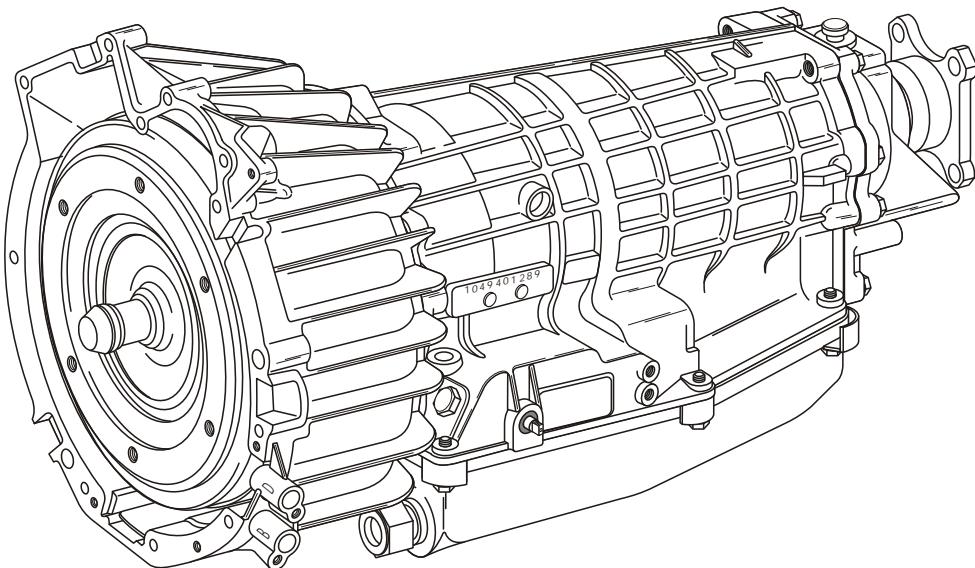


**ATSG**

# 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**

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

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Figure 1

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03-32

Page 1 of 35



# 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.*

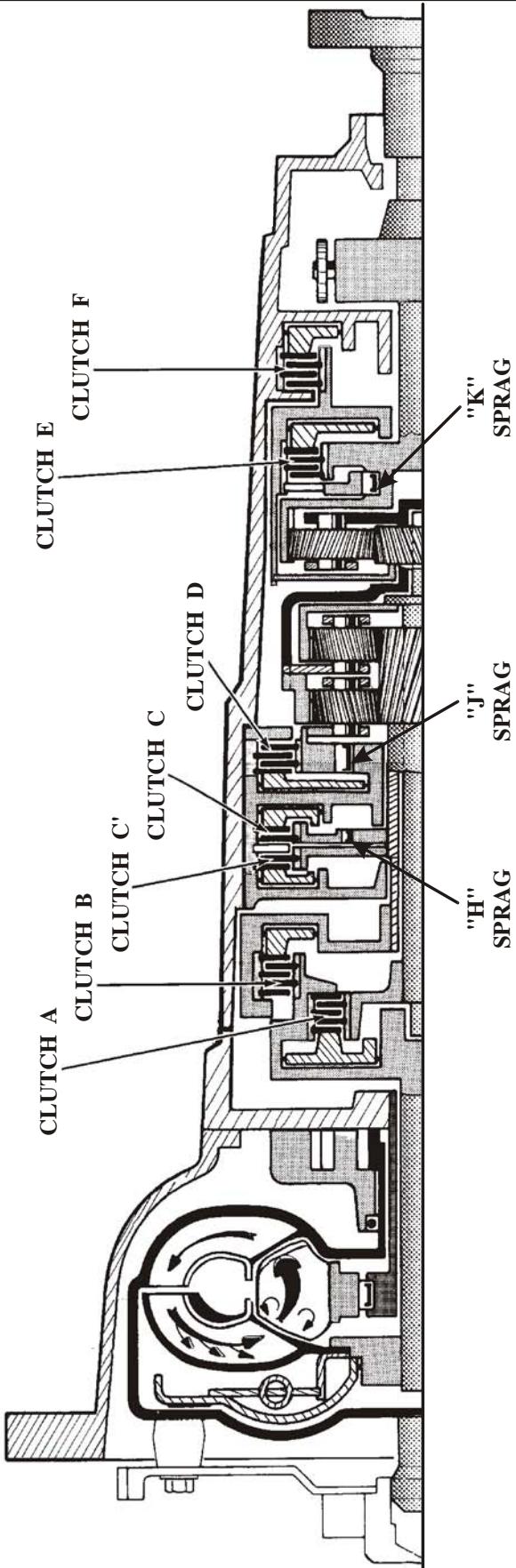
*Refer to Figure 11 for Pressure Control Solenoid Body exploded view, with solenoid identification.*

*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
<i>Park</i>										
<i>Reverse</i>	ON				ON	ON				<i>Hold</i>
<i>Neutral</i>										
<i>"D"-1st</i>	ON						ON		<i>Hold</i>	<i>Hold</i>
<i>"D"-2nd</i>	ON	ON			ON	ON			<i>Hold</i>	<i>Hold</i>
<i>"D"-3rd</i>	ON	ON	ON				ON		<i>Hold</i>	<i>Hold</i>
<i>"D"-4th</i>	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

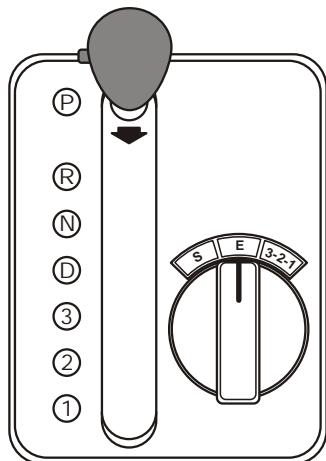
## SHIFT QUADRANTS FOR ZF 4HP-22/24 SERIES

### *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

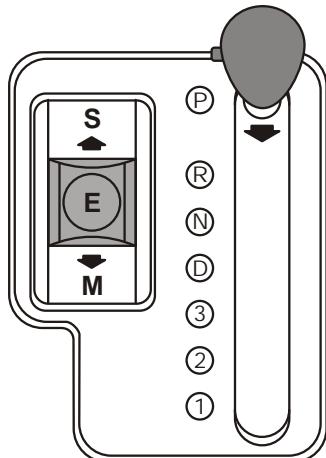


### *Late "E-7" Models Only (5 Solenoid)*

- (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.

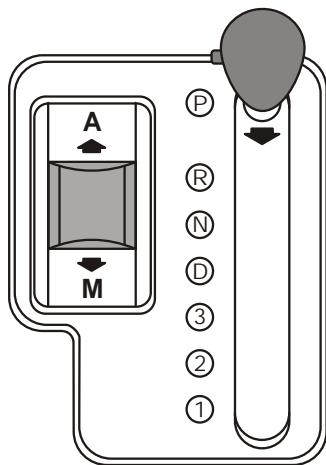


### *"E-9" Models Only (4 Solenoid)*

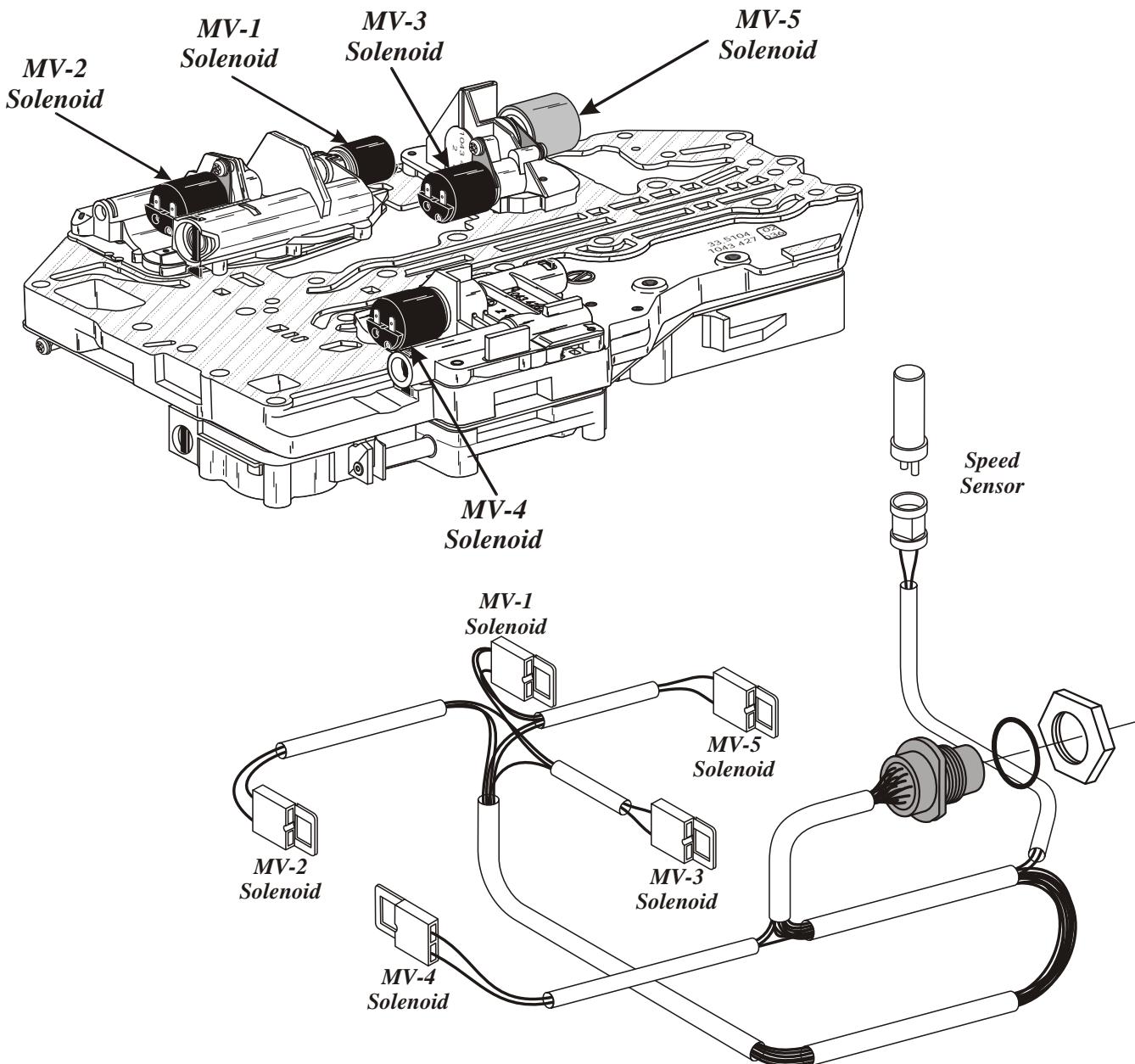
- (P) = Parking Pawl Engaged
- (R) = Reverse Gear
- (N) = Neutral
- (D) = Automatic Shifts 1st thru 4th Gears
- (3) = Automatic Shifts 1st thru 3rd Gears.  
4th Gear is locked out.
- (2) = Automatic Shifts 1st thru 2nd Gears.  
3rd and 4th Gear is locked out.
- (1) = 1st Gear Only.  
2nd, 3rd and 4th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



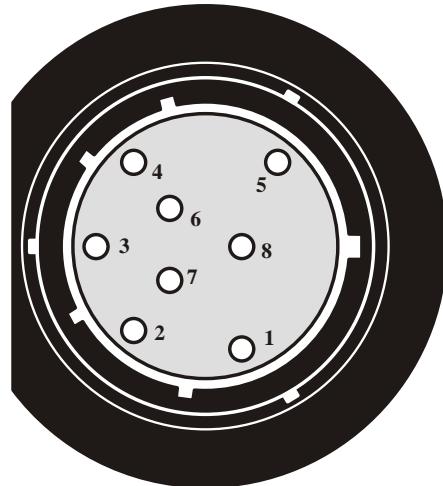
Solenoid	Function	Gear	MV-1	MV-2
<b>MV-1</b>	<i>Shift Control</i>	1st	<i>ON</i>	<i>ON</i>
<b>MV-2</b>	<i>Shift Control</i>	2nd	<i>OFF</i>	<i>ON</i>
		3rd	<i>OFF</i>	<i>OFF</i>
		4th	<i>ON</i>	<i>OFF</i>
<b>MV-3</b>	<i>Lock-Up Control</i>			
<b>MV-4</b>	<i>Reverse Lockout</i>			
<b>MV-5</b>	<i>Line Pressure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

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Figure 4

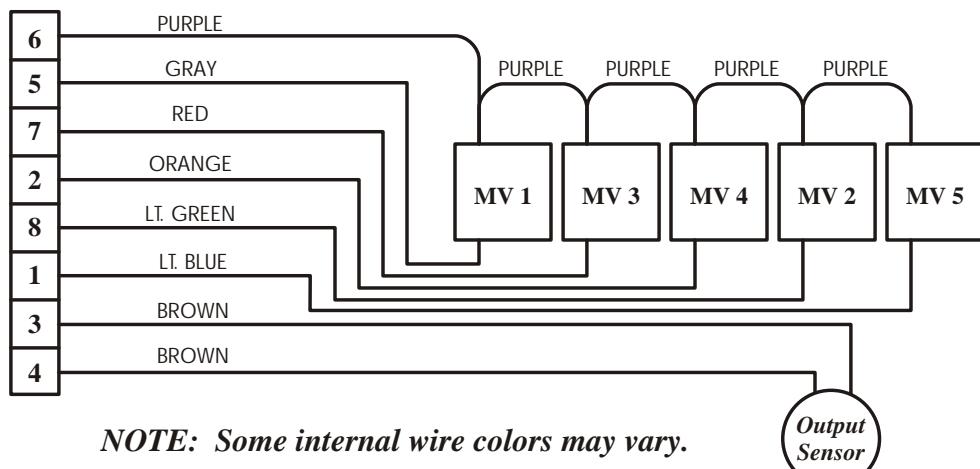
## ZF-4HP-22/24 MODEL "E-7", "5 SOLENOID" INTERNAL WIRE SCHEMATIC AND CONNECTOR TERMINAL IDENTIFICATION

*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*

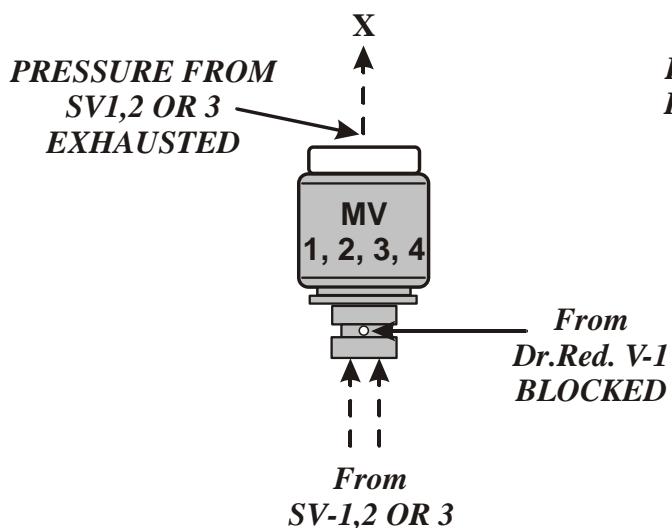
COMPONENT	TERMINALS	RESISTANCE	PART NUMBER
MV 1 Solenoid	5 And 6	30 - 34 Ohms	0501 307 869
MV 2 Solenoid	8 And 6	30 - 34 Ohms	0501 307 869
MV 3 Solenoid	7 And 6	30 - 34 Ohms	0501 307 869
MV 4 Solenoid	2 And 6	30 - 34 Ohms	0501 307 869
MV 5 Solenoid	1 And 6	2.5 - 4.5 Ohms	0501 206 997
Output Speed Sensor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



