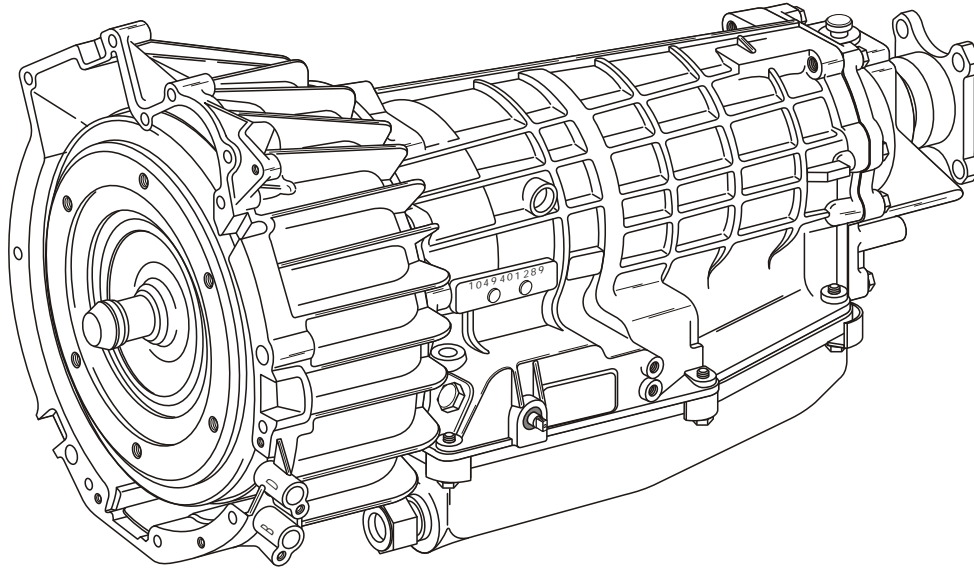




Technical Service Information

ZF 4HP-22/24 SERIES DIAGNOSTIC AND VALVE BODY INFORMATION



The Electronic Control system was first introduced in 1986 and was incorporated into the totally 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										

Copyright © 2003 ATSG

Figure 1



Technical Service Information

FOR ZF 4HP-22/24 SERIES VEHICLES

Refer to Figure 1 for model year usage of the "E7", 5 Solenoid and "E9", 4 Solenoid valve bodies.

Refer to Figure 2 for internal component application chart for all models.

Refer to Figure 3 for shift quadrant and mode switch differences between the different models.

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

Refer to Figure 4 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 5 for internal wire schematic and case connector terminal identification, along with a resistance chart to check the internal electronic components.

Refer to Figure 6 for individual solenoid operation.

Refer to Figure 7 for valve body assembly exploded view.

Refer to Figure 8 for Lower Front Valve Body exploded view, with valve identification, and individual spring specifications, as observed in a used valve body.

Refer to Figure 9 for Lower Rear Valve Body exploded view, with valve identification, and individual spring specifications, as observed in a used valve body.

Refer to Figure 10 for MV-1 and MV-2 Shift Solenoid Body exploded view, with valve identification, and spring specifications, as observed in a used valve body.

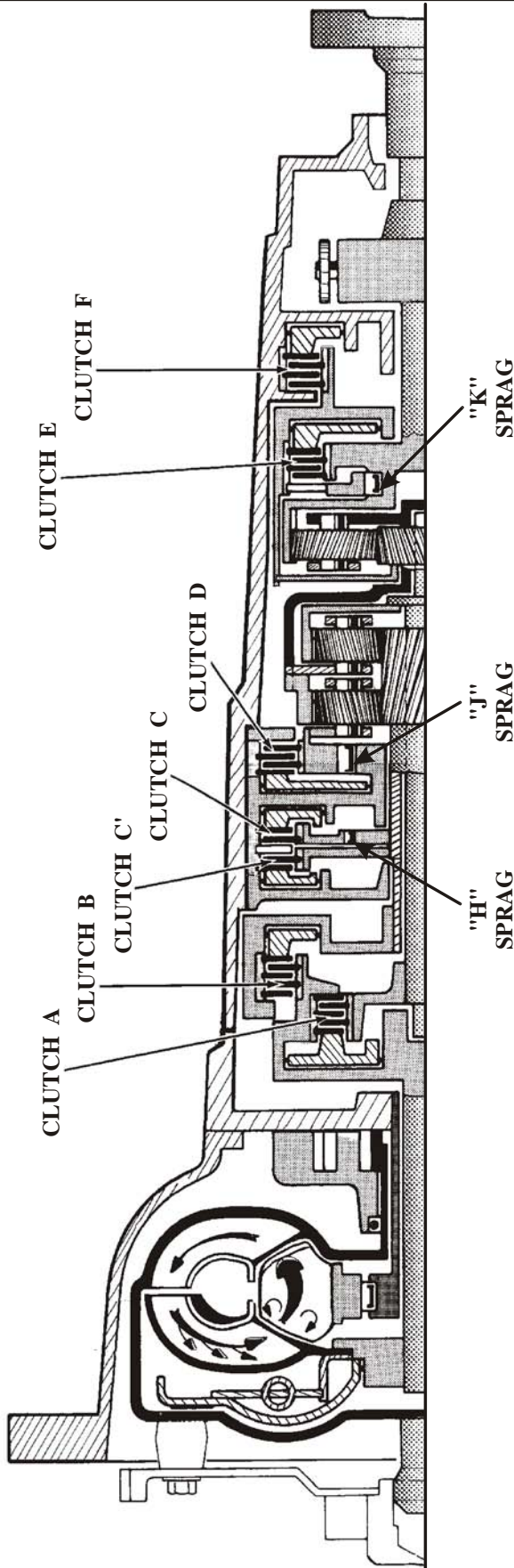
Refer to Figure 11 for Pressure Control Solenoid Body exploded view, with solenoid identification.

Refer to Figure 12 for Reverse Lockout Solenoid Body exploded view, with valve identification, and spring specifications, as observed in a used valve body.

Refer to Figures 13, 14, 15, 16 for retainer, checkball and orifice locations.

FOR MODEL "E9", "4 SOLENOID" VALVE BODY INFORMATION AND THE INDEX REFER TO FIGURE 17 IN THIS BULLETIN

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		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									

Copyright © 2003 ATSG

Figure 2

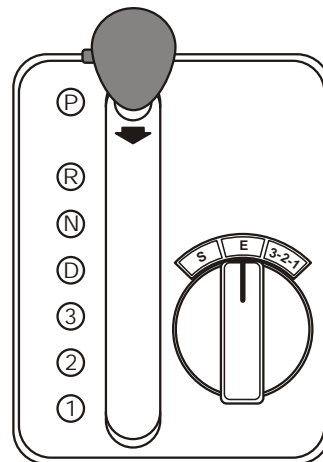
SHIFT QUADRANTS FOR ZF 4HP-22/24 SERIES

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

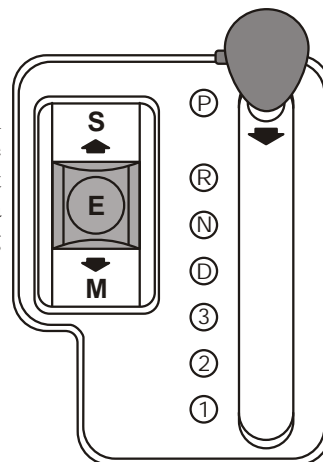


Late "E-7" Models Only (5 Solenoid)

- (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.

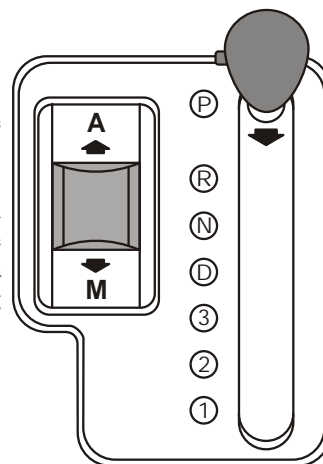


"E-9" Models Only (4 Solenoid)

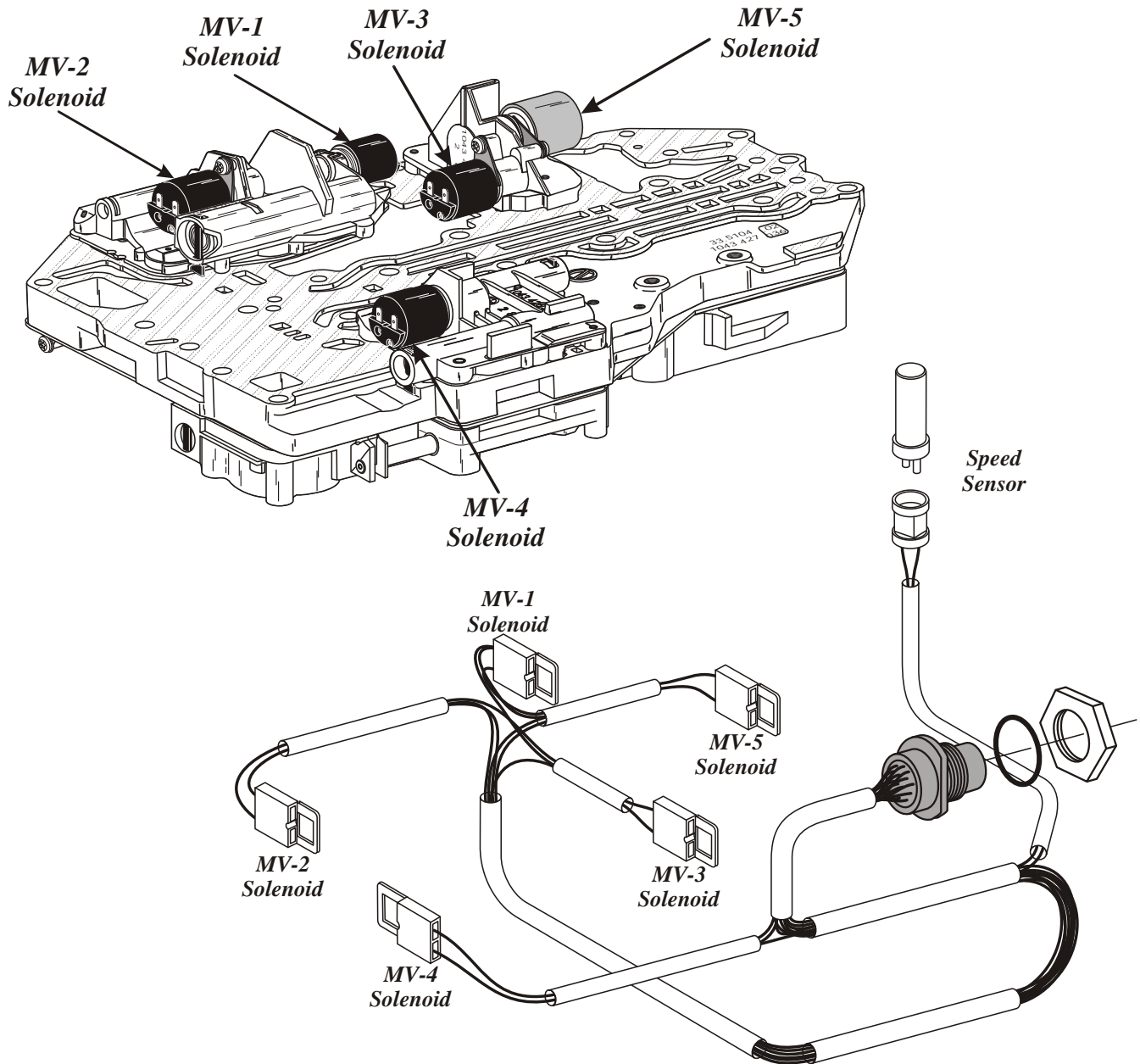
- (P) = Parking Pawl Engaged
- (R) = Reverse Gear
- (N) = Neutral
- (D) = Automatic Shifts 1st thru 4th Gears
- (3) = Automatic Shifts 1st thru 3rd Gears.
4th Gear is locked out.
- (2) = Automatic Shifts 1st thru 2nd Gears.
3rd and 4th Gear is locked out.
- (1) = 1st Gear Only.
2nd, 3rd and 4th Gear 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.



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



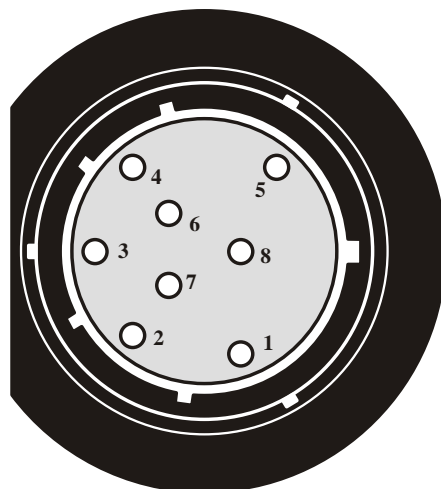
Solenoid	Function	Gear	MV-1	MV-2
MV-1	Shift Control	1st	ON	ON
MV-2	Shift Control	2nd	OFF	ON
		3rd	OFF	OFF
		4th	ON	OFF
MV-3	Lock-Up Control			
MV-4	Reverse Lockout			
MV-5	Line Pressure Control			

Copyright © 2003 ATSG

Figure 4

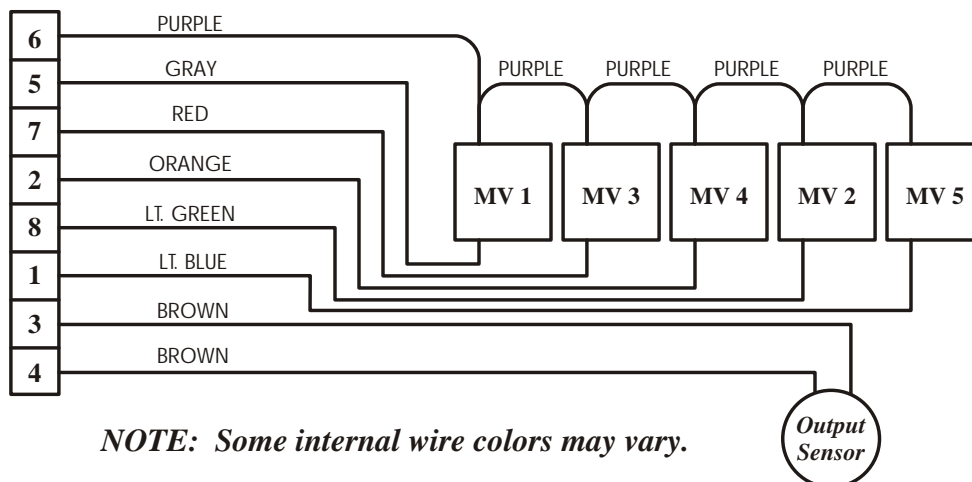
ZF-4HP-22/24 MODEL "E-7", "5 SOLENOID" INTERNAL WIRE SCHEMATIC AND CONNECTOR TERMINAL IDENTIFICATION

