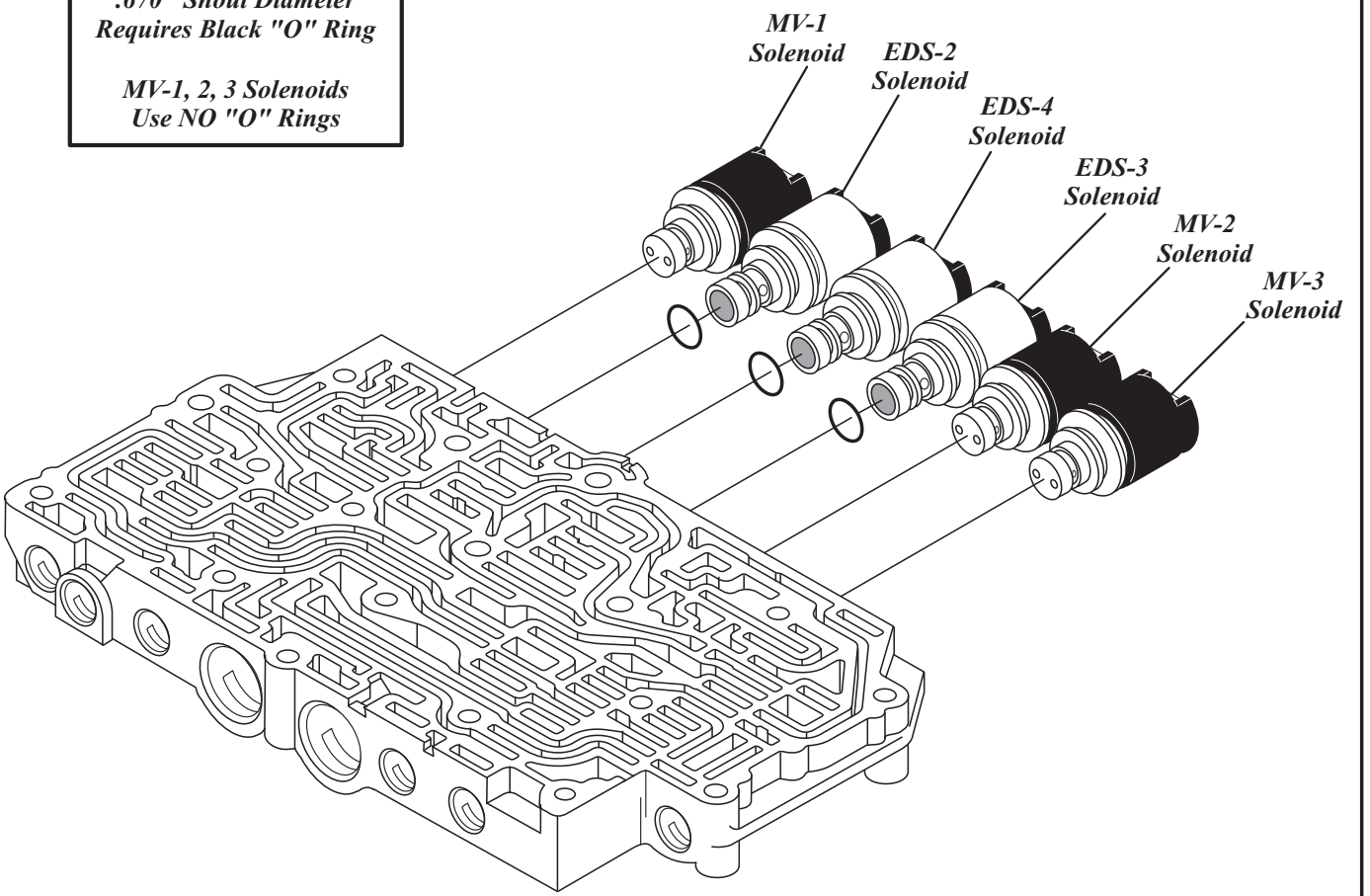
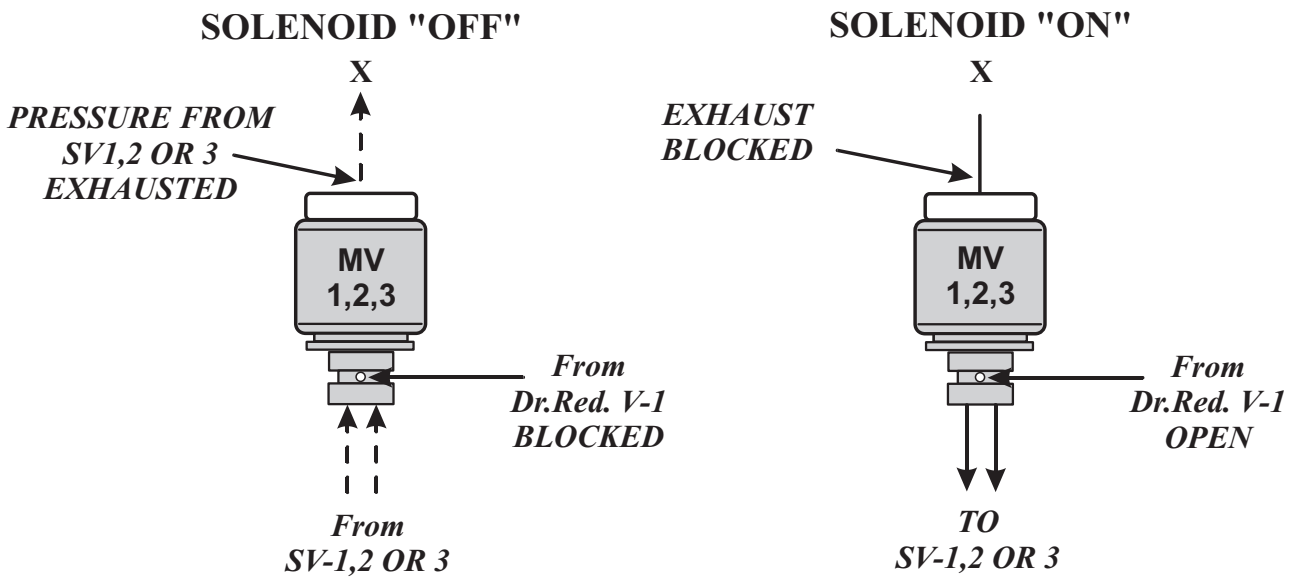


Figure 81

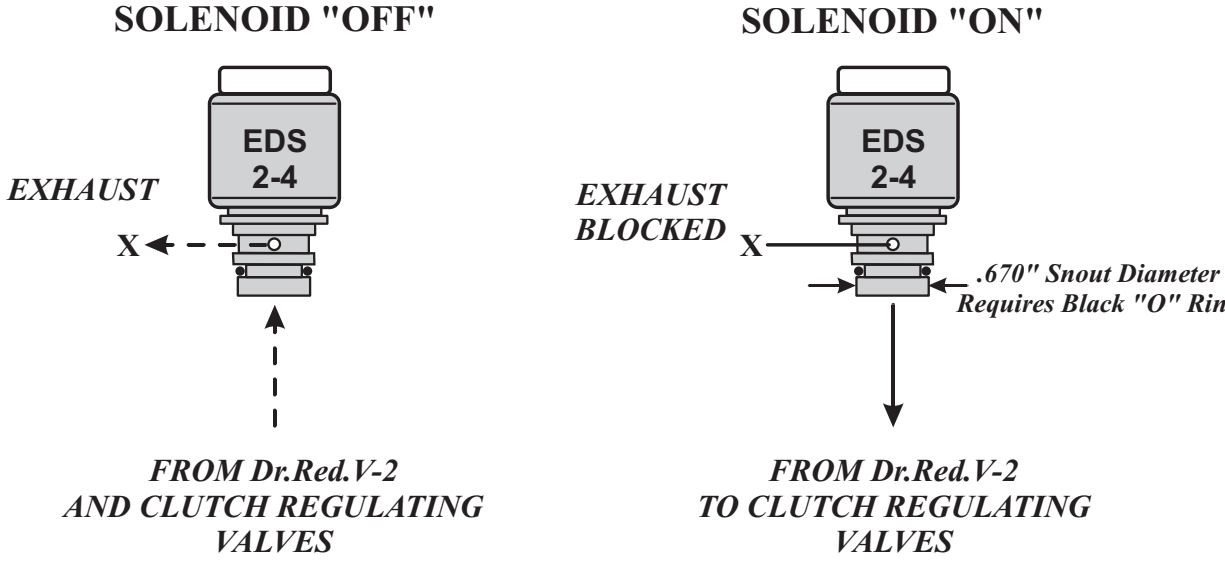
MV1, 2 AND 3 OPERATION



SUMMARY:

When MV 1, 2 or 3 is "OFF" Solenoid reducing pressure, from Dr.Red. V-1, is blocked by the solenoid and oil pressure from SV 1, 2 or 3 is exhausted at the rear of the solenoid. When MV 1, 2 or 3 is "ON" Solenoid reducing pressure, From Dr.Red. V-1, is open through the solenoid and is applied to SV 1, 2 or 3. The exhaust at the rear of the solenoid is closed.

EDS 2, 3 AND 4 OPERATION



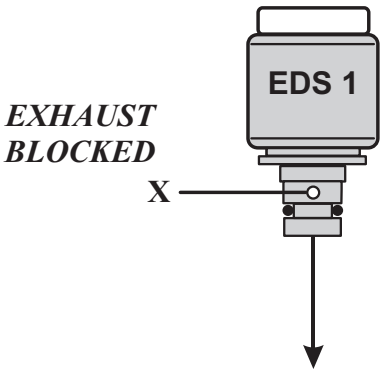
SUMMARY:

When EDS 2-4 solenoids are "OFF" they exhaust orificed solenoid reducing pressure, from Dr. Red. V-2, and the oil pressure from the clutch regulating valves releasing them. When EDS 2-4 solenoids are "ON" the exhaust is blocked by the solenoid and solenoid reducing pressure, from Dr. Red. V-2, is applied to operate clutch regulating valves.

Figure 82

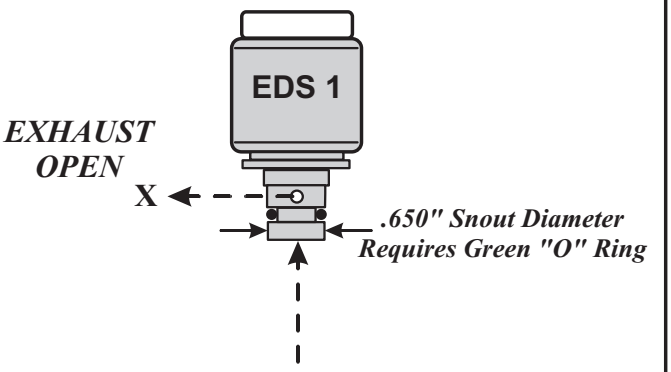
EDS-1 OPERATION
(Line Pressure Solenoid)

SOLENOID "OFF"



From Dr.Red. V-2 to MOD-V

SOLENOID "ON"



From Dr.Red. V-2 and MOD-V

SUMMARY:

When EDS 1 solenoid is "OFF," solenoid reducing pressure, from Dr. Red. V-2, is high to MOD-V valve which creates high line pressure.
When EDS 1 solenoid is "ON," solenoid reducing pressure, from Dr. Red. V-2, is low to

Figure 83

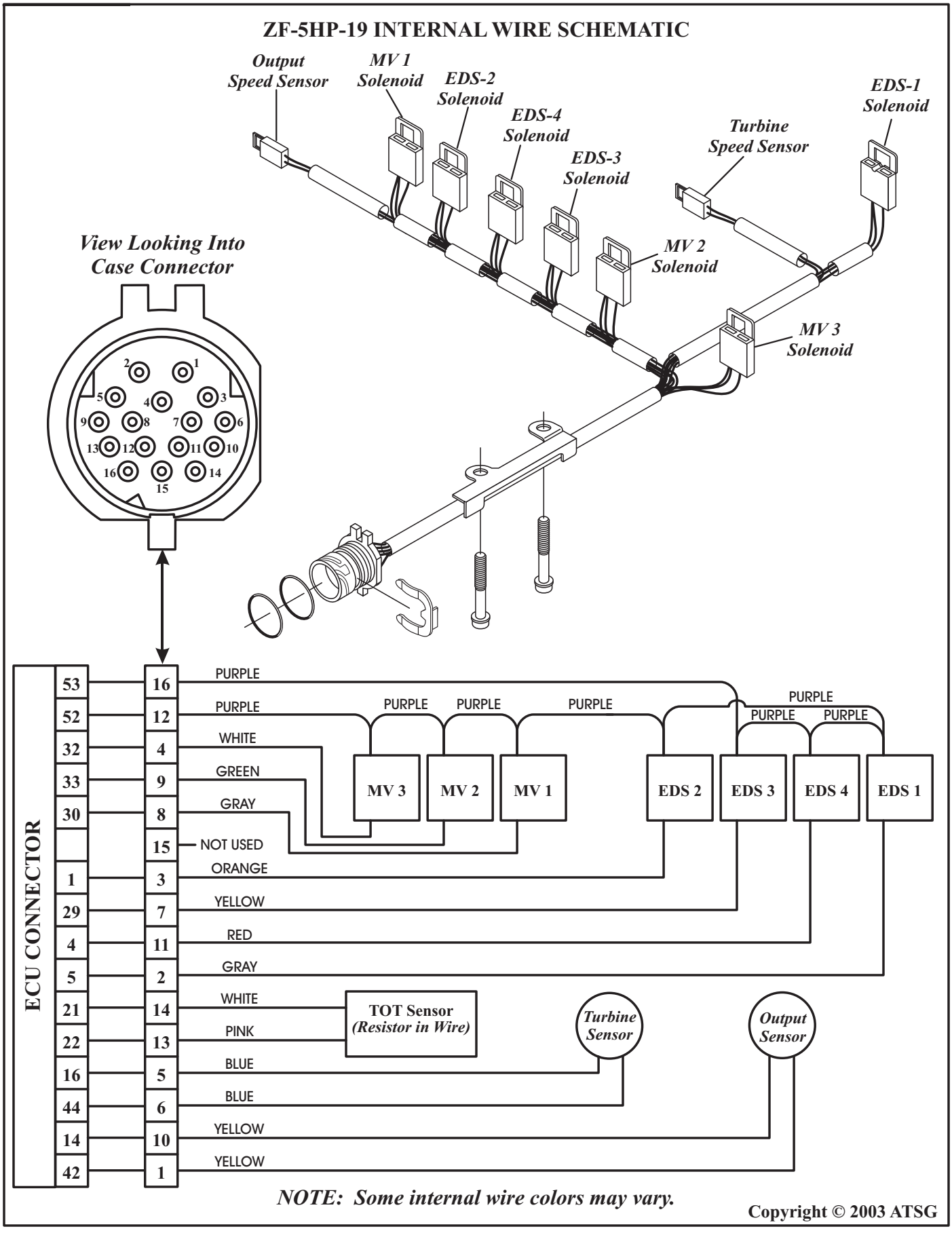

ZF-5HP-19 INTERNAL WIRE SCHEMATIC
Output Speed Sensor
MV 1 Solenoid
EDS-2 Solenoid
EDS-4 Solenoid
EDS-3 Solenoid
Turbine Speed Sensor
EDS-1 Solenoid
MV 2 Solenoid
MV 3 Solenoid
View Looking Into Case Connector
ECU CONNECTOR
53
52
32
33
30
1
29
4
5
21
22
16
44
14
42
16
12
4
9
8
15
3
7
11
2
14
13
5
6
10
1
PURPLE
PURPLE
WHITE
GREEN
GRAY
NOT USED
ORANGE
YELLOW
RED
GRAY
WHITE
PINK
BLUE
BLUE
YELLOW
YELLOW
MV 3
MV 2
MV 1
EDS 2
EDS 3
EDS 4
EDS 1
TOT Sensor (Resistor in Wire)
Turbine Sensor
Output Sensor
NOTE: Some internal wire colors may vary.
Copyright © 2003 ATSG

Figure 84

ZF-5HP-19 SOLENOID APPLICATION CHART

Selector Lever Position	*MV 1 Solenoid*	*MV 2 Solenoid*	*MV 3 Solenoid*	*EDS 1 Solenoid*	*EDS 2 Solenoid*	*EDS 3 Solenoid*	*EDS 4 Solenoid*	GEAR RATIO
PARK	ON			**				
REVERSE	ON		⊛	**		*		4.08:1
NEUTRAL	ON	ON		**		*		
D-1ST	ON	ON		**		*		3.66:1
D-2ND	ON	ON		**	*	*		1.99:1
D-3RD		ON		**	*		-*-	1.40:1
D-4TH				**			-*-	1.00:1
D-5TH			-*	**	*		-*-	0.74:1
Failsafe (4th)	OFF	OFF	OFF	OFF	OFF	OFF	OFF	1.00:1

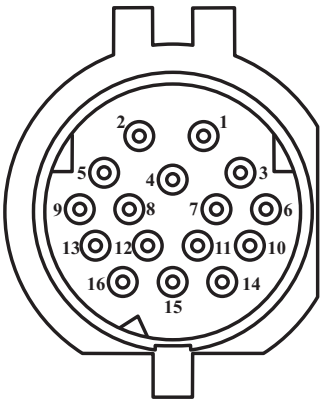
SOLENOID CHART LEGEND

Symbol	*Description*
ON	*MV 1, MV 2 and MV 3 Solenoids are energized by the Electronic Transmission Control unit and have two functions. They are Open or Closed. Energized (On), there is pressure in circuit.*
⊛	*MV 3 is turned "ON" if reverse is selected at a high vehicle speed, to inhibit reverse engagement.*
**	*EDS 1 is used for line pressure control only, and operates from 0 to 0.8 amps. When the solenoid is "OFF" (0 amps), pressure is high. EDS 1 pressure is "Lowered" as the solenoid is modulated by the control unit.*
*	*EDS 2, EDS 3, and EDS 4 Solenoids are also pulse modulated but are exactly the opposite of EDS 1 Solenoid. When these solenoids are "ON" oil pressure in the hydraulic circuit is high, and when they are "OFF" pressure in the hydraulic circuit is low.*
-*	*Solenoid "OFF" (hydraulic pressure low), then Solenoid "ON" (hydraulic pressure high).*
-*-	*EDS 4 Solenoid is used for Torque Converter Clutch apply and release only, and depends on throttle position and vehicle speed as to its application.*

Figure 85

ZF 5HP-19 SOLENOID AND SENSOR RESISTANCE CHART

Solenoid	*Case Connector Pin Numbers* − +	*Control Unit Connector Pin Numbers* − +	*Resistance In Ohms*
MV 1	*8 and 12*	*30 and 52*	*30 - 34 Ω*
MV 2	*9 and 12*	*33 and 52*	*30 - 34 Ω*
MV 3	*4 and 12*	*32 and 52*	*30 - 34 Ω*
EDS 1	*2 and 12*	*5 and 52*	*5.2 - 6.8 Ω*
EDS 2	*3 and 12*	*1 and 52*	*6.2 - 7.8 Ω*
EDS 3	*7 and 12*	*29 and 52*	*6.2 - 7.8 Ω*
EDS 4	*11 and 12*	*4 and 52*	*6.2 - 7.8 Ω*
TOT	*13 and 14*	*21 and 22*	*1000 Ω at 25° C*
OSS	*1 and 10*	*14 and 42*	*292 - 358 Ω*
TSS	*5 and 6*	*44 and 16*	*292 - 358 Ω*



View Looking Into Case Connector

Electronic Control Unit Connector Pin Identification

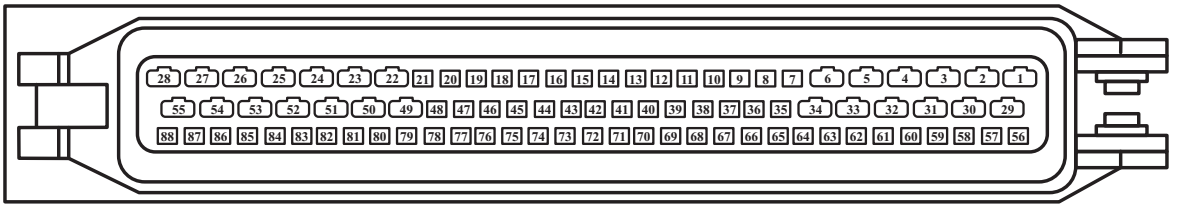


Figure 86

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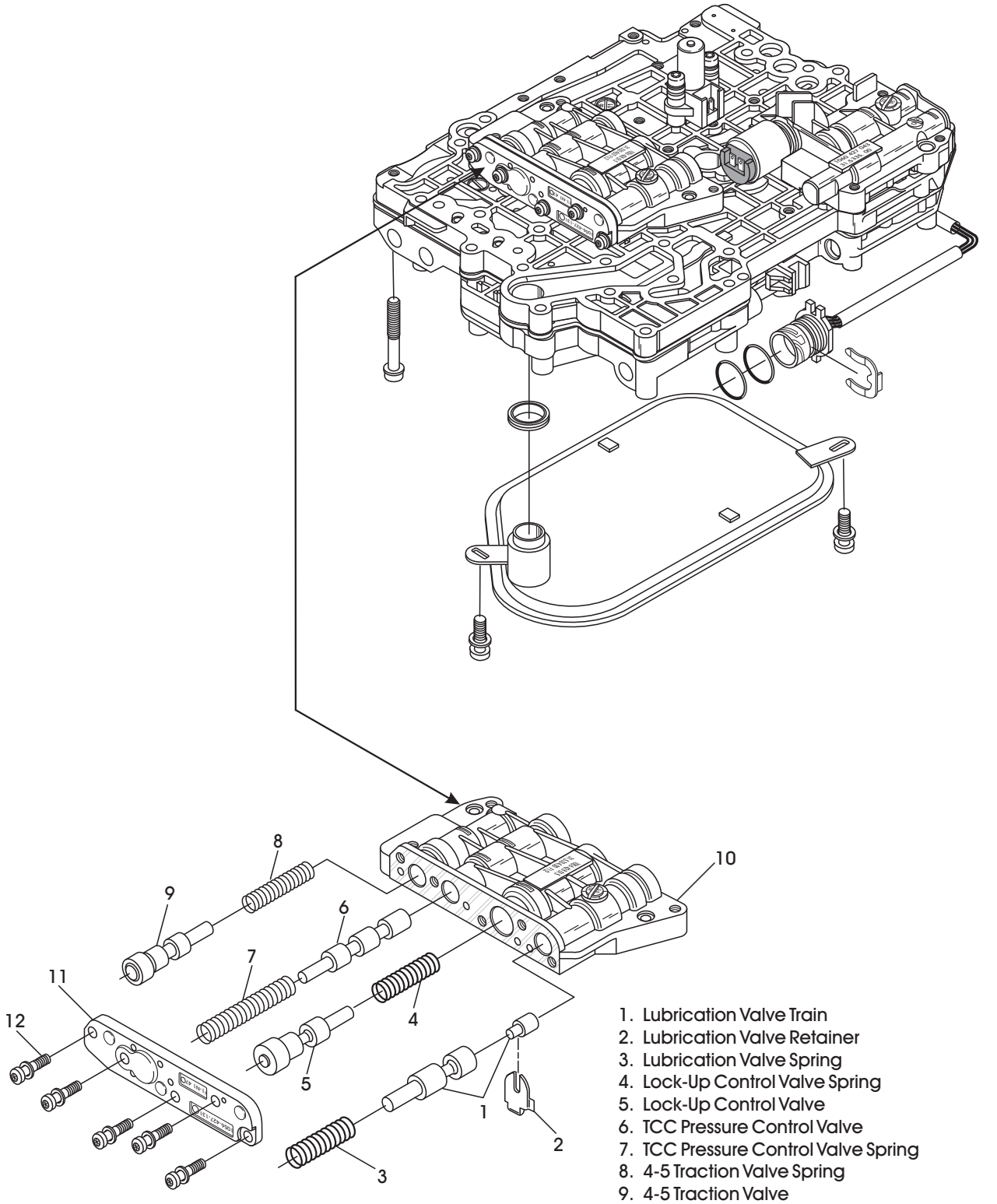
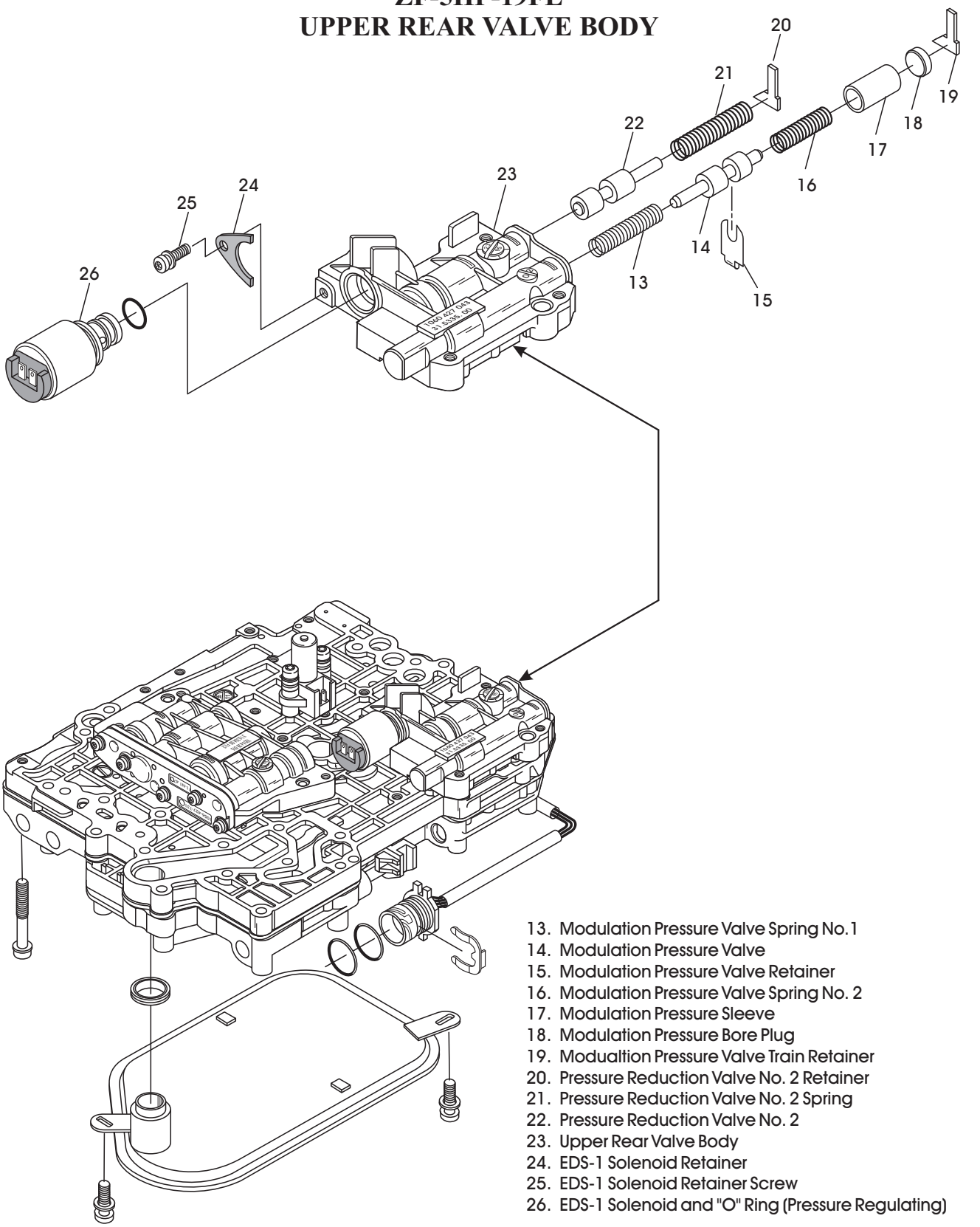
ZF-5HP-19FL
UPPER FRONT VALVE BODY



1. Lubrication Valve Train
2. Lubrication Valve Retainer
3. Lubrication Valve Spring
4. Lock-Up Control Valve Spring
5. Lock-Up Control Valve
6. TCC Pressure Control Valve
7. TCC Pressure Control Valve Spring
8. 4-5 Traction Valve Spring
9. 4-5 Traction Valve
10. Upper Front Valve Body
11. Upper Front Valve Body Cover
12. Cover Retaining Screws (5 Required)

Figure 87

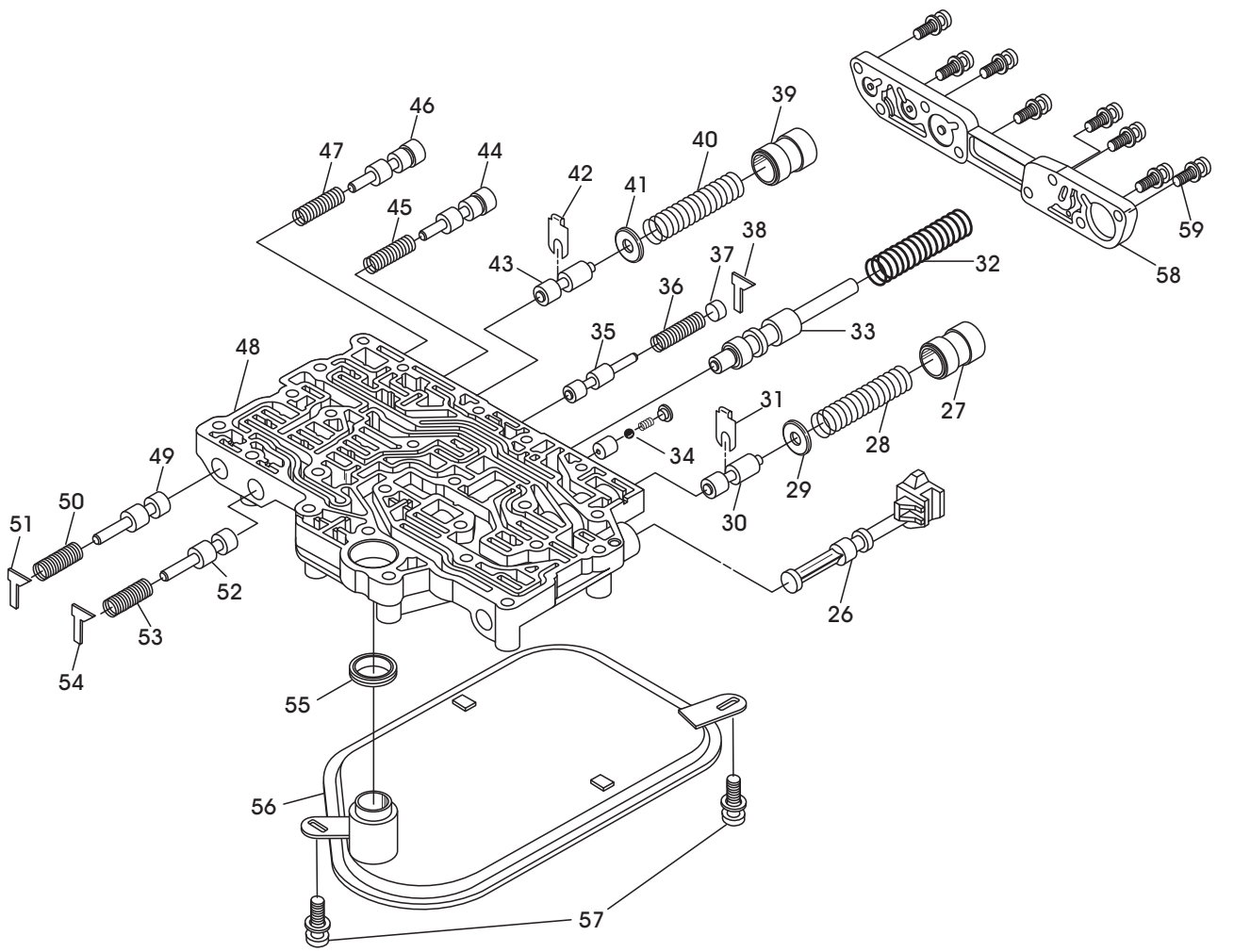
ZF-5HP-19FL
UPPER REAR VALVE BODY



13. Modulation Pressure Valve Spring No.1
14. Modulation Pressure Valve
15. Modulation Pressure Valve Retainer
16. Modulation Pressure Valve Spring No. 2
17. Modulation Pressure Sleeve
18. Modulation Pressure Bore Plug
19. Modualtion Pressure Valve Train Retainer
20. Pressure Reduction Valve No. 2 Retainer
21. Pressure Reduction Valve No. 2 Spring
22. Pressure Reduction Valve No. 2
23. Upper Rear Valve Body
24. EDS-1 Solenoid Retainer
25. EDS-1 Solenoid Retainer Screw
26. EDS-1 Solenoid and "O" Ring (Pressure Regulating)