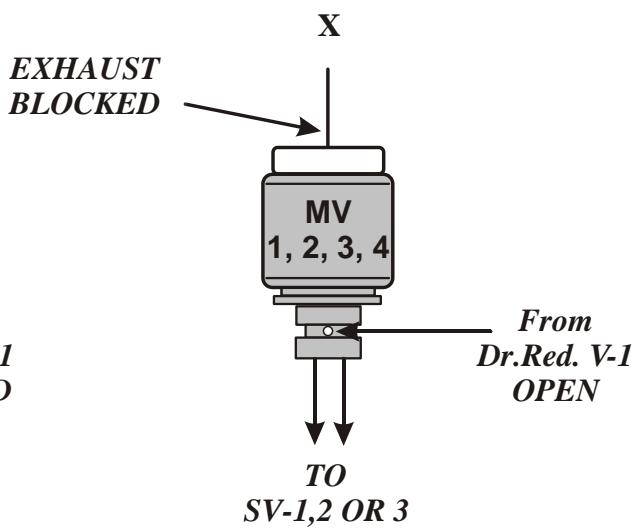
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## ZF-4HP-22 MODEL "E7", "5 SOLENOID" VALVE BODY, SOLENOID OPERATION MV1, 2, 3 AND 4 OPERATION

### SOLENOID "OFF"



### SOLENOID "ON"



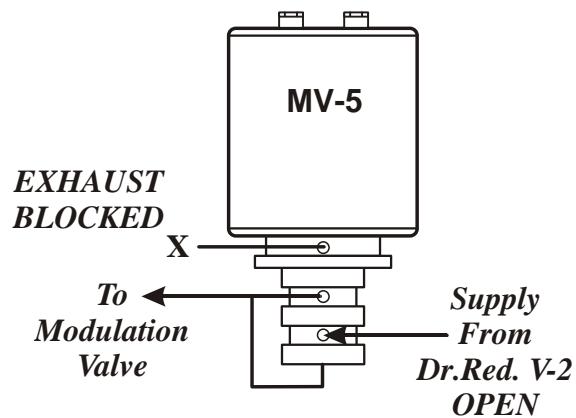
### SUMMARY:

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 SV1, 2 or 3 is exhausted at the rear of the solenoid.

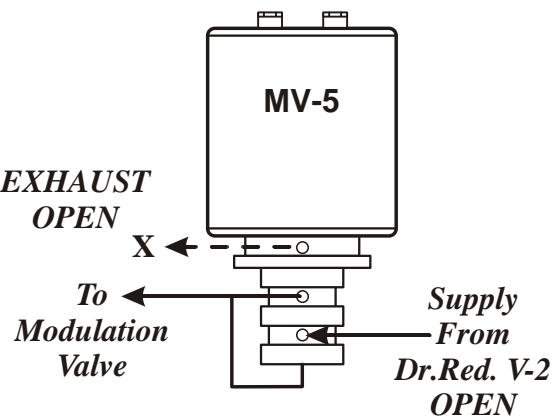
When MV 1, 2, 3 or 4 is "ON" Solenoid reducing pressure, From Dr.Red. V-1, is open through the solenoid and is applied to SV1, 2 or 3. The exhaust at the rear of the solenoid is closed.

## MV-5 OPERATION (Line Pressure Solenoid)

### SOLENOID "OFF"



### SOLENOID "ON"



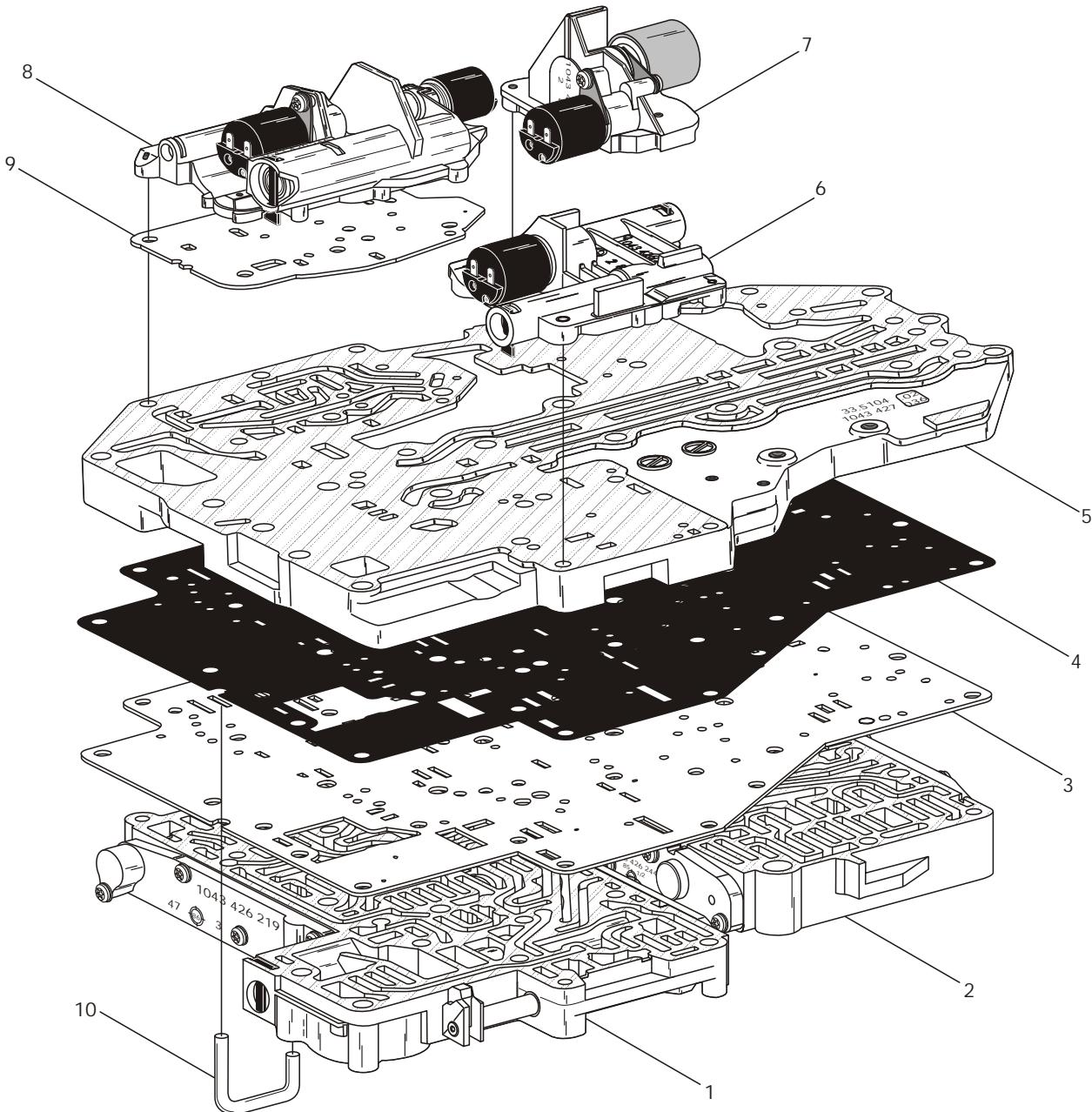
When MV-5 solenoid is "OFF," solenoid reducing pressure, from Dr. Red. V-2, is high to MOD-V valve which creates high line pressure.

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.

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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

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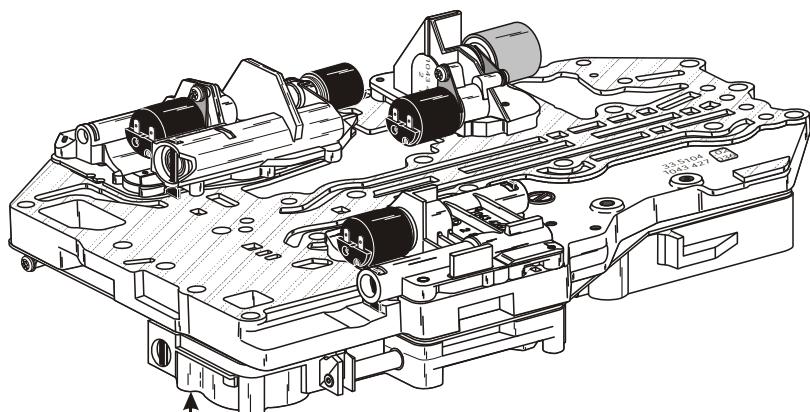
Figure 7

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03-32

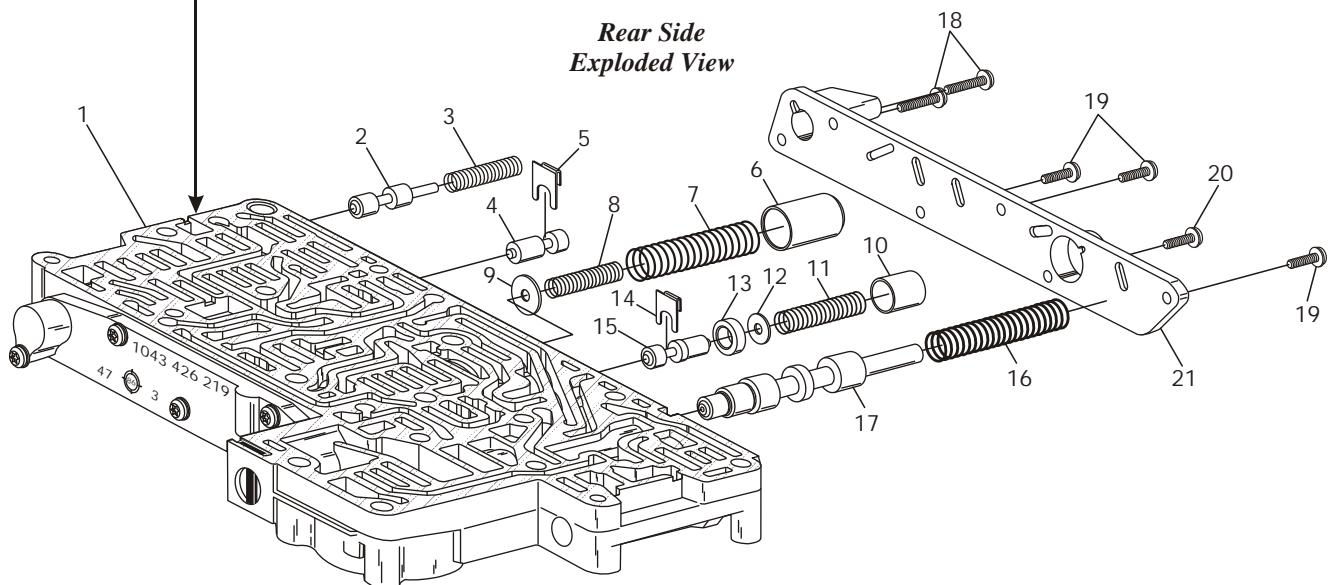
Page 8 of 35

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

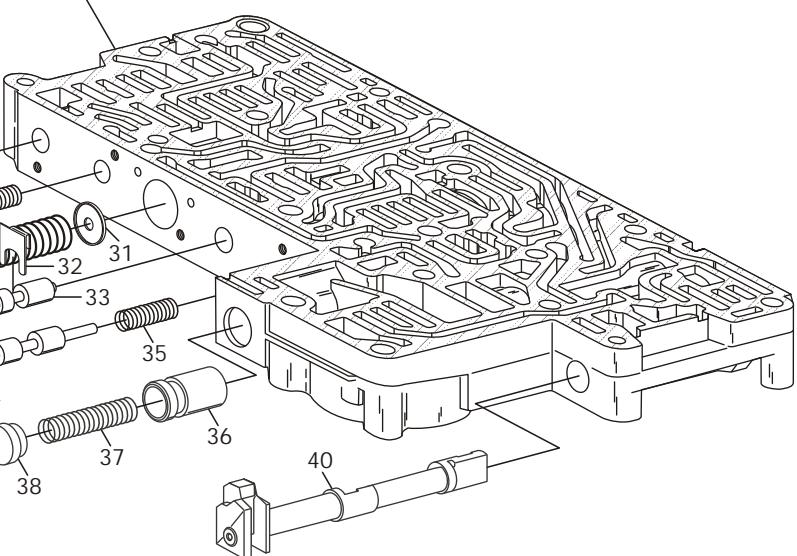


*Legend And Spring  
Specifications Found  
On Page 10.*

*Rear Side  
Exploded View*



1



*Front Side  
Exploded View*

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Figure 8



# Technical Service Information

## FIGURE 8 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	SPRING ILLUSTRATION NO. 25:
37 "A" CLUTCH DAMPER SPRING	FREE LENGTH = 1.830"
38 "A" CLUTCH DAMPER PISTON SPRING SEAT	SPRING DIAMETER = .435"
39 "A" CLUTCH DAMPER SPRING SEAT RETAINER	WIRE DIAMETER = .040"
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 = .360"
	WIRE DIAMETER = .036"
	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. 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"

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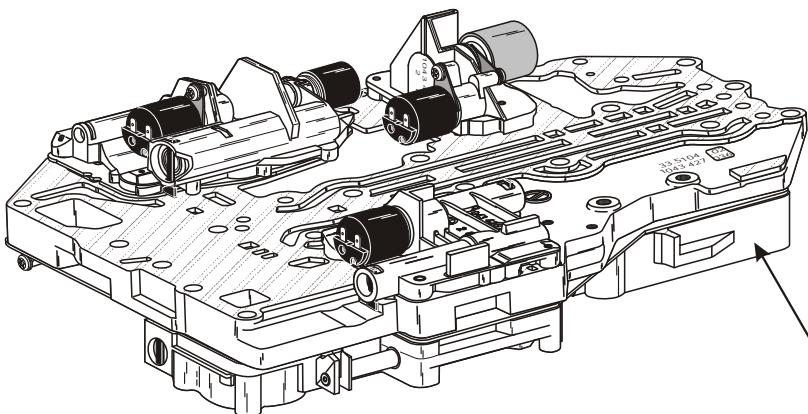
Figure 8 Legend