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

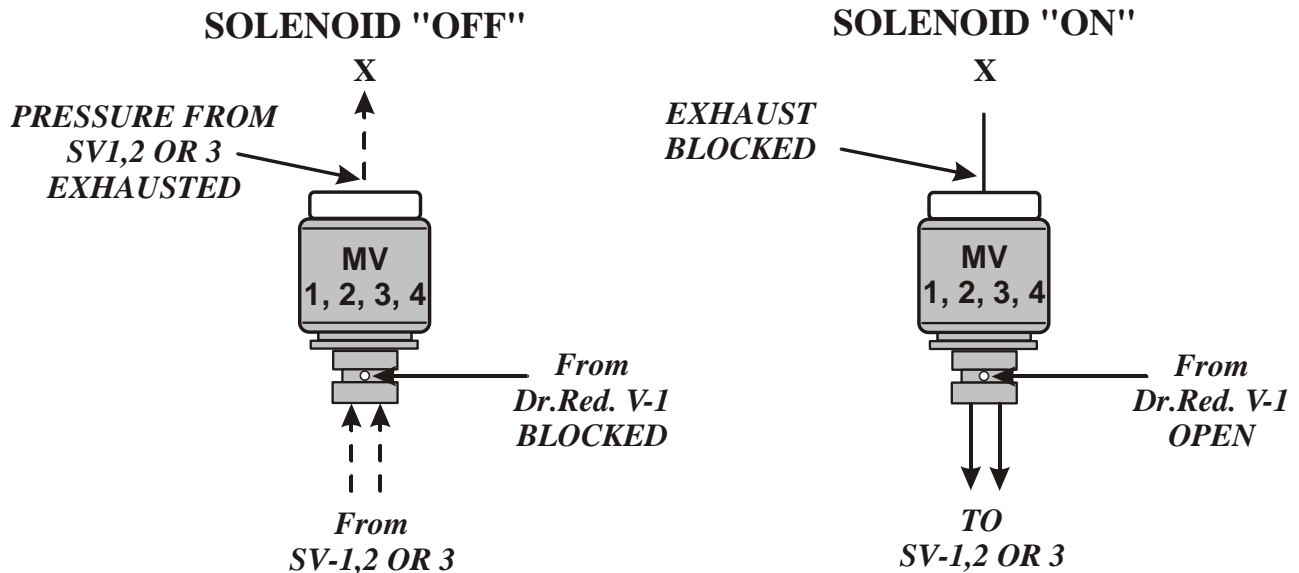
COMPONENT	TERMINALS	RESISTANCE	PART NUMBER
<i>MV 1 Solenoid</i>	<i>5 And 6</i>	<i>30 - 34 Ohms</i>	<i>0501 307 869</i>
<i>MV 2 Solenoid</i>	<i>8 And 6</i>	<i>30 - 34 Ohms</i>	<i>0501 307 869</i>
<i>MV 3 Solenoid</i>	<i>7 And 6</i>	<i>30 - 34 Ohms</i>	<i>0501 307 869</i>
<i>MV 4 Solenoid</i>	<i>2 And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



Copyright © 2003 ATSG

Figure 5

ZF-4HP-22 MODEL "E7", "5 SOLENOID" VALVE BODY, SOLENOID OPERATION MV1, 2, 3 AND 4 OPERATION

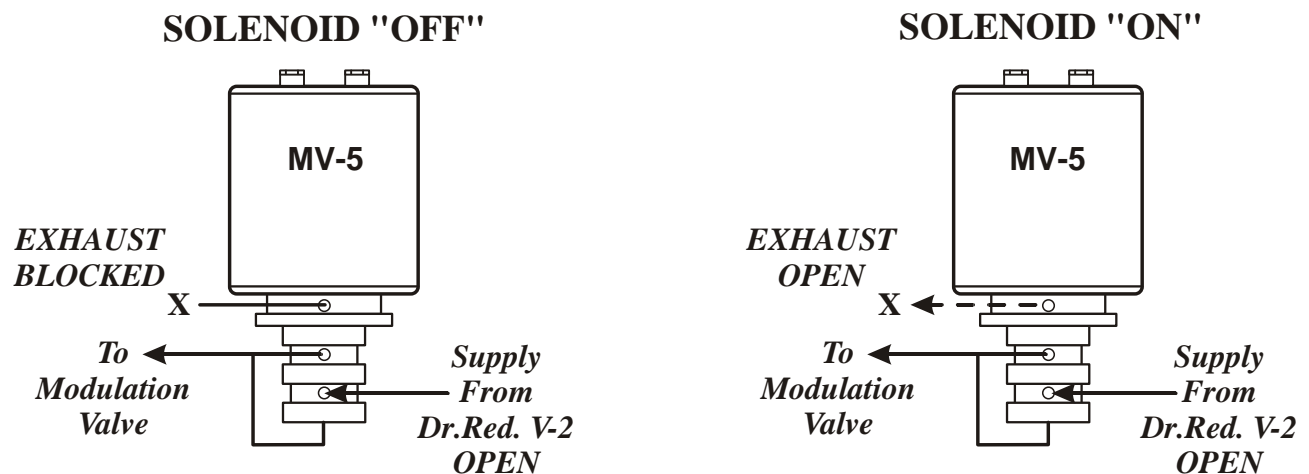


SUMMARY:

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)



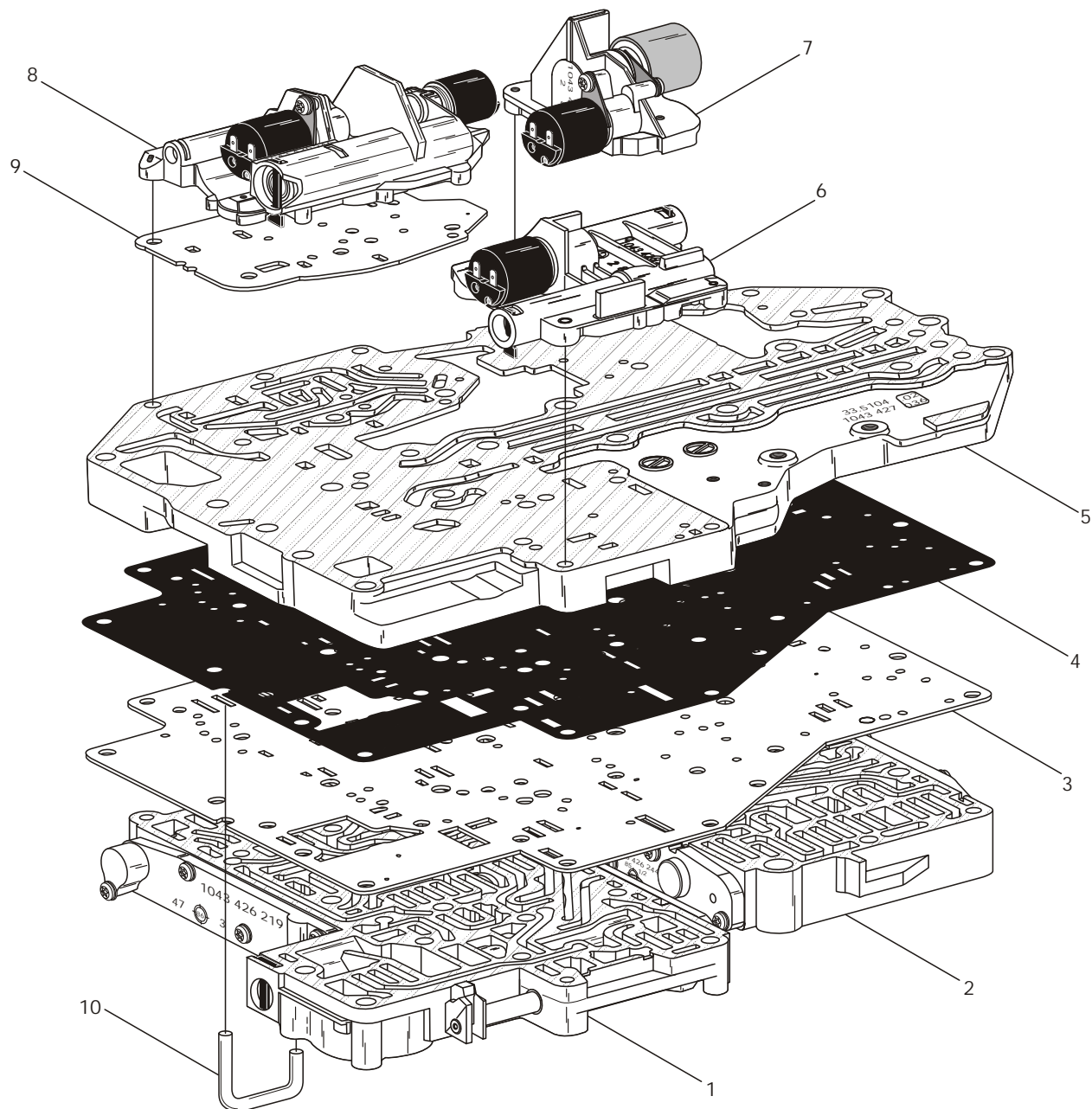
When MV-5 solenoid is "OFF," solenoid reducing pressure, from Dr. Red. V-2, is high to MOD-V valve which creates high line pressure.

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.

Copyright © 2003 ATSG

Figure 6

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

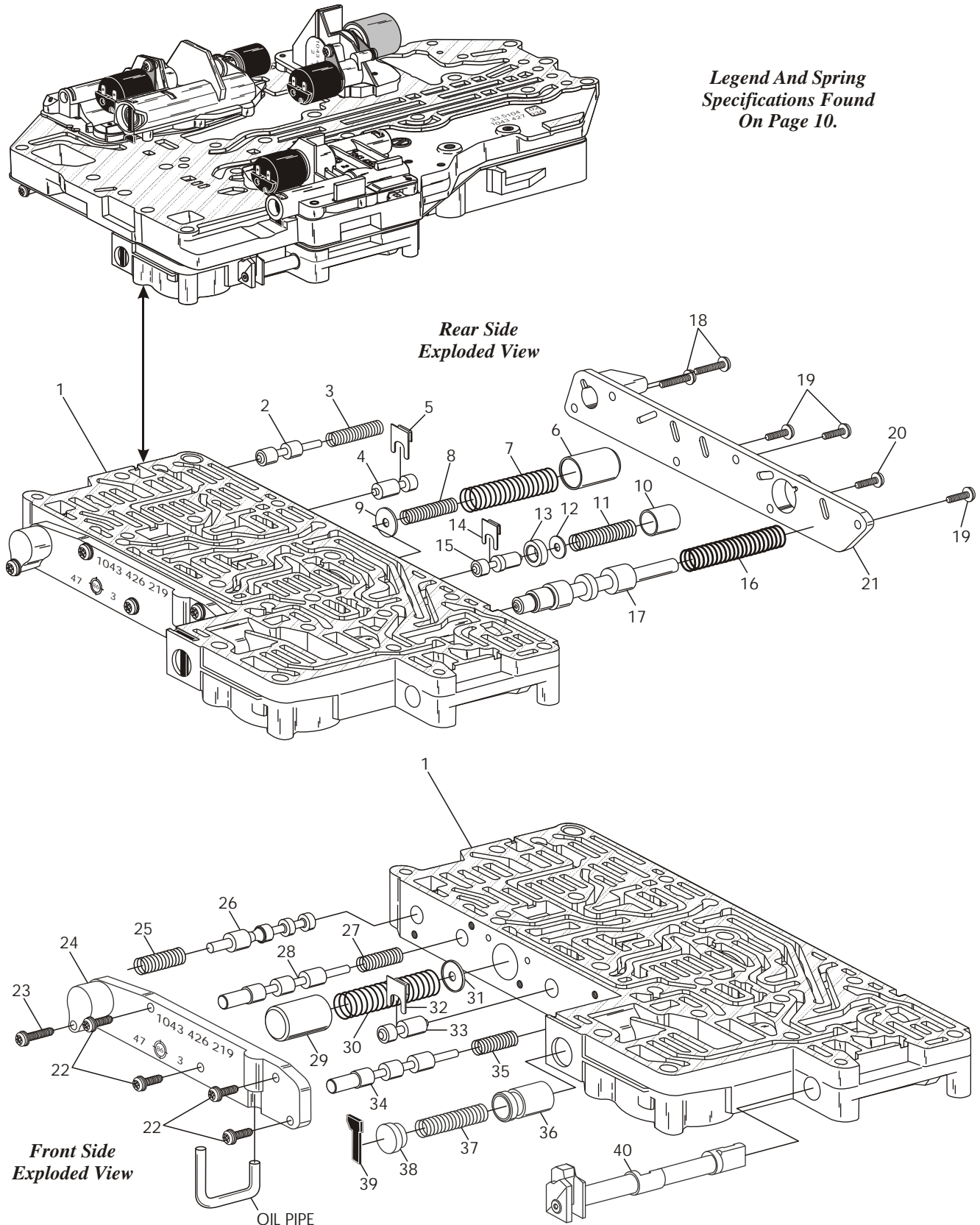
- 6 MV-4 SOLENOID BODY ASSEMBLY
- 7 MV-3 AND MV-5 SOLENOID BODY ASSEMBLY
- 8 MV-1 AND MV-2 SOLENOID BODY ASSEMBLY
- 9 MV-1/MV-2 SOLENOID BODY TO CHANNEL PLATE SPACER PLATE
- 10 OIL PIPE, LOWER FRONT VALVE BODY TO CHANNEL PLATE

Copyright © 2003 ATSG

Figure 7

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

*Legend And Spring
Specifications Found
On Page 10.*



Copyright © 2003 ATSG

Figure 8



Technical Service Information

FIGURE 8 LEGEND AND SPRING SPECIFICATIONS

1 LOWER FRONT VALVE BODY CASTING	36 "A" CLUTCH DAMPER PISTON	
2 "C" CLUTCH VALVE	37 "A" CLUTCH DAMPER SPRING	
3 "C" CLUTCH VALVE SPRING	38 "A" CLUTCH DAMPER PISTON SPRING SEAT	
4 "C" CLUTCH VALVE	39 "A" CLUTCH DAMPER SPRING SEAT RETAINER	
5 "C" CLUTCH VALVE RETAINER	40 MANUAL SHIFT VALVE	
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	SPRING ILLUSTRATION NO. 3:	SPRING ILLUSTRATION NO. 25:
11 "D" CLUTCH DAMPER PISTON SPRING	FREE LENGTH = 1.495"	FREE LENGTH = 1.830"
12 "D" CLUTCH DAMPER PISTON SPRING SEAT	SPRING DIAMETER = .360"	SPRING DIAMETER = .435"
13 "D" CLUTCH VALVE SLEEVE	WIRE DIAMETER = .035"	WIRE DIAMETER = .040"
14 "D" CLUTCH VALVE RETAINER		
15 "D" CLUTCH VALVE	SPRING ILLUSTRATION NO. 7:	SPRING ILLUSTRATION NO. 27:
16 PRESSURE REGULATOR VALVE SPRING	FREE LENGTH = 3.160"	FREE LENGTH = 1.660"
17 PRESSURE REGULATOR VALVE	SPRING DIAMETER = .595"	SPRING DIAMETER = .360"
18 REAR SIDE COVER RETAINING BOLT, 34 mm LENGTH (2)	WIRE DIAMETER = .044"	WIRE DIAMETER = .036"
19 REAR SIDE COVER RETAINING BOLT, 17 mm LENGTH (3)		
20 REAR SIDE COVER RETAINING BOLT, 21 mm LENGTH (1)	SPRING ILLUSTRATION NO. 8:	SPRING ILLUSTRATION NO. 30:
21 REAR SIDE COVER	FREE LENGTH = 1.560"	FREE LENGTH = 3.160"
22 FRONT SIDE COVER RETAINING BOLT, 17 mm LENGTH (4)	SPRING DIAMETER = .430"	SPRING DIAMETER = .595"
23 FRONT SIDE COVER RETAINING BOLT, 29 mm LENGTH (1)	WIRE DIAMETER = .040"	WIRE DIAMETER = .044"
24 FRONT SIDE COVER		
25 TORQUE CONVERTER LOCK-UP VALVE SPRING	SPRING ILLUSTRATION NO. 11:	SPRING ILLUSTRATION NO. 35:
26 TORQUE CONVERTER LOCK-UP VALVE	FREE LENGTH = 1.653"	FREE LENGTH = 1.660"
27 2-3 SHIFT VALVE SPRING	SPRING DIAMETER = .550"	SPRING DIAMETER = .360"
28 2-3 SHIFT VALVE	WIRE DIAMETER = .044"	WIRE DIAMETER = .036"
29 "C" CLUTCH DAMPER PISTON		
30 "C" CLUTCH DAMPER PISTON SPRING	SPRING ILLUSTRATION NO. 16:	SPRING ILLUSTRATION NO. 37:
31 "C" CLUTCH DAMPER PISTON SPRING SEAT	FREE LENGTH = 3.575"	FREE LENGTH = 2.515"
32 "B" CLUTCH REGULATOR VALVE RETAINER	SPRING DIAMETER = .600"	SPRING DIAMETER = .410"
33 "B" CLUTCH REGULATOR VALVE	WIRE DIAMETER = .080"	WIRE DIAMETER = .050"
34 1-2 SHIFT VALVE		
35 1-2 SHIFT VALVE SPRING		