Figure 88

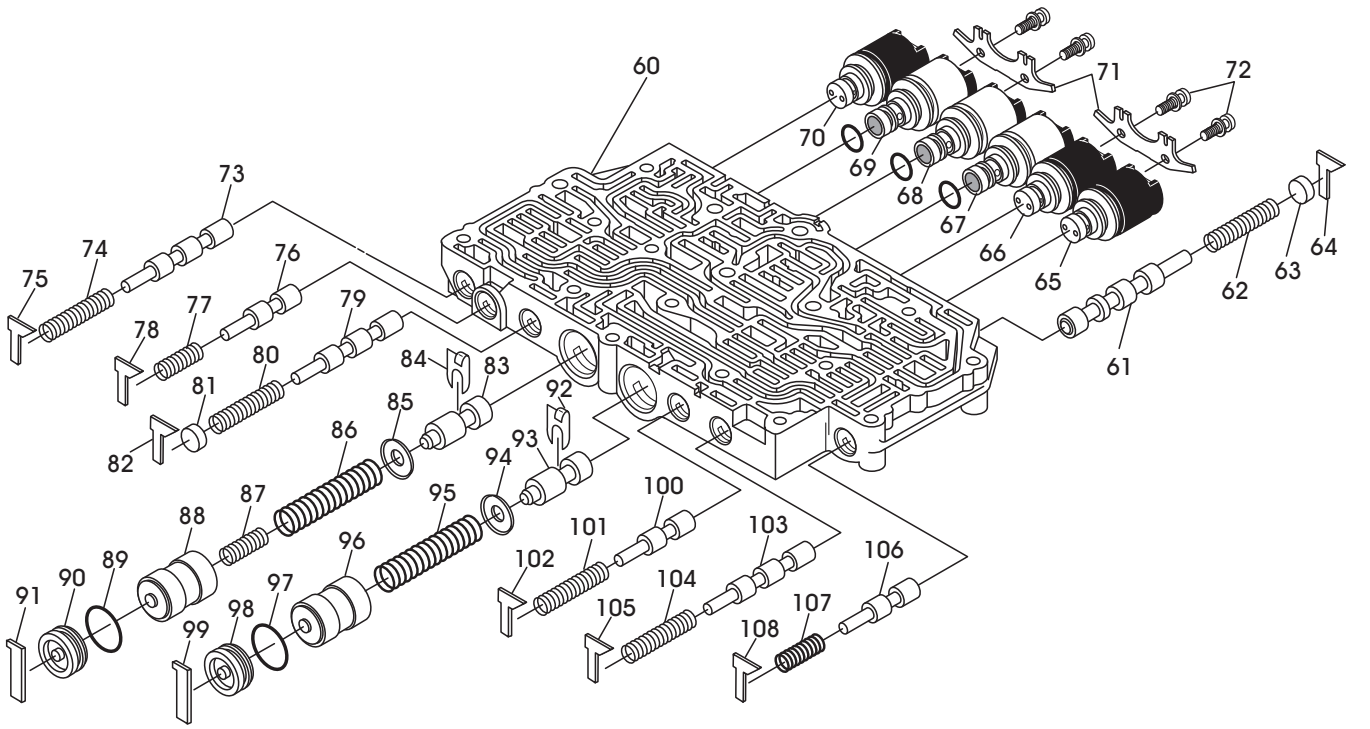
ZF-5HP-19FL
LOWER FRONT VALVE BODY



26. Manual Shift Valve (W-S)
27. "E" Clutch Damper Valve
28. "E" Clutch Damper Valve Spring
29. "E" Clutch Damper Valve Spring Seat
30. "E" Clutch Accumulator Regulator Valve
31. "E" Clutch Accumulator Regulator Valve Retainer
32. Main Pressure Regulator Valve Spring
33. Main Pressure Regulator Valve
34. "D" Clutch One-Way Check Valve Assembly
35. 5-4 Traction Valve
36. 5-4 Traction Valve Spring
37. 5-4 Traction Valve Bore Plug
38. 5-4 Traction Valve Train Retainer
39. "A" Clutch Damper Valve
40. "A" Clutch Damper Valve Spring
41. "A" Clutch Damper Valve Spring Seat
42. "A" Clutch Accumulator Regulator Valve Retainer
43. "A" Clutch Accumulator Regulator Valve
44. "G" Clutch Accumulator Regulator Valve
45. "G" Clutch Accumulator Regulator Valve Spring
46. "C" Clutch Accumulator Regulator Valve
47. "C" Clutch Accumulator Regulator Valve Spring
48. Lower Front Valve Body
49. "C" Clutch Shift Valve
50. "C" Clutch Shift Valve Spring
51. "C" Clutch Shift Valve Retainer
52. "G" Clutch Shift Valve
53. "G" Clutch Shift Valve Spring
54. "G" Clutch Shift Valve Retainer
55. Filter Seal
56. Oil Filter
57. Oil Filter Retaining Screws
58. Lower Valve Body Cover
59. Lower Valve Body Cover Screws (8 Required)

Figure 89

ZF-5HP-19FL
LOWER REAR VALVE BODY



60. Lower Rear Valve Body
61. Number 1 Shift Valve
62. Number 1 Shift Valve Spring
63. Number 1 Shift Valve Bore Plug
64. Number 1 Shift Valve Retainer
65. MV-3 Solenoid (On-Off)
66. MV-2 Solenoid (On-Off)
67. EDS-3 Solenoid and "O" Ring (Pressure Regulating)
68. EDS-4 Solenoid and "O" Ring (Pressure Regulating)
69. EDS-2 Solenoid and "O" Ring (Pressure Regulating)
70. MV-1 Solenoid (On-Off)
71. Solenoid Retaining Brackets (2 Required)
72. Solenoid Retaining Bracket Screws (4 Required)
73. Traction Coast Valve
74. Traction Coast Valve Spring
75. Traction Coast Valve Train Retainer
76. TCC Release Regulator Valve
77. TCC Release Regulator Valve Spring
78. TCC Release Regulator Valve Train Retainer
79. Number 3 Shift Valve
80. Number 3 Shift Valve Spring
81. Number 3 Shift Valve Train Bore Plug
82. Number 3 Shift Valve Train Retainer
83. "D" Clutch Accumulator Regulator Valve
84. "D" Clutch Accumulator Regulator Valve Retainer
85. "D" Clutch Damper Valve Spring Seat
86. "D" Clutch Damper Valve Outer Spring
87. "D" Clutch Damper Valve Inner Spring
88. "D" Clutch Damper Valve
89. "D" Clutch Valve Train Bore Plug "O" Ring
90. "D" Clutch Valve Train Bore Plug
91. "D" Clutch Valve Train Bore Plug Retainer
92. "F" Clutch Accumulator Regulator Valve Retainer
93. "F" Clutch Accumulator Regulator Valve
94. "F" Clutch Damper Valve Spring Seat
95. "F" Clutch Damper Valve Spring
96. "F" Clutch Damper Valve
97. "F" Clutch Valve Train Bore Plug "O" Ring
98. "F" Clutch Valve Train Bore Plug
99. "F" Clutch Valve Train Bore Plug Retainer
100. Reverse Gear Valve
101. Reverse Gear Valve Spring
102. Reverse Gear Valve Train Retainer
103. Number 2 Shift Valve
104. Number 2 Shift Valve Spring
105. Number 2 Shift Valve Train Retainer
106. Pressure Reduction Valve
107. Pressure Reduction Valve Spring
108. Pressure Reduction Valve Train Retainer

Figure 90

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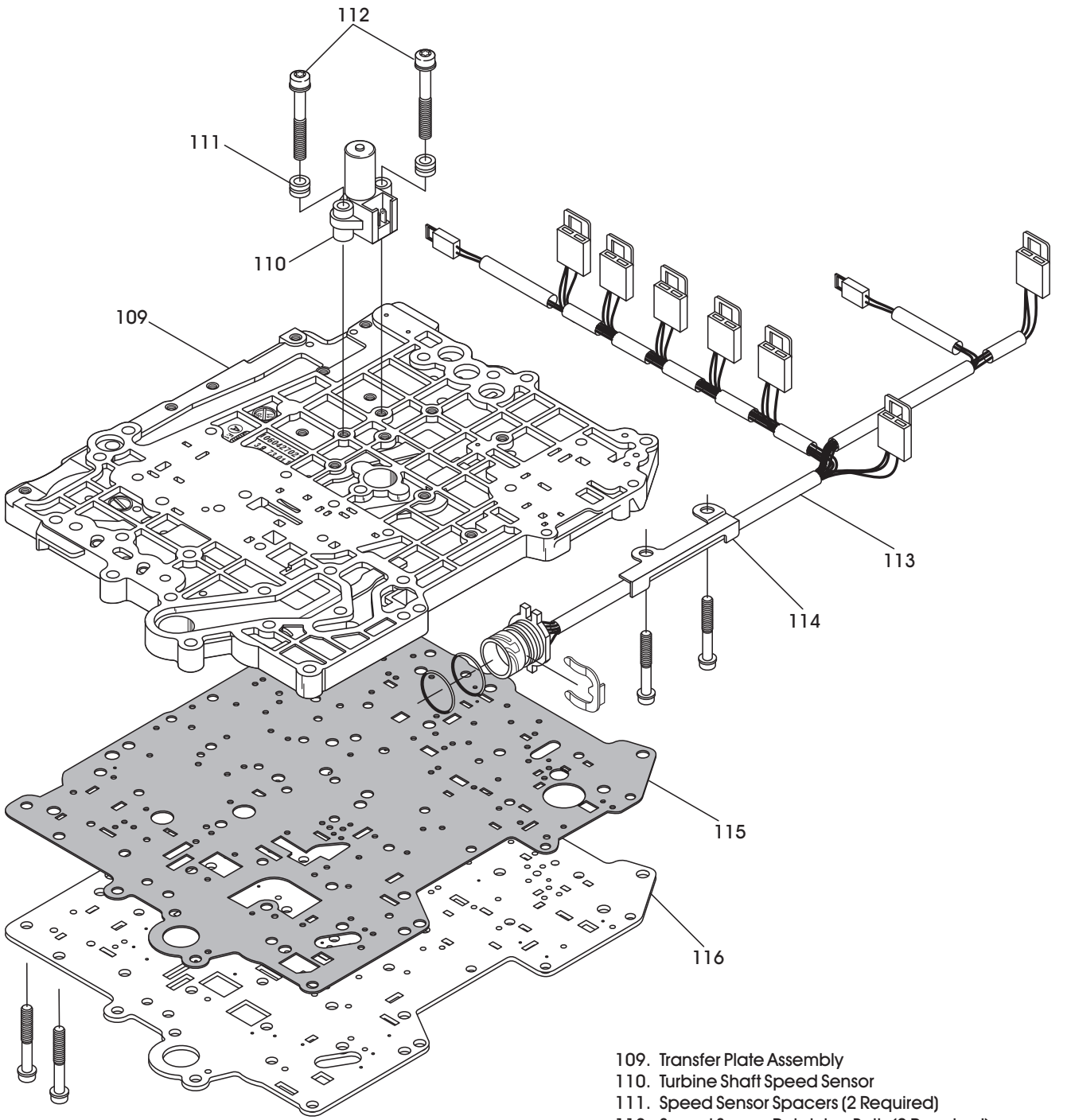
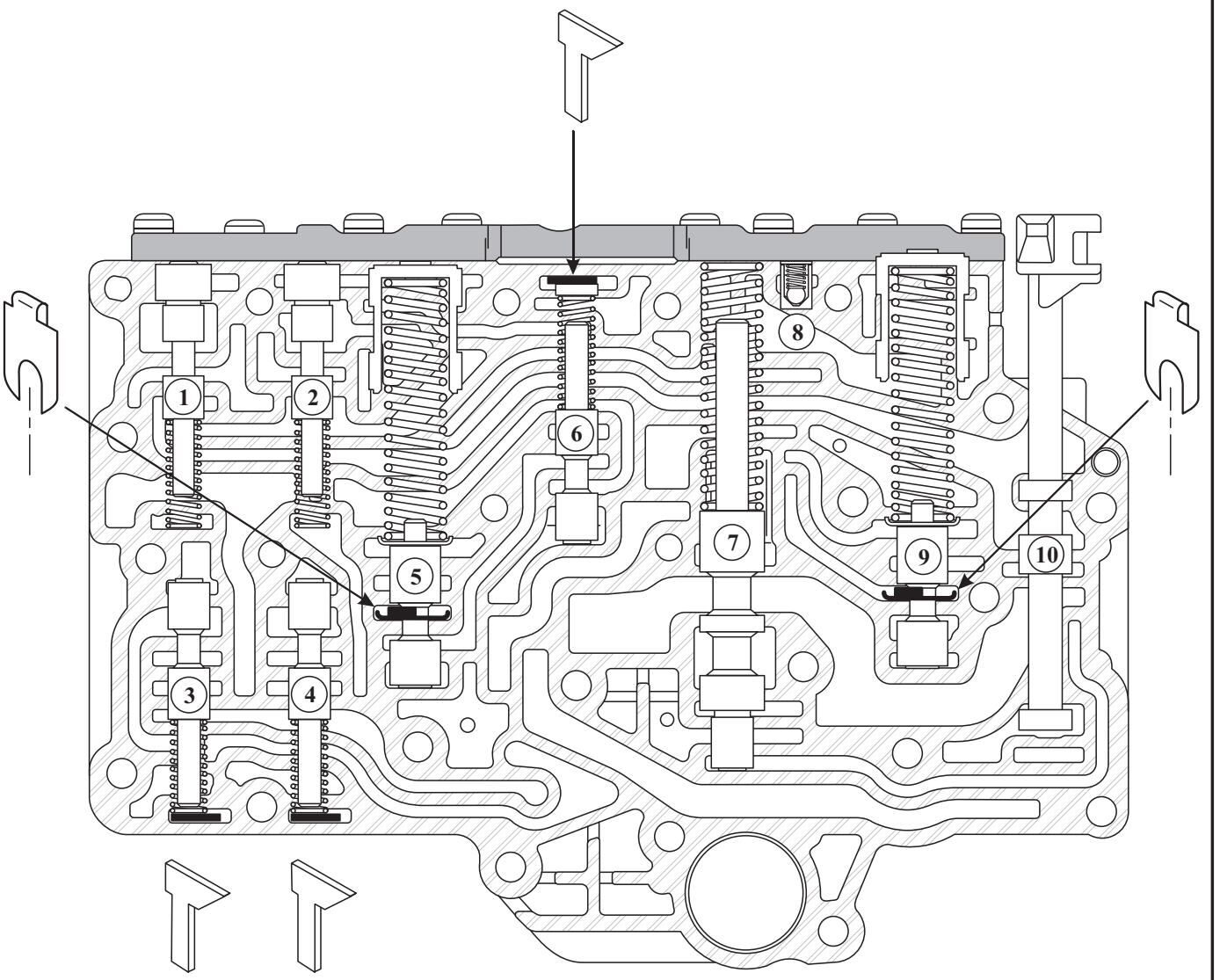
ZF-5HP-19FL
TRANSFER PLATE, SPACER PLATE, AND TURBINE SPEED SENSOR



109. Transfer Plate Assembly
110. Turbine Shaft Speed Sensor
111. Speed Sensor Spacers (2 Required)
112. Speed Sensor Retaining Bolts (2 Required)
113. Internal Wiring Harness Assembly
114. Internal Wire Harness Retaining Bracket
115. Spacer Plate To Transfer Plate Gasket
116. Valve Body Spacer Plate

Figure 91

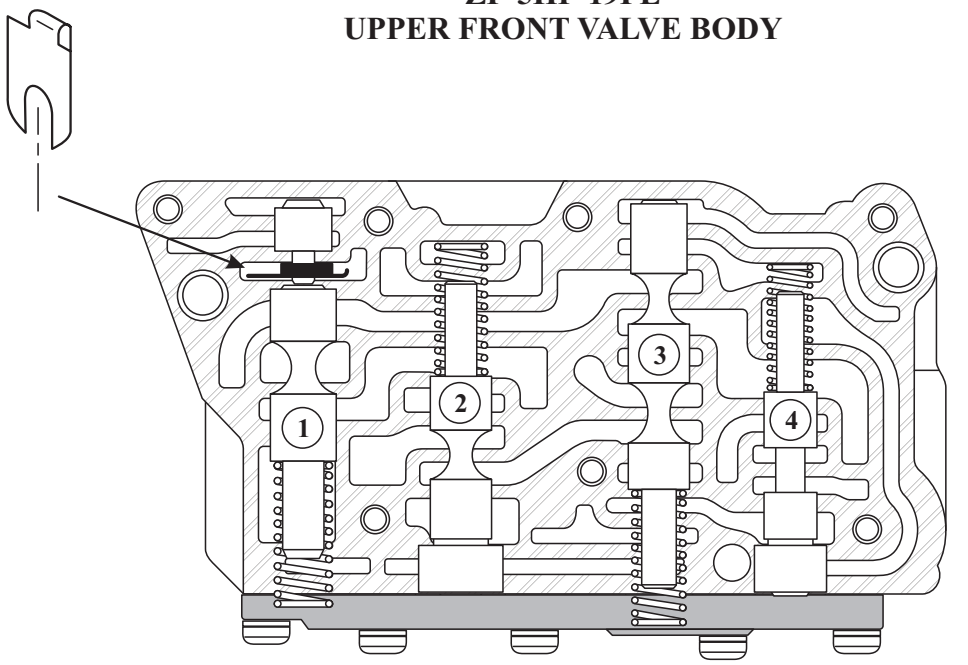
ZF-5HP-19FL
LOWER FRONT VALVE BODY



1. "C" CLUTCH ACCUMULATOR REGULATOR VALVE TRAIN LINE-UP.
2. "G" CLUTCH ACCUMULATOR REGULATOR VALVE TRAIN LINE-UP.
3. "C" CLUTCH SHIFT VALVE TRAIN LINE-UP.
4. "G" CLUTCH SHIFT VALVE TRAIN LINE-UP.
5. "A" CLUTCH ACCUMULATOR REGULATOR VALVE TRAIN LINE-UP.
6. 5-4 TRACTION VALVE TRAIN LINE-UP.
7. MAIN PRESSURE REGULATOR VALVE TRAIN LINE-UP.
8. "D" CLUTCH ONE-WAY CHECK VALVE ASSEMBLY.
9. "E" CLUTCH ACCUMULATOR REGULATOR VALVE TRAIN LINE-UP.
10. MANUAL SELECTOR SHIFT VALVE.

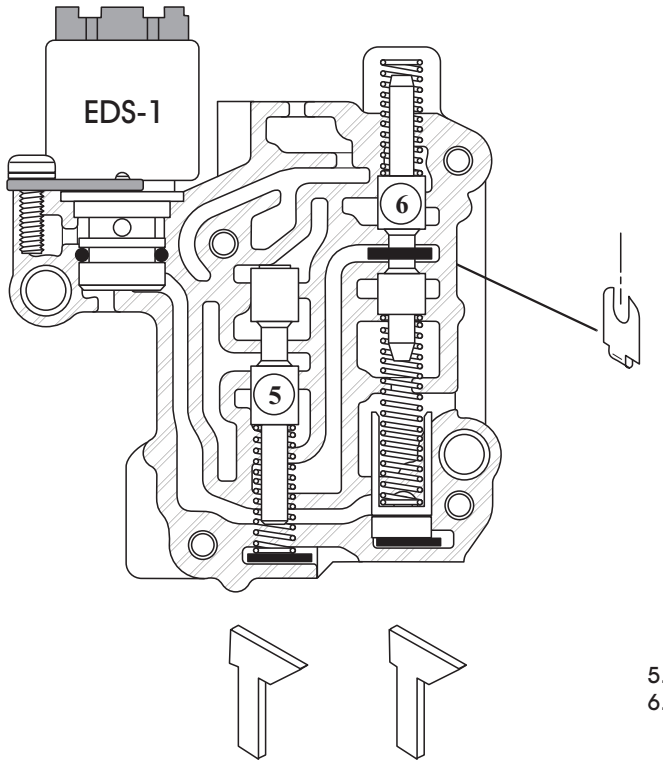
Figure 92

ZF-5HP-19FL
UPPER FRONT VALVE BODY



1. LUBRICATION VALVE TRAIN LINE-UP.
2. LOCK-UP CONTROL VALVE TRAIN LINE-UP.
3. LOCK-UP PRESSURE CONTROL VALVE LINE-UP.
4. 4-5 TRACTION VALVE TRAIN LINE-UP.

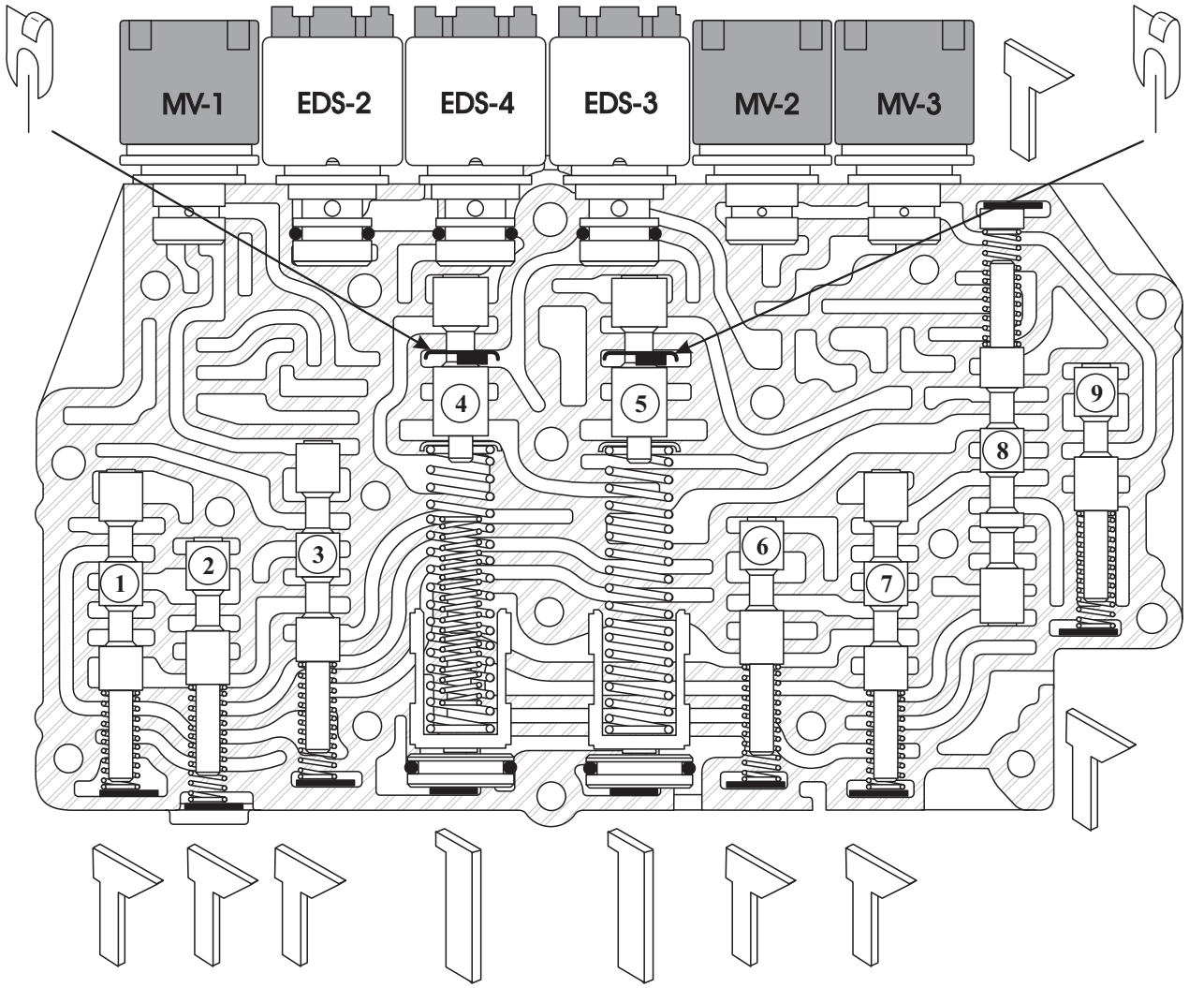
ZF-5HP-19FL
UPPER REAR VALVE BODY



5. MODULATION PRESSURE VALVE TRAIN LINE-UP.
6. PRESSURE REDUCTION VALVE NUMBER TWO LINE-UP.

Figure 93

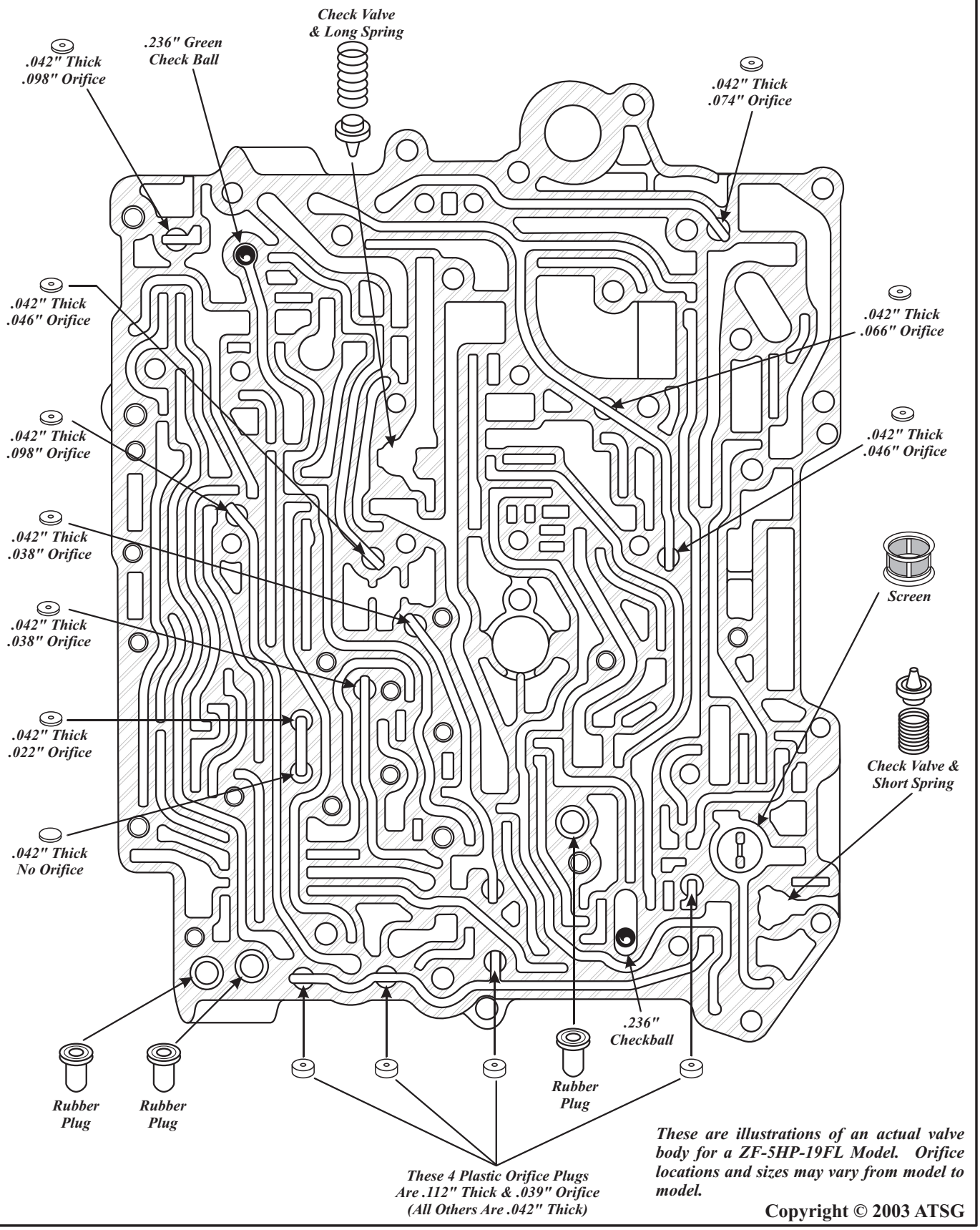
ZF-5HP-19FL
LOWER REAR VALVE BODY



1. TRACTION COAST VALVE TRAIN LINE-UP.
2. TCC RELEASE REGULATOR VALVE TRAIN LINE-UP.
3. NUMBER 3 SHIFT VALVE TRAIN LINE-UP.
4. "D" CLUTCH ACCUMULATOR REGULATOR VALVE TRAIN LINE-UP.
5. "F" CLUTCH ACCUMULATOR REGULATOR VALVE TRAIN LINE-UP.
6. REVERSE GEAR VALVE TRAIN LINE-UP.
7. NUMBER 2 SHIFT VALVE TRAIN LINE-UP.
8. NUMBER 1 SHIFT VALVE TRAIN LINE-UP.
9. PRESSURE REDUCTION VALVE TRAIN LINE-UP.

Figure 94

ZF-5HP-19FL CHANNEL PLATE LOCATIONS



These are illustrations of an actual valve body for a ZF-5HP-19FL Model. Orifice locations and sizes may vary from model to model.

Figure 95

ZF 5HP-19FL SPRING SPECIFICATIONS

UPPER FRONT VALVE BODY

SPRING ILLUSTRATION NO. 3:
FREE LENGTH = 1.540"
SPRING DIAMETER = .419"
WIRE DIAMETER = .048"

SPRING ILLUSTRATION NO. 4:
FREE LENGTH = 1.712"
SPRING DIAMETER = .423"
WIRE DIAMETER = .043"

SPRING ILLUSTRATION NO. 7:
FREE LENGTH = 2.090"
SPRING DIAMETER = .432"
WIRE DIAMETER = .035"

SPRING ILLUSTRATION NO. 8:
FREE LENGTH = 1.482"
SPRING DIAMETER = .367"
WIRE DIAMETER = .027"

UPPER REAR VALVE BODY

SPRING ILLUSTRATION NO. 13:
FREE LENGTH = 1.632"
SPRING DIAMETER = .300"
WIRE DIAMETER = .027"

SPRING ILLUSTRATION NO. 16:
FREE LENGTH = 1.462"
SPRING DIAMETER = .315"
WIRE DIAMETER = .046"

SPRING ILLUSTRATION NO. 21:
FREE LENGTH = 1.987"
SPRING DIAMETER = .375"
WIRE DIAMETER = .042"

LOWER FRONT VALVE BODY

SPRING ILLUSTRATION NO. 28:
FREE LENGTH = 3.438"
SPRING DIAMETER = .567"
WIRE DIAMETER = .038"

SPRING ILLUSTRATION NO. 32:
FREE LENGTH = 3.730"
SPRING DIAMETER = .606"
WIRE DIAMETER = .077"

SPRING ILLUSTRATION NO. 36:
FREE LENGTH = 1.702"
SPRING DIAMETER = .365"
WIRE DIAMETER = .031"

SPRING ILLUSTRATION NO. 40:
FREE LENGTH = 3.102"
SPRING DIAMETER = .590"
WIRE DIAMETER = .042"

SPRING ILLUSTRATION NO. 45 & 47:
FREE LENGTH = 1.430"
SPRING DIAMETER = .365"
WIRE DIAMETER = .031"

SPRING ILLUSTRATION NO. 50 & 53:
FREE LENGTH = 1.690"
SPRING DIAMETER = .375"
WIRE DIAMETER = .042"

Note: The spring illustration numbers refer to the ATSG illustrations in this manual.