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03-32

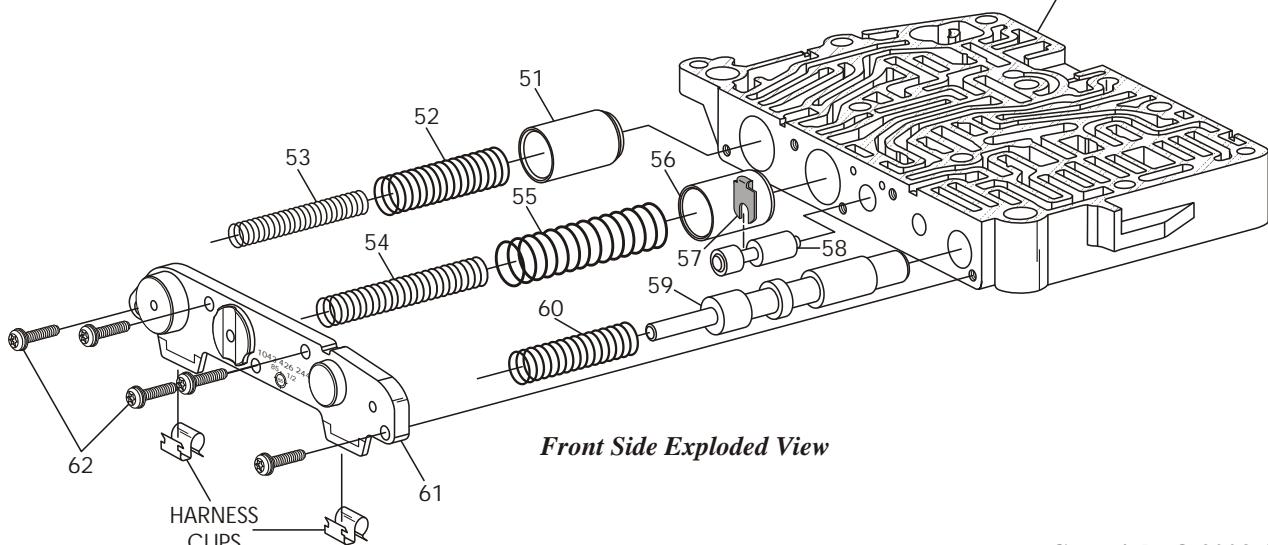
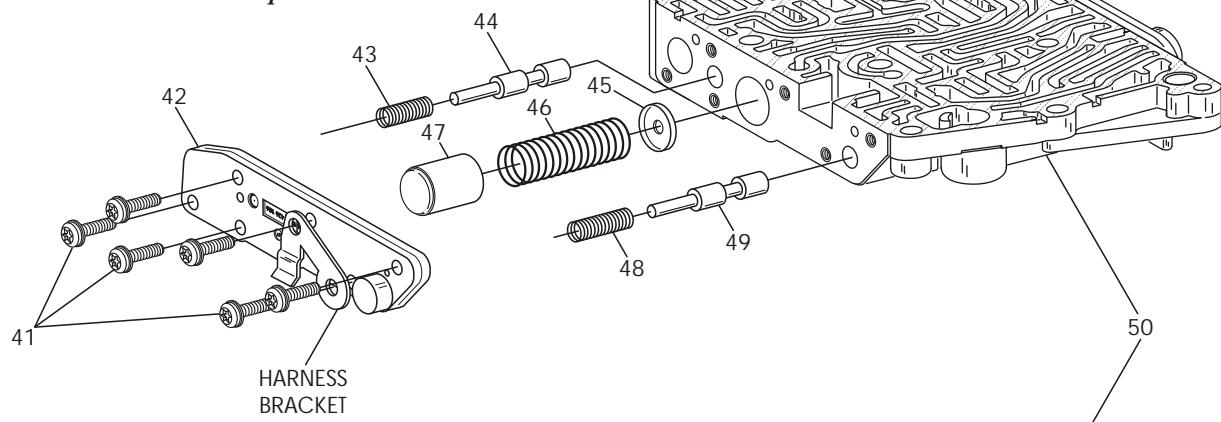
Page 10 of 35

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



*Legend And Spring  
Specifications Found  
On Next Page.*

*Rear Side Exploded View*



*Front Side Exploded View*

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Figure 9



# Technical Service Information

## FIGURE 9 LEGEND AND SPRING SPECIFICATIONS

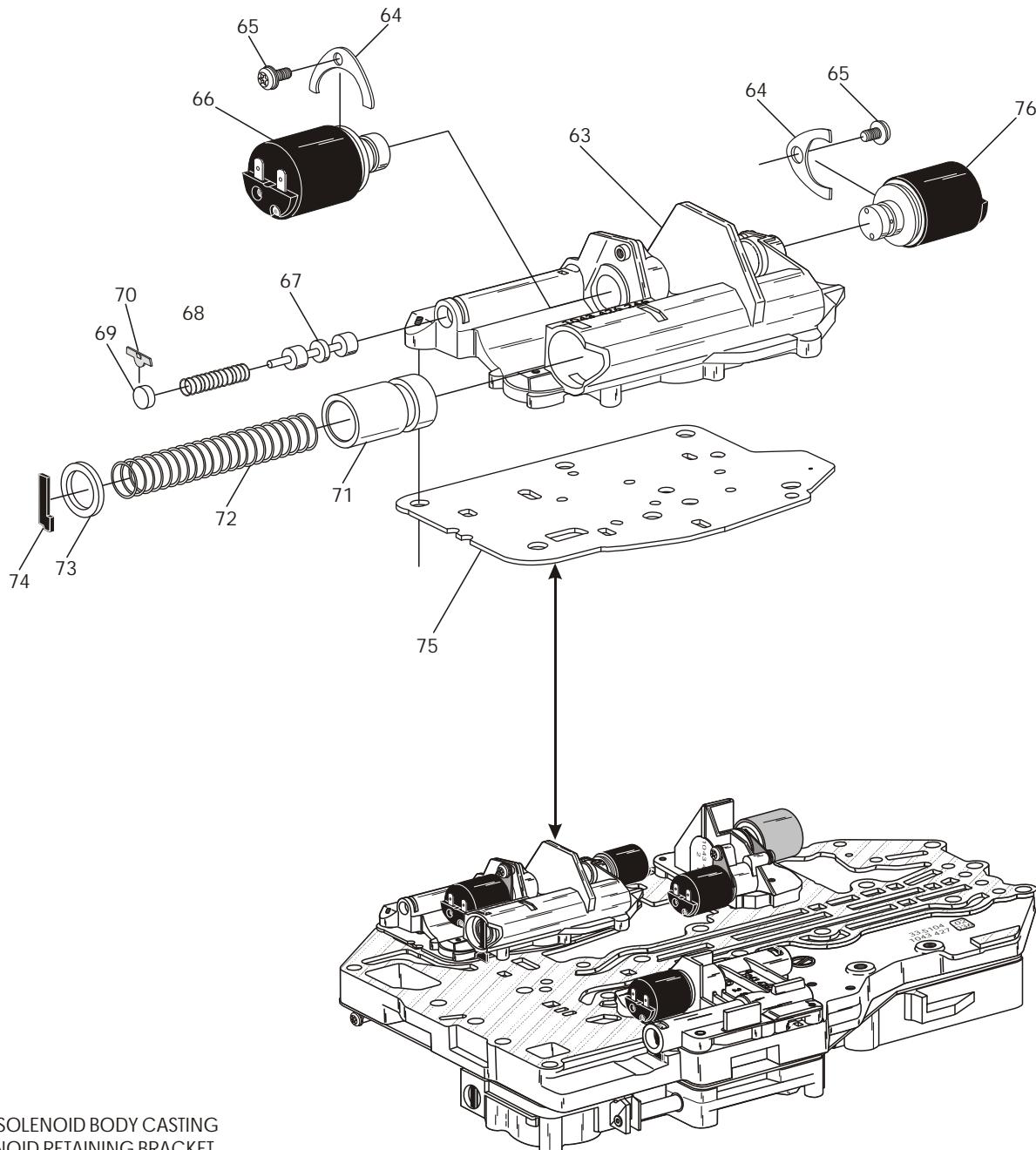
41 REAR SIDE COVER RETAINING BOLTS, 17 mm LENGTH (6)  
42 REAR SIDE COVER  
43 PRESSURE REDUCING VALVE "2" SPRING  
44 PRESSURE REDUCING VALVE "2"  
45 "F" CLUTCH DAMPER PISTON SPRING SEAT  
46 "F" CLUTCH DAMPER PISTON SPRING  
47 "F" CLUTCH DAMPER PISTON  
48 PRESSURE REDUCING VALVE "1" SPRING  
49 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: SPRING ILLUSTRATION NO. 53:  
FREE LENGTH = 1.365" FREE LENGTH = 3.511"  
SPRING DIAMETER = .355" SPRING DIAMETER = .405"  
WIRE DIAMETER = .044" WIRE DIAMETER = .049"  
  
SPRING ILLUSTRATION NO. 46: SPRING ILLUSTRATION NO. 54:  
FREE LENGTH = 3.290" FREE LENGTH = 4.556"  
SPRING DIAMETER = .600" SPRING DIAMETER = .510"  
WIRE DIAMETER = .043" WIRE DIAMETER = .037"  
  
SPRING ILLUSTRATION NO. 48: SPRING ILLUSTRATION NO. 55:  
FREE LENGTH = 1.535" FREE LENGTH = 3.330"  
SPRING DIAMETER = .365" SPRING DIAMETER = .685"  
WIRE DIAMETER = .044" WIRE DIAMETER = .070"  
  
SPRING ILLUSTRATION NO. 52: SPRING ILLUSTRATION NO. 60:  
FREE LENGTH = 2.945" FREE LENGTH = 2.445"  
SPRING DIAMETER = .600" SPRING DIAMETER = .472"  
WIRE DIAMETER = .066" WIRE DIAMETER = .040"

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Figure 9 Legend

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



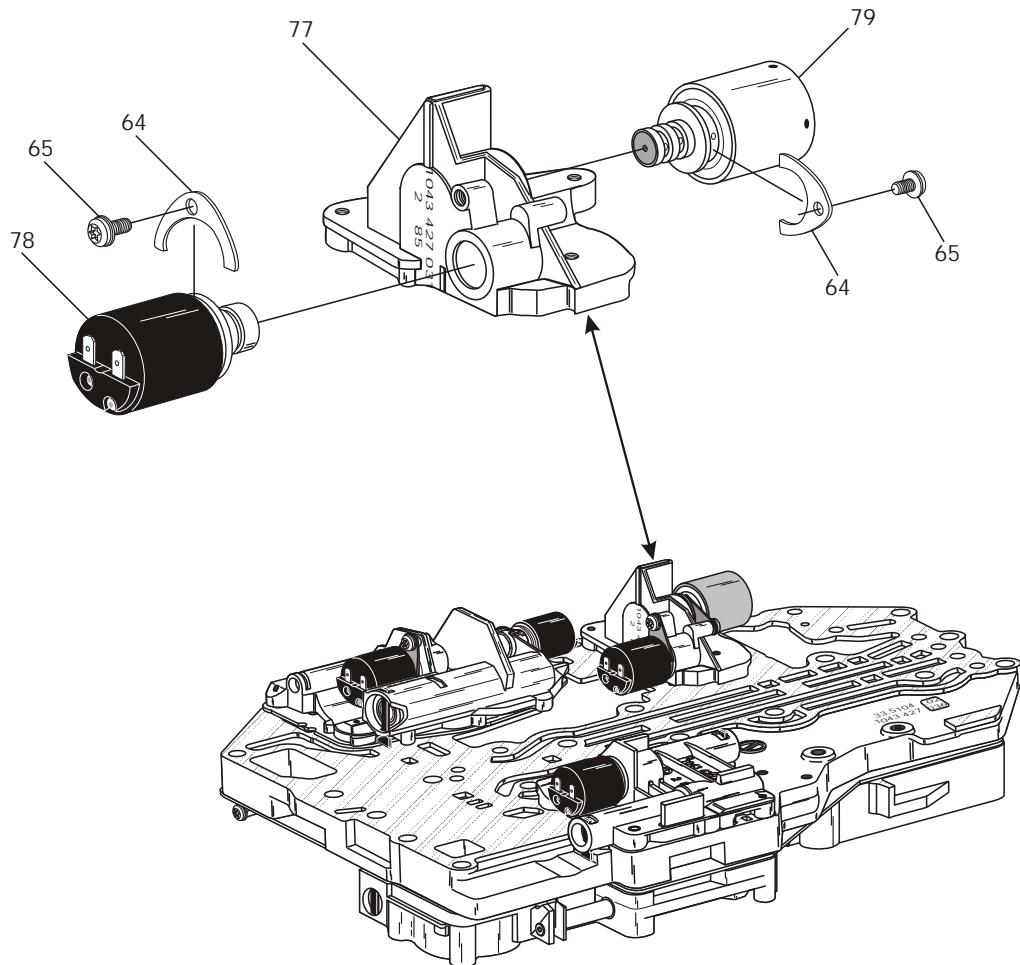
63 SHIFT SOLENOID BODY CASTING  
 64 SOLENOID RETAINING BRACKET  
 65 SOLENOID RETAINING BOLT, 11 mm LENGTH  
 66 MV-2 SHIFT SOLENOID ASSEMBLY  
 67 1-2 AND 3-4 SHIFT CONTROL VALVE  
 68 1-2 AND 3-4 SHIFT CONTROL VALVE SPRING  
 69 1-2 AND 3-4 SHIFT CONTROL VALVE BORE PLUG  
 70 1-2 AND 3-4 SHIFT CONTROL 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"

