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# "What's in Store for 2004" Seminar Information

## *Introduction*

There used to be a time when someone mentioned the "Big 3," they would be referring to G.M., Ford and Chrysler. That reality is dissipating rapidly. The "Big 3" today could mean US, Japan and Europe. What really is a foreign or domestic vehicle these days? The Red and White manuals concentrated on bringing to you information pertaining to US manufacturers meaning G.M., Ford and Chrysler. This Blue Manual concentrates on bringing to you information pertaining to the Japanese and European manufacturers. Information on Mitsubishi, Mazda, Nissan, Isuzu, BMW, VW/Audi are all here and more in this ATSG Seminar "What's in Store for 2004" technical manual.

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# Precision

# Worldwide

**HONDA CIVIC A4RA/B4RA/M4RA****DELAYED FORWARD ENGAGEMENT, SLIPPING IN LOW GEAR**

**COMPLAINT:** The transmission exhibits a delayed forward engagement and slipping in low gear. A low clutch pressure check indicates pressure that is well below the 130 psi that is *required* when the transmission is in low gear.

When the transmission is disassembled, it is discovered that the low clutch plates are burnt. Inspection of the low clutch feed tube, feed tube o-rings and feed tube bushing indicate these components are in good condition. Low sprag is also in good condition.

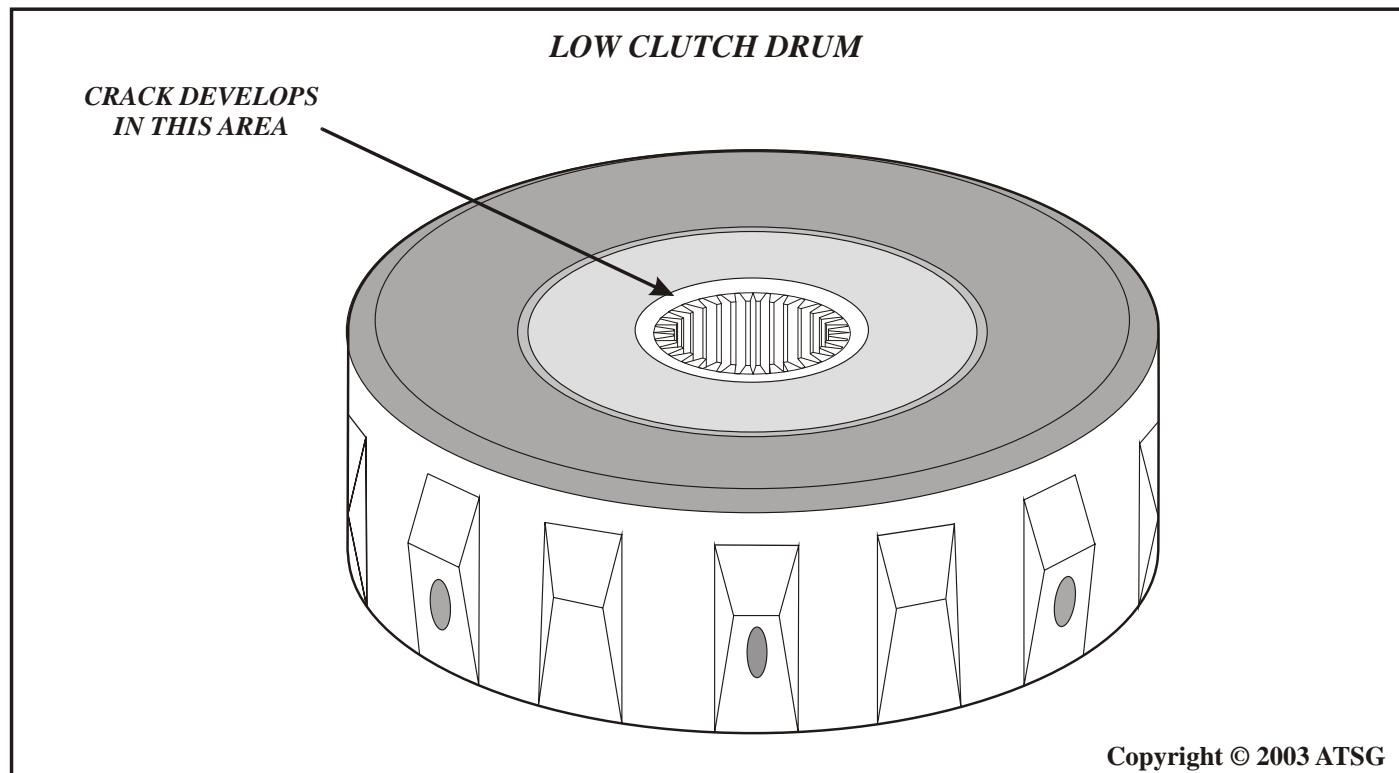
**CAUSE:** The low clutch drum has developed a hairline crack on the back of the drum close to the mainshaft opening as seen in Figure 1. This crack cannot be seen with the mainshaft nut and conical washer in place.

**CORRECTION:** Replace the low clutch drum as necessary, with OEM part number listed below.

**NOTE:** *A new drum can be purchased for about \$25.00. This can be an in vehicle repair by removing the end cover and low clutch drum, with the transmission in the car.*

**SERVICE INFORMATION:**

Low Clutch Drum Assembly ..... 22510P4R003



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Figure 1

**HONDA  
B7XA / B7TA  
REVERSE GRIND OR BANG**

**COMPLAINT:** Some 1999-2000 Honda Odyssey with the B7TA transaxle and 1998-2000 Honda Accord with the B7XA transaxle, may exhibit a complaint of a grind or a bang while the vehicle is driving in Reverse under a load.

**CAUSE:** The cause may be, insufficient pressure holding the Servo Piston in the Reverse position. This may allow the Servo Piston to drop the Reverse Selector out of Reverse gear creating the bang or grinding sensation.

**CORRECTION:** Replace the Servo Valve Body , with a "Counter measured" Servo Valve Body, available from Honda, as shown in Figure 1.

**SERVICE INFORMATION:**

SERVO VALVE BODY (Honda part number).....27400-P7X-A50

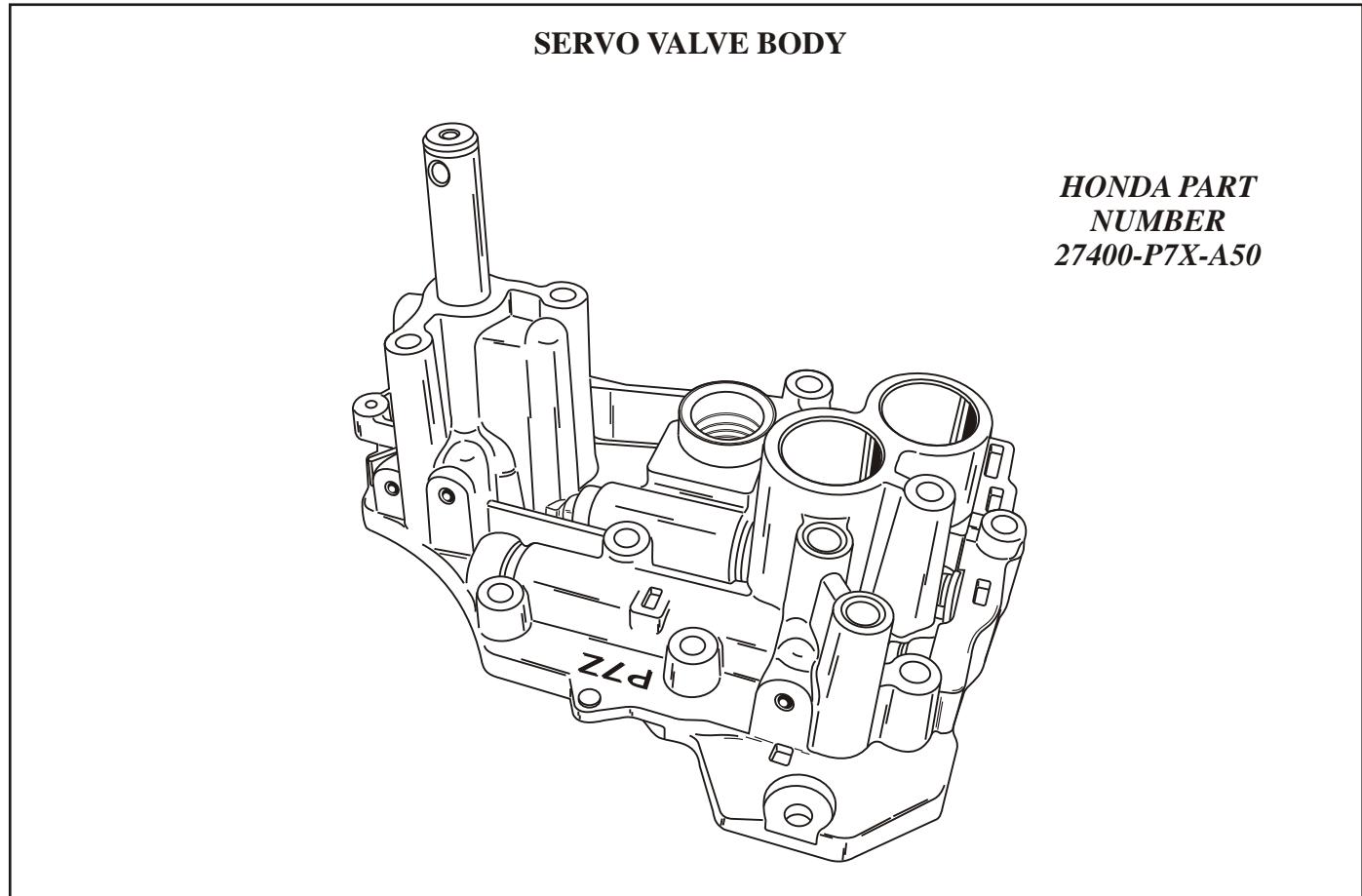


Figure 1  
Automatic Transmission Service Group



### HONDA ODYSSEY

#### DESTRUCTION OF THE COUNTERSHAFT SPEED SENSOR

**COMPLAINT:** After overhauling a B7TA/B7YA transmission (Figure 1) used in 1999 to 2001 Honda Odyssey Vans with 3.5L engines, during the initial run of the transmission, a popping grinding type noise may be heard followed by the illumination and blinking of the D4 light. No speedometer operation is also observed due to the fact that the output speed sensor is the VSS. When checked for codes, a code 9 or P0720 "Countershaft Speed Sensor" is retrieved.

**CAUSE:** The Countershaft Speed Sensor is located at the top of the transmission as seen in Figure 2. Underneath this sensor is a spacer washer used to maintain proper air gap of the sensor tip (See Figure 3). During the sensor's removal, it either falls away unnoticed or is forgotten about and during installation it is left out. Or, the spacer is used as washer on the bolt and the washer is mis-located to the top of the sensor. This allows the tip of the sensor to protrude deeper into the case and press on the gear train. When the gear train rotates, it rips away the tip rendering it completely useless (See Figure 4).

**NOTE:** *The Speed Sensor spacer is .104" thick.*

**CORRECTION:** Install a new or good used sensor with the spacer washer.. The spacer washer is approximately 0.104" in thickness and must be placed between the sensor and the case. The tab prevents the washer from spinning around. Erase the code by removing the 7.5 amp BACK-UP fuse from the passenger's under-dash fuse/relay box for 10 seconds. Start the vehicle and check for proper function of the sensor.

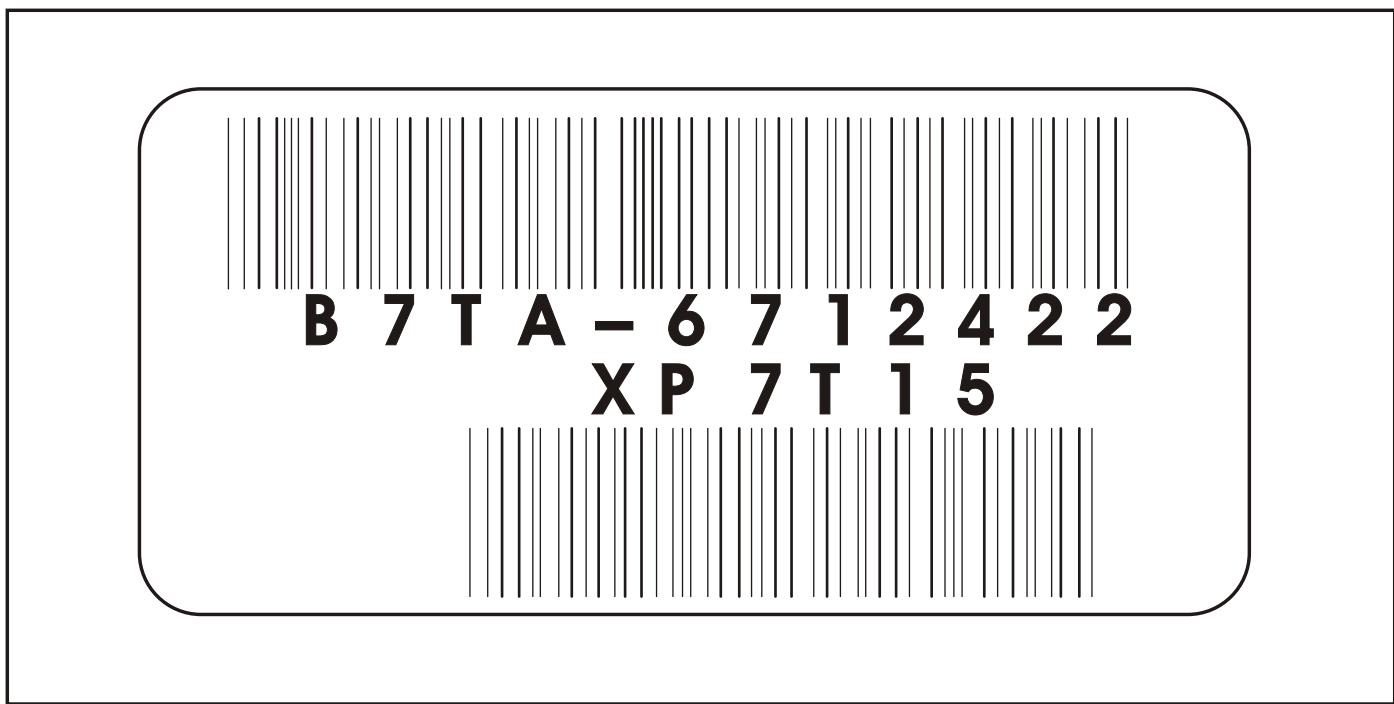
**DESTRUCTION OF THE COUNTERSHAFT SPEED SENSOR**

Figure 1

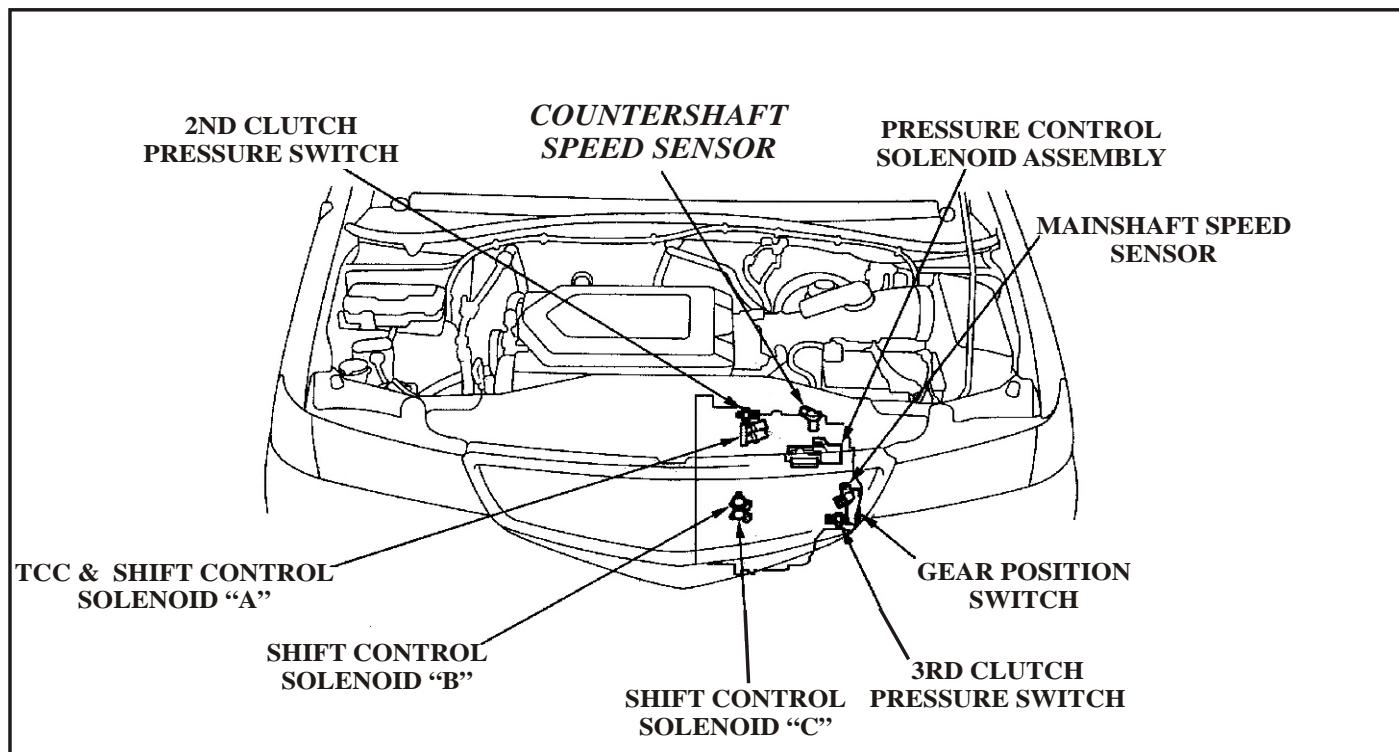


Figure 2

### DESTRUCTION OF THE COUNTERSHAFT SPEED SENSOR

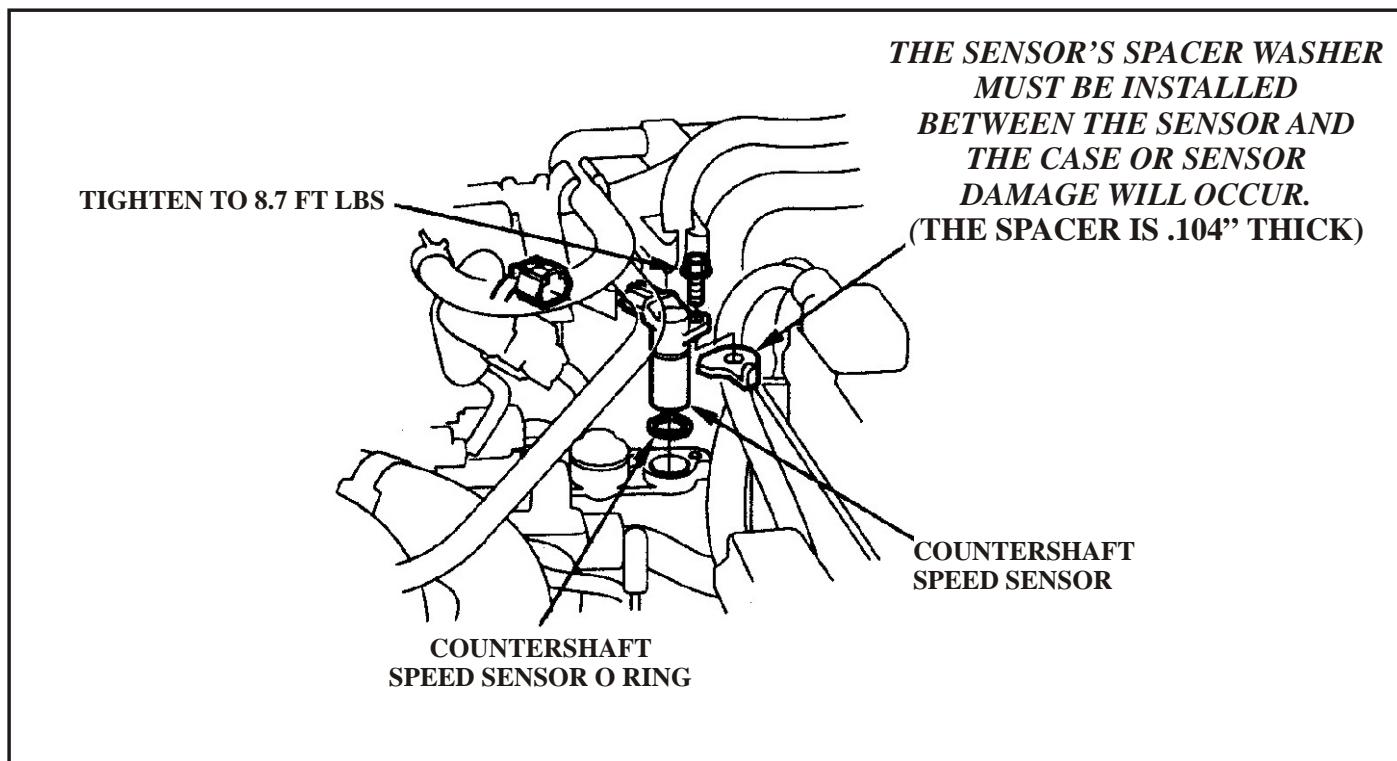


Figure 3

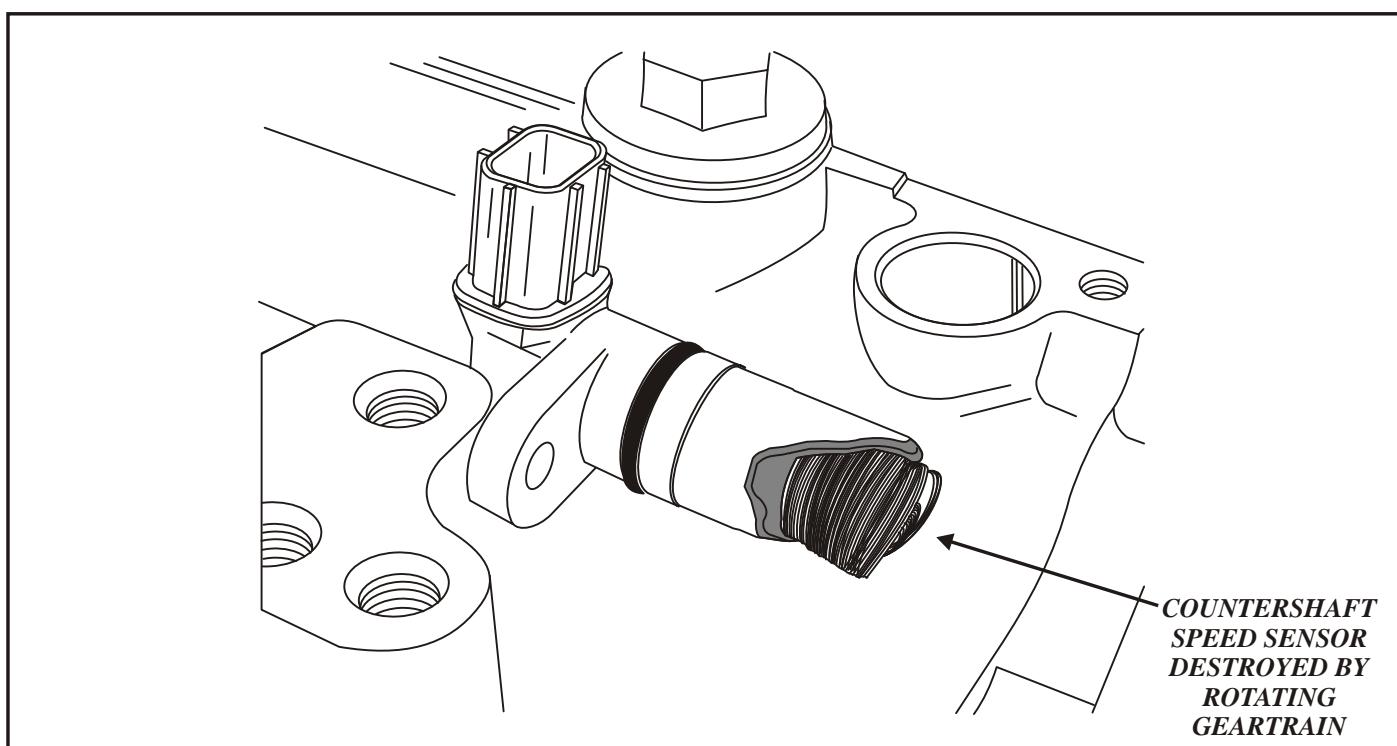


Figure 4



## 2003 HONDA ACCORD

### NO REVERSE

**COMPLAINT:** The vehicle has gotten stuck in snow or sand. The vehicle now exhibits a “No Reverse” condition. After cycling the ignition key, the “No reverse” condition still exists.

**CAUSE:** At some point during the attempt to free the vehicle, the PCM received vehicle speed information that indicated a speed higher than 12 mph in reverse. The PCM initiated the “Reverse Inhibit” function, thereby preventing reverse engagement. The problem is, on the affected vehicles, once the reverse inhibit feature is activated, it cannot be canceled, the vehicle remains in a “No Reverse” condition. The cause is a defective PCM.

**CAUTION:** If this vehicle enters your shop for service, and is equipped with one of these defective PCMs, you can cause this permanent “No Reverse” condition to occur by running it on the lift.

**CORRECTION:** The vehicle will have to be returned to the dealer to have updated software “Flashed” into the PCM to prevent this from happening again.

To verify the “No Reverse” condition is caused by this reverse inhibit problem, check the “RED” wire going to Shift Solenoid “E” using the illustrations in figures 1 and 2.

If no voltage is seen on this circuit, the PCM has activated the reverse inhibit feature.

### SERVICE INFORMATION:

The affected vehicles are as follows:

2003 Accord with L4 engine, both 2 and 4 door models with the following VIN numbers:

*From VIN#.....1HGCM7xxx3A000001 through 1HGCM7xxx3A023877*

*From VIN#.....1HGCM5xxx3A000001 through 1HGCM5xxx3A080789*

*From VIN#.....3HGCM5xxx3A000001 through 3HGCM5xxx3G705659*

*From VIN#.....JHMCM5xxx3C000001 through 3HGCM5xxx3C077295*

If this update has already been preformed, there will be a punch mark above the NINTH VIN digit as shown below.

1HGXXXXXX<sup>•</sup>XXXXXXX

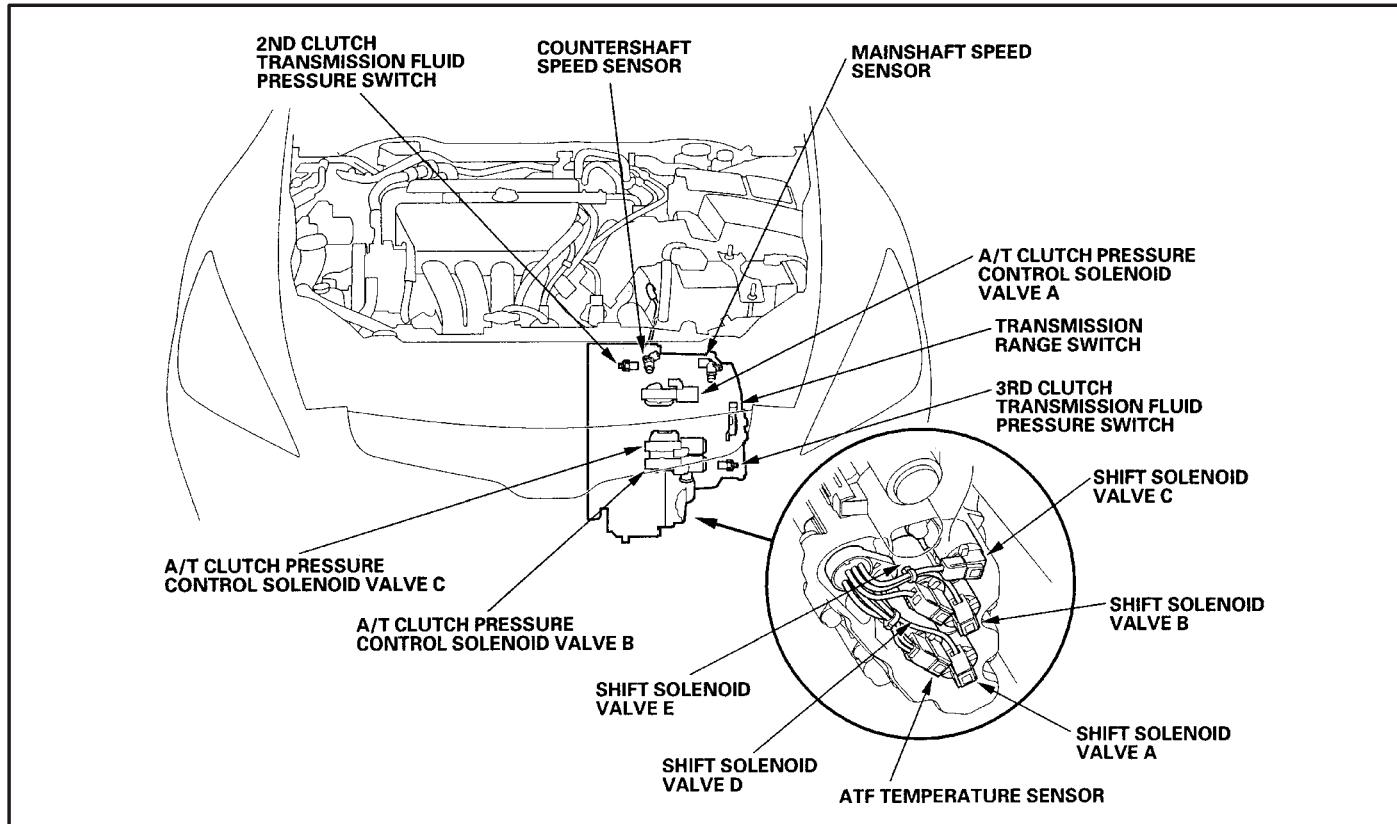
**NO REVERSE**


Figure 1

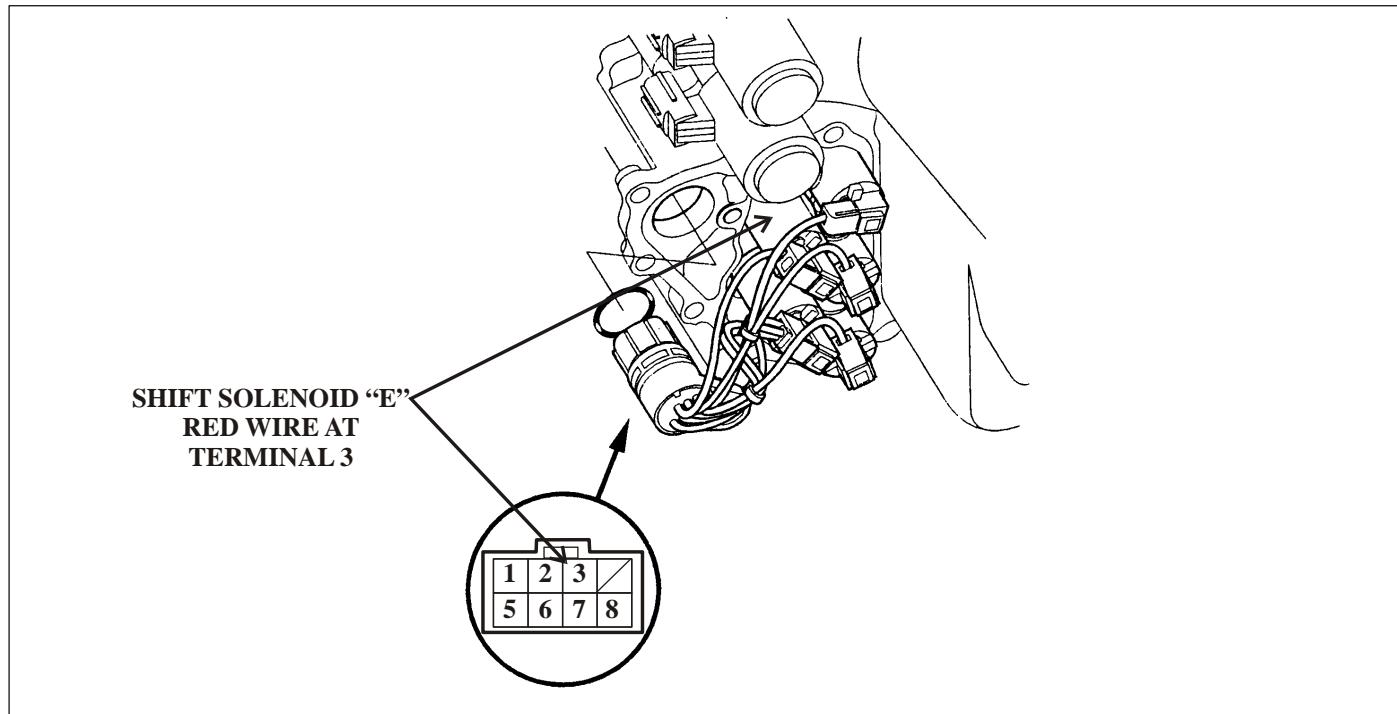


Figure 2

**BMW 530i/540i/740iA/740iLA  
NO 4th GEAR**

**COMPLAINT:** After a highway drive the vehicle will no longer shift into fourth gear.

**CAUSE:** AGS versions 7.32 and 9.22 have a curve recognition feature which inhibits up shifts while cornering. This up shift prevention feature is activated by the observance of wheel speed differences which occurs when cornering. The inside wheels on the turn spin less than the outside wheels. The problem of a highway run causing this feature to be erroneously activated could be:

1. Tires are inflated unequally
2. Tires are different in size
3. Tires are the same size but are a different brand or make
4. Tires are worn unequally

**CORRECTION:** Inspect the tires

1. Check and correct for proper inflation
2. Check and correct for proper size and that they are the same on all 4 wheels
3. Check and correct for the proper brand or make (See Figures 1 and 2). *Tip: If the problem is new, look for new tires.*
4. Check and correct for unequally worn tires, i.e. front end misalignment, deflated or overinflated tire wear, etc..

**530i & 540i Tire Application**

<u>Summer Tires</u>	<u>Wheels</u>	<u>Brands</u>
225/60 R 15 95 V	7 J x 15 H2 Light Alloy ET=20mm	Continental CV 51, Dunlop D40, Dunlop SP Sport 2000, Pirelli P600, Uniroyal Rallye 340/60
240/45 ZR 415	195 TR 415 Light Alloy ET=19mm	Michelin TRX
235/45 ZR 17	8 J x 17 Light Alloy ET=20mm	Michelin Pilot SX MXX3, Pirelli P700Z

Figure 1

## **BMW 530i/540i/740iA/740iLA NO 4th GEAR**

### ***530i & 540i Tire Application***

<b><u>Winter Tires</u></b>	<b><u>Wheels</u></b>	<b><u>Brands</u></b>
205/65 R 15 94 QM+S	7 J X 15 H2	Continental Contact TS 750
225/60 R 15 95 QM+S	Steel ET=20mm	Dunlop SP Winter, SP Winter Sports Michelin XM+S100 or 300 Pirelli Winter 190 or 210 Performance Uniroyal MS Plus 3
225/60 R 15 95 QM+S	7 J X 15 H2 Light Alloy	Continental Contact TS 750
225/60 R 15 94 QM+S	Steel ET=20mm	Dunlop SP Winter, SP Winter Sports Michelin XM+S300 Pirelli Winter 210 Performance Uniroyal MS Plus 3
240/45 R 15 94 HM+S	195 TR 415 Light Alloy ET=19mm	Michelin TRX M+S 300

### ***740i & 740il Tire Application***

<b><u>Summer Tires</u></b>	<b><u>Wheels</u></b>	<b><u>Brands</u></b>
225/60 ZR 15	7 J x 15 H2 Light Alloy ET=22mm	Dunlop SP Sport D40, Pirelli P600, Uniroyal Rallye 340/60
<b><u>Winter Tires</u></b>	<b><u>Wheels</u></b>	<b><u>Brands</u></b>
205/60 R 15 95 HM+S	7 J X 15 H2 Light Alloy ET=20mm	Continental Contact TS 750 Michelin XM+S300 or 330 Pirelli Winter 210 Performance Uniroyal MS Plus 3, Dunlop SP Winter Dunlop SP Winter Sport

Figure 2

# HFT



# "2004" SEMINAR INFORMATION

## SLIDE

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### 4L30-E

#### BIND ON TAKE-OFF OR BIND ON 2-3 SHIFT

**COMPLAINT:** Before or after overhaul, vehicles equipped with the 4L30-E transmission may exhibit a binding sensation on take-off when Drive is selected or a binding condition on the 2-3 upshift. NOTE: This may cause continual band or 3rd clutch failure.

**CAUSE:** The cause may be,

*Bind on Take-off*

The 2-3 shift solenoid, which is Normally Open, may be partially closed from debris, causing the 2-3 shift valve to be partially stroked to the right. This connects a Line Pressure passage from the Manual Valve to the release side of the servo and 3rd clutch apply. This can create a binding condition because the servo is partially released and the 3rd clutch is partially applied when the servo is supposed to be fully applied. See Figure 3 for partial hydraulic schematics.

*Bind on the 2-3 upshift*

The 2-3 shift solenoid, which is Normally Open, may not close quickly causing the 2-3 shift valve to be in a position that limits servo release and 3rd clutch pressure creating a bind because the servo is not fully released, when the 3rd clutch is being applied.

**CORRECTION:** Refer to Figure 1 for the location of the 2-3 solenoid, and verify the 2-3 solenoid's mechanical operation as shown in Figure 2. Ensure that the 2-3 shift valve, which is behind the 2-3 solenoid is not binding in its bore. Replace the 2-3 solenoid as necessary.