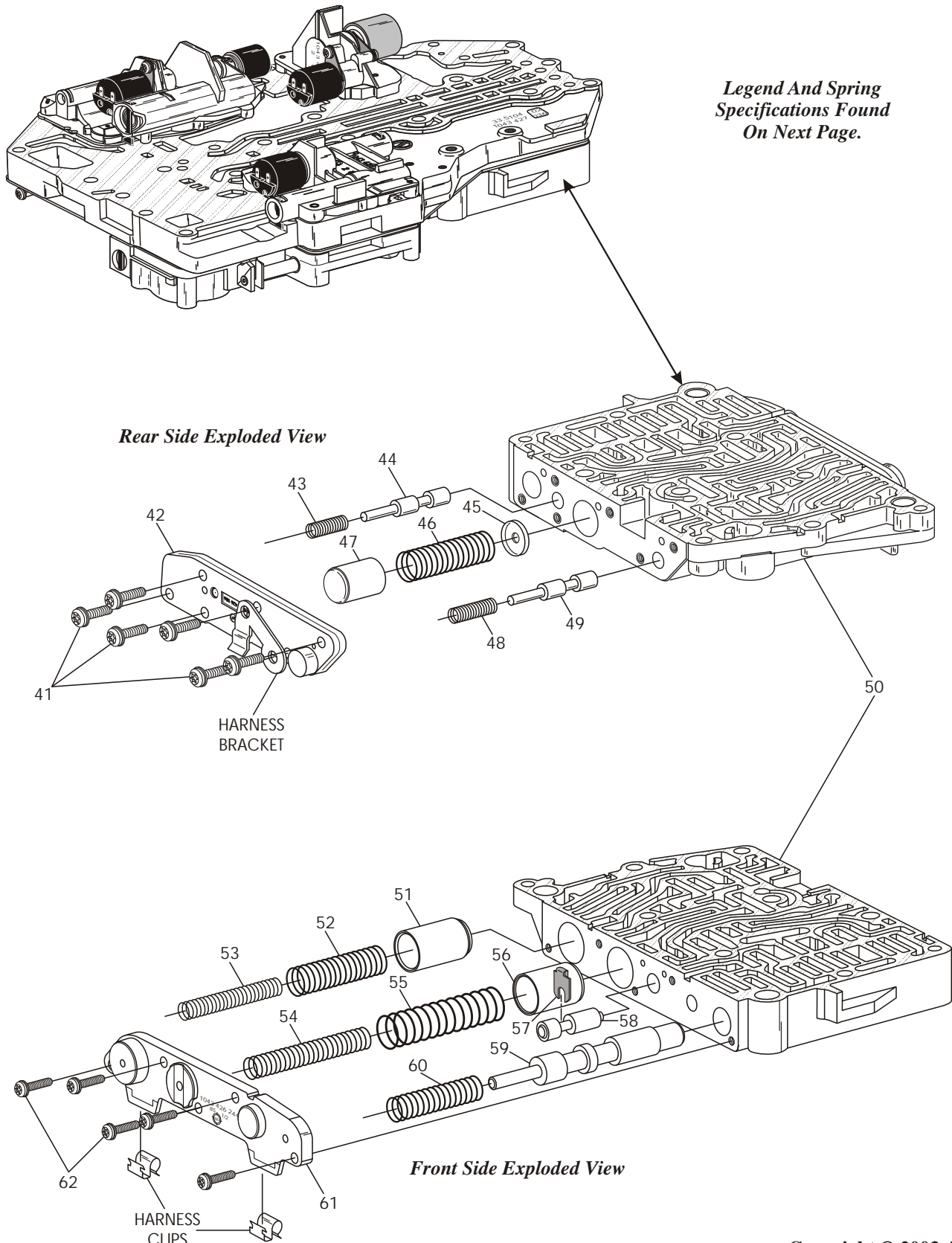
Copyright © 2003 ATSG

Figure 8 Legend

Copyright © 2003 ATSG

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

*Legend And Spring
Specifications Found
On Next Page.*



Copyright © 2003 ATSG

Figure 9



Technical Service Information

FIGURE 9 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. 53: FREE LENGTH = 3.511"
SPRING DIAMETER = .405"
WIRE DIAMETER = .049"

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

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

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

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

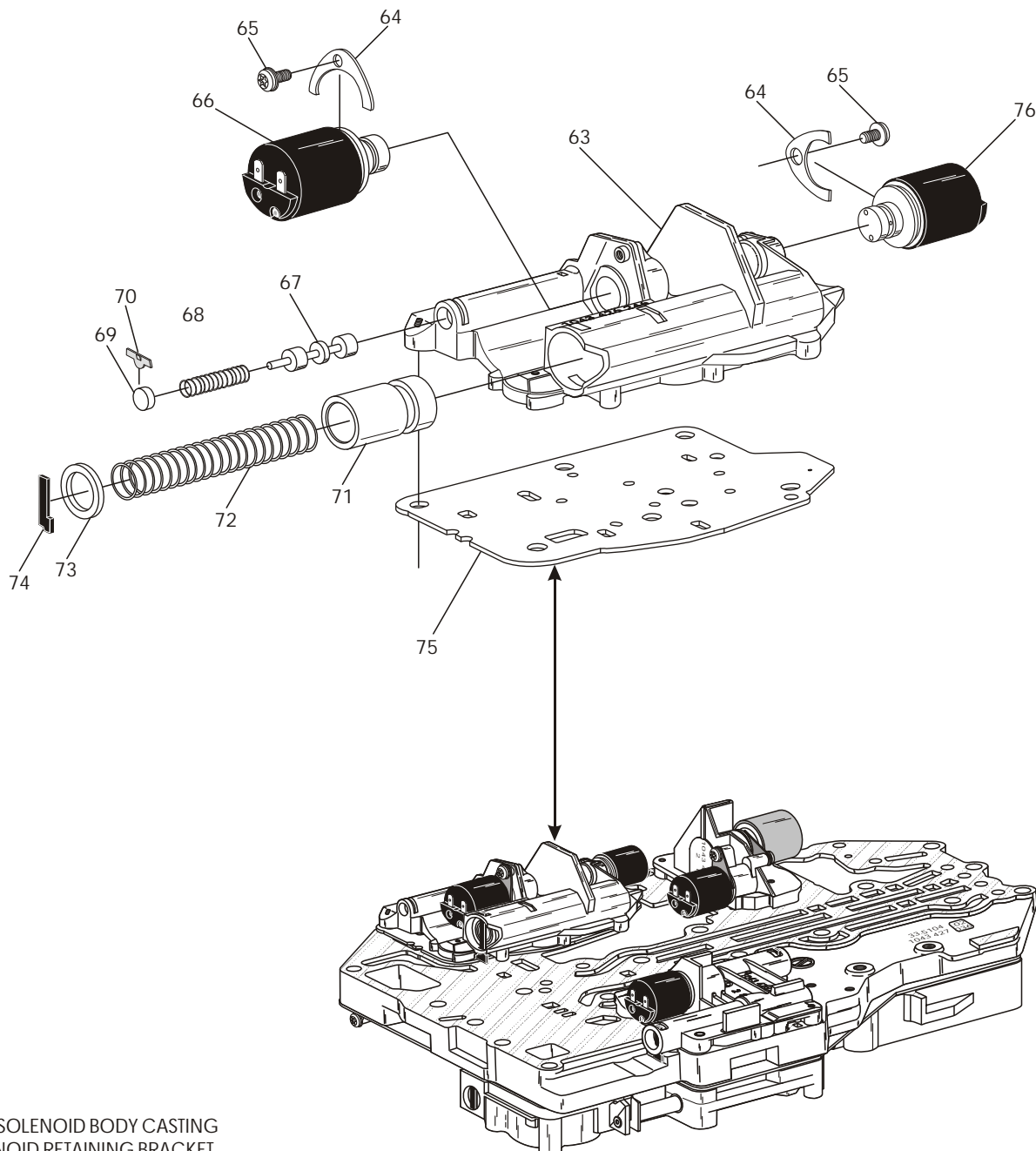
SPRING ILLUSTRATION NO. 52: FREE LENGTH = 2.945"
SPRING DIAMETER = .600"
WIRE DIAMETER = .066"

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

Copyright © 2003 ATSG

Figure 9 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

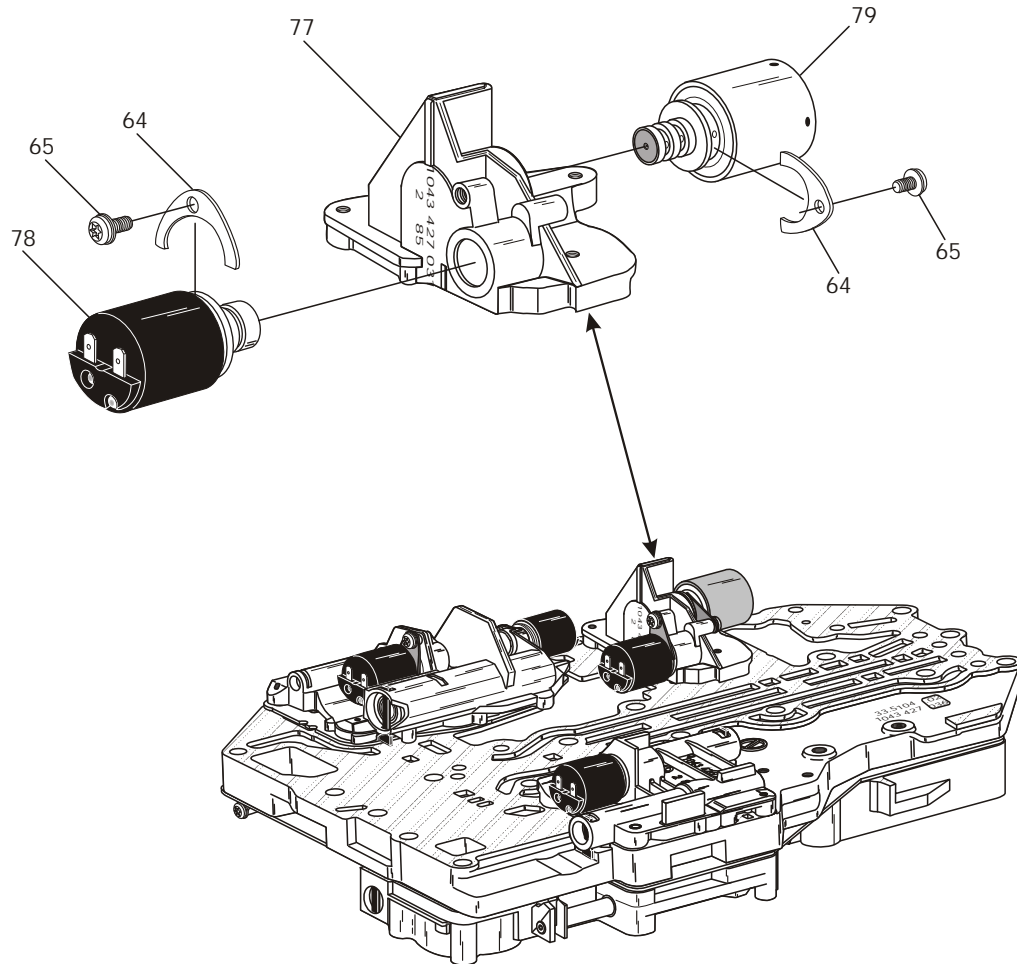
SPRING ILLUSTRATION NO. 68:
FREE LENGTH = 1.542"
SPRING DIAMETER = .372"
WIRE DIAMETER = .035"