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Figure 10

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

64 SOLENOID RETAINING BRACKET

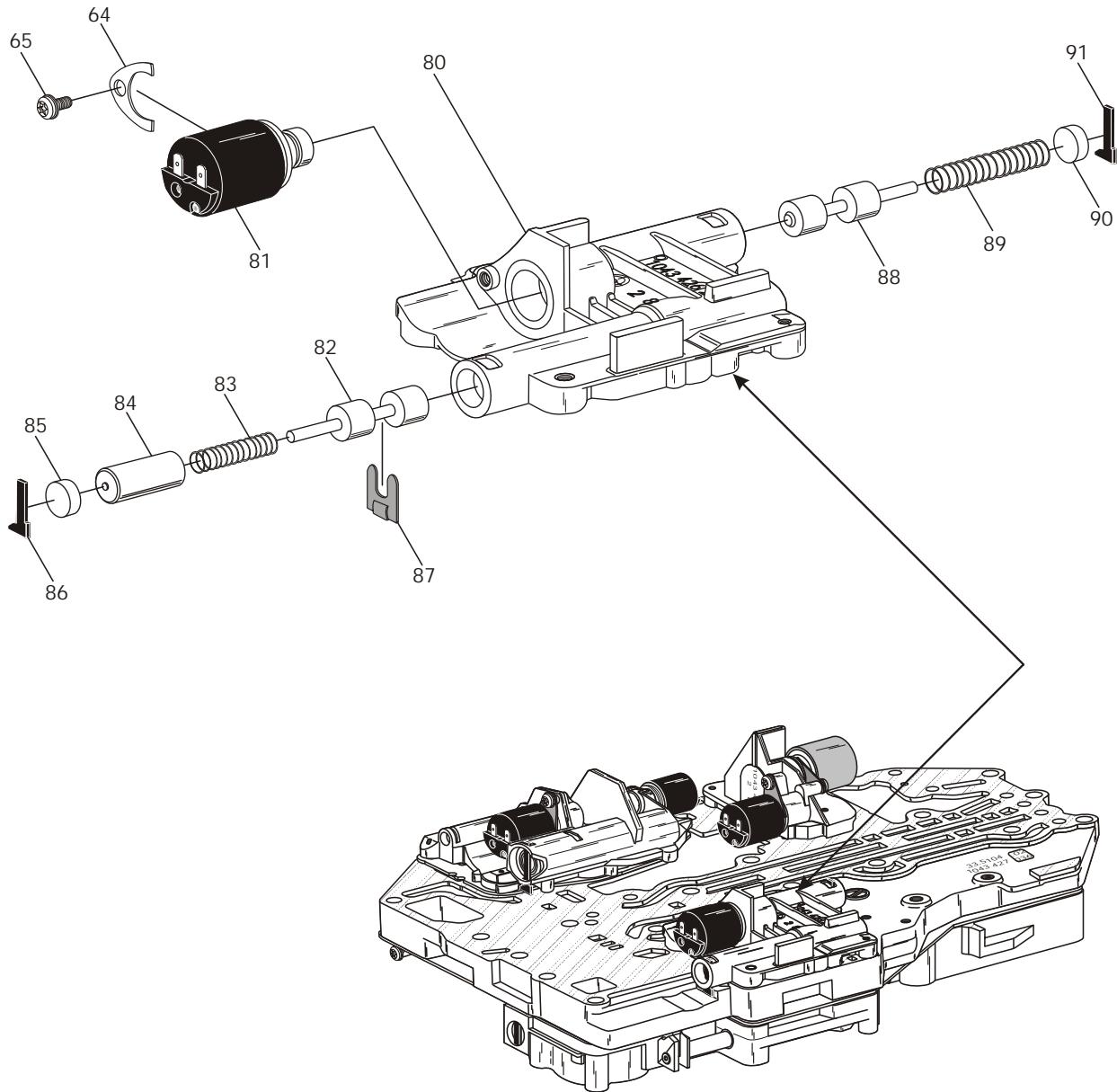
65 SOLENOID RETAINING BOLT, 11 mm LENGTH

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



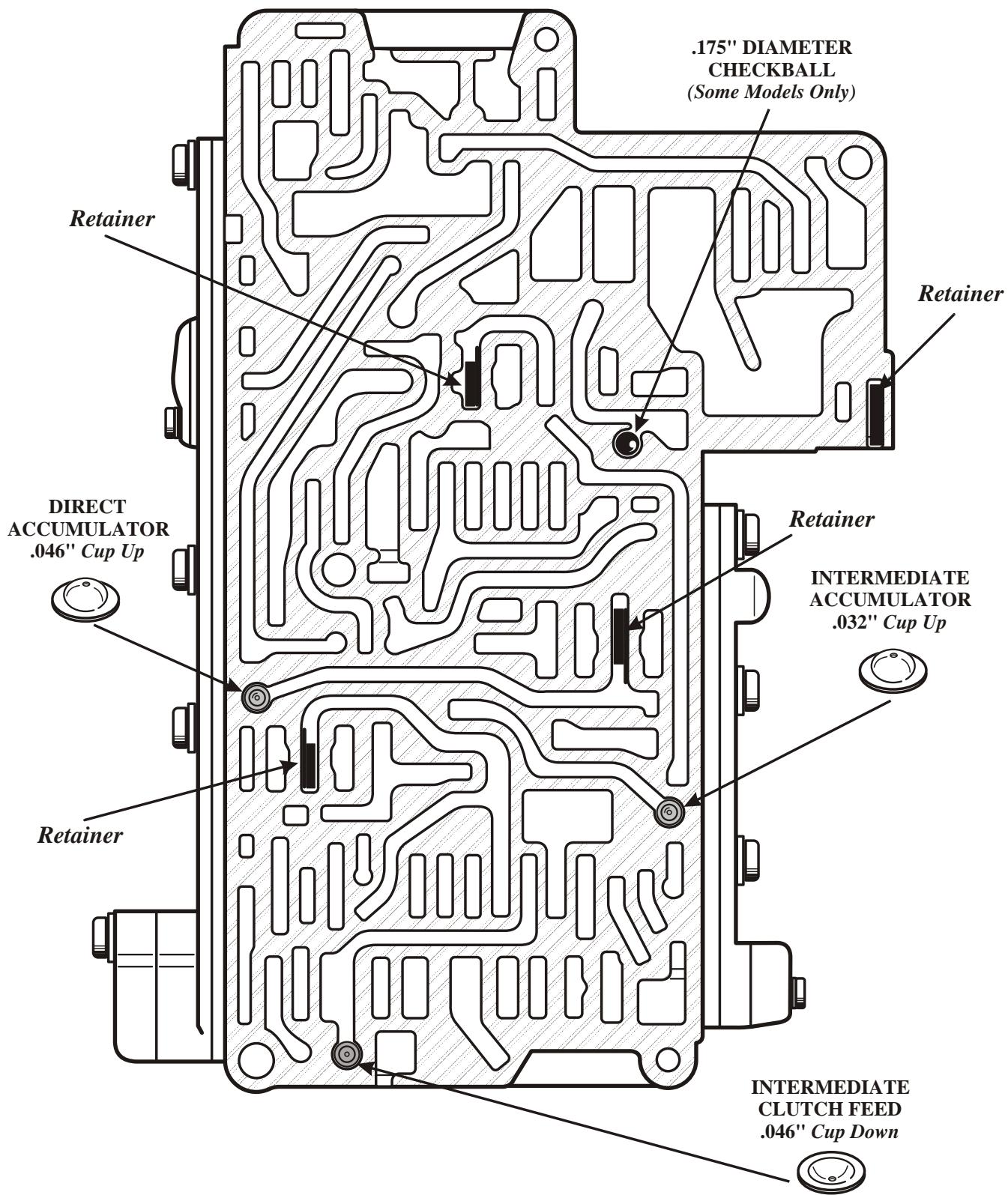
64 SOLENOID RETAINING BRACKET  
 65 SOLENOID RETAINING BOLT, 11 mm LENGTH  
 80 REVERSE LOCKOUT SOLENOID BODY CASTING  
 81 MV-4 REVERSE LOCKOUT SOLENOID ASSEMBLY  
 82 MODULATION VALVE  
 83 MODULATION VALVE SPRING  
 84 MODULATION VALVE SLEEVE  
 85 MODULATION VALVE BORE PLUG  
 86 MODULATION VALVE 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"

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Figure 12

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

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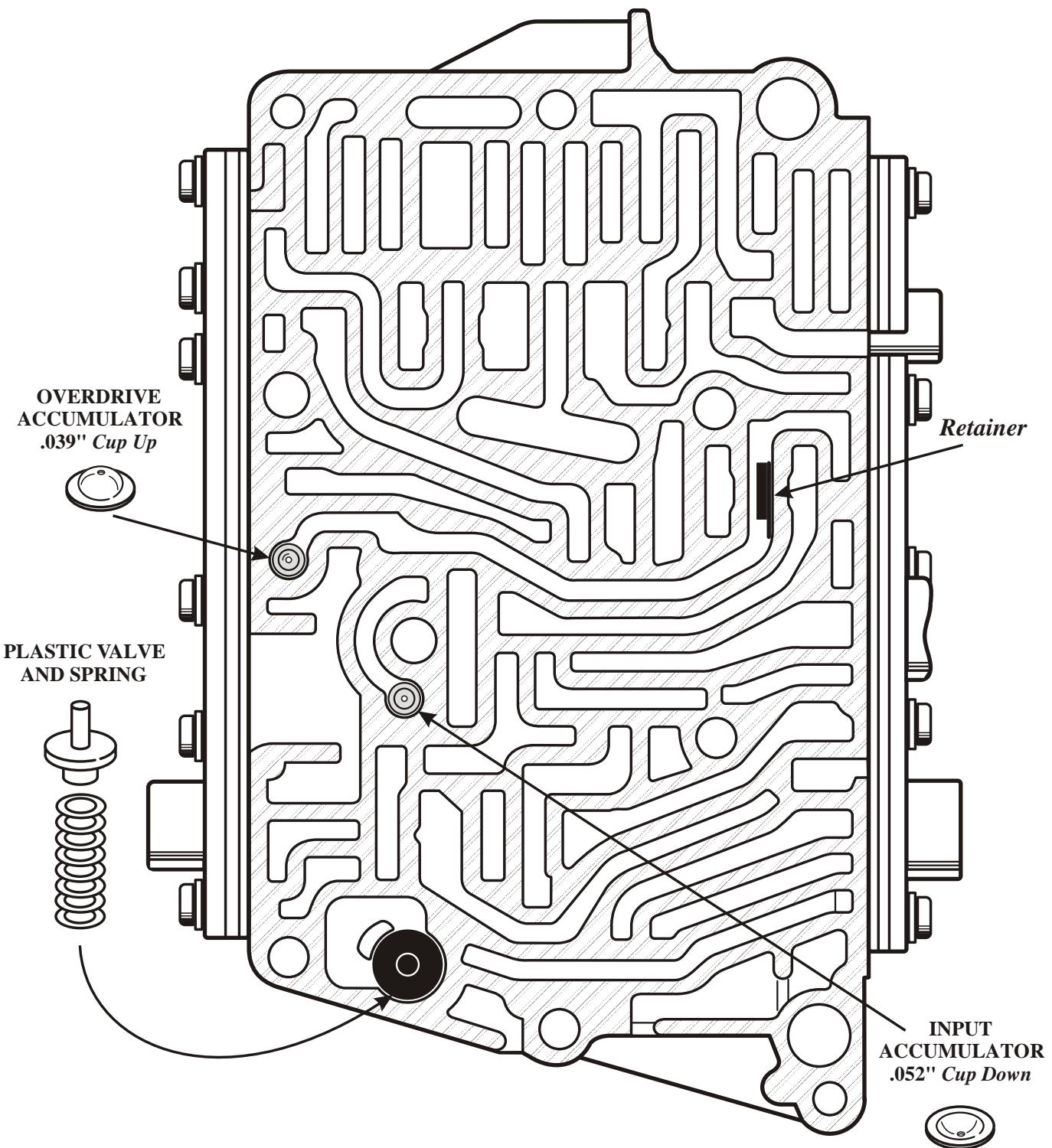
Figure 13