#### SERVICE INFORMATION:

2-3 SOLENOID (ISUZU part no.).....	8960143240
2-3 SOLENOID (G.M. part no.).....	96014224

### 2-3 SOLENOID LOCATION

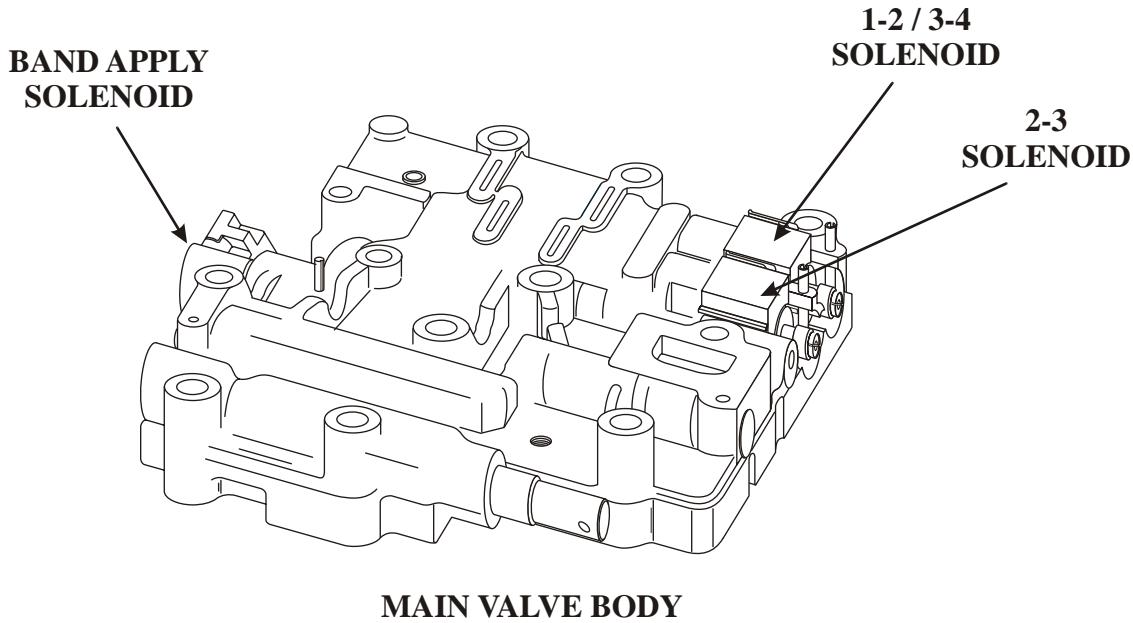
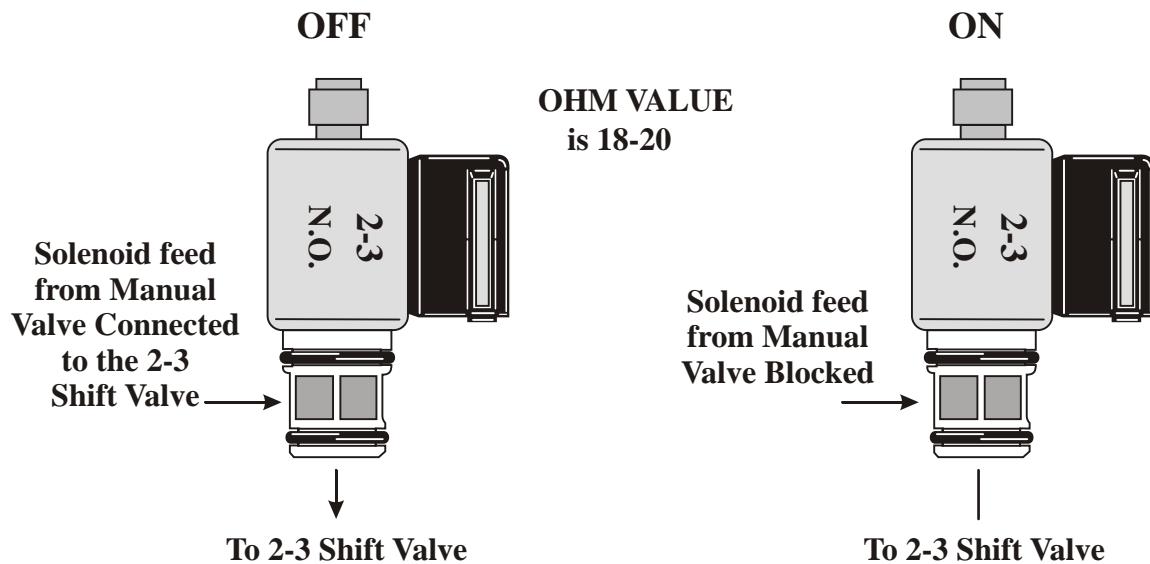


Figure 1

### 2-3 SOLENOID CHECK



*Summary: When the 2-3 Solenoid is OFF, solenoid feed from the Manual Valve, (Drive ranges) passes thru the solenoid and is connected to the 2-3 shift valve stroking it.*

*When the 2-3 Solenoid is ON, solenoid feed from the Manual Valve, (Drive ranges) is blocked to the 2-3 shift valve keeping the valve from stroking against its spring.*

Figure 2

Automatic Transmission Service Group

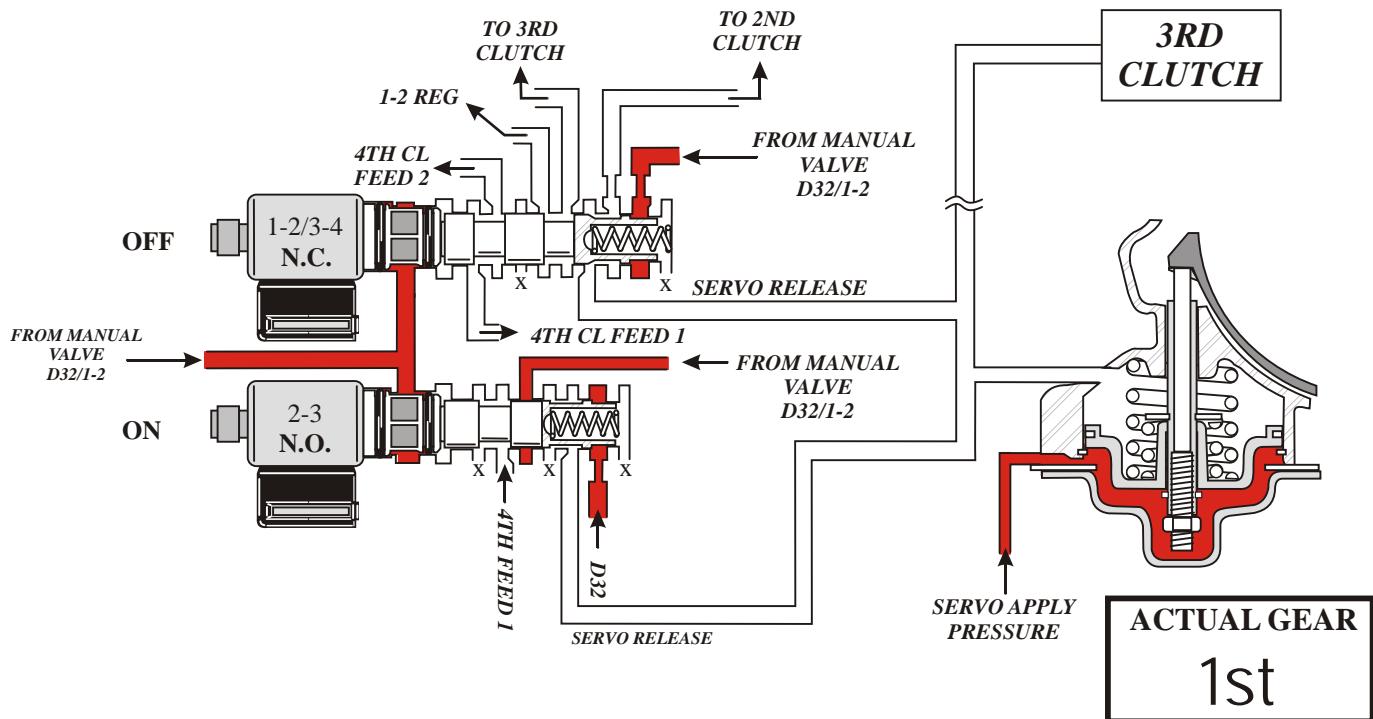
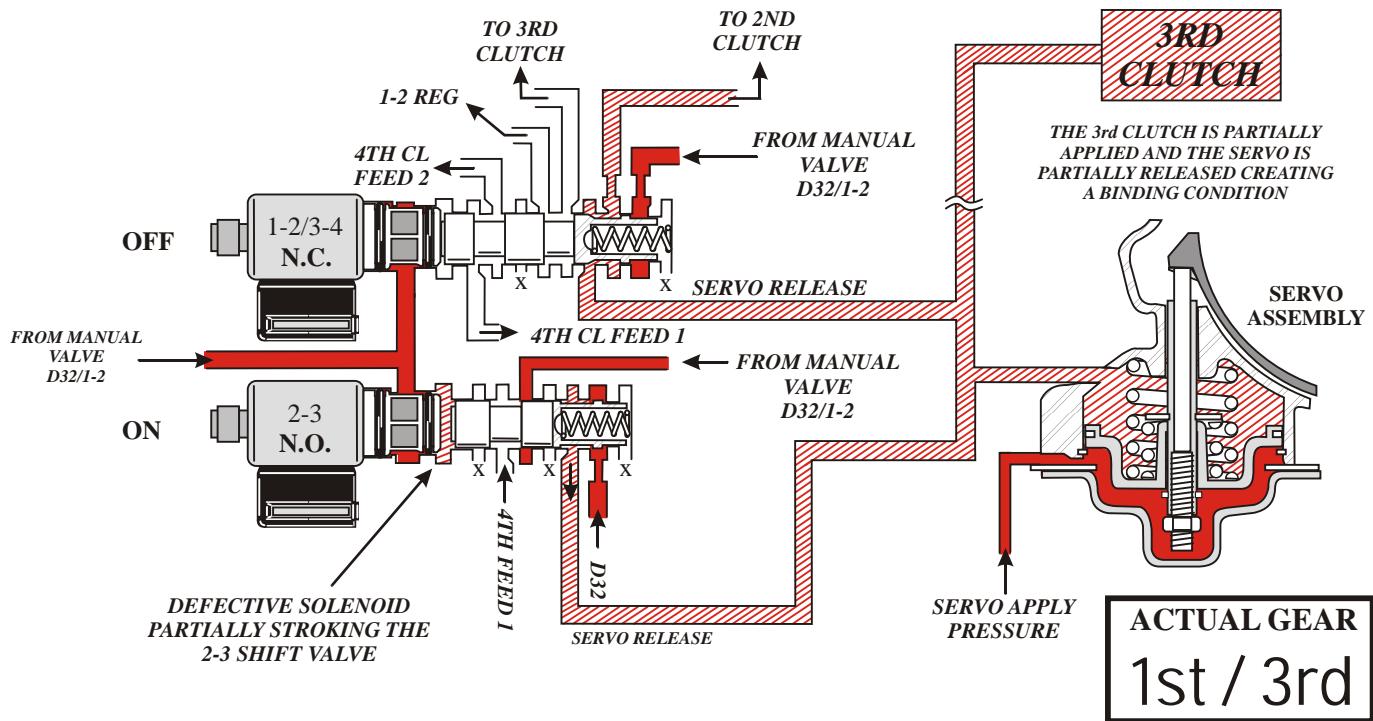
**PARTIAL HYDRAULIC OF A 1st GEAR COMMAND**

**PARTIAL HYDRAULIC OF A 1st GEAR COMMAND  
WITH 2-3 SOLENOID MECHANICAL FAULT**


Figure 3  
Automatic Transmission Service Group

**ISUZU / HONDA****4L30-E****4TH GEAR STARTS, HARSH 3RD GEAR OR HARSH DOWNSHIFTS**

**COMPLAINT:** Isuzu or Honda vehicles, equipped with the 4L30-E transmission may exhibit 4th gear starts in the Drive position or a harsh upshift to 3rd, or harsh downshifts when slowing to a stop. This may or may not be accompanied by trouble codes 82 or 56, for 1990-93 models, 53 or 54 on 1994-95 models, or P0705 or P0706 on 1996 and up models.

**CAUSE:** The cause may be, a defective Mode Switch, or a missing fused battery input to the Mode switch. **REASON:** The reason for the complaint is that computer strategy on 1990-93 models may create 4th gear starts when there are problems in the Mode Switch circuit. Computer strategy on vehicles built after 1993 may create 4th gear starts or high line pressure, which can create the harsh upshift to 3rd and or harsh downshifts.

**CORRECTION:** Locate terminal 5 or D as shown in Figure 1 to verify fused battery input to the switch.

**NOTE:** A quick check for this fused input would be to verify if the Reverse lights are working when you select Reverse. If the lights are working, the fused input is good. If there is no fused input to terminal 5 or D, replace the appropriate fuse as shown in Figure 2. If there is fused input to terminal 5 or D, check the Mode switch , from the face side of the connector as shown in Figure 3, to verify continuity in all ranges. Replace or repair as necessary.

**MODE SWITCH**

*With the Connector Plugged in*  
**BACK-PROBE TERMINAL 5 OR D**  
(Wire color is Pink with a black stripe)  
(Blue on 95 & up models)  
**IGNITION ON = 12 volts**

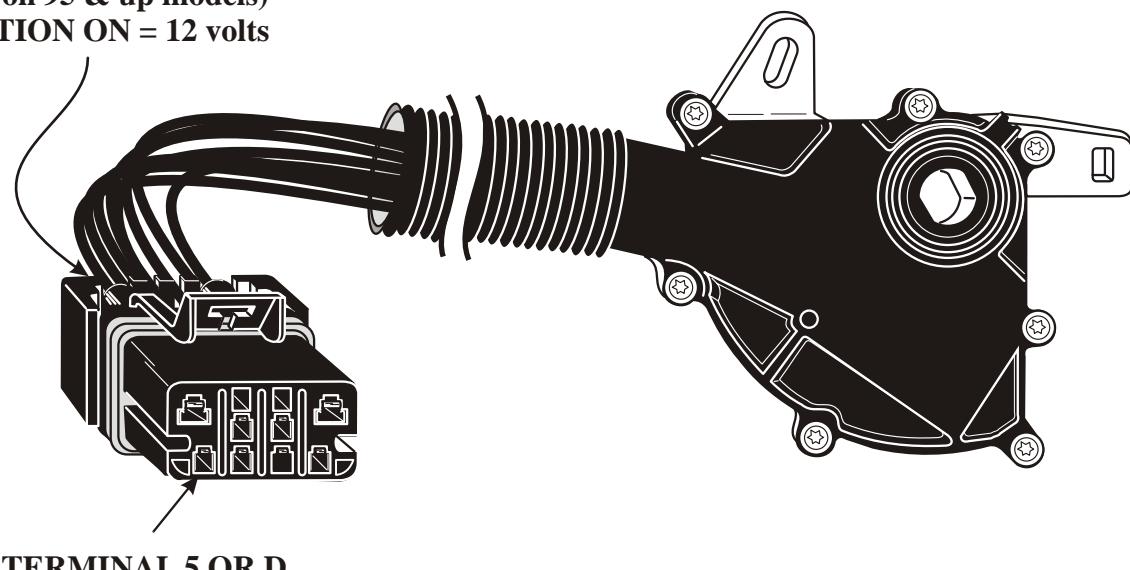


Figure 1  
Automatic Transmission Service Group

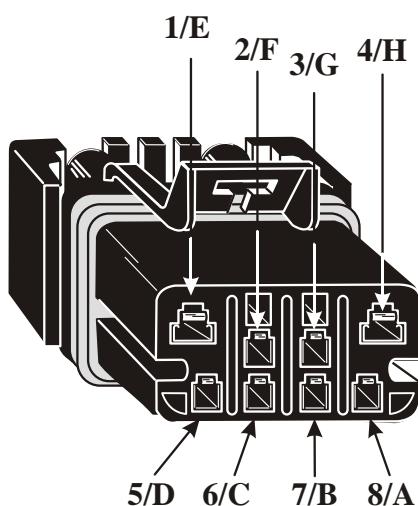


## FUSE LOCATIONS

VEHICLE	DASH FUSE NUMBER
1990-91 Trooper	Fuse #15
1992& UP Trooper	Fuse # C-3
1991-94 Passport and Rodeo	Fuse # 5
1995-97 Passport and Rodeo	Fuse # CB-15
1998 & UP Passport and Rodeo	Back-up or #14

Figure 2

## MODE SWITCH CONTINUITY CHECK

TRANSMISSION MODE  
SWITCH CONNECTOR  
(FACE VIEW)

LATE TERMINAL I.D.	5	8	7	6	3	1	4	2
EARLY TERMINAL I.D.	D	A	B	C	G	E	H	F
SELECTOR POSITION	P	●	●			●	●	
R	●	●	●	●				●
N	●		●		●	●	●	
D	●		●	●	●			
3	●	●	●	●	●			
2	●	●			●			
1	●				●	●		

NOTE: TERMINALS "1 & 4" OR "E & H" HAVE CONTINUITY  
TO EACH OTHER ONLY

**EXAMPLE:** Using an ohm meter, with the shift selector in the D position, the "D" or number 5 terminal should have continuity to terminals "B" or 7 and "C" or 6 ONLY

Figure 3

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## **HYUNDAI F4A42/51**

### **ERRATIC SHIFT, 3RD GEAR FAILSAFE & MULTIPLE CODES STORED**

**COMPLAINT:** Hyundai vehicles equipped with the F4A42/51 transaxle may come in with complaints of erratic and/or harsh shifting, third gear failsafe and codes P0743, P0750, P0755, P0760 or P0765 for open or shorted solenoid circuits.

A P0740 for a TCC system fault may also be stored as well P0770 for a loss of solenoid power or a P1723 for a Control Relay open or shorted. The 20 amp ATM Relay fuse may also be blown.

**CAUSE:** The most common cause is the routing of the transmission internal harness. If the transmission internal wiring harness is routed incorrectly as seen in figure 1, It comes in contact with the detent spring which eventually cuts through the insulation of one or more wires of the internal harness resulting in the above complaints.

**CORRECTION:** Route the internal wiring as shown in figure 2, this will avoid contact with the detent spring and prevent the wiring damage explained above.

#### **SERVICE INFORMATION:**

<i>Transmission Internal Wiring Harness for Sonata, Elantra, Sante Fe and Tiburon</i> .....	<b>46307-39050</b>
<i>Transmission Internal Wiring Harness for XG300 &amp; XG350</i> .....	<b>46308-39550</b>
<i>Oil Temperature Sensor</i> .....	<b>46386-39050</b>

# Alto Products

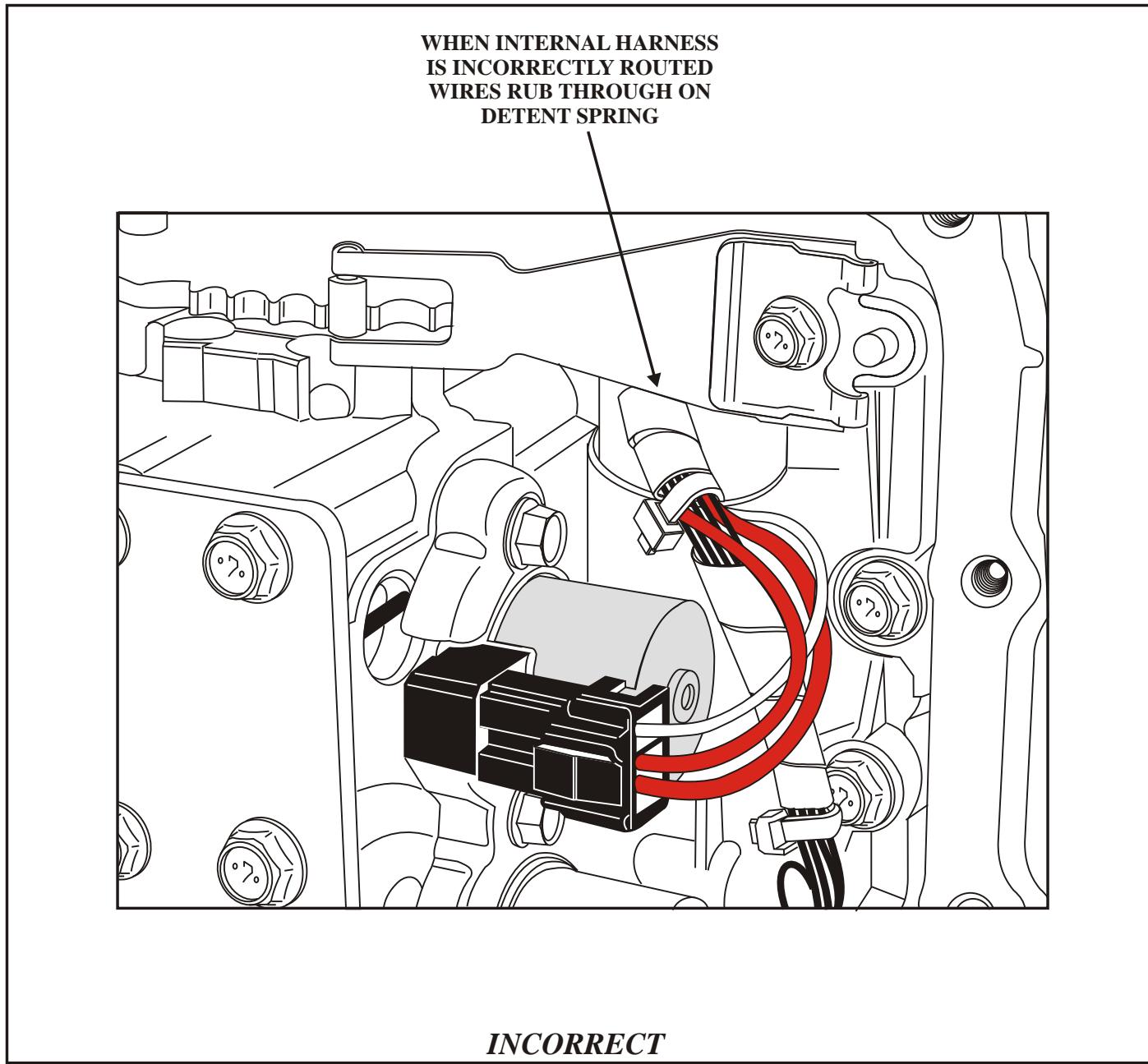
**ERRATIC SHIFT, 3RD GEAR FAILSAFE & MULTIPLE CODES STORED**

Figure 1

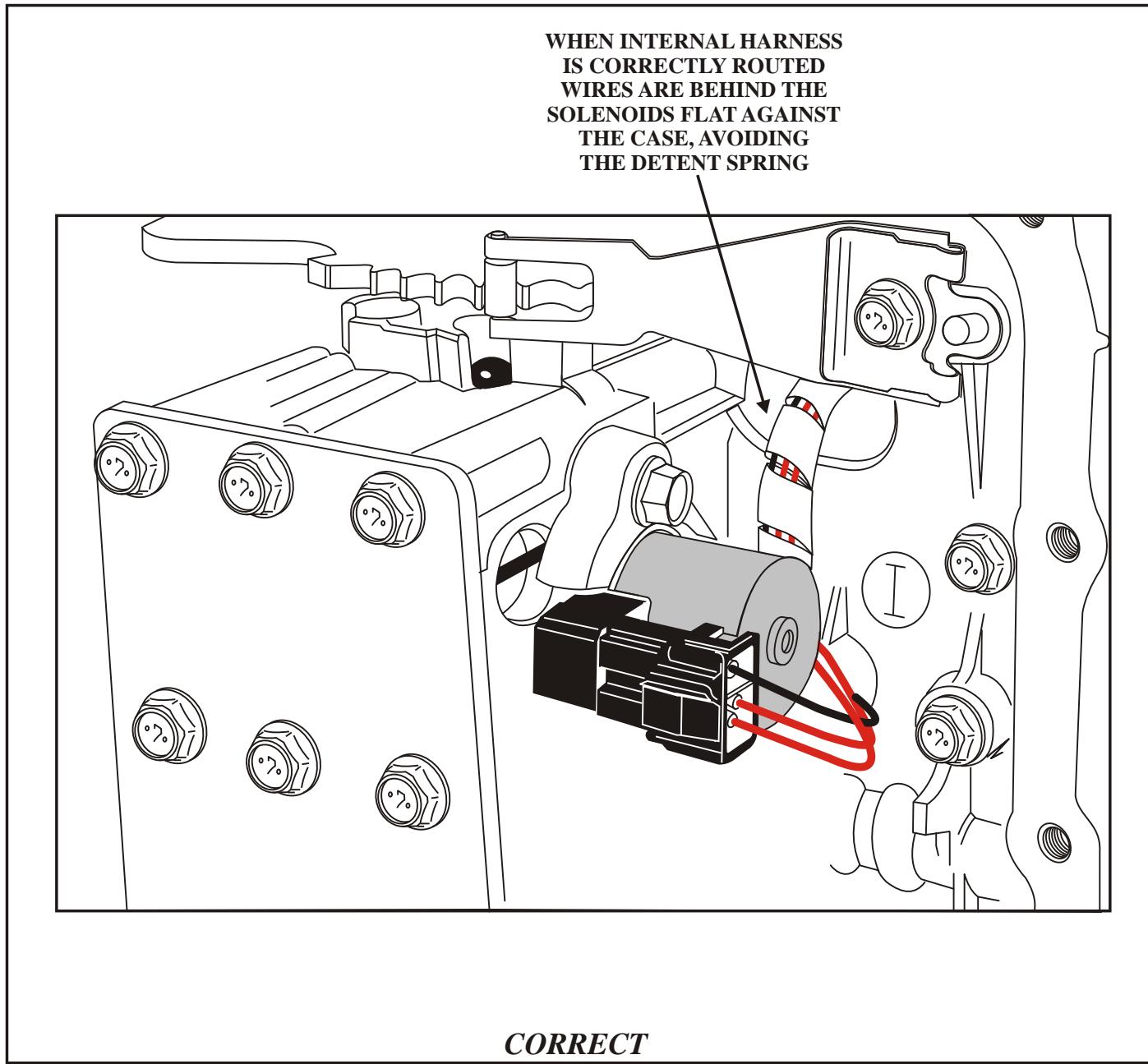
**ERRATIC SHIFT, 3RD GEAR FAILSAFE & MULTIPLE CODES STORED**

Figure 2

# **SPX Filtran**

**2001 & LATER HYUNDAI****CODE P0500/501; LOSS OF VSS SIGNAL DIAGNOSIS**

**COMPLAINT:** A 2001 & Later Hyundai (all models) may store a diagnostic trouble code P0500 for a loss of VSS signal, or a P0501 for an abnormal VSS signal. The problem that faces the technician is, which is the Vehicle Speed Sensor that is causing the speedometer to become inoperative, turn on the ABS warning lamp, inhibit cruise control operation, late shifts and store the previously mentioned codes.

**CAUSE:** Hyundai vehicles utilize three (3) types of vehicle speed sensors depending on model.

- (1) It could be located in the speedometer cluster, (**ACCENT ONLY**), this is a Magnetic Reed Switch type that requires the use of a speedometer cable. (See Figure 1)
- (2) It could be located in the transmission over the final drive and is gear driven, this is a Hall Effect type. (See Figure 2)
- (3) It could be the **RIGHT FRONT WHEEL SPEED SENSOR (RF-WSS)**, which is an AC Voltage Pulse Generator. (See Figure 3)

*Any one of these speed sensors can cause codes P0500 or P0501 to be stored.*

The chart in figure 4 indicates which model uses which combination of Vehicle Speed Sensors.

**DESCRIPTION:** When driving over a very rough road, the engine will experience a sharply varying load, transferred from the wheels to the crankshaft, which may incorrectly appear to be an engine misfire to the ECM misfire diagnostic logic based on the ECM's analysis of the Crankshaft Position Sensor. The RF-WSS is used to minimize inaccurate diagnoses that an engine misfire has occurred.

The Right Front Wheel Speed Sensor (RF-WSS), in some Hyundai models is used to determine if the vehicle is going over rough road. If the ECM determines that the vehicle is going over rough road, based on the roughness of the signal coming from the RF-WSS, the misfire diagnosis will be suspended until the driving conditions have changed. All Hyundai models with ABS use the RF-WSS to determine rough road conditions.

**NOTE:** Not all vehicles are equipped with a RF-WSS. Vehicles which are not equipped with a RF-WSS will use a rough road sensor on the left front shock tower.

**DIAGNOSTIC AID:** Vehicles that are using the RF-WSS for a VSS signal may turn on the ABS warning lamp. Scan the ABS Control Module for a code C1203. This will help narrow the search as to which is the VSS.

**CORRECTION:** Because the code alone does not pinpoint which sensor/circuit may be generating the code, use the chart in figure 5 to determine this.

*Even the same model with different engines will not have the same VSS combination.*

**SERVICE INFORMATION:**

<i>Right Front Wheel Speed Sensor.....</i>	<b>95670-2D100</b>
<i>Pulse Generator VSS (2 Wire)(Transmission Mounted).....</i>	<b>46517-39000</b>
<i>Hall Effect VSS, Gear Driven (3 Wire) (Transmission Mounted).....</i>	<b>46517-39500</b>
<i>Reed Switch VSS (Speedometer Mounted).....</i>	<b>94216-33010</b>

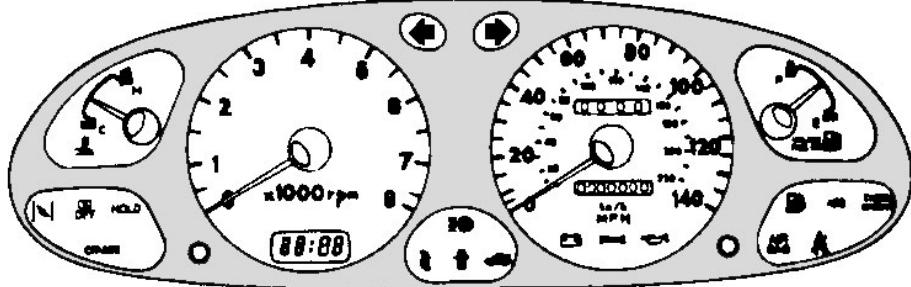
**CODE P0500/501; LOSS OF VSS SIGNAL DIAGNOSIS****VSS IN SPEEDOMETER CLUSTER IS A MAGNETIC REED SWITCH TYPE**

Figure 1

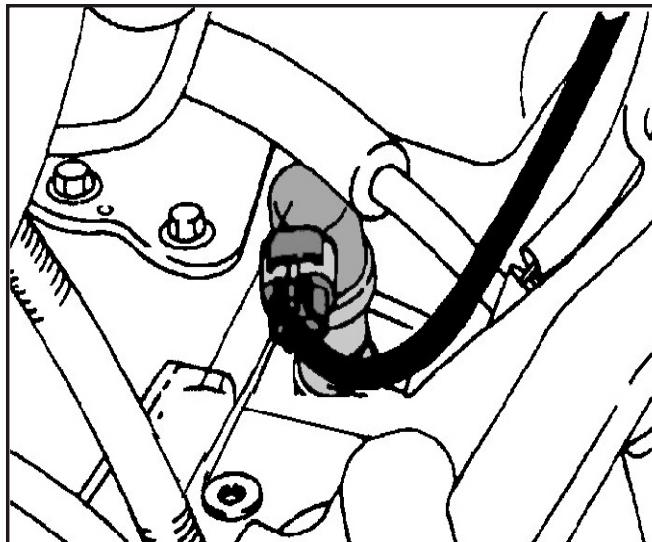
**VSS IN TRANSMISSION IS A GEAR  
DRIVEN HALL EFFECT TYPE**

Figure 2

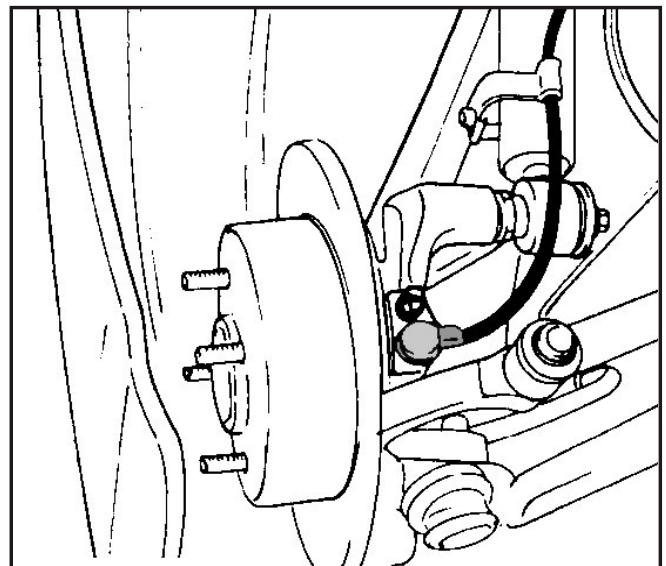
**RF-WSS ON THE RIGHT  
FRONT WHEEL HUB IS AN AC  
VOLTAGE PULSE GENERATOR**

Figure 3



# "2004" SEMINAR INFORMATION

## SLIDE

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### CODE P0500/501; LOSS OF VSS SIGNAL DIAGNOSIS

VEHICLE SPEED SENSOR APPLICATION CHART				
MODEL	ENGINE	VSS ON TRANSMISSION	RF-WSS	VSS IN SPEEDOMETER
ELANTRA	2.0L-I4	YES	YES	NO
SANTA FE	2.4L-I4	YES	NO	NO
SANTA FE	2.7L-V6	YES	YES	NO
SONATA	2.4L-I4	YES	NO	NO
SONATA	2.5L-V6	YES	YES	NO
XG300	3.0L-V6	YES	NO	NO
TIBURON	2.0L-I4	YES	NO	NO
ACCENT	1.5L-I4	NO	NO	YES
ACCENT	1.6L-I4	NO	NO	YES

Figure 4

**CODE P0500/501; LOSS OF VSS SIGNAL DIAGNOSIS**

VEHICLE SPEED SENSOR DIAGNOSTIC CHART			
MODEL	DETAILS	RF-WHEEL SPEED SENSOR (DISCONNECTED)	VSS ON TRANSMISSION OR IN SPEEDOMETER (DISCONNECTED)
ELANTRA	Check Engine Lamp On	YES	NO
	Diagnostic Trouble Code	P0501	NO
	Speedometer Operative	OPERATIVE	INOPERATIVE
	Data Parameter Available	NO	YES
SANTA FE...2.4L	Check Engine Lamp On		YES
	Diagnostic Trouble Code	NO	P0500
	Speedometer Operative	RF-WSS	INOPERATIVE
	Data Parameter Available		NO
SANTA FE...2.7L	Check Engine Lamp On	YES	NO
	Diagnostic Trouble Code	P0500	NO
	Speedometer Operative	OPERATIVE	INOPERATIVE
	Data Parameter Available	NO	YES
SONATA...2.4L	Check Engine Lamp On		YES
	Diagnostic Trouble Code	NO	P0500
	Speedometer Operative	RF-WSS	INOPERATIVE
	Data Parameter Available		NO
SONATA...2.5L	Check Engine Lamp On	YES	NO
	Diagnostic Trouble Code	P0500	NO
	Speedometer Operative	OPERATIVE	INOPERATIVE
	Data Parameter Available	NO	YES
XG300	Check Engine Lamp On	ABS/TCS	YES
	Diagnostic Trouble Code	C1203	P0500
	Speedometer Operative	OPERATIVE	INOPERATIVE
	Data Parameter Available		NO
TIBURON	Check Engine Lamp On		YES
	Diagnostic Trouble Code	NO	P0501
	Speedometer Operative	RF-WSS	INOPERATIVE
	Data Parameter Available		NO
ACCENT	Check Engine Lamp On		YES
	Diagnostic Trouble Code	NO	P0501
	Speedometer Operative	RF-WSS	YES OR NO
	Data Parameter Available		NO

Figure 5



### MITSUBISHI/HYUNDAI F4A41/42/51

#### LOW/REVERSE, SECOND BRAKE ASSEMBLY PROCEDURE

**COMPLAINT:** After overhaul, codes are stored for a second gear ratio and solenoid performance resulting in a limp-in condition.. The transmission slips badly in second gear and may also chatter in reverse.

**CAUSE:** Mis-assembly of the Low/Reverse and/or the Second Brake clutch packs are responsible for the above mentioned complaints.  
These are complex assemblies and are easily mis-assembled. In addition to this, clutch pack friction and steel quantities vary depending on car model and engine application.

**CORRECTION:** Figure 1 illustrates identification and the correct order of assembly of the Low/Reverse and the 2nd Brake clutch packs.  
Refer to the chart in Figure 2 for the correct quantity of friction and steel plates used in the various transmission models.  
Low/Reverse clutch clearance is .048" to .062". Second Brake clearance is .025 to .040", refer to the chart in Figure 3 for the correct selective snap ring to adjust the height of the 2nd Brake stepped reaction plate.

Refer to the charts in Figures 4 and 5 to obtain the correct Low/Reverse and 2nd Brake selective pressure plates in order to obtain correct clutch clearances.

#### SERVICE INFORMATION:

*There is a "dummy plate" Low/Reverse, 2nd Clutch adjustment tool used to obtain proper clutch clearance during transmission assembly. In the event you wish to fabricate one, the tools specifications are as follows:*

*F4A41/42.....6.25" O/D; .075" Thick  
F4A51.....7.16" O/D; .075" Thick*

*However, a feeler gauge will work equally as well, as long as care is taken, not to damage the friction plates.*

#### *Factory Tool Information:*

*F4A41/42 Low/Reverse, 2nd Brake clutch "Dummy Plate".....MB991631-01  
F4A51 Low/Reverse, 2nd Brake Clutch "Dummy Plate" .....MB991632-01*

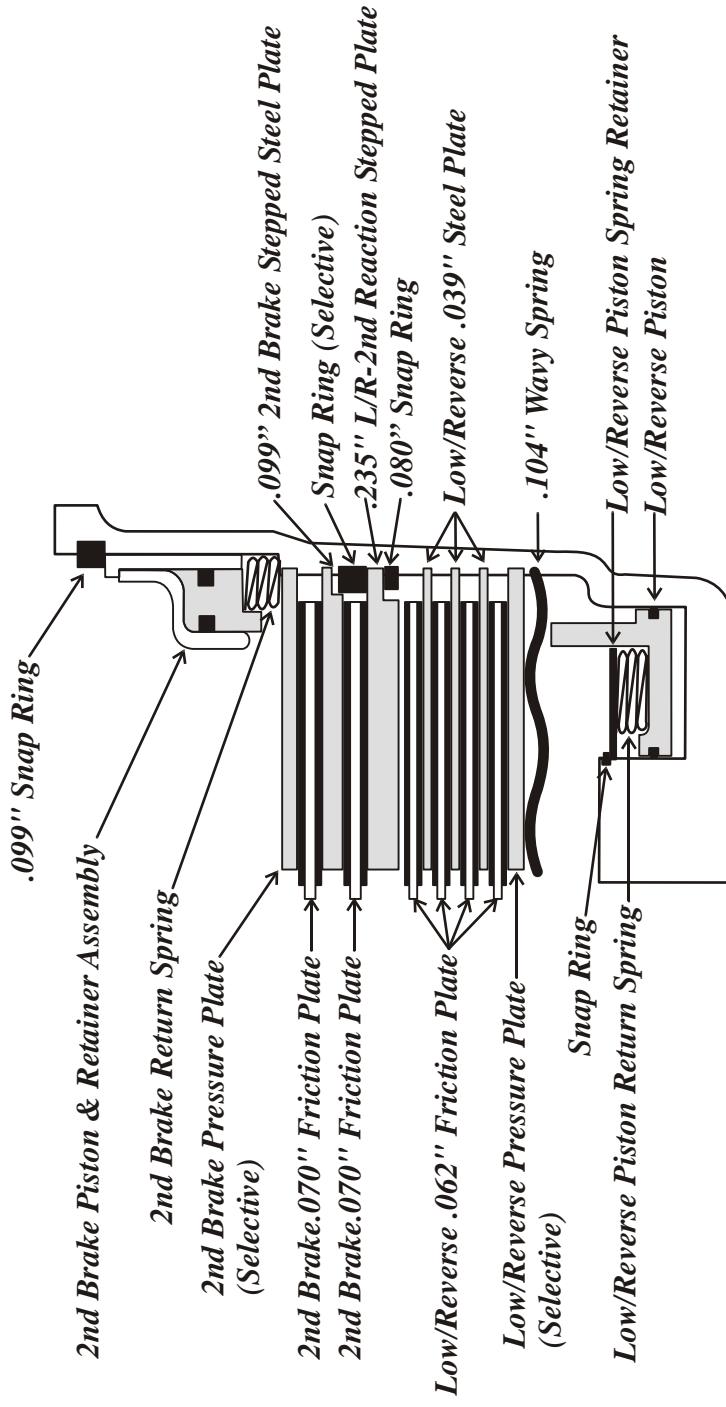
**LOW/REVERSE, SECOND BRAKE ASSEMBLY PROCEDURE**
**ASSEMBLY OF THE LOW/REVERSE 2ND BRAKE CLUTCH PACKS**


Figure 1

**LOW/REVERSE, SECOND BRAKE ASSEMBLY PROCEDURE**

LOW/REVERSE-2ND BRAKE CLUTCH PLATE APPLICATION CHART						
MODEL YEAR	VEHICLE MODEL	ENGINE SIZE	TRANSMISSION TYPE	L/R FRICTION PLATES	L/R STEEL PLATES	2ND BRAKE FRICTION PLATES
1997-02	MIRAGE	1.5L-L4	F4A41	4	3	2
1997-02	MIRAGE	1.8L-L4	F4A42	5	4	3
2003	LANCER	2.0L-L4	F4A42	5	4	3
2000-03	ECLIPSE	2.4L-L4	F4A42	5	4	3
1999-03	ECLIPSE	3.0L-V6	F4A51	6	5	4
1999-03	GALANT	2.4L-L4	F4A42	5	4	3
1999-03	GALANT	3.0L-V6	F4A51	6	5	4
1997-03	DIAMANTE	3.5L-V6	F4A51	6	5	4
2001-02	ELANTRA	2.0L-L4	F4A42	5	4	3
2003	TIBURON	2.0L-L4	F4A42	5	4	3
1999-02	SONATA	2.4L-L4 2.5L/2.7L-V6	F4A42	5	4	3
2001-02	SANTA FE	2.4L-L4 2.7L-V6	F4A51	6	5	4

Figure 2  
Automatic Transmission Service Group



# "2004" SEMINAR INFORMATION

## SLIDE

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### LOW/REVERSE, SECOND BRAKE ASSEMBLY PROCEDURE

SECOND BRAKE REACTION PLATE SELECTIVE SNAP RING CHART					
40 SERIES			50 SERIES		
THICKNESS	ID COLOR	PART NUMBER	THICKNESS	ID COLOR	PART NUMBER
.087" (2.2MM)	BLUE	MD754786	.087" (2.2MM)	NONE	MD756784
.091" (2.3MM)	BROWN	MD754787	.091" (2.3MM)	BLUE	MD756785
.094" (2.4MM)	NONE	MD758240	.094" (2.4MM)	BROWN	MD758552
.098" (2.5MM)	BLUE	MD758241	.098" (2.5MM)	NONE	MD758553

Figure 3

LOW/REVERSE CLUTCH SELECTIVE PRESSURE PLATES					
40 SERIES			50 SERIES		
SELECTIVE PLATE THICKNESS	PLATE ID SYMBOL	PART NUMBER	SELECTIVE PLATE THICKNESS	PLATE ID SYMBOL	PART NUMBER
.063" (1.6MM)	L	MD759567	.063" (1.6MM)	F	MD759568
.071" (1.8MM)	1	MD759414	.071" (1.8MM)	E	MD759425
.079" (2.0MM)	0	MD759415	.079" (2.0MM)	D	MD759426
.087" (2.2MM)	2	MD759416	.087" (2.2MM)	C	MD759427
.094" (2.4MM)	4	MD759417	.094" (2.4MM)	B	MD759428
.102" (2.6MM)	6	MD759418	.102" (2.6MM)	A	MD759429
.110" (2.8MM)	8	MD759419	.110" (2.8MM)	0	MD759430
.118" (3.0MM)	D	MD759420	.118" (3.0MM)	1	MD759431

Figure 4

2ND BRAKE CLUTCH SELECTIVE PRESSURE PLATES					
40 SERIES			50 SERIES		
SELECTIVE PLATE THICKNESS	PLATE ID SYMBOL	PART NUMBER	SELECTIVE PLATE THICKNESS	PLATE ID SYMBOL	PART NUMBER
.063" (1.6MM)	L	MD759567	.071" (1.8MM)	E	MD759425
.071" (1.8MM)	1	MD759414	.079" (2.0MM)	D	MD759426
.079" (2.0MM)	0	MD759415	.087" (2.2MM)	C	MD759427
.087" (2.2MM)	2	MD759416	.094" (2.4MM)	B	MD759428
.094" (2.4MM)	4	MD759417	.102" (2.6MM)	A	MD759429
.102" (2.6MM)	6	MD759418	.110" (2.8MM)	0	MD759430

Figure 5

**MITSUBISHI/HYUNDAI F4A40/50 SERIES TRANSAXLE****LOW ONE-WAY, TCM COMPATIBILITY**

**COMPLAINT:** The Transmission or the Transmission Control Module (TCM) has been changed. The transmission now exhibits a neutral condition after it reaches 6 mph, (*Late PLASTIC TCM with Early Transmission*), or a harsh 2-1 coast downshift, (*Early METAL TCM with Late Transmission*).

**CAUSE:** Midway through the 1997 model year Mitsubishi added a *Low Sprag* to the F4A40/50 series transmission. Hyundai followed Mitsubishi for the 1999 model year. When the One-Way Clutch was added, the application of the Low/Reverse Clutch was also changed. Transmissions that are equipped with the Low One-Way Clutch keep the Low/Reverse Clutch on, at speeds of up to 6 mph as shown in the clutch/solenoid application chart in figure 1.

The Transfer Gear shown in Figure 2 fits a transaxle *without* a Low Sprag and is identified by the four (4) mounting bolt holes and the smooth machined journal.

The Transfer Gear shown in Figure 3 fits a transaxle *with* a Low Sprag and is identified by the eight (8) mounting holes and the splined journal to accept the low sprag inner race. The sprag assembly is loaded into the underdrive ring gear also shown in Figure 3.

The change in clutch application strategy resulted in a change in the Transmission Control Module (TCM). The TCM for a transmission with a Low One-Way Clutch is **NOT** interchangeable with a TCM for a transmission without a Low One-Way Clutch.

The TCM programmed for a transmission *without* a Low One-Way Clutch has a **METAL** cover as seen in Figure 4.

The TCM programmed for a transmission *with* a Low One-Way Clutch has a **PLASTIC** cover as seen in Figure 5.

***Installing the wrong transmission or TCM will cause the above complaints!***

**CORRECTION:** Use the correct Transmission/TCM combination as explained above.

***How can you tell if your transmission has a low sprag or not?***

Check the transaxle serial number on top of the case. If the serial number has an "A" in it, as shown in Figure 6, it **does not** have a low sprag and should have the TCM with the **METAL** cover.

If the serial number has a "B" in it, as shown in Figure 7, It **does** have a low sprag and should have the TCM with the **PLASTIC** cover.