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

Copyright © 2003 ATSG

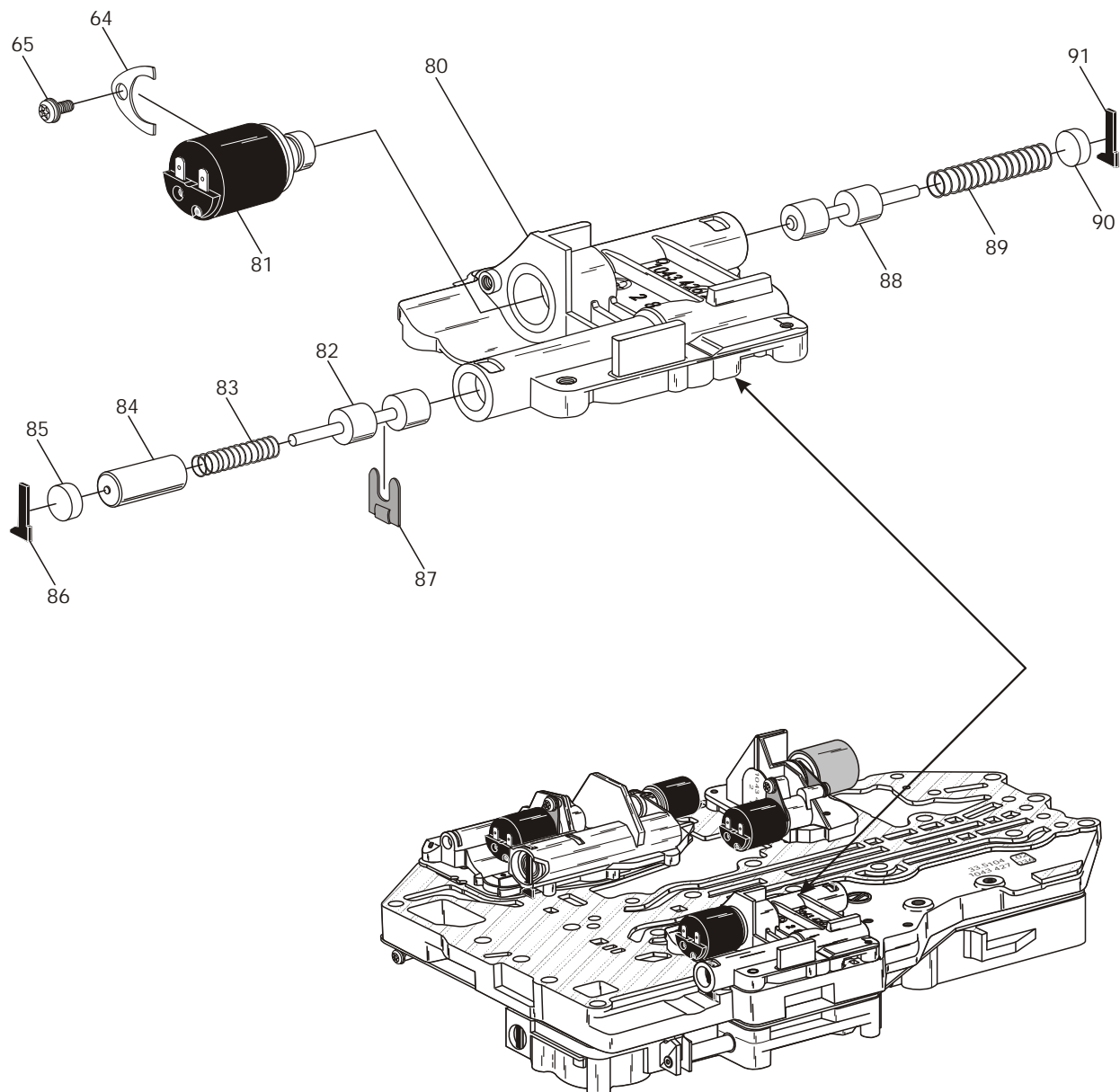
Figure 10

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

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

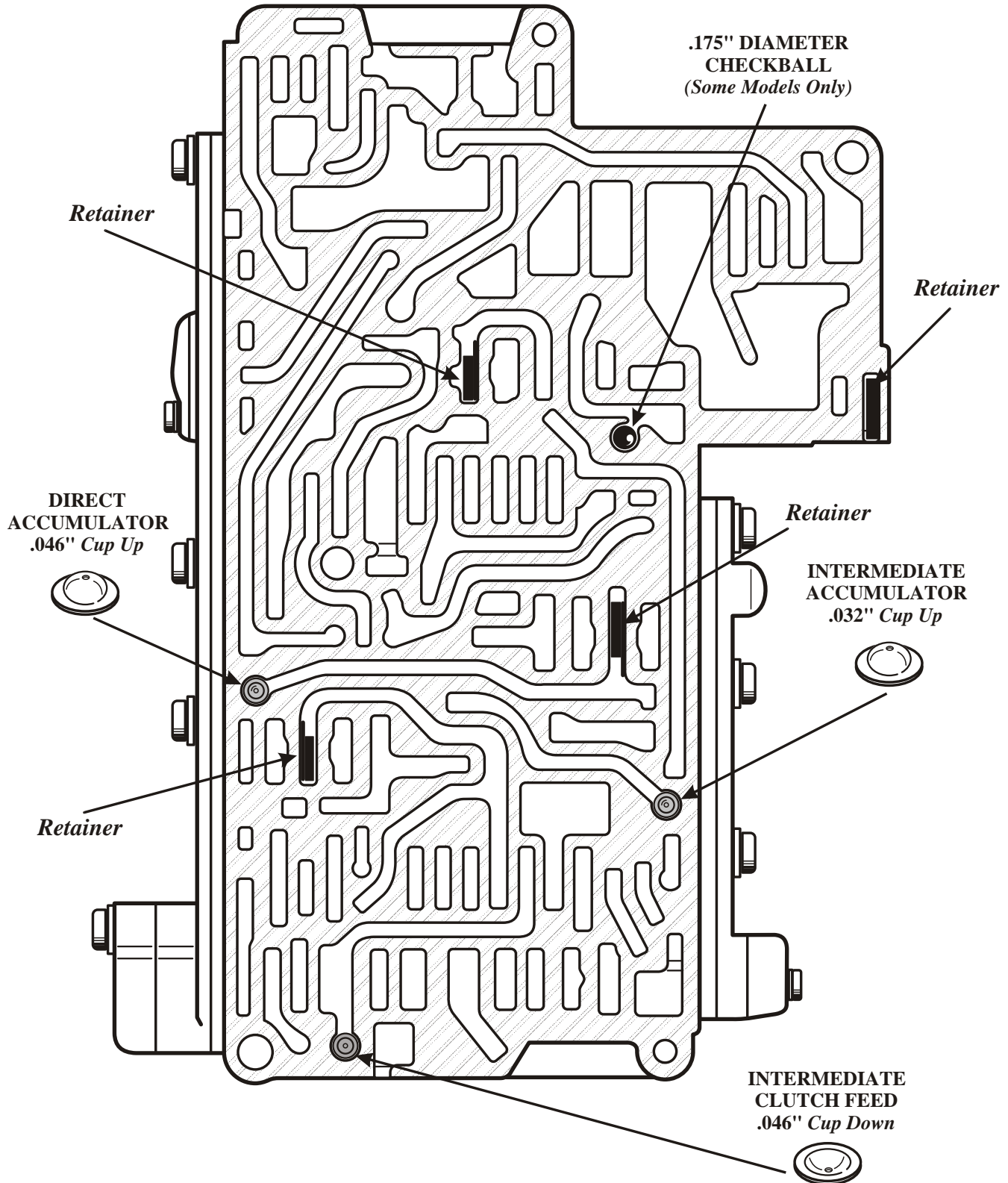
SPRING ILLUSTRATION NO. 83:
FREE LENGTH = 1.480"
SPRING DIAMETER = .310"
WIRE DIAMETER = .035"

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

Copyright © 2003 ATSG

Figure 12

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



Copyright © 2003 ATSG

Figure 13

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

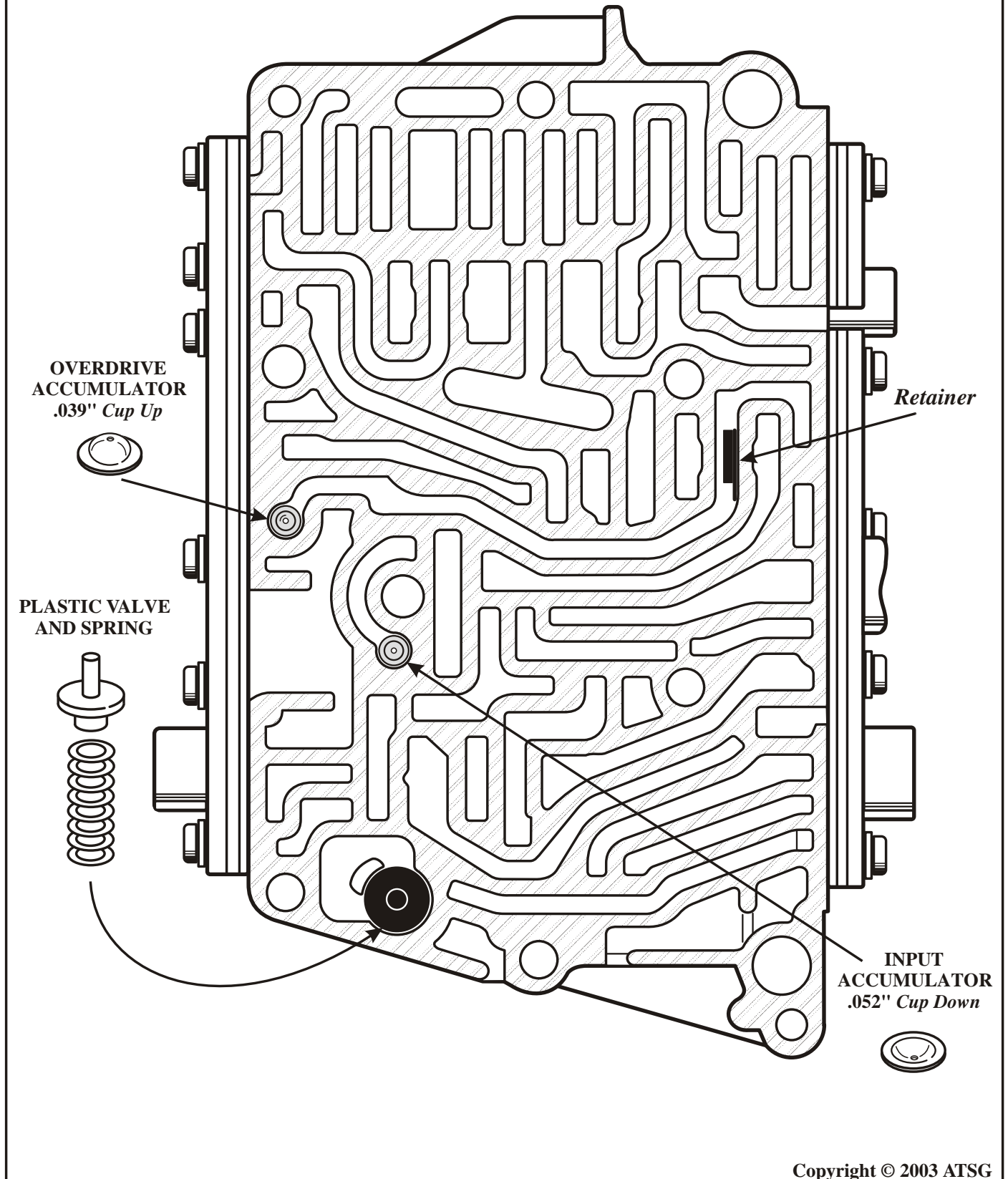
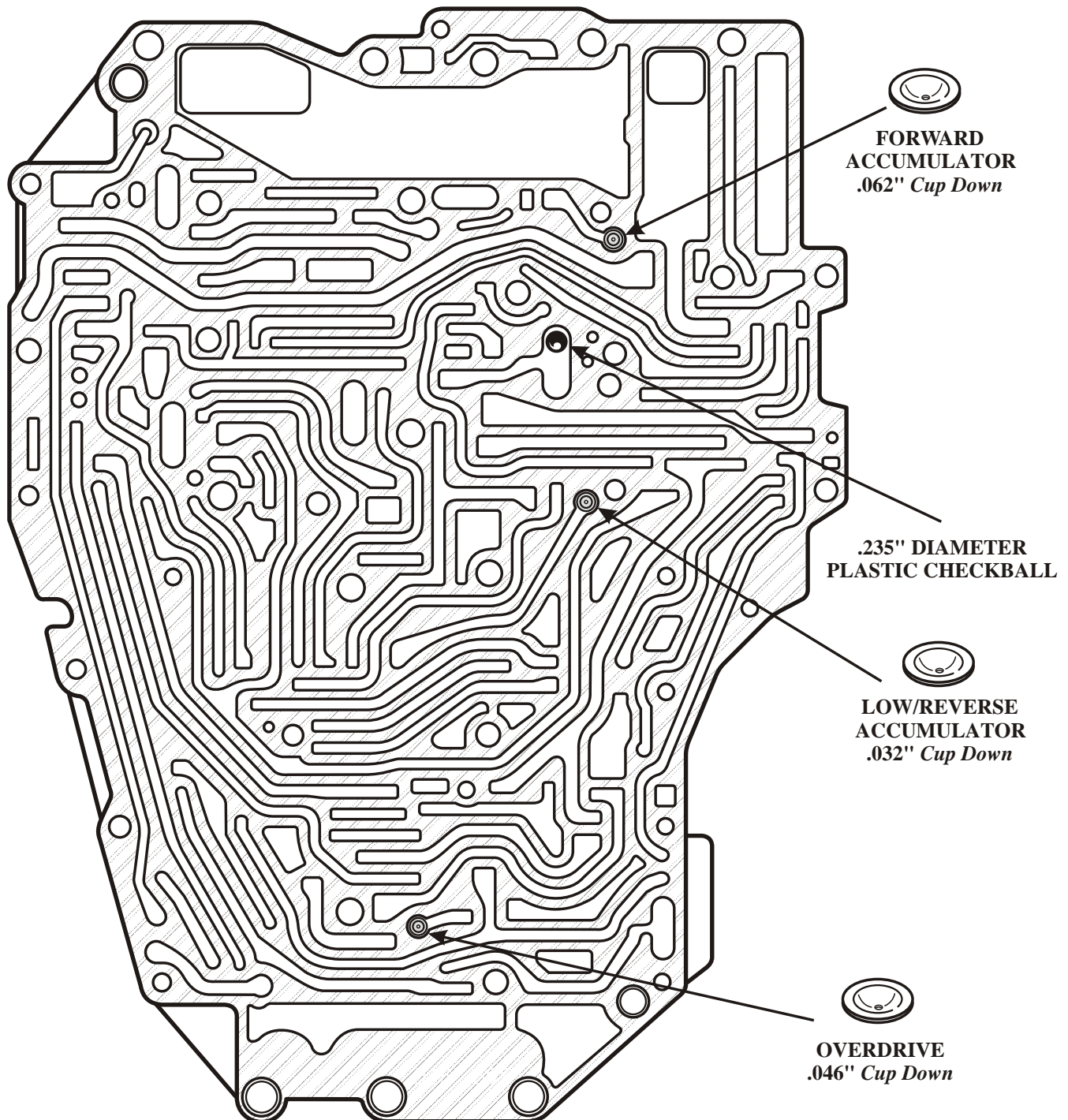