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03-32

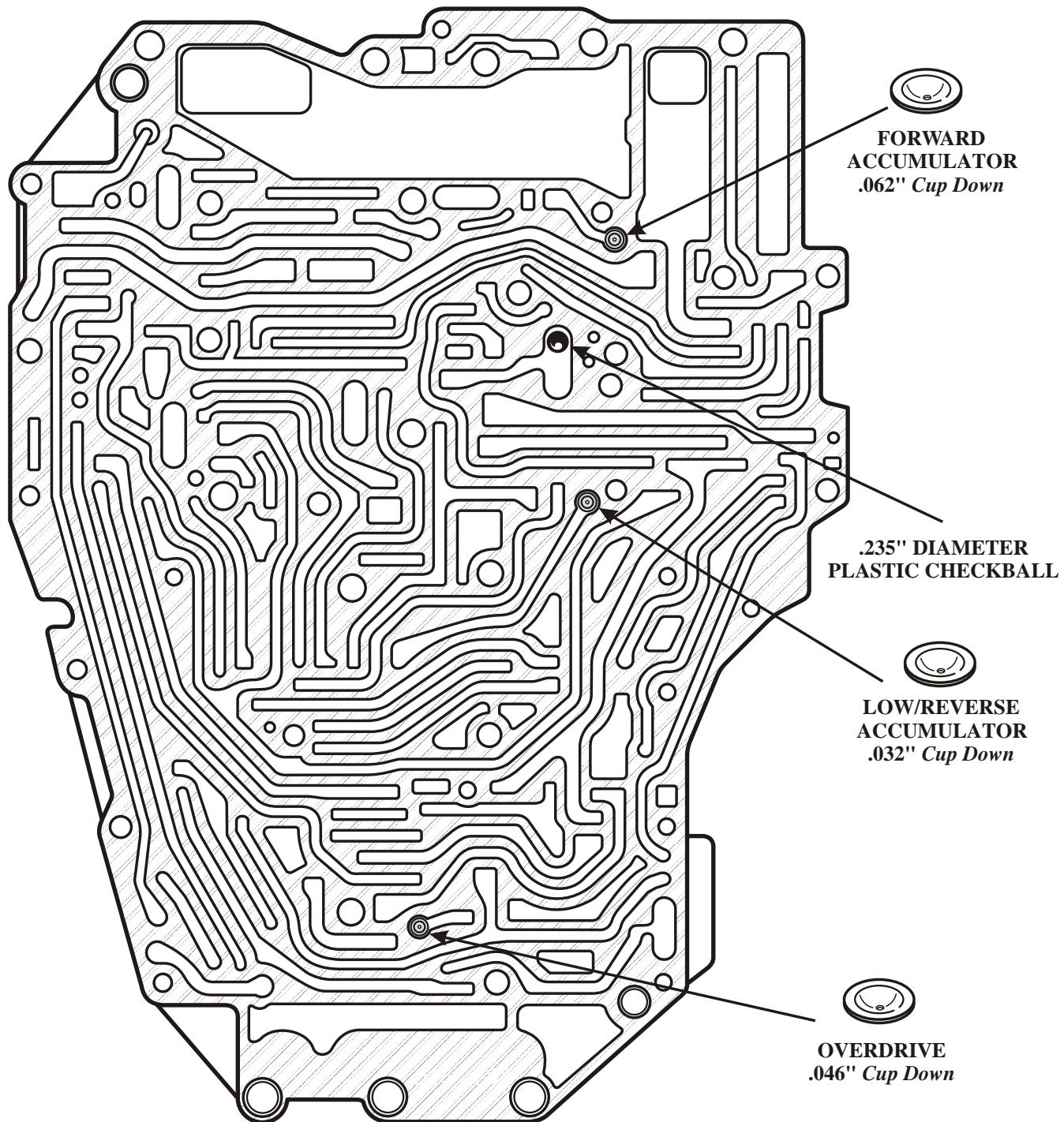
Page 16 of 35

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



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Figure 14

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

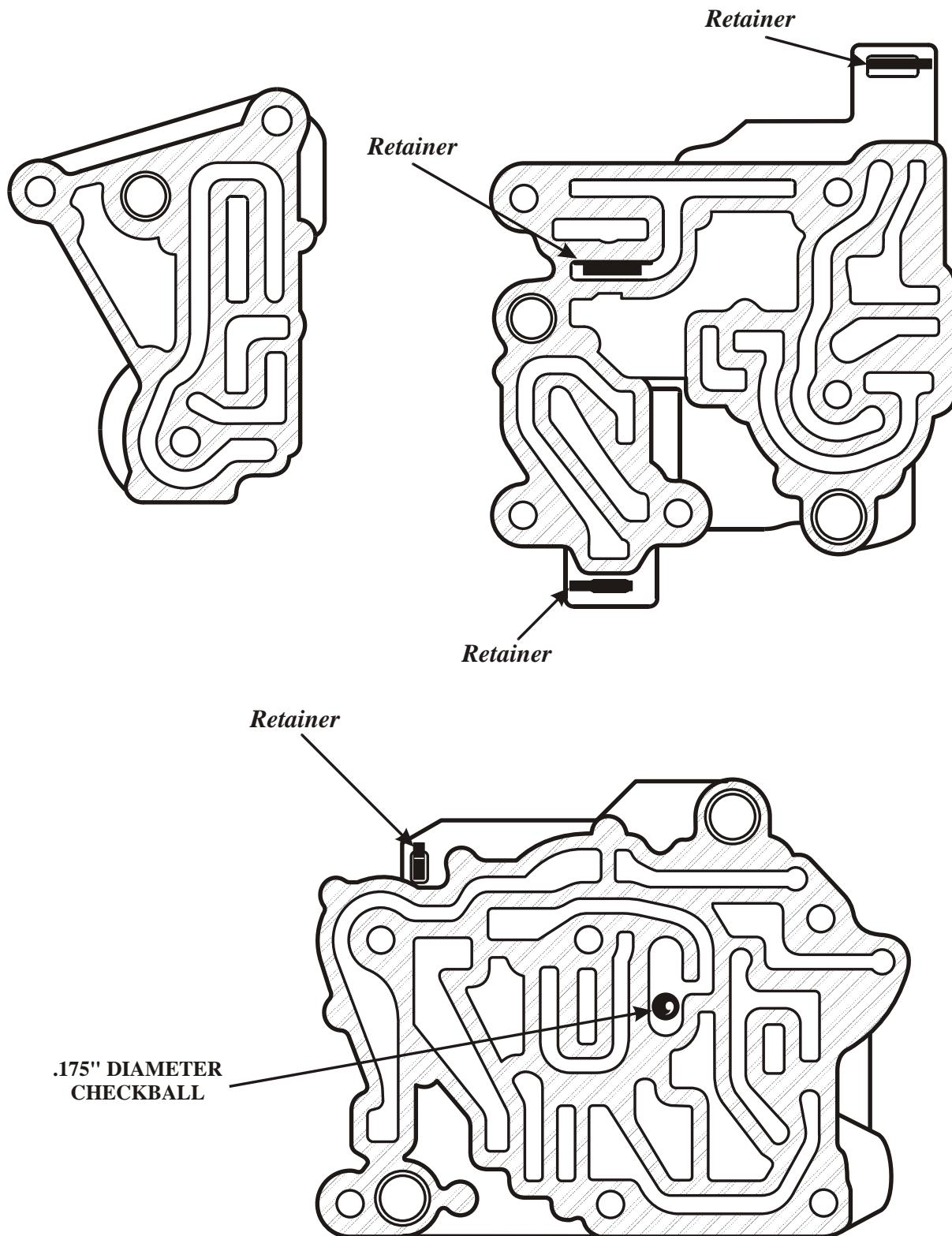
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Figure 15

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03-32

Page 18 of 35

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

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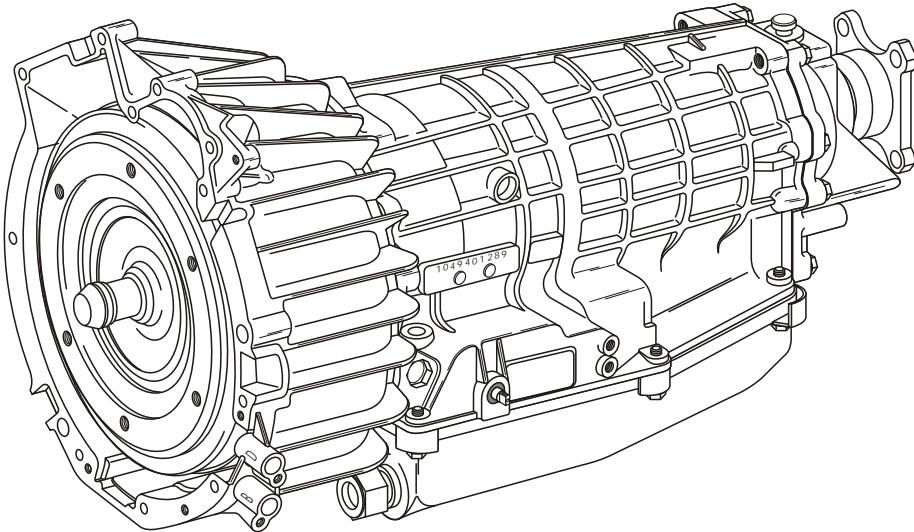
Figure 16

AUTOMATIC TRANSMISSION SERVICE GROUP

03-32

Page 19 of 35

## 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.

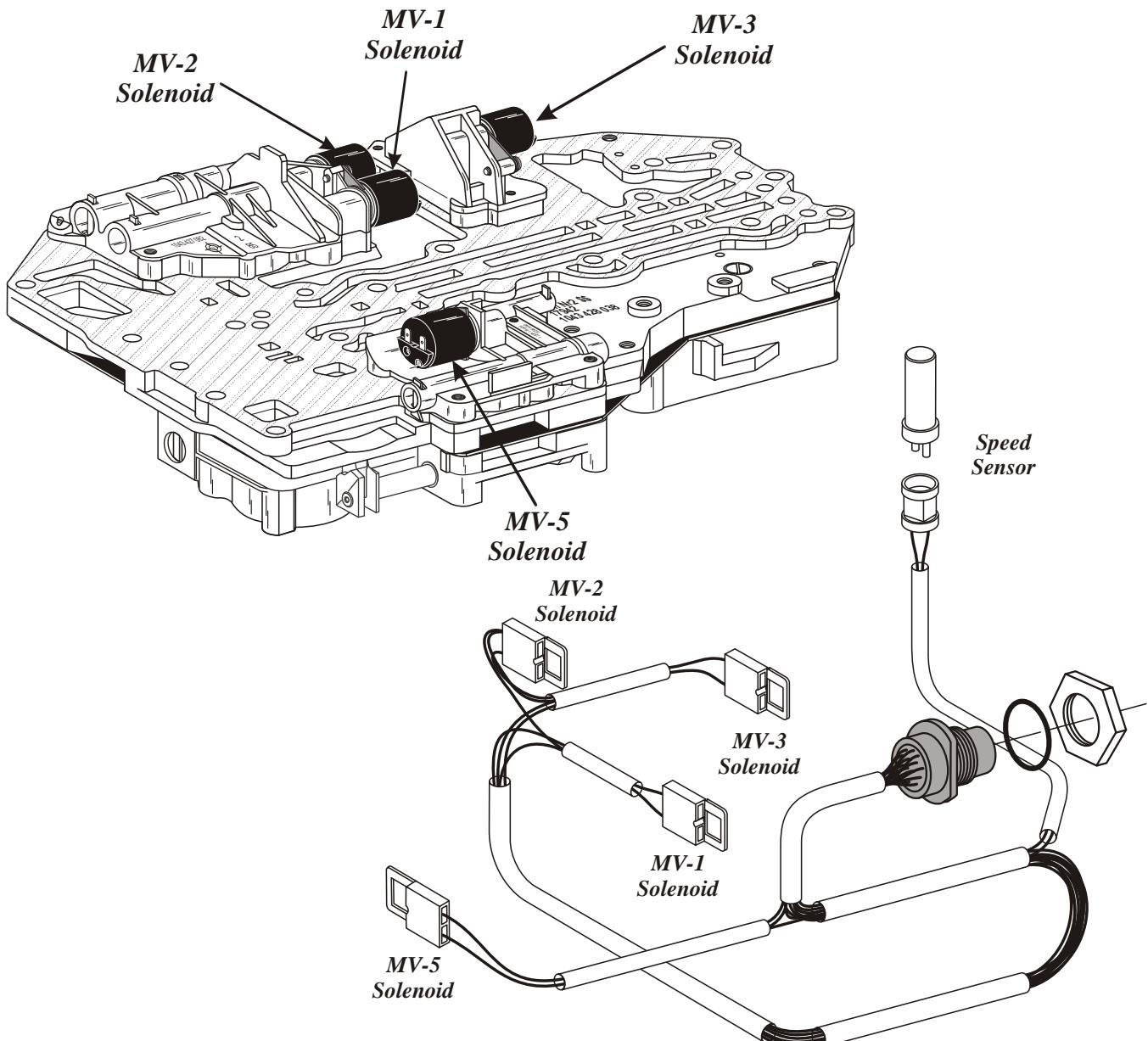
**MODEL YEAR USAGE CHART**

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

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Figure 17

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



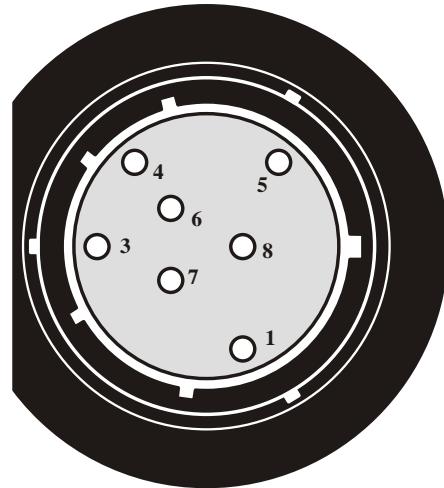
Solenoid	Function	Gear	MV-1	MV-2
<b>MV-1</b>	<i>Shift Control</i>	<i>1st</i>	<b>OFF</b>	<b>ON</b>
<b>MV-2</b>	<i>Shift Control</i>	<i>2nd</i>	<b>ON</b>	<b>ON</b>
		<i>3rd</i>	<b>ON</b>	<b>OFF</b>
		<i>4th</i>	<b>OFF</b>	<b>OFF</b>
		<i>Rev 0 mph</i>	<b>ON</b>	<b>OFF</b>
		<i>Rev Above 3 mph</i>	<b>OFF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

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Figure 18

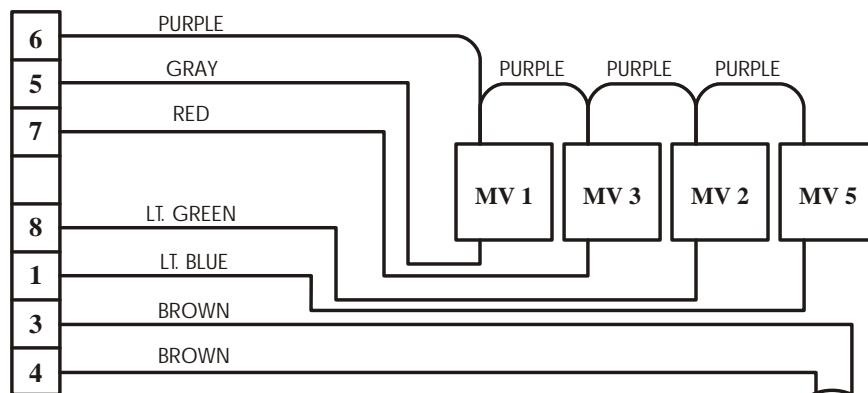
## ZF-4HP-22/24 MODEL "E-9", "4 SOLENOID" INTERNAL WIRE SCHEMATIC AND CONNECTOR TERMINAL IDENTIFICATION

*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



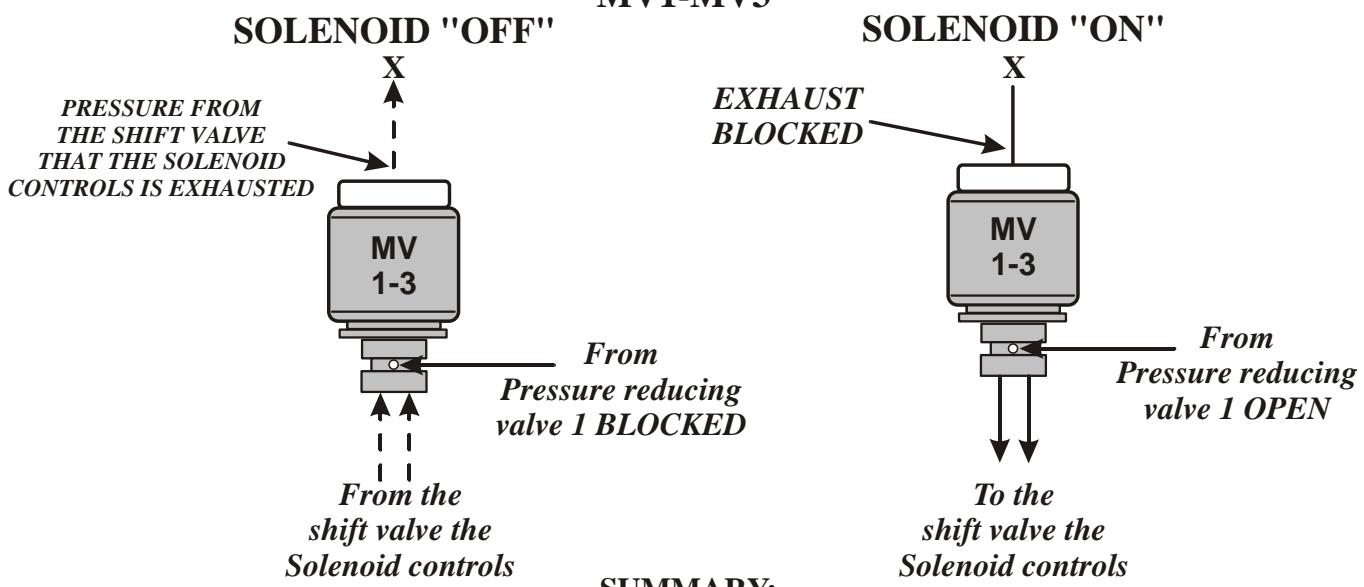
*NOTE: Some internal wire colors may vary.*



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## 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.