**SERVICE INFORMATION:**

<i>Mitsubishi Non-One-Way Clutch TCM.....</i>	<i>MD760927</i>
<i>Mitsubishi with One-Way Clutch TCM.....</i>	<i>MR357259</i>
<i>Hyundai Non-One-Way, 2.4L, Federal.....</i>	<i>39110-38970</i>
<i>Hyundai Non-One-Way Clutch, 2.4L, California.....</i>	<i>39110-38317</i>
<i>Hyundai Non-One-Way Clutch, 2.5L with TCS.....</i>	<i>95440-39012</i>
<i>Hyundai Non-One-Way Clutch, 2.5L without TCS.....</i>	<i>95440-39032</i>
<i>Hyundai with One-Way Clutch, 2.4L, Federal.....</i>	<i>39110-38298</i>
<i>Hyundai with One-Way Clutch, 2.4L, California.....</i>	<i>39110-38318</i>
<i>Hyundai with One-Way Clutch, 2.5L, with TCS.....</i>	<i>95440-39013</i>
<i>Hyundai with One-Way Clutch, 2.5L, without TCS.....</i>	<i>95440-39033</i>

**F4A42/51 CLUTCH & SOLENOID APPLICATION CHART**

GEAR LEVER POSITION	GEAR RANGE	REVERSE CLUTCH	UNDER DRIVE CLUTCH	OVER DRIVE CLUTCH	LOW REVERSE SOLENOID	2ND BRAKE SOLENOID	ONE-WAY CLUTCH (SPRAG)
PARK	P		PULSED	PULSED	APPLIED		PULSED
REVERSE	R	APPLIED	PULSED	PULSED	APPLIED		PULSED
NEUTRAL	N		PULSED	PULSED			PULSED
	1ST	APPLIED		PULSED	*APPLIED		PULSED
DRIVE	2ND	APPLIED		PULSED	APPLIED	PULSED	
	3RD	APPLIED		APPLIED		PULSED	
	4TH		PULSED	APPLIED		PULSED	
	1ST	APPLIED		PULSED	APPLIED	PULSED	
3	2ND	APPLIED		PULSED		PULSED	
	3RD	APPLIED		APPLIED		PULSED	
	1ST	APPLIED		PULSED	APPLIED	PULSED	
2	2ND	APPLIED		PULSED	*APPLIED	PULSED	
	1ST	APPLIED		PULSED	APPLIED	PULSED	
L	1ST	APPLIED		PULSED	APPLIED	PULSED	

*\*The Low/Reverse Clutch is applied at speeds of up to 6 mph when the transmission is equipped with a One-Way Clutch.*

Figure 1  
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# Lory

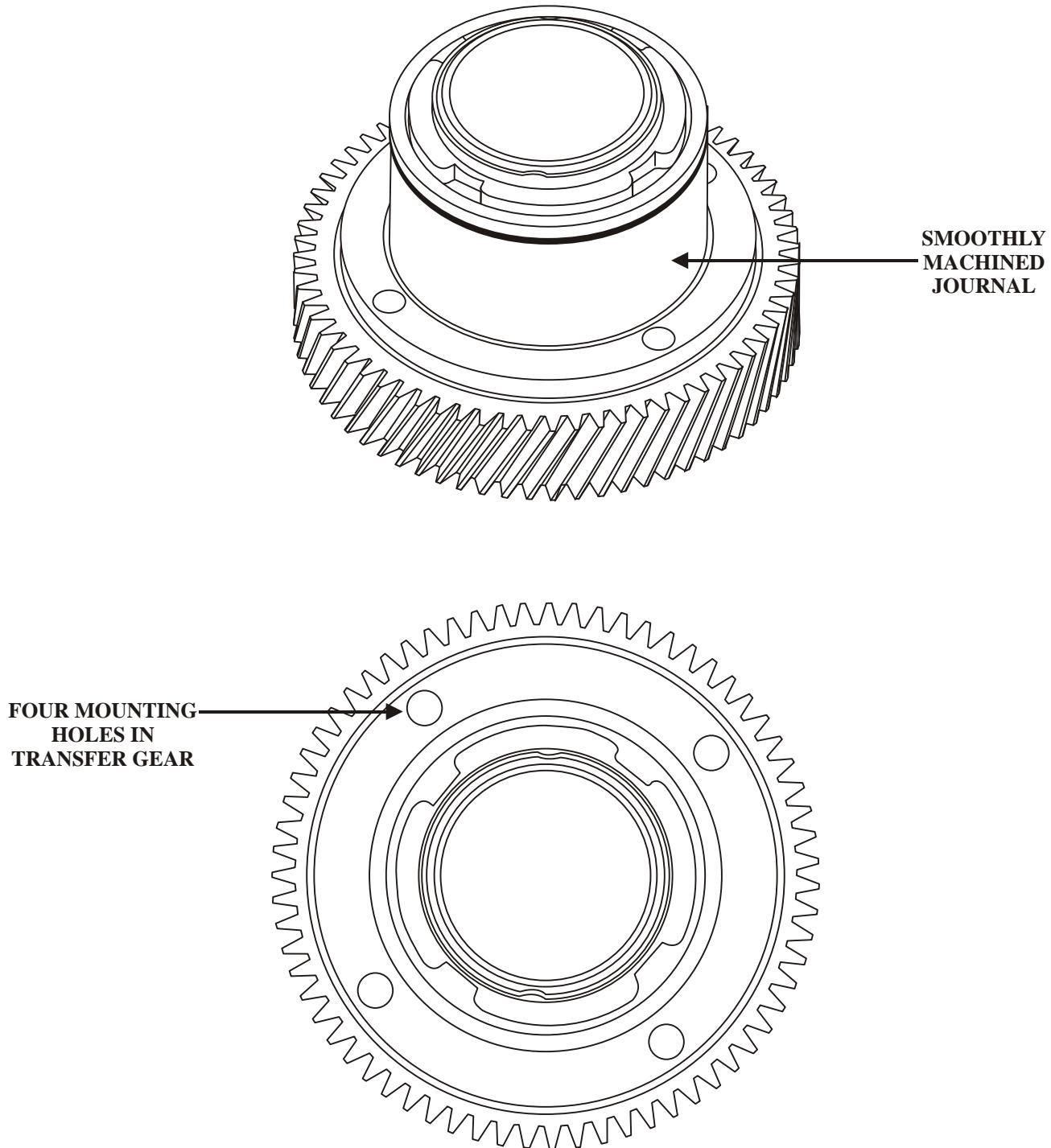
**LOW ONE-WAY, TCM COMPATIBILITY****TRANSFER DRIVE GEAR WITHOUT LOW SPRAG**

Figure 2

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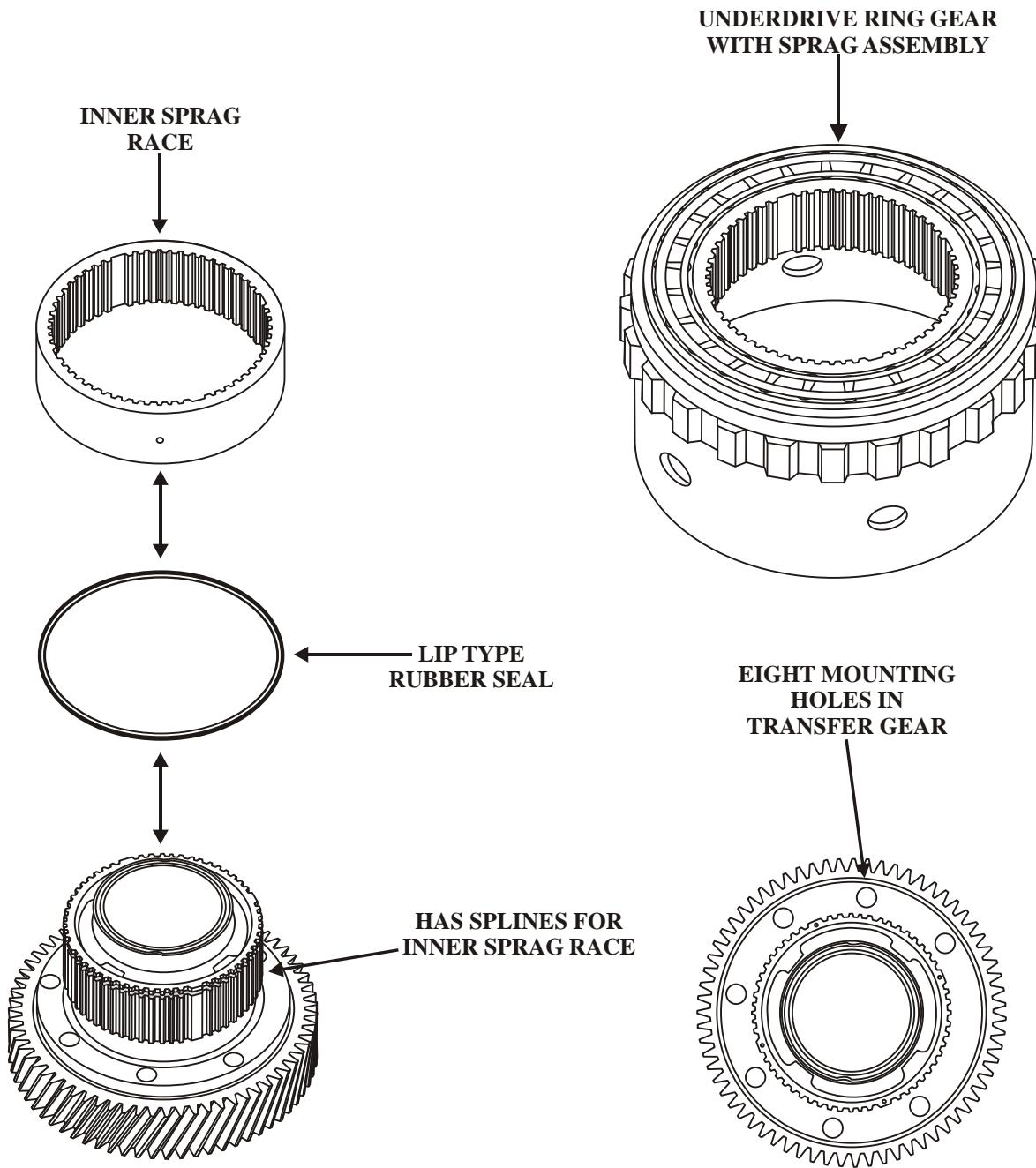
**LOW ONE-WAY, TCM COMPATIBILITY****TRANSFER DRIVE GEAR WITH LOW SPRAG**

Figure 3

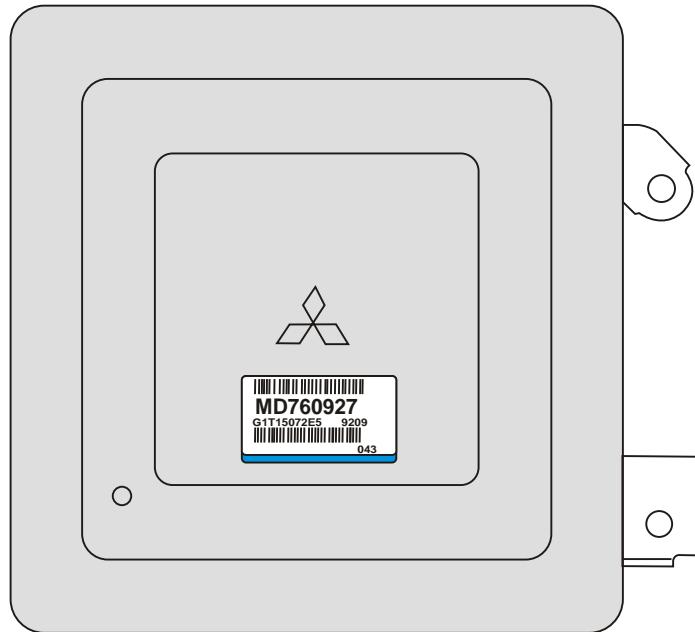
**LOW ONE-WAY, TCM COMPATIBILITY****TCM WITH METAL HOUSING FOR TRANSAXLES WITHOUT A LOW SPRAG**

Figure 4

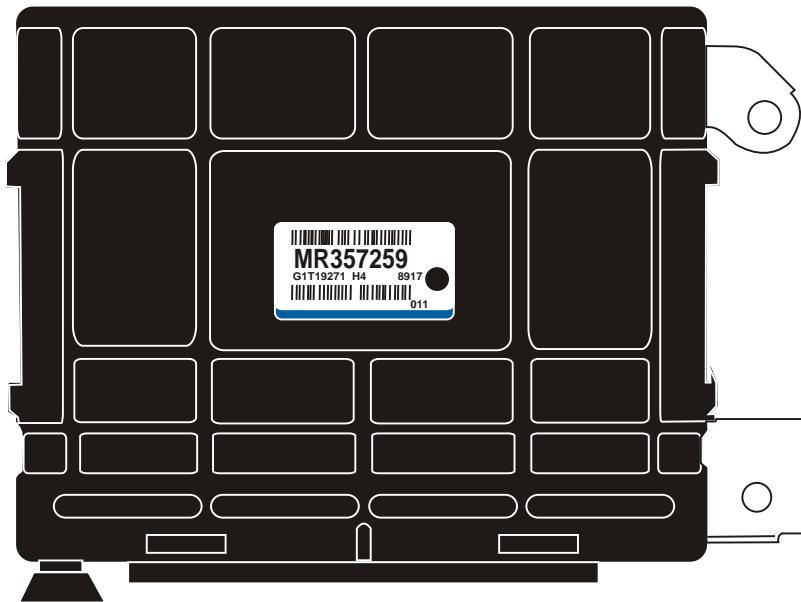
**TCM WITH PLASTIC HOUSING FOR TRANSAXLES WITH A LOW SPRAG**

Figure 5

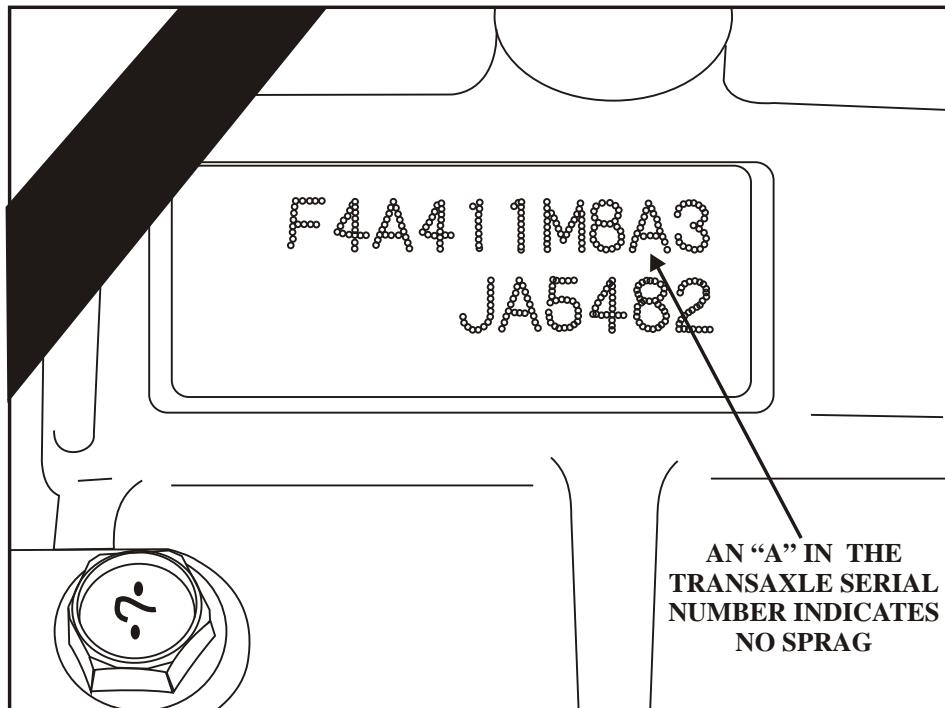
**LOW ONE-WAY, TCM COMPATIBILITY  
TRANSAXLE IDENTIFICATION**

Figure 6

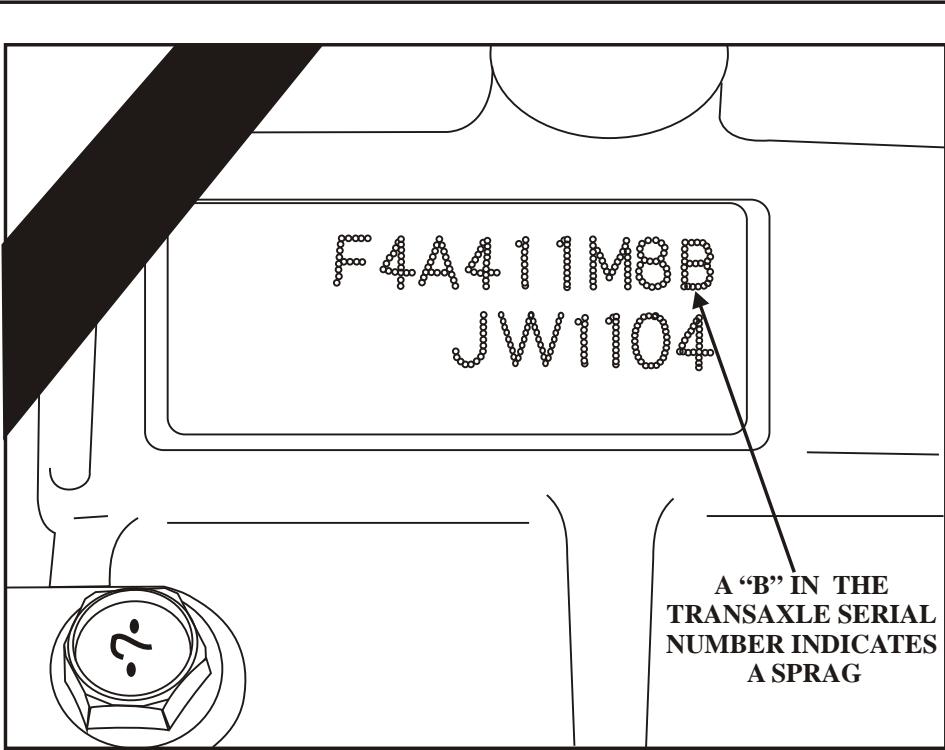


Figure 7

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## **MITSUBISHI F4A40/50 SERIES SHUDDERING ENGAGEMENTS OR HARSH SHIFTS**

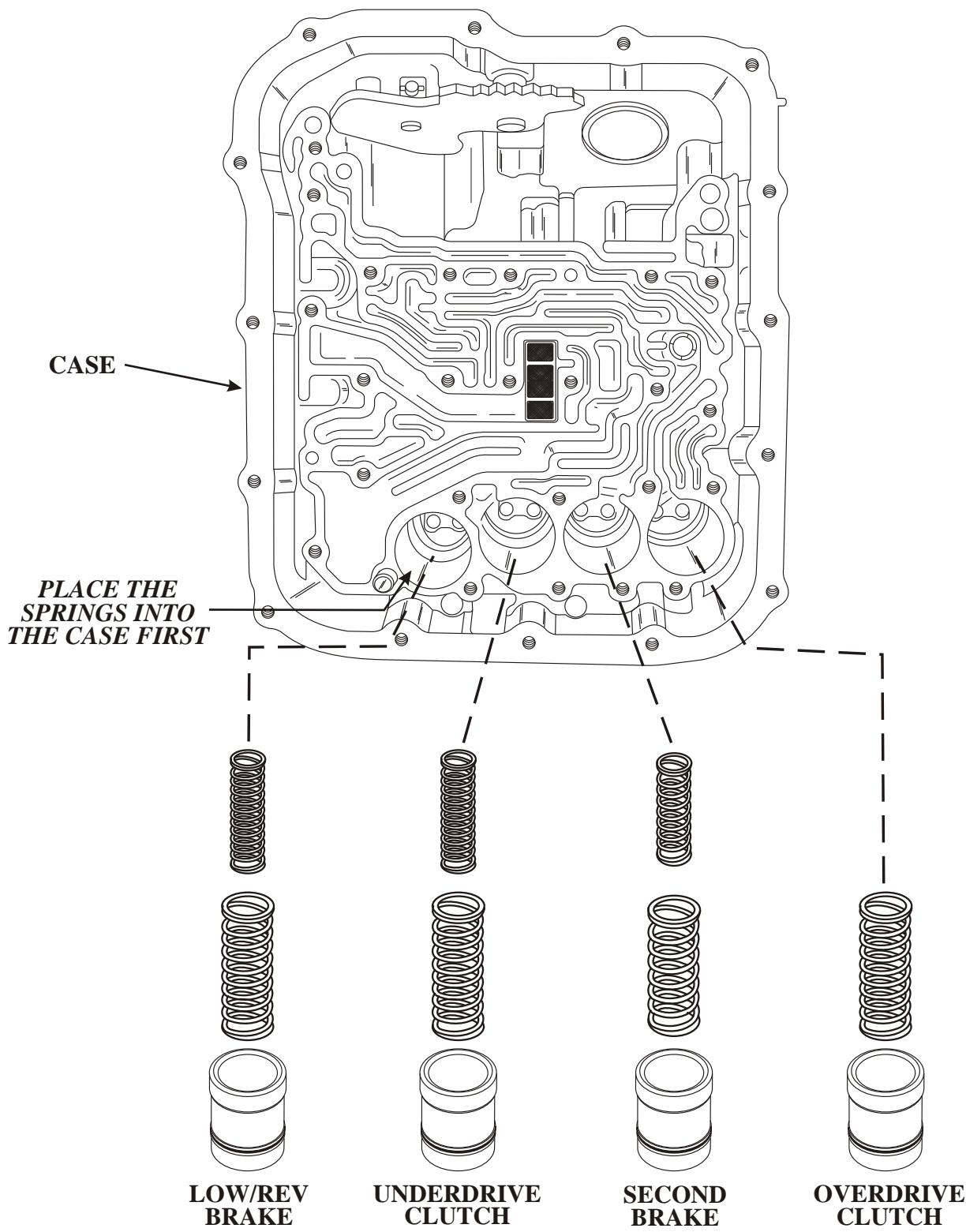
**COMPLAINT:** After overhaul, vehicles equipped with the F4A40/50 series transaxles may exhibit Shuddering engagements into gear or Harsh upshifts.

**CAUSE:** The cause may be, during overhaul, the Accumulator Pistons and springs were installed backwards into the case or the springs were mis-assembled in the Accumulator Pistons.

**CORRECTION:** Refer to Figure 1 for the spring dimensions for each Accumulator piston. Refer to Figure 2 for the Accumulator identification and placement. **NOTE: Ensure that each Accumulator line-up is placed into the case springs first.**

### **ACCUMULATOR SPRING DIMENSIONS**

APPLICATION	SPRING	COIL DIAMETER	FREE LENGTH	APPROX. # OF COILS	COLOR
<i>LOW/REV BRAKE</i>	<i>OUTER</i>	<i>.136"</i>	<i>2.590"</i>	<i>12</i>	<i>PLAIN</i>
<i>LOW/REV BRAKE</i>	<i>INNER</i>	<i>.102"</i>	<i>2.273"</i>	<i>15</i>	<i>PLAIN</i>
<i>UNDERDRIVE CLUTCH</i>	<i>OUTER</i>	<i>.158"</i>	<i>2.545"</i>	<i>12</i>	<i>BLACK</i>
<i>UNDERDRIVE CLUTCH</i>	<i>INNER</i>	<i>.113"</i>	<i>2.093"</i>	<i>15</i>	<i>BLACK</i>
<i>SECOND BREAK</i>	<i>OUTER</i>	<i>.138"</i>	<i>2.575"</i>	<i>10</i>	<i>BLACK</i>
<i>SECOND BREAK</i>	<i>INNER</i>	<i>.113"</i>	<i>2.127"</i>	<i>9</i>	<i>BLACK</i>
<i>OVERDRIVE CLUTCH</i>	<i>OUTER</i>	<i>.158"</i>	<i>2.545"</i>	<i>12</i>	<i>PLAIN</i>
<i>OVERDRIVE CLUTCH</i>	<i>NO INNER SPRING ON THE OVERDRIVE CLUTCH</i>				

**ACCUMULATOR PISTON AND SPRING PLACEMENT IN THE CASE**

## MITSUBISHI F4A40/50 SERIES HARSH OR FLARED 3RD GEAR UPSHIFT

**COMPLAINT:** Before or after overhaul, vehicles equipped with the F4A40 or F4A50 series transaxles may exhibit a Flared or Harsh upshift into 3rd gear.

**CAUSE:** The cause may be, worn sealing ring lands where the Overdrive Clutch sealing rings ride, creating leakage in the Overdrive Clutch circuit.

**CORRECTION:** Refer to Figure 1 to identify the Overdrive Clutch Sealing Rings. Using a feeler gage ensure that there is no more than .005" clearance between the sealing ring and the sealing ring groove. Replace Rear Cover as necessary.

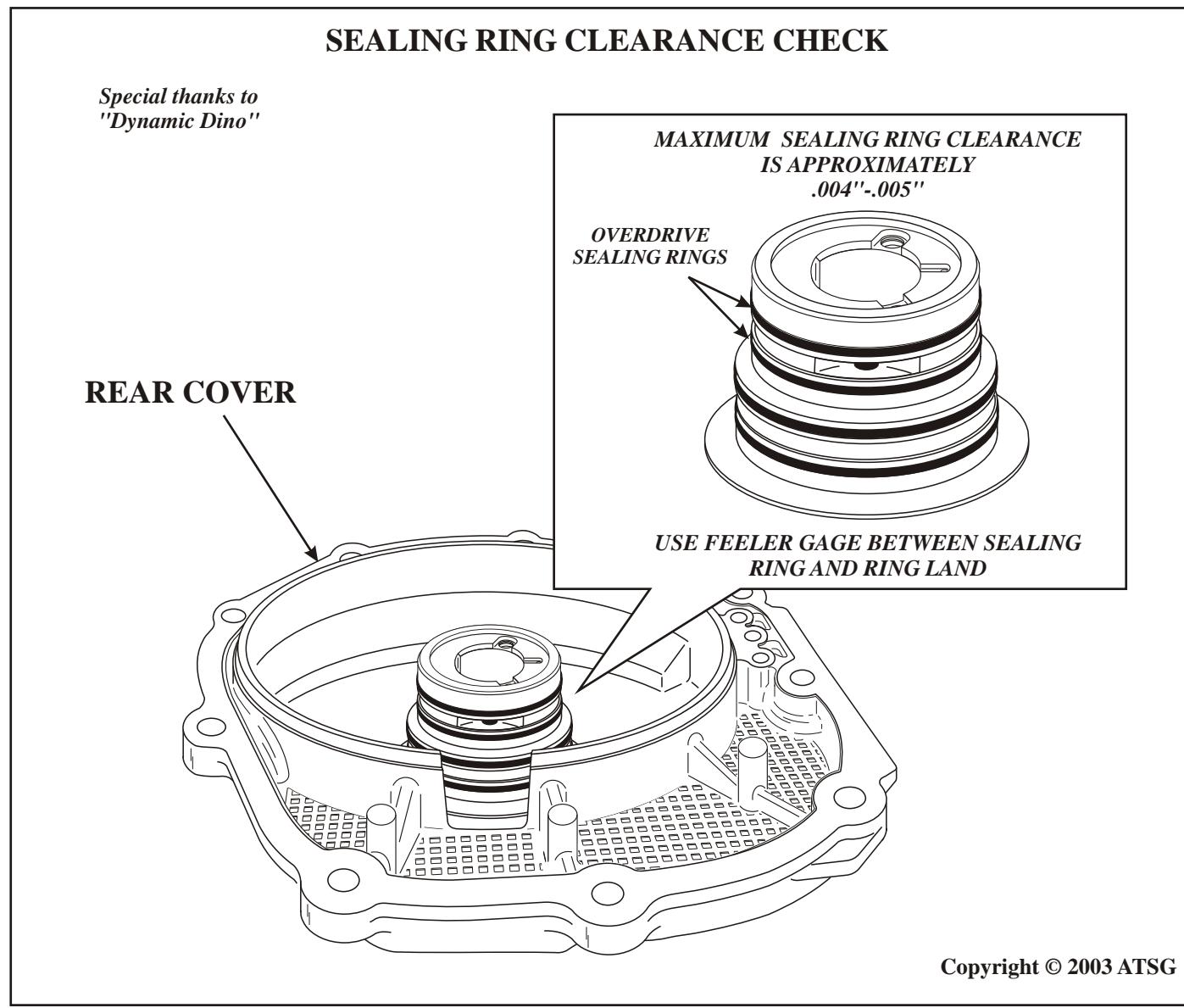


Figure 1  
Automatic Transmission Service Group

## **MITSUBISHI MONTERO SPORT/XLS WITH V4A51 TRANSMISSION & FOUR WHEEL DRIVE**

### **TRANSFER CASE DETECTION SWITCHES**

**COMPLAINT:** The vehicle comes into the shop with a complaint of poor engine performance, no 3-4 shift and the transfer case is stuck in two wheel drive.

**CAUSE:** A shorted Low Detection Switch, Refer to Figure 1, can cause all the above complaints. There are three (3) switches mounted on the transfer case, one of these is the Low Detection Switch. These switches are prone to getting stuck from lack of use and they are also susceptible to connector water intrusion.

#### *Description and Operation:*

##### **LOW DETECTION SWITCH**

The Low Detection Switch activates when the transfer case is shifted to 4LOW. It signals the PCM to initiate "Fuel Cut" in 4LOW mode and to prevent the transmission from shifting into 4th gear. The Low detection Switch has a single wire with a **WHITE** connector.

##### **2 - 4WD DETECTION SWITCH**

The 2 - 4 Detection Switch activates when the transfer case is shifted from 2WD to 4WD. It engages the front axle by signaling the 4WD ECU. If this switch does not operate properly, the 4WD lamp may stay on while in 2WD mode, or the front axle may not engage. The 2 - 4 Detection Switch is a two wire switch with a **BLACK** connector.

##### **HIGH - LOW DETECTION SWITCH**

The High - Low Detection Switch turns OFF the 4WD indicator lamp when the transmission is shifted into "N" (Neutral) and the transfer case is shifted between 4H and 4L. Its purpose is to detect the neutral position of the transfer case, (the position between 4H and 4L). The High - Low Detection Switch is a two wire switch with a **GRAY** connector.

**CORRECTION:** If any of these switches are stuck, get the transfer case to normal operating temperature and shift the transfer case in and out of all positions in an attempt to free the switch in question. If they cannot be successfully freed, then they will have to be replaced.

If water intrusion and switch terminal corrosion is found to be the problem, the switch(s) in question will need replacement.

#### **SERVICE INFORMATION:**

<b><i>Low Detection Switch.....</i></b>	<b><i>MR246221</i></b>
<b><i>2 - 4WD Detection Switch.....</i></b>	<b><i>MB811554</i></b>
<b><i>High - Low Detection Switch.....</i></b>	<b><i>MB886426</i></b>

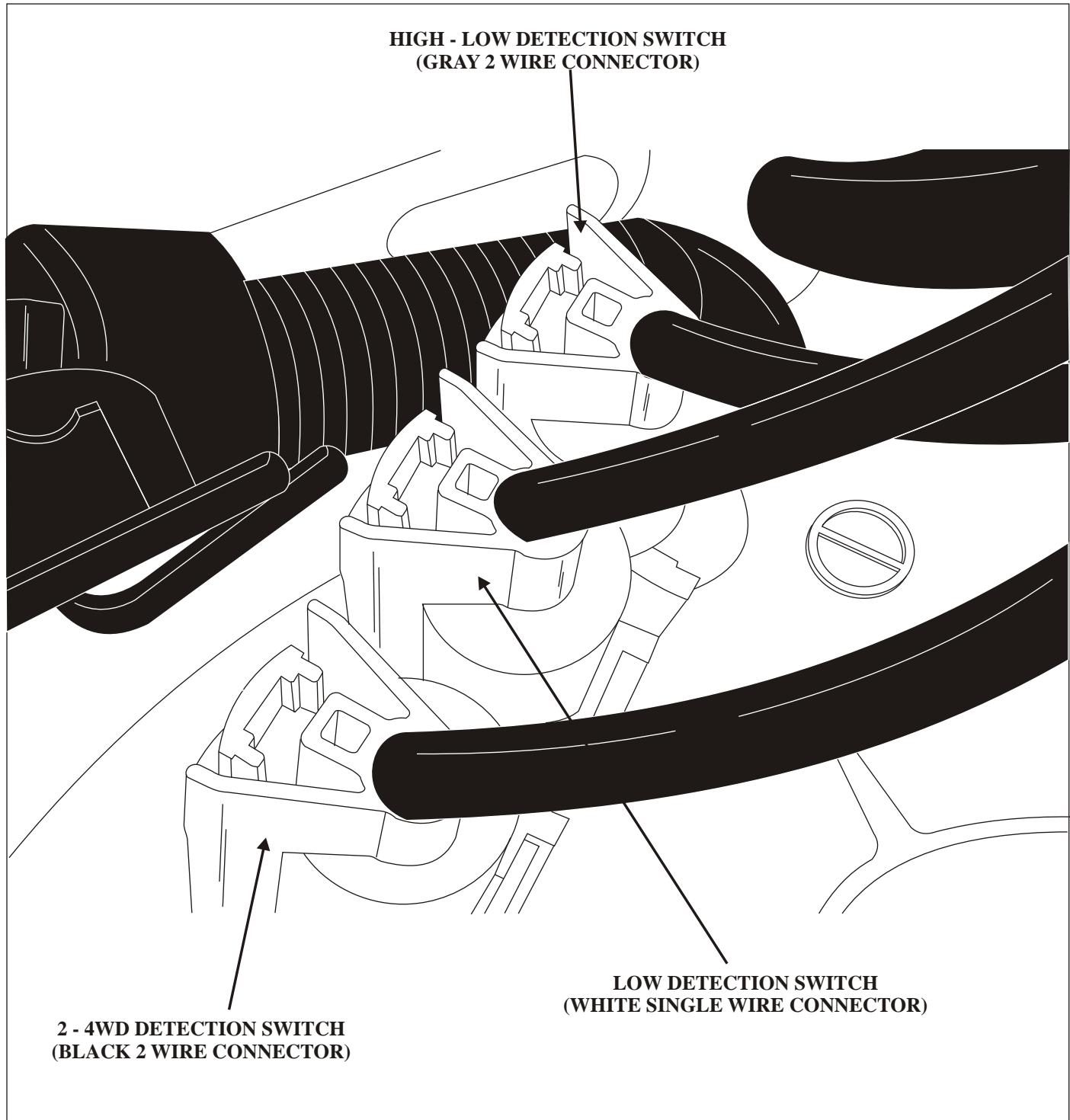
**TRANSFER CASE DETECTION SWITCHES**

Figure 1

## MITSUBISHI VEHICLES WITH 20/30 SERIES TRANSMISSIONS

### PUMP AND TORQUE CONVERTER DAMAGE

**COMPLAINT:** After the transmission has been installed back into the vehicle, and the initial fluid fill has been added, the vehicle is now started. As more fluid is added, the fluid is pouring out onto the floor almost as fast as it is being added. It is determined that the fluid is pouring out of the front seal area.

Upon removal and inspection of the front seal area, it is noticed that the pump bushing has spun, in some cases it might even be welded to the converter neck.

Upon further inspection, it is evident that the flex plate will also require replacement.

**CAUSE:** When the converter was removed, the crankshaft to converter hub pilot bushing that these vehicles use to allow the torque converter to spin in alignment with the crankshaft, came out with the original converter and had gone unnoticed. The newly rebuilt transmission and converter was installed into the vehicle without the pilot bushing, causing a severe misalignment, resulting in the damage, causing the above complaints.

**CORRECTION:** When a pilot bushing is lost and a replacement is needed, care must be taken when selecting a pilot as the overall height, and where the machined step is located, vary from one to another as can be seen in Figure 1.

#### SERVICE INFORMATION:

Refer to the chart in Figure 2 for pilot bushing dimensions and corresponding part numbers.

*A very special thanks to Don Stone of AAA Quality Transmissions in Stuart, Fl. for his foresight in keeping track of all the different size pilot bushings that are used.*

## PUMP AND TORQUE CONVERTER DAMAGE

### TORQUE CONVERTER HUB TO CRANKSHAFT PILOT BUSHINGS

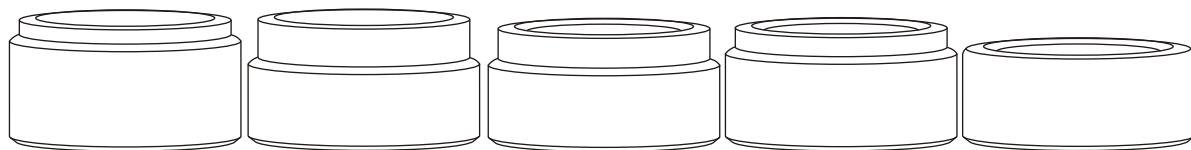


Figure 1

**PILOT BUSHING DIMENSION & PART NUMBER CHART**

PART NUMBER	TOP ID	TOP OD	BOTTOM ID	BOTTOM OD	CRANK STEP WIDTH	FLYWHEEL STEP WIDTH	OVERALL HEIGHT
MD756766	1.064"	1.496"	0.659"	1.615"	0.554"	0.194"	0.748"
MD756765	1.097"	1.496"	1.059"	1.615"	0.560"	0.280"	0.840"
MD753995	1.097"	1.496"	1.059"	1.615"	0.730"	0.110"	0.840"
MD732972	1.105"	1.502"	1.062"	1.615"	0.612"	0.108"	0.720"
MD011848	1.336"	1.615"	0.472"	1.615"	No Step	No Step	0.630"

Figure 2

**NISSAN RE4FO4A****3-2 SHIFT CONCERNS**

**COMPLAINT:** The 3-2 downshift is drawn out and the 1-2 upshift is of poor quality. This complaint can occur before or after overhaul.

There is an orifice cup plug in the bottom of the 2-4 servo. Behind this cup plug is the Servo Release Pressure Metering Exhaust Valve, (Refer to Figure 1). When this valve gets stuck, It causes the above complaints.

**CAUSE:** This "stem" valve is placed on the release side of the servo bore in the case. Its' function is to provide a very small metered leak any time third gear oil is present on the release side of the servo.

This prevents the release side of the servo from becoming air bound or hydraulically bound. When this circuit becomes restricted, due to the valve getting stuck, air and residual oil opposes servo apply causing the above complaints. The 1-2 shift is affected depending on how quickly the downshift to first gear occurs, the longer this downshift takes the more opportunity there is for the trapped air/oil to dissipate.

**CORRECTION:**

The best way to check the operation of this hydraulic circuit is to fill the exhaust side of the valve passage through the release port over the pump as seen in Figure 2, and blow air through the orifice in the servo bore. The initial blast will push some fluid out, but maintain your air supply and watch for residual fluid to ooze out. As long as fluid oozes out the valve is working as it should. If fluid stops oozing out the cup plug will have to be removed and the valve and valve bore will have to be cleaned and dressed.

**NOTE:** *Be sure the valve rattles after the case is removed from the cleaning machine because, cleaning soap residue can cause the valve to stick.*

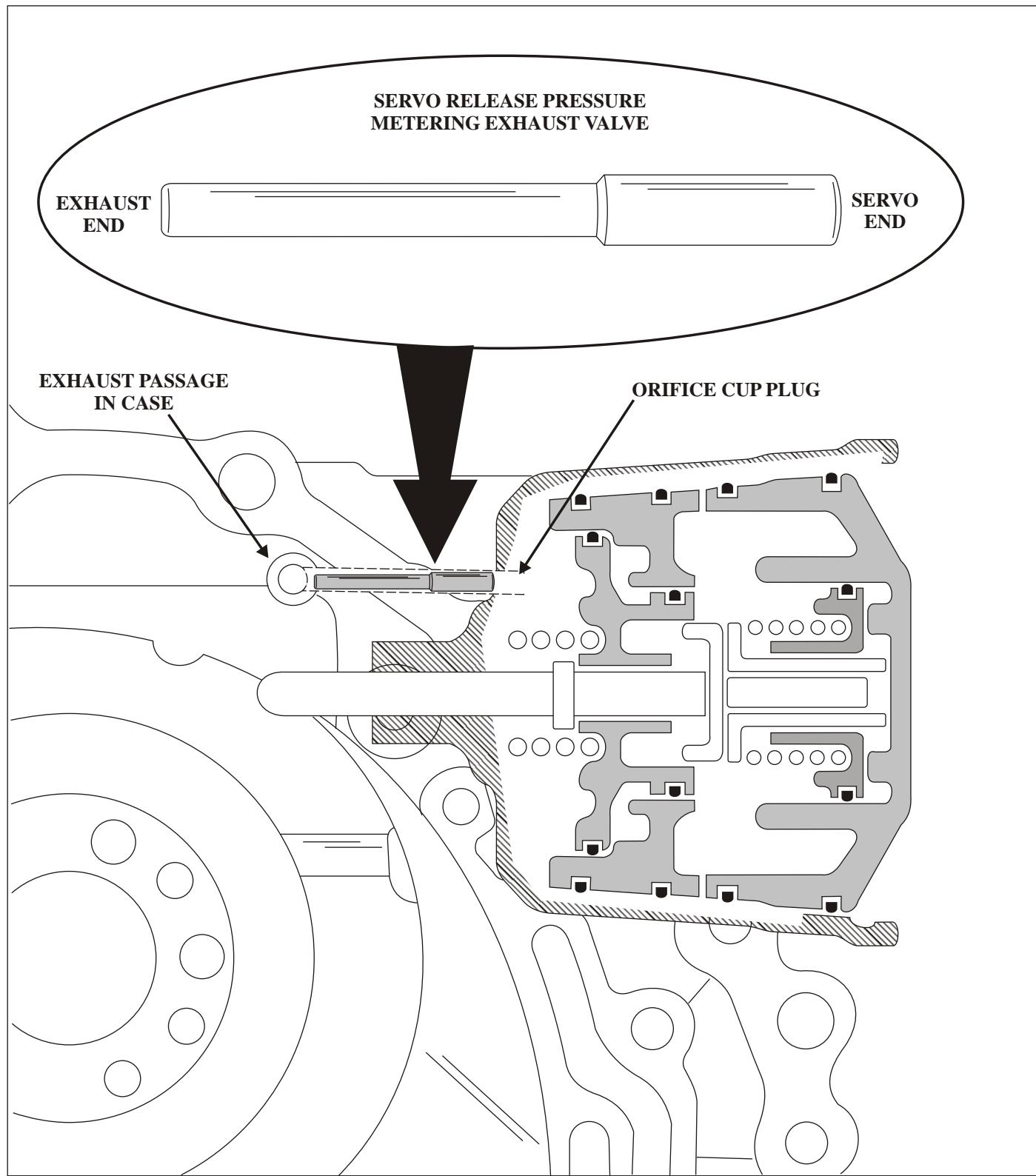
**3-2 SHIFT CONCERNS**

Figure 1

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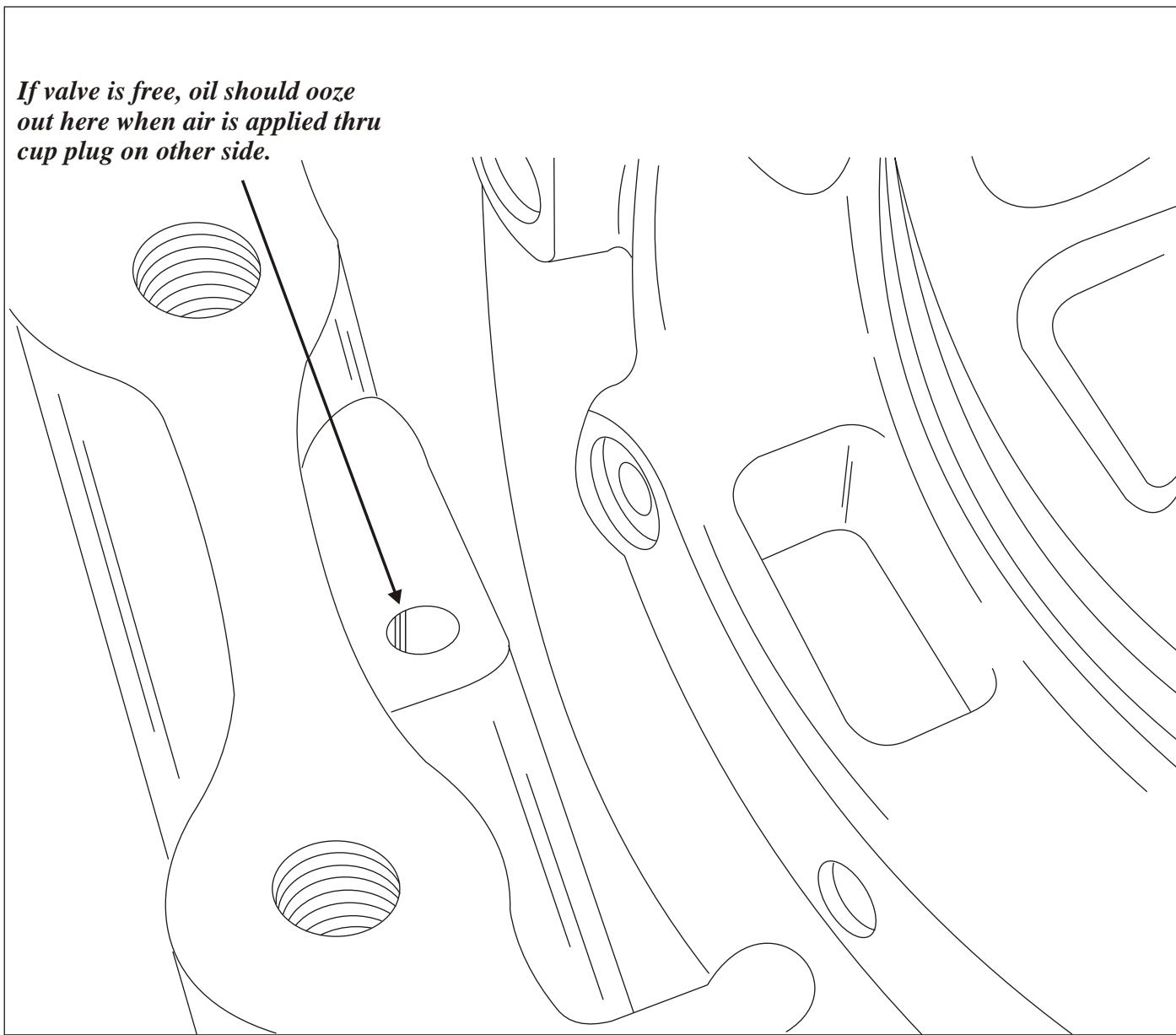
**3-2 SHIFT CONCERNS**

Figure 2

**NISSAN/INFINITI****DTC P1605 - A/T DIAGNOSTIC COMM LINE FAILURE**

**COMPLAINT:** An OBD-II compliant Nissan or Infiniti vehicle comes in with a P1605 code, stored in the Engine Control Module (ECM), indicating the Transmission Control Module (TCM) is not sending information to the ECM, and ***the transmission is stuck in third gear.*** The TCM may also be incapable of code retrieval.