Note: ZF is now working on a "Valve Body Kit" for the 5HP-19 that includes all new stock springs, all check balls, all orifices and screens, but was not ready at the time of this printing.

LOWER REAR VALVE BODY

SPRING ILLUSTRATION NO. 62:
FREE LENGTH = 1.825"
SPRING DIAMETER = .367"
WIRE DIAMETER = .031"

SPRING ILLUSTRATION 74:
FREE LENGTH = 1.832"
SPRING DIAMETER = .367"
WIRE DIAMETER = .031"

SPRING ILLUSTRATION NO. 77:
FREE LENGTH = 1.439"
SPRING DIAMETER = .365"
WIRE DIAMETER = .031"

SPRING ILLUSTRATION NO. 80:
FREE LENGTH = 1.832"
SPRING DIAMETER = .367"
WIRE DIAMETER = .031"

SPRING ILLUSTRATION NO. 86:
FREE LENGTH = 2.925"
SPRING DIAMETER = .640"
WIRE DIAMETER = .049"

SPRING ILLUSTRATION NO. 87:
FREE LENGTH = 1.595"
SPRING DIAMETER = .422"
WIRE DIAMETER = .035"

SPRING ILLUSTRATION NO. 95:
FREE LENGTH = 3.818"
SPRING DIAMETER = .590"
WIRE DIAMETER = .044"

SPRING ILLUSTRATION NO. 101:
FREE LENGTH = 1.825"
SPRING DIAMETER = .367"
WIRE DIAMETER = .031"

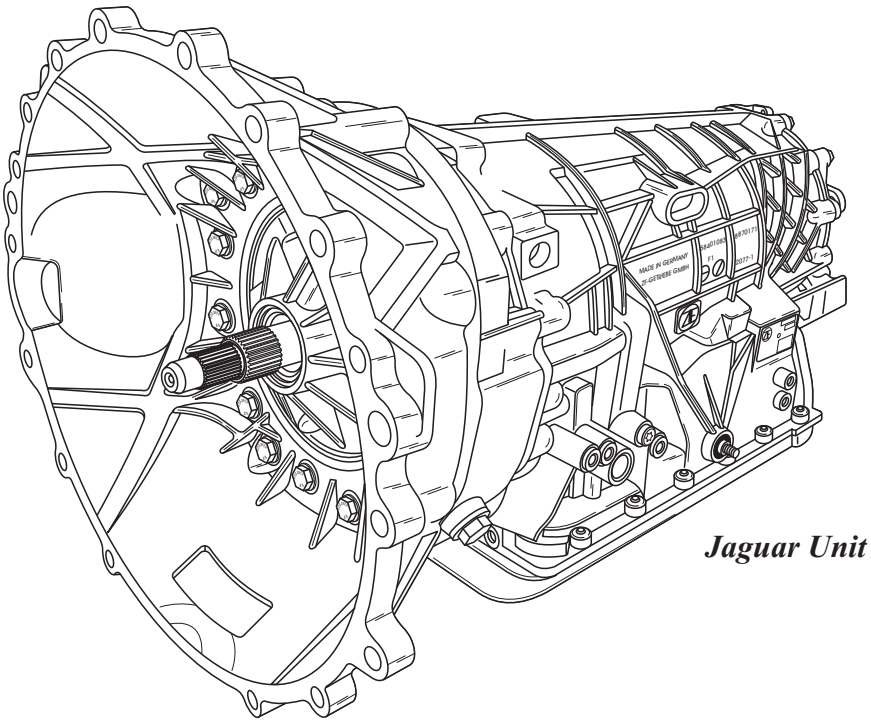
SPRING ILLUSTRATION NO. 104:
FREE LENGTH = 1.825"
SPRING DIAMETER = .367"

SPRING ILLUSTRATION NO. 107:
FREE LENGTH = 1.506"
SPRING DIAMETER = .381"
WIRE DIAMETER = .043"

Figure 96

ZF-5HP-24
DIAGNOSTIC INFORMATION

FOUND IN:
BMW 5 Series E39, 7 Series E38, 8 Series E31 ..... 95-Current
Jaguar XK8 (X100), ... 96-Current
Jaguar XJ8 (X300), ... 97-Current
Audi A8 (All Wheel Drive 5HP-24A) 96-Current



Jaguar Unit Shown

This transmission is manufactured in Germany by ZF and carries the BMW designation A5S 440Z.

The A5S 440Z is an electronically controlled, five speed automatic transmission with a lock-up clutch type torque converter. Three planetary gear sets (Wilson Gearing), three rotating multiple disc clutches, three multiple disc brake clutches, and one sprag clutch (Freewheel) are used to provide the five forward speeds and reverse.

Key to designation:

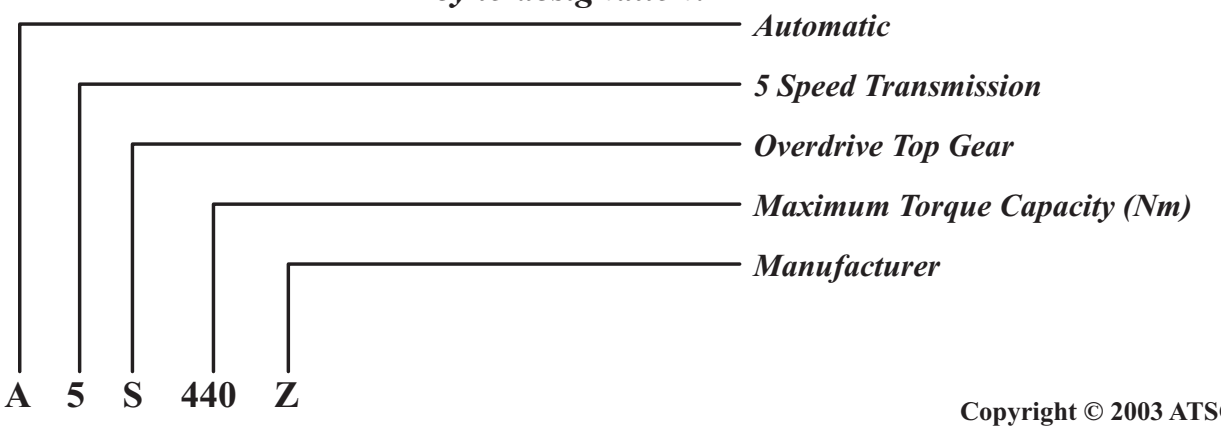


Figure 97

Refer to Figure 98 for Clutch and Band Application Chart.

Refer to Figure 99 for Manual Shift Lever Operation, and Failsafe Operation.

Refer to Figures 100, and 101 for Solenoid identification and both MV Solenoid Operation and EDS Solenoid Operation and Tests.

Refer to Figure 102 for wiring harness identification, internal wiring schematic, and transmission case connector pin identification and functions.

Refer to Figure 103 for Shift Solenoid Application chart. Notice that EDS 1 Solenoid is used for line pressure control, and MV-4 is used for converter clutch.

Refer to Figure 104 for EDS Solenoid "Principles of Operation", as some are normally open and some are normally closed.

Refer to Figure 105 for internal components resistance chart, with the pins identified for both the transmission case connector and the Electronic Control Unit.

Refer to Figure 106 for Upper Valve Body exploded view and identification of valves.

Refer to Figure 107 for Lower Front Valve Body exploded view and identification of valves.

Refer to Figure 108 for Lower Rear Valve Body exploded view and identification of valves.

Refer to Figures 109, 110, and 111 for valve body retainer locations in the various valve bodies.

Refer to Figure 112 for Channel Plate screen location on the upper side.

Refer to Figure 113 for the locations of the orifices, checkballs, screens, and the check valves and springs that are located in the channel plate.

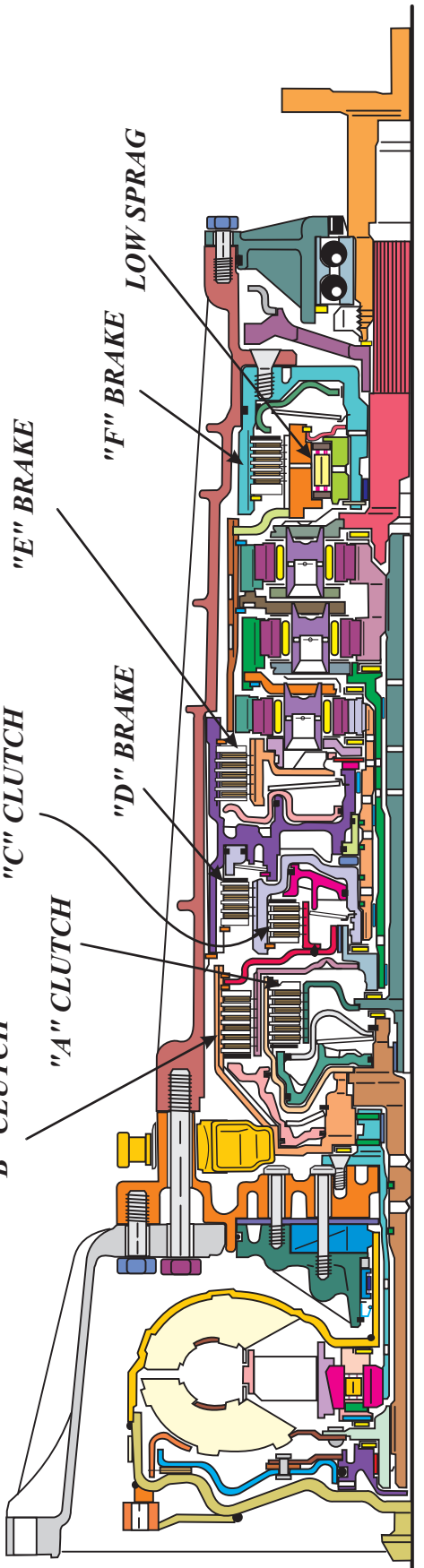
Refer to Figure 114 for external pressure tap locations in the main case.

Refer to Figure 115 for Pump Volume Control Valve location, in the pump cover.

Refer to Figure 116 for explanation of Pump Volume Control Valve operation.

Refer to Figure 119 for all valve body spring specifications, as observed in a used valve body.

ZF-5HP-24 INTERNAL COMPONENT APPLICATION CHART



APPLICATION CHART

GEAR	"A" CLUT	"B" CLUT	"C" CLUT	"D" BRAK	"E" BRAK	"F" BRAK	LOW SPRAG	GEAR RATIO
PARK						ON		
REV			ON			ON		4.10:1
NEUT						ON		
D-1ST	ON						HOLD	3.57:1
D-2ND	ON				ON			2.20:1
D-3RD	ON			ON				1.51:1
D-4TH	ON	ON						1.00:1
D-5TH		ON		ON				0.80:1
M-1	ON					ON	HOLD	3.57:1

Figure 98

SELECTOR LEVER POSITIONS

P = ***Park,*** and should only be selected when the vehicle is at a standstill. First apply the hand brake, and then select the Park position with the manual lever. Refer to Figure 99.

R = ***Reverse,*** and should only be selected when the vehicle is at a standstill with engine at idle. Refer to Figure 99.

N = ***Neutral,*** and may be selected when the vehicle is at a standstill, but first applying the handbrake. May also be selected while vehicle is moving, to restart the engine or to counteract a skidding concern. Refer to Figure 99.

D = ***Drive,*** is the standard position for normal driving in the XE program (AGS) and provides automatic upshifts from 1st to 5th and automatic downshifts from 5th to 1st gear. The adaptive transmission control (AGS) system contains various driving programs such as Stop and Go, Trailer Towing, Mountain Driving, City Driving and Highway Driving (constant speed). These programs are selected by the Electronic Control Unit (ECU), which automatically modifies the transmissions shift characteristics according to rolling resistance, engine load, accelerator pedal movement and vehicle speed. The standard "Drive" position is position "1", as shown in Figure 99.

"S" - Program

The "S" Program is a performance oriented program, where the gear changing characteristics of the transmission are moved up to higher engine speeds. To select the "S" Program, the selector lever is shifted to the left-hand gate (position "2" in Figure 99), without moving shift lever towards plus or minus. The "S" Program provides automatic upshifts from 1st to 4th and automatic downshifts from 4th to 1st gear. 5th gear is inhibited when the "S" Program is selected.

"M" - Program

The "M" Program is a manual shift program which is activated by simply pushing the selector lever towards the minus sign for sequential downshifts and towards the plus sign for sequential upshifts, while the shift lever is in the left-hand gate (position "2" in Figure 99). It is possible to drive off in 1st gear, 2nd gear or 3rd gear, however, 4th gear can be manually selected only at a speed of approximately 40 km per hour and 5th gear at approximately 60 km per hour.

4th Gear, Select this position if the transmission tends to hunt between 5th-4th/4th-5th gears under certain driving conditions.

3rd Gear, Select this position if the transmission tends to hunt between 3rd and 5th gears under certain driving conditions. Also recommended for lengthy descents in mountainous areas.

2nd Gear, Select this position when driving over mountain passes with lengthy ascents and descents.

1st Gear, This position can be selected for engine braking effect, depending on vehicle speed.

Typical BMW Shift Lever

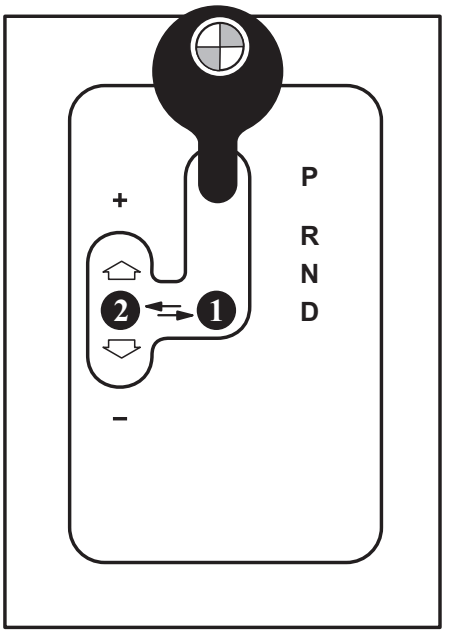


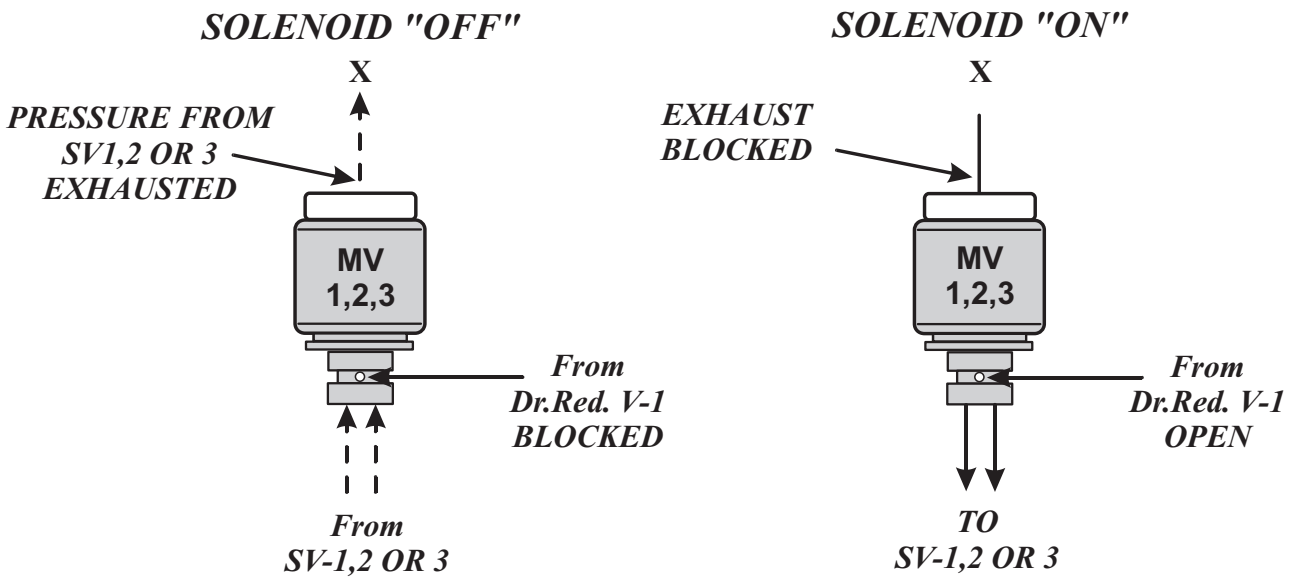
Figure 99

FAILSAFE OPERATION:

When a system fault is detected which would impair normal reliable operation, the transmission control module interrupts the power supply to Pin 12 at the transmission case connector. The transmission control module also alerts the driver of any faults by signaling the vehicle's "check control" system. To enable the vehicle to be driven to a repair shop, the following manual gear selections are permitted:

Selector Lever Position	**P R N D 4 3 2**
Actual Gear Obtained	**P R N 5 5 5 5**

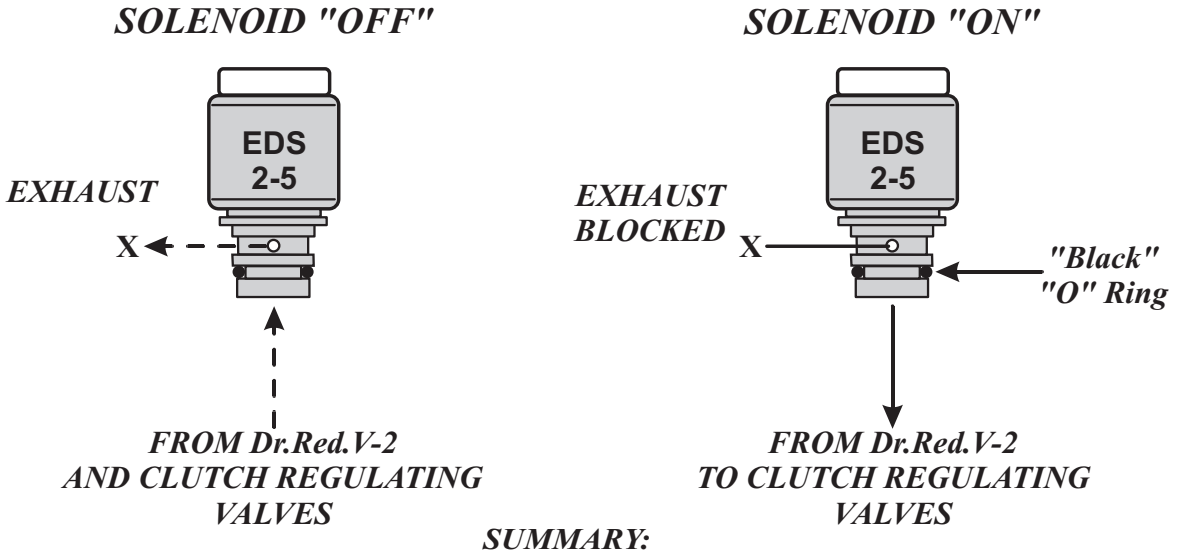
MV1, 2 AND 3



SUMMARY:

When MV 1, 2 or 3 is "OFF" Solenoid reducing pressure, from Dr.Red. V-1, is blocked by the solenoid and oil pressure from SV 1, 2 or 3 is exhausted at the rear of the solenoid.
When MV 1, 2 or 3 is "ON" Solenoid reducing pressure, From Dr.Red. V-1, is open through the solenoid and is applied to SV 1, 2 or 3. The exhaust at the rear of the solenoid is closed.

EDS 2, 3, 4, 5,

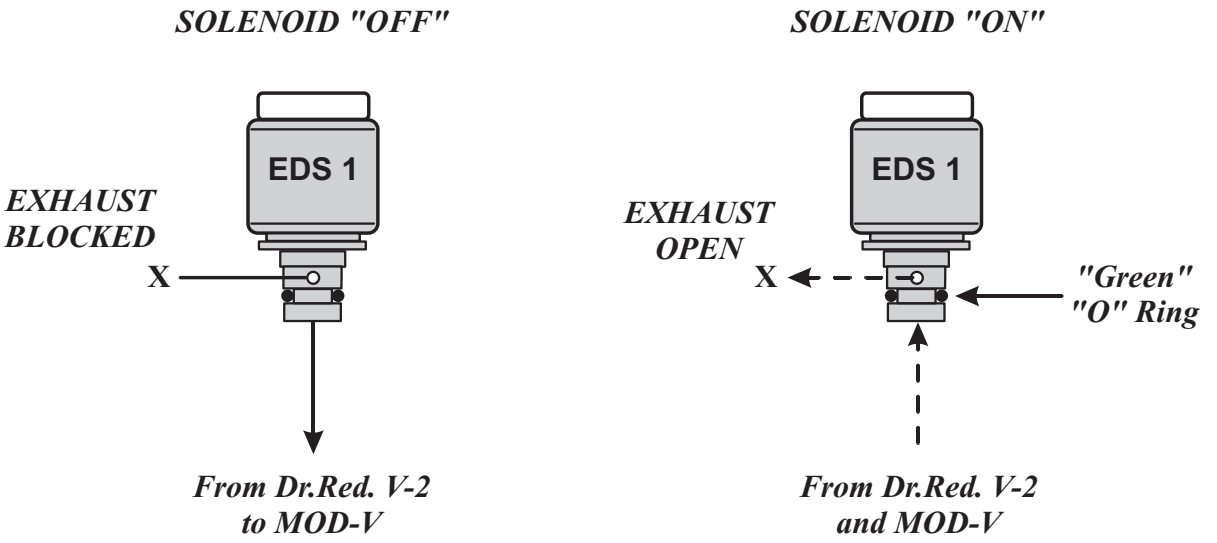


SUMMARY:

When EDS 2 thru 5 solenoids are "OFF" they exhaust orificed solenoid reducing pressure, from Dr. Red. V-2, and the oil pressure from the clutch regulating valves releasing them.
When EDS 2 thru 5 solenoids are "ON" the exhaust is blocked by the solenoid and solenoid reducing pressure, from Dr. Red. V-2, is applied to operate clutch regulating valves.

Figure 100

EDS 1 *(Line Pressure)*

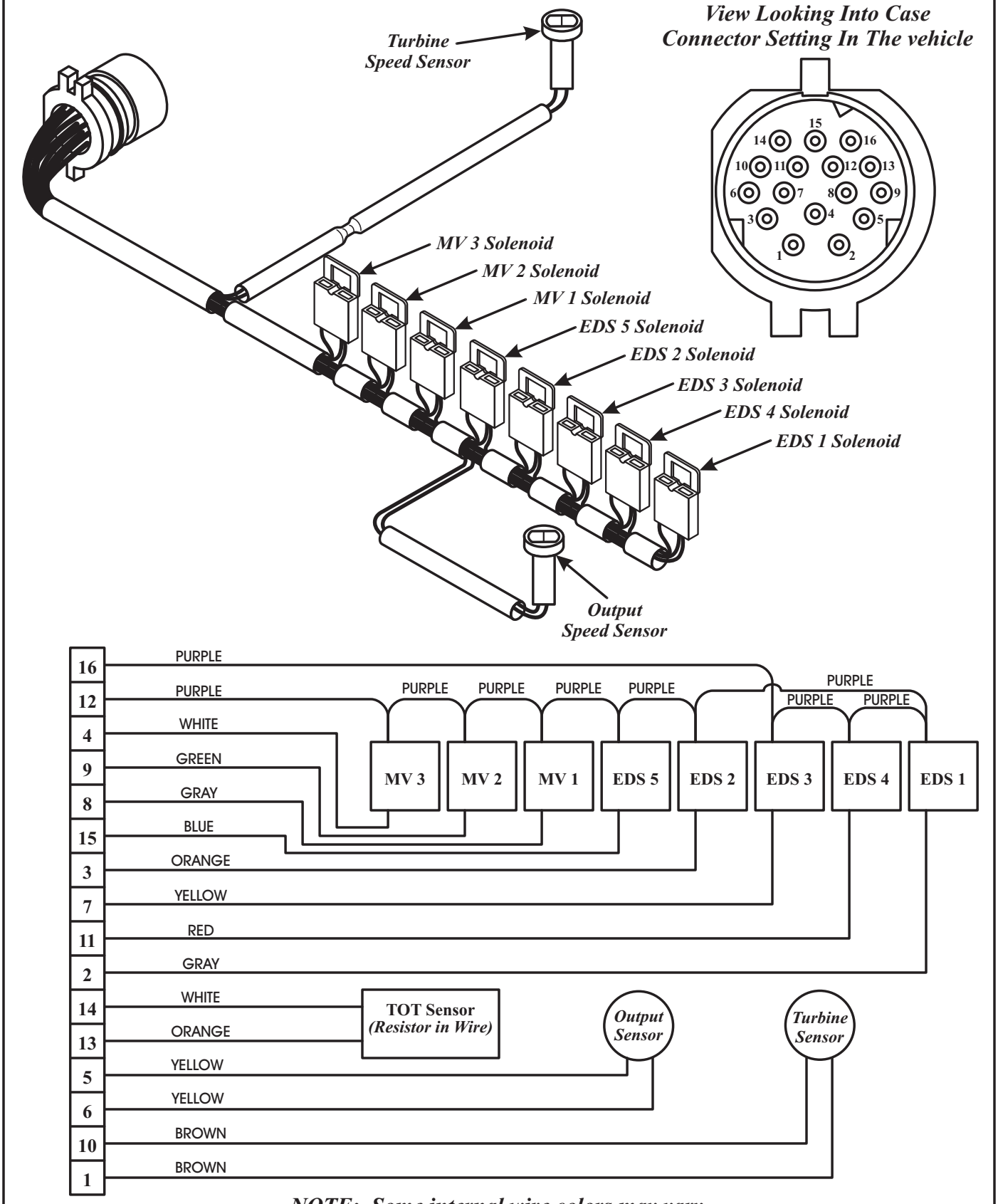


SUMMARY:

When EDS 1 solenoid is "OFF," solenoid reducing pressure, from Dr. Red. V-2, is high to MOD-V valve which creates high line pressure.
When EDS 1 solenoid is "ON," solenoid reducing pressure, from Dr. Red. V-2, is low to

Figure 101

ZF-5HP-24 INTERNAL WIRE SCHEMATIC



NOTE: Some internal wire colors may vary.

Figure 102

ZF-5HP-24 SOLENOID APPLICATION CHART

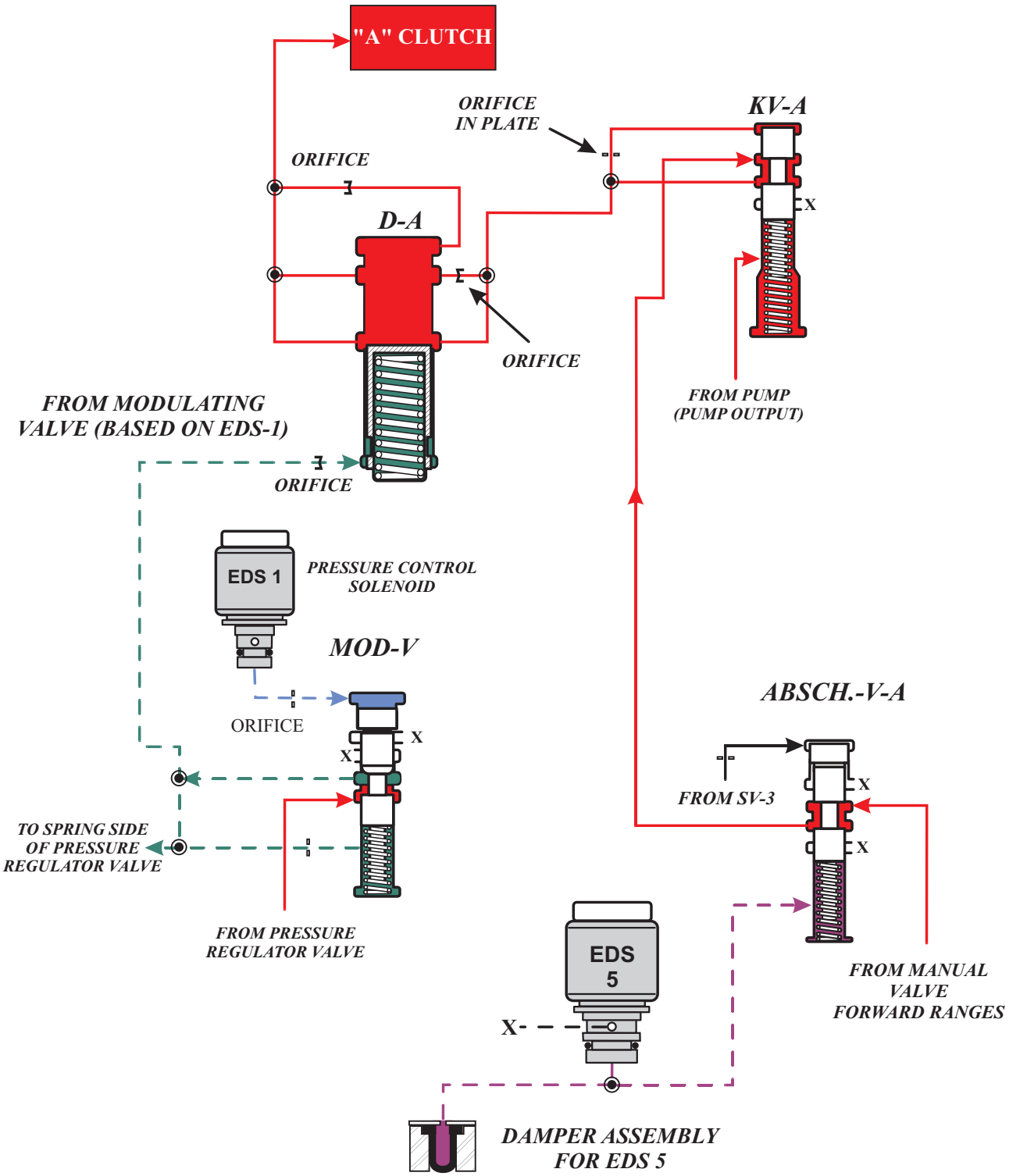
Selector Lever Position	*MV 1 Solenoid*	*MV 2 Solenoid*	*MV 3 Solenoid*	*EDS 1 Solenoid*	*EDS 2 Solenoid*	*EDS 3 Solenoid*	*EDS 4 Solenoid*	*EDS 5 Solenoid*	GEAR RATIO
PARK	ON		ON	**	-*	*		-*	
REVERSE		ON	⊛	**	*-	*		*-	4.10:1
NEUTRAL	ON		ON	**	-*	*		-*	
D-1ST	ON			**	*-	*		*-	3.57:1
D-2ND	ON	ON		**		*		*	2.20:1
D-3RD		ON		**		*			1.51:1
D-4TH		ON		**			-*-		1.00:1
D-5TH				**			-*-		0.80:1
D-5TH "TCC"				**			*		0.80:1

SOLENOID CHART LEGEND

Symbol	*Description*
ON	*MV 1, MV 2 and MV 3 Solenoids are energized by the Electronic Transmission Control unit and have two functions. They are Open or Closed. Energized (On), there is pressure in circuit.*
⊛	*MV 3 is turned "ON" if reverse is selected at a high vehicle speed, to inhibit reverse engagement.*
**	*EDS 1 is used for line pressure control only, and operates from 0 to 0.8 amps. When the solenoid is "OFF" (0 amps), pressure is high. EDS 1 pressure is "Lowered" as the solenoid is modulated by the control unit.*
*	*EDS 2, EDS 3, EDS 4 and EDS 5 Solenoids are also pulse modulated but are exactly the opposite of EDS 1 Solenoid. When these solenoids are "ON" oil pressure in the hydraulic circuit is high, and when they are "OFF" pressure in the hydraulic circuit is low.*
-*	*Solenoid "OFF" (hydraulic pressure low), then Solenoid "ON" (hydraulic pressure high).*
*-	*Solenoid "ON" briefly (hydraulic pressure high), then Solenoid "OFF" (hydraulic pressure low). The pressure acts briefly on regulator valves to cushion clutch application.*
-*-	*EDS 4 Solenoid is used for Torque Converter Clutch apply and release only, and depends on throttle position and vehicle speed as to its application.*

Figure 103

EDS-5 SOLENOID OPERATION



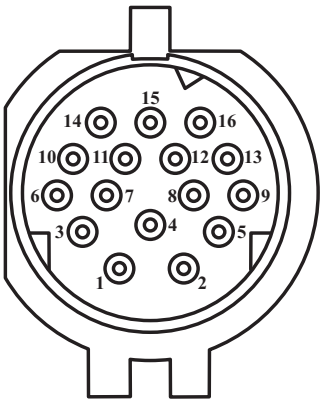
EDS 5 is used to prevent the ABSCH.-V-A, which is the switch valve for the A clutch, from stroking against its spring. Its use is mainly for forward engagement and a 5-4 downshift.