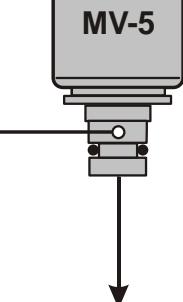
### MV-5

(Line Pressure Solenoid)

### SOLENOID "OFF"

EXHAUST BLOCKED

X

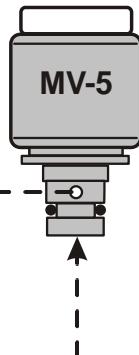


From Pressure reducing valve 2 to Mod. valve

### SOLENOID "ON"

EXHAUST OPEN

X



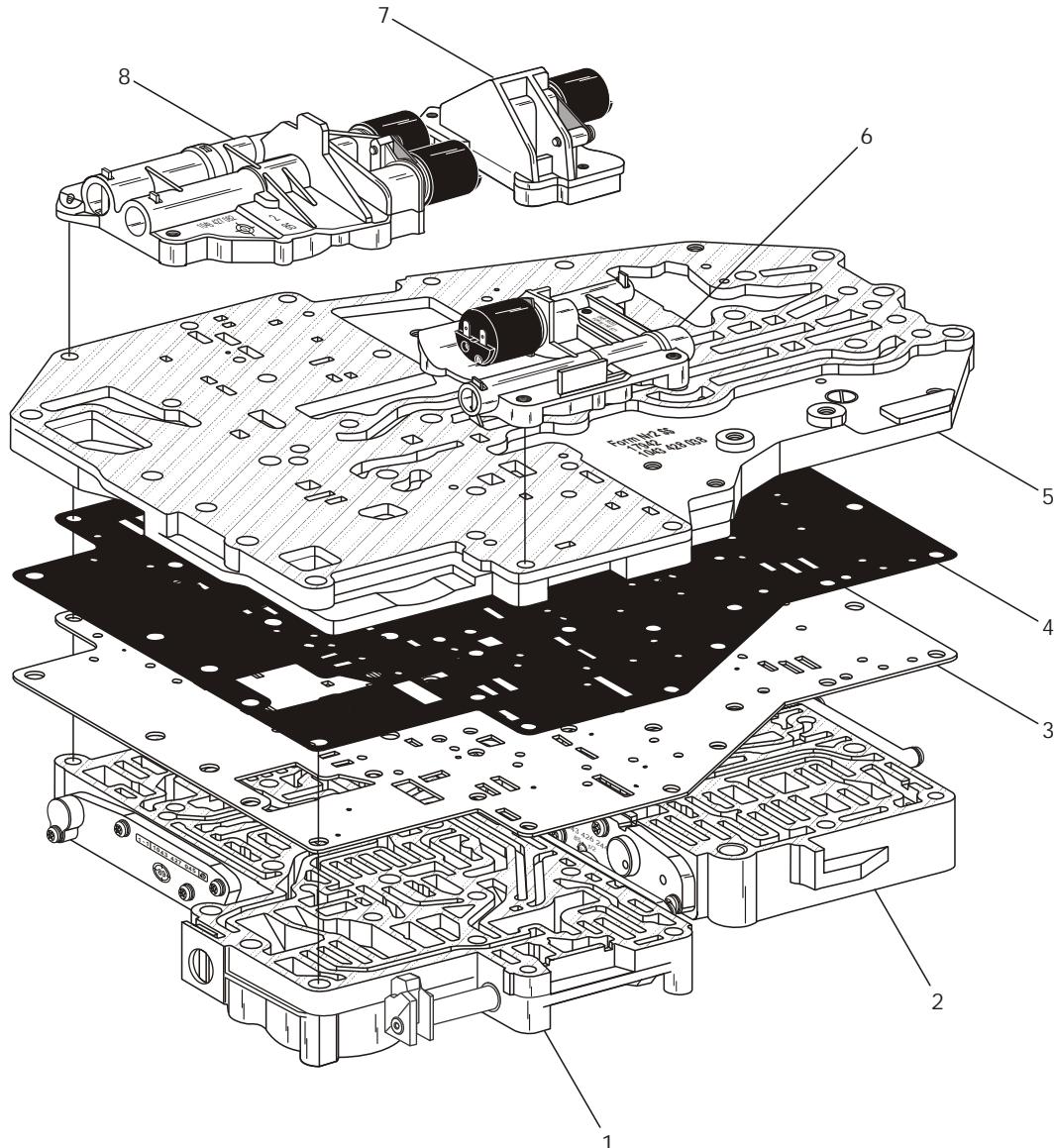
From Pressure reducing valve 2 and Mod. valve

### 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.

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**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

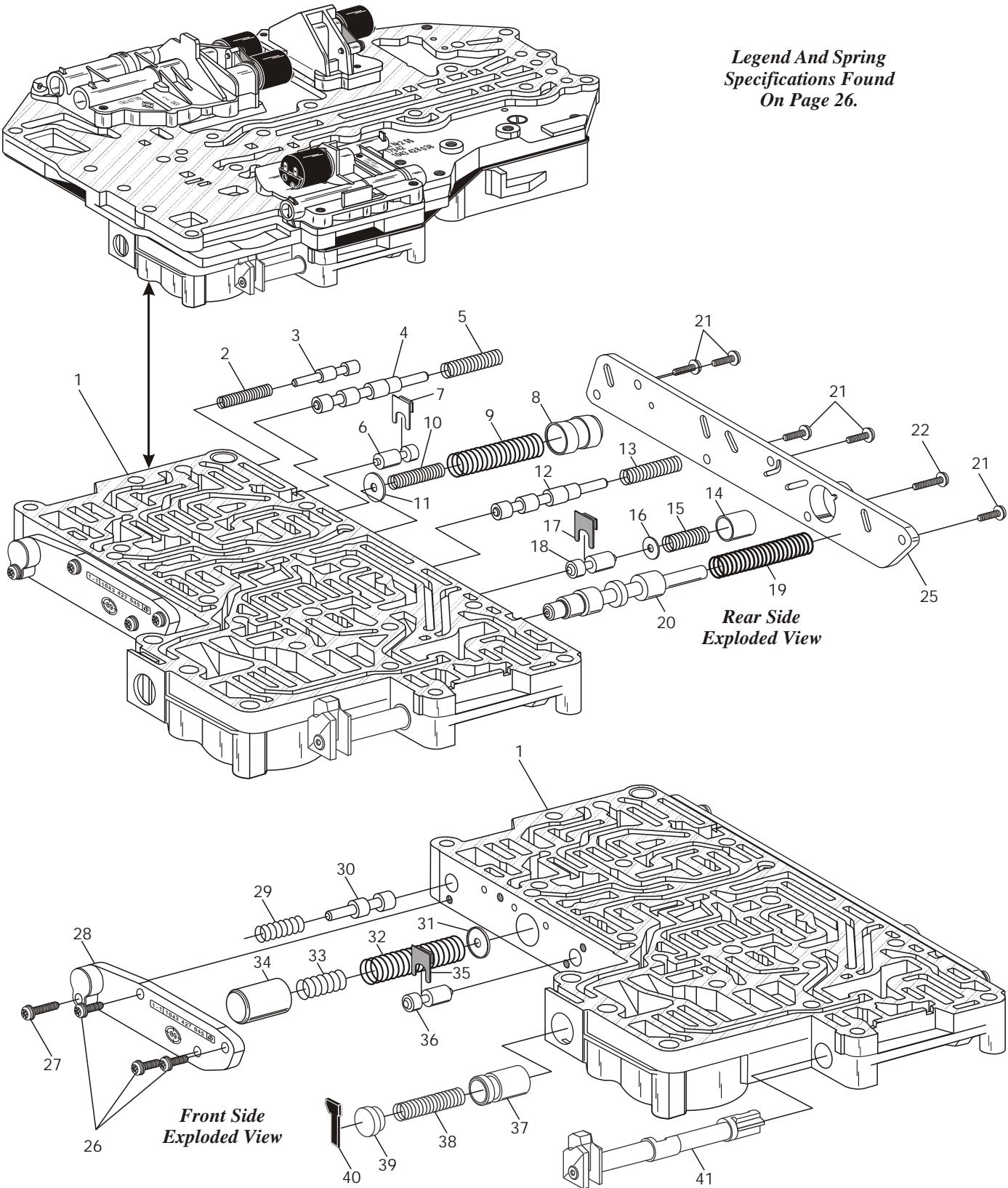
6 MV-5 SOLENOID BODY ASSEMBLY

7 MV-3 SOLENOID BODY ASSEMBLY

8 MV-1 AND MV-2 SOLENOID BODY ASSEMBLY

Figure 21

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



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Figure 22



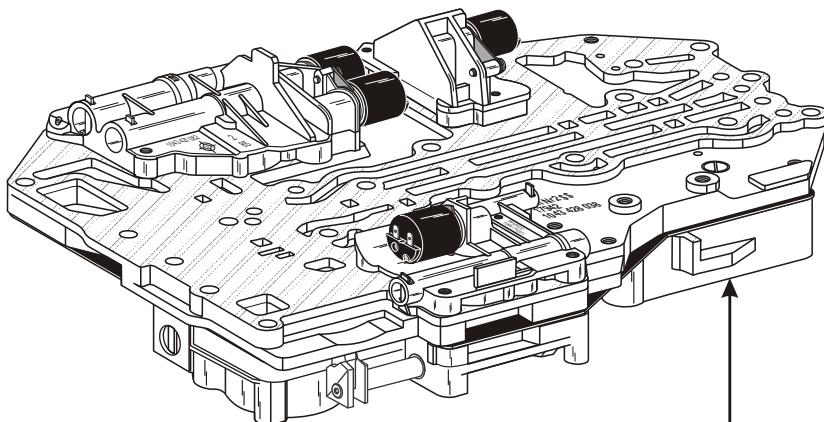
# Technical Service Information

## FIGURE 22 LEGEND AND SPRING SPECIFICATIONS

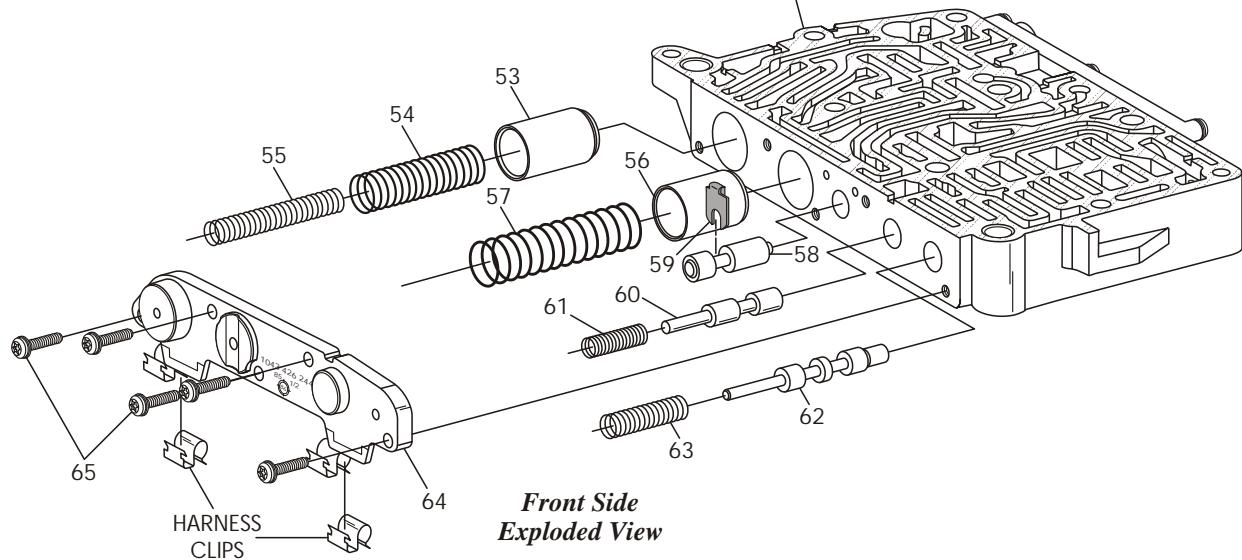
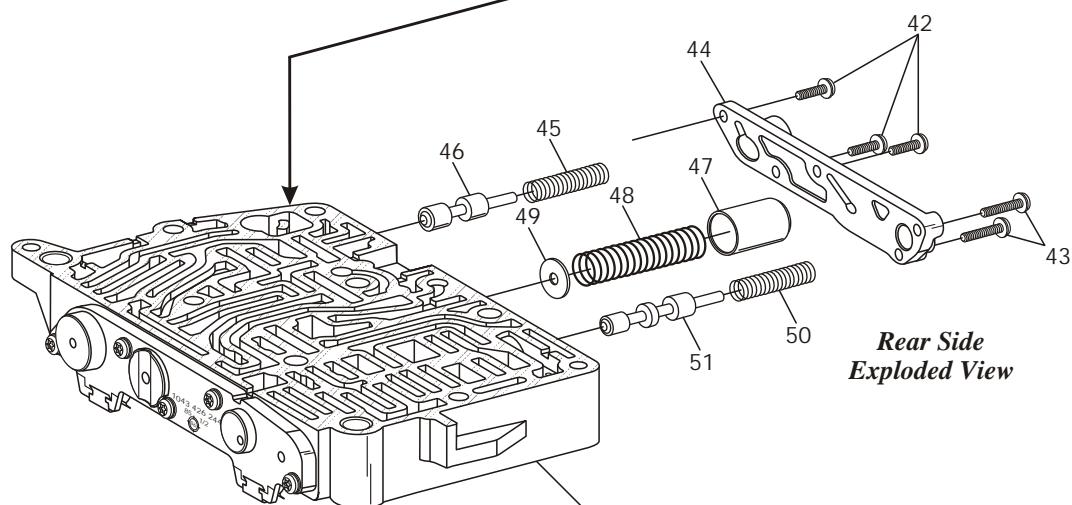
1 LOWER FRONT VALVE BODY CASTING	37 "A" CLUTCH DAMPER PISTON	SPRING ILLUSTRATION NO. 15:
2 "C" CLUTCH VALVE SPRING	38 "A" CLUTCH DAMPER SPRING	FREE LENGTH = 1.655"
3 "C" CLUTCH VALVE	39 "A" CLUTCH DAMPER PISTON SPRING SEAT	SPRING DIAMETER = .560"
4 2-3 SHIFT VALVE	40 "A" CLUTCH DAMPER SPRING SEAT RETAINER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

Figure 22 Legend

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



*Legend And Spring  
Specifications Found  
On Page 28.*





# Technical Service Information

## FIGURE 23 LEGEND AND SPRING SPECIFICATIONS

42 REAR SIDE COVER RETAINING BOLTS, 17 mm LENGTH (3)	SPRING ILLUSTRATION NO. 45:	SPRING ILLUSTRATION NO. 55:
43 REAR SIDE COVER RETAINING BOLTS, 21 mm LENGTH (2)	FREE LENGTH = 1.395"	FREE LENGTH = 3.490"
44 REAR SIDE COVER	SPRING DIAMETER = .305"	SPRING DIAMETER = .408"
45 PRESSURE REDUCING VALVE "1" SPRING	WIRE DIAMETER = .040"	WIRE DIAMETER = .045"
46 PRESSURE REDUCING VALVE "1"		
47 "F" CLUTCH DAMPER PISTON	SPRING ILLUSTRATION NO. 48:	SPRING ILLUSTRATION NO. 57:
48 "F" CLUTCH DAMPER PISTON SPRING	FREE LENGTH = 3.160"	FREE LENGTH = 2.905"
49 "F" CLUTCH DAMPER PISTON SPRING SEAT	SPRING DIAMETER = .690"	SPRING DIAMETER = .614"
50 SAFETY VALVE SPRING	WIRE DIAMETER = .044"	WIRE DIAMETER = .065"
51 SAFETY VALVE	SPRING ILLUSTRATION NO. 50:	SPRING ILLUSTRATION NO. 61:
52 LOWER REAR VALVE BODY CASTING	FREE LENGTH = 1.267"	FREE LENGTH = 1.515"
53 "C" CLUTCH DAMPER PISTON	SPRING DIAMETER = .315"	SPRING DIAMETER = .339"
54 "C" CLUTCH DAMPER PISTON OUTER SPRING	WIRE DIAMETER = .025"	WIRE DIAMETER = .045"
55 "C" CLUTCH DAMPER PISTON INNER SPRING	SPRING ILLUSTRATION NO. 54:	SPRING ILLUSTRATION NO. 63:
56 "E" CLUTCH DAMPER PISTON	FREE LENGTH = 2.900"	FREE LENGTH = 1.595"
57 "E" CLUTCH DAMPER PISTON SPRING	SPRING DIAMETER = .603"	SPRING DIAMETER = .67"
58 "F" CLUTCH VALVE	WIRE DIAMETER = .065"	WIRE DIAMETER = .032"
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)		