Figure 14

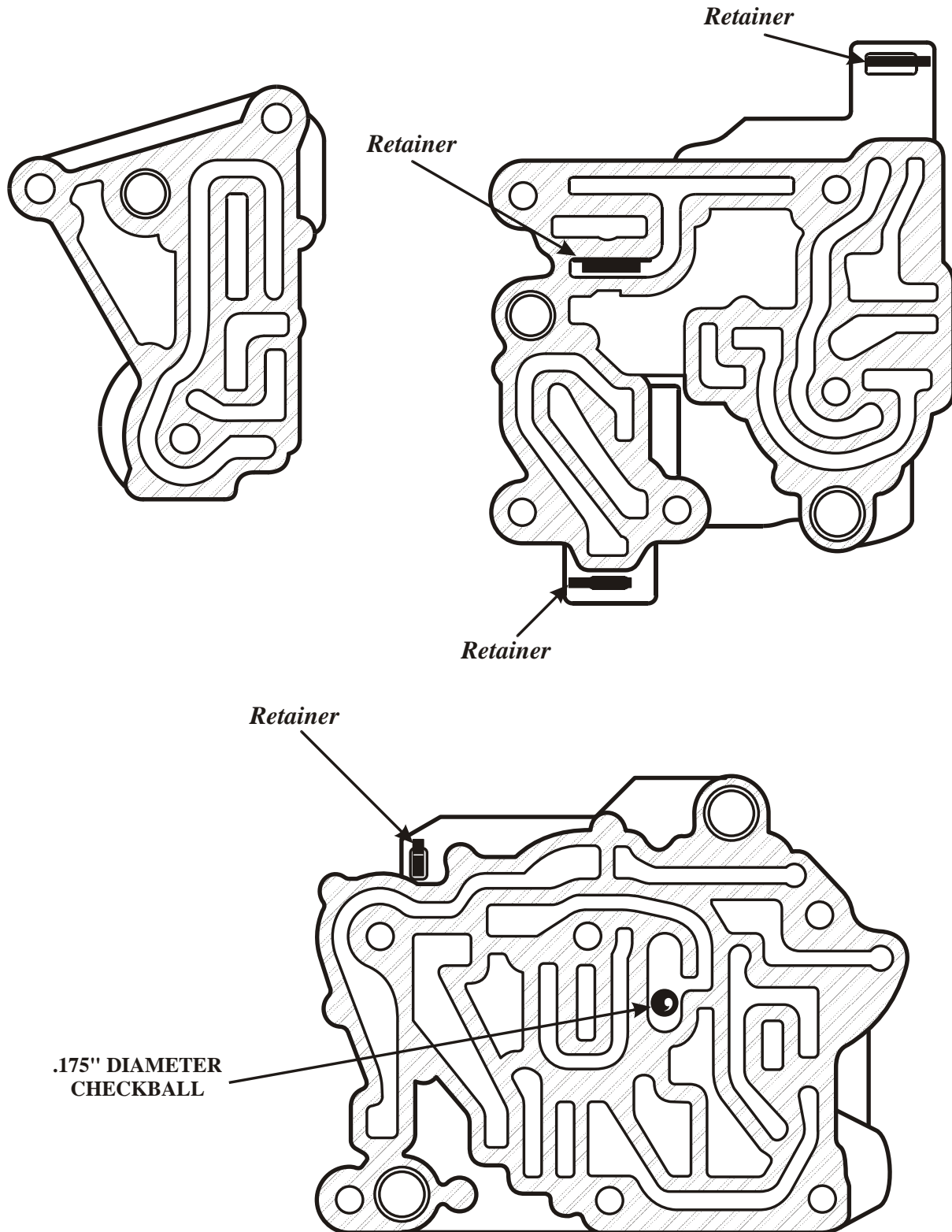
ZF-4HP-22/24 MODEL "E-7", "5 SOLENOID" CHANNEL PLATE



Copyright © 2003 ATSG

Figure 15

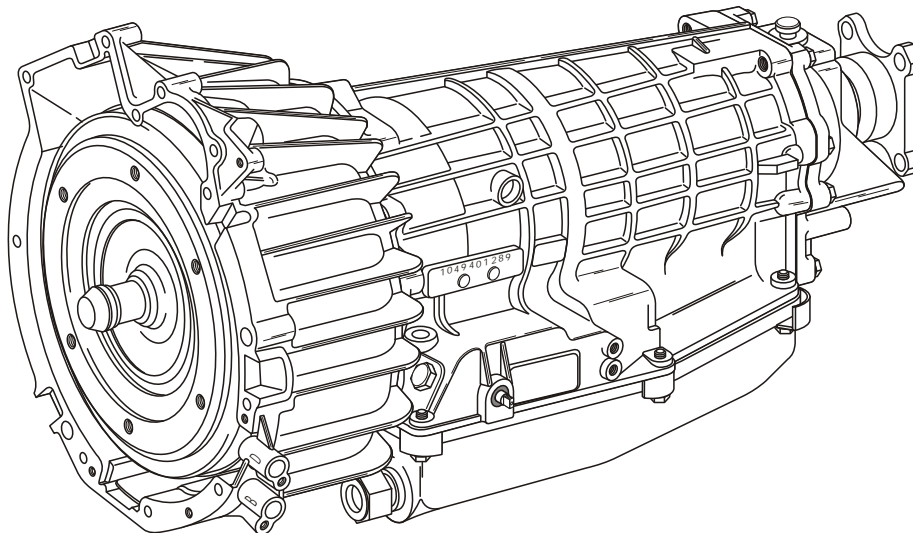
ZF-4HP-22/24 MODEL "E-7", "5 SOLENOID" ALL SOLENOID BODIES



Copyright © 2000 ATSG

Figure 16

ZF 4HP-22/24 SERIES DIAGNOSTIC INFORMATION



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

Refer to Figure 18 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 19 for internal wire schematic and case connector terminal identification, along with a resistance chart to check the internal electronic components.

Refer to Figure 20 for individual solenoid operation.

Refer to Figure 21 for Complete Valve Body Assembly exploded view.

Refer to Figure 22 for Lower Front Valve Body exploded view, with valve identification.

Refer to Figure 23 for Lower Rear Valve Body exploded view, with valve identification.

Refer to Figure 24 for MV-5 Solenoid Body exploded view, with valve identification.

Refer to Figure 25 for MV-1 and MV-2 Solenoid Body exploded view, with valve identification.

Refer to Figure 26 for MV-3 Lock-Up Solenoid Body exploded view, with identification.

Refer to Figures 27, 28, 29 and 30 for retainer, checkball and orifice locations.

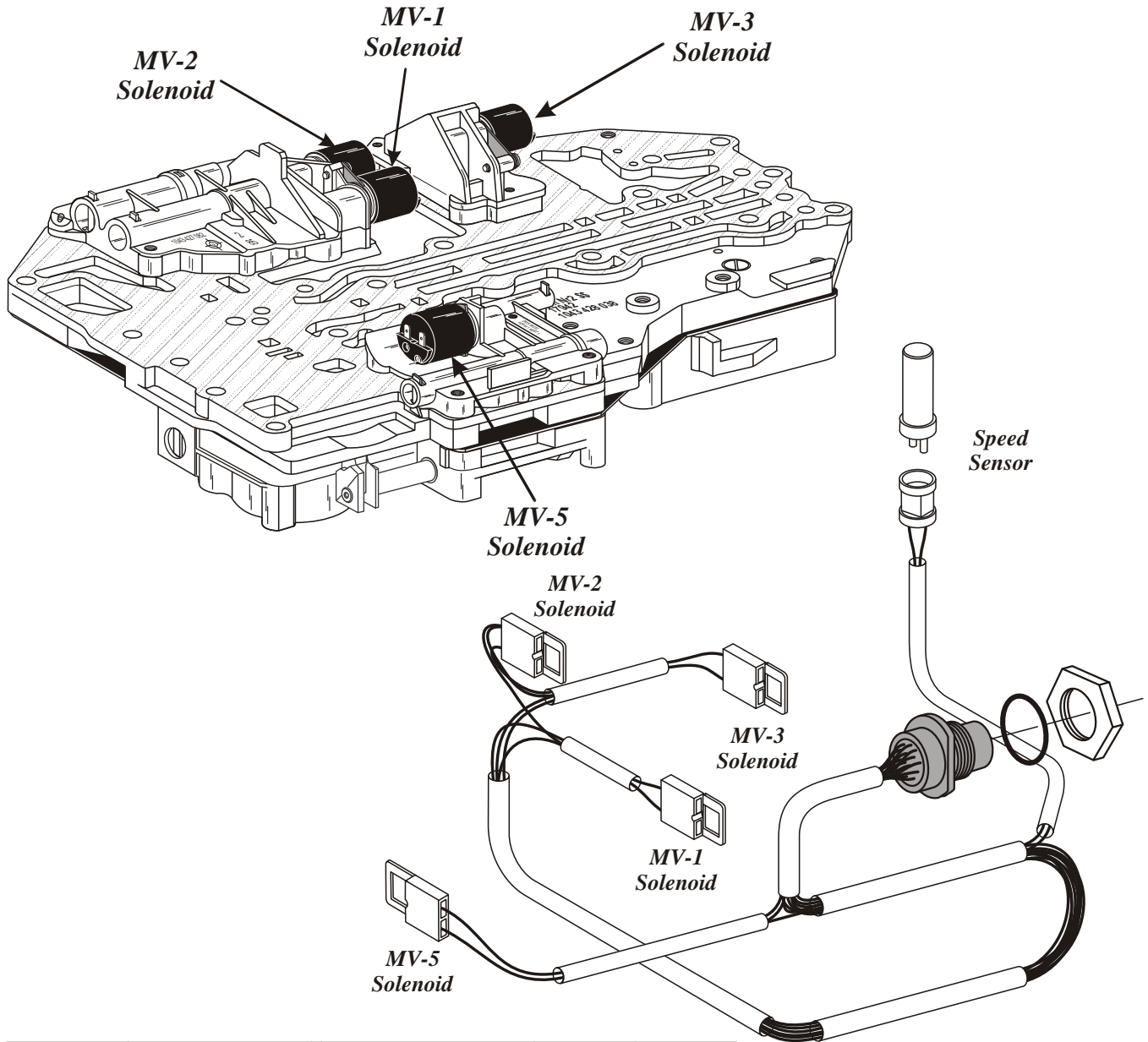
MODEL YEAR USAGE CHART

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									

Copyright © 2003 ATSG

Figure 17

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



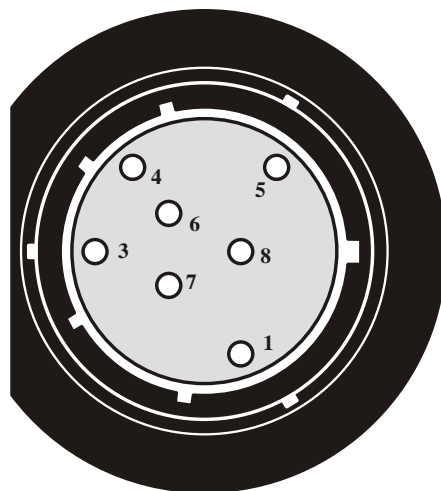
<i>Solenoid</i>	<i>Function</i>	<i>Gear</i>	<i>MV-1</i>	<i>MV-2</i>
<i>MV-1</i>	<i>Shift Control</i>	<i>1st</i>	<i>OFF</i>	<i>ON</i>
<i>MV-2</i>	<i>Shift Control</i>	<i>2nd</i>	<i>ON</i>	<i>ON</i>
		<i>3rd</i>	<i>ON</i>	<i>OFF</i>
		<i>4th</i>	<i>OFF</i>	<i>OFF</i>
		<i>Rev 0 mph</i>	<i>ON</i>	<i>OFF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

Copyright © 2003 ATSG

Figure 18

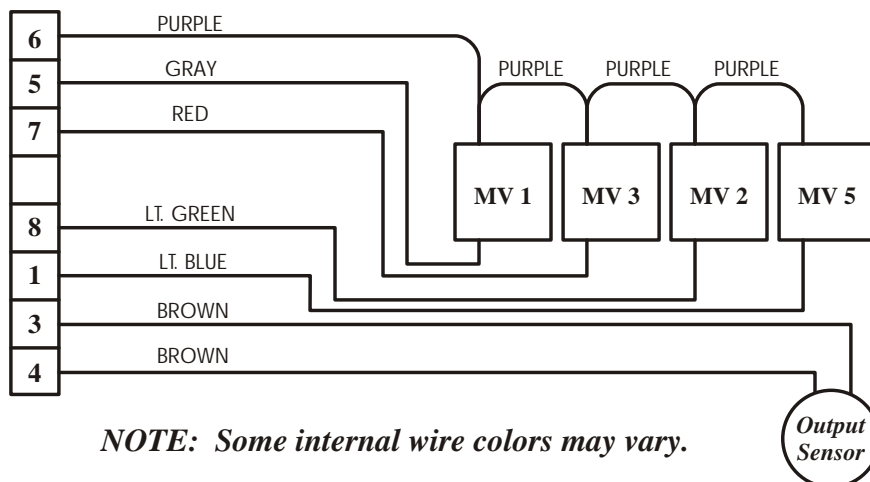
ZF-4HP-22/24 MODEL "E-9", "4 SOLENOID" INTERNAL WIRE SCHEMATIC AND CONNECTOR TERMINAL IDENTIFICATION

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



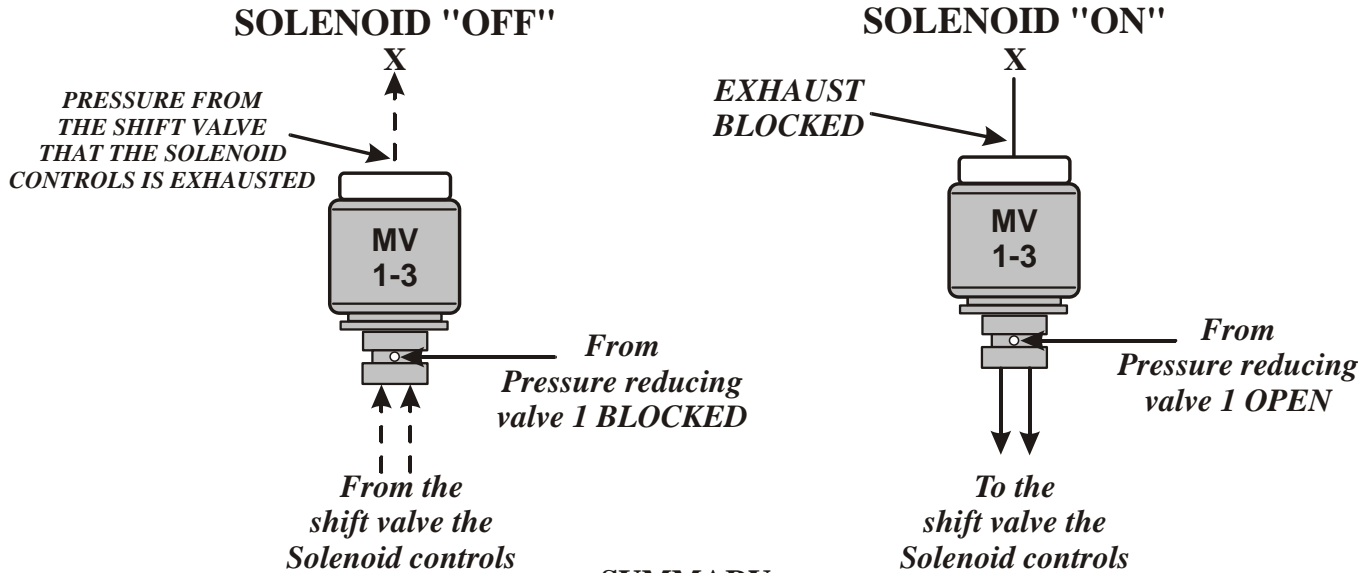
NOTE: Some internal wire colors may vary.