**CAUSE:** The A/T Diagnostic Communication Line circuit is an operating strategy circuit from the TCM to the ECM.

When this circuit fails, this code is stored in the ECM. This code can also be stored when the TCM loses power or the TCM is faulty, which is why the transmission is stuck in 3rd gear since this results in both shift solenoids, turned off. This can also be caused by a weak battery.

**CORRECTION:** ***To diagnose the P1605 code, verify the following:***

- (1) The A/T Diagnostic Comm Line wire has continuity between the TCM and ECM.
- (2) Check for power and ground at the TCM, and fuses, should there be no power present.
- (3) Check the Overdrive Indicator or A/T Check Lamp circuit by making certain the circuit has battery voltage, with the ignition on, then ground it and see if the bulb illuminates.  
The computer usually grounds the lamp circuit during the "key on" bulb check.  
If the lamp circuit does not have battery voltage, then the wire, bulb or power source may be at fault.
- (4) When steps 1 through 3 have been verified good, replace the TCM.

***Refer to the following figures to locate the correct Comm Line, power, ground and overdrive or A/T check lamp circuit:***

Figure 1...Use this chart to find the location of the TCM and ECM.

Figure 2...Use this chart to locate the correct TCM and ECM for NISSAN/INFINITI vehicles from 1995 to 1998.

Figure 3.....TCM #1

Figure 4.....TCM #2

Figure 5.....ECM #1

Figure 6.....ECM #2

Figure 7.....ECM #3

Figure 8...Use this chart to locate the correct TCM and ECM for NISSAN/INFINITI vehicles from 1999 to 2002.

Figure 9.....TCM #3

Figure 10.....ECM #4

Figure 11.....ECM #5

Figure 12.....ECM #6

Figure 13.....ECM #7

Figure 14.....ECM #8

**DTC P1605 - A/T DIAGNOSTIC COMM LINE FAILURE**

NISSAN/INFINITI ECM/TCM LOCATIONS		
MAKE, MODEL, YEAR	TCM LOCATION	ECM LOCATION
1996-01 MAXIMA	Behind left center of dash	Below center of dash
1996 300ZX	Behind right side of dash	Below center of dash
1996-02 QUEST/VILLAGER	Behind dash, right of steering column	Behind ride side of dash
1996-97 ALTIMA	Behind passenger kick panel	Below center of dash
1998-01 ALTIMA	Under front of center console	Behind instrument lower cover
1996-02 PATHFINDER	Behind dash, left of steering column	Behind center of dash
1996-98 240SX	Behind left side of dash	Behind passenger kick panel
1996-99 SENTRA, 2.0L 1996-98 200SX	Behind left kick panel	Below center of dash
2000-01 SENTRA	Behind passenger kick panel	In right rear corner of engine bay
1999-02 FRONTIER, 3.3L	Behind left side of dash	Below center of dash, behind lower cover
2000-02 Xterra, 3.3L	Behind dash, left of steering column	Below center of dash, behind lower cover
1995-96 G20	Behind left kick panel	Under center of dash, behind center console
1999-02 G20	Behind lower center os dash, forward of selector lever	Behind base of center console
1997-01 I30	Below center of dash, under Body Control Module or ASCD Module	Below center of dash
1997-02 QX4	Behind dash left of steering column	Behind center of dash
1997-01 Q45	Behind left kick panel	Behind right kick panel
2002 Q45	Behind glove box, next to ECM on the right	Behind glove box, in between TCM and A/C Module

Figure 1

1995 - 1998 P1605 DIAGNOSTIC CHART						
VEHICLE MAKE	VEHICLE MODEL &YEAR	REFER TO ECM #	ECM A/T COMM LINE TERMINAL	REFER TO TCM #	TCM A/T COMM LINE TERMINAL	POWER/O/D/A/T CHECK LAMP TERMINAL
NISSAN	1996-98 MAXIMA 1996 300ZX	2	6	1	45	
	1996-98 QUEST					
	1996 VILLAGER	1	7	1	45	
	1996-98 ALTIMA					
	1996-97 PATHFINDER					
	1998 PATHFINDER	2				
	1996-98 240SX	1				
	1996-98 SENTRA 2.0L	1	7	1	13	
	1996-98 200SX					
	1995-96 G20	1	7	1	13	
INFINITI	1997-98 I30	2	6	1	45	
	1997 QX4	1	7	2	4	12
	1998 QX4	2				
	1997 Q45	2	73	1	47	3
	1998 Q45	3	99	1	47	4, 9, 23
						15, 48

Figure 2

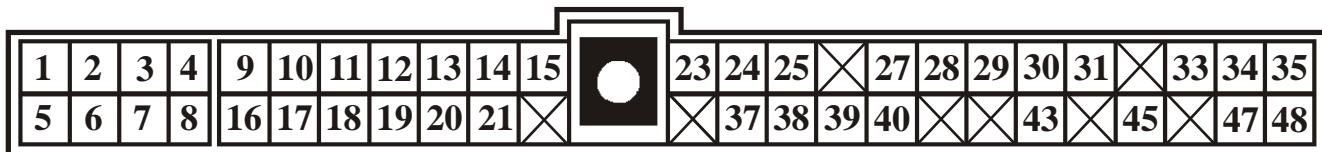
**DTC P1605 - A/T DIAGNOSTIC COMM LINE FAILURE**
**1995 - 98 ALL EXCEPT QX4**

**TCM #1 WIRE SIDE VIEW**

Figure 3

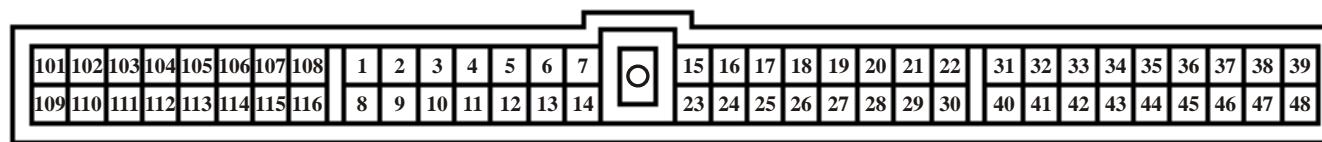
**1997 - 98 QX4**

**TCM #2 WIRE SIDE VIEW**

Figure 4

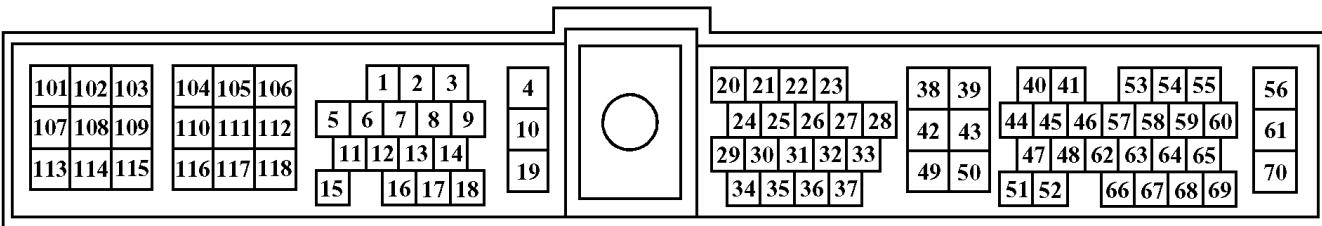
**1996 - 98 QUEST, VILLAGER, ALTIMA, 240SX, SENTRA 2.0L, 200SX**
**1996 - 97 PATHFINDER**
**1995 - 97 G20**
**1997 QX4**

**ECM #1 WIRE SIDE VIEW**

Figure 5

## DTC P1605 - A/T DIAGNOSTIC COMM LINE FAILURE

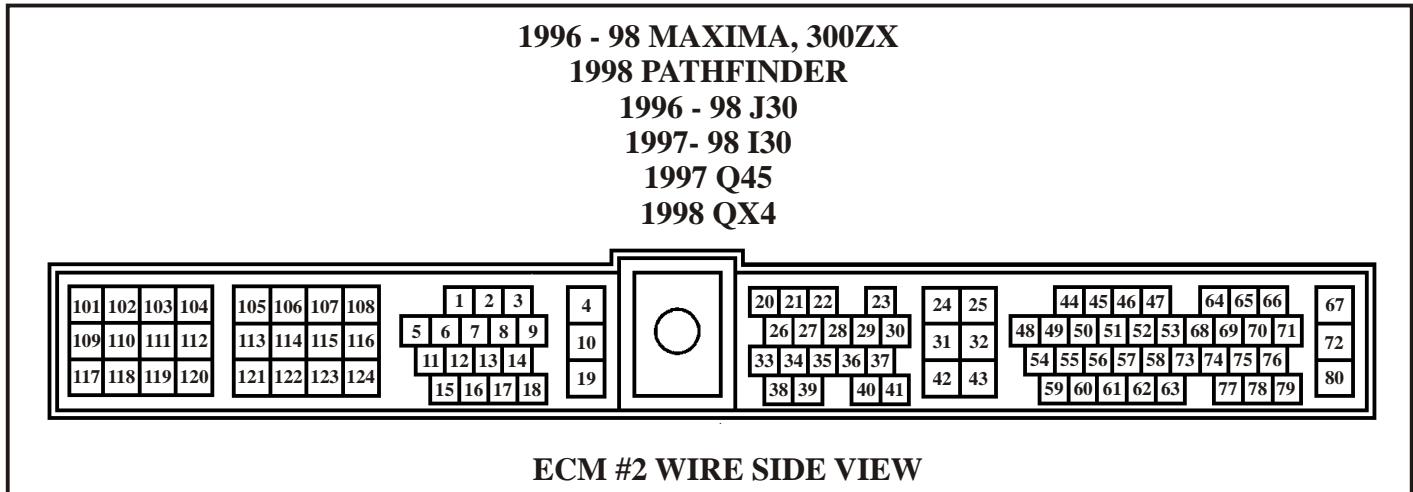


Figure 6

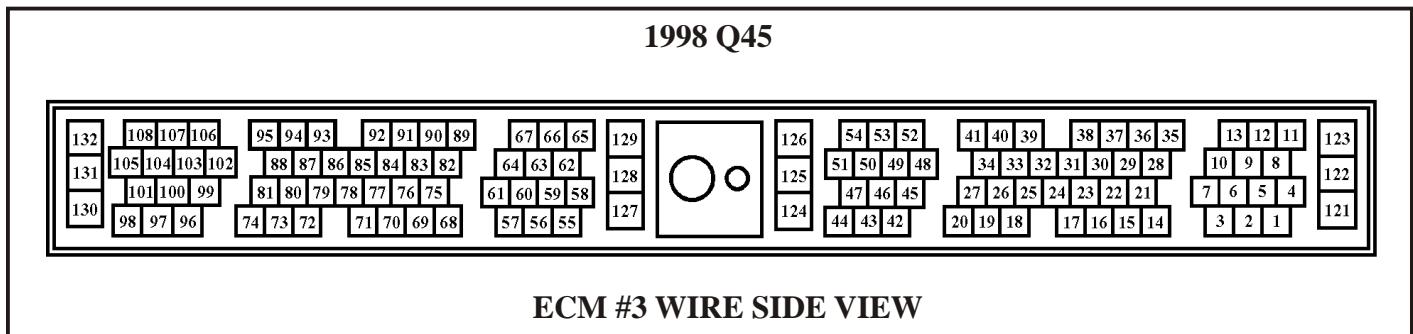


Figure 7



# "2004" SEMINAR INFORMATION

## SLIDE

55

1999 - 2002 P1605 DIAGNOSTIC CHART							
VEHICLE MAKE	VEHICLE MODEL & YEAR	REFER TO ECM #	ECM A/T COMM LINE TERMINAL	REFER TO TCM #	TCM A/T COMM LINE TERMINAL	POWER/O/D/A/T CHECK LAMP TERMINAL	TCM B+ SUPPLY TERMINAL
	1999 MAXIMA	5	33	3	68		
	2000-01 MAXIMA	6	60	3	15		
NISSAN	1999-02 QUEST 1999-02 VILLAGER	5					
	2000-01 ALTIMA	4					
	2000 PATHFINDER	5	7	3	15		
	1999 SENTRA 2.0L	4					
	1999-02 FRONTIER, 3.3L 2000-02 XTERRA, 3.3L	5					
	1999 ALTIMA	4	7	3	45		
	1999 PATHFINDER	5	7	3	4		
	2001-02 PATHFINDER	5	114	3	33		
	1999 SENTRA 2.0L	4	7	3	13		
	2000-01 SENTRA 1.8L FED & 2.0L	6	91	3	15		
INFINITI	1999 G20	4	7	3	15		
	2000-02 G20	6	91	3	15		
	1999 I30	5	68	3	33		
	2000-01 I30	6	60	3	15		
	1999-01 QX4	5	7	3	4		
	2000 QX4	6	114	3	33		
	2001-02 QX4						
	1999-01 Q45	7	99	3	47	3	4, 9, 23
	2002 Q45	8	171, 174	3	6, 7	N/A	15, 48
						2, 3, 9, 33, 42	5, 14, 24, 46

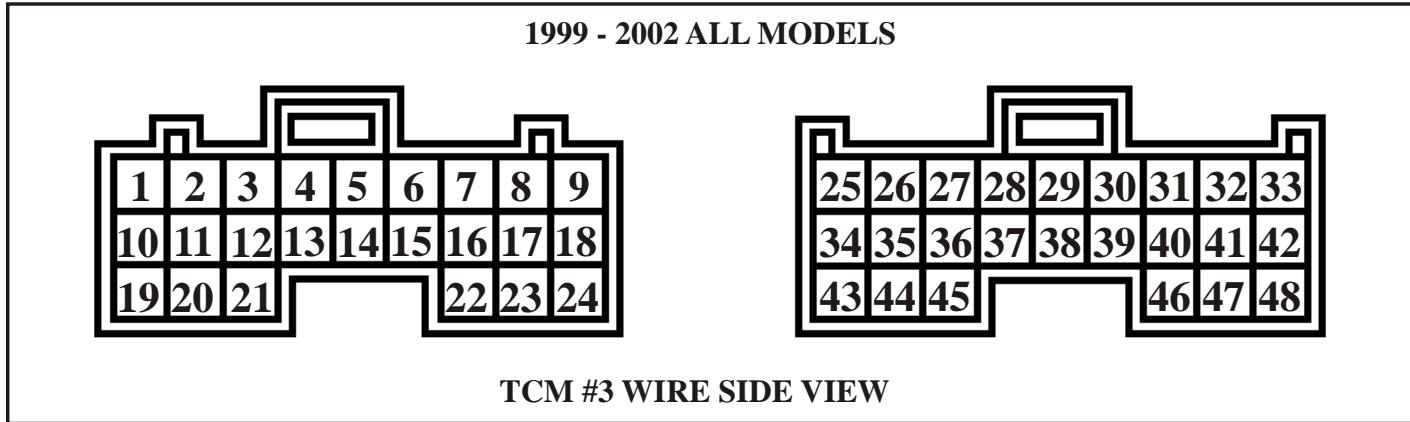
**DTC P1605 - A/T DIAGNOSTIC COMM LINE FAILURE**


Figure 9

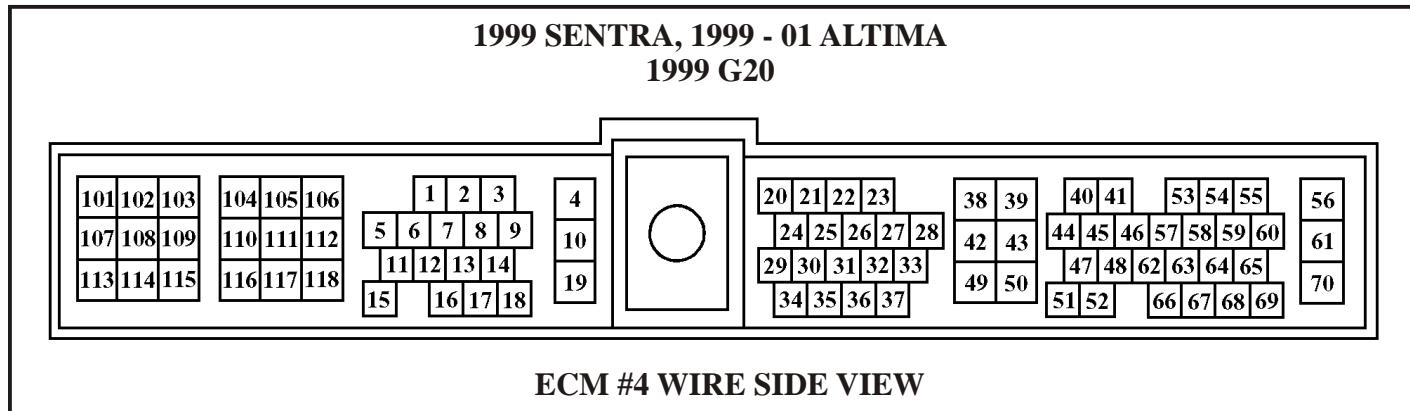


Figure 10

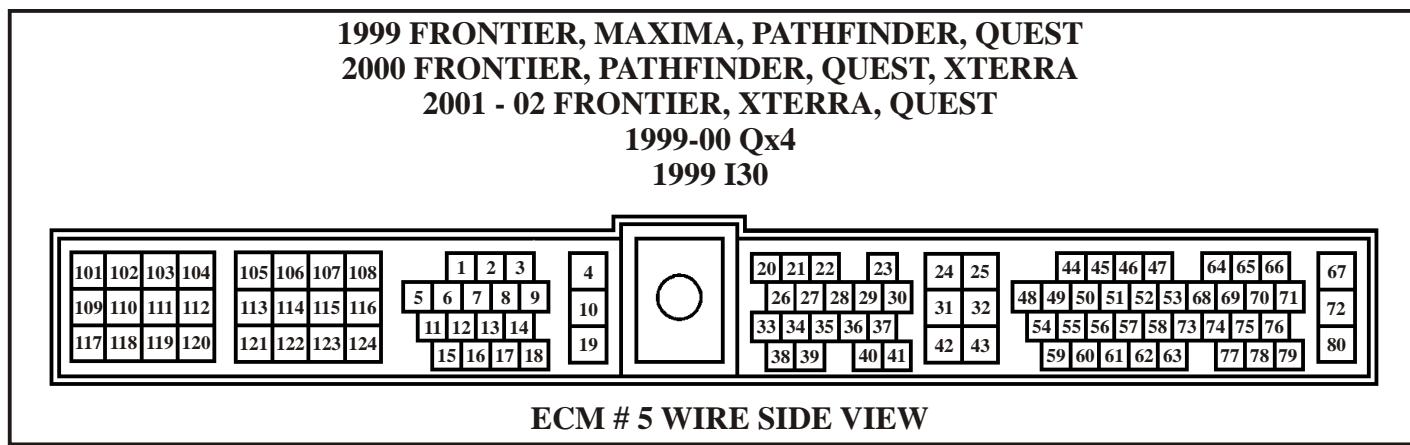


Figure 11

## DTC P1605 - A/T DIAGNOSTIC COMM LINE FAILURE

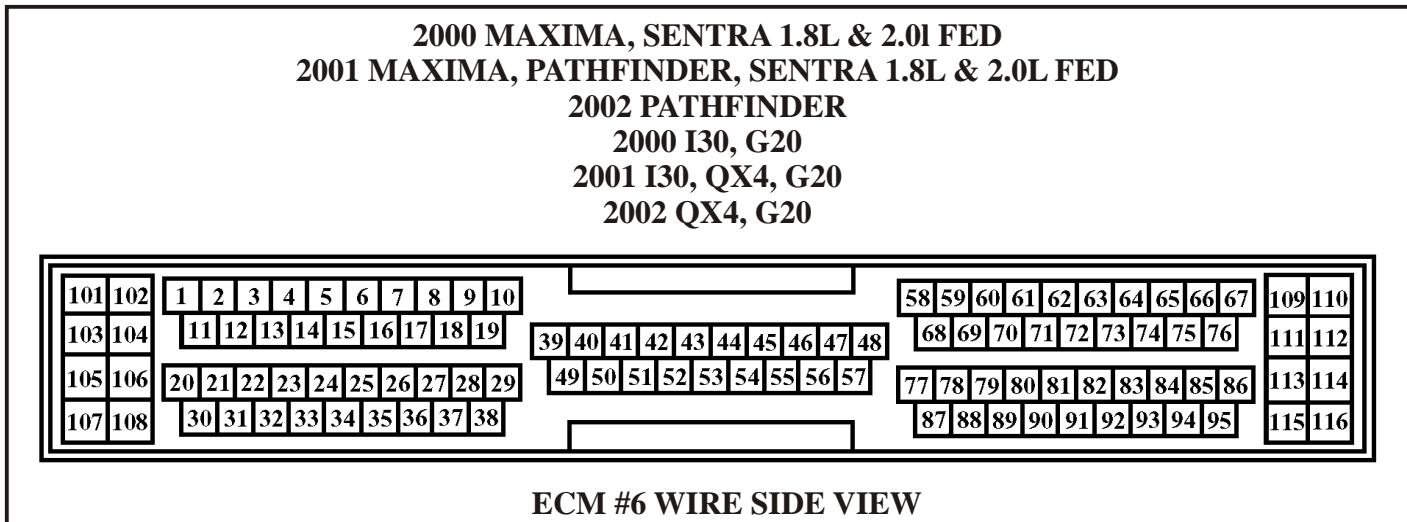


Figure 12

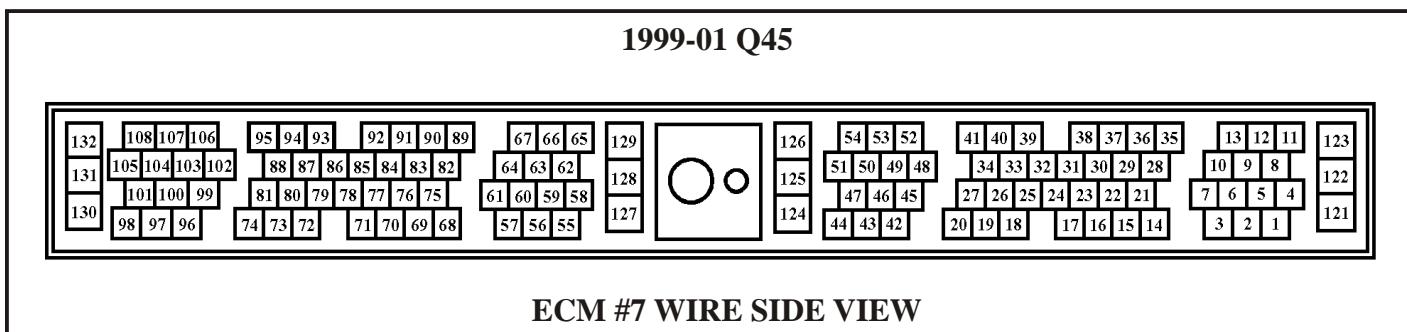


Figure 13

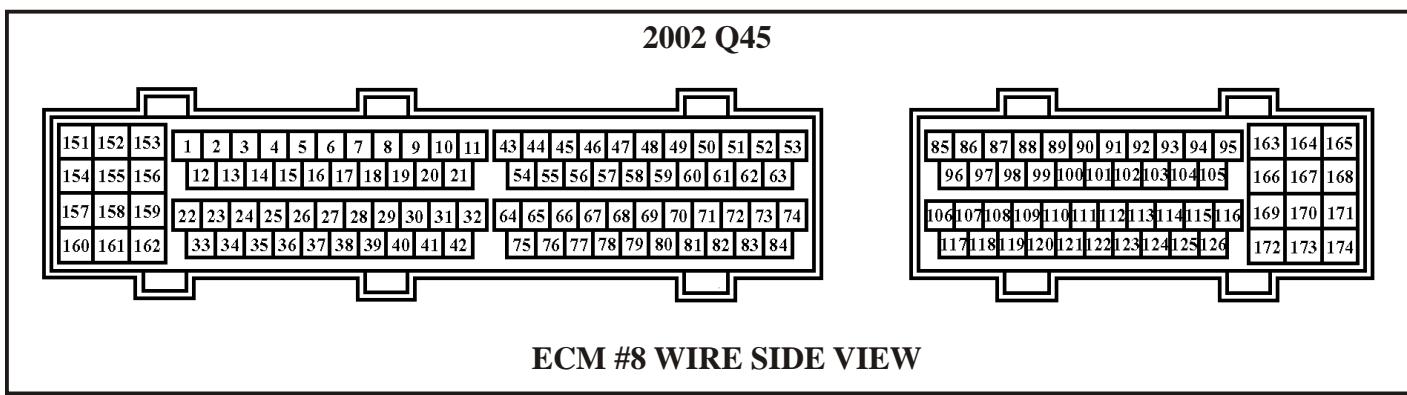


Figure 14

**SUBARU 4-AT  
DELAYED OR NO FORWARD ENGAGEMENT**

**COMPLAINT:** 1998 or later Subaru vehicles equipped with the new design 4-AT 4 speed automatic transaxle, may exhibit a complaint of delayed engagement in forward, or a no forward condition.

**CAUSE:** This condition may be caused by the outer piston seal of the Low clutch drum shrinking to the point it will no longer seal effectively. Refer to Figure 1 for identification of the Low drum and piston.

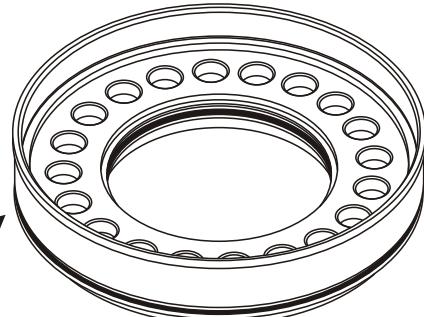
**CORRECTION:** Replace the piston seals on the Low clutch piston.

**SERVICE INFORMATION:**

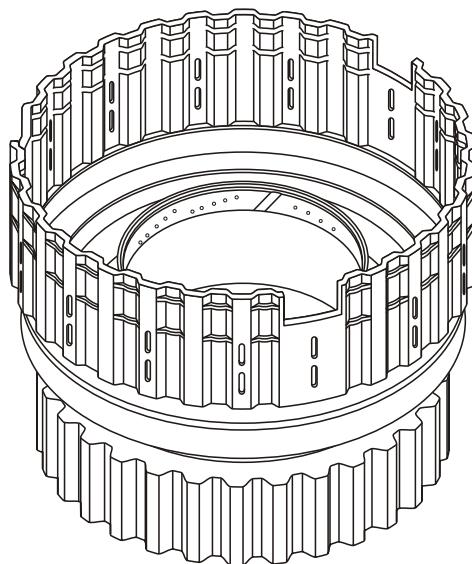
As of the printing of this information, most aftermarket suppliers have changed the material of the Low Clutch Piston seals to Viton, which are at this point working very well.

**LOW CLUTCH PISTON AND HOUSING**

*Transtec Part Number  
26792 Inner "D" Ring  
26793 Outer "D" Ring*



*The outer piston seal is notorious  
for shrinking*



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Figure 1

# Rostra

# European

## **TOYOTA A-340 SERIES TRANSMISSION FLUID OVERHEATS**

**COMPLAINT:** Some Toyota vehicles, equipped with the A-340 series transmissions, may exhibit a condition of Transmission Fluid Overheating due to poor cooler flow, while the Torque Converter Clutch is "ON."

**CAUSE:** The cause may be,

- A worn Primary Regulator Boost Valve Sleeve, causing line pressure to be higher than normal, placing the Primary Regulator Valve in a position where it restricts Converter Apply Pressure, that is sent to the Lock-up Relay Valve, as shown in the partial circuit diagram in Figure 1.
- A worn Lock-up Relay Valve Sleeve, causing a loss of Converter Apply Pressure and or Solenoid 3 signal pressure, as shown in the partial hydraulic circuit diagram in Figure 1.

**CORRECTION:** To correct this condition:

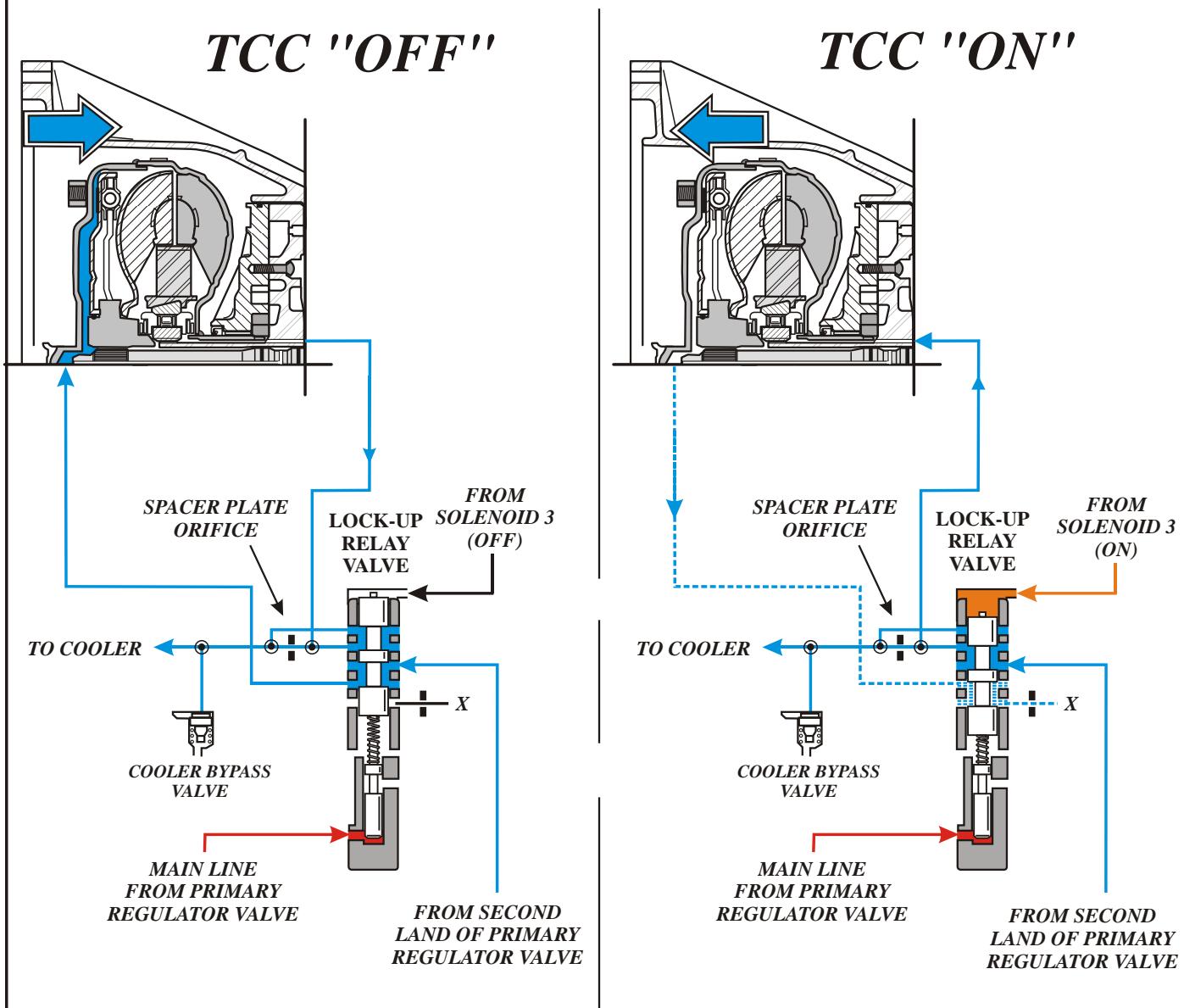
- Refer to Figure 2 and locate the Primary Regulator Valve Boost Sleeve and check for wear in the areas shown. Replace the sleeve as necessary.
- Refer to Figure 3 and locate the Lock-up Relay Valve line-up. Check for wear as shown and replace as necessary.

*NOTE: Refer to Figure 4 and enlarge the orifice, in the Main Valve Body Spacer Plate, .040" to .050" larger than its original size (the size shown may vary model to model). This will help increase cooler flow.*

### **SERVICE INFORMATION:**

Primary Regulator Boost Sleeve (Toyota part no.) ..... 35417-35010  
*NOTE: This part number is for the Boost Valve dimensions as shown in Figure 2.*

Lock-Up Relay Valve Sleeve (Toyota part no.) ..... 35215-30020

PARTIAL HYDRAULIC SCHEMATIC OF  
TORQUE CONVERTER CLUTCH OPERATION

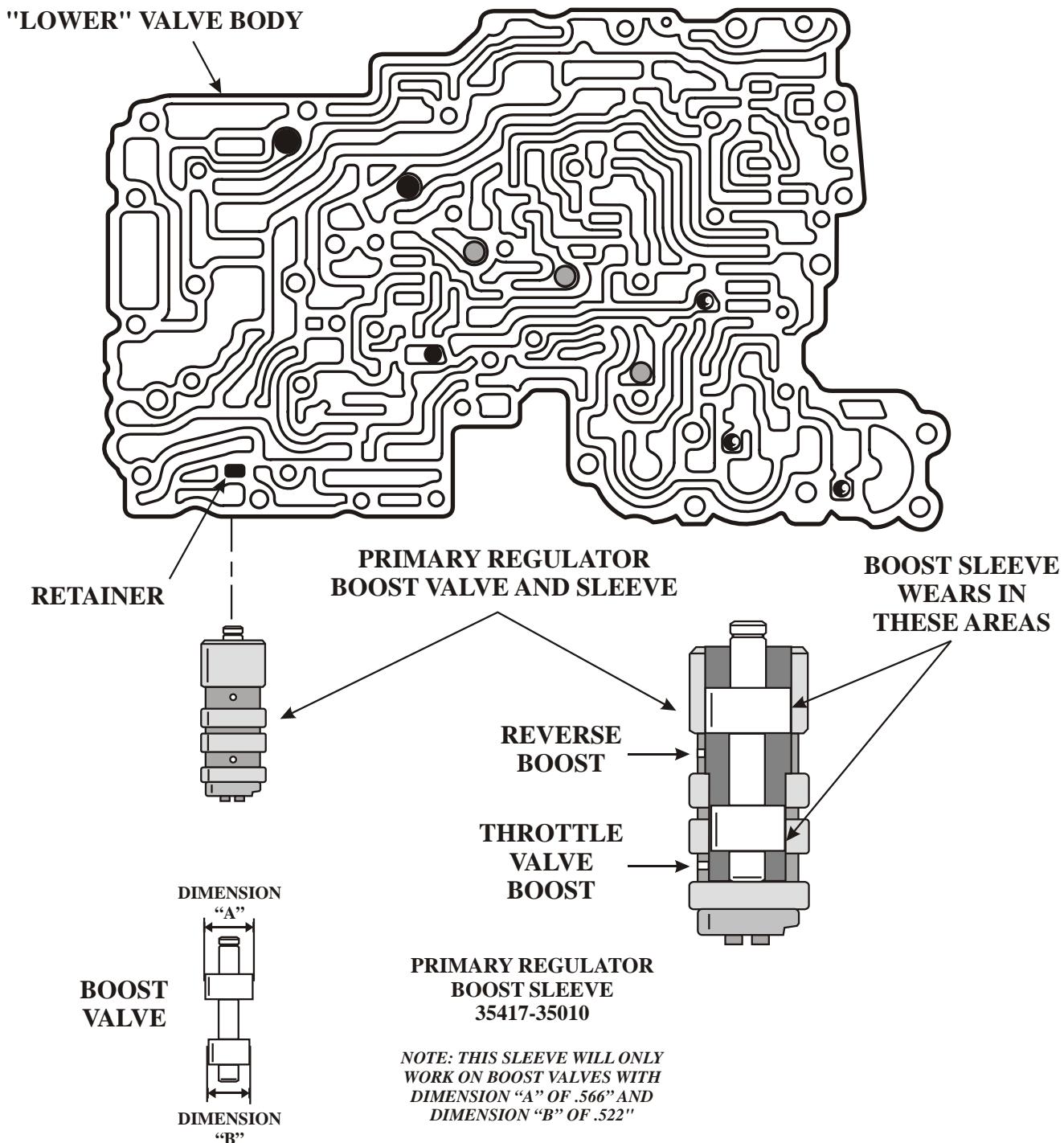
**SUMMARY:** When the Torque Converter Clutch is "OFF," Converter pressure, from the 2nd land of the Primary Regulator valve goes thru the 2nd and 3rd land of the Lock-up relay valve, thru the torque Converter and returns to the Lock-up Relay Valve between the 1st and 2nd land where it is connected to the "To Cooler passage."

When the Torque Converter Clutch is "ON," Solenoid 3 is turned ON which strokes the Lock-up Relay Valve and switches the Converter pressure, from the 2nd land of the Primary Regulator Valve, to Converter Apply pressure. This pressure is directed thru the 1st and 2nd land of the Lock-up Relay Valve to apply side of the Torque Converter Clutch and, thru an orifice, to the "To Cooler Passage."

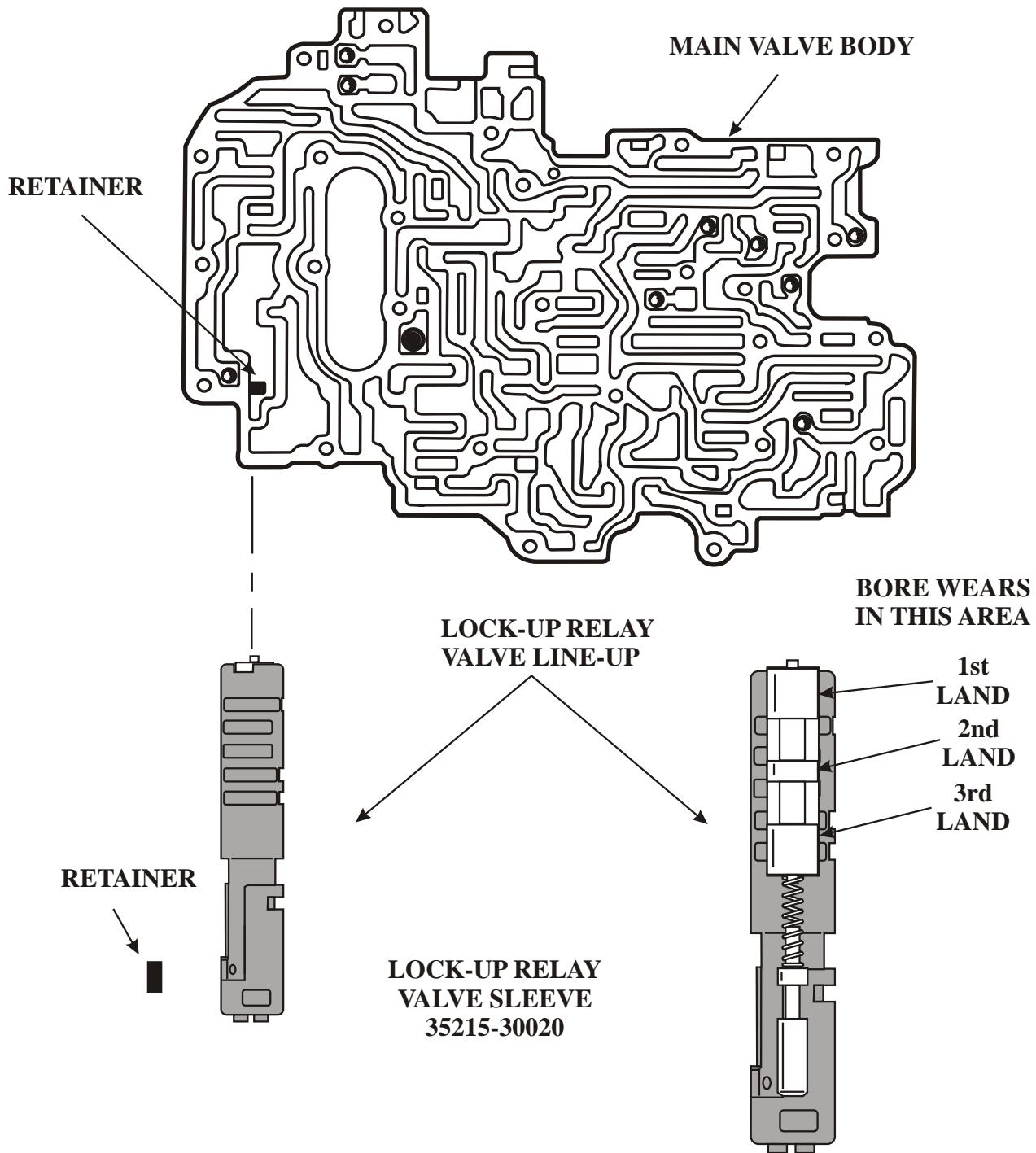
**PROBLEM AREAS:** The first problem area is from the Primary Regulator Boost Sleeve. Wear in this sleeve can cause Line pressure to be higher than normal minimizing Converter pressure from the 2nd land of the Primary Regulator Valve. The second problem area is wear in the Lock-up Relay Valve Sleeve. Wear in this sleeve may cause a loss of Converter Apply Pressure while in Lock-up and even a loss of Solenoid 3 signal pressure, which may not fully stroke the Lock-up Relay Valve against its spring.