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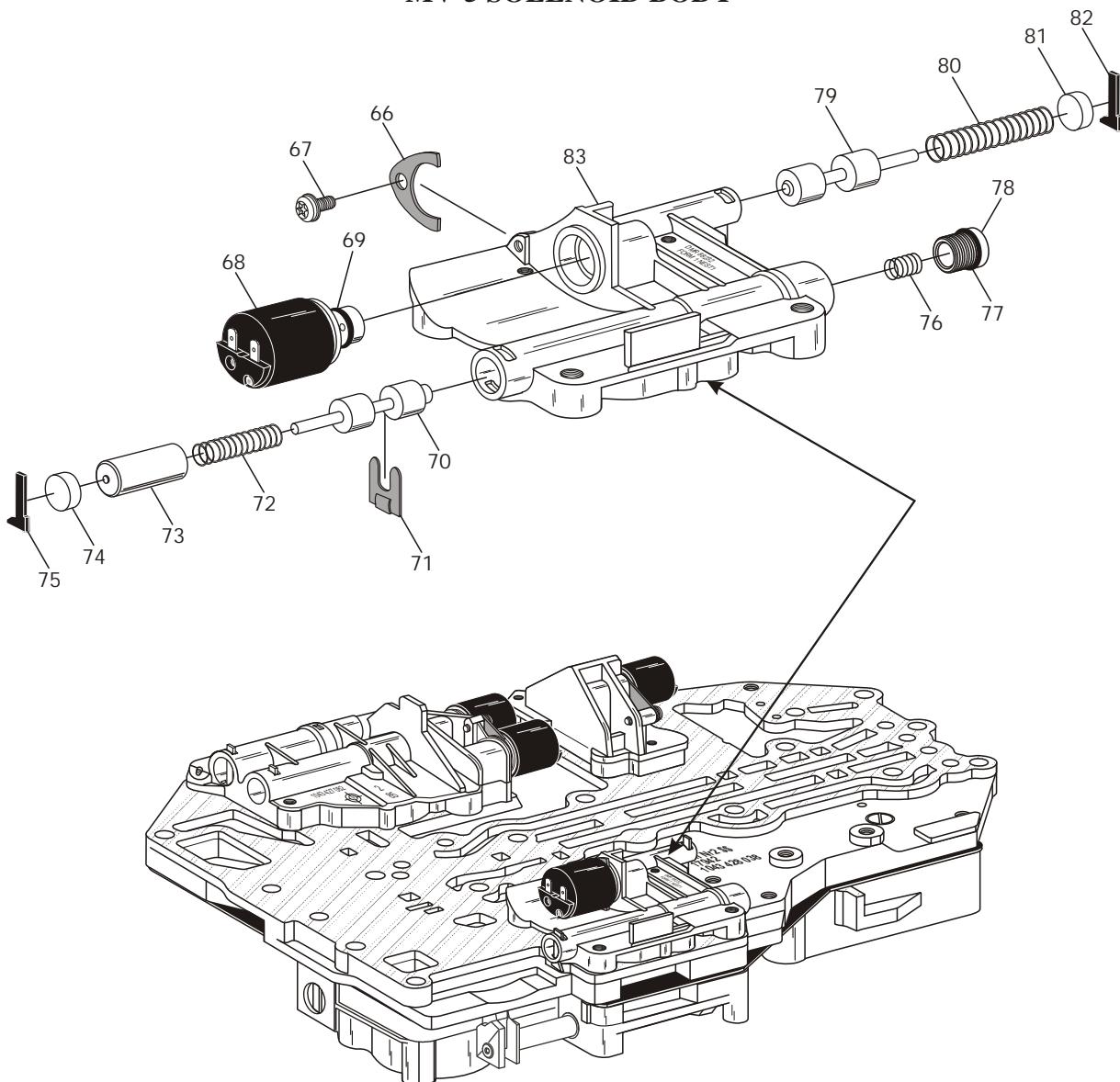
Figure 23 Legend

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03-32

Page 28 of 35

## 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"

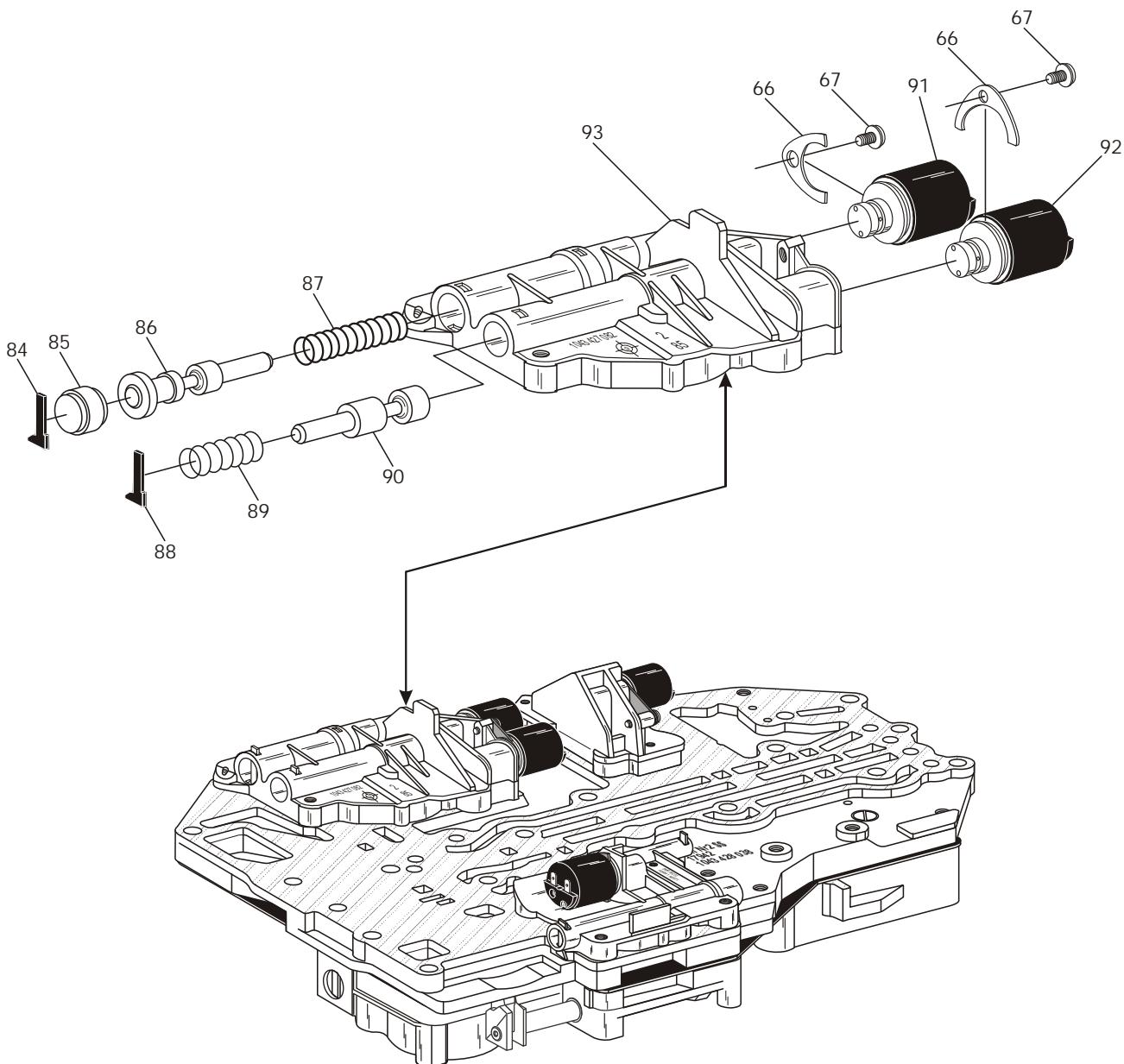
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Figure 24  
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03-32

Page 29 of 35

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



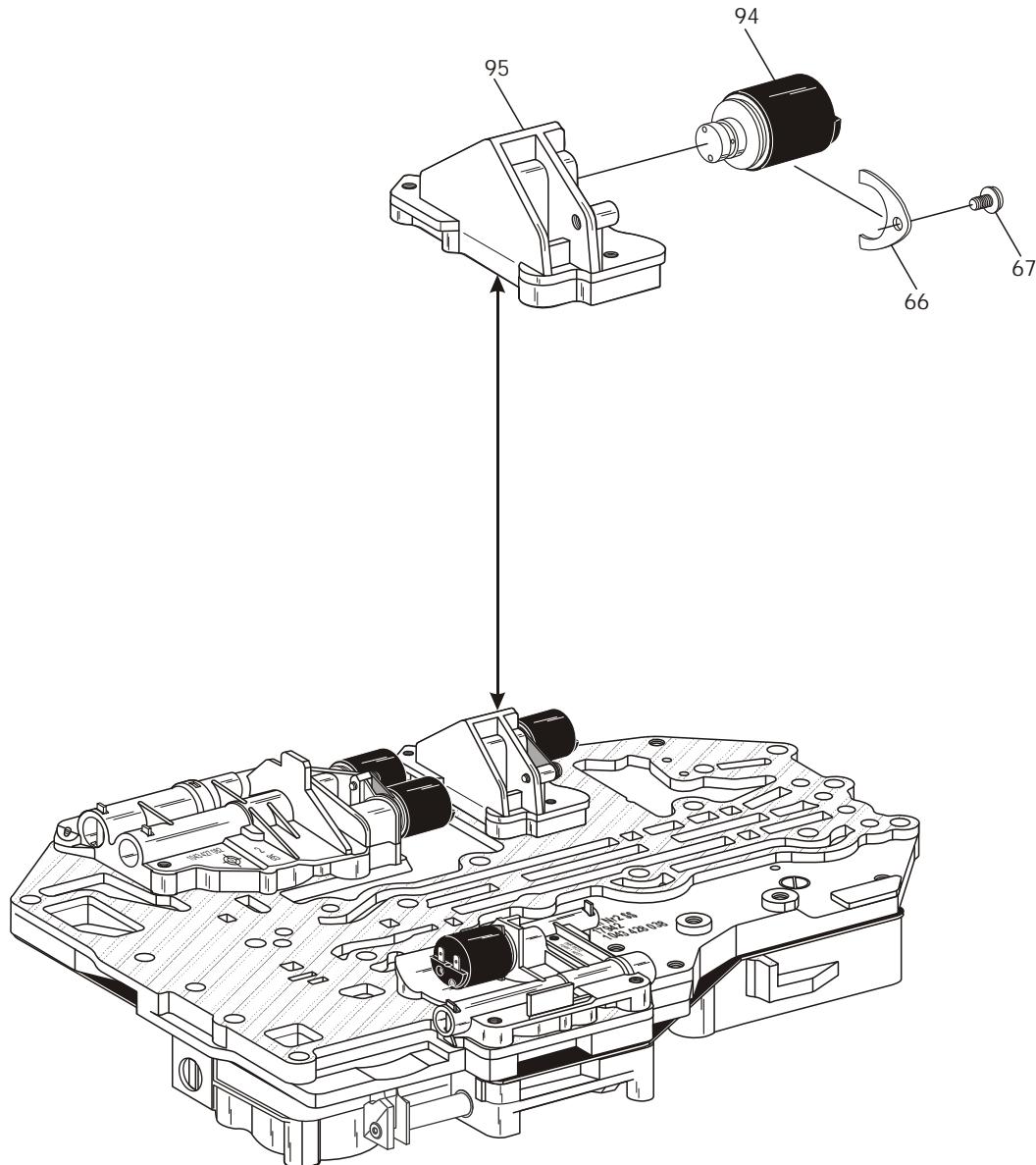
66 SOLENOID RETAINING BRACKET  
 67 SOLENOID RETAINING BOLT, 11 mm LENGTH  
 84 T.C.C. VALVE BORE PLUG RETAINER  
 85 T.C.C. VALVE BORE PLUG  
 86 TORQUE CONVERTER CLUTCH VALVE  
 87 TORQUE CONVERTER CLUTCH VALVE SPRING  
 88 LUBRICATION VALVE SPRING RETAINER  
 89 LUBRICATION VALVE SPRING  
 90 LUBRICATION 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"

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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

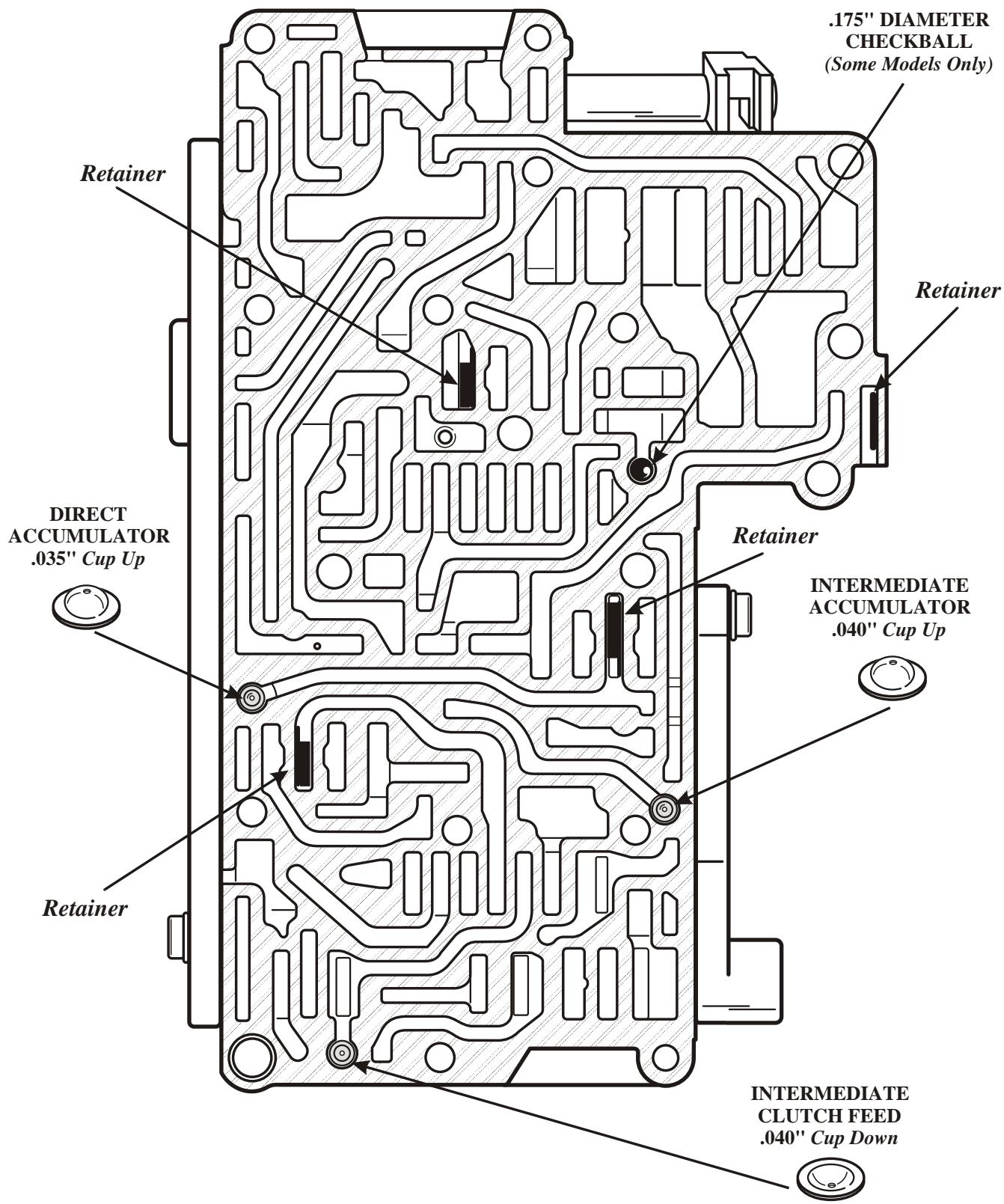
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Figure 26