Figure 104

SOLENOID AND SENSOR RESISTANCE CHART

Solenoid	*Case Connector Pin Numbers* (− +)	*Resistance In Ohms*
MV 1	*8 and 12*	*30 - 34 Ω*
MV 2	*9 and 12*	*30 - 34 Ω*
MV 3	*4 and 12*	*30 - 34 Ω*
EDS 1	*2 and 12*	*5.2 - 6.8 Ω*
EDS 2	*3 and 12*	*6.2 - 7.8 Ω*
EDS 3	*7 and 12*	*6.2 - 7.8 Ω*
EDS 4	*11 and 12*	*6.2 - 7.8 Ω*
EDS 5	*15 and 12*	*6.2 - 7.8 Ω*
TOT	*13 and 14*	*1000 Ω at 25° C*
TSS	*1 and 10*	*292 - 358 Ω*
OSS	*5 and 6*	*292 - 358 Ω*

View Looking Into Case
Connector Setting In The vehicle



Electronic Control Unit Connector Pin Identification

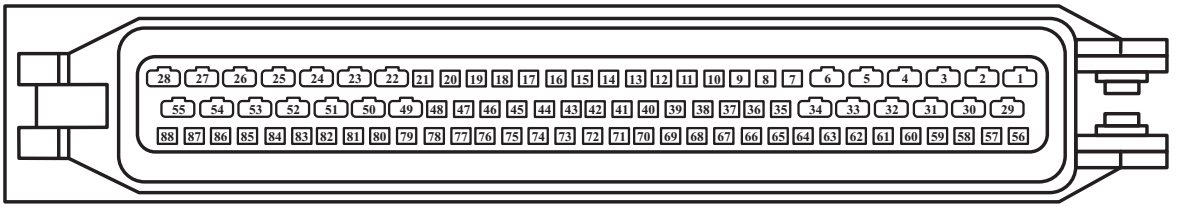
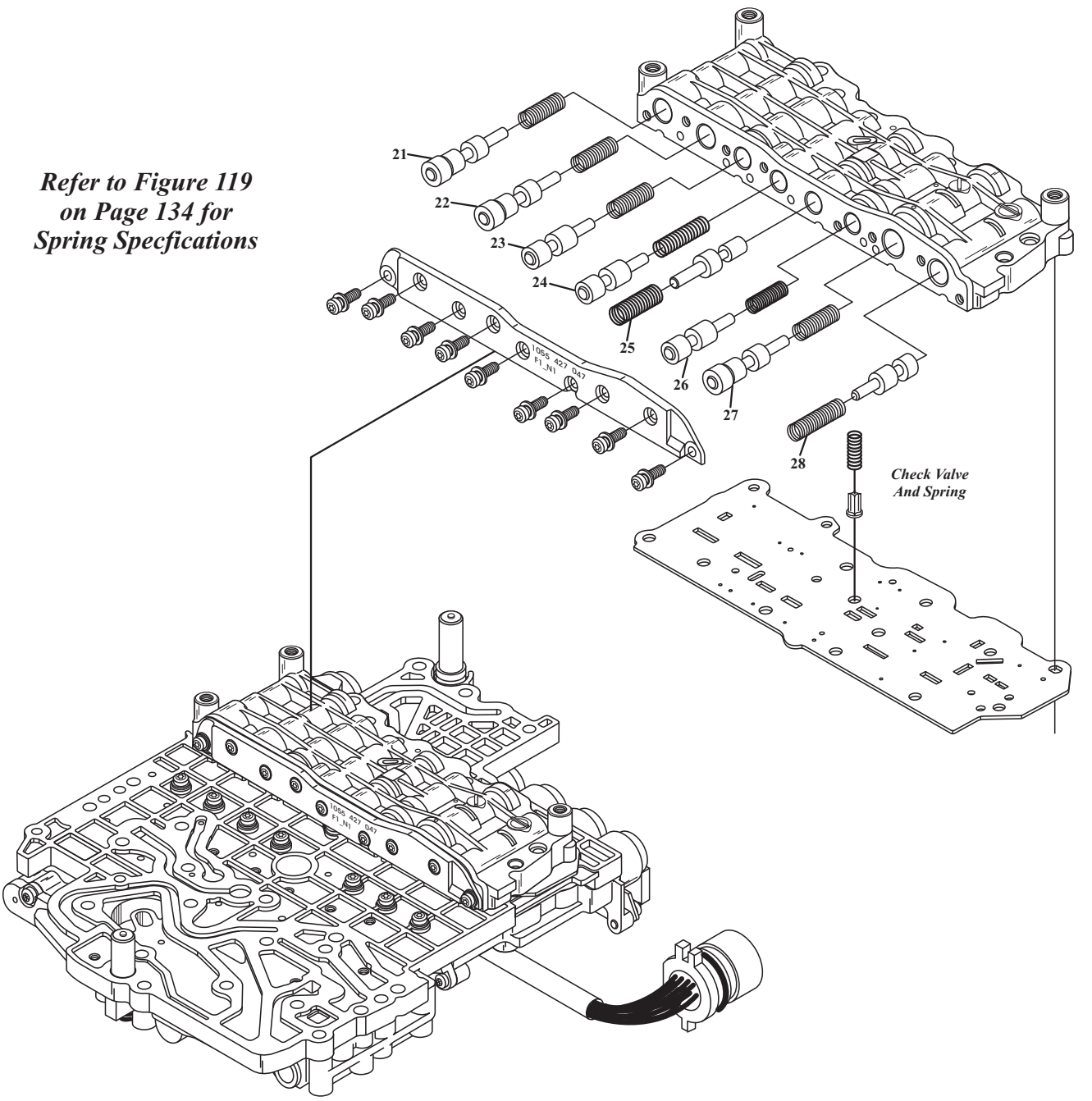


Figure 105

INDEX

ZF-5HP-24 UPPER VALVE BODY

Refer to Figure 119 on Page 134 for Spring Specfications



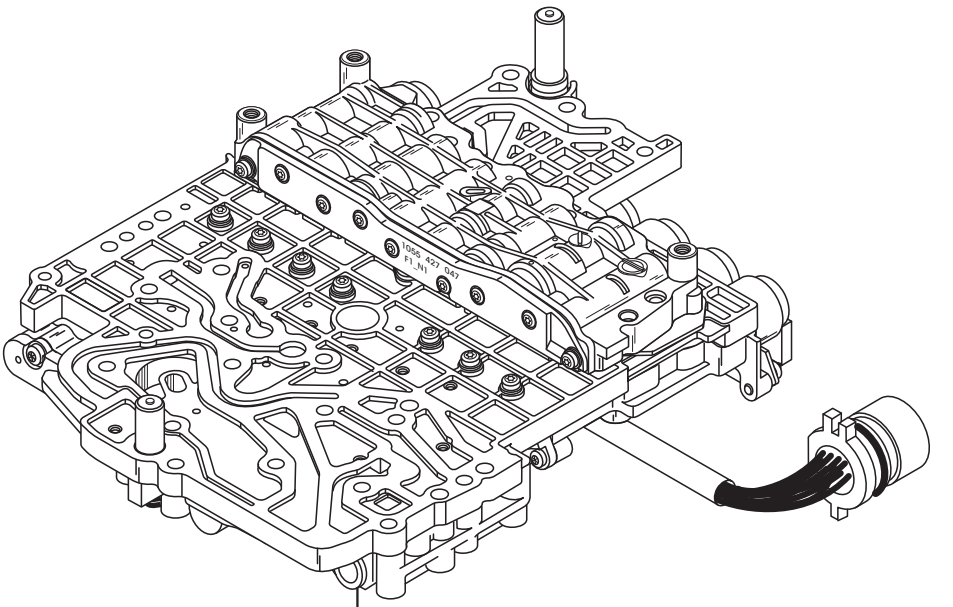
21. Clutch Valve "F" Line-Up (KV-F).
22. Clutch Valve "E" Line-Up KV-E).
23. Pressure Reducing Valve 1 (DR-V1).
24. Pressure Reducing Valve 2 (DR-V2).
25. Clutch Valve "B" Line-Up (KV-B).
26. Holding Valve "E" Line-Up (HV-E).
27. Switch Valve For "A" Clutch (ABSCH-V-A).

Figure 106

INDEX

ZF-5HP-24 LOWER FRONT VALVE BODY

Refer to Figure 119 on Page 134 for Spring Specfications



9. Manual Shift Valve (W-S).
10. Converter Clutch Apply Oil Control Valve (WK-V).
11. Converter Clutch Release Oil Control Valve (WD-V).
12. Main Pressure Regulator Valve Line-Up (HD-V).
13. Lubrication Valve (SCHM-V)
14. Modulating Valve Line-Up (MOD-V).
15. Holding Valve For "B" Clutch (HV-B).
16. Accumulator Valve For EDS 2 Solenoid (D-2).
17. Holding Valve For "D" Clutch (HV-D).
18. Accumulator Valve For EDS 4 Solenoid (D-4).
19. Accumulator Valve For EDS 3 Solenoid (D-3).

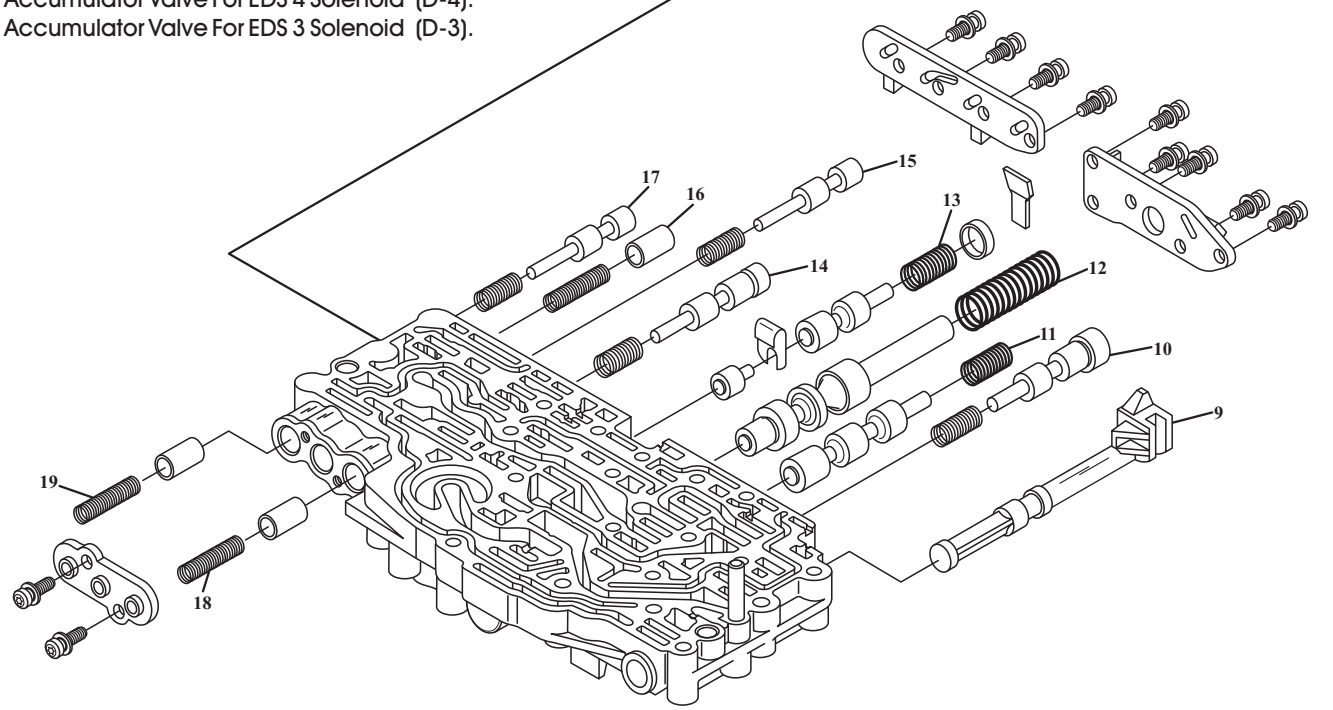
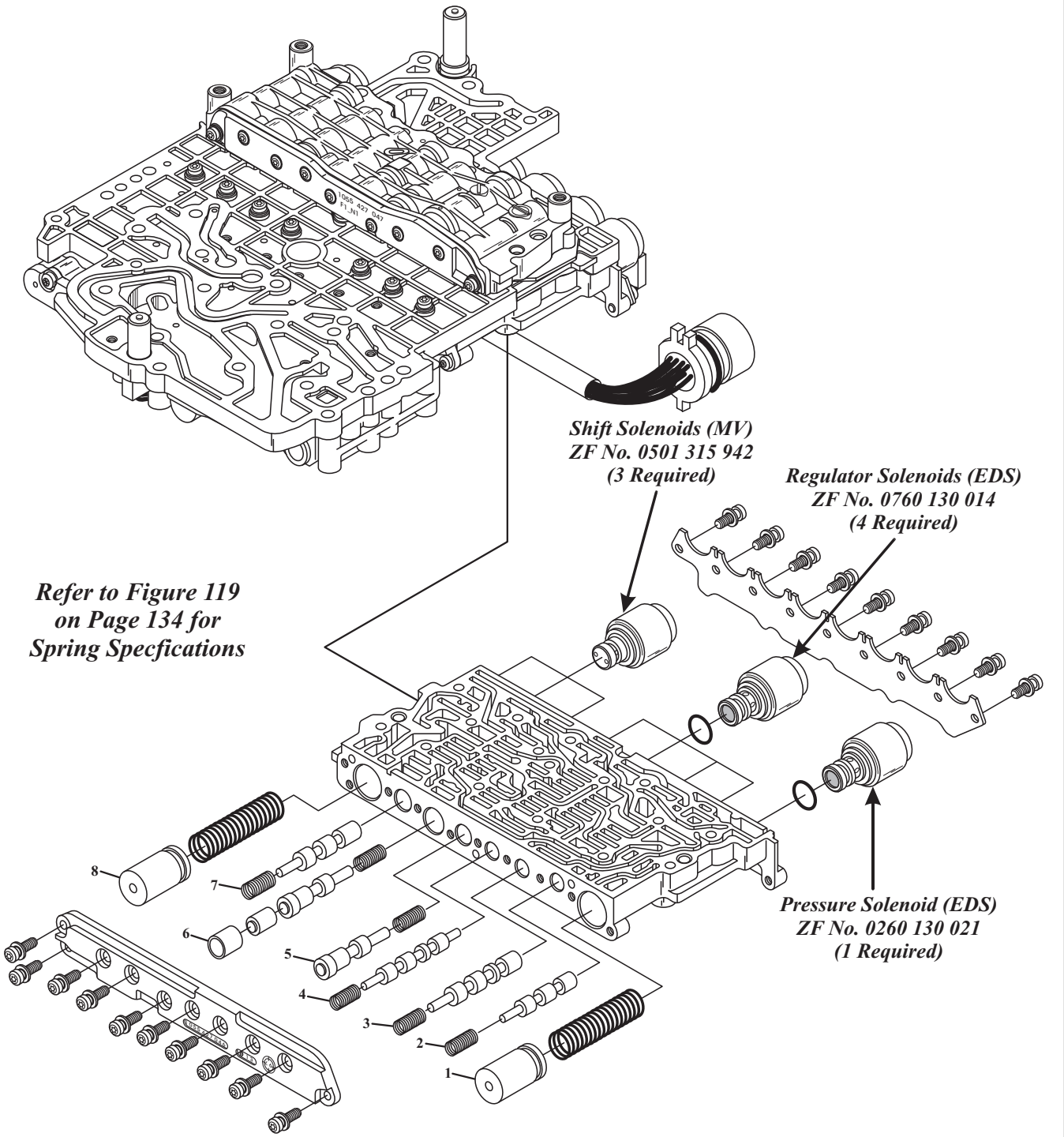


Figure 107

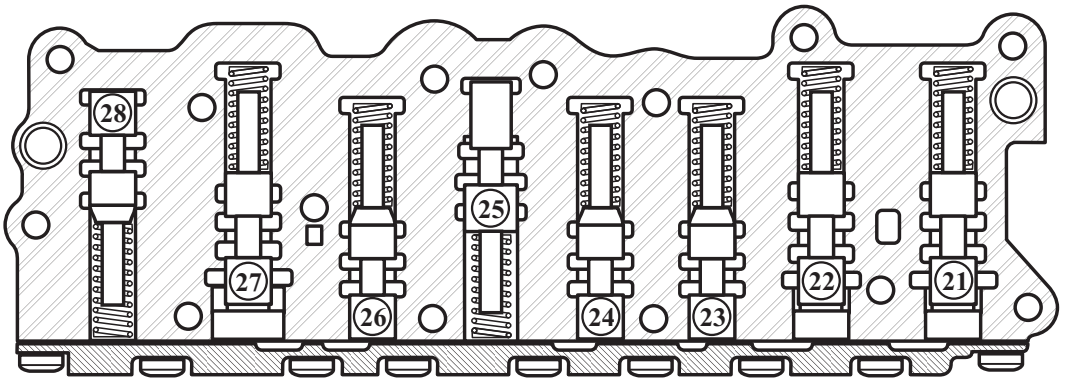
ZF-5HP-24 LOWER REAR VALVE BODY



1. "A" Clutch Accumulator Line-Up (D-A).
2. Shift Valve Number 1 (SV-1).
3. Shift Valve Number 2 (SV-2).
4. Shift Valve Number 3 (SV-3).
5. Switch Valve For "D" Clutch (ABSCH-V-D).
6. Clutch Valve "D" Line-Up (KV-D).
7. Reverse Gear Valve Line-Up (RG-V).

Figure 108

ZF 5HP-24 UPPER VALVE BODY



21. Clutch Valve "F" Line-Up (KV-F).
22. Clutch Valve "E" Line-Up KV-E).
23. Pressure Reducing Valve 1 (DR-V1).
24. Pressure Reducing Valve 2 (DR-V2).
25. Clutch Valve "B" Line-Up (KV-B).
26. Holding Valve "E" Line-Up (HV-E).
27. Switch Valve For "A" Clutch (ABSCH-V-A).

Refer to Figure 119 on Page 134 for Spring Specfications

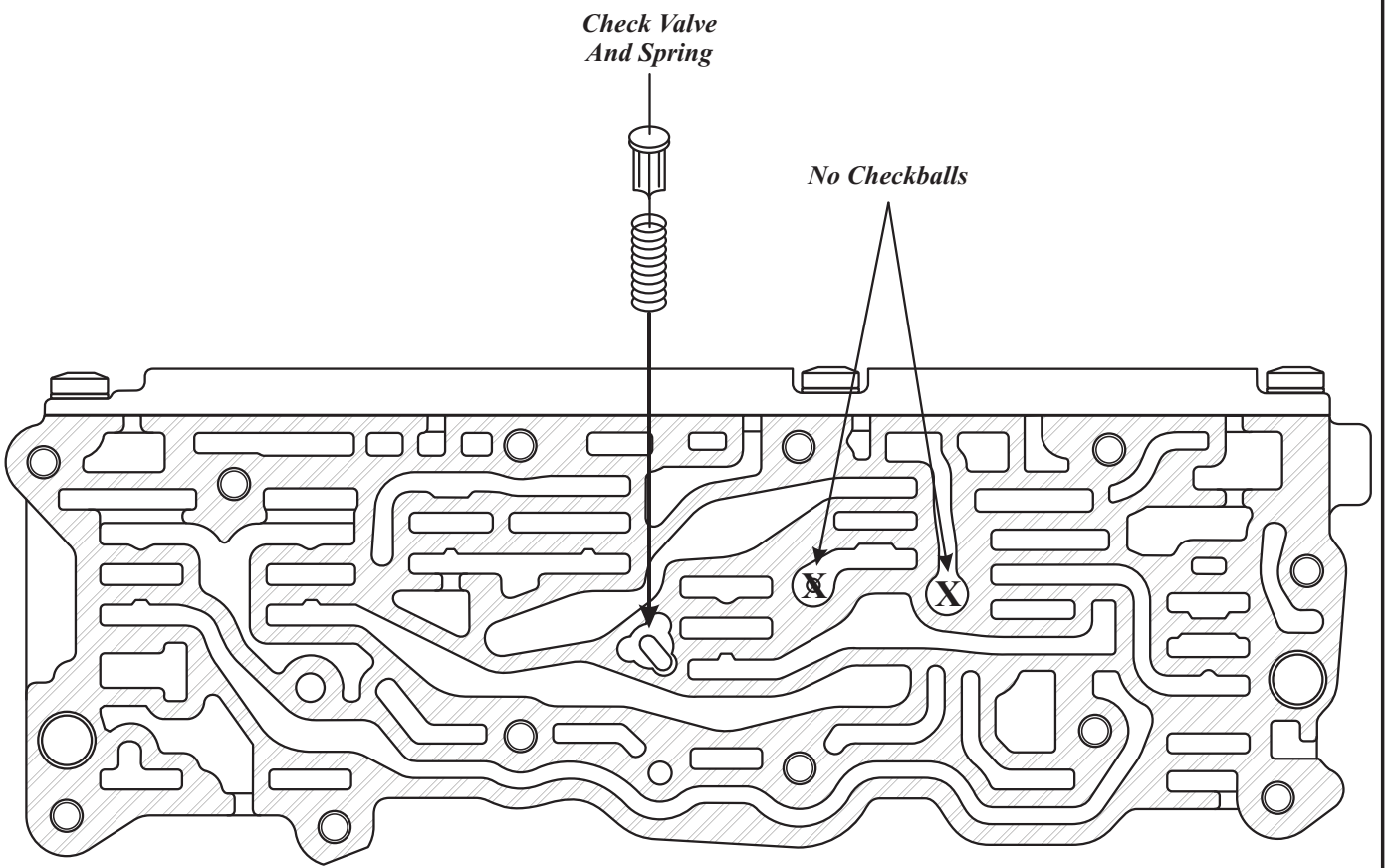


Figure 109

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ZF 5HP-24 LOWER FRONT VALVE BODY

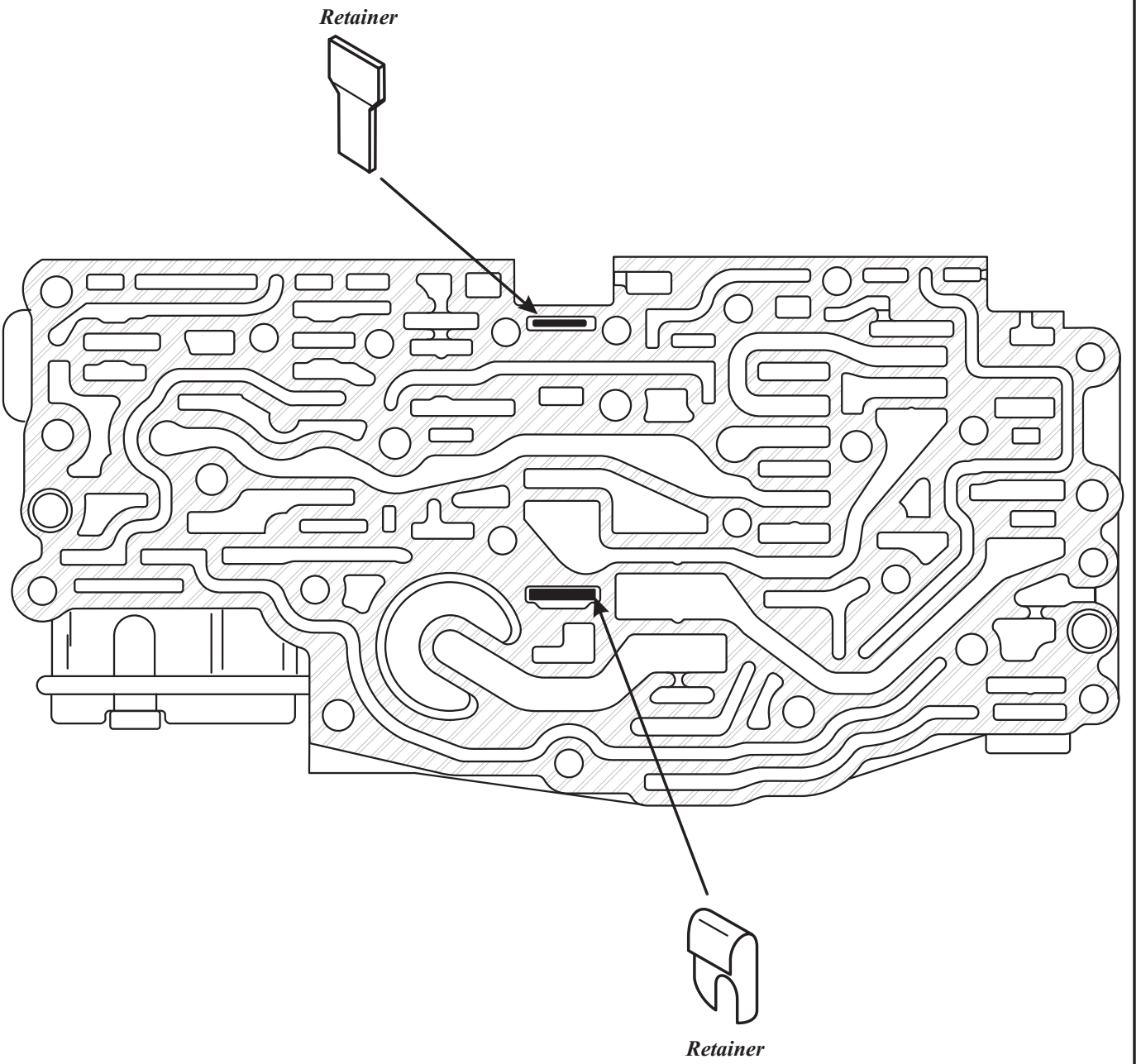
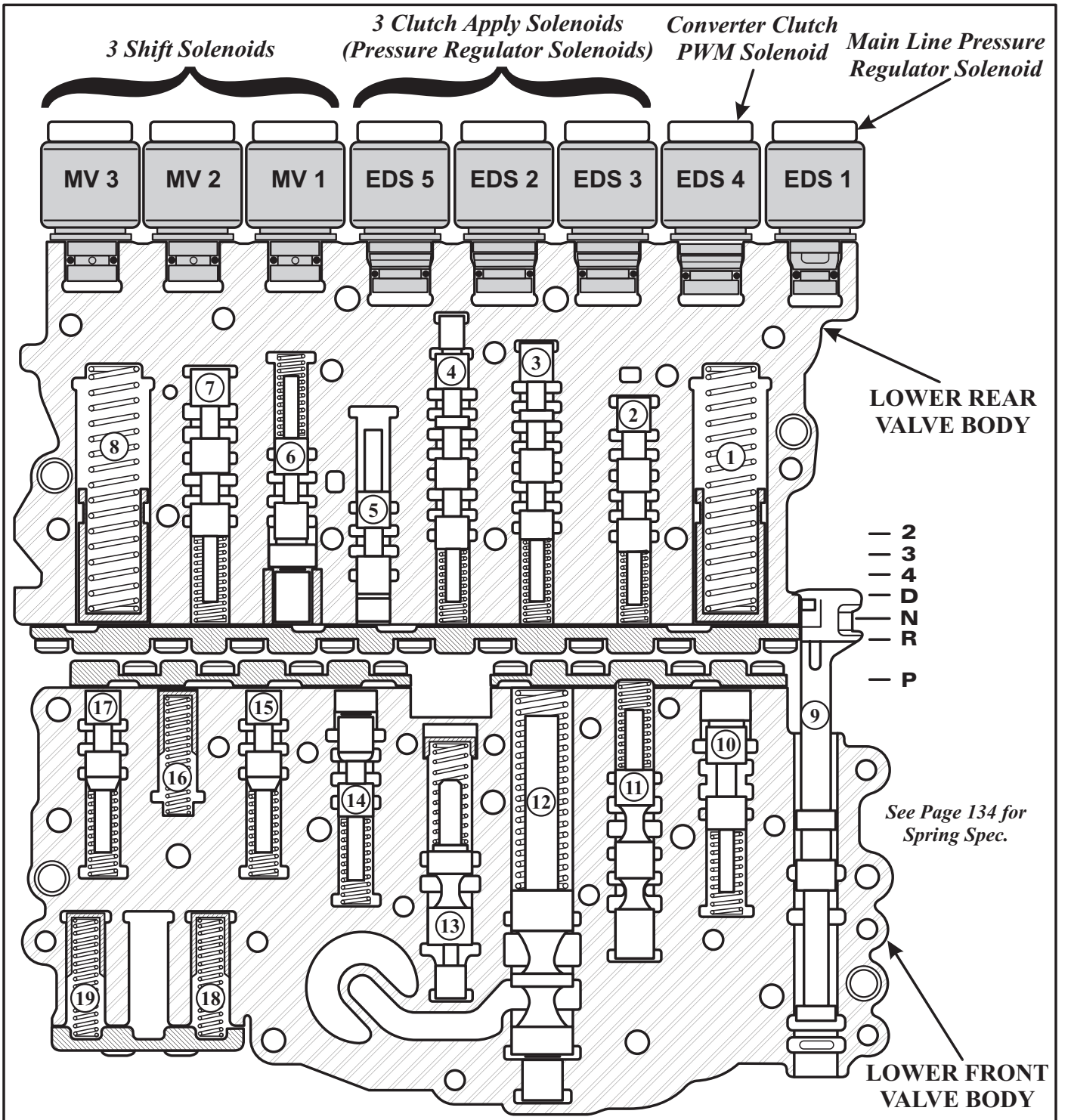


Figure 110



1. "A" Clutch Accumulator Line-Up (D-A).
2. Shift Valve Number 1 (SV-1).
3. Shift Valve Number 2 (SV-2).
4. Shift Valve Number 3 (SV-3).
5. Switch Valve For "D" Clutch (ABSCH-V-D).
6. Clutch Valve "D" Line-Up (KV-D).
7. Reverse Gear Valve Line-Up (RG-V).
8. "C" Clutch Accumulator Line-Up (D-C).
9. Manual Shift Valve (W-S).
10. Converter Clutch Apply Oil Control Valve (WK-V).
11. Converter Clutch Release Oil Control Valve (WD-V).
12. Main Pressure Regulator Valve Line-Up (HD-V).
13. Lubrication Valve (SCHM-V)
14. Modulating Valve Line-Up (MOD-V).
15. Holding Valve For "B" Clutch (HV-B).
16. Accumulator Valve For EDS 2 Solenoid (D-2).
17. Holding Valve For "D" Clutch (HV-D).
18. Accumulator Valve For EDS 4 Solenoid (D-4).
19. Accumulator Valve For EDS 3 Solenoid (D-3).