Copyright © 2003 ATSG

Figure 19

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

MV1-MV3



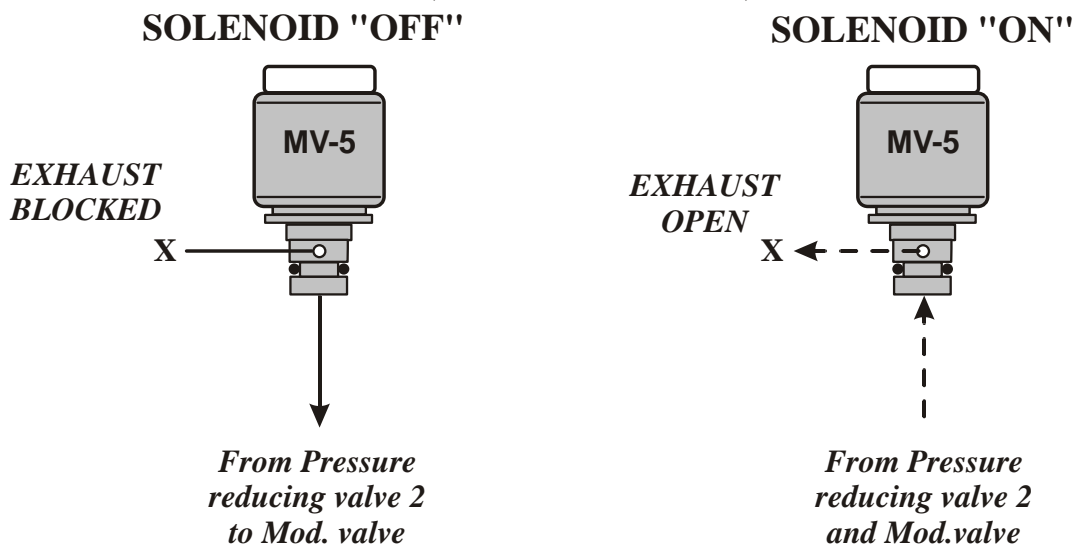
SUMMARY:

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:

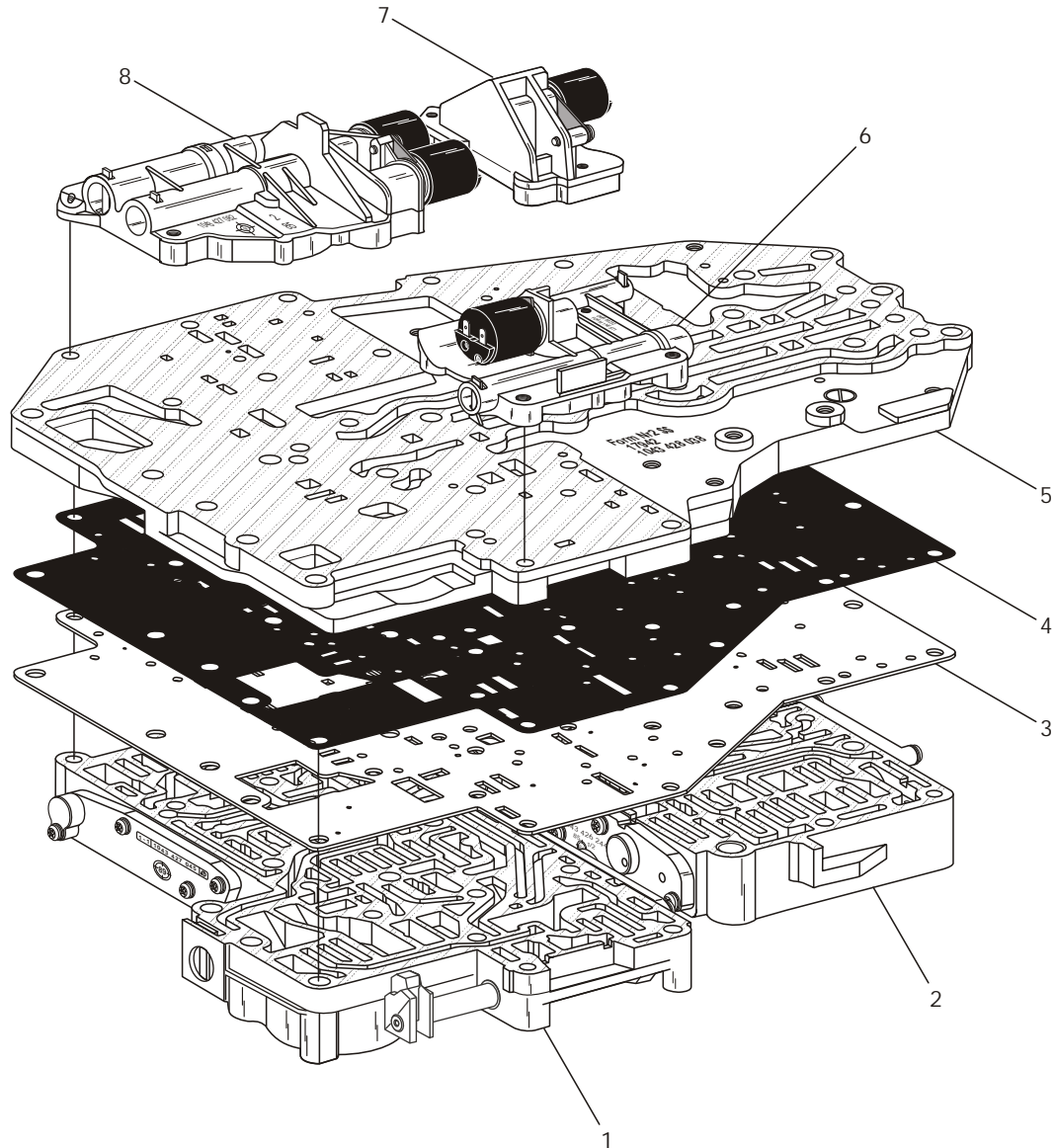
When MV-5 solenoid is "OFF," solenoid reducing pressure, from Pressure reducing valve 2, is high to the Modulating valve which creates high line pressure.

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.

Copyright © 2003 ATSG

Figure 20

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

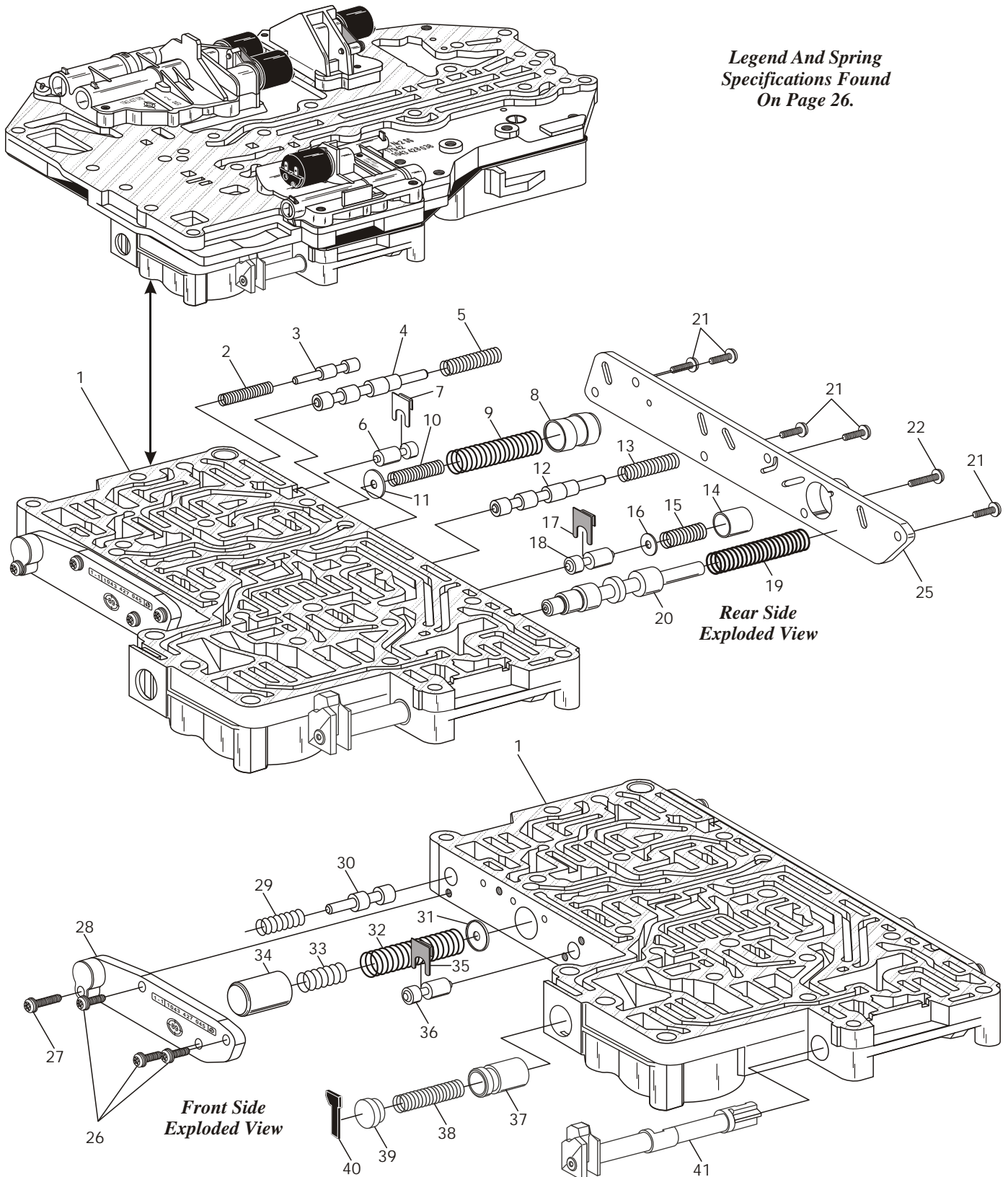
- 6 MV-5 SOLENOID BODY ASSEMBLY
- 7 MV-3 SOLENOID BODY ASSEMBLY
- 8 MV-1 AND MV-2 SOLENOID BODY ASSEMBLY