## PRIMARY REGULATOR VALVE LOCATION



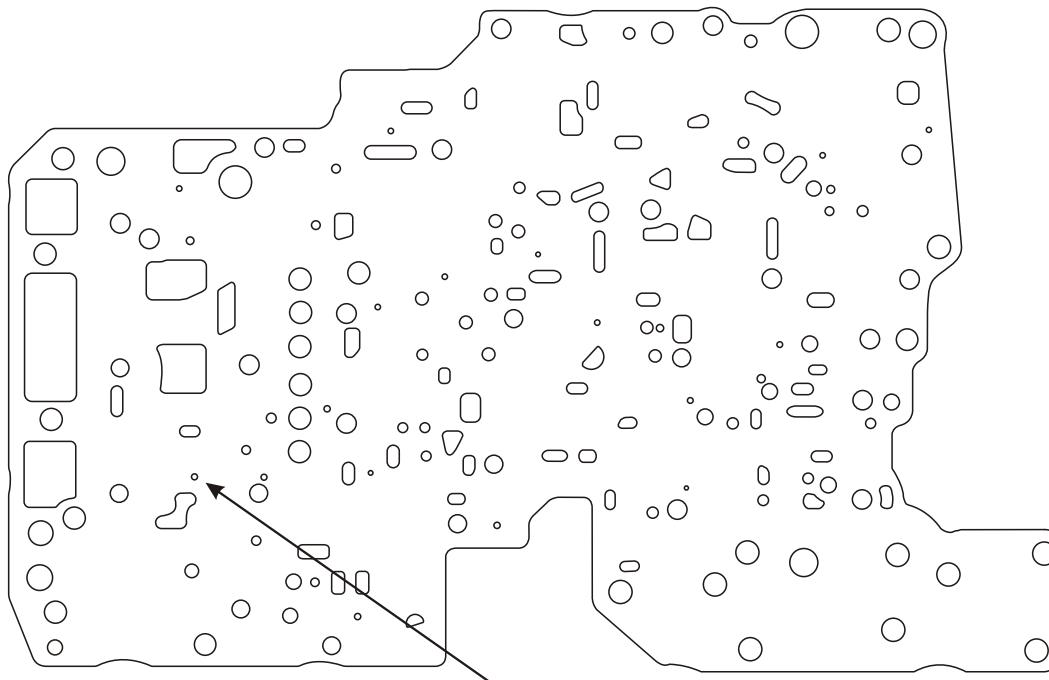
*NOTE: Wear in the Primary Boost Valve Sleeve may place the Primary Regulator valve in a position which can cause higher than normal line pressure, which limits Torque Converter Apply Pressure as well as cooler flow.*

LOCK-UP RELAY  
VALVE LOCATION

*Wear in the 1st land of the Lock-up Relay Valve bore may cause a loss of Solenoid no.3 signal pressure, which may place the valve into a partially stroked position instead of a fully stroked position, when the TCC is applied. Wear in the 2nd and 3rd land, while the TCC is ON, may cause Converter apply pressure to be connected to the already exhausting converter off pressure, which may cause a loss of converter apply pressure as well as cooler flow.*

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Figure 3

**MAIN CONTROL VALVE BODY SPACER PLATE****TO COOLER  
ORIFICE****ENLARGE THIS ORIFICE  
.040" TO .050" LARGER  
THAN THE ORIGINAL SIZE****O.E. DIAMETER  
IS .059"****(ORIFICE SIZE MAY VARY)**

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Figure 4

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**VOLVO/Saab AW50-42LE  
VALVE BODY EXPLODED VIEWS  
AND IDENTIFICATION OF COMPONENTS**

*Refer to Figure 1 for Solenoid identification and locations on the valve body.*

*Refer to Figure 2 for valve identification and locations in the "Upper" valve body.*

*Refer to Figure 3 for valve identification and locations in the "Center" valve body, "Front" side.*

*Refer to Figure 4 for valve identification and locations in the "Center" valve body, "Rear" side.*

*Refer to Figure 5 for valve identification and locations in the "Lower" valve body, "Front" side.*

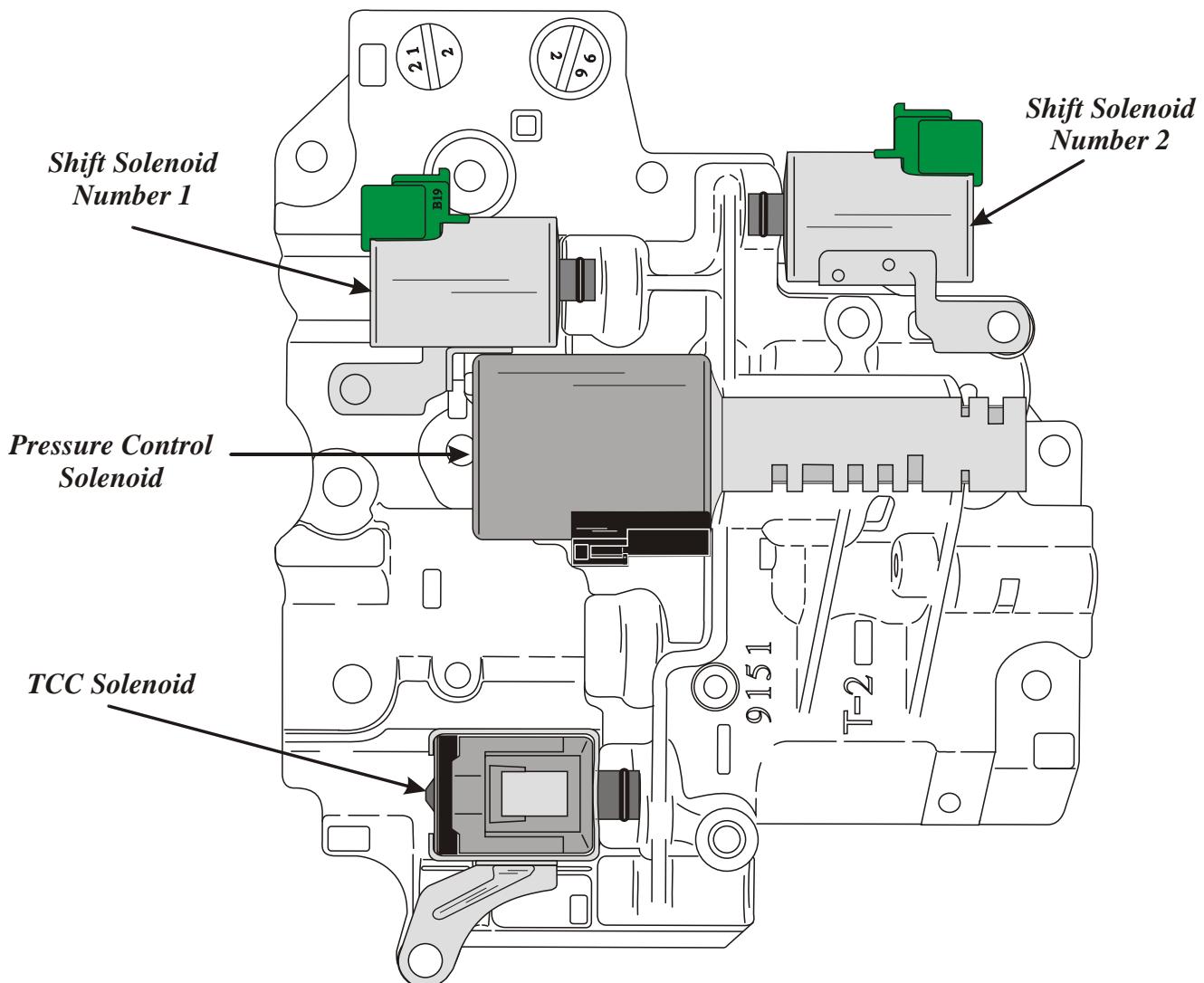
*Refer to Figure 6 for valve identification and locations in the "Lower" valve body, "Rear" side.*

*Refer to Figure 7 for illustrations of the typical spacer plates.*

*Refer to Figure 8 for the check valve and check ball locations in the "Lower" valve body.*

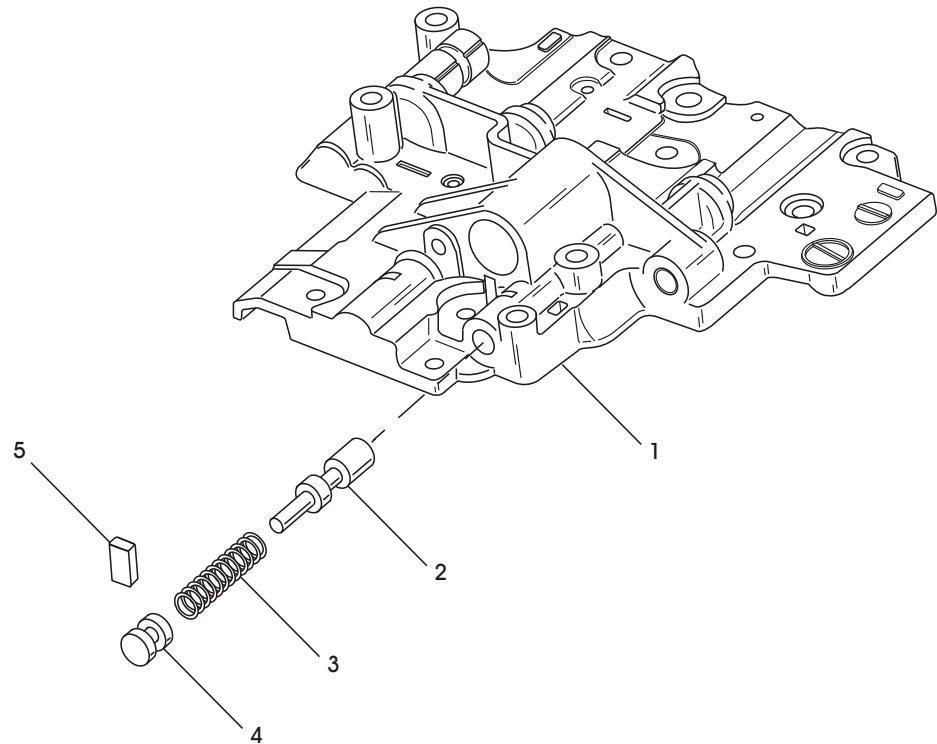
*Refer to Figure 9 for the screen locations in the "Center" valve body, "Upper" valve body side.*

*Refer to Figure 10 for the check valve and check ball locations in the "Center" valve body, "Lower" valve body side.*

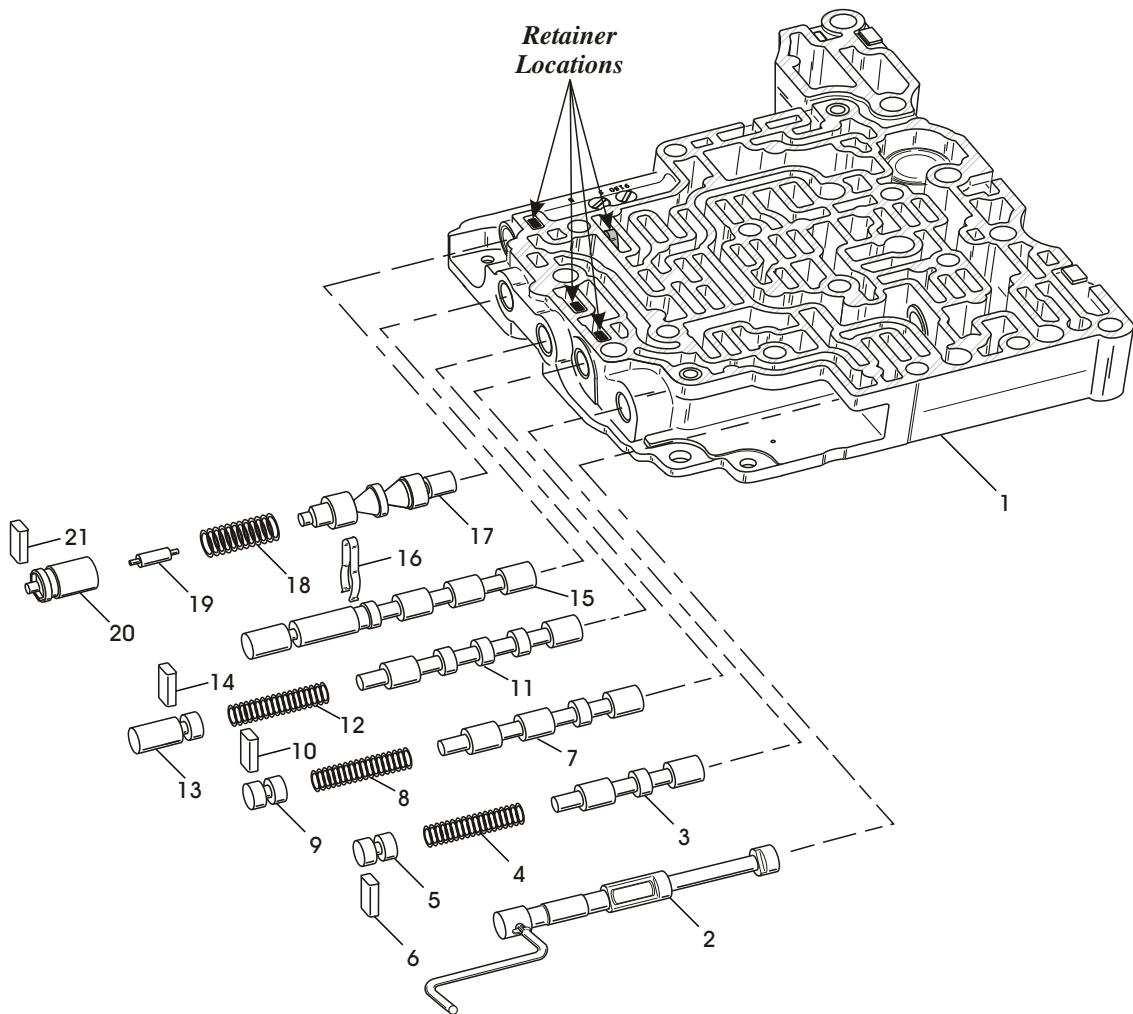
**SOLENOID IDENTIFICATION  
AND LOCATIONS**

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Figure 1

UPPER VALVE BODY  
VALVE IDENTIFICATION AND LOCATIONS

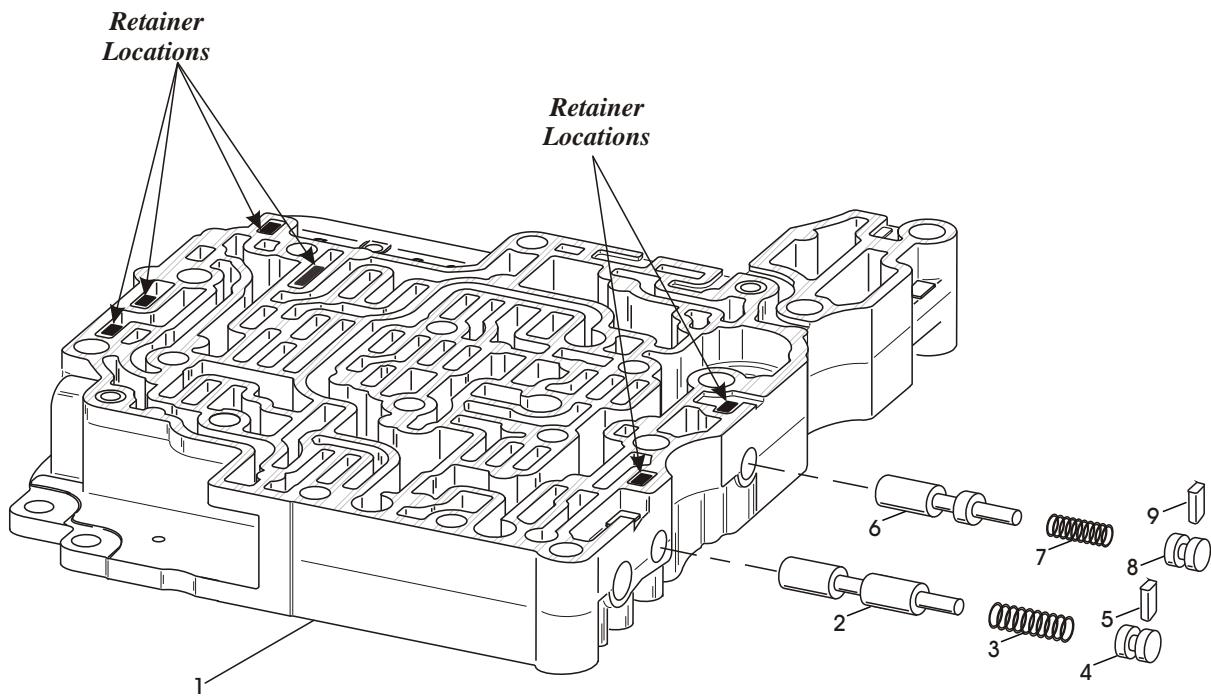
1. UPPER VALVE BODY CASTING
2. PRESSURE CONTROL SOLENOID REGULATOR VALVE
3. PRESSURE CONTROL SOLENOID REGULATOR VALVE SPRING
4. PRESSURE CONTROL SOLENOID REGULATOR VALVE BORE PLUG
5. PRESSURE CONTROL SOLENOID REGULATOR VALVE BORE PLUG RETAINER

CENTER VALVE BODY "FRONT" SIDE  
VALVE IDENTIFICATION AND LOCATIONS

- |  |                                    |
|--|------------------------------------|
| 1. CENTER VALVE BODY CASTING                     | 12. 1-2 SHIFT VALVE SPRING         |
| 2. MANUAL VALVE                                  | 13. 1-2 SHIFT VALVE BORE PLUG      |
| 3. 2-3 SHIFT VALVE                               | 14. 1-2 SHIFT VALVE RETAINER       |
| 4. 2-3 SHIFT VALVE SPRING                        | 15. NEUTRAL CONTROL VALVE          |
| 5. 2-3 SHIFT VALVE BORE PLUG                     | 16. NEUTRAL CONTROL VALVE RETAINER |
| 6. 2-3 SHIFT VALVE RETAINER (Location not shown) | 17. PRIMARY REGULATOR VALVE        |
| 7. 3-4 SHIFT VALVE                               | 18. PRIMARY REGULATOR VALVE SPRING |
| 8. 3-4 SHIFT VALVE SPRING                        | 19. PLUNGER                        |
| 9. 3-4 SHIFT VALVE BORE PLUG                     | 20. PLUNGER SLEEVE                 |
| 10. 3-4 SHIFT VALVE RETAINER                     | 21. PLUNGER SLEEVE RETAINER        |
| 11. 1-2 SHIFT VALVE                              |                                    |

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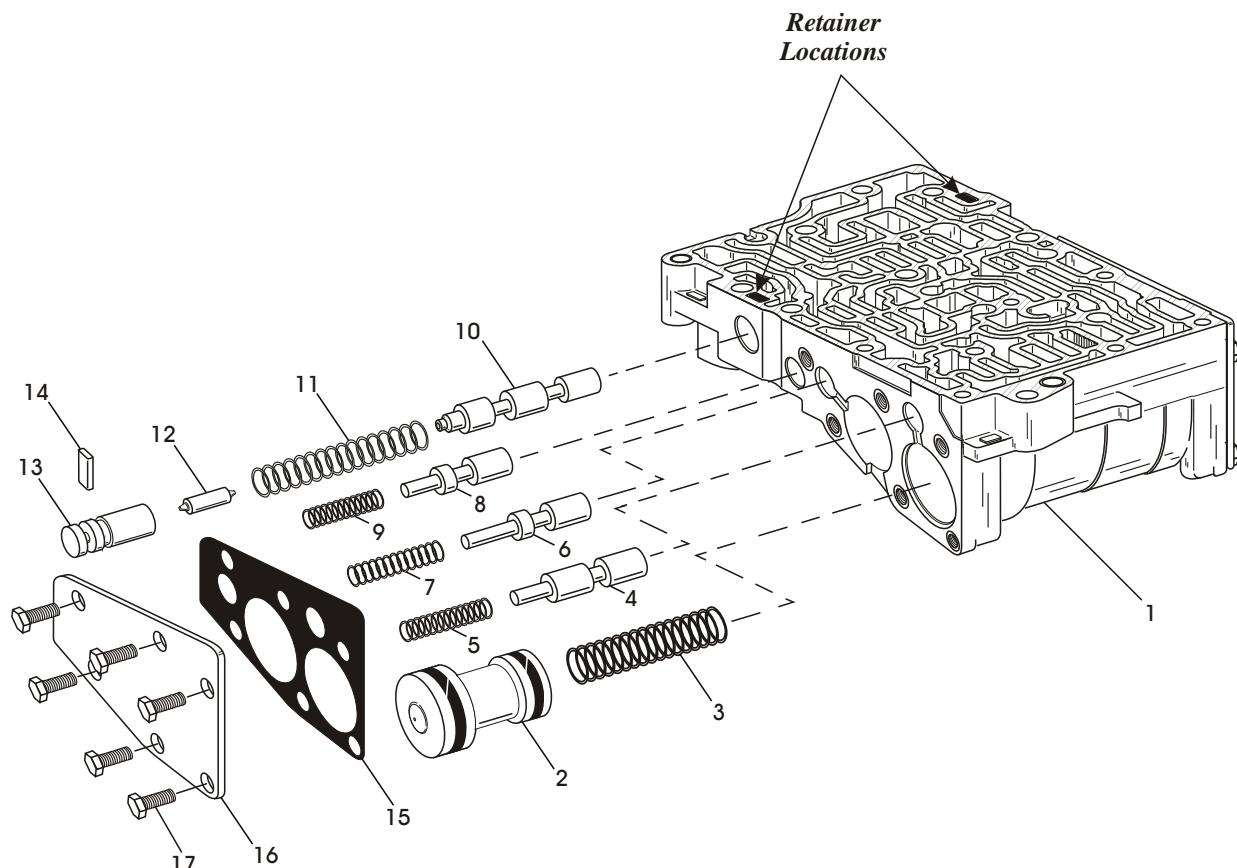
Figure 3

CENTER VALVE BODY "REAR" SIDE  
VALVE IDENTIFICATION AND LOCATIONS

1. CENTER VALVE BODY CASTING
2. CLUTCH MODULATOR VALVE
3. CLUTCH MODULATOR VALVE SPRING
4. CLUTCH MODULATOR VALVE BORE PLUG
5. CLUTCH MODULATOR VALVE RETAINER
6. TCC SOLENOID REGULATOR VALVE
7. TCC SOLENOID REGULATOR VALVE SPRING
8. TCC SOLENOID REGULATOR VALVE BORE PLUG
9. TCC SOLENOID REGULATOR VALVE RETAINER

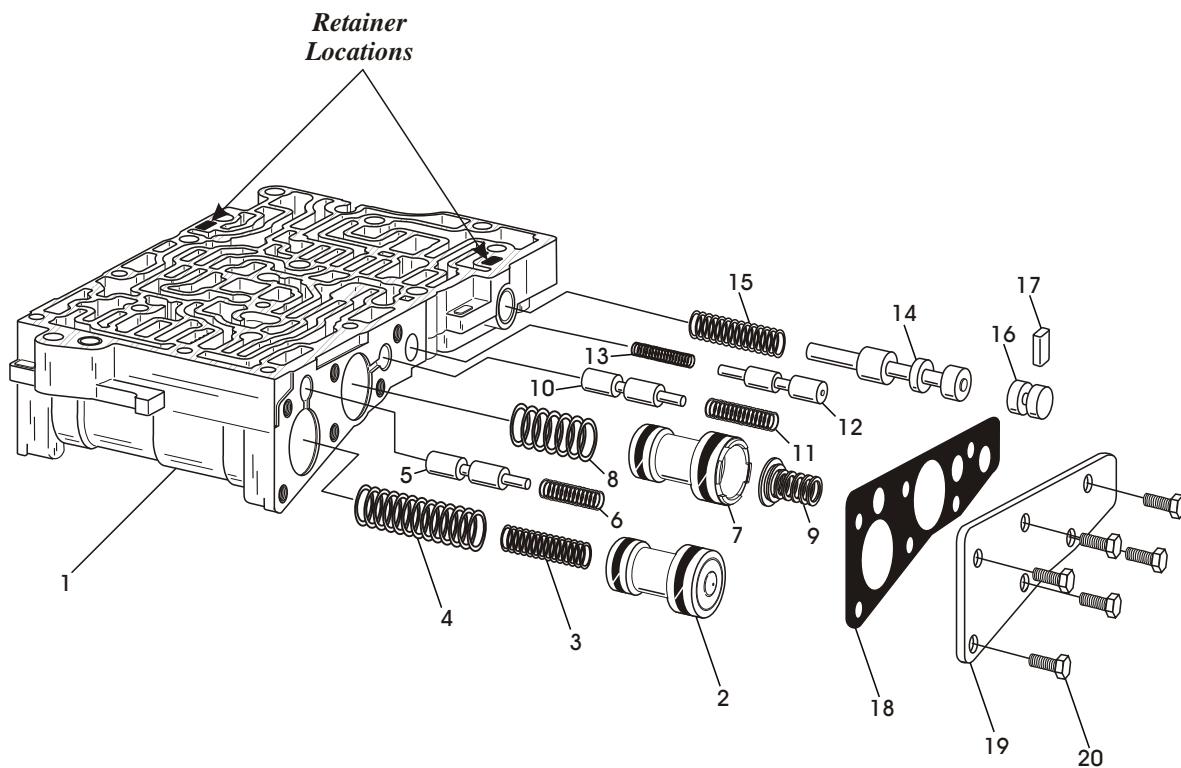
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Figure 4

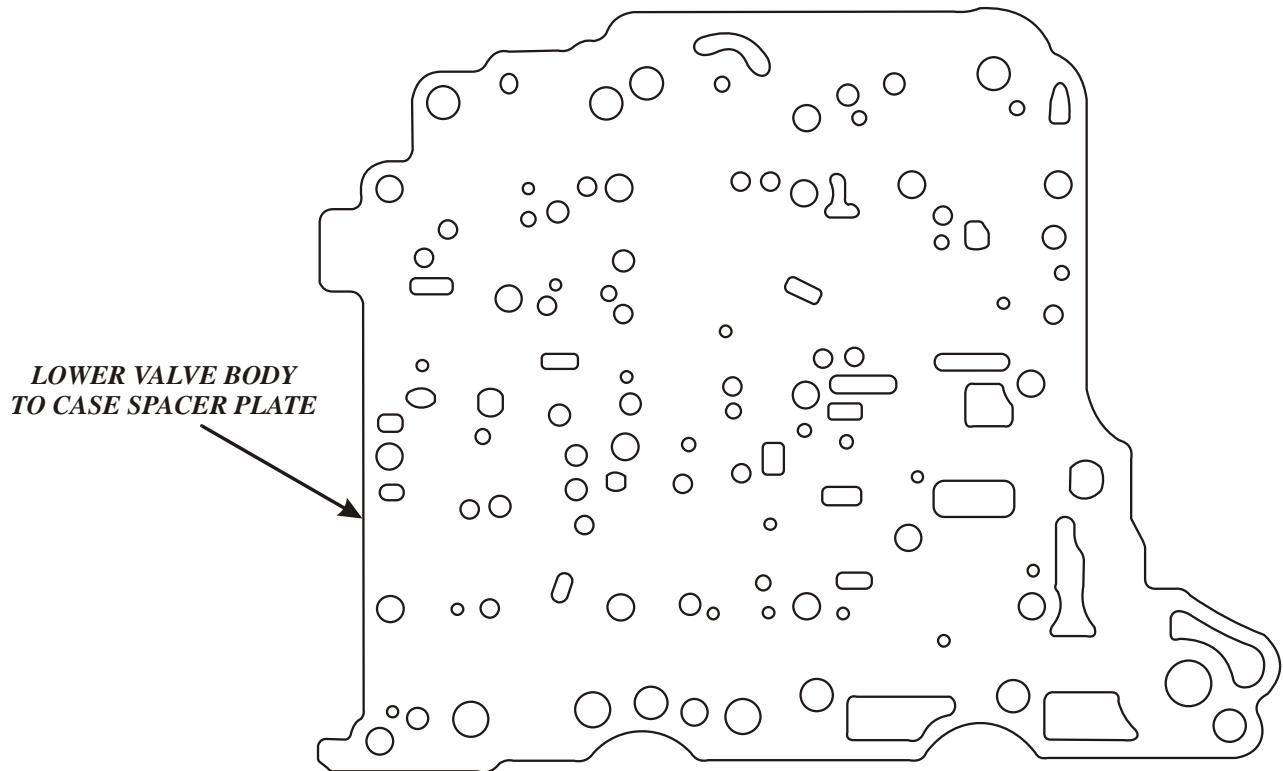
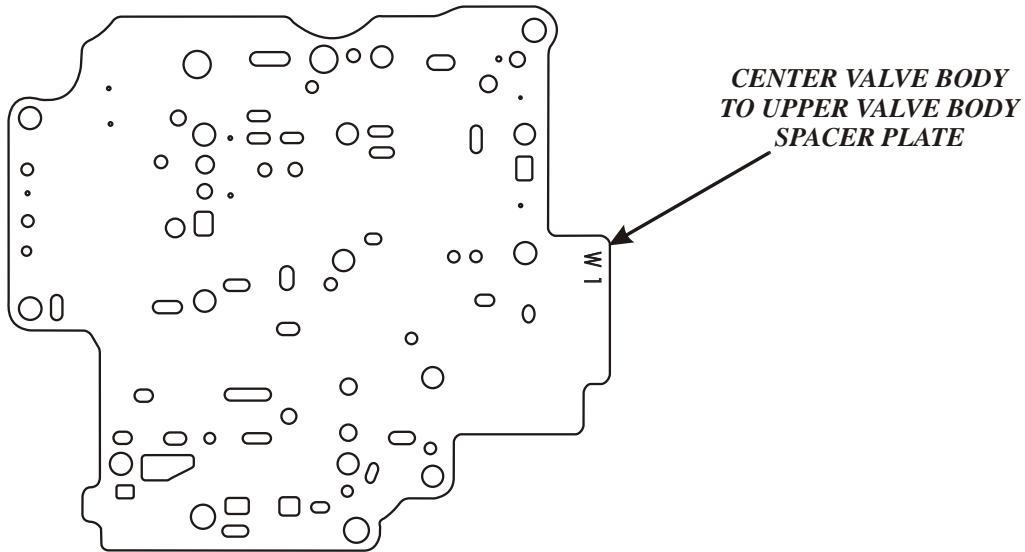
**LOWER VALVE BODY "FRONT" SIDE  
VALVE IDENTIFICATION AND LOCATIONS**

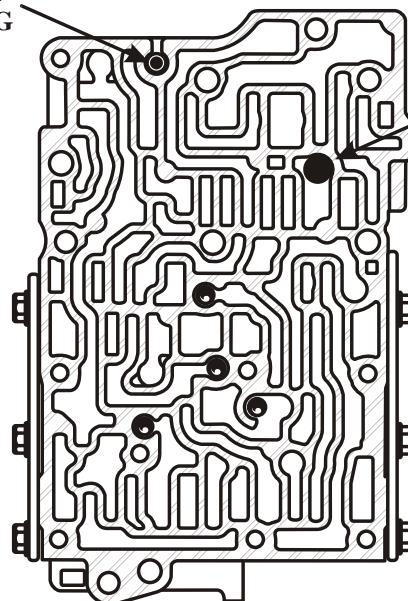
- |                                   |  |
|-----------------------------------|--|
| 1. LOWER VALVE BODY               | 9. LOW COAST MODULATOR VALVE SPRING (B3) |
| 2. C3 ACCUMULATOR PISTON          | 10. LOCK-UP CONTROL VALVE                |
| 3. C3 ACCUMULATOR PISTON SPRING   | 11. LOCK-UP CONTROL VALVE SPRING         |
| 4. C3 ACCUMULATOR VALVE           | 12. PLUNGER                              |
| 5. C3 ACCUMULATOR VALVE SPRING    | 13. PLUNGER SLEEVE                       |
| 6. B1 ACCUMULATOR VALVE           | 14. LOCK-UP CONTROL VALVE RETAINER       |
| 7. B1 ACCUMULATOR VALVE SPRING    | 15. COVER PLATE GASKET                   |
| 8. LOW COAST MODULATOR VALVE (B3) | 16. COVER PLATE                          |
|                                   | 17. COVER PLATE BOLTS (6)                |

Figure 5

**LOWER VALVE BODY "REAR" SIDE  
VALVE IDENTIFICATION AND LOCATIONS**


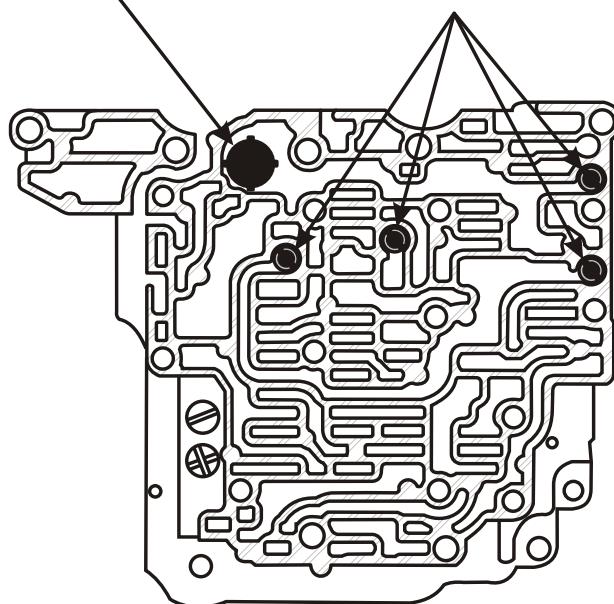
- |                                     |   |
|-------------------------------------|---|
| 1. LOWER VALVE BODY                 | 11. B2 ACCUMULATOR SPRING               |
| 2. C2 ACCUMULATOR PISTON            | 12. ACCUMULATOR CONTROL VALVE           |
| 3. C2 ACCUMULATOR SPRING (INNER)    | 13. ACCUMULATOR CONTROL VALVE SPRING    |
| 4. C2 ACCUMULATOR SPRING (OUTER)    | 14. SECONDARY REGULATOR VALVE           |
| 5. C2 ACCUMULATOR VALVE             | 15. SECONDARY REGULATOR VALVE SPRING    |
| 6. C2 ACCUMULATOR VALVE SPRING      | 16. SECONDARY REGULATOR VALVE BORE PLUG |
| 7. B2 ACCUMULATOR PISTON            | 17. SECONDARY REGULATOR VALVE RETAINER  |
| 8. B2 ACCUMULATOR SPRING (INBOARD)  | 18. COVER PLATE GASKET                  |
| 9. B2 ACCUMULATOR SPRING (OUTBOARD) | 19. COVER PLATE                         |
| 10. B2 ACCUMULATOR VALVE            | 20. COVER PLATE BOLTS (6)               |

**"TYPICAL" SPACER PLATES**

**"LOWER" VALVE BODY****PRESSURE RELIEF  
VALVE AND SPRING****CHECK VALVE  
AND SPRING****REQUIRES FOUR  
RUBBER CHECKBALLS  
5.0mm (.197") IN DIAMETER**

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Figure 8

**VOLVO/Saab AW50-42LE  
"CENTER" VALVE BODY, "UPPER" VALVE BODY SIDE****LARGE  
FILTER  
SCREEN****4 SMALL  
FILTER  
SCREENS**

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Figure 9

Automatic Transmission Service Group

# Jaggi

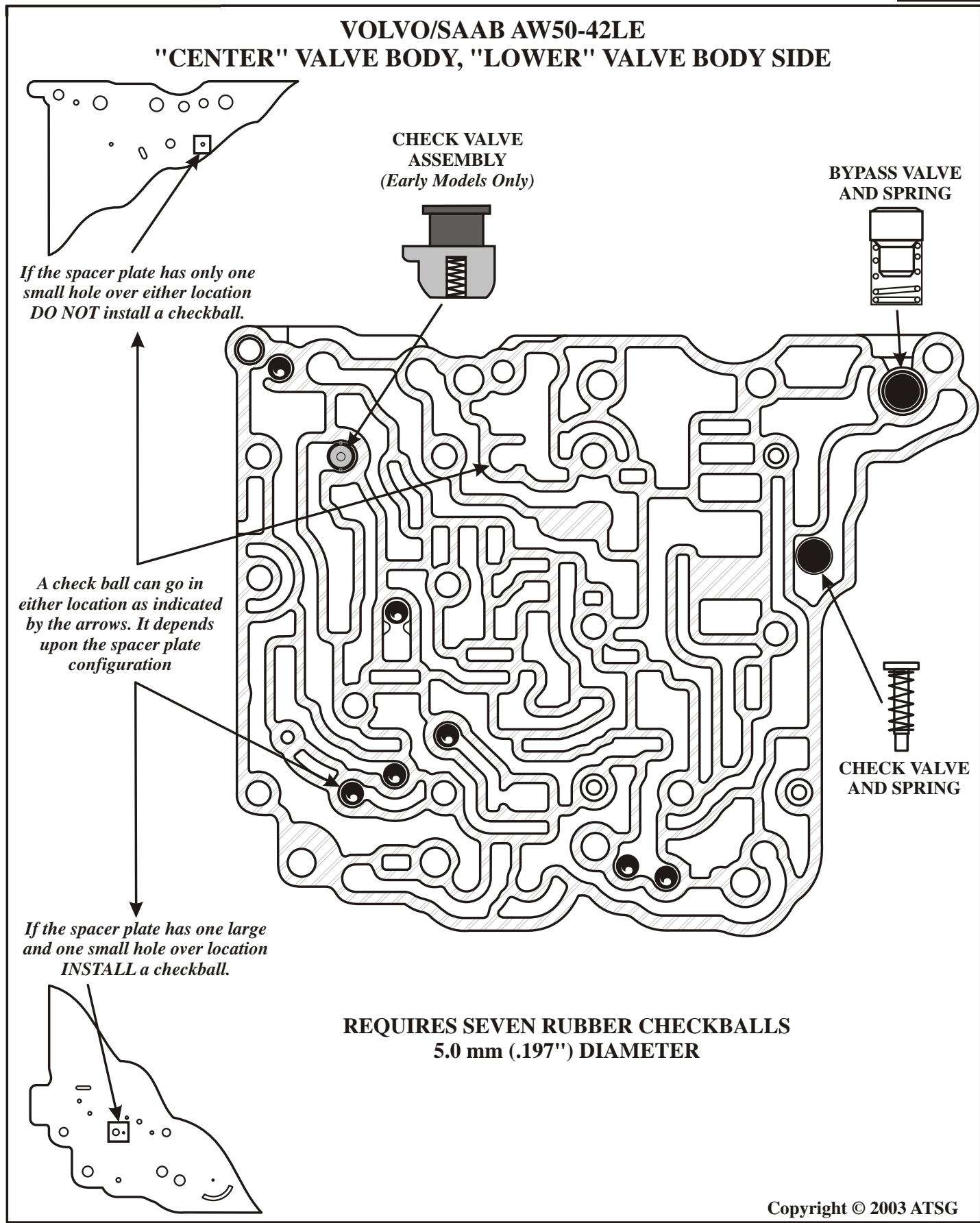


Figure 10

**COMPLAINT:** After overhaul, vehicles equipped with the 50-40 LE series transaxles, may exhibit a speedometer that is registering in the Park position and no Reverse when Reverse is selected from the Park position. Reverse will engage if Drive is selected before Reverse.

**CAUSE:** The cause may be, that during installation, the Vehicle Speed Sensor was placed into the Turbine sensor location on the case. This will create a Vehicle speed reading in the Park position because of the Turbine shaft rotating in the Park position. The Transmission Control Module will cancel Reverse application by turning on Solenoid 1 to block the application of the B3 Clutch, which is the Low Reverse Clutch. Once the selector is placed into Drive the turbine shaft will come to a stop and Reverse will apply from the Drive position.

**CORRECTION:** Refer to Figure 1 for the wire colors of the Turbine shaft speed sensor and the Vehicle Speed Sensor for their correct location on the case.