Figure 111

ZF 5HP-24 CHANNEL PLATE "UPPER SIDE"

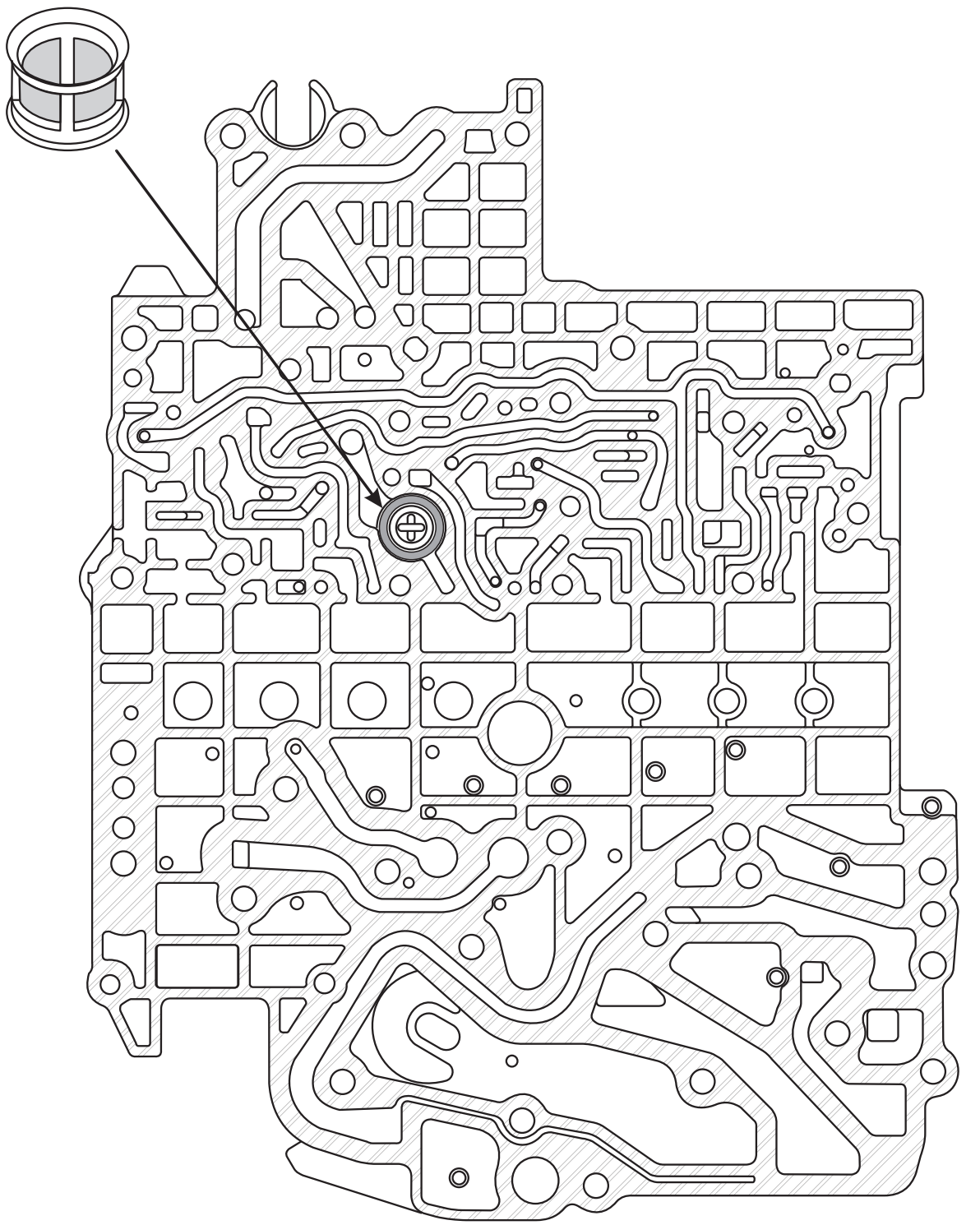


Figure 112

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ZF 5HP-24 CHANNEL PLATE "LOWER SIDE"

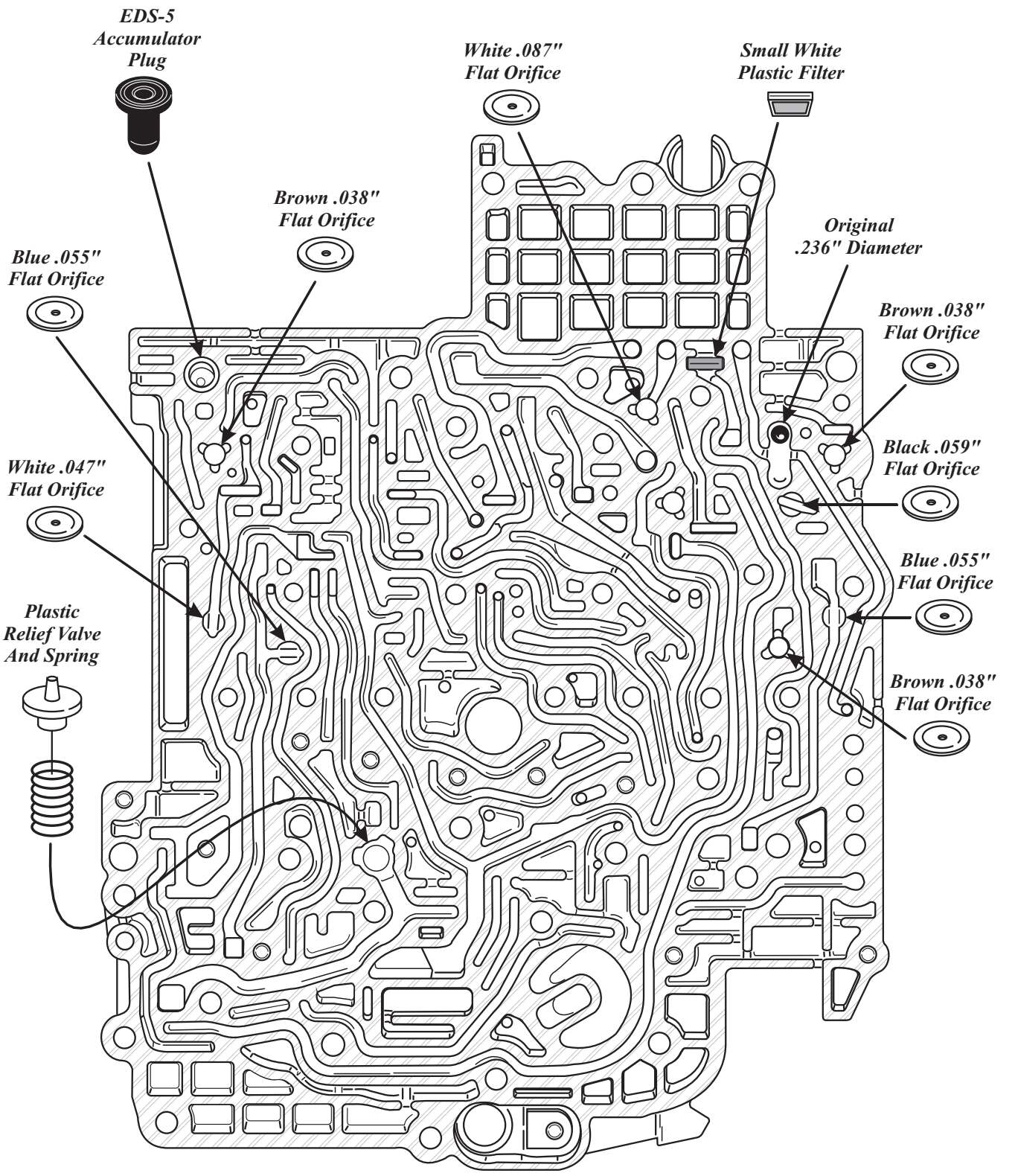


Figure 113

INDEX

PRESSURE TAP LOCATIONS AND IDENTIFICATION

Jaguar Model Shown

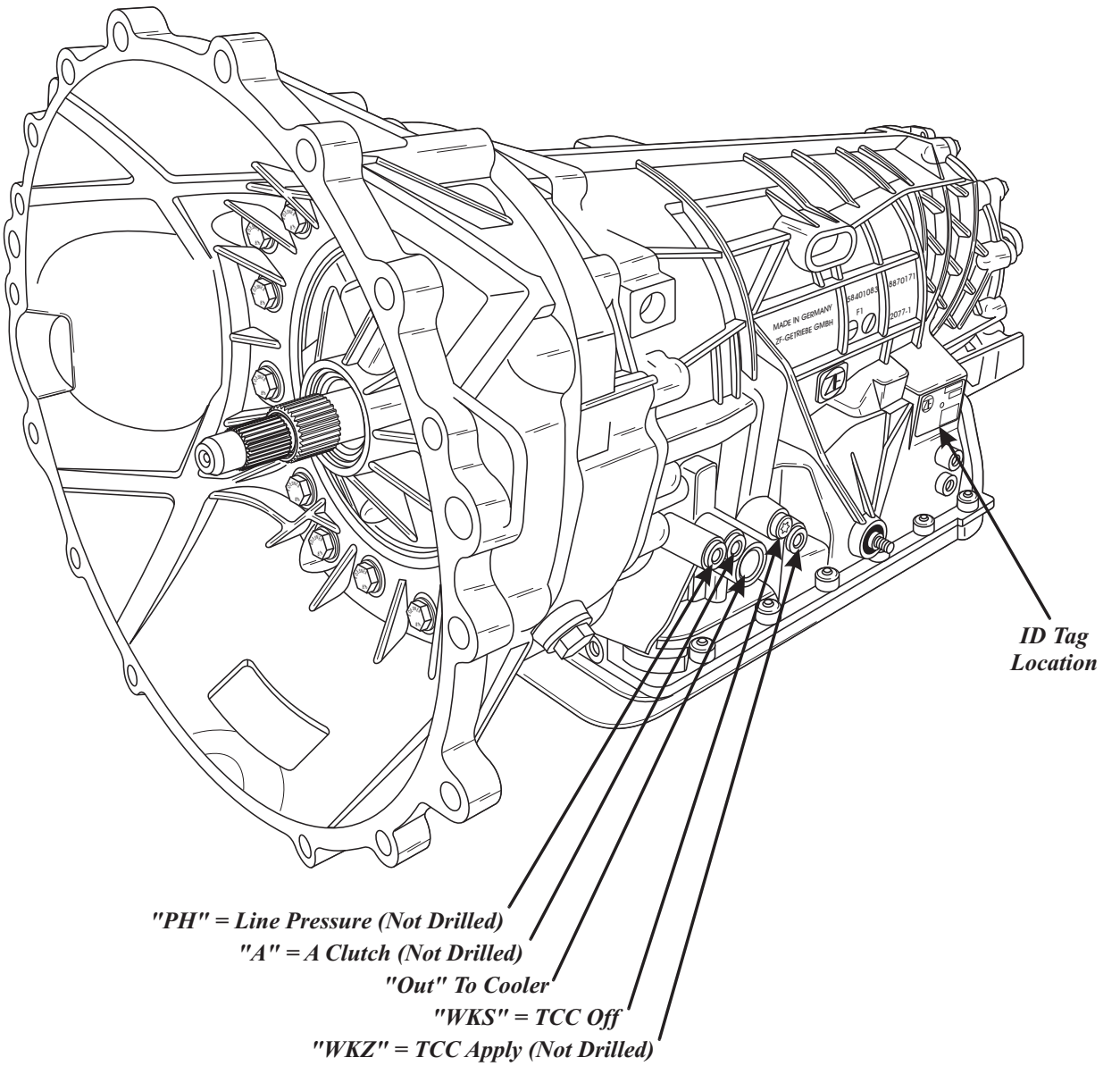


Figure 114

PUMP VOLUME CONTROL VALVE LOCATION

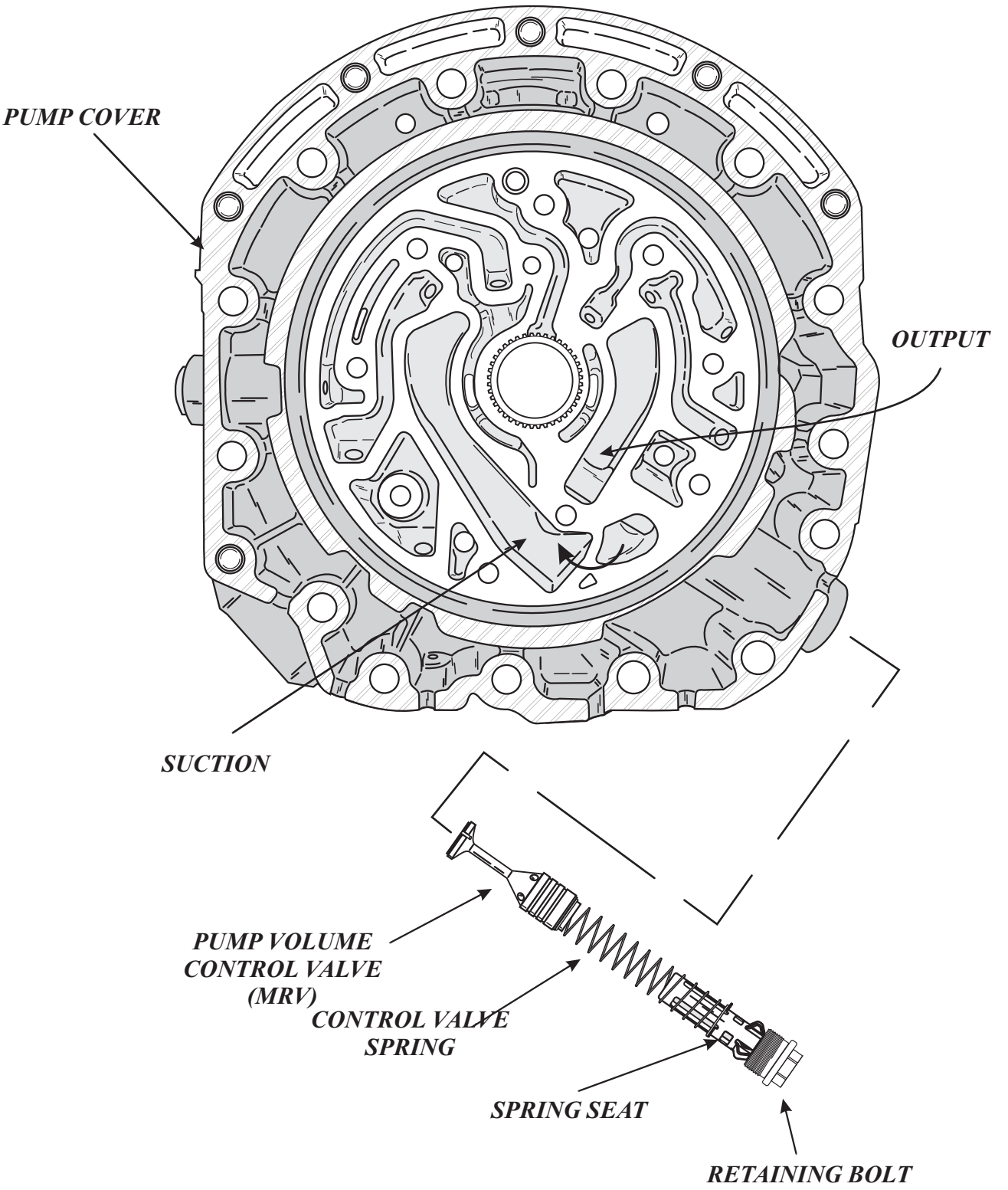
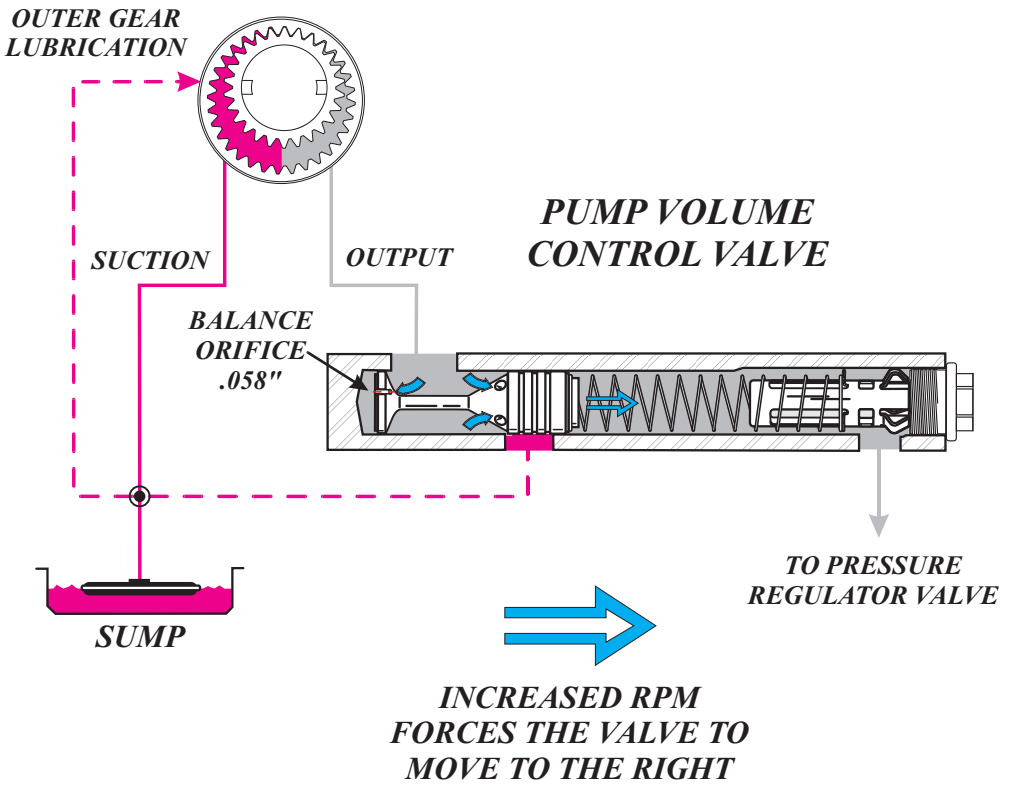


Figure 115

PUMP VOLUME CONTROL VALVE OPERATION



The Pump Volume Control Valve regulates the amount of oil volume to the Pressure Regulator Valve. As engine rpm. increases, pump output increases and forces the Pump Volume Control Valve to move to the right. This allows excess pump output to return to the sump, and a consistent amount of volume to be sent to the Pressure Regulator Valve.
The Pump Control Valve maintains 45 to 48 gallons per minute from 2000 to 6000 rpm.

Figure 116

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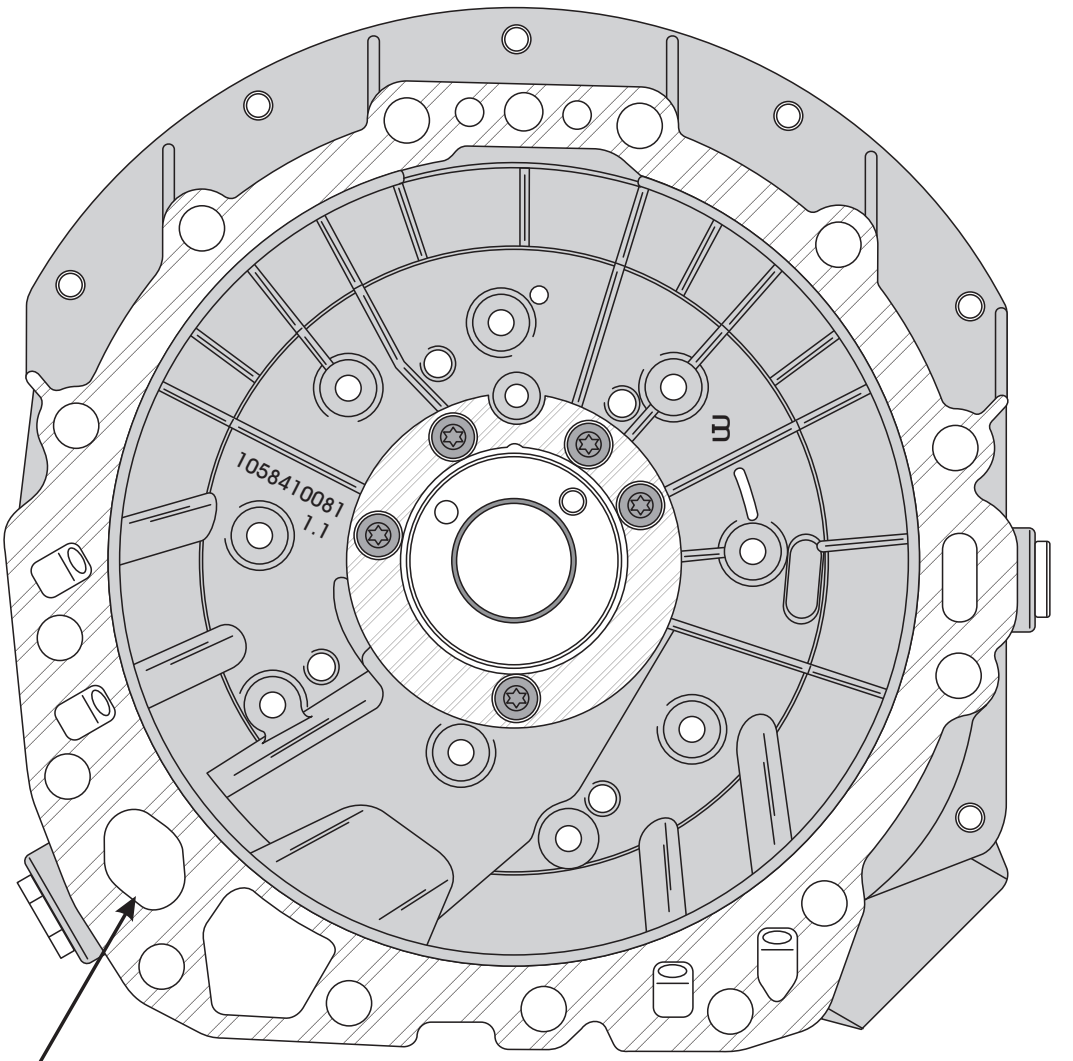
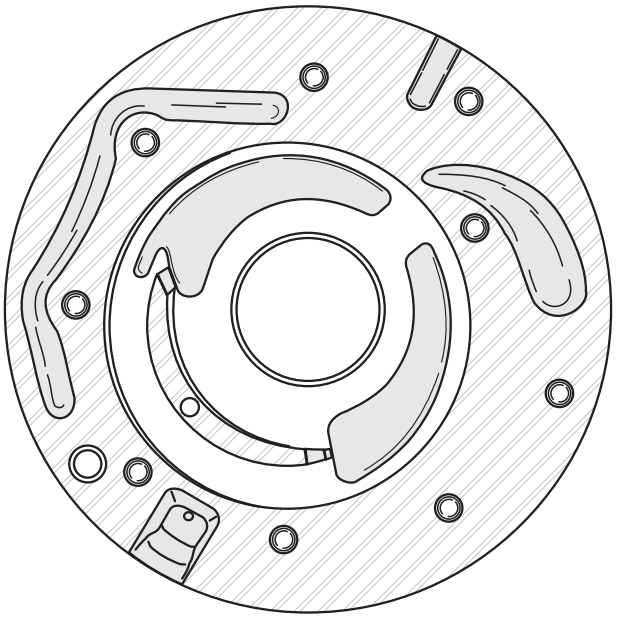
ZF 5HP-24 PUMP COVER REAR VIEW



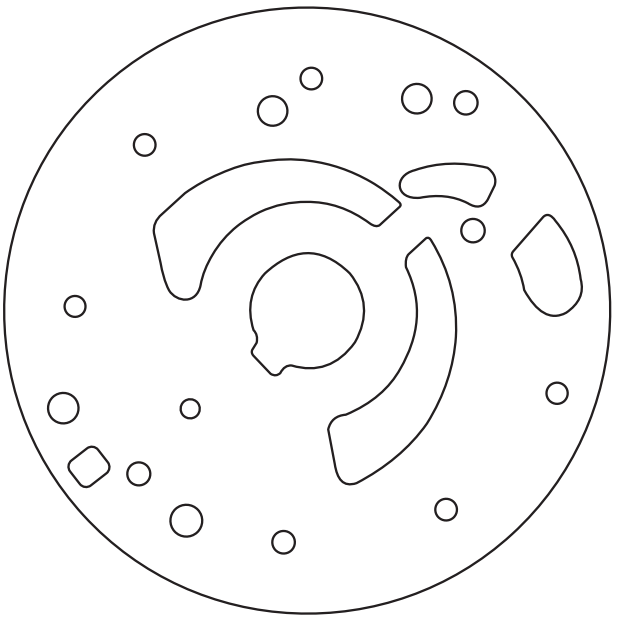
Output to Pressure Regulator Valve

Figure 117

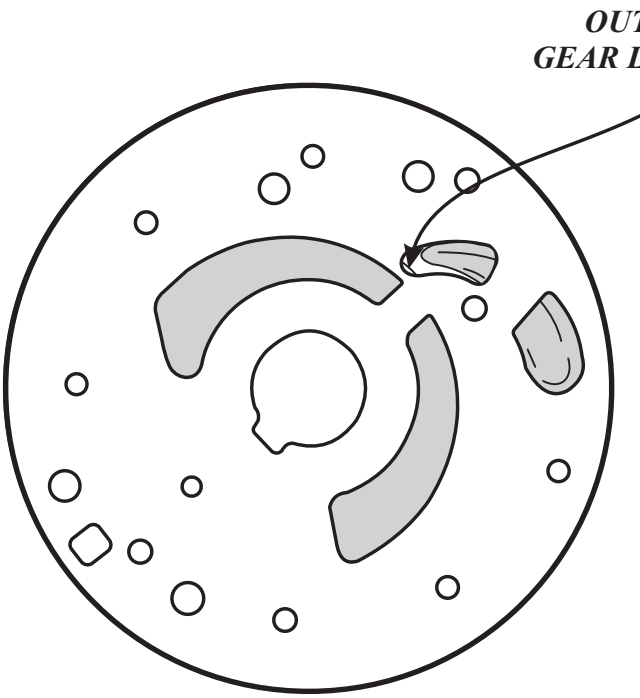
**PUMP AND
PUMP PLATE**



PUMP BODY



PUMP PLATE



**PUMP PLATE INSTALLED
ON PUMP BODY**

Figure 118

ZF 5HP-24 VALVE BODY SPRING SPECIFICATIONS

UPPER VALVE BODY

21. Clutch Valve "F" (KV-F)
    Free Length = 1.400"
    Wire Diameter = .031"
    Outside Diameter = .365"
22. Clutch Valve "E" (KV-E)
    Free Length = 1.551"
    Wire Diameter = .031"
    Outside Diameter = .365"
23. Pressure Reducing Valve (DR-V1)
    Free Length = 1.685"
    Wire Diameter = .042"
    Outside Diameter = .370"
24. Pressure Reducing Valve (DR-V2)
    Free Length = 1.942"
    Wire Diameter = .045"
    Outside Diameter = .370"
25. Clutch Valve "B" (KV-B)
    Free Length = 1.710"
    Wire Diameter = .042"
    Outside Diameter = .420"
26. Holding Valve "E" (KV-E)
    Free Length = 1.685"
    Wire Diameter = .042"
    Outside Diameter = .372"
27. A Clutch Swit Valve (ABSCH.V-A)
    Free Length = 1.455"
    Wire Diameter = .028"
    Outside Diameter = .365"
28. Clutch Valve "A" (KV-A)
    Free Length = 1.830"
    Wire Diameter = .028"
    Outside Diameter = .316"

These spring locations shown on Page 121.

LOWER "FRONT" VALVE BODY

10. TCC Apply Control Valve (WK-V)
    Free Length = 1.952"
    Wire Diameter = .042"
    Outside Diameter = .370"
11. TCC Release Control Valve (WD-V)
    Free Length = 2.052"
    Wire Diameter = .034"
    Outside Diameter = .438"
12. Pressure Regulator Valve (HD-V)
    Free Length = 3.780"
    Wire Diameter = .087"
    Outside Diameter = .686"
13. Lubrication Valve (SCHM.-V)
    Free Length = 1.710"
    Wire Diameter = .048"
    Outside Diameter = .485"
14. Modulating Valve (MOD-V)
    Free Length = 1.493"
    Wire Diameter = .031"
    Outside Diameter = .365"
15. Holding Valve, "B" Clutch (HV-B)
    Free Length = 1.414"
    Wire Diameter = .031"
    Outside Diameter = .365"
16. EDS 2, Accumulator Valve (D-2)
    Free Length = 1.565"
    Wire Diameter = .042"
    Outside Diameter = .322"
17. Holding Valve, "D" Clutch (HV-B)
    Free Length = 1.681"
    Wire Diameter = .042"
    Outside Diameter = .375"
18. EDS 4, Accumulator Valve (D-4)
    Free Length = 1.560"
    Wire Diameter = .042"
    Outside Diameter = .322"
19. EDS 3, Accumulator Valve (D-3)
    Free Length = 1.560"
    Wire Diameter = .042"
    Outside Diameter = .322"

These spring locations shown on Page 122.

LOWER REAR VALVE BODY

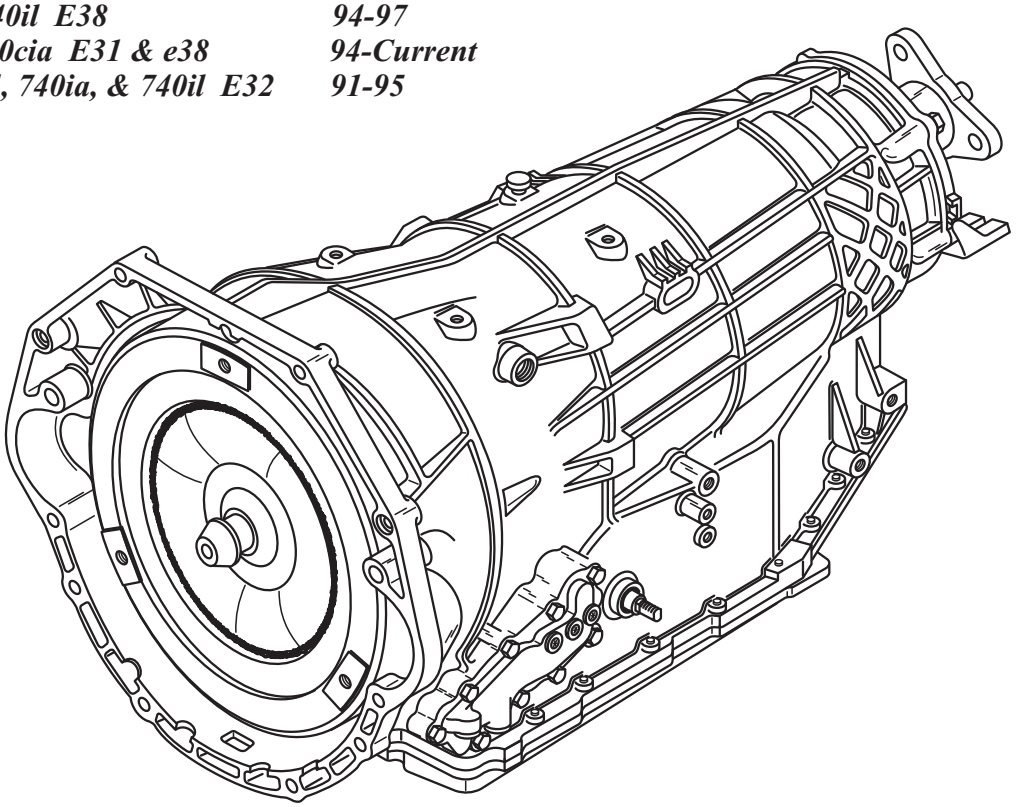
1. "A" Clutch Accumulator (D-A)
    Free Length = 3.067"
    Wire Diameter = .066"
    Outside Diameter = .595"
2. Shift Valve Number 1 (SV-1)
    Free Length = 1.755"
    Wire Diameter = .031"
    Outside Diameter = .367"
3. Shift Valve Number 2 (SV-2)
    Free Length = 1.770"
    Wire Diameter = .031"
    Outside Diameter = .367"
4. Shift Valve Number 3 (SV-3)
    Free Length = 1.640"
    Wire Diameter = .031"
    Outside Diameter = .366"
5. Switch Valve "D" Clutch (ABSCH.V-D)
    Free Length = 1.396"
    Wire Diameter = .039"
    Outside Diameter = .300"
6. Clutch Valve "D" Line-Up (KV-D)
    Free Length = 1.800"
    Wire Diameter = .031"
    Outside Diameter = .360"
7. Reverse Gear Valve (RG-V)
    Free Length = 1.800"
    Wire Diameter = .038"
    Outside Diameter = .435"
8. "C" Clutch Accumulator (D-C)
    Free Length = 3.067"
    Wire Diameter = .066"
    Outside Diameter = .595"

These spring locations shown on Page 123.