Copyright © 2003 ATSG

Figure 21

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

*Legend And Spring
Specifications Found
On Page 26.*



Copyright © 2003 ATSG

Figure 22



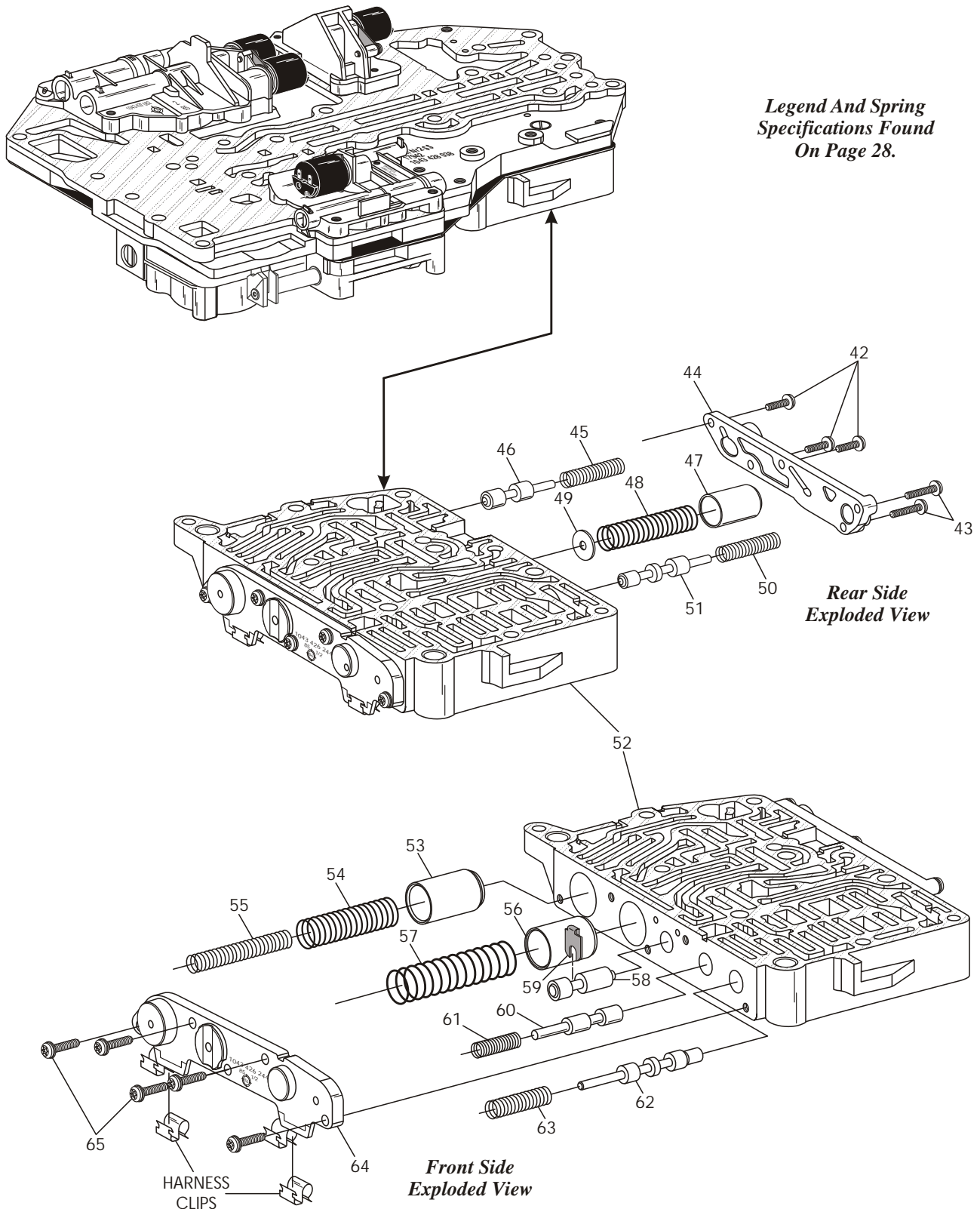
Technical Service Information

FIGURE 22 LEGEND AND SPRING SPECIFICATIONS

1 LOWER FRONT VALVE BODY CASTING	37 "A" CLUTCH DAMPER PISTON	
2 "C" CLUTCH VALVE SPRING	38 "A" CLUTCH DAMPER SPRING	
3 "C" CLUTCH VALVE	39 "A" CLUTCH DAMPER PISTON SPRING SEAT	
4 2-3 SHIFT VALVE	40 "A" CLUTCH DAMPER SPRING SEAT RETAINER	
5 2-3 SHIFT VALVE SPRING	41 MANUAL SHIFT VALVE	
6 "C" CLUTCH VALVE		
7 "C" CLUTCH VALVE RETAINER		
8 "B" CLUTCH DAMPER PISTON	SPRING ILLUSTRATION NO. 2:	SPRING ILLUSTRATION NO. 15:
9 "B" CLUTCH DAMPER PISTON OUTER SPRING	FREE LENGTH = 1.075"	FREE LENGTH = 1.655"
10 "B" CLUTCH DAMPER PISTON INNER SPRING	SPRING DIAMETER = .280"	SPRING DIAMETER = .560"
11 "B" CLUTCH DAMPER PISTON SPRING SEAT	WIRE DIAMETER = .033"	WIRE DIAMETER = .045"
12 1-2 SHIFT VALVE		
13 1-2 SHIFT VALVE SPRING	SPRING ILLUSTRATION NO. 5:	SPRING ILLUSTRATION NO. 19:
14 "D" CLUTCH DAMPER PISTON	FREE LENGTH = 1.925"	FREE LENGTH = 3.625"
15 "D" CLUTCH DAMPER PISTON SPRING	SPRING DIAMETER = .363"	SPRING DIAMETER = .600"
16 "D" CLUTCH DAMPER PISTON SPRING SEAT	WIRE DIAMETER = .033"	WIRE DIAMETER = .080"
17 "D" CLUTCH VALVE RETAINER		
18 "D" CLUTCH VALVE	SPRING ILLUSTRATION NO. 9:	SPRING ILLUSTRATION NO. 29:
19 PRESSURE REGULATOR VALVE SPRING	FREE LENGTH = 2.900"	FREE LENGTH = 1.690"
20 PRESSURE REGULATOR VALVE	SPRING DIAMETER = .594"	SPRING DIAMETER = .443"
21 REAR SIDE COVER RETAINING BOLT, 17 mm LENGTH (5)	WIRE DIAMETER = .040"	WIRE DIAMETER = .032"
22 REAR SIDE COVER RETAINING BOLT, 24 mm LENGTH (1)		
25 REAR SIDE COVER	SPRING ILLUSTRATION NO. 10:	SPRING ILLUSTRATION NO. 32:
26 FRONT SIDE COVER RETAINING BOLT, 17 mm LENGTH (3)	FREE LENGTH = 1.580"	FREE LENGTH = 3.310"
27 FRONT SIDE COVER RETAINING BOLT, 29 mm LENGTH (1)	SPRING DIAMETER = .432"	SPRING DIAMETER = .585"
28 FRONT SIDE COVER	WIRE DIAMETER = .040"	WIRE DIAMETER = .045"
29 TORQUE CONVERTER LOCK-UP VALVE SPRING		
30 TORQUE CONVERTER LOCK-UP VALVE	SPRING ILLUSTRATION NO. 13:	SPRING ILLUSTRATION NO. 33:
31 "C" CLUTCH DAMPER PISTON SPRING SEAT	FREE LENGTH = 1.880"	FREE LENGTH = 1.590"
32 "C" CLUTCH DAMPER PISTON OUTER SPRING	SPRING DIAMETER = .367"	SPRING DIAMETER = .442"
33 "C" CLUTCH DAMPER PISTON INNER SPRING	WIRE DIAMETER = .032"	WIRE DIAMETER = .032"
34 "C" CLUTCH DAMPER PISTON		
35 "B" CLUTCH REGULATOR VALVE RETAINER		SPRING ILLUSTRATION NO. 38:
36 "B" CLUTCH REGULATOR VALVE		FREE LENGTH = 2.727"
		SPRING DIAMETER = .400"
		WIRE DIAMETER = .050"

Figure 22 Legend

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



Copyright © 2003 ATSG

Figure 23



Technical Service Information

FIGURE 23 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. 55: FREE LENGTH = 3.490"
SPRING DIAMETER = .408"
WIRE DIAMETER = .045"

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

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

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

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

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

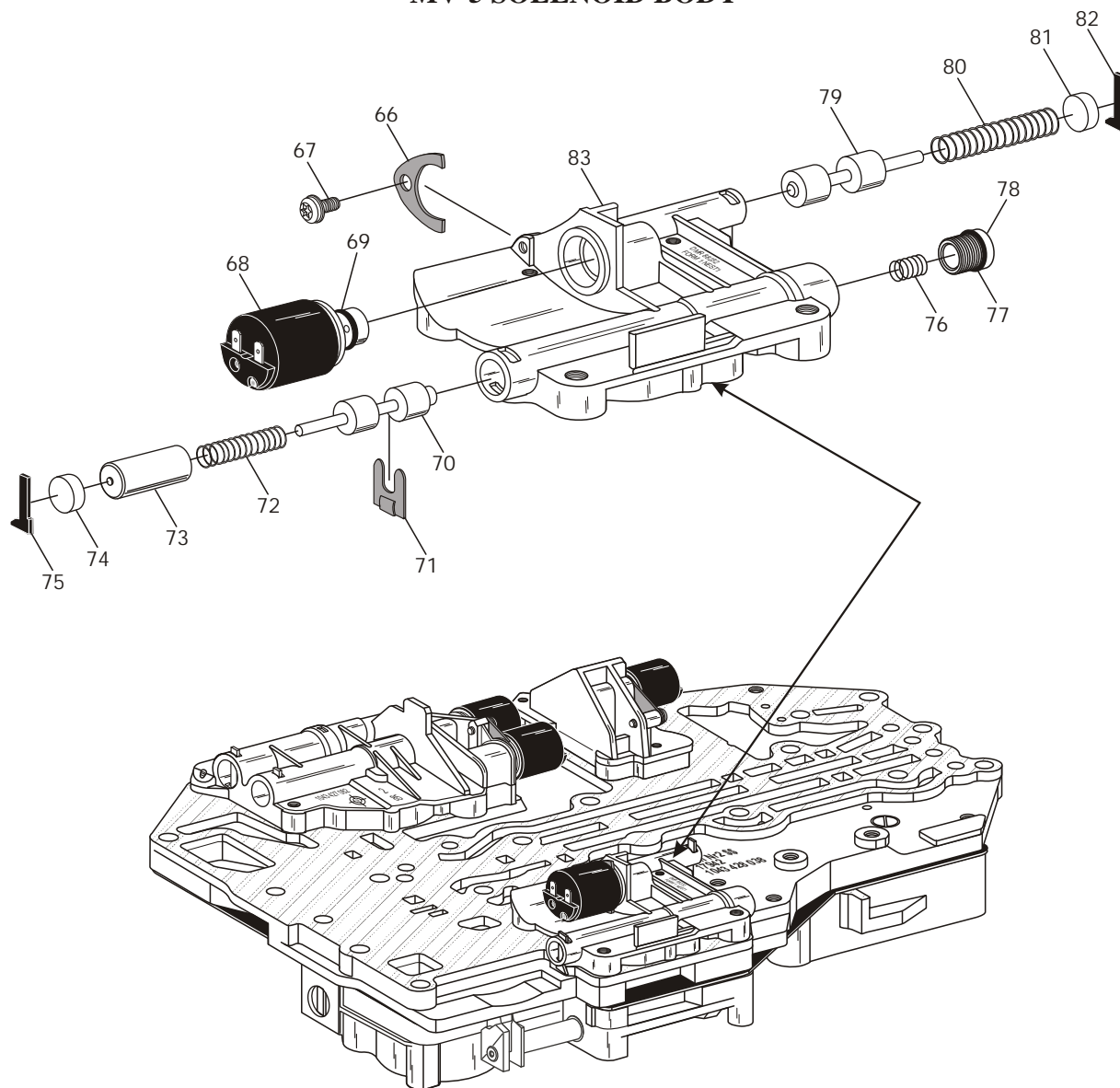
SPRING ILLUSTRATION NO. 63: FREE LENGTH = 1.595"
SPRING DIAMETER = .67"
WIRE DIAMETER = .032"

Copyright © 2003 ATSG

Figure 23 Legend

Copyright © 2003 ATSG

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"

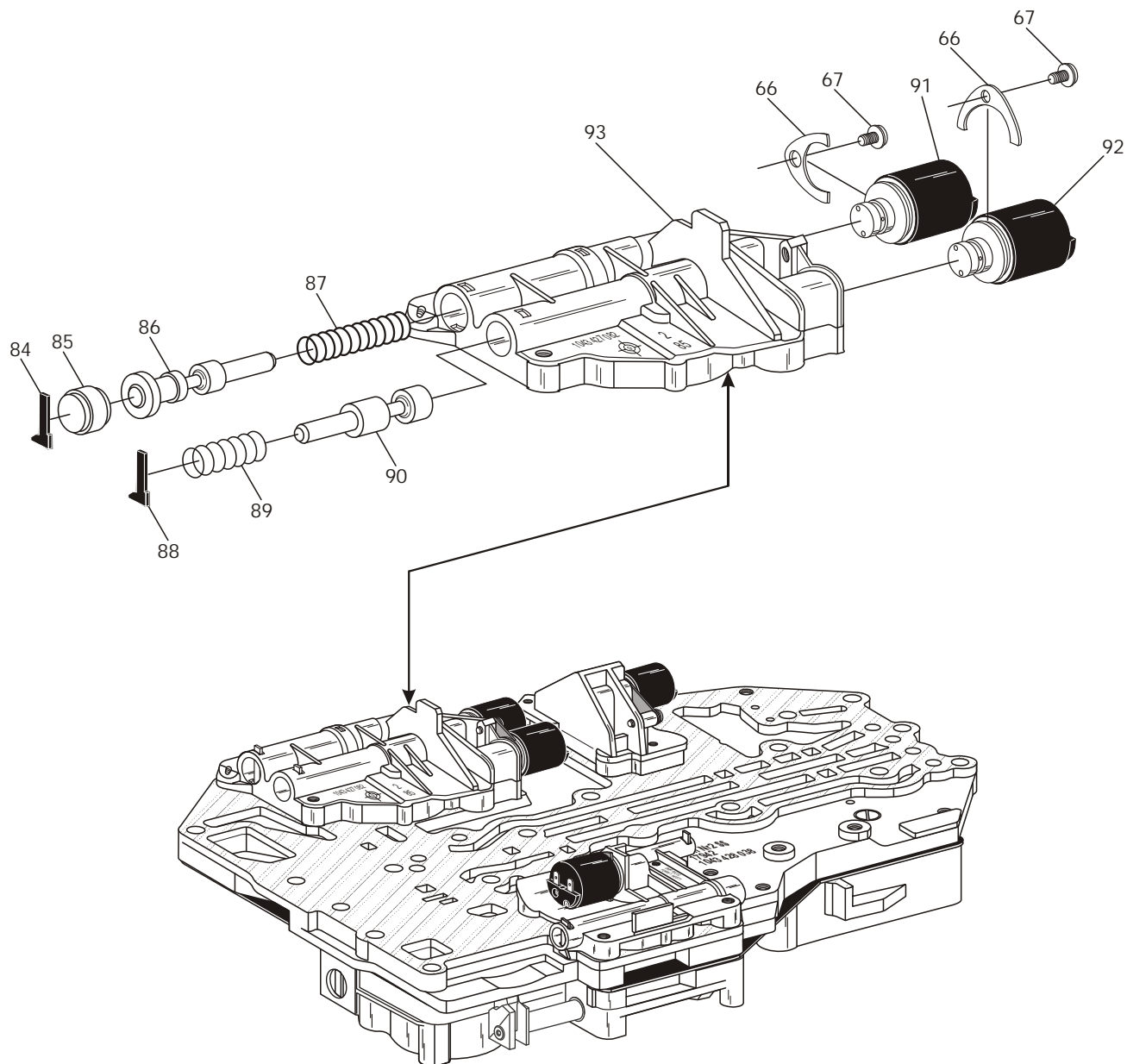
SPRING ILLUSTRATION NO. 76:
FREE LENGTH = .770"
SPRING DIAMETER = .377"
WIRE DIAMETER = .027"

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

Copyright © 2003 ATSG

Figure 24

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

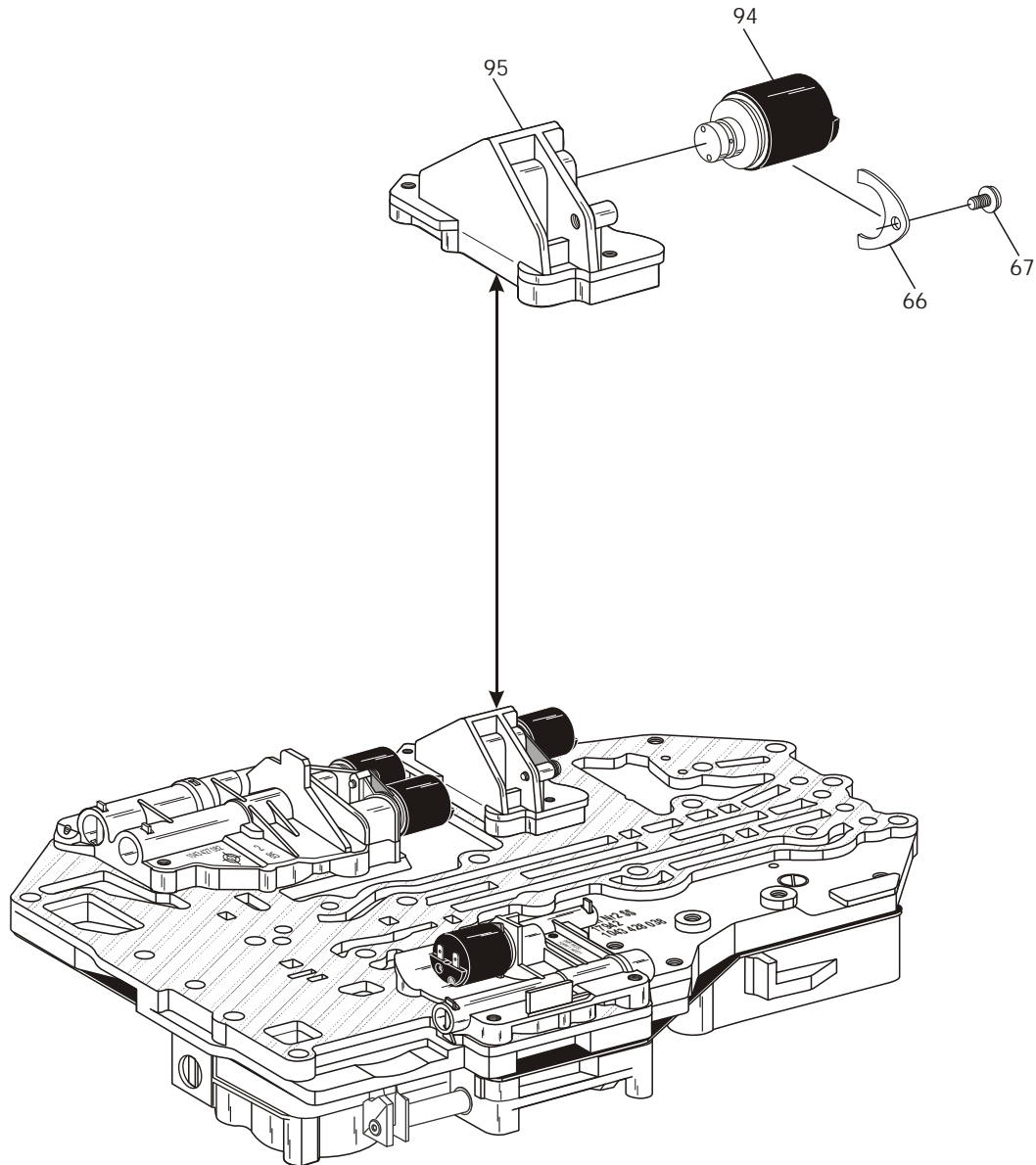
SPRING ILLUSTRATION NO. 87:
FREE LENGTH = 1.570"
SPRING DIAMETER = .430"
WIRE DIAMETER = .039"

