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GM POWERTRAIN

4T40-E

HYDRA-MATIC

CONTENTS

PREFACE

The Hydra-matic 4T40-E Technician's Guide is intended for automotive technicians that are familiar with the operation of an automatic transaxle or transmission. Technicians or other persons not having automatic transaxle or transmission know-how may find this publication somewhat technically complex if additional instruction is not provided. Since the intent of this book is to explain the fundamental mechanical, hydraulic and electrical operating principles, technical terms used herein are specific to the transmission industry. However, words commonly associated with the specific transaxle or transmission function have been defined in a Glossary rather than within the text of this book.

The Hydra-matic 4T40-E Technician's Guide is intended to assist technicians during the service, diagnosis and repair of this transaxle. However, this book is not intended to be a substitute for other General Motors service publications that are normally used on the job. Since there is a wide range of repair procedures and technical specifications specific to certain vehicles and transaxle models, the proper service publication must be referred to when servicing the Hydra-matic 4T40-E transaxle.

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INTRODUCTION

The Hydra-matic 4T40-E Technician's Guide is another Powertrain publication from the Technician's Guide series of books. The purpose of this publication, as is the case with other Technician's Guides, is to provide complete information on the theoretical operating characteristics of this transaxle. Operational theories of the mechanical, hydraulic and electrical components are presented in a sequential and functional order to better explain their operation as part of the system.

In the first section of this book entitled "Principles of Operation", exacting explanations of the major components and their functions are presented. In every situation possible, text describes component operation during the apply and release cycle as well as situations where it has no effect at all. The descriptive text is then supported by numerous graphic illustrations to further emphasize the operational theories presented.

The second major section entitled "Power Flow", blends the information presented in the "Principles of Operation" section into the complete transaxle assembly. The transfer of torque from the engine through the transaxle is graphically displayed on a full page while a narrative description is provided on a facing half page. The opposite side of the half page contains the narrative description of the hydraulic fluid as it applies components or shifts valves in the system. Facing this partial page is a hydraulic schematic that shows the position of valves, checkballs, etc., as they function in a specific gear range.

The third major section of this book displays the "Complete Hydraulic Circuit" for specific gear ranges. Fold-out pages containing fluid flow schematics and two dimensional illustrations of major components graphically display hydraulic circuits. This information is extremely useful when tracing fluid circuits for learning or diagnosis purposes.

The "Appendix" section of this book provides additional transaxle information regarding lubrication circuits, seal locations, illustrated parts lists and more. Although this information is available in current model year Service Manuals, its inclusion provides for a quick reference guide that is useful to the technician.

Production of the Hydra-matic 4T40-E Technician's Guide was made possible through the combined efforts of many staff areas within the General Motors Powertrain Division. As a result, the Hydra-matic 4T40-E Technician's Guide was written to provide the user with the most current, concise and usable information available regarding this product.

HOW TO USE THIS BOOK

First time users of this book may find the page layout a little unusual or perhaps confusing. However, with a minimal amount of exposure to this format its usefulness becomes more obvious. If you are unfamiliar with this publication, the following guidelines are helpful in understanding the functional intent for the various page layouts:

- Read the following section, "Understanding the Graphics" to know how the graphic illustrations are used, particularly as they relate to the mechanical power flow and hydraulic controls (see Understanding the Graphics page 6).

- Unfold the cutaway illustration of the Hydra-matic 4T40-E (page 8) and refer to it as you progress through each major section. This cutaway provides a quick reference of component location inside the transaxle assembly and their relationship to other components.