Figure 119

BMW ZF-5HP-30
DIAGNOSTIC INFORMATION

840cia E31	*92-96*
740ia & 740il E38	*94-97*
750il & 850cia E31 & e38	*94-Current*
540ia E34, 740ia, & 740il E32	*91-95*



This transmission is manufactured in Germany by ZF and carries the BMW designation A5S 560Z.

The A5S 560Z is an electronically controlled, five speed automatic transmission with a lock-up clutch type torque converter. Three planetary gear sets (Wilson Gearing), three rotating multiple disc clutches, four multiple disc brake clutches, and two sprag clutches (Freewheels) are used to provide the five forward speeds and reverse.

Key to designation:

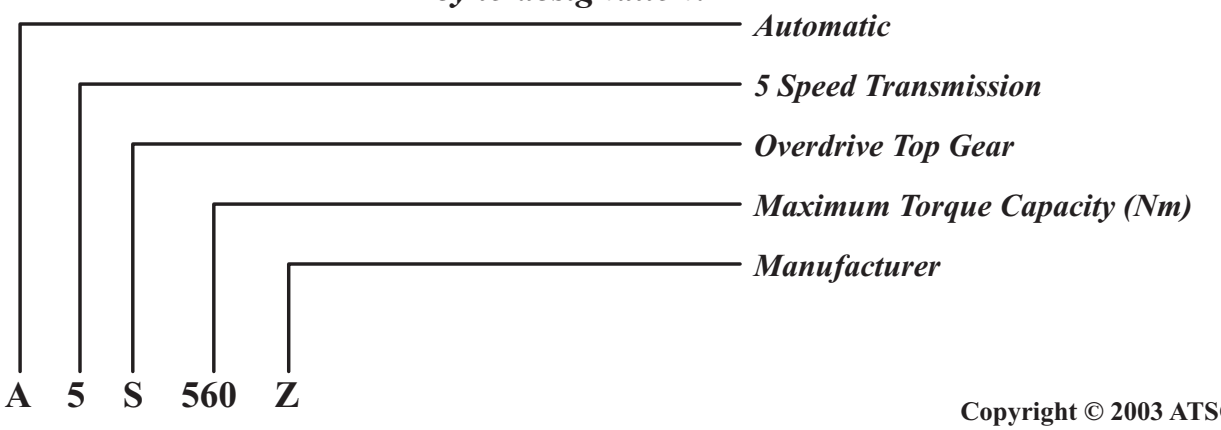


Figure 120

Refer to Figure 121 for Internal Component Application Chart.

Refer to Figure 122 for Normal Operation, Adaptive Shift Control, and Failsafe Operation.

Refer to Figures 123, 124, and 125 for Solenoid identification and locations, and both MV Solenoid Operation and EDS Solenoid Operation and tests.

Refer to Figure 126 for wiring harness identification, internal wiring schematic, and transmission case connector pin identification.

Refer to Figure 127 for individual Solenoid Application Chart and definitions.

Refer to Figure 128 for internal components resistance chart, with the pins identified for both the transmission case connector and the Electronic Control Unit.

Refer to Figure 129 and 130 for Retrieving Fault Codes, a Fault Code Chart with code definitions and the Diagnostic Tool required.

Refer to Figure 131 for all pressure tap locations.

Refer to Figure 132 for Upper Rear Valve Body exploded view and identification of valves.

Refer to Figure 133 for Lower Front Valve Body exploded view and identification of valves.

Refer to Figure 134 for Lower Rear Valve Body explode view and identification of valves.

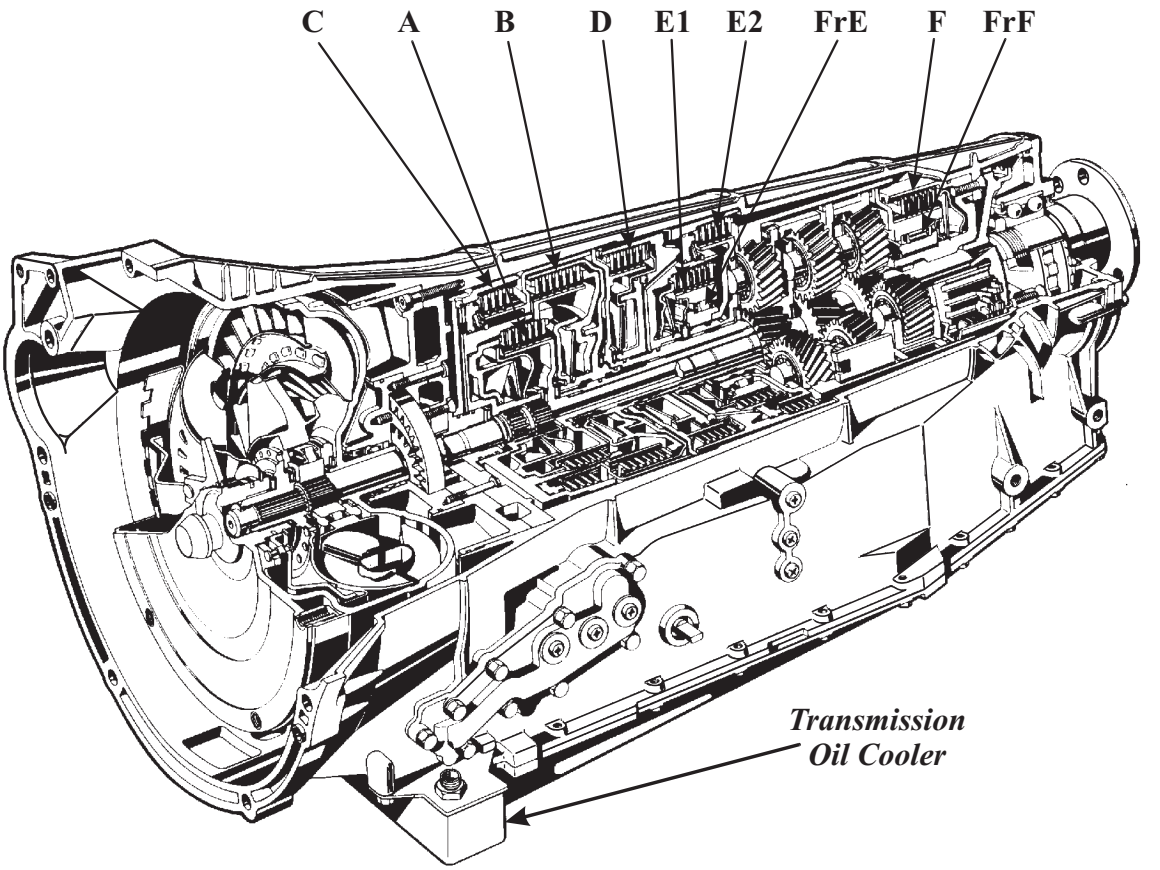
Refer to Figures 135 and 136 for cut-away views and check ball locations in uppre rear valve body.

Refer to Figure 137 for all valve body spring specifications, as observed in a used valve body.

Refer to Figures 138 and 139 for the locations of the orifices, checkballs, screens and the check valves and springs that are located in the channel plate.

Refer to Page 156 for a condition of "No Reverse".

BMW ZF-5HP-30



The oil cooler is a seperate unit mounted on the underside of the transmission just ahead of the oil pan. The connections to the transmission oil supply are integrated into the mounting. The two external fittings visible are the supply and return lines for engine coolant. Full flow is maintained through the cooler at all times.

GEAR	"A" CLUT	"B" CLUT	"C" CLUT	"D" CLUT	"E1" CLUT	"E2" CLUT	"F" CLUT	"FrE" SPRAG	"FrF" SPRAG	GEAR RATIO
PARK							ON			
REV			ON	ON			ON			3.68:1
NEUT							ON			
D-1ST	ON								HOLD	3.55:1
D-2ND	ON				ON	ON		HOLD		2.24:1
D-3RD	ON			ON	ON					1.54:1
D-4TH	ON	ON			ON					1.00:1
D-5TH		ON		ON	ON					0.79:1
M-2	ON						ON			

Figure 121

NORMAL OPERATION:
A console mounted tip switch allows the driver to select either the Automatic or Winter mode. The Winter mode is designated by an ice crystal symbol (✻) on the program switch. When in the Winter mode, the transmission starts off in 2nd gear and the upshifts are programmed to occur earlier to reduce the torque at the drive wheels and prevent wheel spin. The following chart explains the gear selection and each program mode based on the selector lever position.

SELECTOR LEVER POSITION	PROGRAM MODE	
	AUTOMATIC (A)	WINTER (✻)
P	P	P
R	R	R
N	N	N
D	*D - Economy Program*	*D - Starts In 2nd, Early Upshifts 2-5*
4	*4 - Sport Program Delayed Upshifts 1-4*	*4 - Starts In 2nd, Early Upshifts 2-4*
3	*3 - Sport Program Delayed Upshifts 1-3*	*3 - Starts In 2nd, Early Upshifts 2-3*
2	*2 - Sport Program Delayed Upshifts 1-2*	*2 - Locked In 2nd*

ADAPTIVE SHIFT CONTROL:

Stop and Go Function:
When the transmission control module detects that the vehicle is being driven in a heavy traffic situation with many stops and starts at very low road speed, it will begin using 2nd gear when pulling away. Starting in 2nd gear and not downshifting to 1st gear when stopping eliminates the feeling of excessive load reversals, and provides a more comfortable driving style in this situation.

Deceleration Rate:
Typically, automatic transmission software programs will upshift to the highest gear possible when driven at a given road speed with no throttle application. The transmission control module on the A5S 560Z moniters the rate of change in throttle position when the throttle is released. If the throttle is released quickly, the transmission will stay in the present gear engaged, in anticipation of the drivers intent to slow down. If the throttle is gradually released, as when approaching desired road speed, the transmission will upshift to the next highest possible gear for that road speed.

FAILSAFE OPERATION:
When a system fault is detected which would impair normal reliable operation, the transmission control module interrupts the power supply to Pin 12 at the transmission case connector. The transmission control module also alerts the driver of any faults by signaling the vehicle's "check control" system. To enable the vehicle to be driven to a repair shop, the following manual gear selections are permitted:

Selector Lever Position	**P R N D 4 3 2**
Actual Gear Obtained	**P R N 4 4 4 4**

Figure 122

ZF 5HP-30
SOLENOID LOCATIONS AND IDENTIFICATION

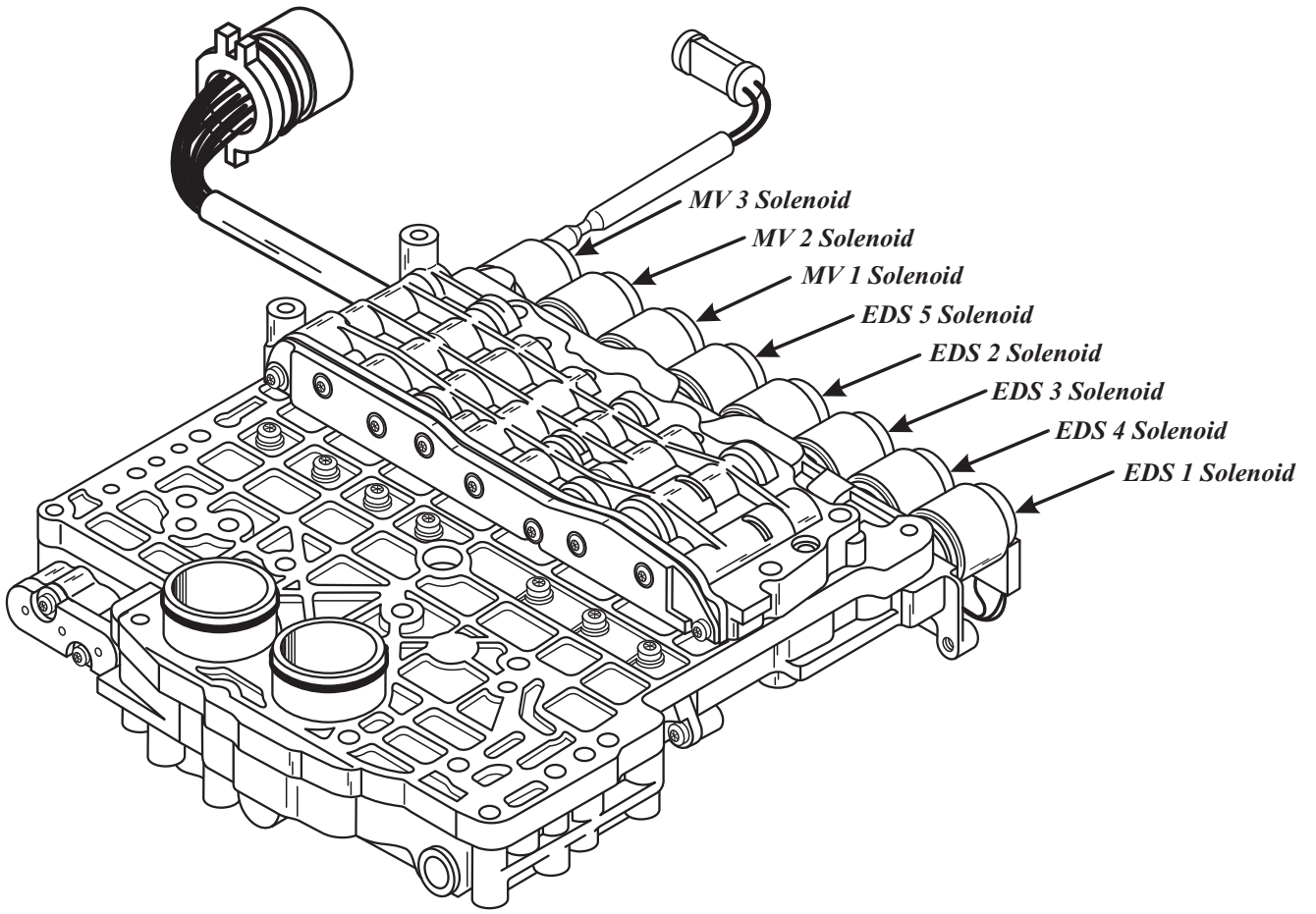
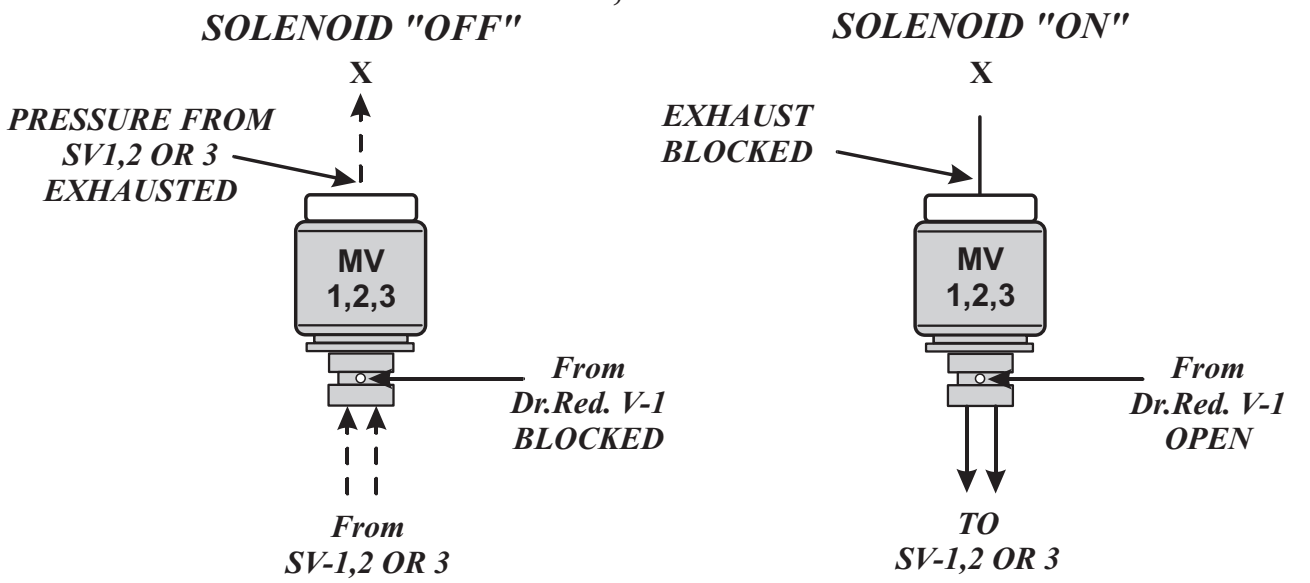


Figure 123

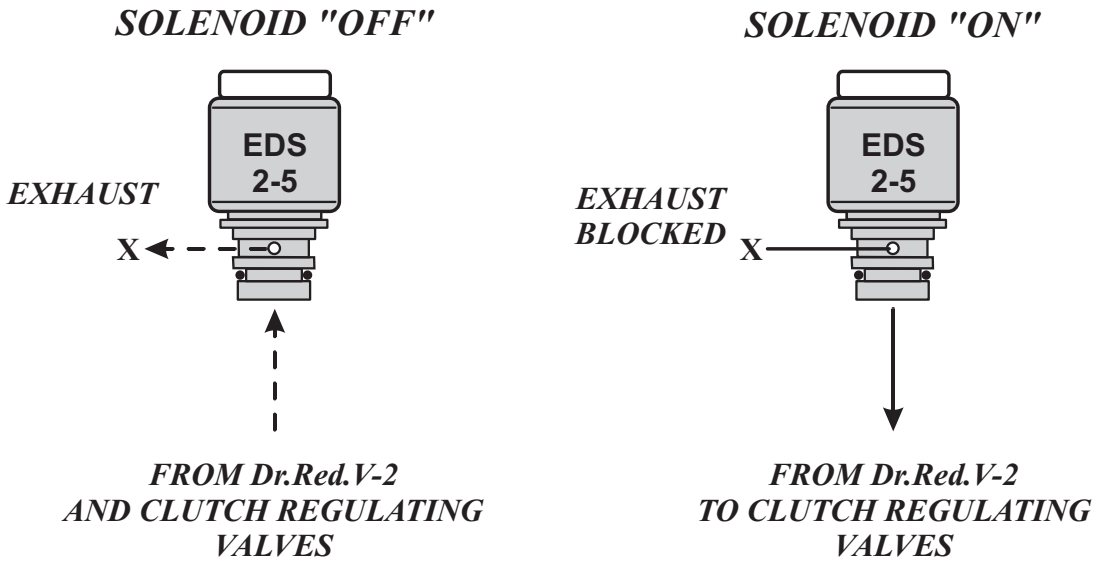
MV1, 2 AND 3



SUMMARY:

When MV 1, 2 or 3 is "OFF" Solenoid reducing pressure, from Dr.Red. V-1, is blocked by the solenoid and oil pressure from SV 1, 2 or 3 is exhausted at the rear of the solenoid.
When MV 1, 2 or 3 is "ON" Solenoid reducing pressure, From Dr.Red. V-1, is open through the solenoid and is applied to SV 1, 2 or 3. The exhaust at the rear of the solenoid is closed.

EDS 2 -5



SUMMARY:

When EDS 2-5 solenoids are "OFF" they exhaust orificed solenoid reducing pressure, from Dr. Red. V-2, and the oil pressure from the clutch regulating valves releasing them.
When EDS 2-5 solenoids are "ON" the exhaust is blocked by the solenoid and solenoid reducing pressure, from Dr. Red. V-2, is applied to operate clutch regulating valves.

Figure 124

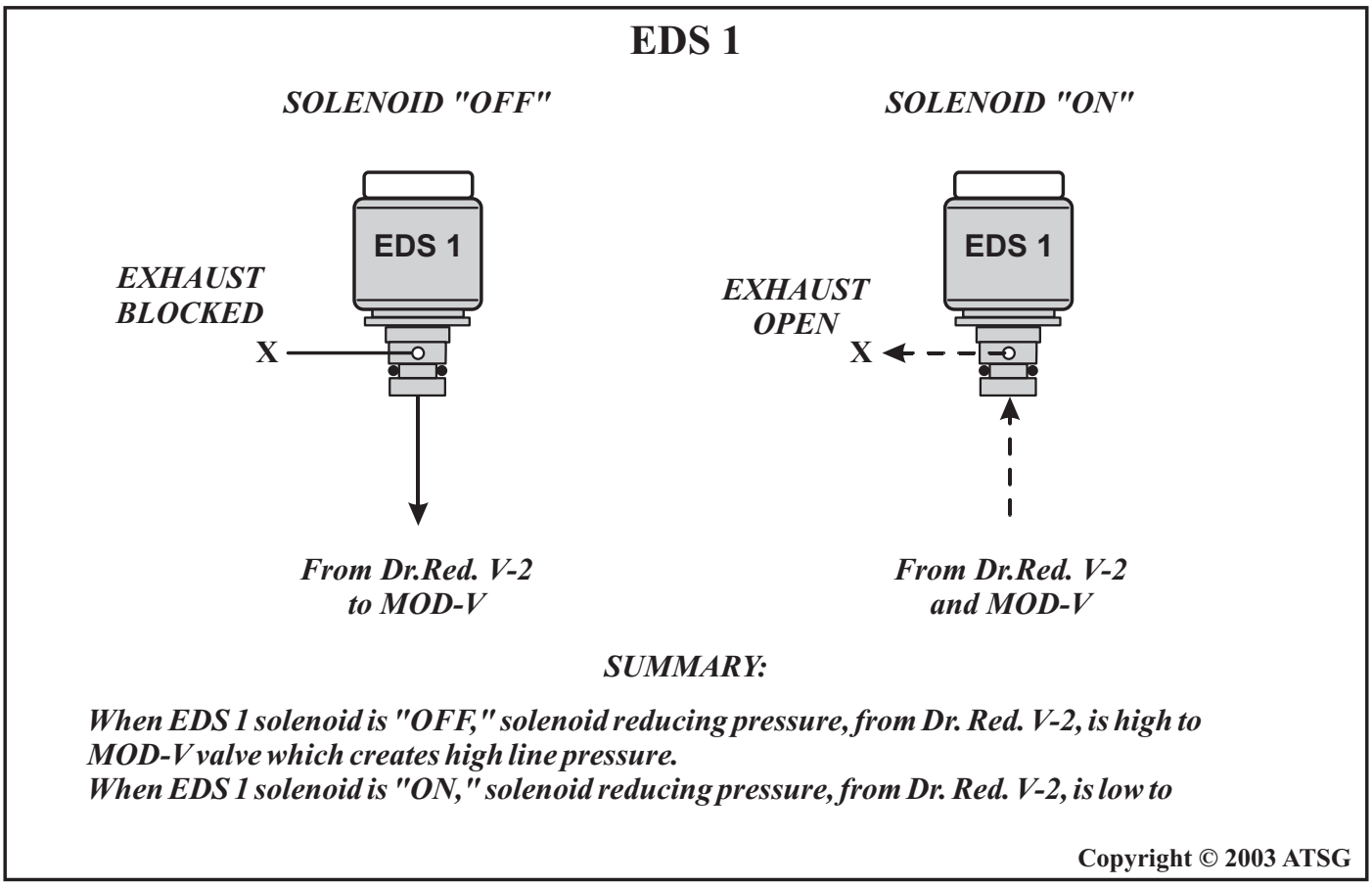

EDS 1
SOLENOID "OFF"
SOLENOID "ON"
EXHAUST BLOCKED
X
EDS 1
EXHAUST OPEN
X
EDS 1
From Dr.Red. V-2 to MOD-V
From Dr.Red. V-2 and MOD-V
SUMMARY:
When EDS 1 solenoid is "OFF," solenoid reducing pressure, from Dr. Red. V-2, is high to MOD-V valve which creates high line pressure.
When EDS 1 solenoid is "ON," solenoid reducing pressure, from Dr. Red. V-2, is low to
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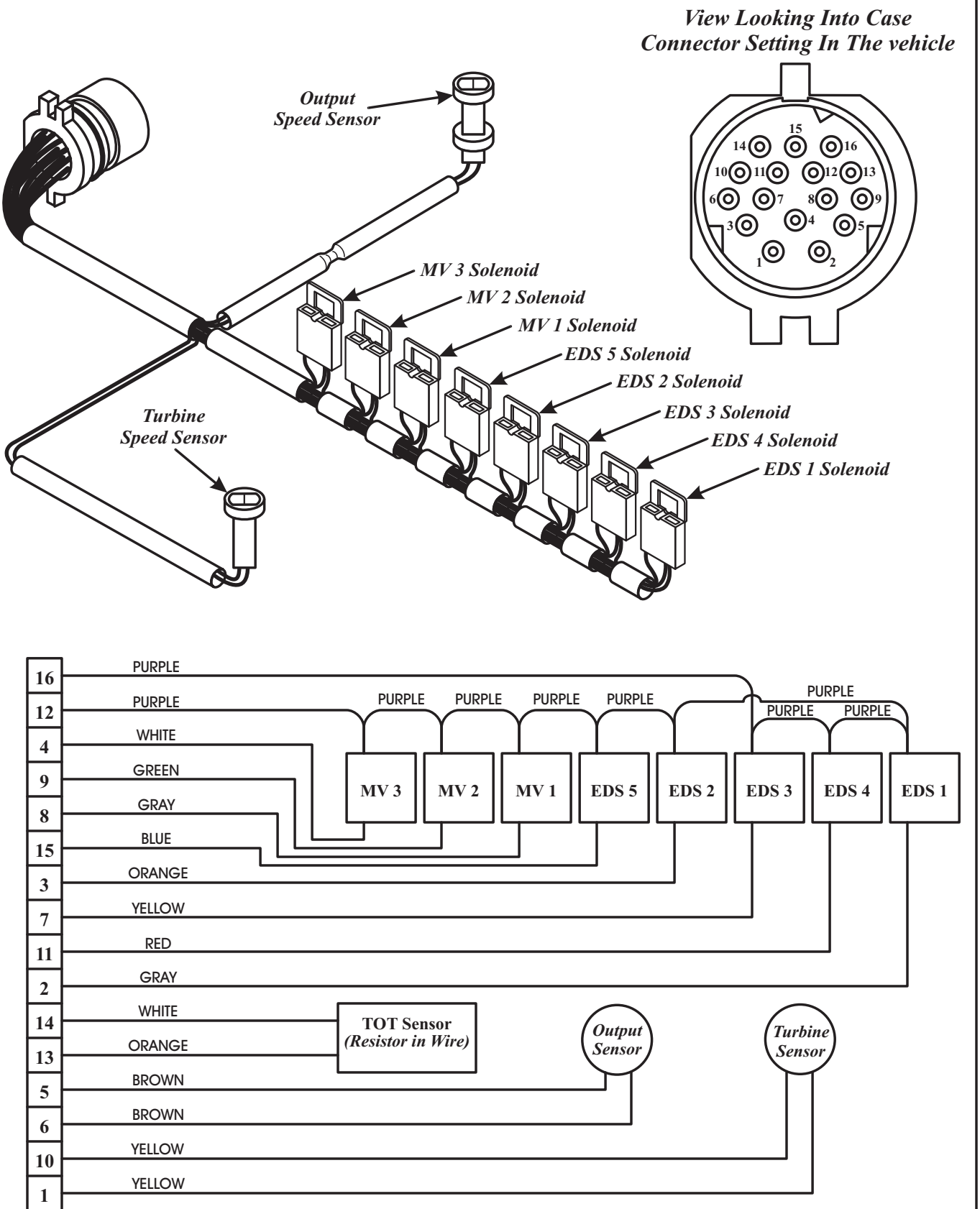
Figure 125

ZF-5HP-30 INTERNAL WIRE SCHEMATIC



NOTE: Some internal wire colors may vary.