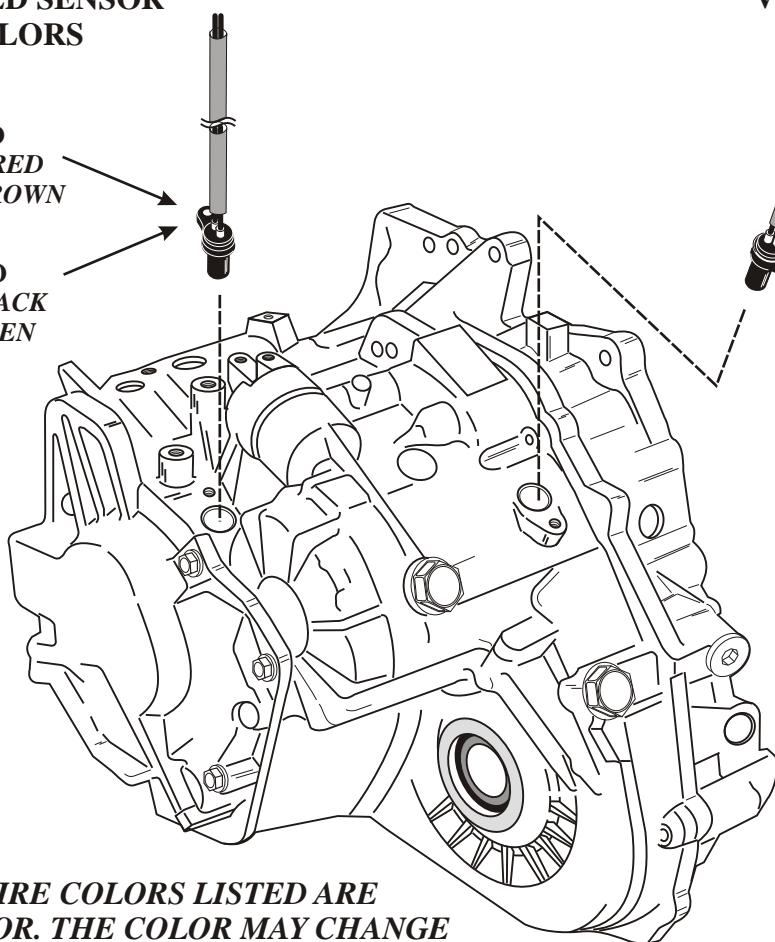
#### SPEED SENSOR LOCATIONS AND WIRE COLORS

##### TURBINE SPEED SENSOR WIRE COLORS

VOLVO  
YELLOW/RED  
YELLOW/BROWN  
  
DAEWOO  
YELLOW/BLACK  
LIGHT GREEN

##### VEHICLE SPEED SENSOR WIRE COLORS

VOLVO  
TAN  
GREY  
  
DAEWOO  
YELLOW  
GREY



**NOTE: THE WIRE COLORS LISTED ARE  
AT THE SENSOR. THE COLOR MAY CHANGE  
LEADING TO THE TRANSMISSION CONTROL MODULE**

Figure 1

Automatic Transmission Service Group

## **ZF 5HP-24**

### **SLIPPING OR NO FORWARD ENGAGEMENT**

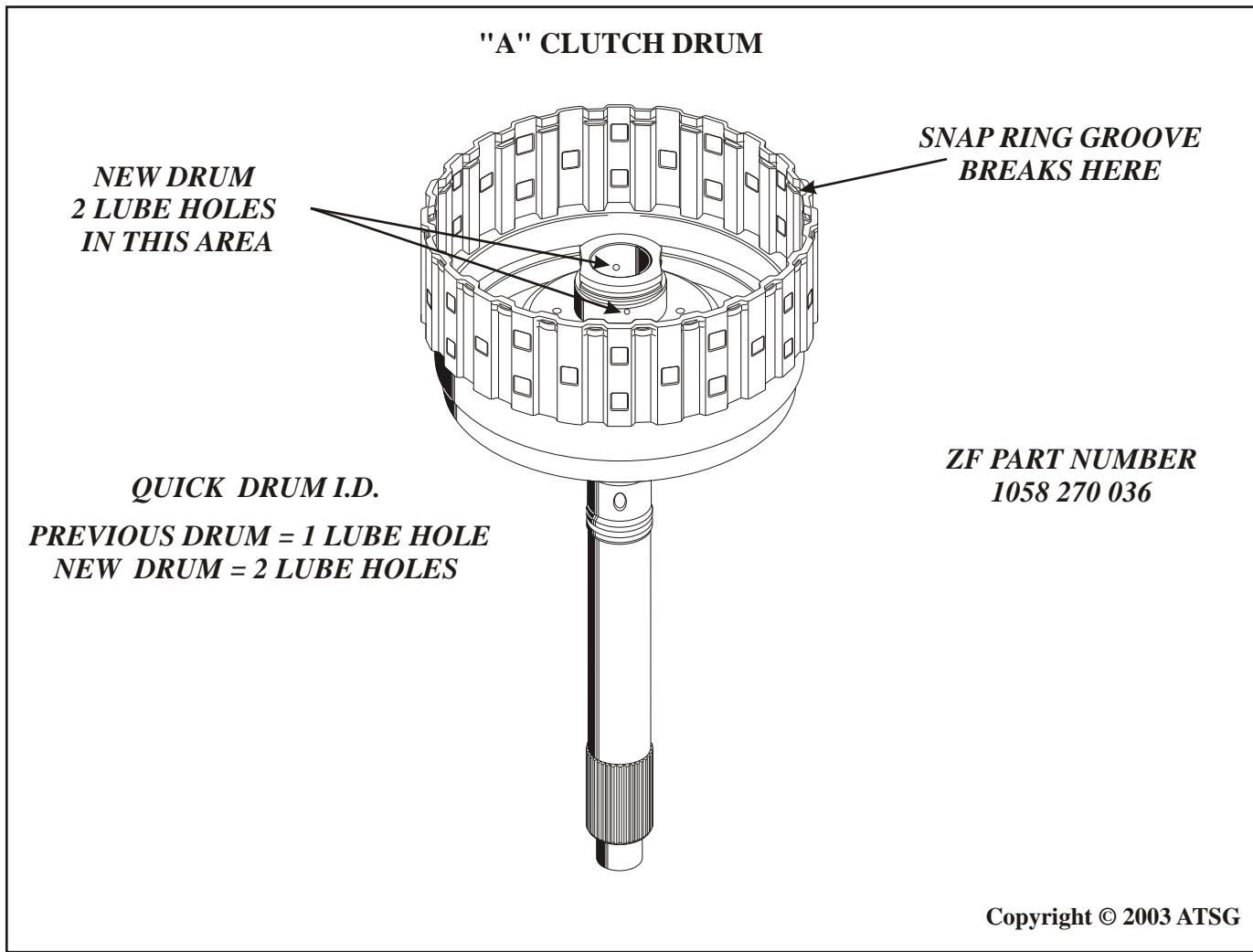
**COMPLAINT:** Vehicles equipped with the ZF 5HP-24 transmission may exhibit a Slipping or no Forward engagement.

**CAUSE:** The cause may be, a broken snap ring groove in the "A" Clutch Drum allowing the "A" Clutch to slip, as shown in Figure 1.

**CORRECTION:** Replace the "A" Clutch Drum with the updated drum available from ZF.

#### **SERVICE INFORMATION:**

A CLUTCH DRUM (ZF part number).....1058 270 036



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Figure 1  
Automatic Transmission Service Group

**ZF5HP24  
SLIPPING OR NO REVERSE**

**COMPLAINT:** Some 1999 to 2000 vehicles equipped with the 5HP24 transmission may exhibit a slipping or no engagement in Reverse.

**CAUSE:** The cause may be, a defective "F" clutch bonded piston. The "F" clutch is the Low and Reverse Clutch, which holds to provide Reverse application and Engine braking in Manual Low. The "F" clutch piston on some of these later versions have had problems with the bonding coming off of the piston.

**CORRECTION:** Replace the "F" clutch piston as shown in Figure 1.

**SERVICE INFORMATION:**

"F" CLUTCH BONDED PISTON (ZF part number).....0501-212-967

**"F" CLUTCH DRUM AND PISTON**

*Special thanks to  
Carl at Supreme*

**"F" CLUTCH PISTON**  
*ZF part number 0501-212-967*

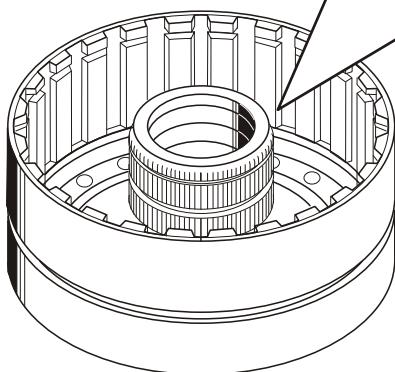
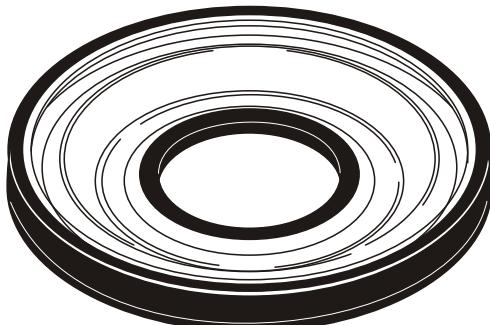


Figure 1

## **ZF 4HP-18 FLE/FLA NEUTRAL AFTER A 3-4 UPSHIFT**

**COMPLAINT:** Vehicles equipped with the ZF 4HP-18 FLE or FLA may exhibit a neutralizing condition on the 3-4 upshift, then a neutral condition when the vehicle comes to a stop. After an ignition cycle the vehicle will then move forward, but will go through the whole cycle once the 3-4 shift is attempted again.

**CAUSE:** The cause may be split conical cushion washers in the 2-4 servo assembly as shown in Figure 1. This will create a neutral condition when the band is re-applied in 4th gear, because of the broken cushion washers limiting the travel of the servo. **NOTE: The 2-4 servo is also applied in 2nd gear but only provides engine braking because of the application of the "C" clutch in 2nd gear. See Figure 2 for the Clutch and Band application chart.** The Transmission Control Module will put the transmission in a "Fail Safe Mode" when it neutrals out in 4th. In this situation, this is a 4th gear command (all solenoids OFF), which is now Neutral. The driver of the vehicle will have to cycle the ignition switch to regain forward application.

**NOTE:** There are two different Fail Safe Modes that the TCM provides. The first Fail Safe Mode is related to soft codes or ratio errors that may occur. This is a 4th gear command (all solenoids OFF) which will result in a stalling condition when coming to a stop, (if 4th gear is available). The second Fail Safe Mode provides 2nd gear only (all solenoids OFF) if a solenoid circuit code is set before the vehicle is started. The Safety Mode Valve in the Main Valve body controls the routing of fluid for these two different fail safe modes. It is controlled by the MV-2 solenoid. This solenoid is turned ON in Park to move the Safety Mode Valve to the left as shown in Figure 3. When the Second Fail Safe mode is initiated, MV-2 is **not** energized which does not stroke the Safety Mode valve. This blocks the passages feeding the E clutch for 3rd and 4th gear, providing 2nd gear only.

**CORRECTION:** Replace the conical washers, as shown in Figure 1. The entire 2-4 servo assembly can be purchased through an authorized ZF parts distributor, as the conical washers are not sold separately. If good used conical washers are found, ensure that the washers are assembled in a "clam shell" configuration, as shown in Figure 1.

### **SERVICE INFORMATION:**

2-4 SERVO ASSEMBLY ..... 1050 201 227

**NOTE: This is a ZF part number and is available only through an authorized ZF distributor.**

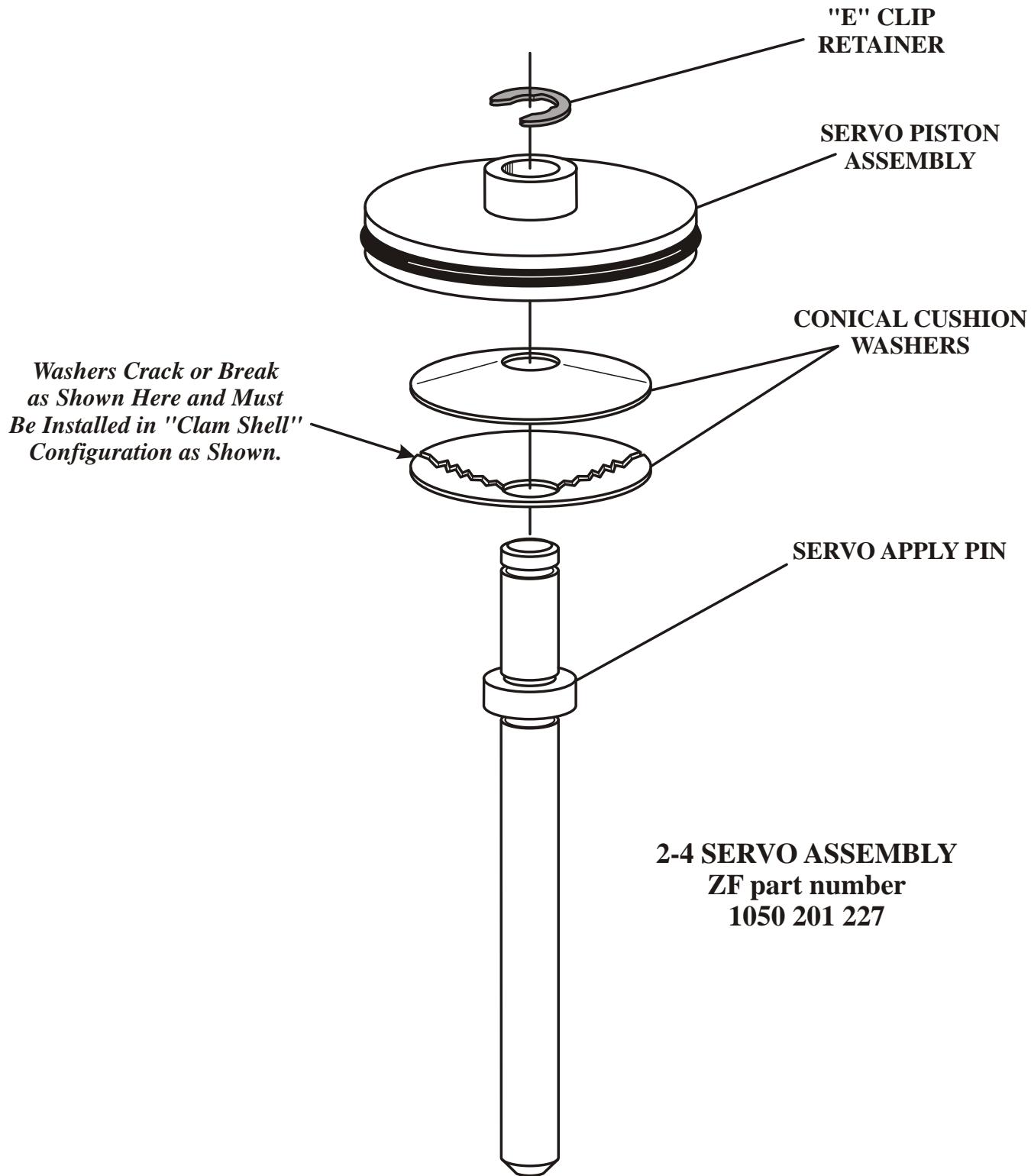
**2-4 SERVO ASSEMBLY**

Figure 1

Automatic Transmission Service Group



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.

#### SPECIAL NOTE:

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

Figure 2

### SAFETY MODE VALVE OPERATION

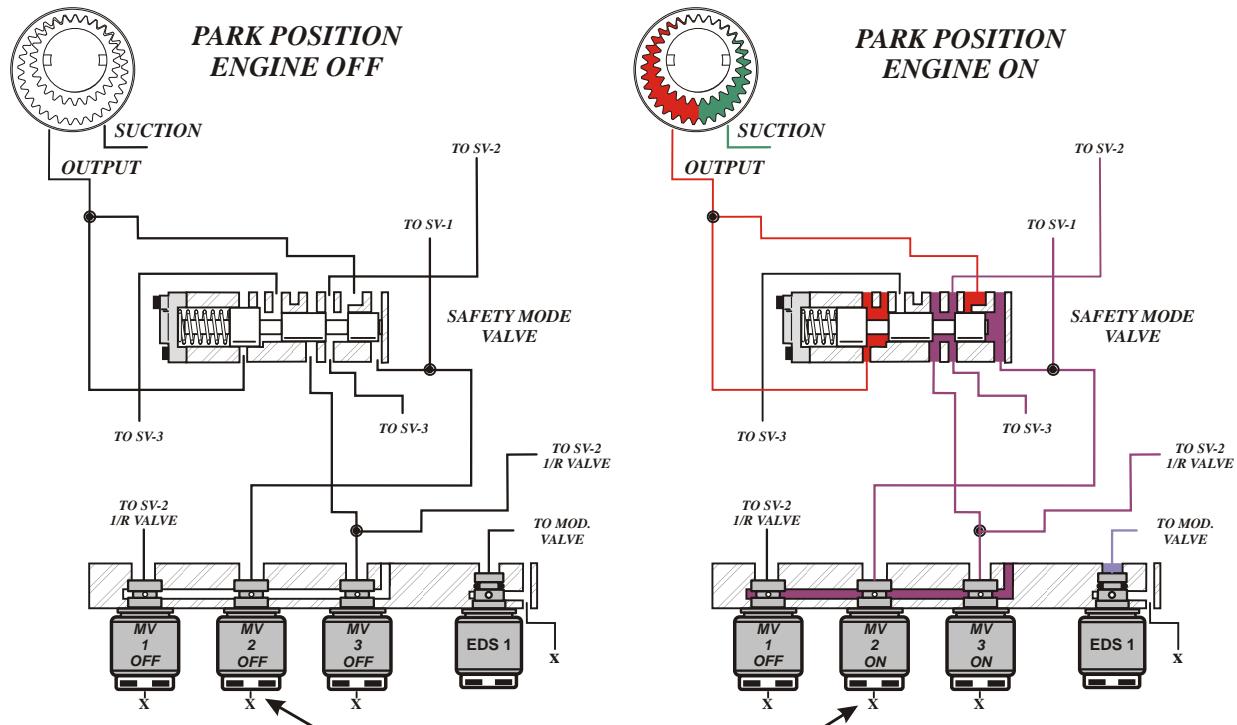
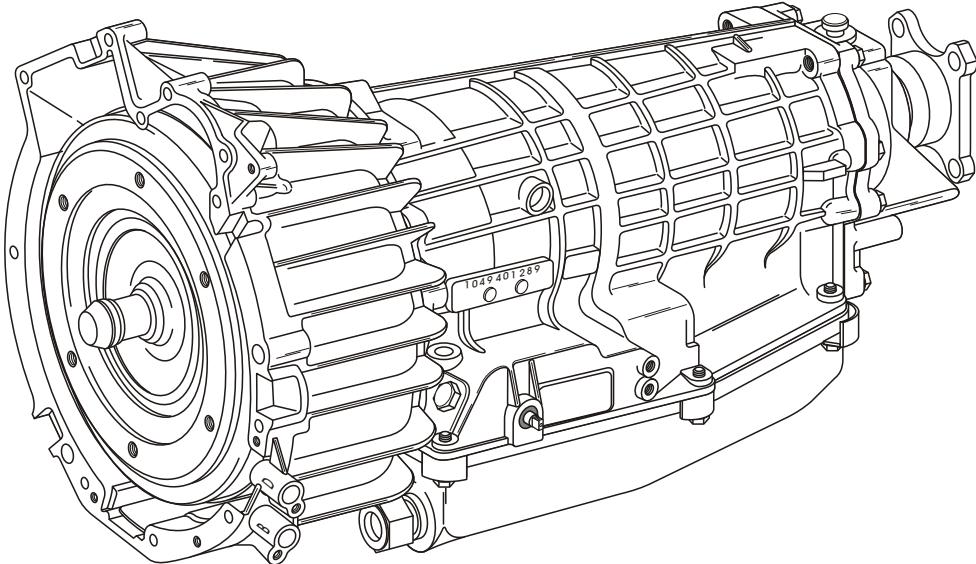


Figure 3

Automatic Transmission Service Group

**ZF 4HP-22/24 SERIES  
DIAGNOSTIC 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**

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

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Figure 1



### 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.

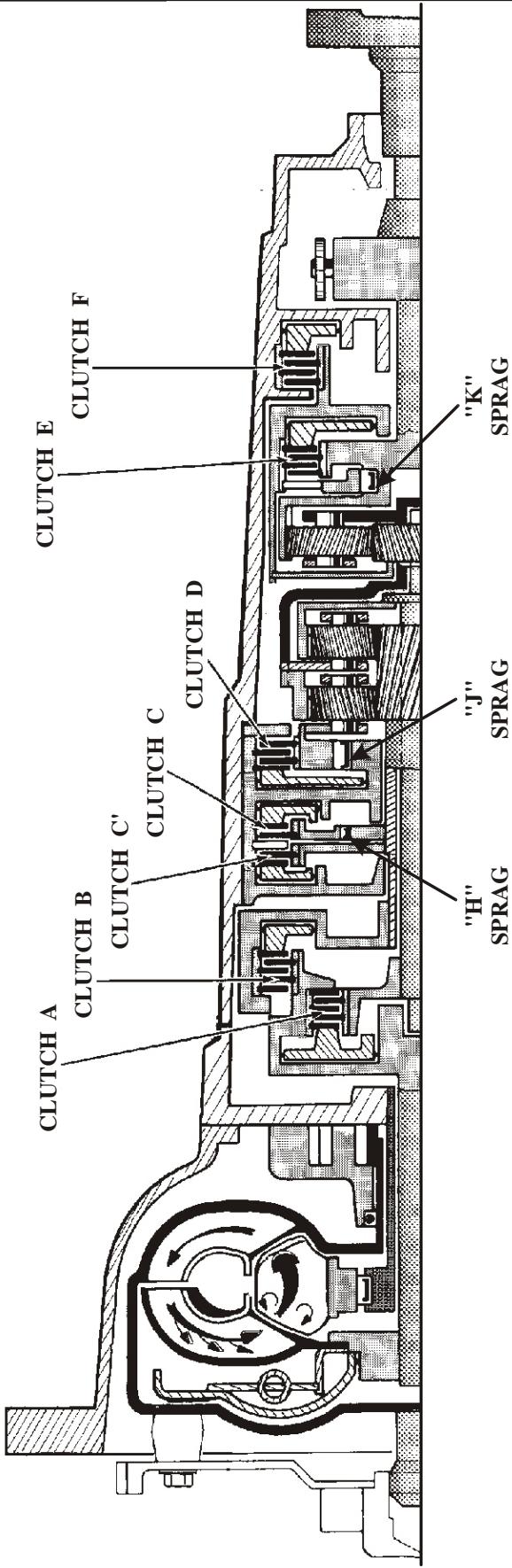
Refer to Figure 12 for Reverse Lockout Solenoid Body exploded view, with valve identification, and spring specifications, as observed in a used valve body.

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

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



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



RANGE	"A" Clutch	"B" 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		Hold	Hold
"D"-3rd	ON	ON	ON			ON		Hold	Hold
"D"-4th	ON	ON		ON			ON		
"3"									
"2"									
"1"									

"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 2



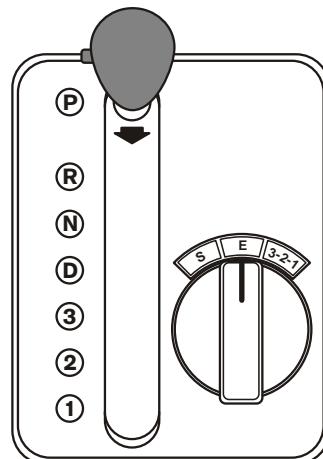
## SHIFT QUADRANTS FOR ZF 4HP-22/24 SERIES

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

*Mode Switch Description*

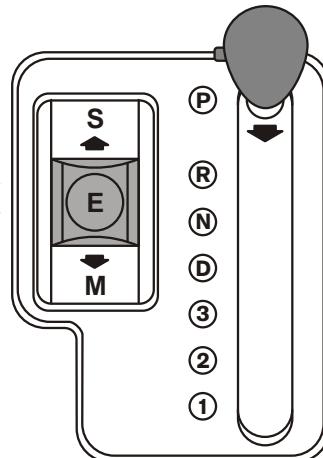
A *rotary* switch with three fixed positions and an indicator light in the instrument cluster for the 3-2-1 (M) mode when selected

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

*Mode Switch Description*

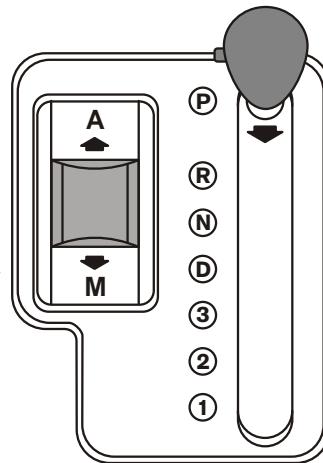
A *three* position slide switch with Digital display of the three individual positions in instrument cluster (E-S-M). The switch is a momentary contact and spring loaded to a neutral position.

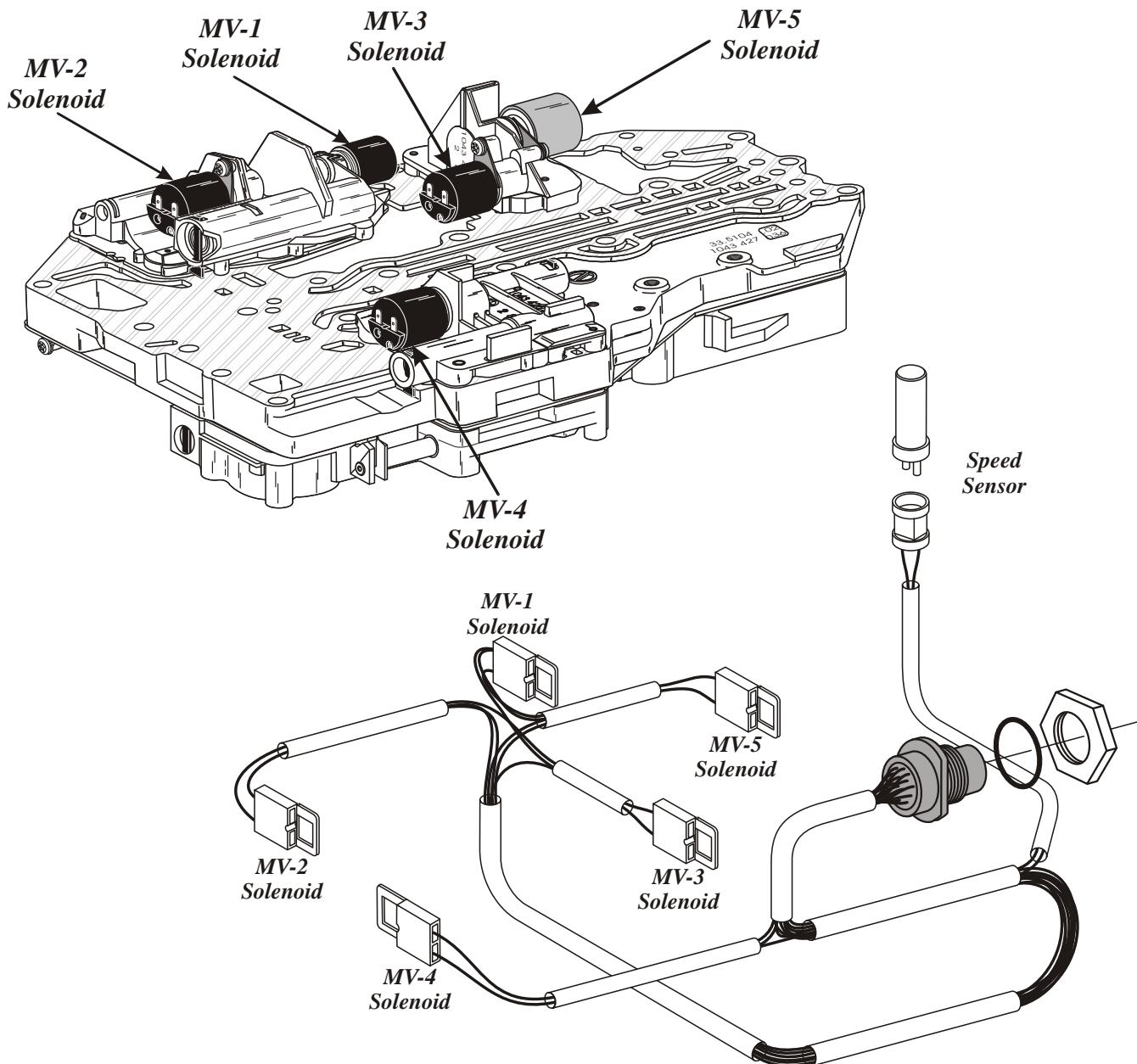
*"E-9" Models Only (4 Solenoid)*

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

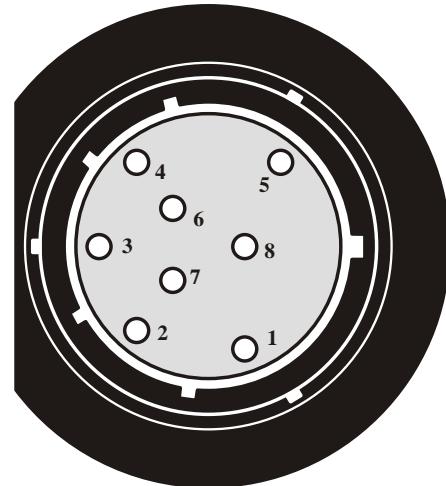
Solenoid	Function	Gear	MV-1	MV-2
MV-1	Shift Control	1st	ON	ON
MV-2	Shift Control	2nd	OFF	ON
		3rd	OFF	OFF
		4th	ON	OFF
MV-3	Lock-Up Control			
MV-4	Reverse Lockout			
MV-5	Line Pressure Control			

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Figure 4

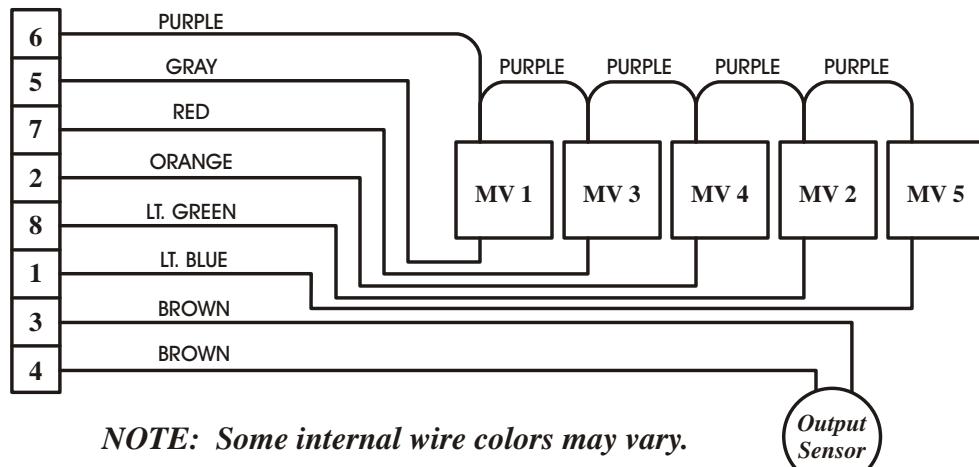
ZF-4HP-22/24 MODEL "E-7", "5 SOLENOID" INTERNAL WIRE SCHEMATIC  
AND CONNECTOR TERMINAL IDENTIFICATION

*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



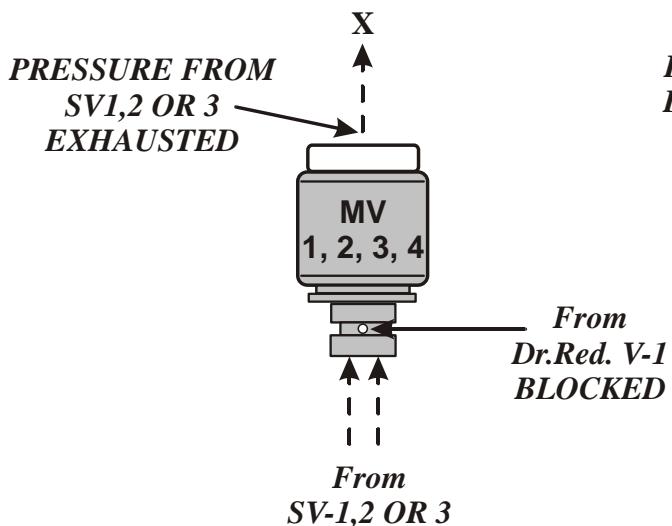
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Figure 5

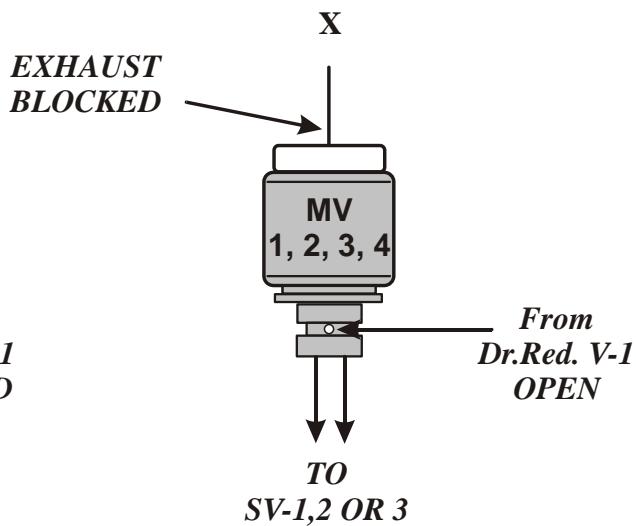


**ZF-4HP-22 MODEL "E7", "5 SOLENOID" VALVE BODY, SOLENOID OPERATION  
MV1, 2, 3 AND 4 OPERATION**

**SOLENOID "OFF"**



**SOLENOID "ON"**



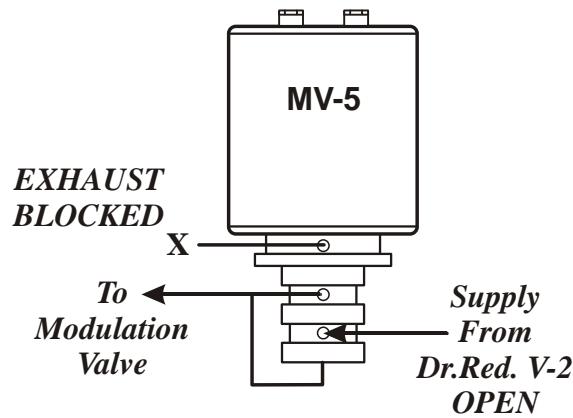
**SUMMARY:**

*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.*

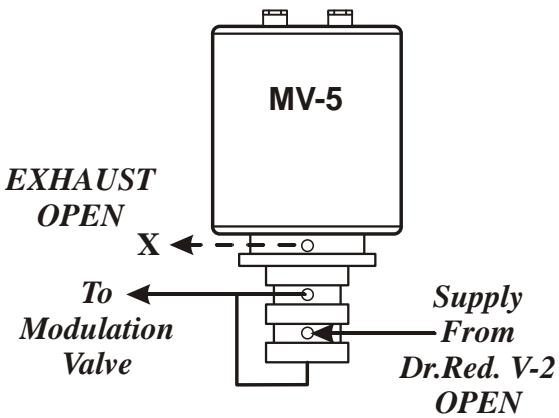
*When MV 1, 2, 3 or 4 is "ON" Solenoid reducing pressure, From Dr.Red. V-1, is open through the solenoid and is applied to SV1, 2 or 3. The exhaust at the rear of the solenoid is closed.*

**MV-5 OPERATION  
(Line Pressure Solenoid)**

**SOLENOID "OFF"**



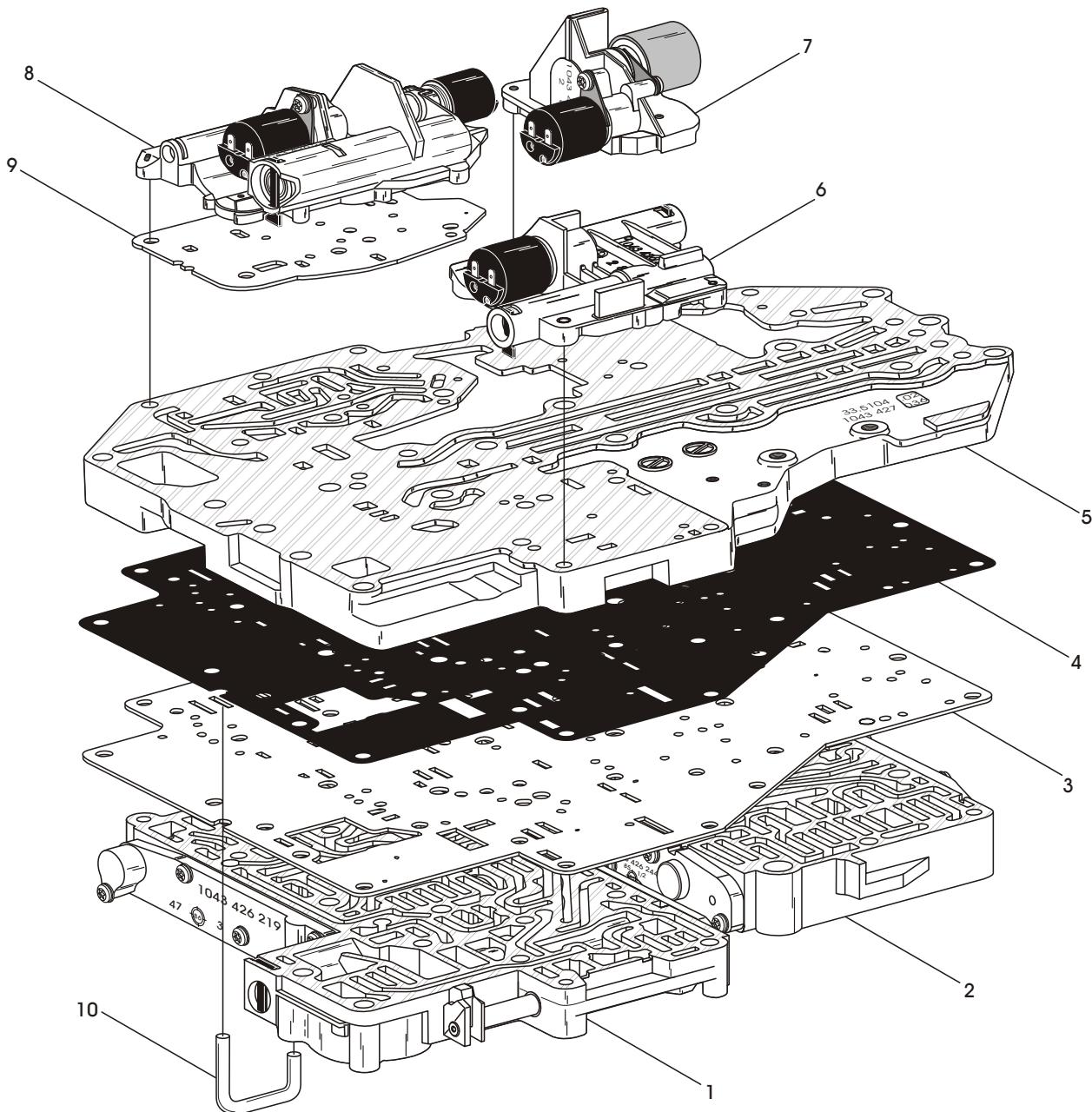
**SOLENOID "ON"**



*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.*

Figure 6

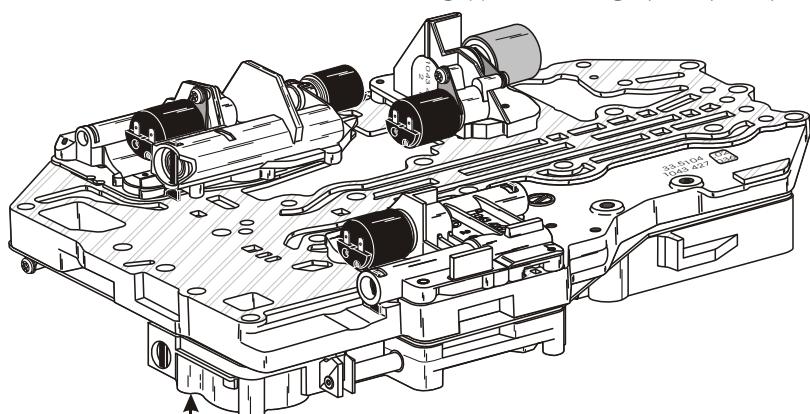
**ZF-4HP-22/24 MODEL "E-7", "5 SOLENOID"  
VALVE BODY ASSEMBLY**

- 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

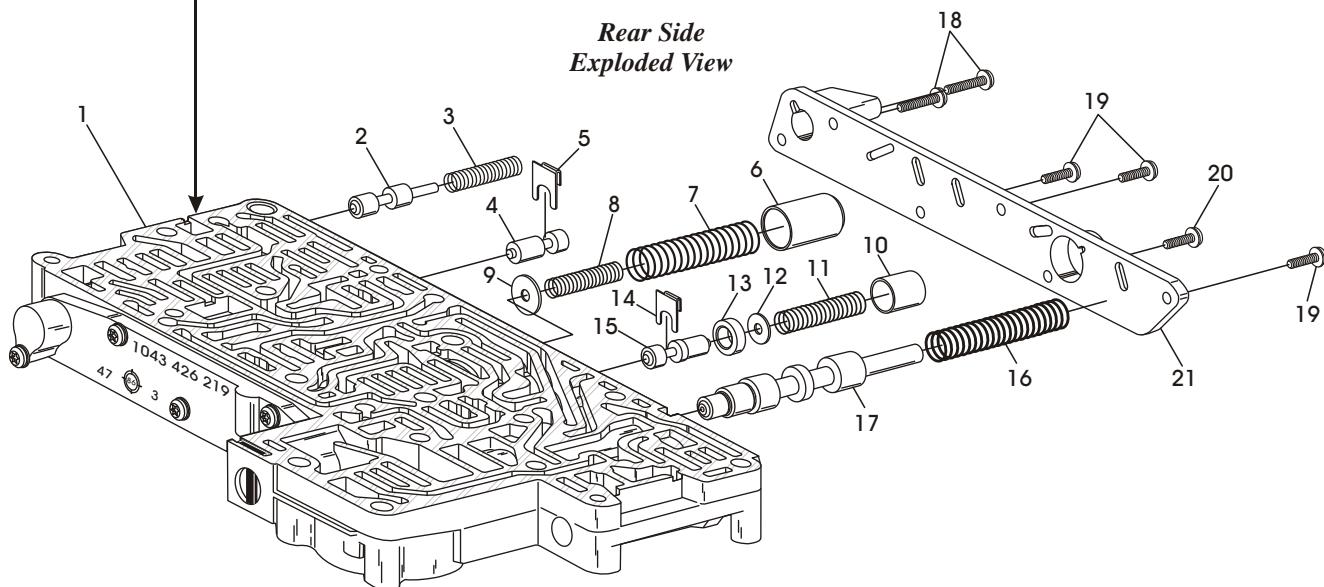
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Figure 7