AUTOMATIC TRANSMISSION SERVICE GROUP

03-32  
Page 31 of 35

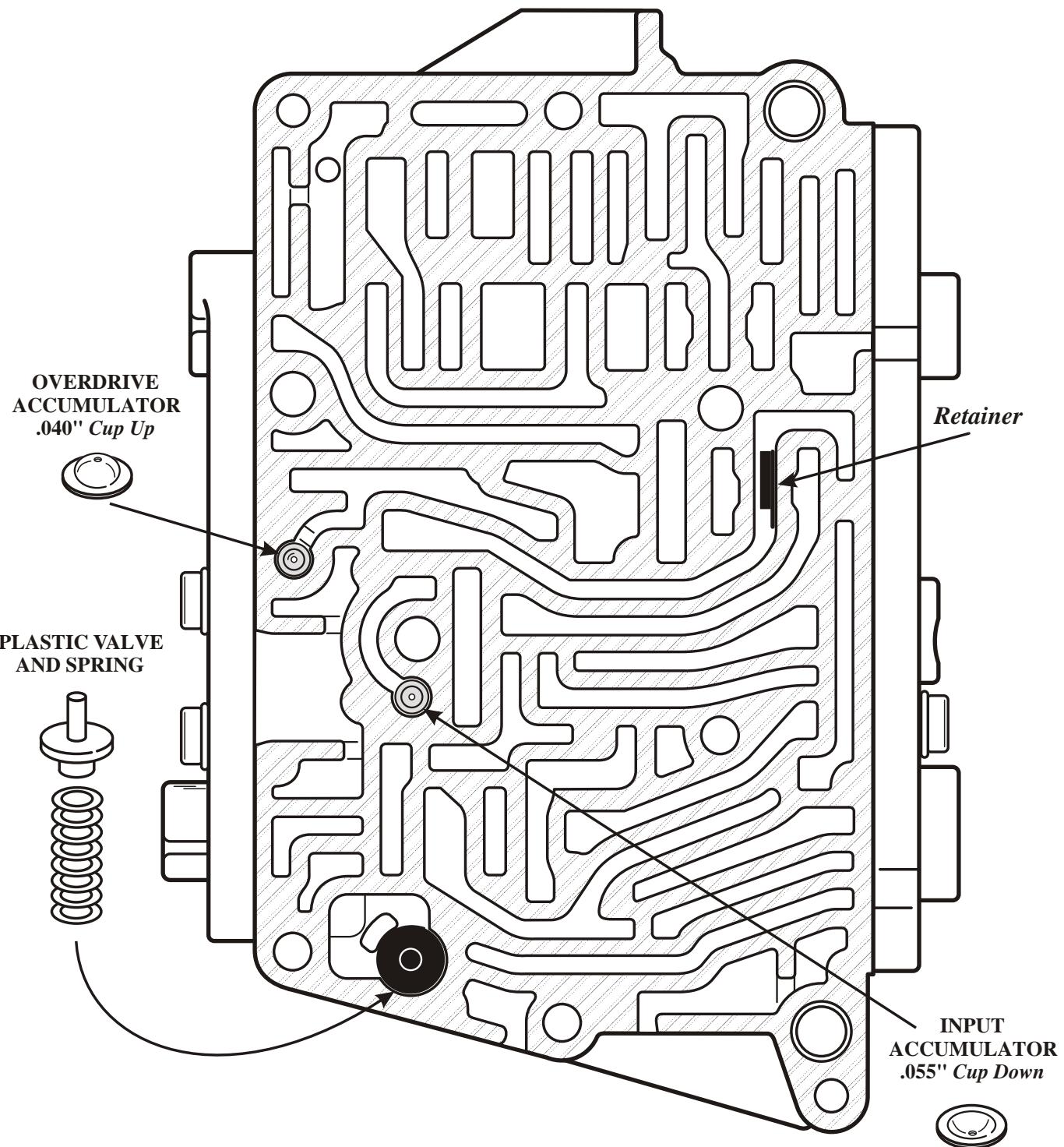
**ZF-4HP-22/24 MODEL "E-9", "4 SOLENOID"  
LOWER "FRONT" VALVE BODY**



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Figure 27

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



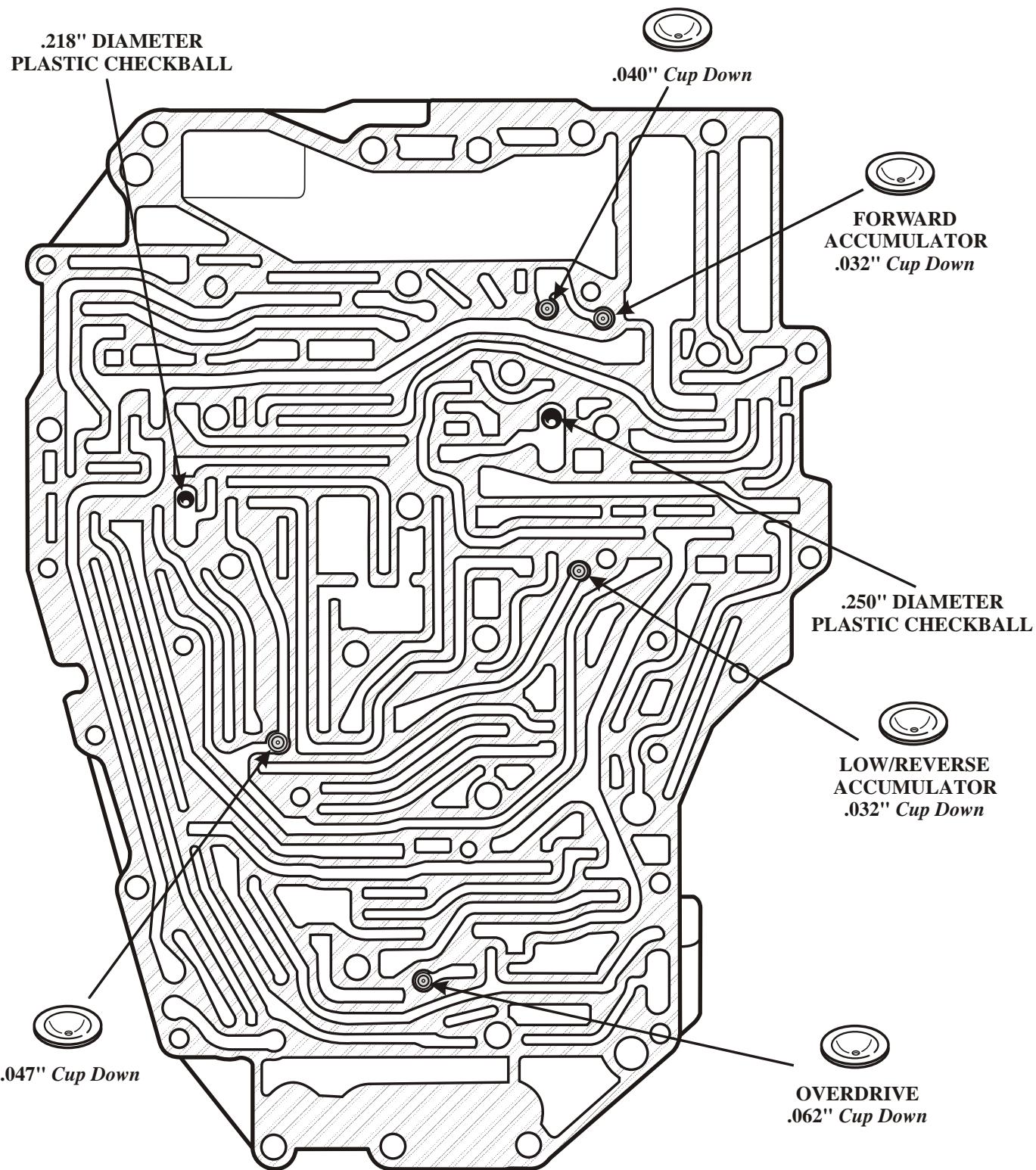
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Figure 28

AUTOMATIC TRANSMISSION SERVICE GROUP

03-32

Page 33 of 35

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

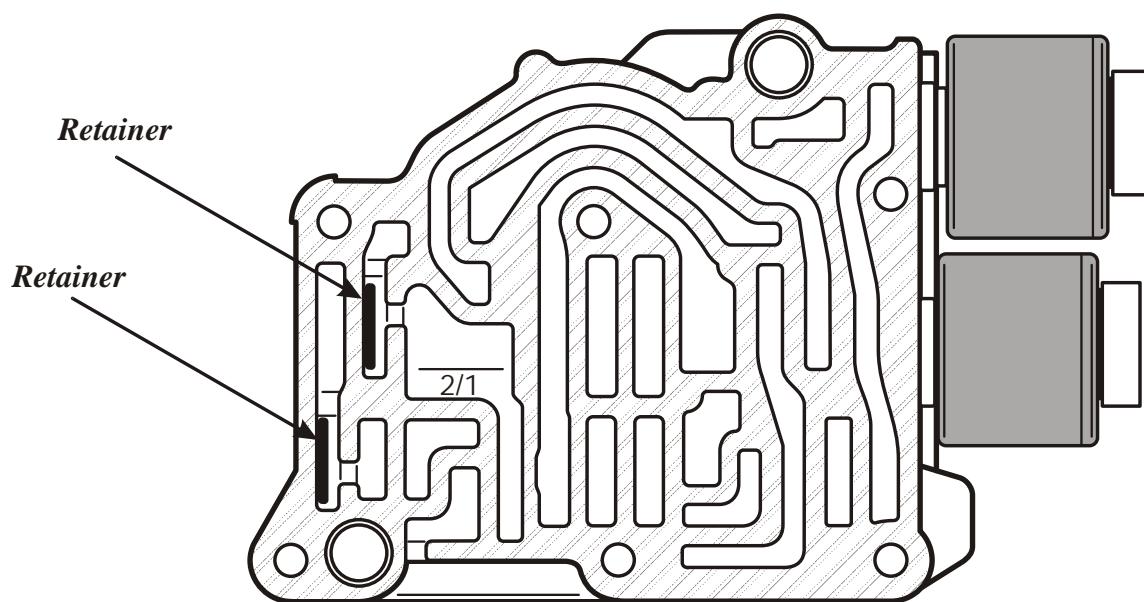
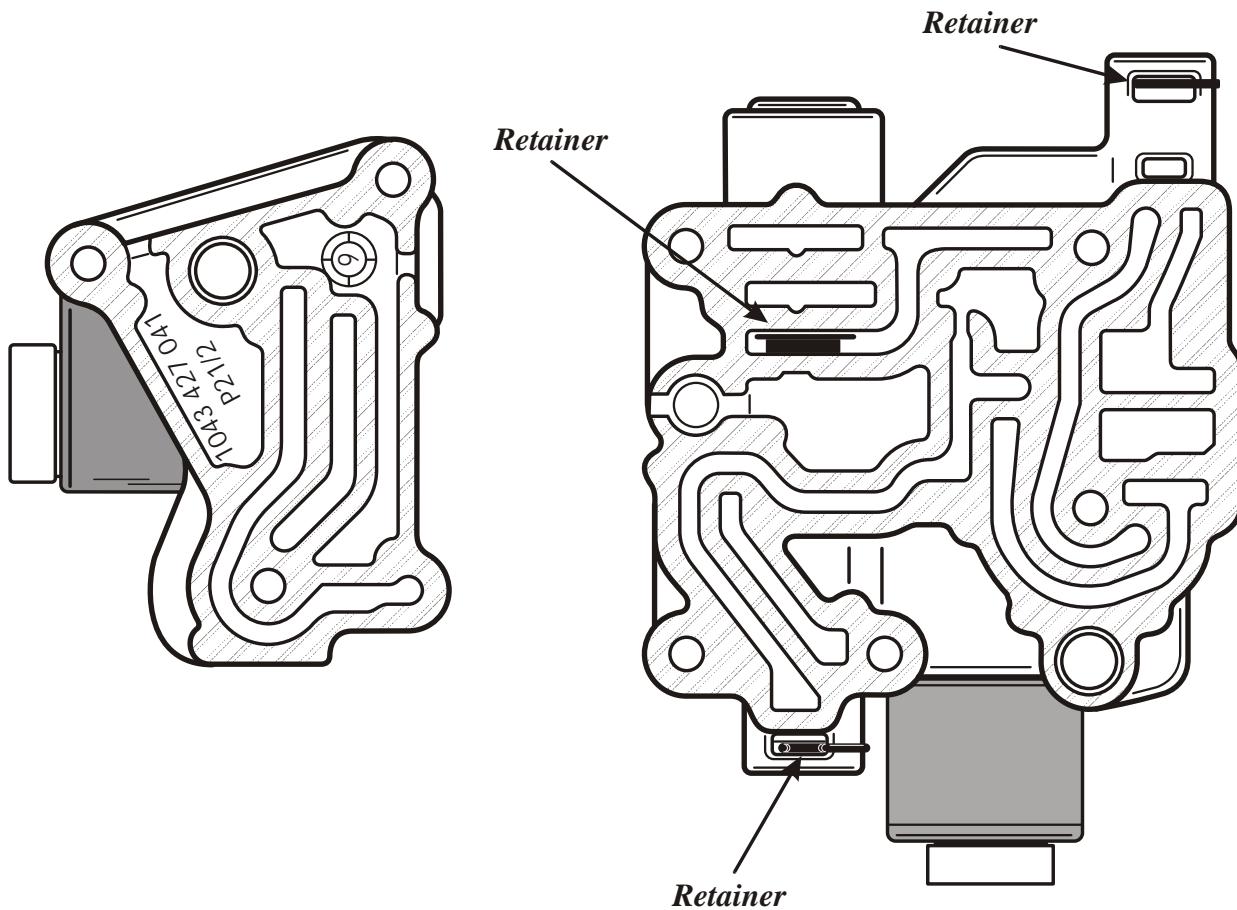
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Figure 29

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03-32

Page 34 of 35

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

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Figure 30

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03-32

Page 35 of 35