Figure 126

ZF-5HP-30 SOLENOID APPLICATION CHART

Selector Lever Position	MV 1 Solenoid	MV 2 Solenoid	MV 3 Solenoid	EDS 1 Solenoid	EDS 2 Solenoid	EDS 3 Solenoid	EDS 4 Solenoid	EDS 5 Solenoid	GEAR RATIO
PARK	ON			**					
REVERSE		ON	⊛	**	*-	*		*-	3.68:1
NEUTRAL	ON			**					
D-1ST	ON			**	*-	*-		*-	3.55:1
D-2ND	ON	ON		**		*		*	2.24:1
D-3RD		ON		**	*	*		*	1.54:1
D-4TH		ON		**	*-		-*-	*-	1.00:1
D-5TH			-*	**	*		-*-	*-	0.79:1
Failsafe (4th)	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	1.00:1

SOLENOID CHART LEGEND

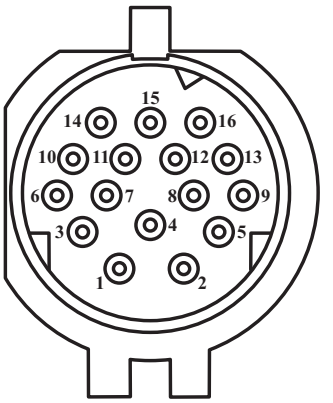
Symbol	Description
ON	*MV 1, MV 2 and MV 3 Solenoids are energized by the Electronic Transmission Control unit and have two functions. They are Open or Closed. Energized (On), there is pressure in circuit.*
⊛	*MV 3 is turned "ON" if reverse is selected at a high vehicle speed, to inhibit reverse engagement.*
**	*EDS 1 is used for line pressure control only, and operates from 0 to 0.8 amps. When the solenoid is "OFF" (0 amps), pressure is high. EDS 1 pressure is "Lowered" as the solenoid is modulated by the*
*	*EDS 2, EDS 3, EDS 4 and EDS 5 Solenoids are also pulse modulated but are exactly the opposite of EDS 1 Solenoid. When these solenoids are "ON" oil pressure in the hydraulic circuit is high, and when they are "OFF" pressure in the hydraulic circuit is low.*
-*	*Solenoid "OFF" (hydraulic pressure low), then Solenoid "ON" (hydraulic pressure high).*
*-	*Solenoid "ON" briefly (hydraulic pressure high), then Solenoid "OFF" (hydraulic pressure low). The pressure acts briefly on regulator valves to cushion clutch application.*
-*-	*EDS 4 Solenoid is used for Torque Converter Clutch apply and release only, and depends on throttle position and vehicle speed as to its application.*

Figure 127

SOLENOID AND SENSOR RESISTANCE CHART

Solenoid	*Case Connector Pin Numbers* (− +)	*Control Unit Connector Pin Numbers* (− +)	*Resistance In Ohms*
MV 1	*8 and 12*	*30 and 52*	*30 - 34 Ω*
MV 2	*9 and 12*	*33 and 52*	*30 - 34 Ω*
MV 3	*4 and 12*	*32 and 52*	*30 - 34 Ω*
EDS 1	*2 and 12*	*5 and 52*	*5.2 - 6.8 Ω*
EDS 2	*3 and 12*	*1 and 52*	*6.2 - 7.8 Ω*
EDS 3	*7 and 12*	*29 and 52*	*6.2 - 7.8 Ω*
EDS 4	*11 and 12*	*4 and 52*	*6.2 - 7.8 Ω*
EDS 5	*15 and 12*	*51 and 52*	*6.2 - 7.8 Ω*
TOT	*13 and 14*	*21 and 22*	*1000 Ω at 25° C*
TSS	*1 and 10*	*44 and 16*	*292 - 358 Ω*
OSS	*5 and 6*	*14 and 42*	*292 - 358 Ω*

View Looking Into Case
Connector Setting In The vehicle



Electronic Control Unit Connector Pin Identification

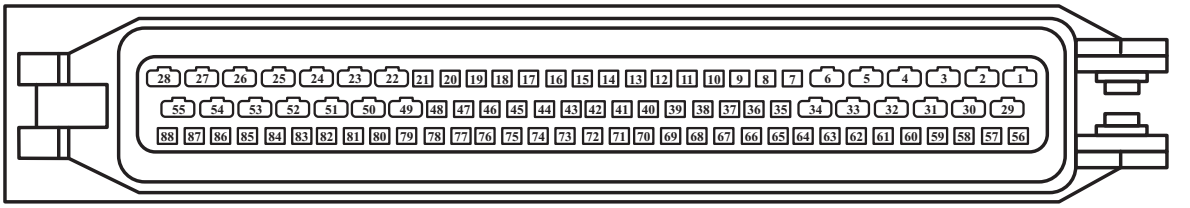


Figure 128

RETREIVING FAULT CODES

The BMW, Audi, Porsche Diagnostic Tool is ***required*** to retrieve the fault codes that are stored in the control unit. The diagnostic tool has the ability to retrieve codes, clear codes and activate individual components, and is adaptable to 3 Series, 5 Series, 7 Series and 8 Series vehicles equipped with 4HP-22/24, 4L30-E, 4HP-18FLE, 5HP-18, 5HP-19, and 5HP-30. The BMW, Audi, Porsche Diagnostic Tool can be purchased from:

Assenmacher Specialty Tools, Inc
Phone (303) 530-2424 Fax (303) 530-4720

BMW ZF-5HP-30 FAULT CODE CHART

Code	*Description and TCM Terminal I.D.*	*Possible Causes*
01	Pressure Regulator, EDS 2 - Pin 1	Questionable signal, or break or short in wiring
02	Park-Neutral Lock Solenoid - Pin 2	Break or short in wiring
04	Pressure Regulator, EDS 4 - Pin 4	Questionable signal, or break or short in wiring
05	Pressure Regulator, EDS 1 - Pin 5	Questionable signal, or break or short in wiring
08	Selector Lever Position L2 - Pin 8	Vehicle acceleration detected while selector lever in P or N position, or engine has been started even though EGS control unit has not detected a selector lever position of P or N
09	Selector Lever Position L3/L4 - Pins 37 and 9	Engine has been started even though EGS control unit has not detected a selector lever position of P or N
0C	Program Selector Switch - Pins 12, 13 and 45	Short in wiring, or more than one program selector switch input is applied to ground
10	Rotational Speed Sensor, Turbocharger Pins 16 and 44	No input, or incorrect engine speed information
12	Kickdown Switch - Pin 18	Questionable signal
13	ASC Monitering - Pin 19	ASC operation has been detected while selector lever was in Park or Neutral position
16	TOT Sensor - Pins 21 and 22	Resistance of TOT Sensor not within permissible range
1A	Battery Voltage Supply - Pin 26	Break in wiring
1D	Pressure Regulator, EDS 3 - Pin 29	Questionable signal, or break or short in wiring
1E	MV 1 Solenoid - Pin 30	Break or short in wiring, or defective winding in solenoid
20	MV 3 Solenoid - Pin 32	Break or short in wiring, or defective winding in solenoid
21	MV 2 Solenoid - Pin 33	Break or short in wiring, or defective winding in solenoid
24	Selector Lever Position L1 - Pin 36	Break or short in wiring, or defective sensor
2A	Output Speed Sensor signal and Stall Speed signal - Pins 13 and 42	No input, or incorrect engine speed information
33	Pressure Regulator, EDS 5 - Pin 51	Questionable signal, or break or short in wiring
34	Power Supply to transmission - Pin 52	Break or short in wiring

Figure 129

BMW ZF-5HP-30 FAULT CODE CHART

Code	*Description and TCM Terminal I.D.*	*Possible Causes*
36	Power Supply - Pin 54	Power Supply less than 9 volts at engine speeds greater than 1600 RPM
64	Speed Monitoring	Faulty Speed Sensor signal, or slip in Transmission
65	EPROM - Checksum	Program memory in Transmission Control Unit faulty
66	Incorrect Program Checksum	Program memory in Transmission Control Unit faulty
67	Transmission Relay - Pin 52	Pickup and dropout times too long
68	Over-revving Lock	Engine RPM greater than 6816 has been detected
69	Speed Monitoring	Faulty Speed Sensor signal, or slip in Transmission
6A	Speed Monitoring	Faulty Speed Sensor signal, or slip in Transmission
96	CAN Timeout 1	CAN signal not sent during initialization (Ignition On)
97	CAN Timeout 2	CAN signal not sent during operation
98	CAN Bus monitoring	Values in CAN RAM are not updated
99	CAN status fault	
9A	CAN throttle valve information	DME detects faulty throttle valve signal
9B	CAN load signal information	DME detects faulty load signal
9C	CAN engine intervention	DME cannot carry out reduction in engine torque desire by the EGS, or DME has different requirements compared to other CAN users
9D	CAN engine temperature info	DME detects faulty engine temperature signal

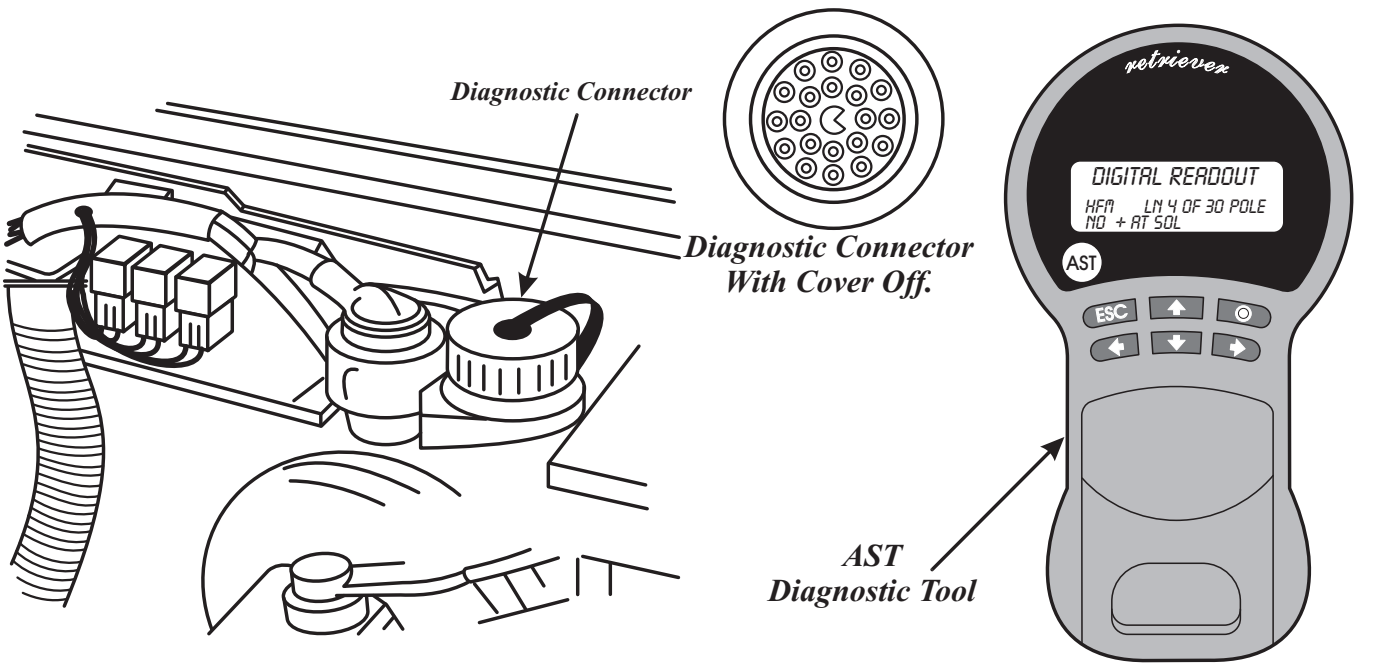
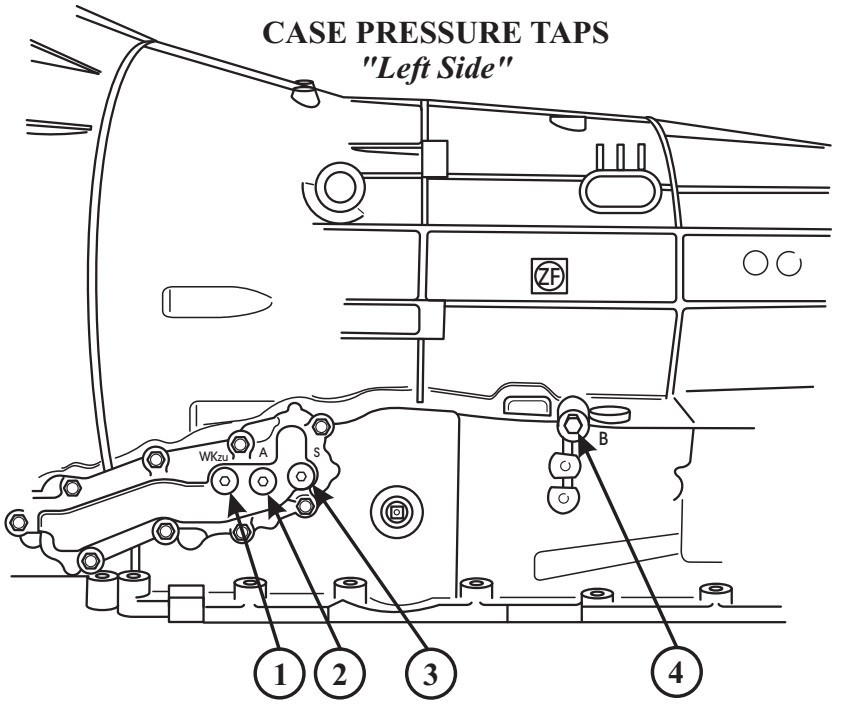
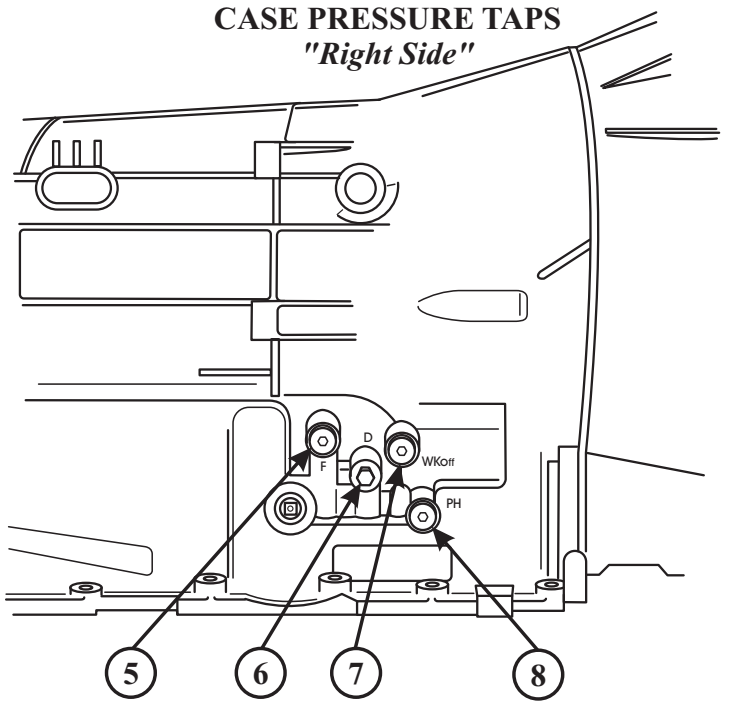


Figure 130

CASE PRESSURE TAPS
"Left Side"



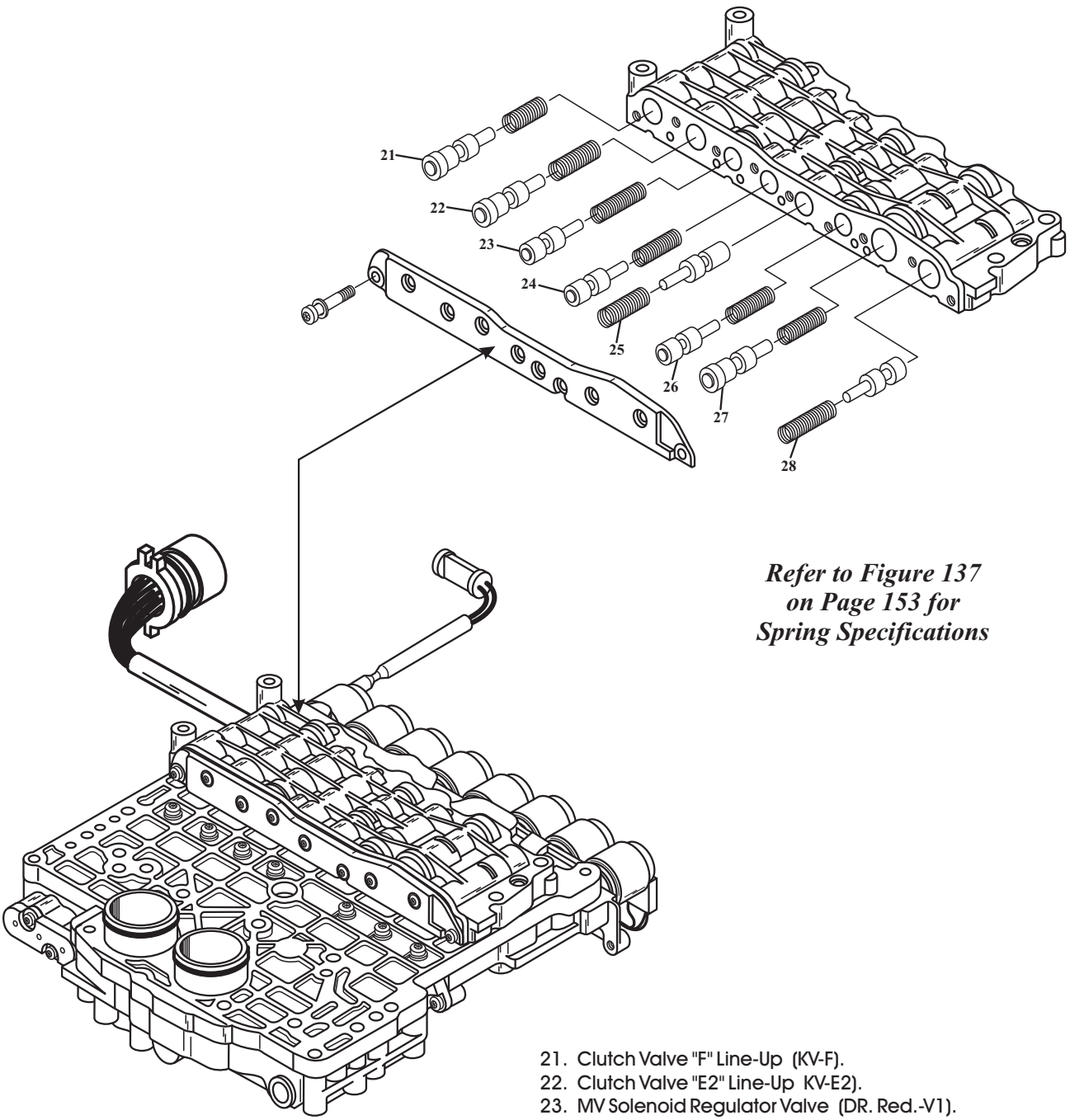
CASE PRESSURE TAPS
"Right Side"



1. *WKzu = Converter Clutch ON Pressure.*
2. *A = "A" Clutch Pressure.*
3. *S = Cooler Pressure.*
4. *B = "B" Clutch Pressure (Must Drill and Tap for Access).*
5. *F = "F" Clutch Pressure.*
6. *D = "D" Clutch Pressure (Must Drill and Tap for Access).*
7. *WKoff = Converter Clutch OFF Pressure.*
8. *PH = Line Pressure.*

Figure 131

ZF-5HP-30
UPPER REAR VALVE BODY

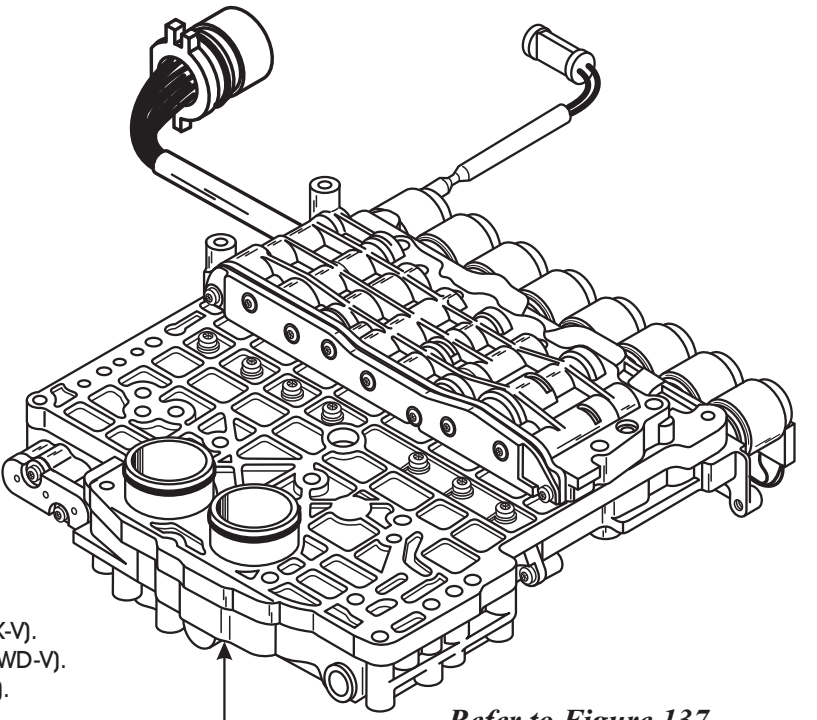


Refer to Figure 137 on Page 153 for Spring Specifications

21. Clutch Valve "F" Line-Up (KV-F).
22. Clutch Valve "E2" Line-Up KV-E2).
23. MV Solenoid Regulator Valve (DR. Red.-V1).
24. EDS Solenoid Regulator Valve (DR. Red.-V2).
25. Clutch Valve "B" Line-Up (KV-B).
26. Clutch Valve "E1" Line-Up (KV-E1).
27. Switch Valve For "A" Clutch (ABSCH-V-A).

Figure 132

ZF-5HP-30
LOWER FRONT VALVE BODY



9. Manual Shift Valve (W-S).
10. Converter Clutch Apply Oil Control Valve (WK-V).
11. Converter Clutch Release Oil Control Valve (WD-V).
12. Main Pressure Regulator Valve Line-Up (HD-V).
13. Lubrication Valve (SCHM-V)
14. Modulating Valve Line-Up (MOD-V).
15. Main Regulator Valve For "B" Clutch (HV-B).
16. Accumulator Valve For EDS 2 Solenoid (D-2).
17. Main Regulator Valve For "D" Clutch (HV-D).
18. Accumulator Valve For EDS 4 Solenoid (D-4).
19. Accumulator Valve For EDS 5 Solenoid (D-5).
20. Accumulator Valve For EDS 3 Solenoid (D-3).

Refer to Figure 137 on Page 153 for Spring Specifications

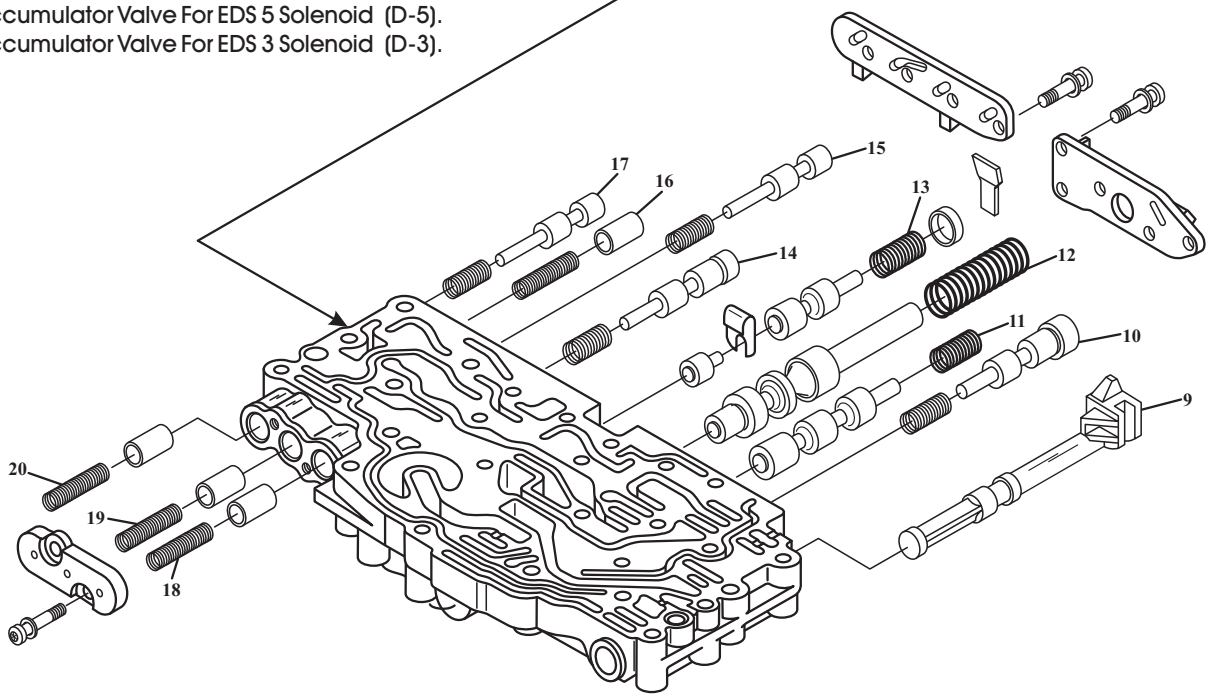
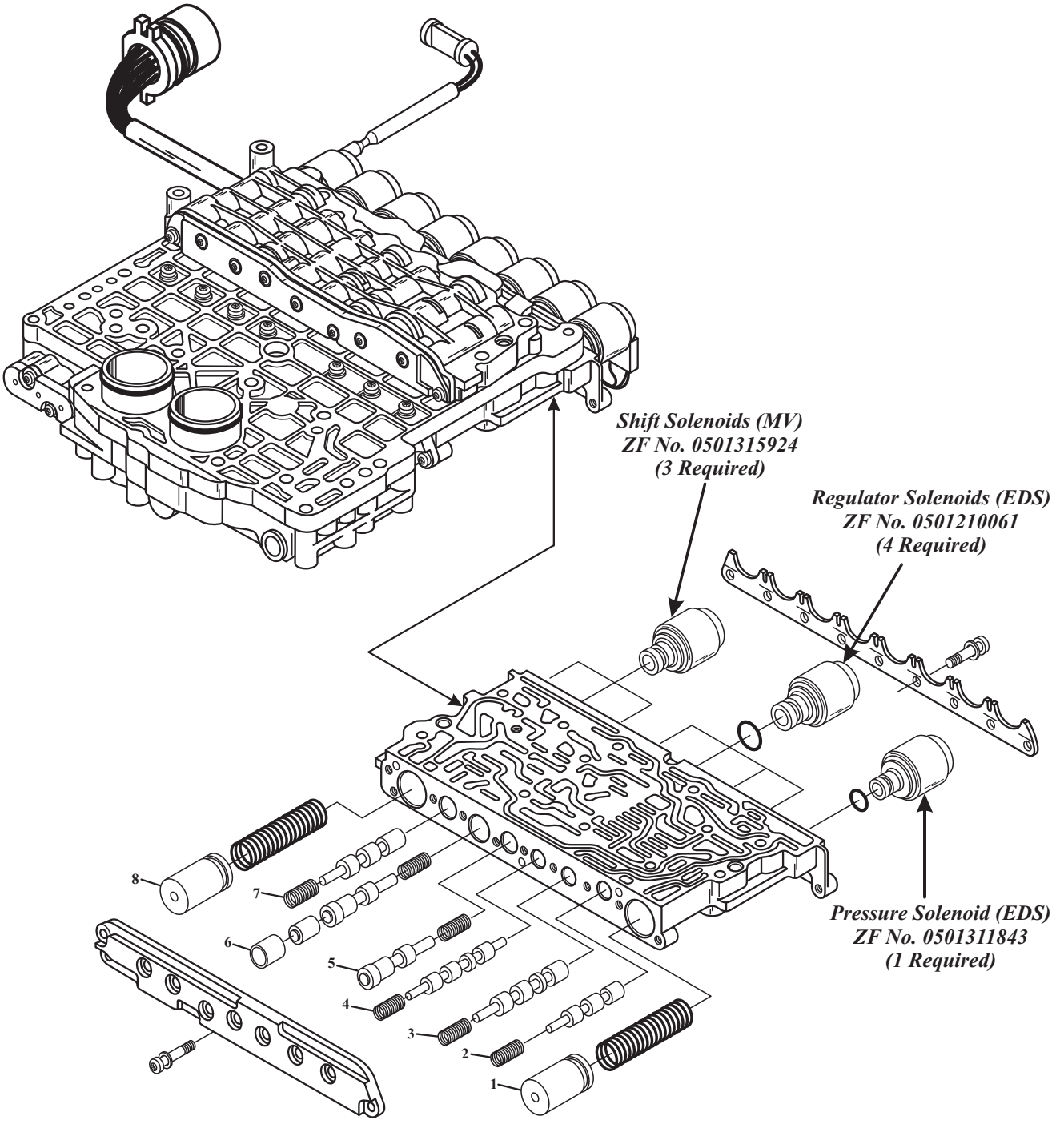


Figure 133

ZF-5HP-30
LOWER REAR VALVE BODY

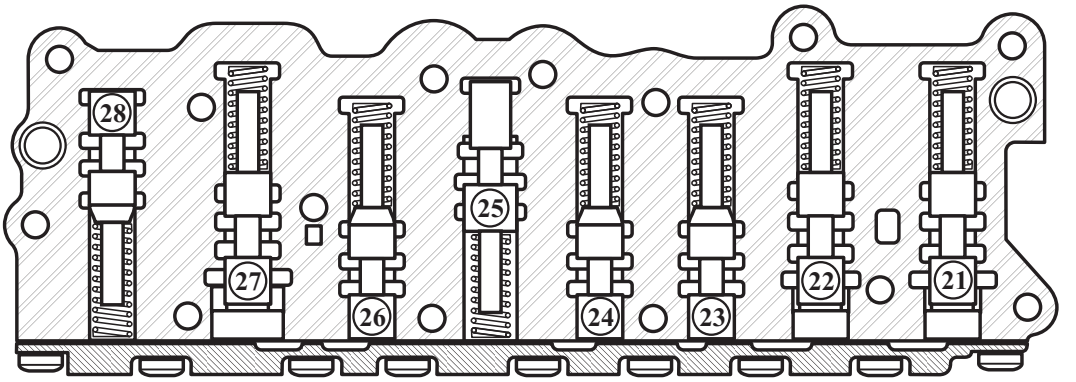


1. "A" Clutch Accumulator Line-Up (D-A).
2. Shift Valve Number 1 (SV-1).
3. Shift Valve Number 2 (SV-2).
4. Shift Valve Number 3 (SV-3).
5. Switch Valve For "D" Clutch (ABSCH-V-D).
6. Clutch Valve "D" Line-Up (KV-D).
7. Reverse Gear Valve Line-Up (RG-V).

Refer to Figure 137 on Page 153 for Spring Specifications

Figure 134

UPPER REAR VALVE BODY



21. Clutch Valve "F" Line-Up (KV-F).
22. Clutch Valve "E2" Line-Up KV-E2).
23. MV Solenoid Regulator Valve (DR. Red.-V1).
24. EDS Solenoid Regulator Valve (DR. Red.-V2).
25. Clutch Valve "B" Line-Up (KV-B).
26. Clutch Valve "E1" Line-Up (KV-E1).
27. Switch Valve For "A" Clutch (ABSCH-V-A).

Only One .250" (6.35mm) ball is located here.
Do Not install a ball in the pocket marked X.

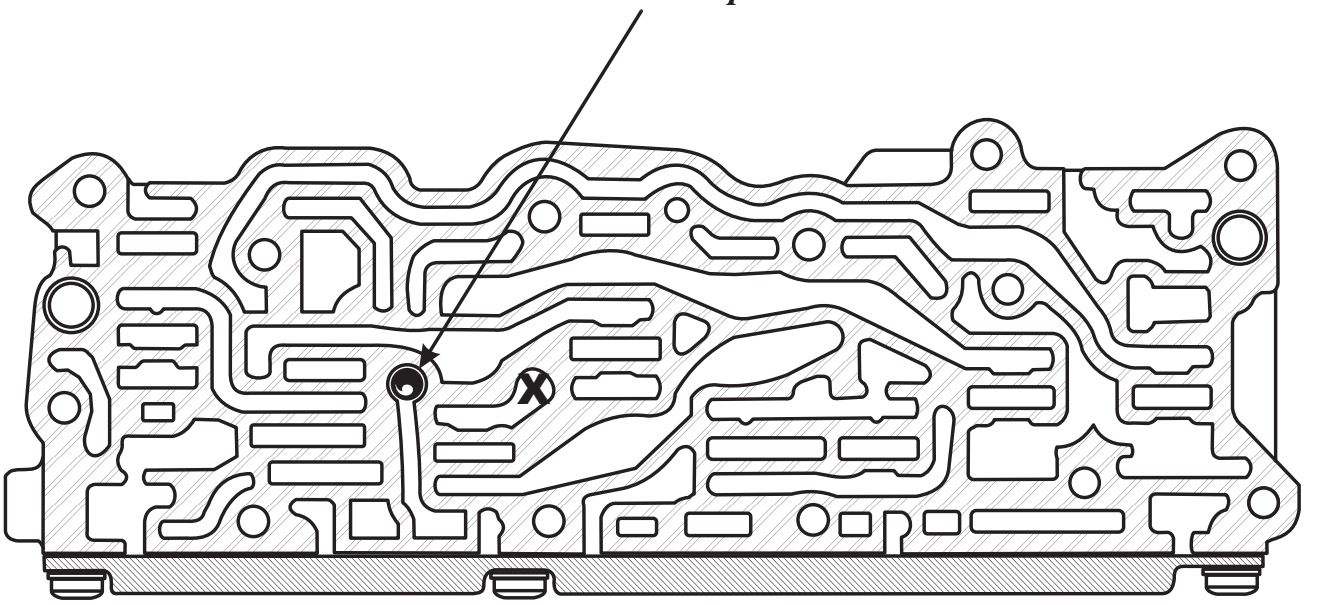
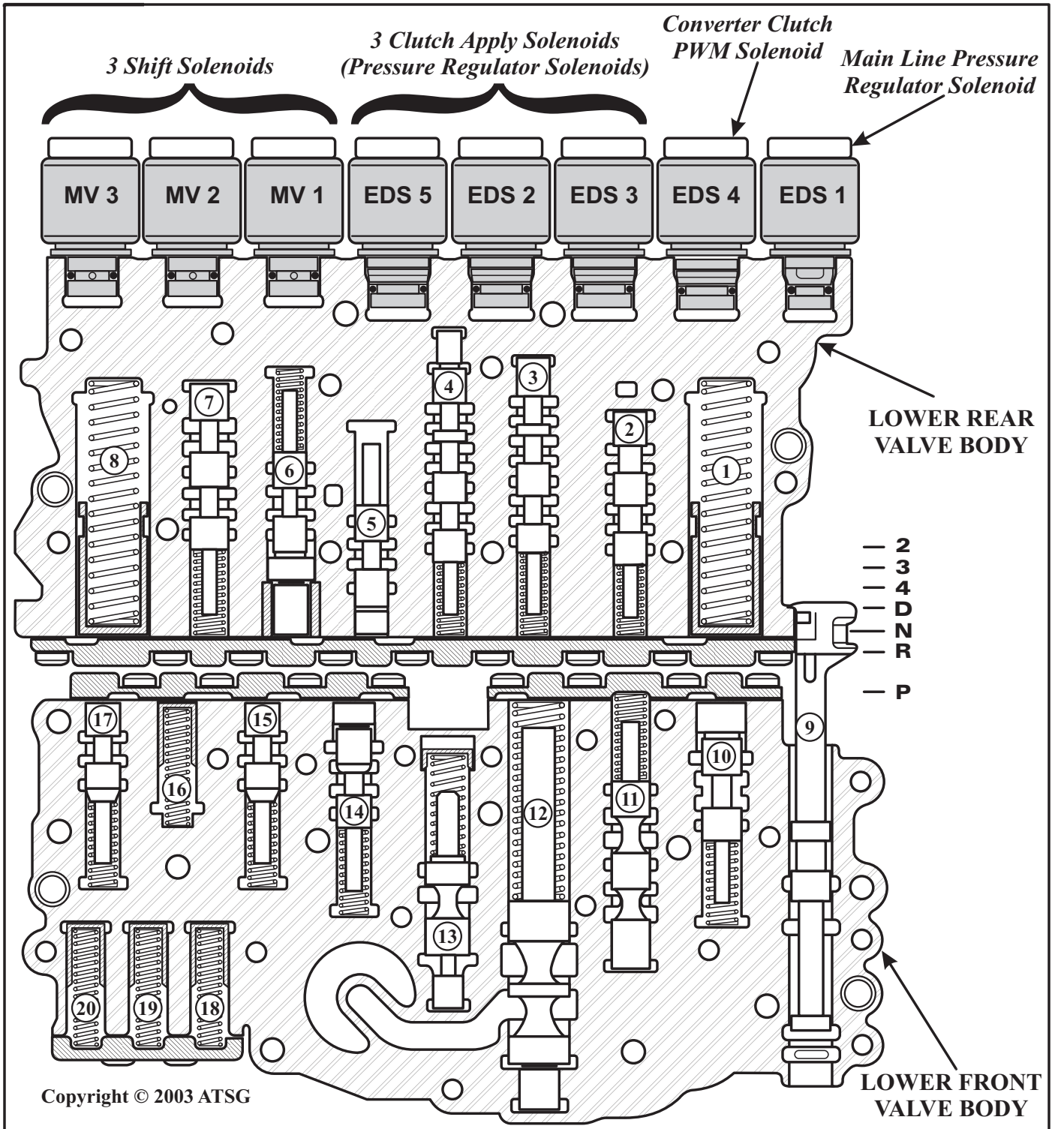


Figure 135



1. "A" Clutch Accumulator Line-Up (D-A).
2. Shift Valve Number 1 (SV-1).
3. Shift Valve Number 2 (SV-2).
4. Shift Valve Number 3 (SV-3).
5. Switch Valve For "D" Clutch (ABSCH-V-D).
6. Clutch Valve "D" Line-Up (KV-D).
7. Reverse Gear Valve Line-Up (RG-V).
8. "C" Clutch Accumulator Line-Up (D-C).
9. Manual Shift Valve (W-S).
10. Converter Clutch Apply Oil Control Valve (WK-V).
11. Converter Clutch Release Oil Control Valve (WD-V).
12. Main Pressure Regulator Valve Line-Up (HD-V).
13. Lubrication Valve (SCHM-V)
14. Modulating Valve Line-Up (MOD-V).
15. Main Regulator Valve For "B" Clutch (HV-B).
16. Accumulator Valve For EDS 2 Solenoid (D-2).
17. Main Regulator Valve For "D" Clutch (HV-D).
18. Accumulator Valve For EDS 4 Solenoid (D-4).
19. Accumulator Valve For EDS 5 Solenoid (D-5).
20. Accumulator Valve For EDS 3 Solenoid (D-3).