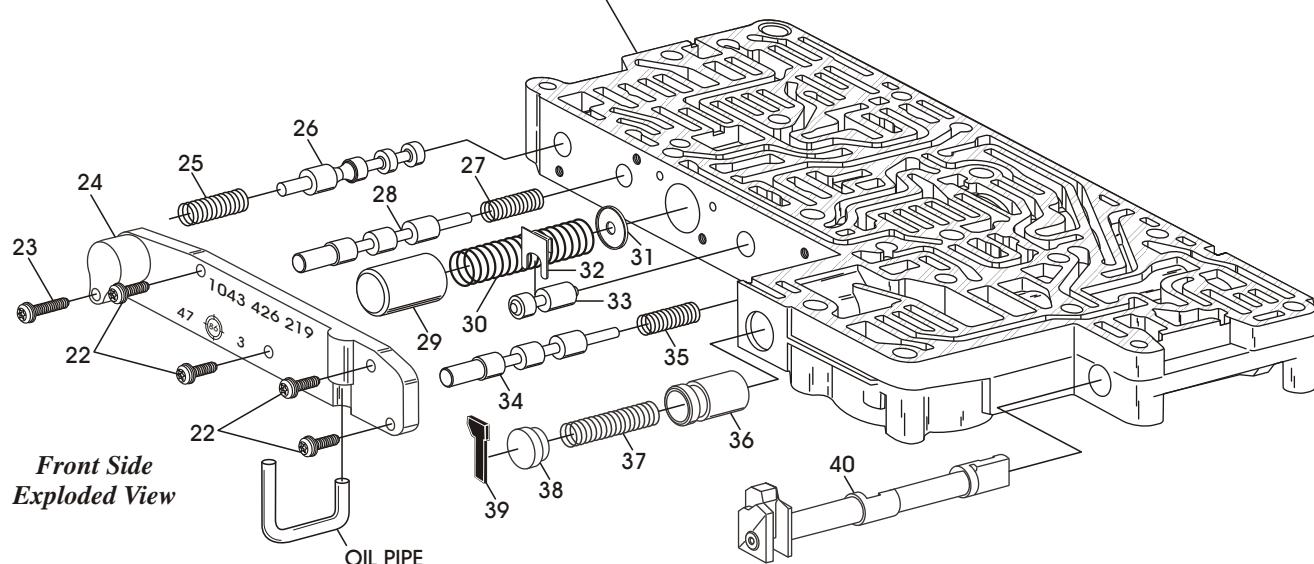
**ZF-4HP-22/24 MODEL "E-7", "5 SOLENOID"  
LOWER "FRONT" VALVE BODY**

*Legend And Spring  
Specifications Found  
On Next Page.*

*Rear Side  
Exploded View*



1



*Front Side  
Exploded View*

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Figure 8

**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

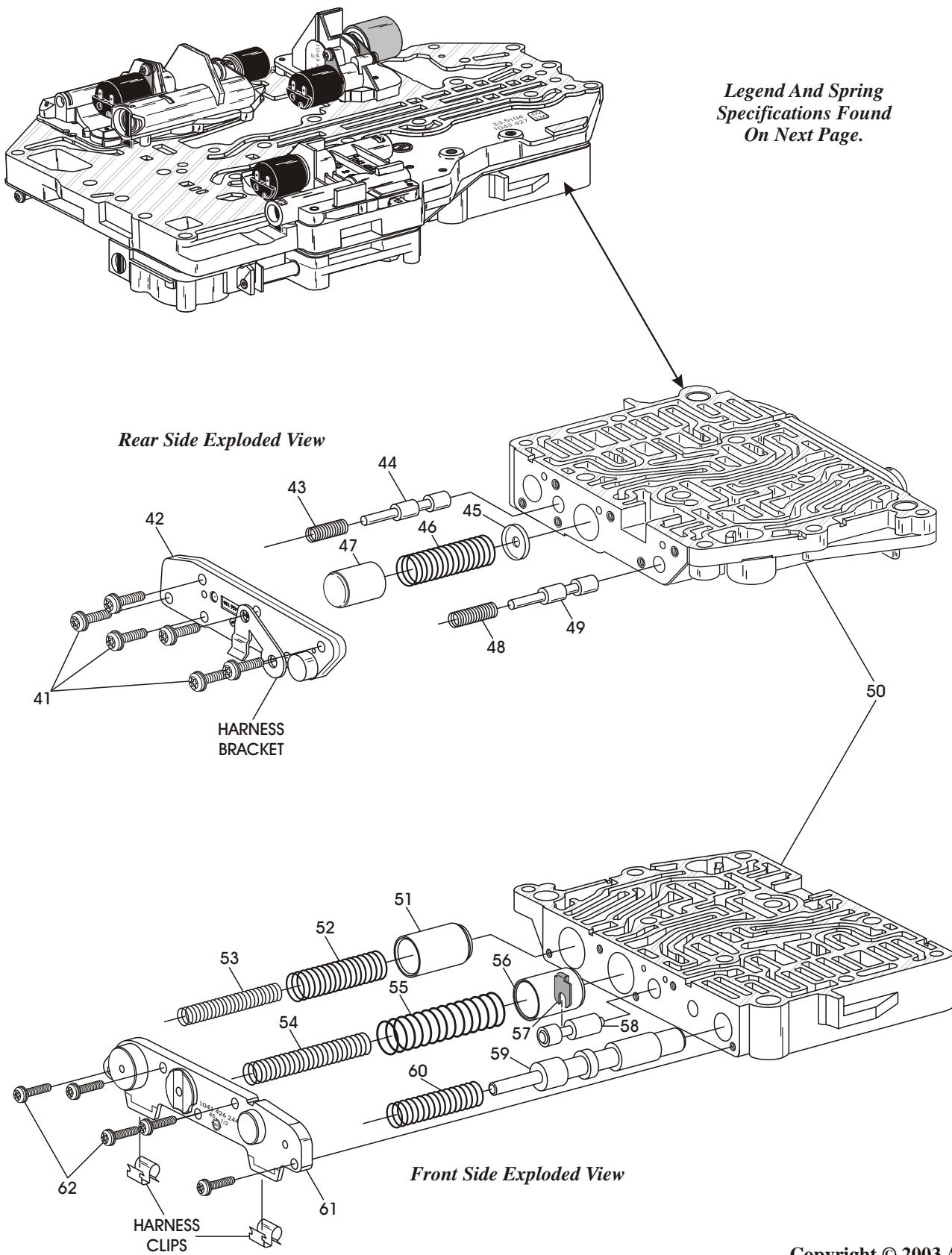
- 36 "A" CLUTCH DAMPER PISTON
- 37 "A" CLUTCH DAMPER SPRING
- 38 "A" CLUTCH DAMPER PISTON SPRING SEAT
- 39 "A" CLUTCH DAMPER SPRING SEAT RETAINER
- 40 MANUAL SHIFT VALVE

SPRING ILLUSTRATION NO. 3:	SPRING ILLUSTRATION NO. 25:
FREE LENGTH = 1.495"	FREE LENGTH = 1.830"
SPRING DIAMETER = .360"	SPRING DIAMETER = .435"
WIRE DIAMETER = .035"	WIRE DIAMETER = .040"
SPRING ILLUSTRATION NO. 7:	SPRING ILLUSTRATION NO. 27:
FREE LENGTH = 3.160"	FREE LENGTH = 1.660"
SPRING DIAMETER = .595"	SPRING DIAMETER = .360"
WIRE DIAMETER = .044"	WIRE DIAMETER = .036"
SPRING ILLUSTRATION NO. 8:	SPRING ILLUSTRATION NO. 30:
FREE LENGTH = 1.560"	FREE LENGTH = 3.160"
SPRING DIAMETER = .430"	SPRING DIAMETER = .595"
WIRE DIAMETER = .040"	WIRE DIAMETER = .044"
SPRING ILLUSTRATION NO. 11:	SPRING ILLUSTRATION NO. 35:
FREE LENGTH = 1.653"	FREE LENGTH = 1.660"
SPRING DIAMETER = .550"	SPRING DIAMETER = .360"
WIRE DIAMETER = .044"	WIRE DIAMETER = .036"
SPRING ILLUSTRATION NO. 16:	SPRING ILLUSTRATION NO. 37:
FREE LENGTH = 3.575"	FREE LENGTH = 2.515"
SPRING DIAMETER = .600"	SPRING DIAMETER = .410"
WIRE DIAMETER = .080"	WIRE DIAMETER = .050"

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Figure 8 Legend

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

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Figure 9

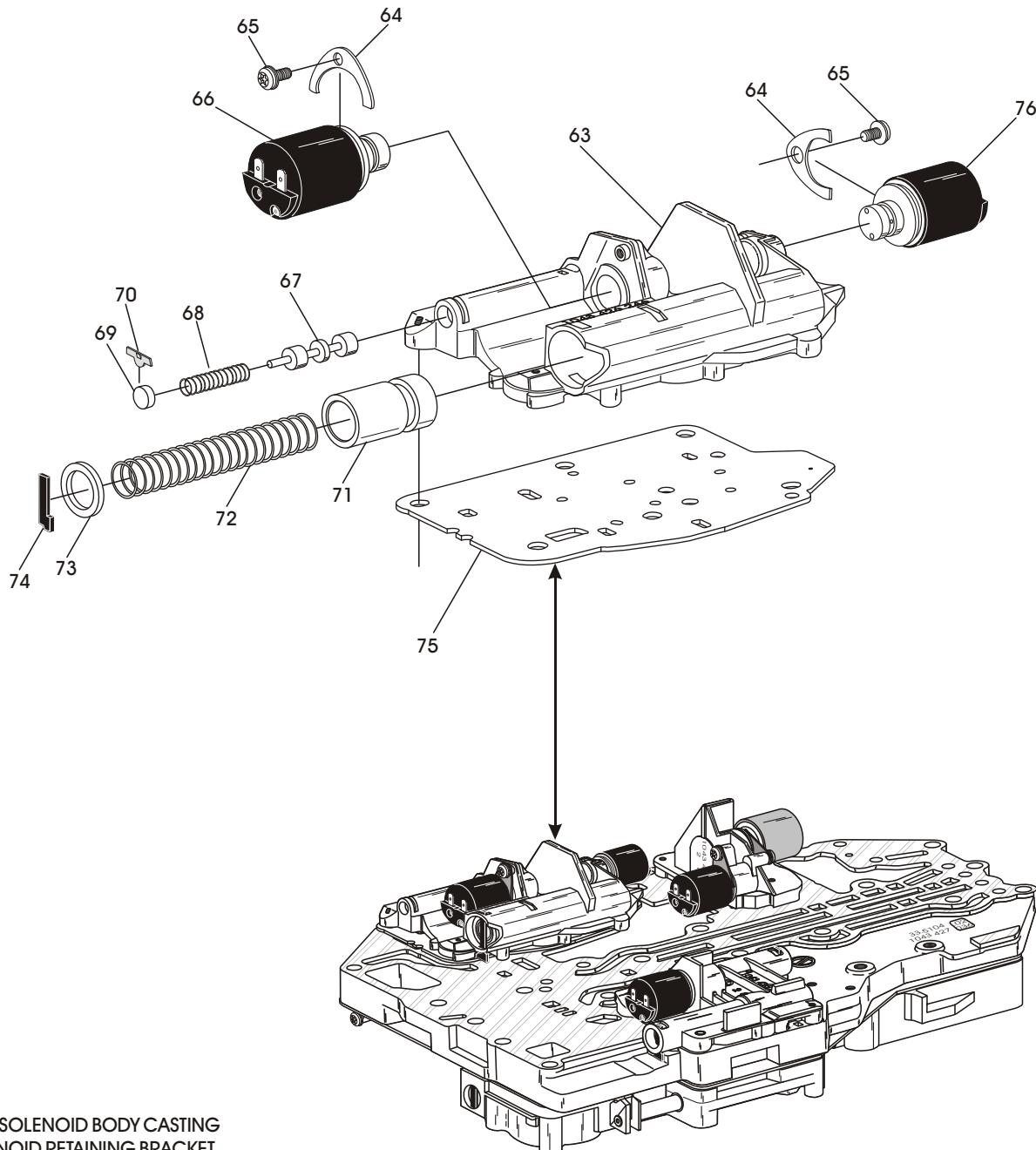
**FIGURE 9 LEGEND AND SPRING SPECIFICATIONS**

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

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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"

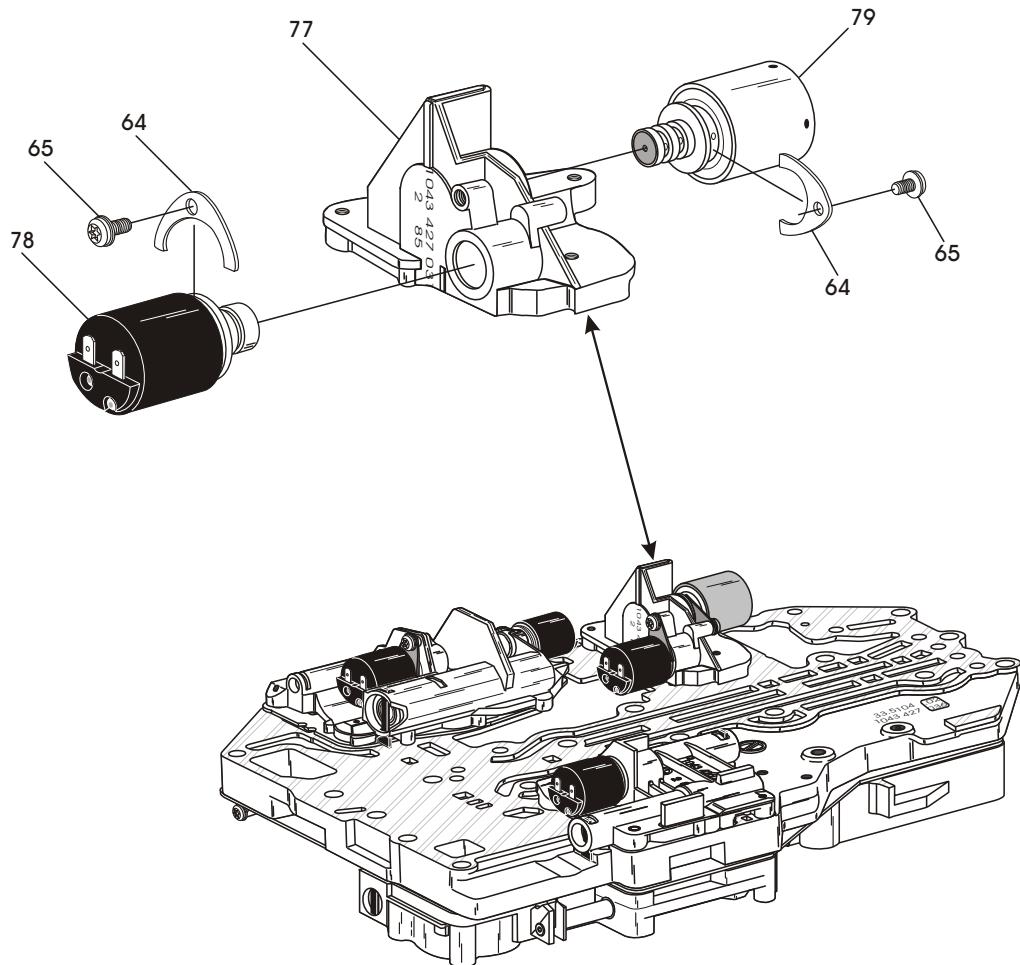
SPRING ILLUSTRATION NO. 72:  
FREE LENGTH = 3.622"  
SPRING DIAMETER = .422"  
WIRE DIAMETER = .044"

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Figure 10



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



64 SOLENOID RETAINING BRACKET

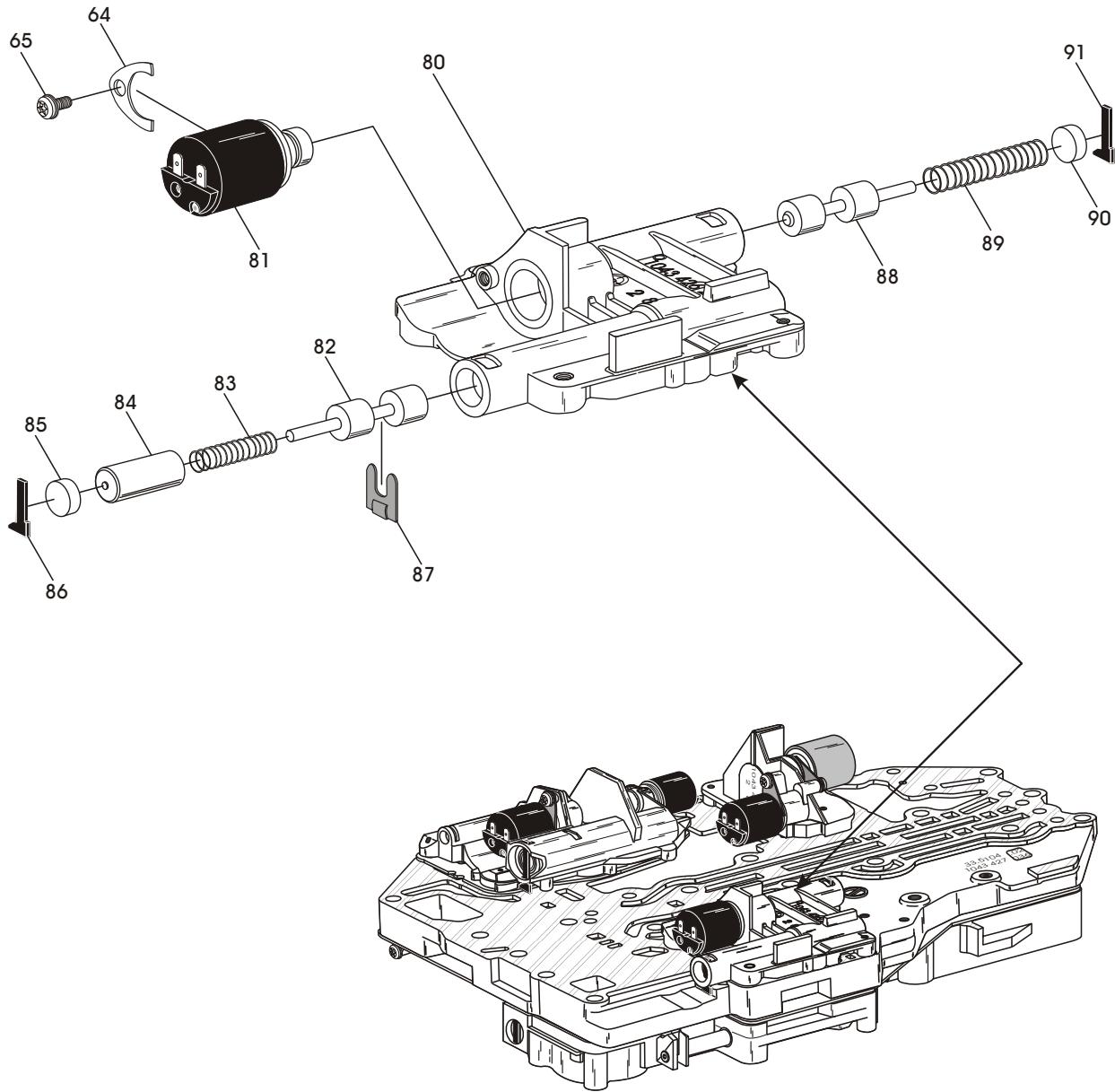
65 SOLENOID RETAINING BOLT, 11 mm LENGTH

77 PRESSURE CONTROL SOLENOID BODY CASTING

78 MV-3 LOCK-UP CONTROL SOLENOID ASSEMBLY

79 MV-5 PRESSURE CONTROL SOLENOID ASSEMBLY

Figure 11

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"

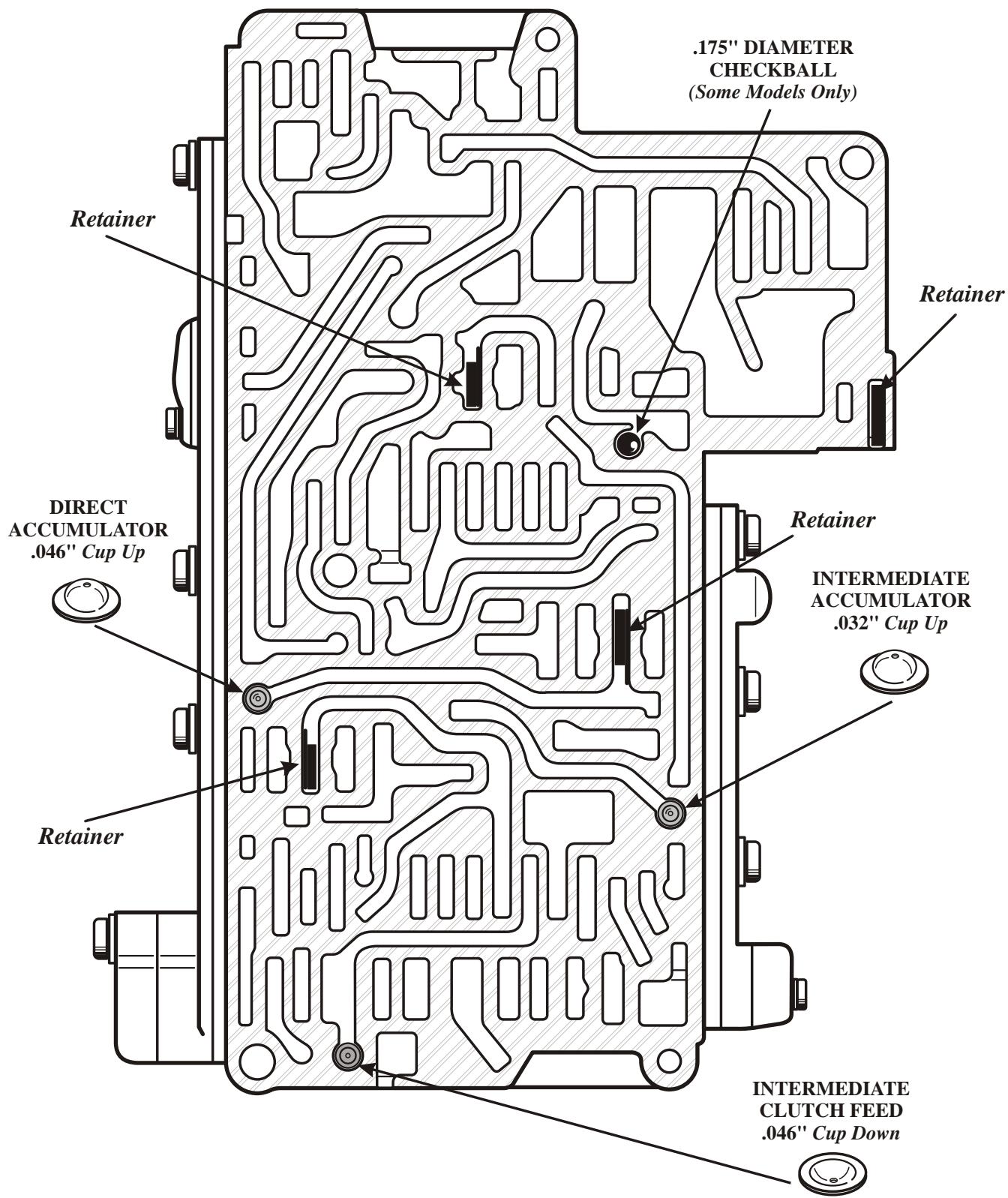
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Figure 12

ZF



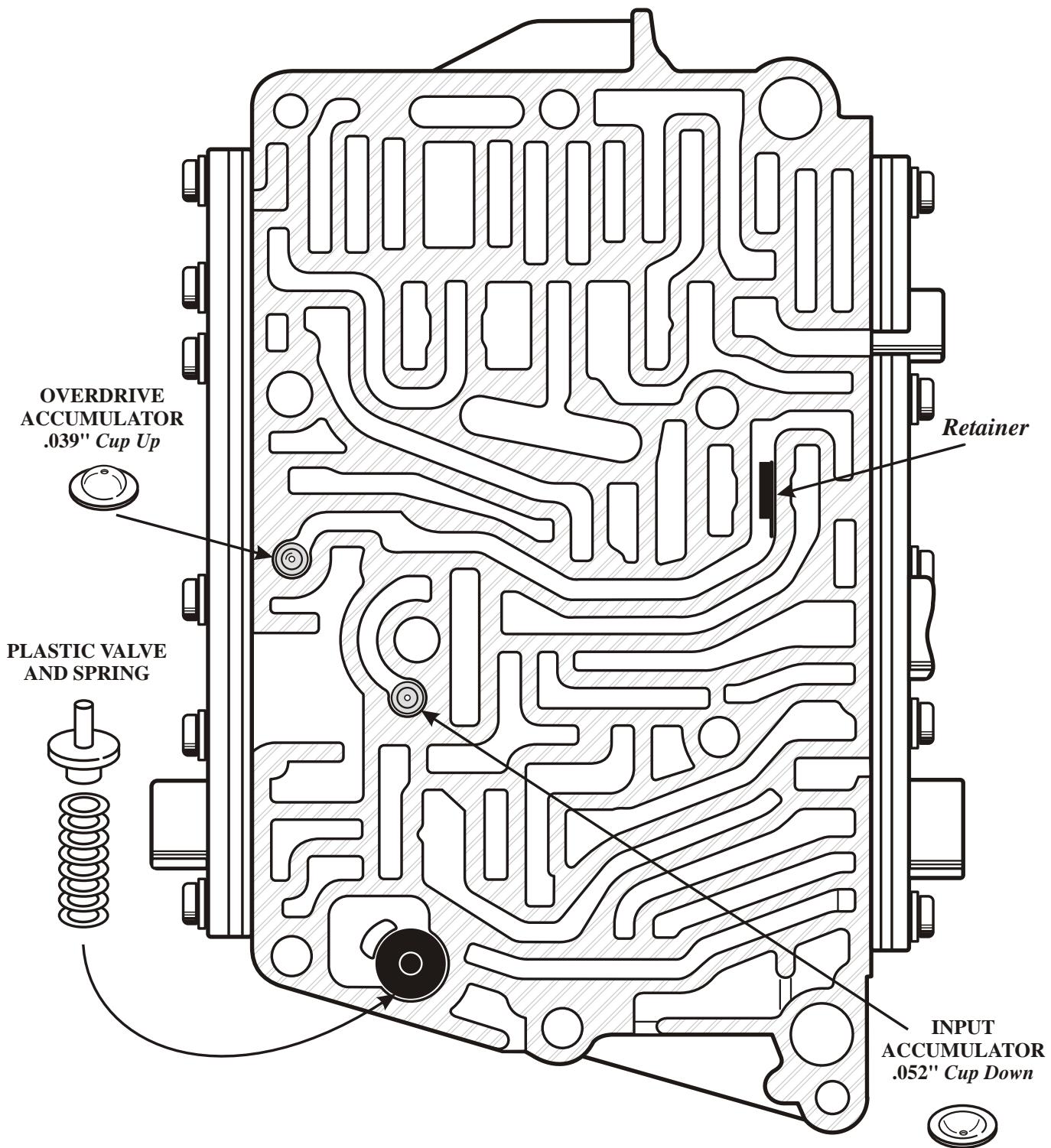
ZF-4HP-22/24 MODEL "E-7", "5 SOLENOID"  
LOWER "FRONT" VALVE BODY



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Figure 13

ATSG

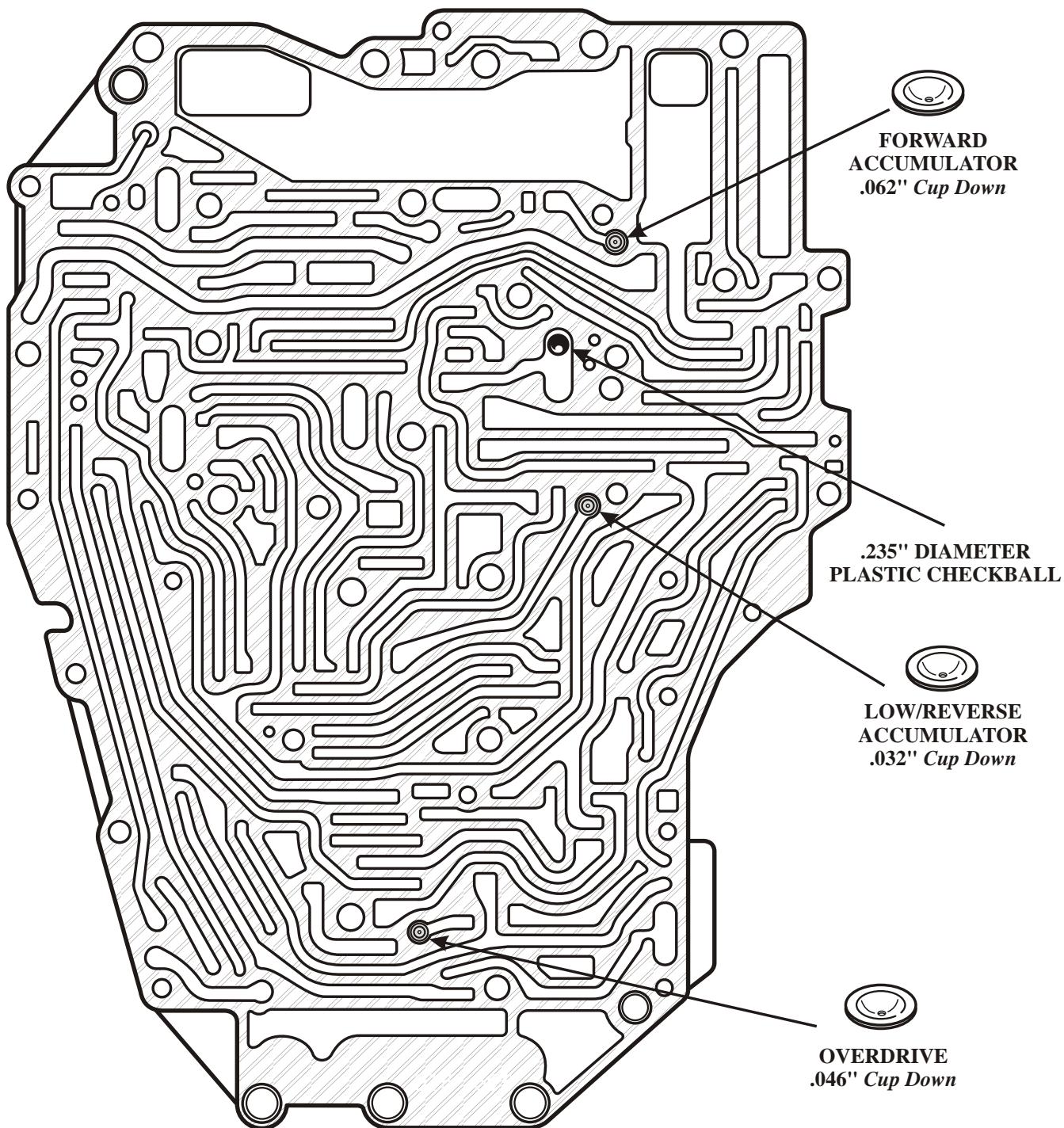
ZF-4HP-22/24 MODEL "E-7", "5 SOLENOID"  
LOWER "REAR" VALVE BODY

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Figure 14

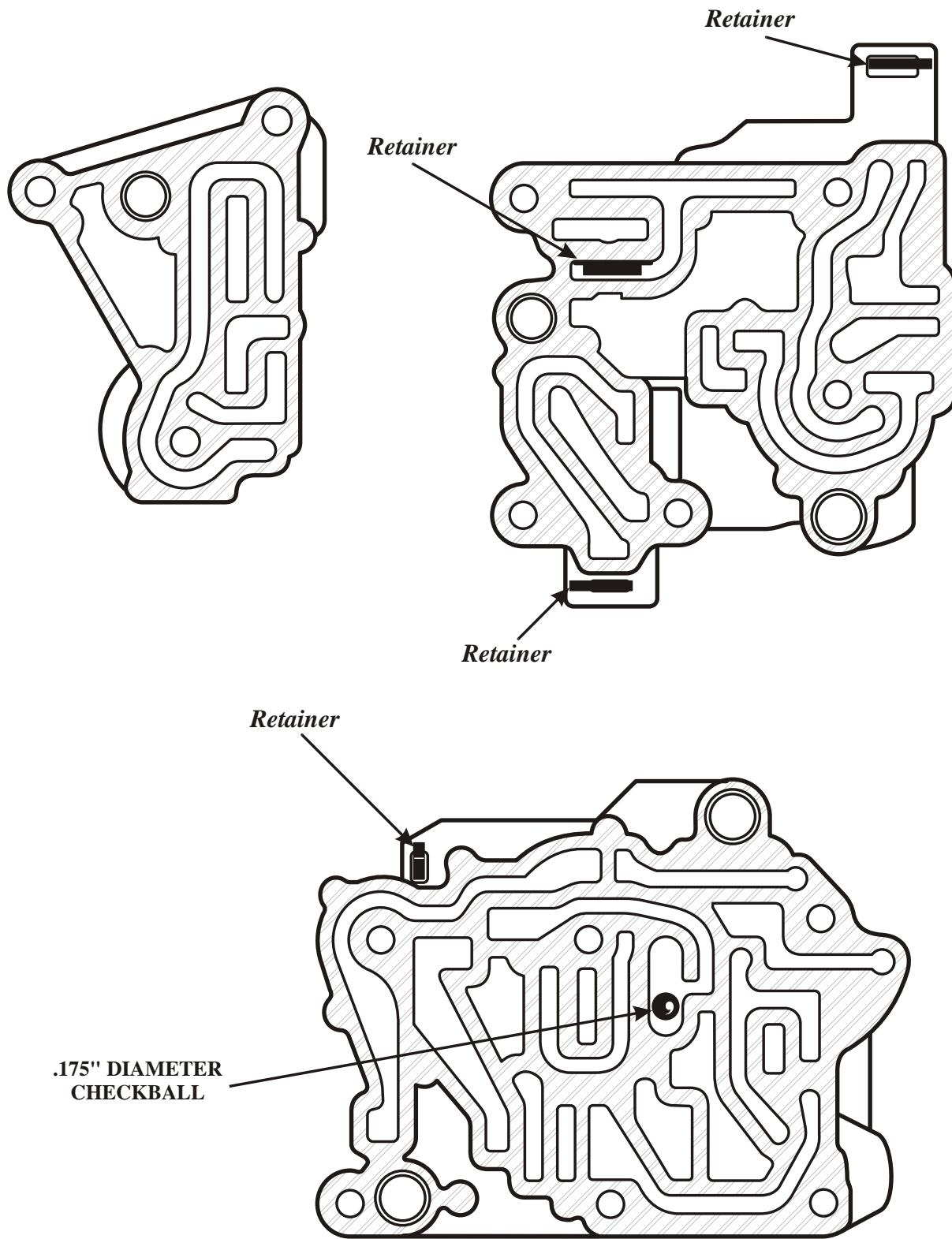


ZF-4HP-22/24 MODEL "E-7", "5 SOLENOID"  
CHANNEL PLATE



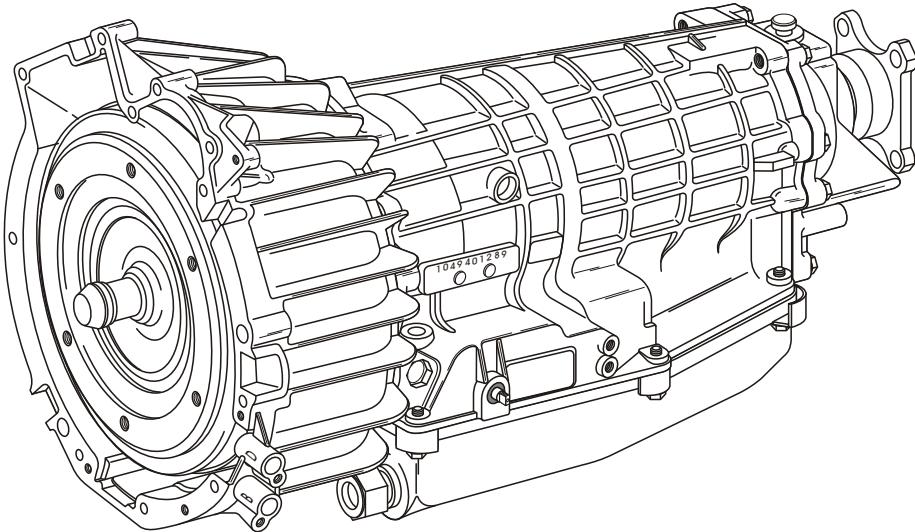
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Figure 15

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

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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.

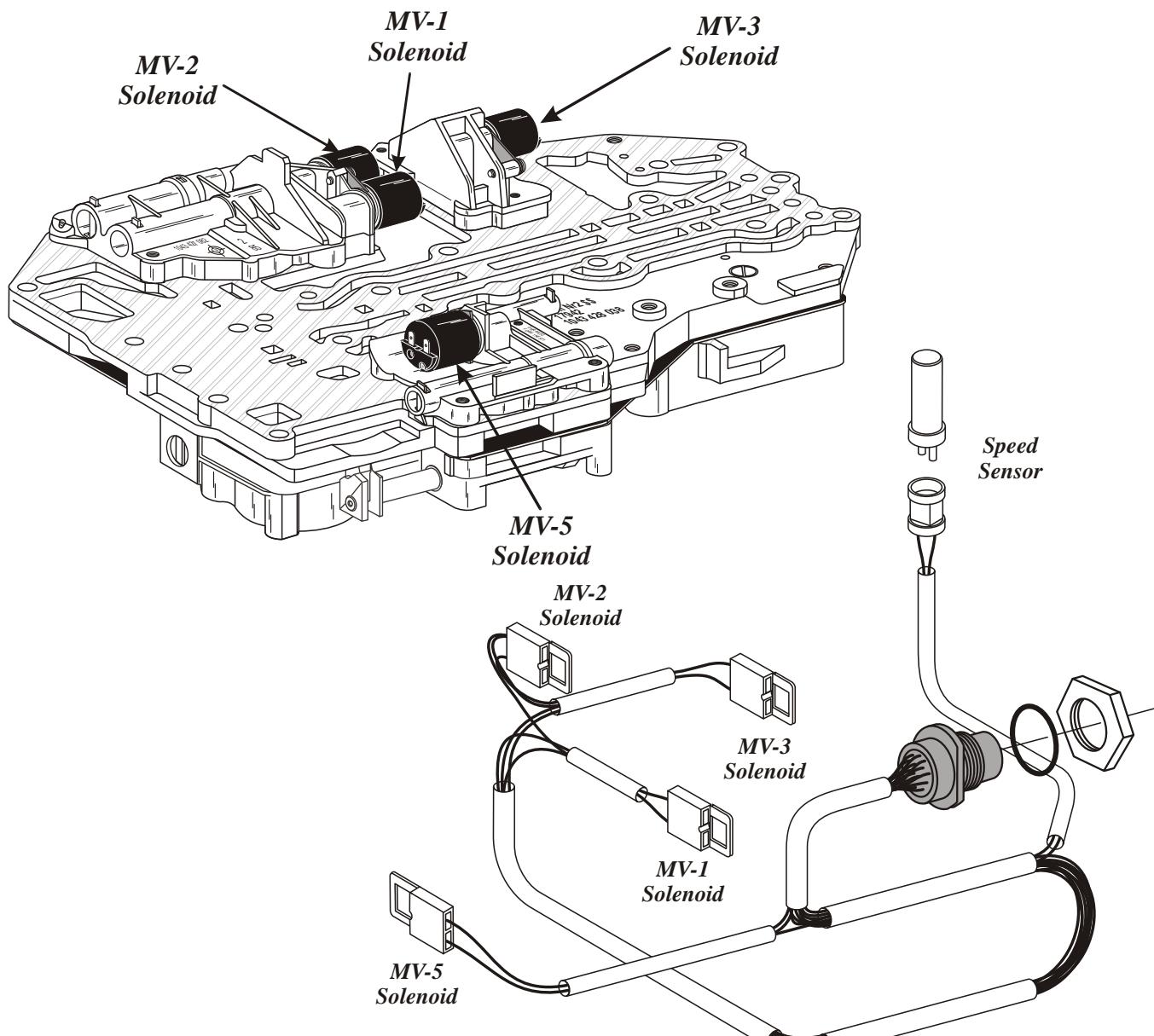
Refer to Figures 27, 28, 29 and 30 for retainer, checkball and orifice locations.

**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									

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Figure 17

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

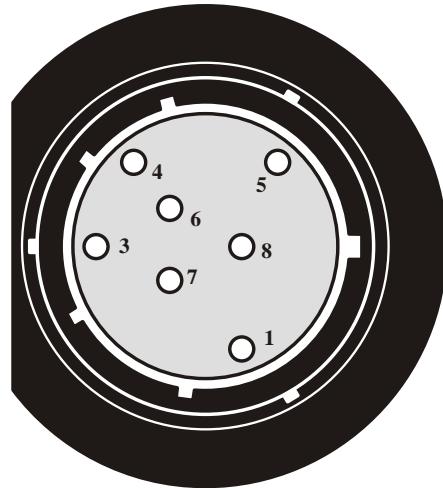
Solenoid	Function	Gear	MV-1	MV-2
MV-1	Shift Control	1st	OFF	ON
MV-2	Shift Control	2nd	ON	ON
		3rd	ON	OFF
		4th	OFF	OFF
		Rev 0 mph	ON	OFF
		Rev Above 3 mph	OFF	ON
MV-3	Lock-Up Control			
MV-5	Line Pressure Control			

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Figure 18

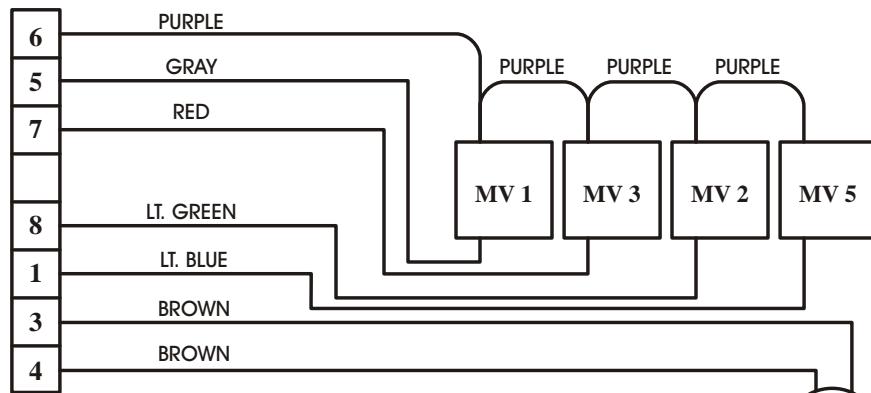
ZF-4HP-22/24 MODEL "E-9", "4 SOLENOID" INTERNAL WIRE SCHEMATIC  
AND CONNECTOR TERMINAL IDENTIFICATION

*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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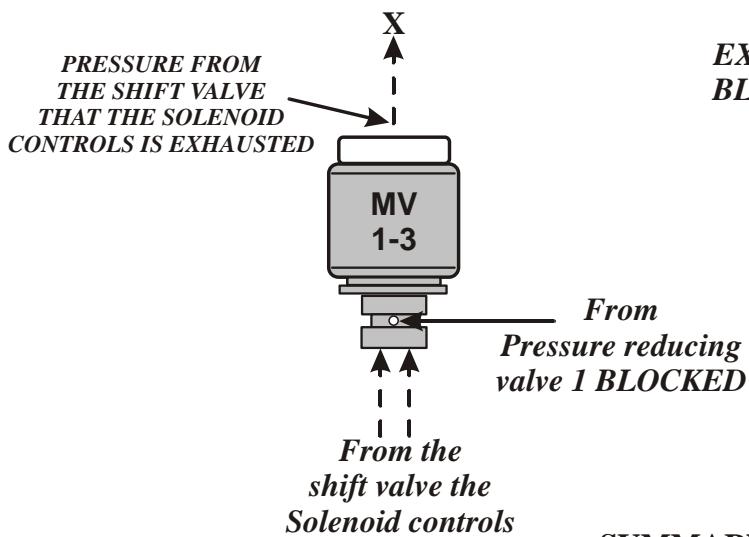
Figure 19



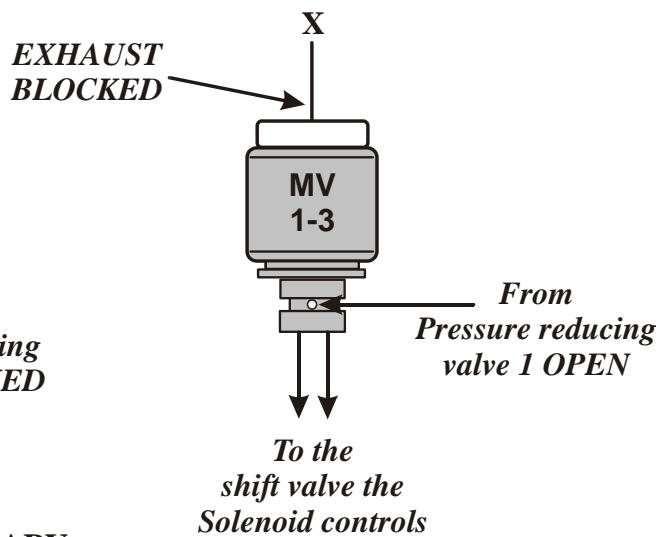
ZF-4HP-22/24 MODEL "E-9", "4 SOLENOID" VALVE BODY, SOLENOID OPERATION

**MV1-MV3**

**SOLENOID "OFF"**



**SOLENOID "ON"**



**SUMMARY:**

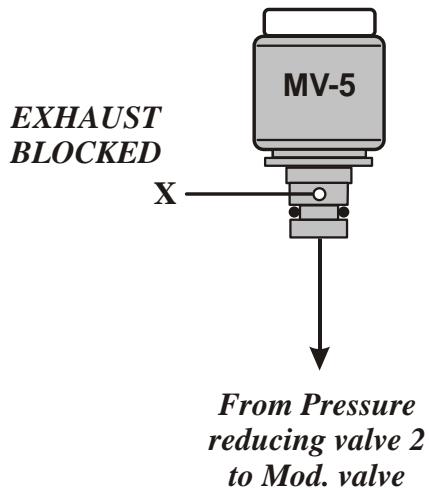
When MV 1 thru 3 is in the "OFF" state, Solenoid reducing pressure, from Pressure reducing valve 1, is blocked by the solenoid and oil pressure from the valve that the solenoid controls is exhausted at the rear of the solenoid.