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

Copyright © 2003 ATSG

Figure 25

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

Copyright © 2003 ATSG

Figure 26

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

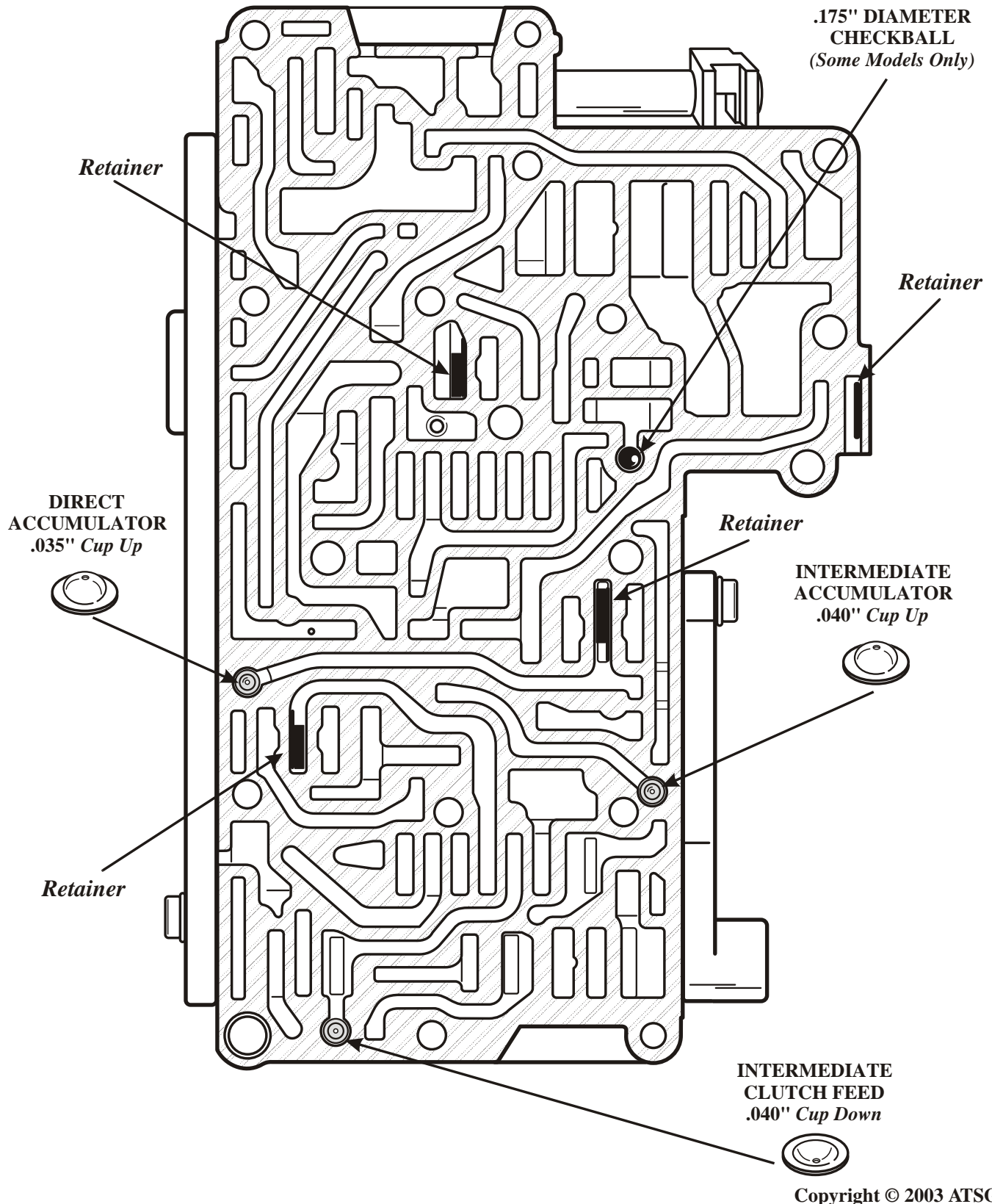
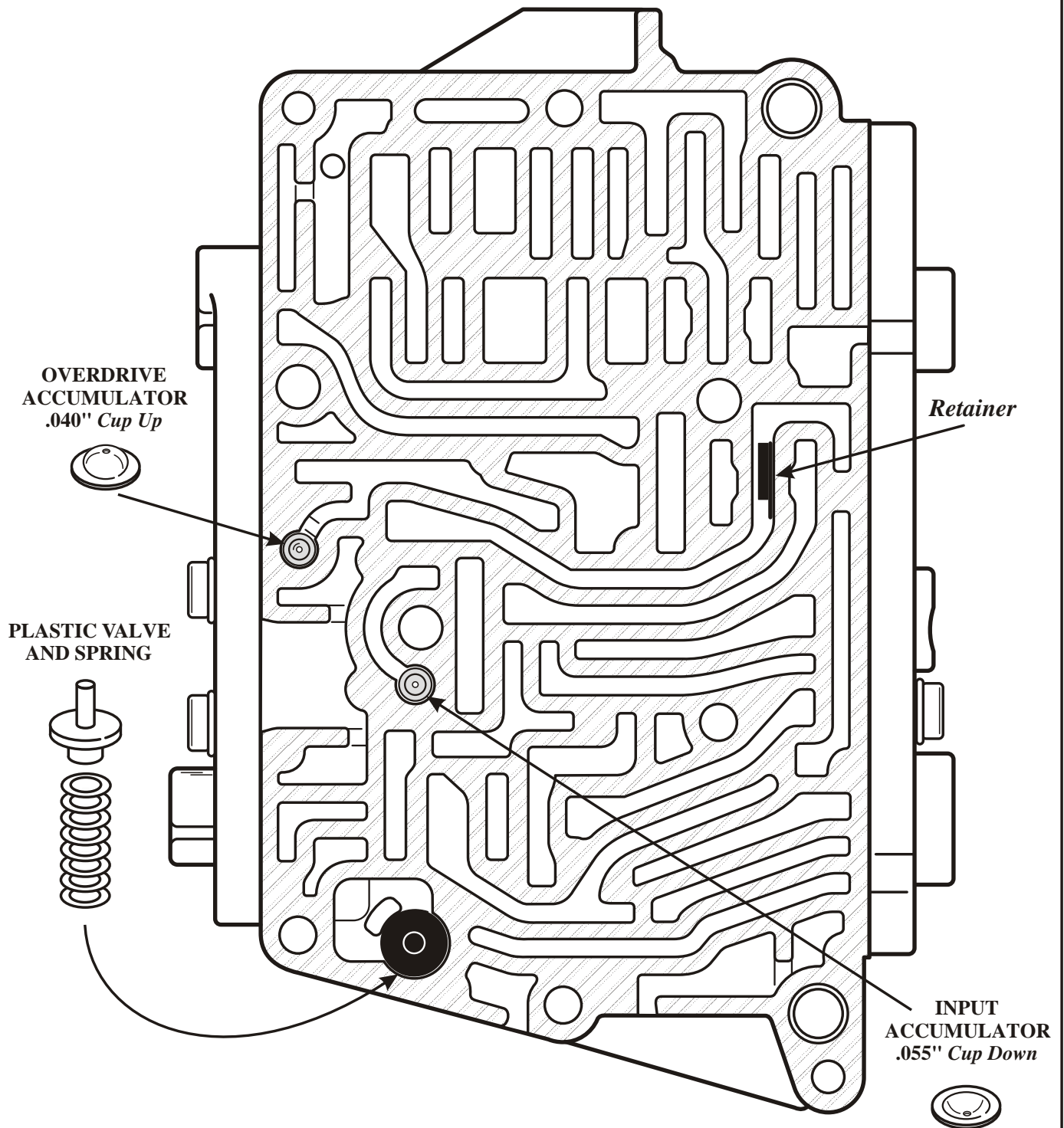


Figure 27

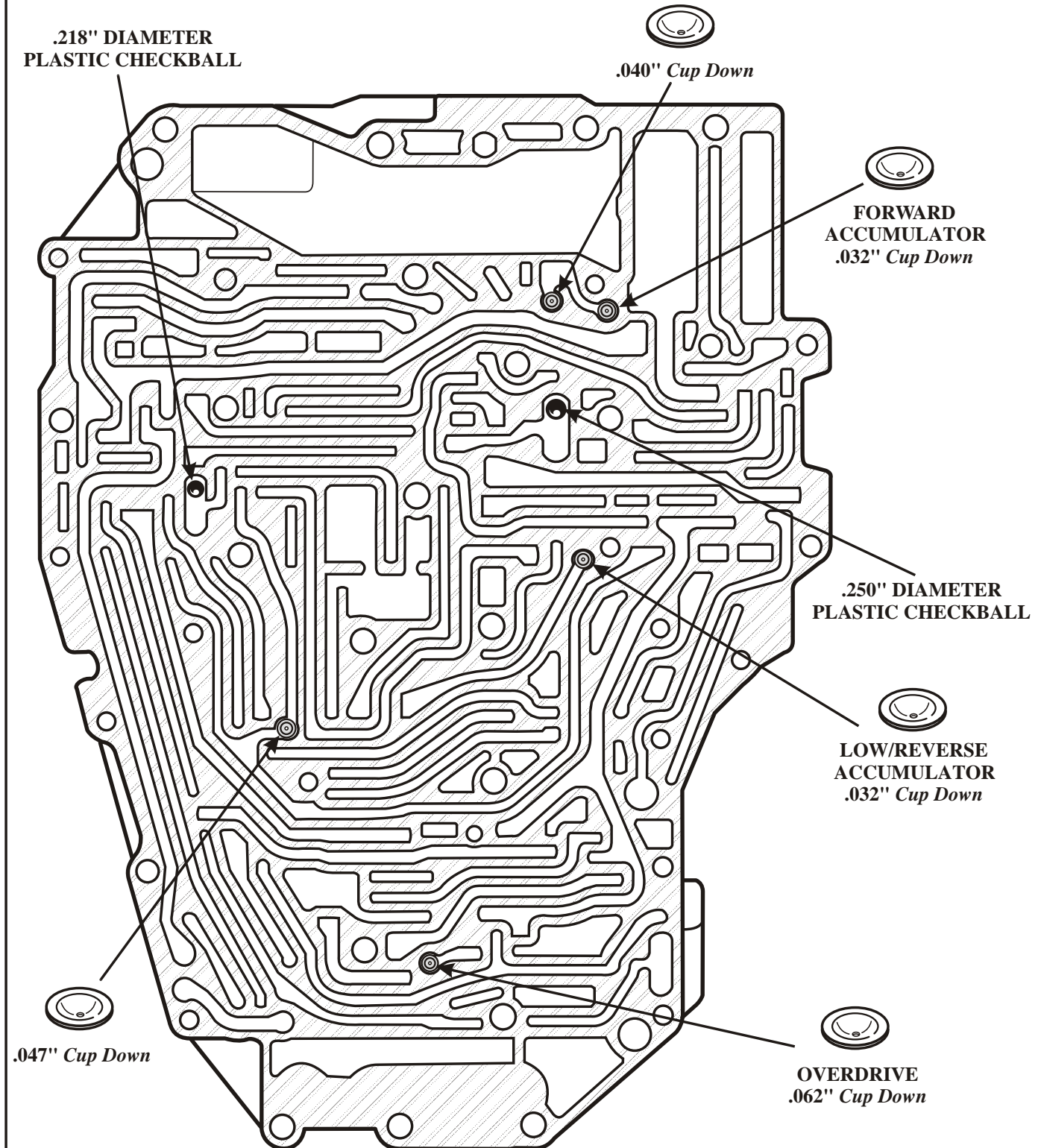
ZF-4HP-22/24 MODEL "E-9", "4 SOLENOID" LOWER "REAR" VALVE BODY



Copyright © 2003 ATSG

Figure 28

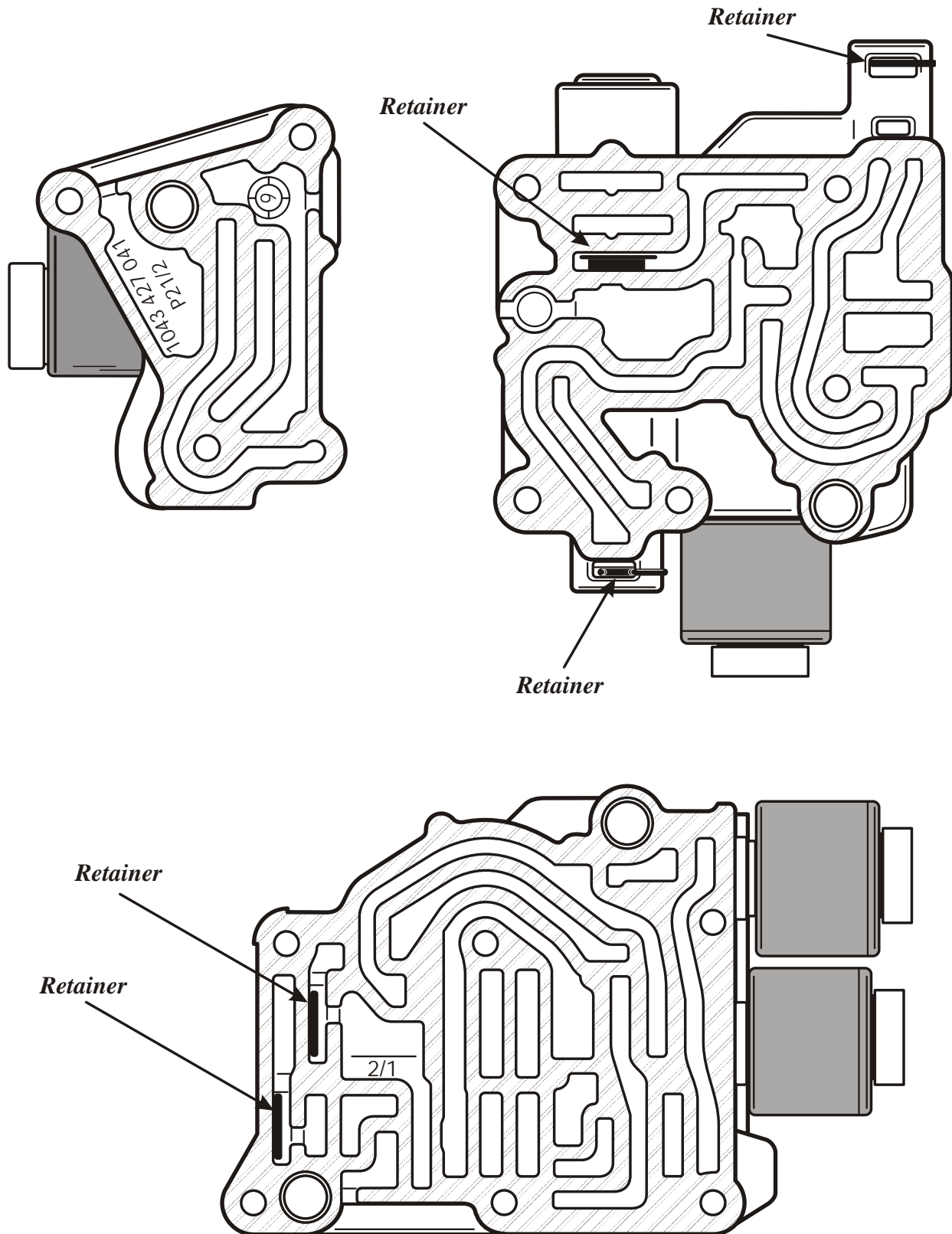
ZF-4HP-22/24 MODEL "E-9", "4 SOLENOID" CHANNEL PLATE



Copyright © 2003 ATSG

Figure 29

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



Copyright © 2003 ATSG

Figure 30