Figure 136

ZF 5HP-30 VALVE BODY SPRING SPECIFICATIONS

UPPER REAR VALVE BODY

21. Clutch Valve "F" (KV-F)
    Free Length = 1.370"
    Wire Diameter = .030"
    Outside Diameter = .365"

22. Clutch Valve "E2" (KV-E2)
    Free Length = 1.558"
    Wire Diameter = .031"
    Outside Diameter = .365"

23. MV Solenoid Reg Valve (DR-V1)
    Free Length = 1.395"
    Wire Diameter = .038"
    Outside Diameter = .301"

24. EDS Solenoid Reg Valve (DR-V2)
    Free Length = 1.980"
    Wire Diameter = .045"
    Outside Diameter = .370"

25. Clutch Valve "B" (KV-B)
    Free Length = 1.710"
    Wire Diameter = .042"
    Outside Diameter = .424"

26. Clutch Valve "E1" (KV-E1)
    Free Length = 1.742"
    Wire Diameter = .023"
    Outside Diameter = .352"

27. A Clutch Swit Valve (ABSCH.V-A)
    Free Length = 1.692"
    Wire Diameter = .031"
    Outside Diameter = .365"

28. Clutch Valve "A" (KV-A)
    Free Length = 1.792"
    Wire Diameter = .031"
    Outside Diameter = .358"

These spring locations shown on Page 148.

LOWER "FRONT" VALVE BODY

10. TCC Apply Control Valve (WK-V)
    Free Length = 1.628"
    Wire Diameter = .048"
    Outside Diameter = .440"

11. TCC Release Control Valve (WD-V)
    Free Length = 2.007"
    Wire Diameter = .034"
    Outside Diameter = .438"

12. Pressure Regulator Valve (HD-V)
    Free Length = 3.548"
    Wire Diameter = .087"
    Outside Diameter = .686"

13. Lubrication Valve (SCHM.-V)
    Free Length = 1.750"
    Wire Diameter = .048"
    Outside Diameter = .480"

14. Modulating Valve (MOD-V)
    Free Length = 1.493"
    Wire Diameter = .031"
    Outside Diameter = .365"

15. "B" Clutch Reg Valve (HV-B)
    Free Length = 1.414"
    Wire Diameter = .030"
    Outside Diameter = .365"

16. EDS 2, Accumulator Valve (D-2)
    Free Length = 1.530"
    Wire Diameter = .042"
    Outside Diameter = .322"

17. "D" Clutch Reg Valve (HV-D)
    Free Length = 1.543"
    Wire Diameter = .042"
    Outside Diameter = .348"

18. EDS 4, Accumulator Valve (D-4)
    Free Length = 1.530"
    Wire Diameter = .042"
    Outside Diameter = .322"

19. EDS 5, Accumulator Valve (D-5)
    Free Length = 1.530"
    Wire Diameter = .042"
    Outside Diameter = .322"

20. EDS 3, Accumulator Valve (D-3)
    Free Length = 1.530"
    Wire Diameter = .042"
    Outside Diameter = .322"

These spring locations shown on Page 149.

LOWER "REAR" VALVE BODY

1. "A" Clutch Accumulator (D-A)
    Free Length = 2.929"
    Wire Diameter = .066"
    Outside Diameter = .608"

2. Shift Valve Number 1 (SV-1)
    Free Length = 1.800"
    Wire Diameter = .031"
    Outside Diameter = .360"

3. Shift Valve Number 2 (SV-2)
    Free Length = 1.800"
    Wire Diameter = .031"
    Outside Diameter = .360"

4. Shift Valve Number 3 (SV-3)
    Free Length = 1.640"
    Wire Diameter = .031"
    Outside Diameter = .366"

5. Switch Valve "D" Clutch (ABSCH.V-D)
    Free Length = 1.733"
    Wire Diameter = .023"
    Outside Diameter = .350"

6. Clutch Valve "D" Line-Up (KV-D)
    Free Length = 1.763"
    Wire Diameter = .031"
    Outside Diameter = .360"

7. Reverse Gear Valve (RG-V)
    Free Length = 1.836"
    Wire Diameter = .038"
    Outside Diameter = .435"

8. "C" Clutch Accumulator (D-C)
    Free Length = 2.929"
    Wire Diameter = .066"
    Outside Diameter = .608"

These spring locations shown on Page 150.

Note: There is now available from ZF distributers a "Valve Body Kit" for the 5HP-30 that includes all new stock springs, all check balls, all orifices and screens. ZF part number "5HP-30 VBK".

Note: The number in front of the name of the valve line-up is the illustration number in the ATSG illustrations in this manual.

Figure 137

ZF-5HP-30 CHANNEL PLATE
UPPER VALVE BODY SIDE

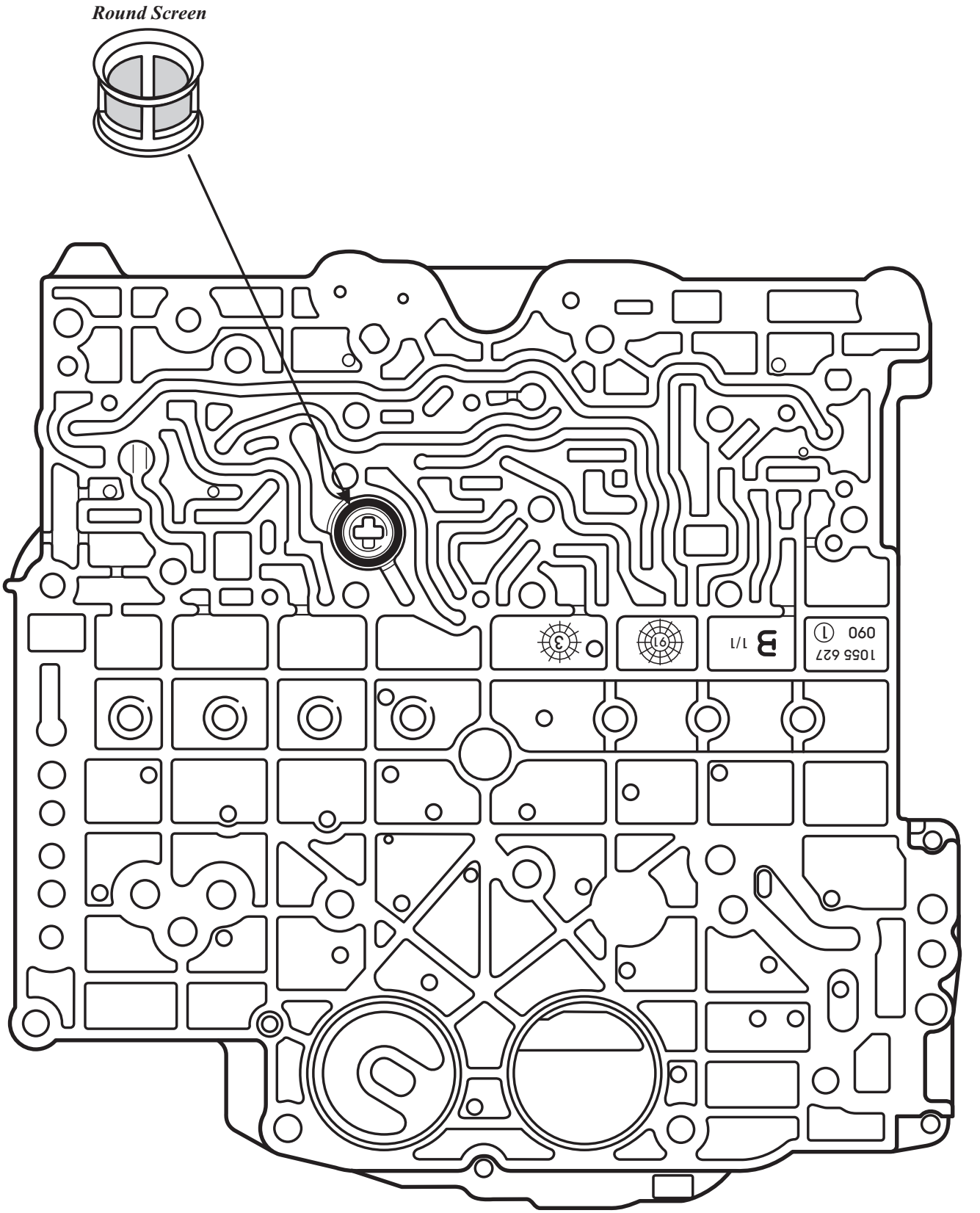


Figure 138

ZF-5HP-30 CHANNEL PLATE
LOWER VALVE BODY SIDE

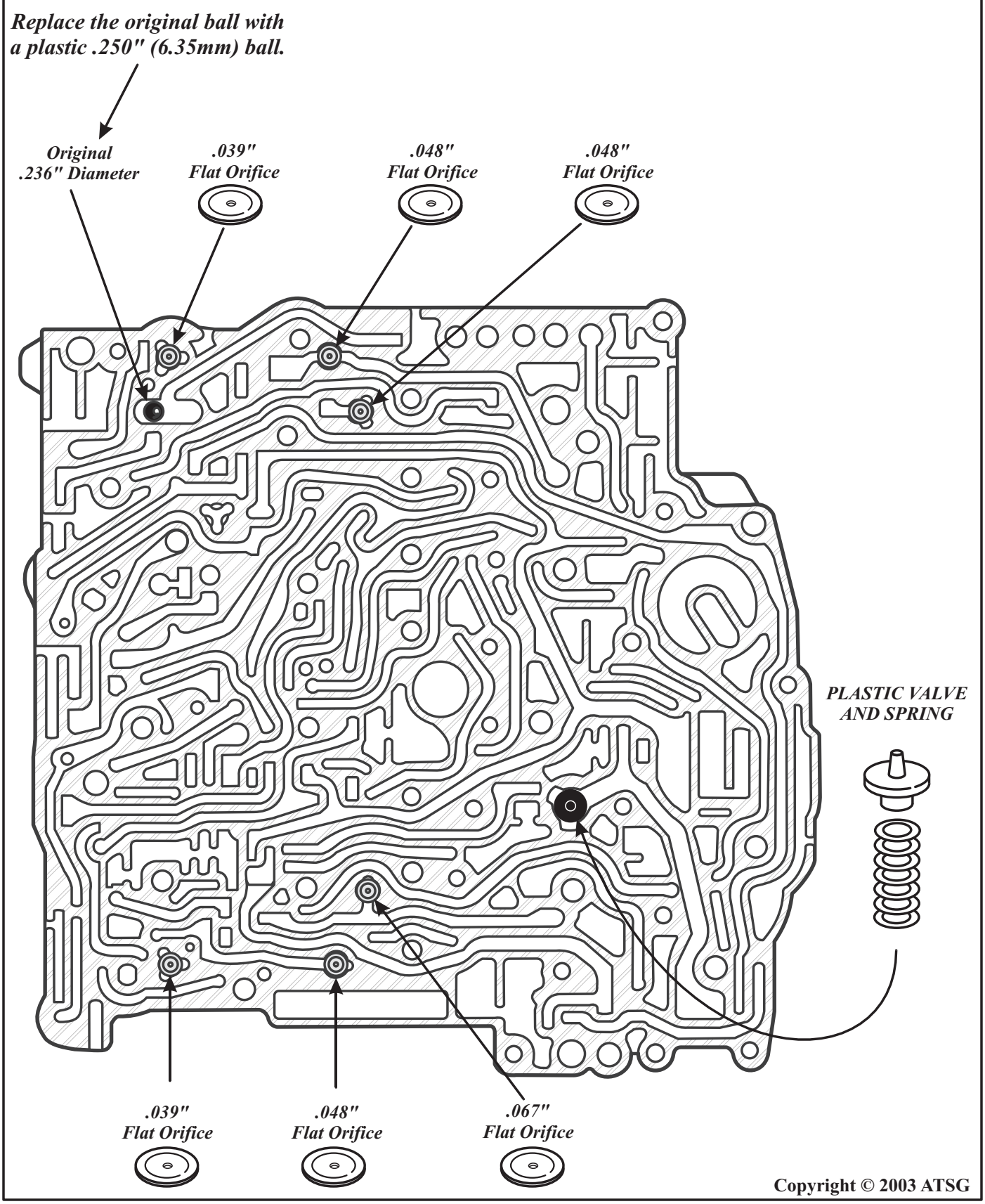


Figure 139

BMW ZF 5-HP-30
NO REVERSE

COMPLAINT: 1991 and later BMW vehicles equipped with the ZF 5-HP-30 transmission may exhibit a no reverse condition, when the selector lever is placed into reverse.

CAUSE: The cause may be, the .236" diameter checkball located in the bathtub in the channel plate has blown through the spacer plate, which will now exhaust "F" clutch (Reverse) oil pressure.

CORRECTION: Install a .250" diameter plastic checkball into the bathtub in the channel plate as shown in Figure 140. The holes in the spacer plate over the bathtub measure .198" and the larger diameter checkball will greatly decrease the probability of this condition occuring again. There is also ample room in the bathtub for the increased diameter of the checkball to perform its duties. Refer to Figure 140. Figure 141 illustrates the location of the only other checkball in this unit and, ***do not install checkball in the location marked "X".***

SPECIAL NOTE: The checkball wearing and blowing through the spacer plate causing the loss of reverse, may also have caused some damage to the "C" Clutch, which is also on in reverse. This condition has also been known to create damage to the "A"/"C" Clutch Housing as well. If the clutch housing has been severly damaged, aluminum material will be evident in the bottom pan upon inspection.

When the unit is removed and the "A"/"C" Clutch Housing is dis-assembled, it is not uncommon for the unit to set for over a week waiting on parts. When re-assembling, it is ***very easy to mis-assemble the "B" Clutch Hub*** on top of the retaining snap ring for the "A" Clutch pack. This mis-assembly will allow the "B" clutch hub to move out of the A/C clutch housing and create a neutralizing on the 3-4 upshift, and the Trans light will begin flashing. ***Ensure that you assemble the "B" Clutch Hub on top of the "A" Clutch stack, and then install the "A" Clutch Pressure Plate and snap ring, as shown in Figures 142 and 143.***

ZF-5HP-30 CHANNEL PLATE
LOWER VALVE BODY SIDE

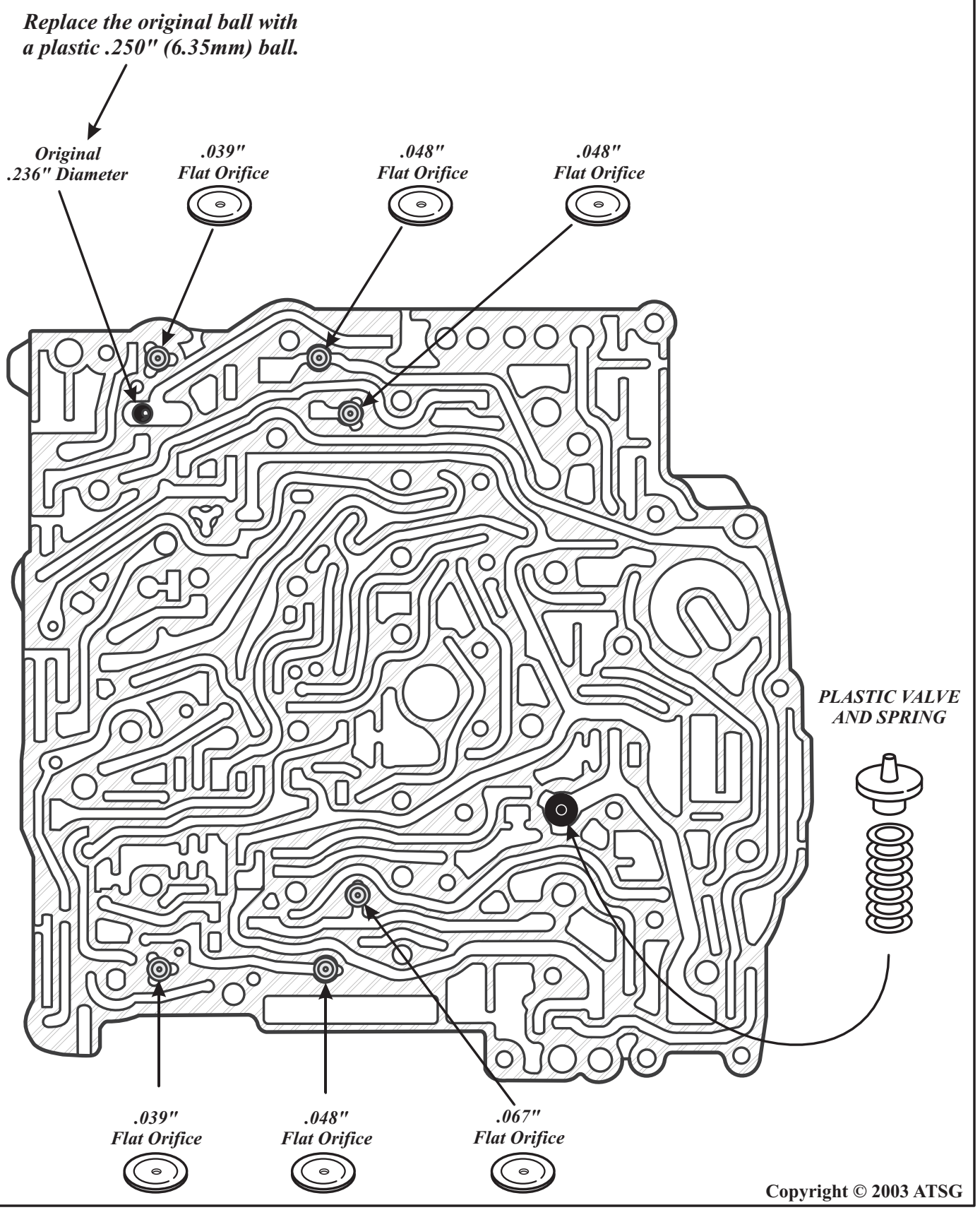


Figure 140

UPPER REAR VALVE BODY
CHECKBALL LOCATION

Only One .250" (6.35mm) ball is located here.
Do Not install a ball in the pocket marked X.

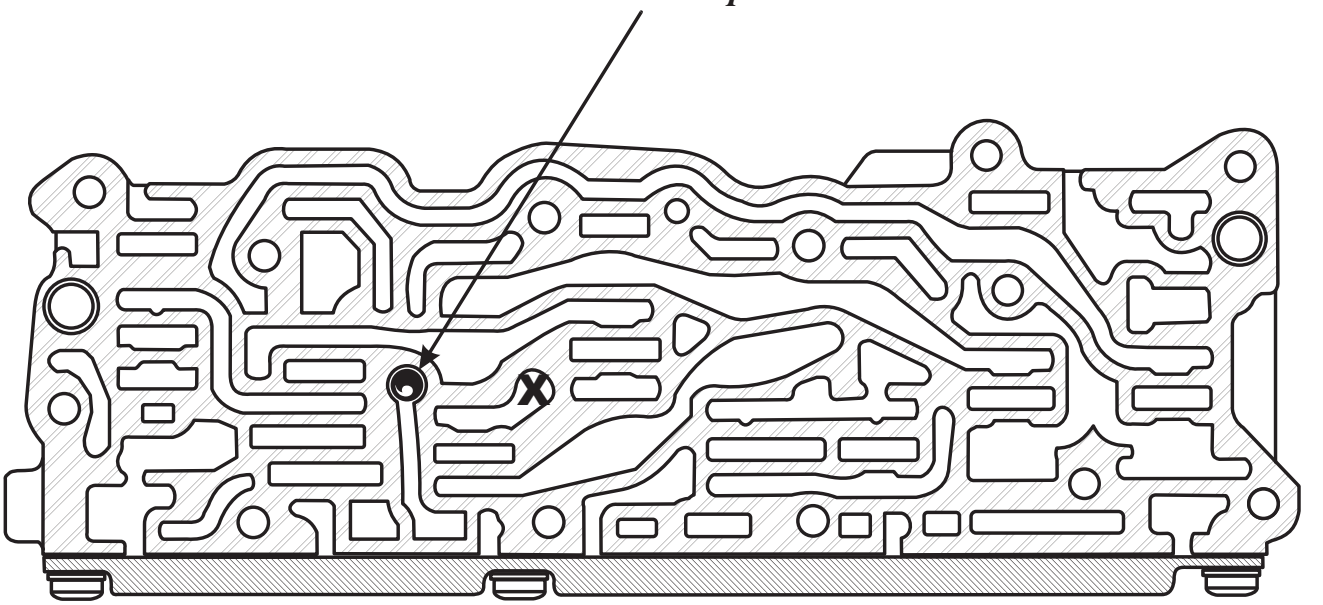
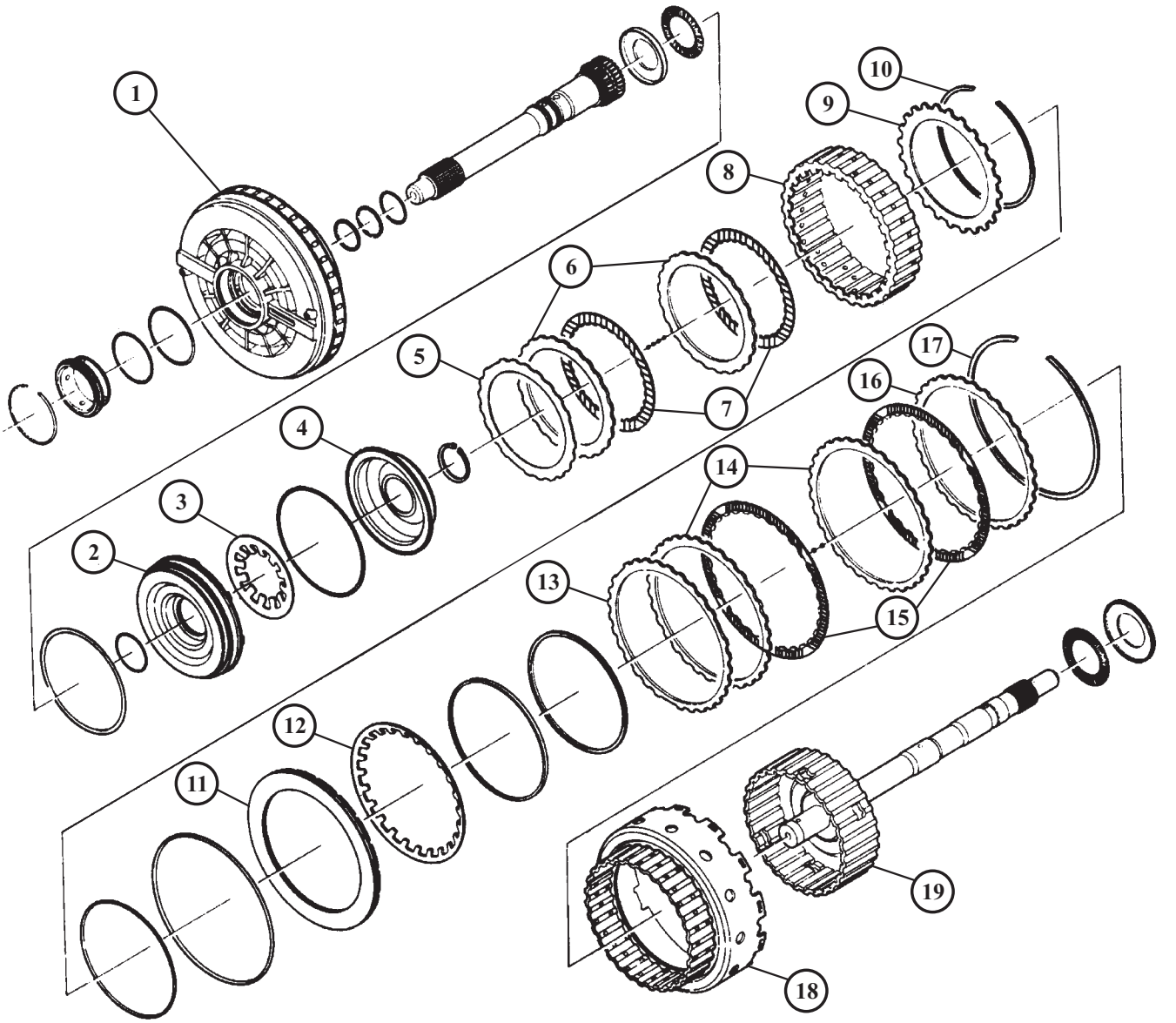


Figure 141

"A"/"C" CLUTCH HOUSING COMPONENTS



1. "A"/"C" Clutch Housing Assembly
2. "A" Clutch Apply Piston
3. "A" Clutch Bellville Return Spring
4. "A" Clutch Piston Oil Dam
5. "A" Clutch Cushion Plate
6. "A" Clutch Steel Plates (5 Required)
7. "A" Clutch Friction Plates (5 Required)
8. "B" Clutch Hub
9. "A" Clutch Pressure Plate
10. "A" Clutch Pressure Plate Snap Ring
11. "C" Clutch Apply Piston
12. "C" Clutch Apply Piston Return Spring
13. "C" Clutch Cushion Plate
14. "C" Clutch Steel Plates (3 Required)
15. "C" Clutch Friction Plates (3 Required)
16. "C" Clutch Pressure Plate
17. "C" Clutch Pressure Plate Snap Ring
18. "C" Clutch Hub
19. "A" Clutch Hub And Input Shaft

Figure 142

A/C CLUTCH HOUSING CUT-AWAY

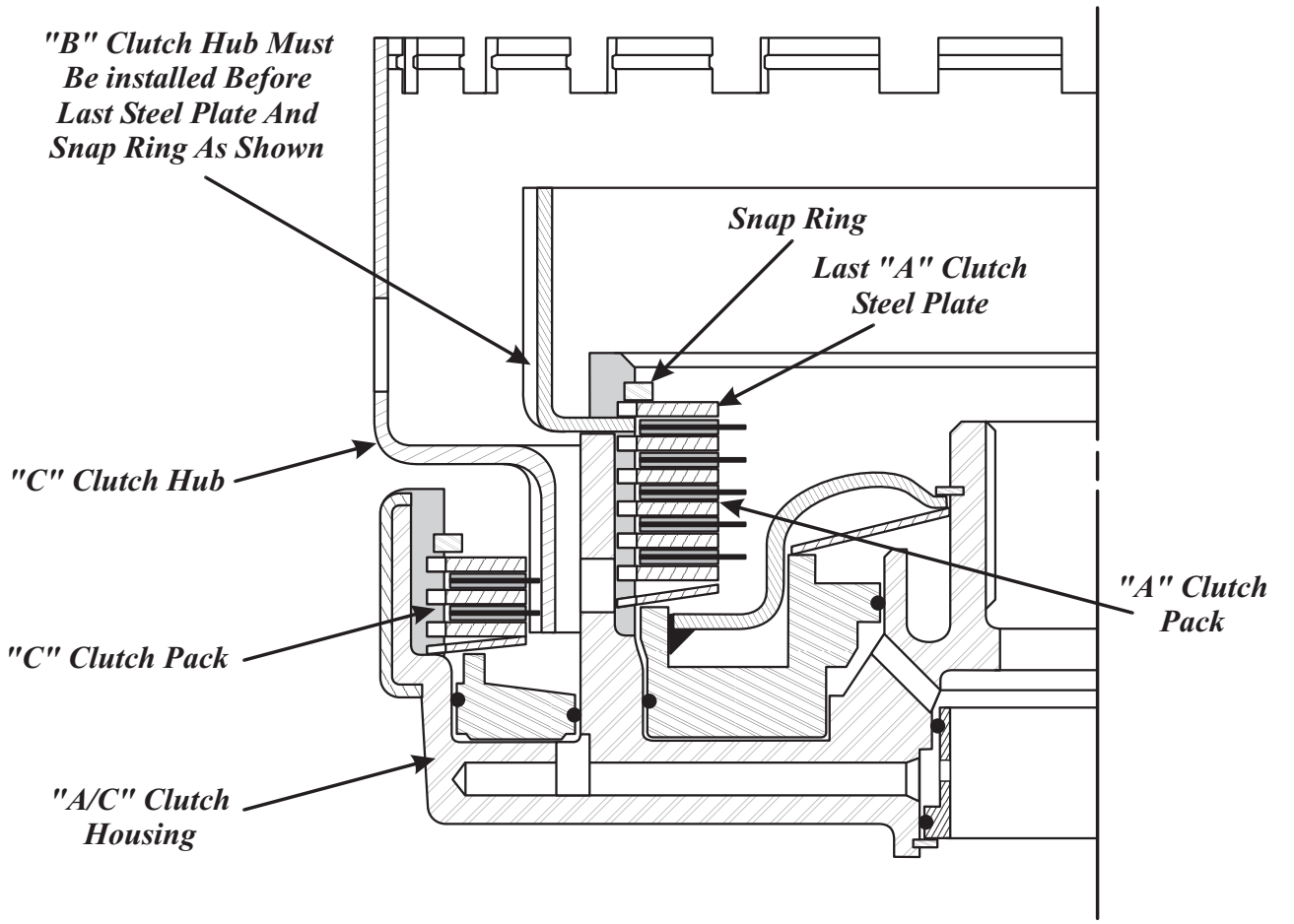


Figure 143