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.

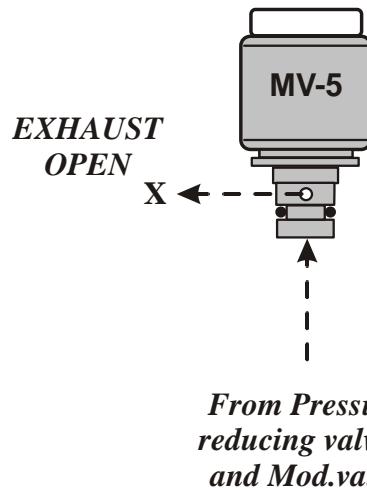
**MV-5**

*(Line Pressure Solenoid)*

**SOLENOID "OFF"**



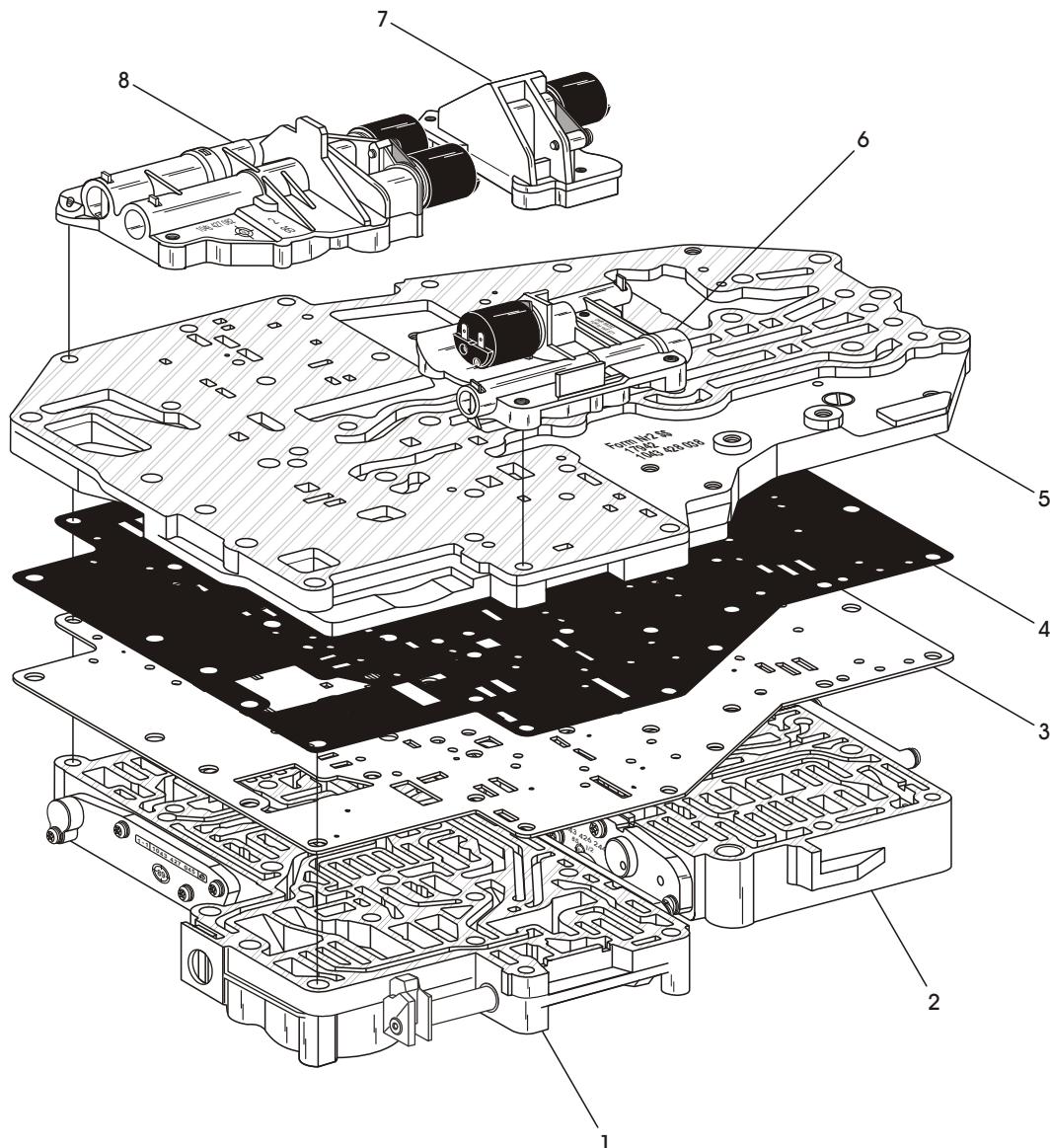
**SOLENOID "ON"**



**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.

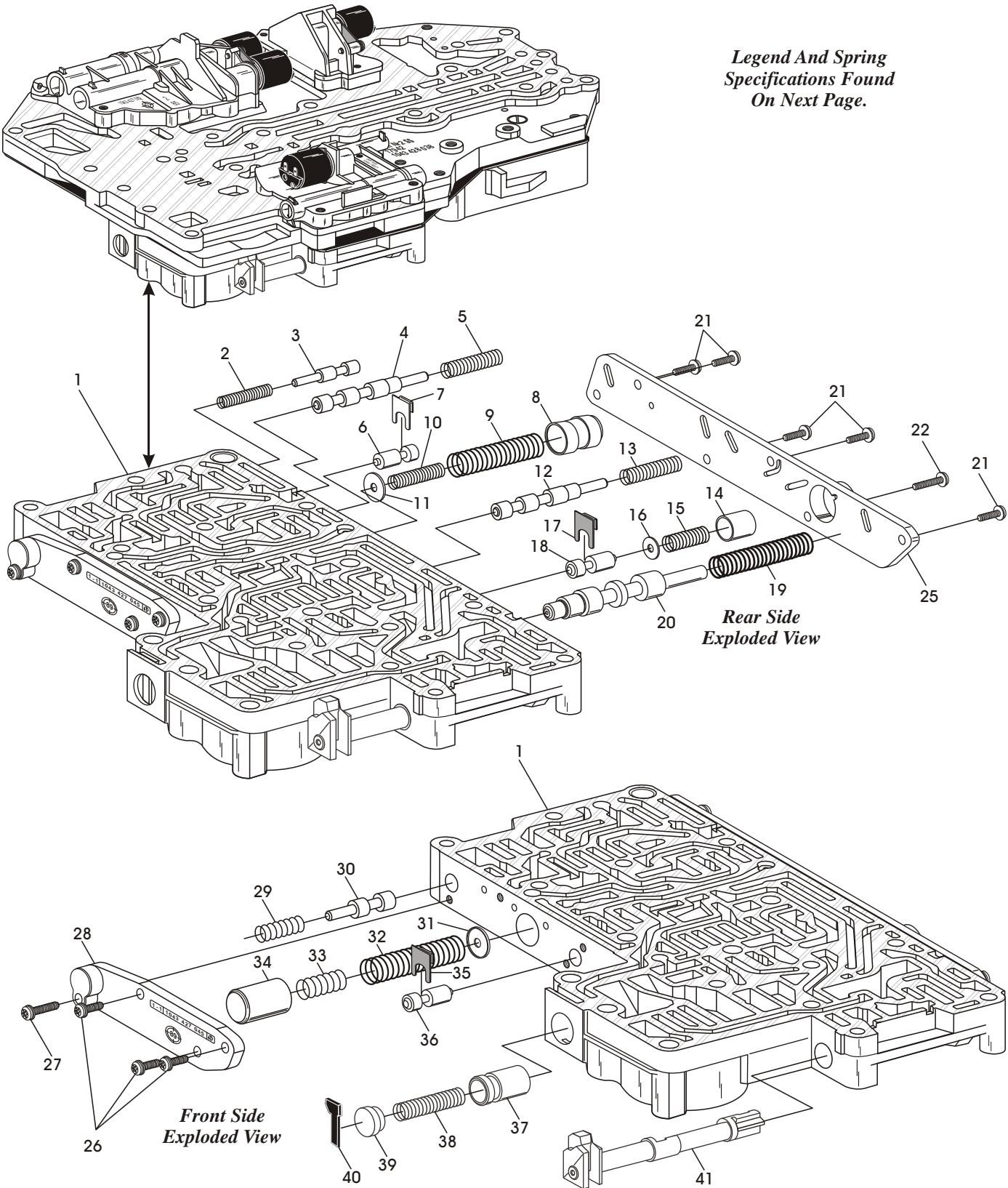
When MV-5 solenoid is "ON," solenoid reducing pressure, from Pressure reducing valve 2, is low to the Modulating valve which creates low line pressure.

**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**

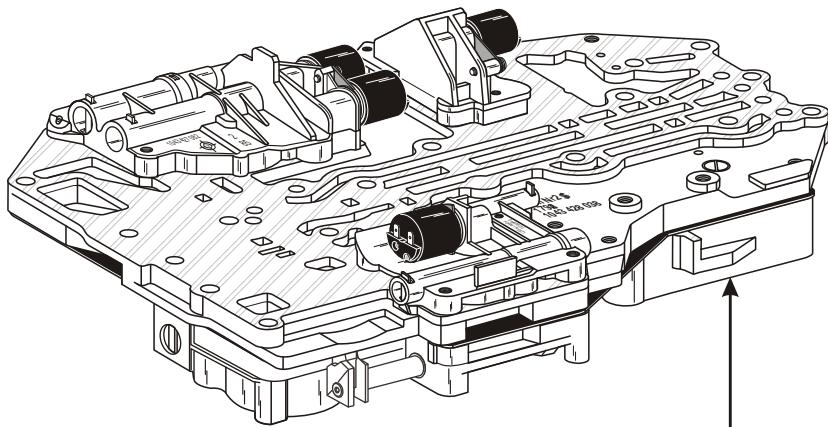
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Figure 22

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

Figure 22 Legend

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

*Legend And Spring  
Specifications Found  
On Next Page.*

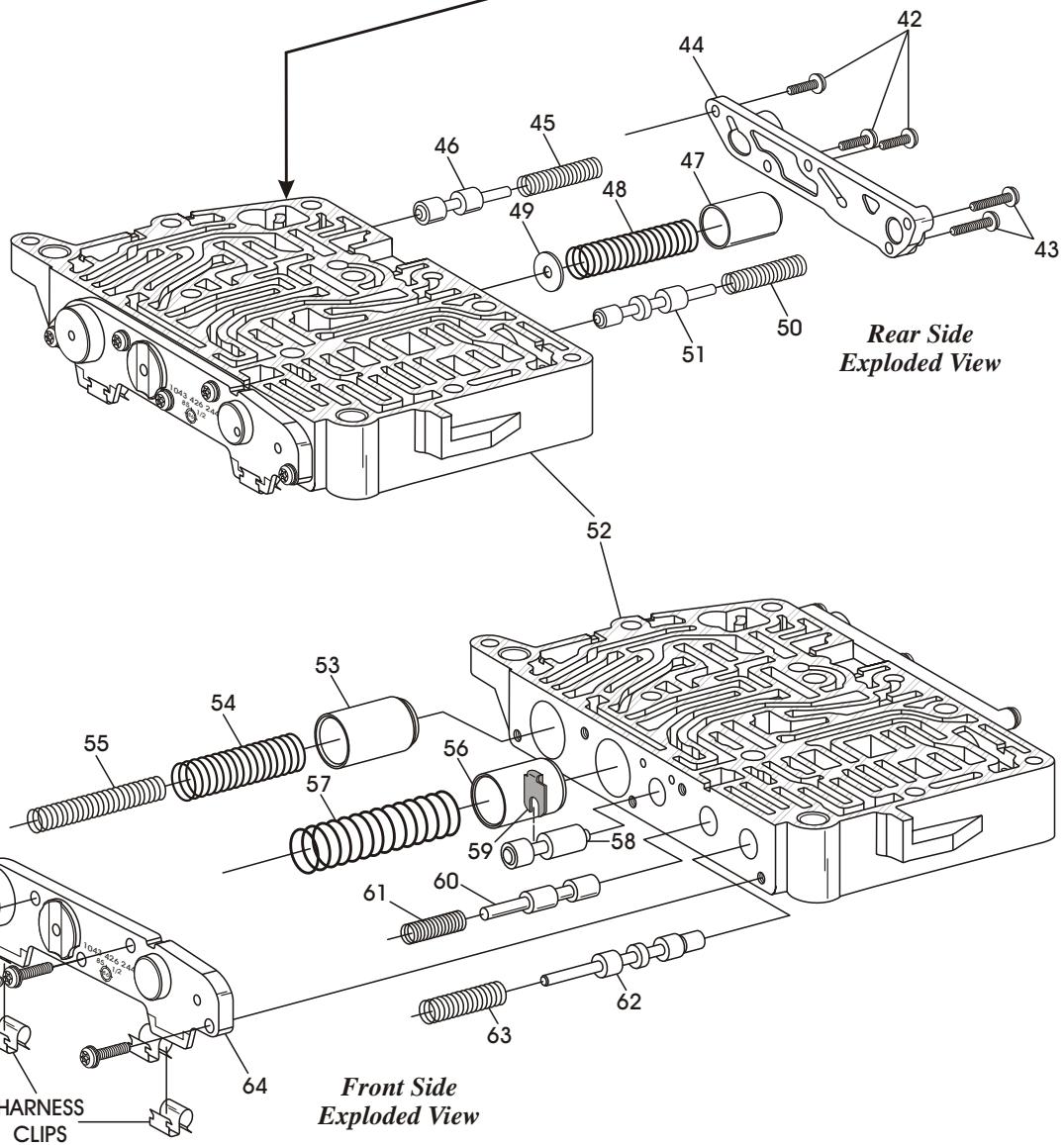


Figure 23

**FIGURE 23 LEGEND AND SPRING SPECIFICATIONS**

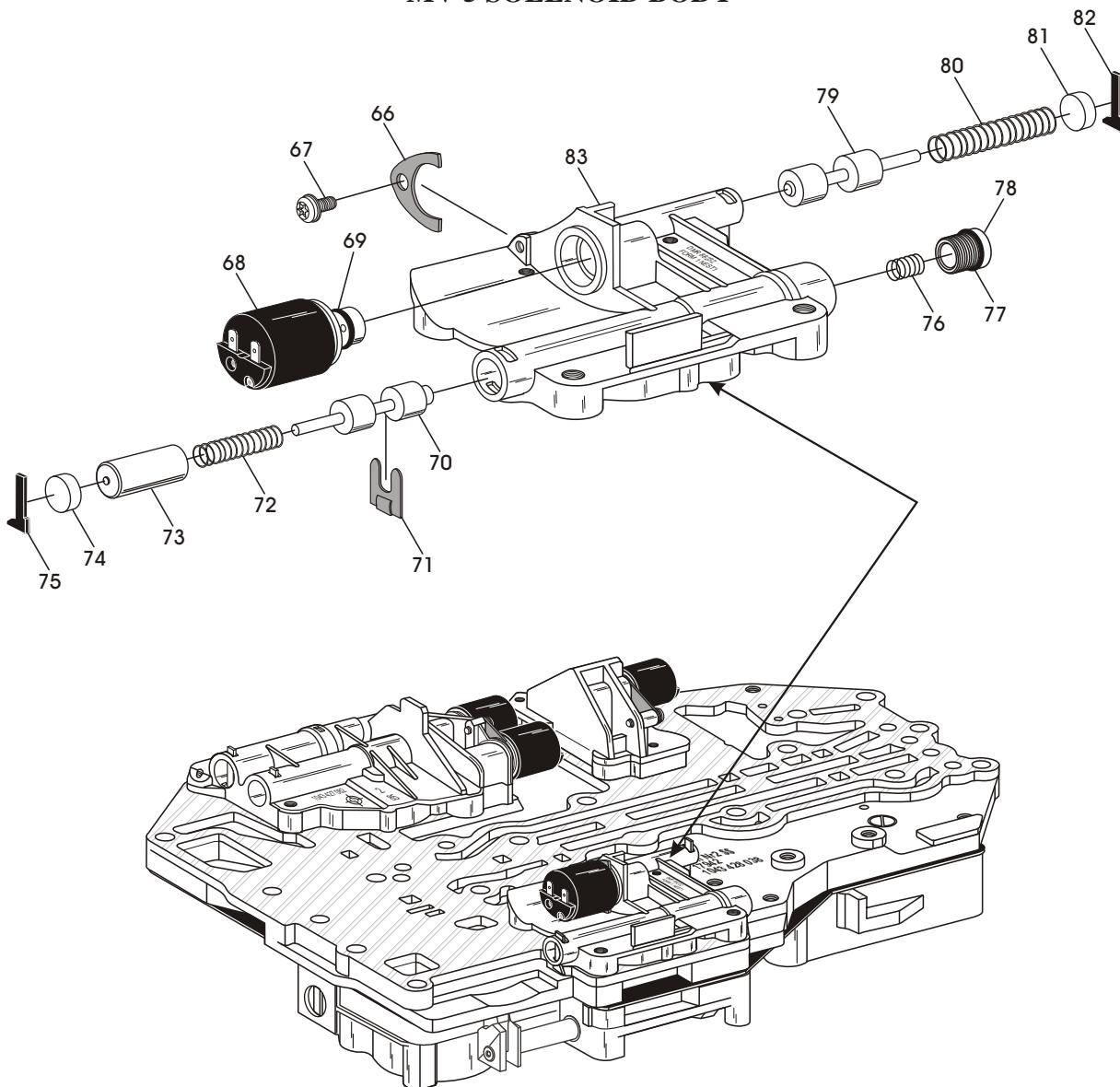
42 REAR SIDE COVER RETAINING BOLTS, 17 mm LENGTH (3)  
43 REAR SIDE COVER RETAINING BOLTS, 21 mm LENGTH (2)  
44 REAR SIDE COVER  
45 PRESSURE REDUCING VALVE "1" SPRING  
46 PRESSURE REDUCING VALVE "1"  
47 "F" CLUTCH DAMPER PISTON  
48 "F" CLUTCH DAMPER PISTON SPRING  
49 "F" CLUTCH DAMPER PISTON SPRING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

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Figure 23 Legend

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

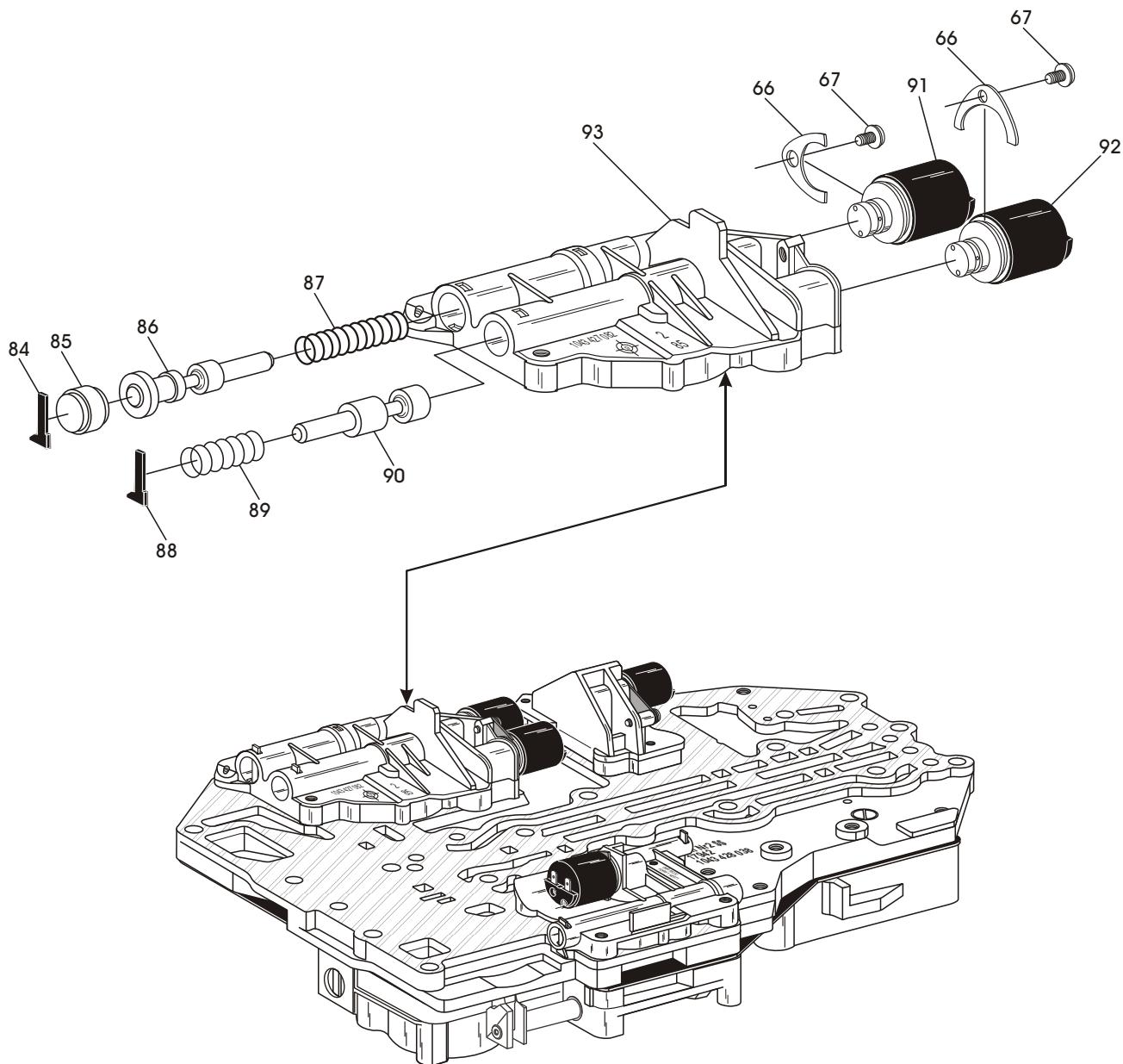
- 66 SOLENOID RETAINING BRACKET
- 67 SOLENOID RETAINING BOLT, 11 mm LENGTH
- 68 MV-5 LINE PRESSURE SOLENOID ASSEMBLY
- 69 MV-5 LINE PRESSURE SOLENOID "O" RING
- 70 MODULATION VALVE
- 71 MODULATION VALVE RETAINER
- 72 MODULATION VALVE SPRING
- 73 MODULATION VALVE SPRING SLEEVE
- 74 MODULATION VALVE BORE 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 24

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

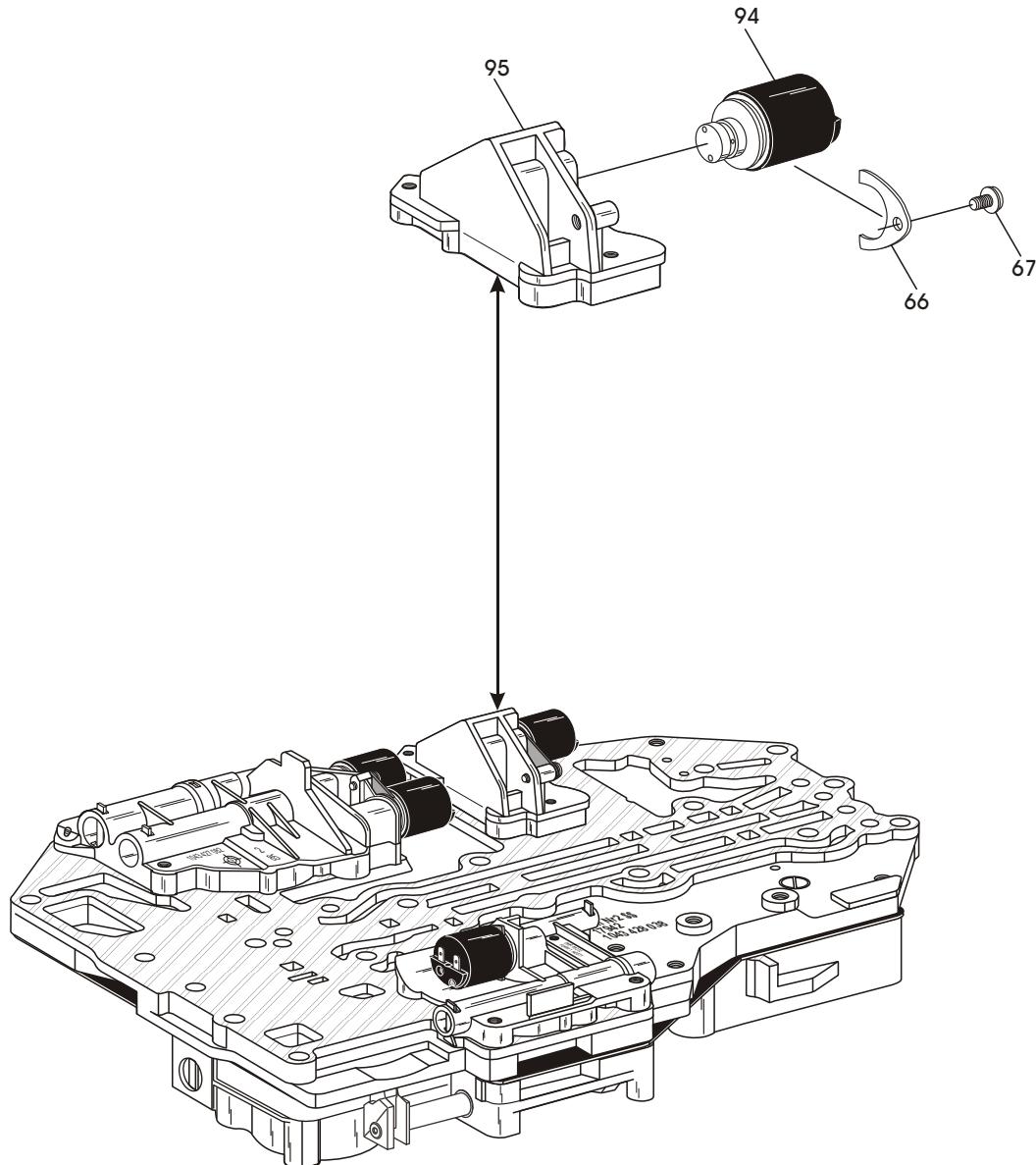
66 SOLENOID RETAINING BRACKET  
67 SOLENOID RETAINING BOLT, 11 mm LENGTH  
84 T.C.C. VALVE BORE PLUG RETAINER  
85 T.C.C. VALVE BORE PLUG  
86 TORQUE CONVERTER CLUTCH VALVE  
87 TORQUE CONVERTER CLUTCH VALVE SPRING  
88 LUBRICATION VALVE SPRING RETAINER  
89 LUBRICATION VALVE SPRING  
90 LUBRICATION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

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Figure 25

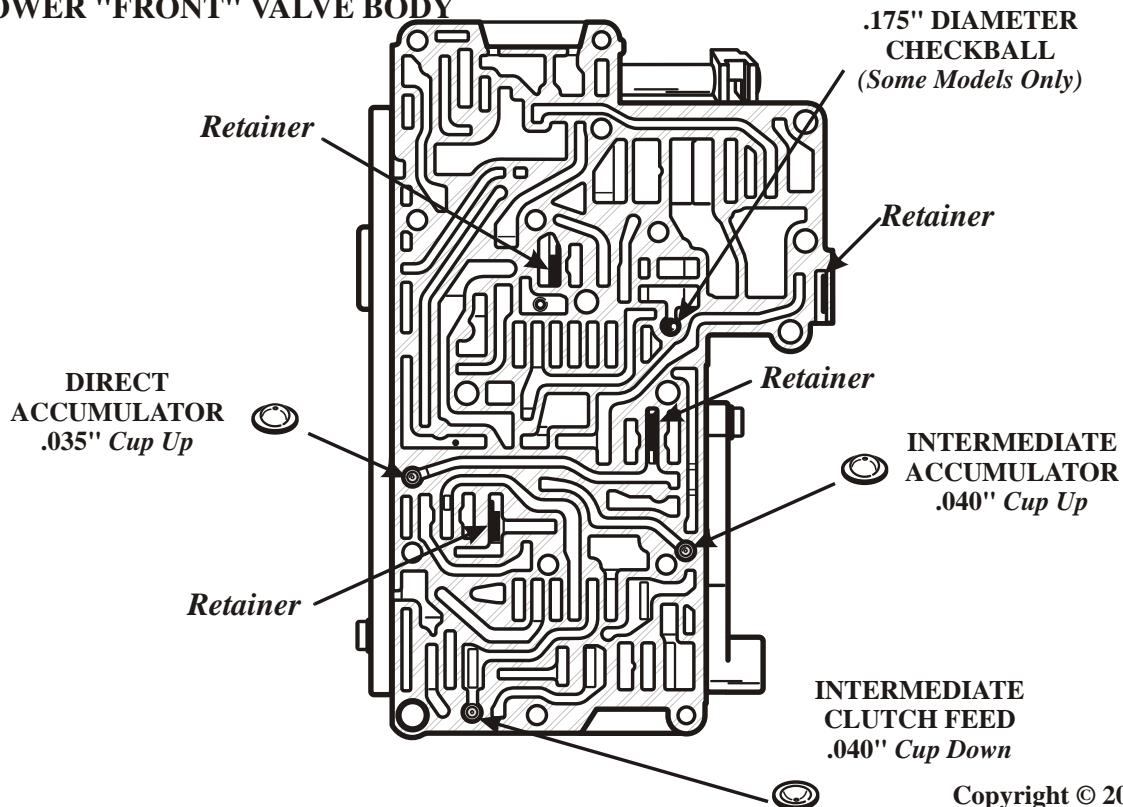
**ZF-4HP-22/24 MODEL "E-9", "4 SOLENOID"  
MV-3 SOLENOID BODY**

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

**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**

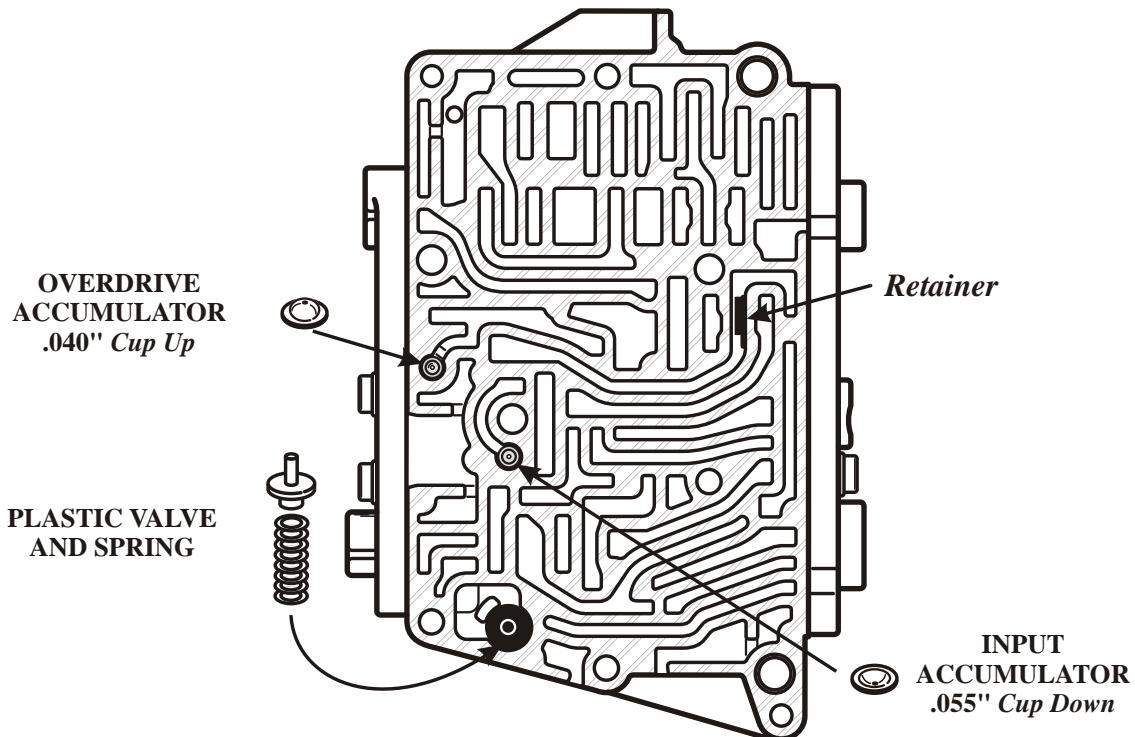
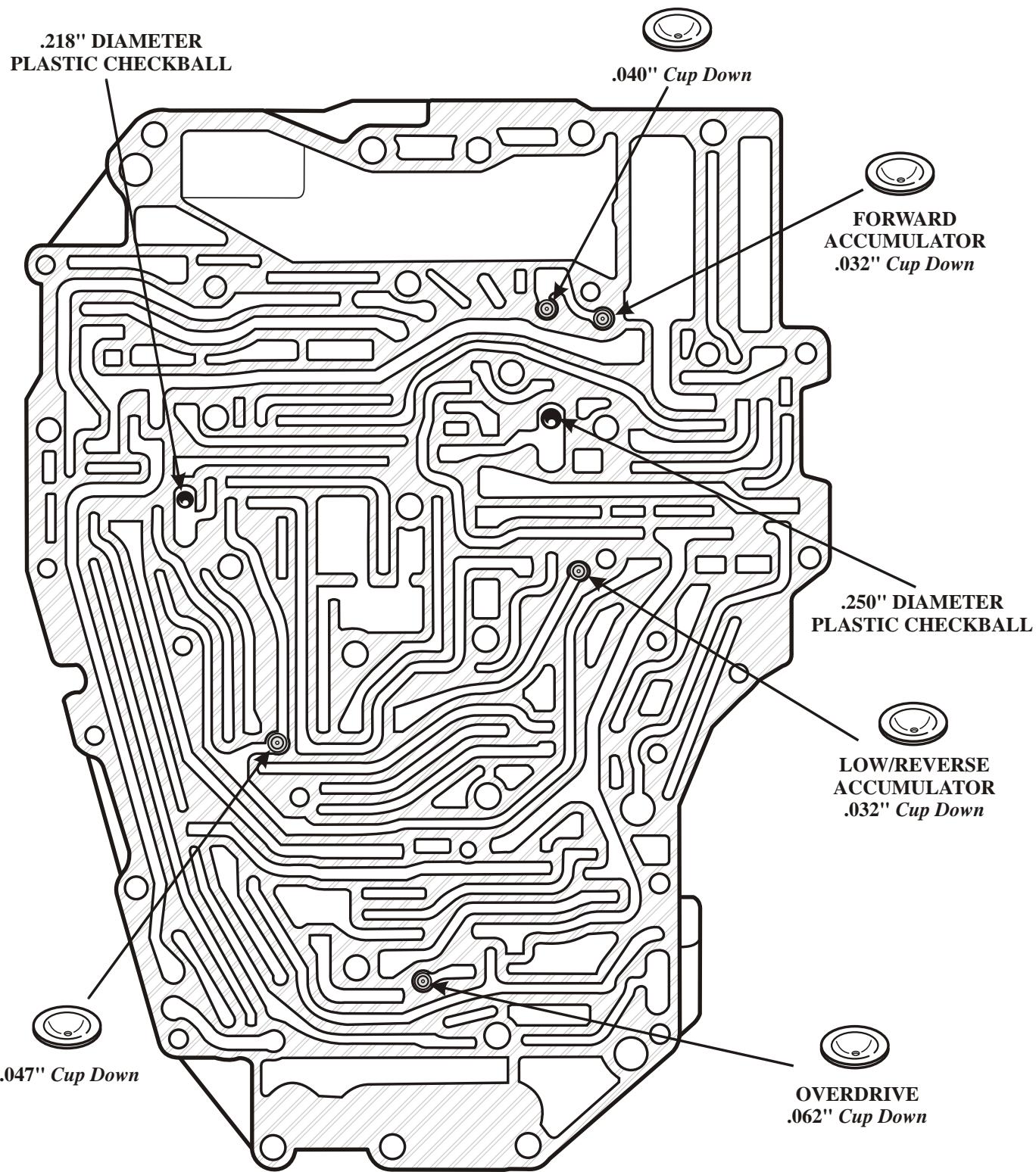


Figure 28



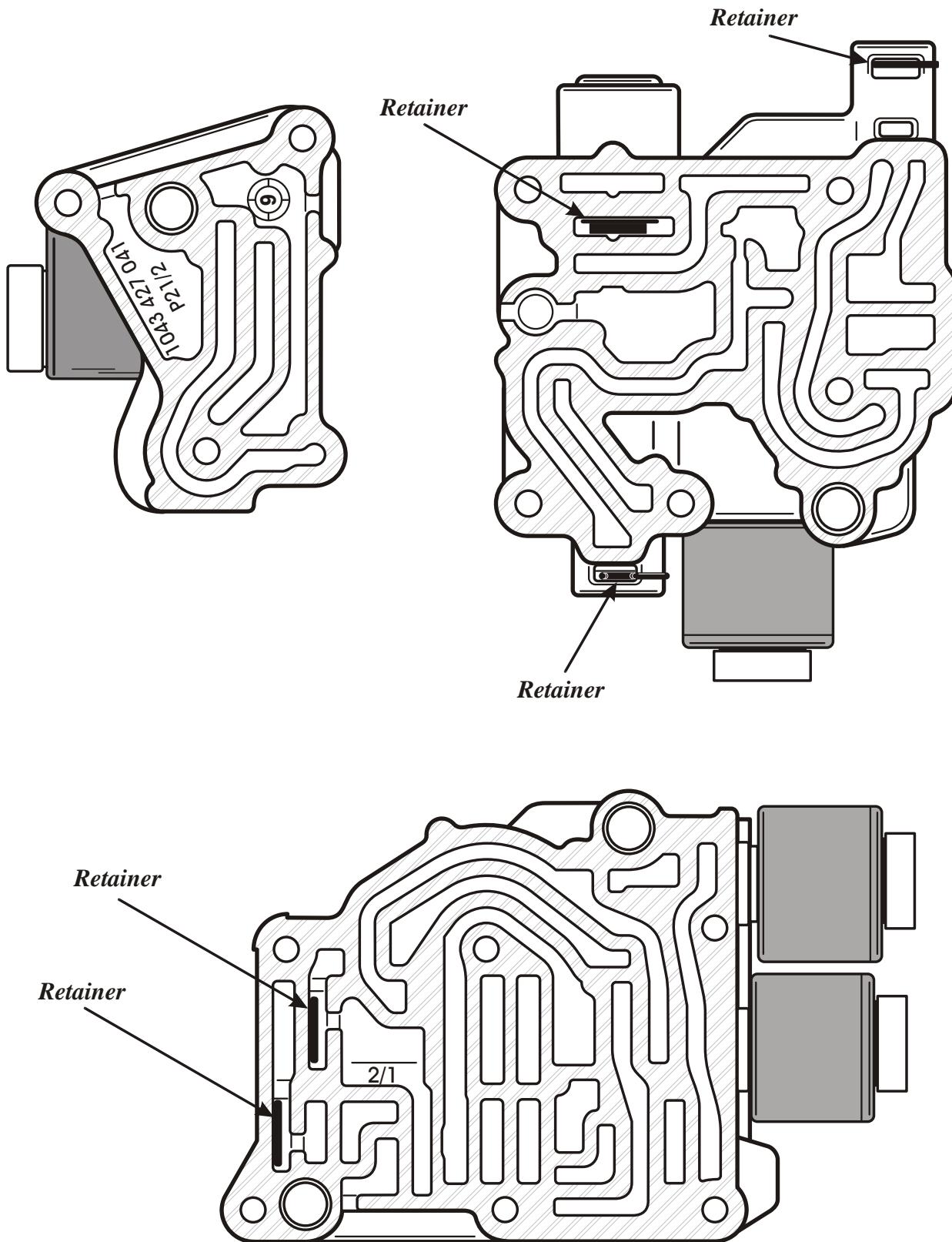
ZF-4HP-22/24 MODEL "E-9", "4 SOLENOID"  
CHANNEL PLATE



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Figure 29

# Auto Trans Group

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

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Figure 30

# Raybestos

**IBC**

**TTXE**

BC

# Lubegard