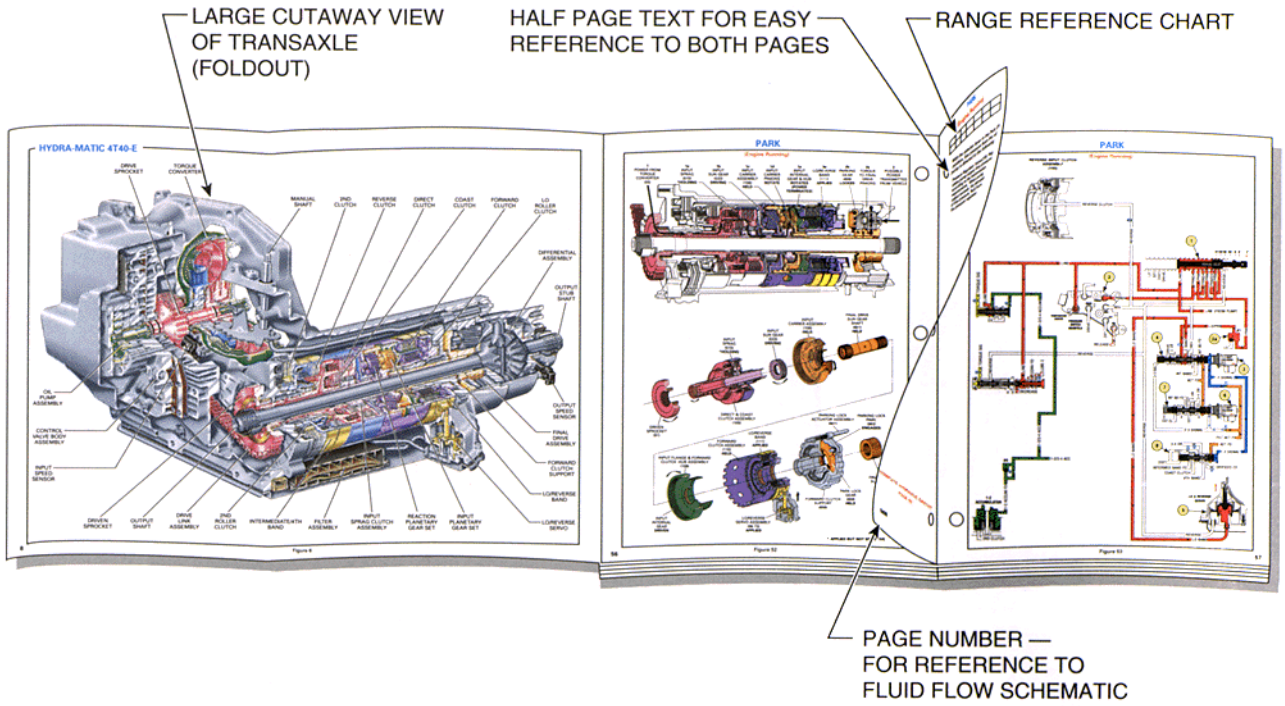
- The Principles of Operation section (beginning on page 9A) presents information regarding the major apply components and hydraulic control components used in this transaxle. This section describes "how" specific components work and interfaces with the sections that follow.

- The Power Flow section (beginning on page 53) presents the mechanical and hydraulic functions corresponding to specific gear ranges. This section builds on the information presented in the Principles of Operation section by showing specific fluid circuits that enable the mechanical components to operate. The mechanical power flow is graphically displayed on a full size page and is followed by a half page of descriptive text. The opposite side of the half page contains the narrative description of the hydraulic fluid as it applies components or moves valves in the system. Facing this partial page is a hydraulic schematic which shows the position of valves, checkballs, etc., as they function in a specific gear range. Also, located at the bottom of each half page is a reference to the Complete Hydraulic Circuit section that follows.

- The Complete Hydraulic Circuits section (beginning on page 81) details the entire hydraulic system. This is accomplished by using a fold-out circuit schematic with a facing page two dimensional fold-out drawing of each component. The circuit schematics and component drawings display only the fluid passages for that specific operating range.

- Finally, the Appendix section contains a schematic of the lubrication flow through the transaxle, disassembled view parts lists and transaxle specifications. This information has been included to provide the user with convenient reference information published in the appropriate vehicle Service Manuals. Since component parts lists and specifications may change over time, this information should be verified with Service Manual information.

HOW TO USE THIS BOOK



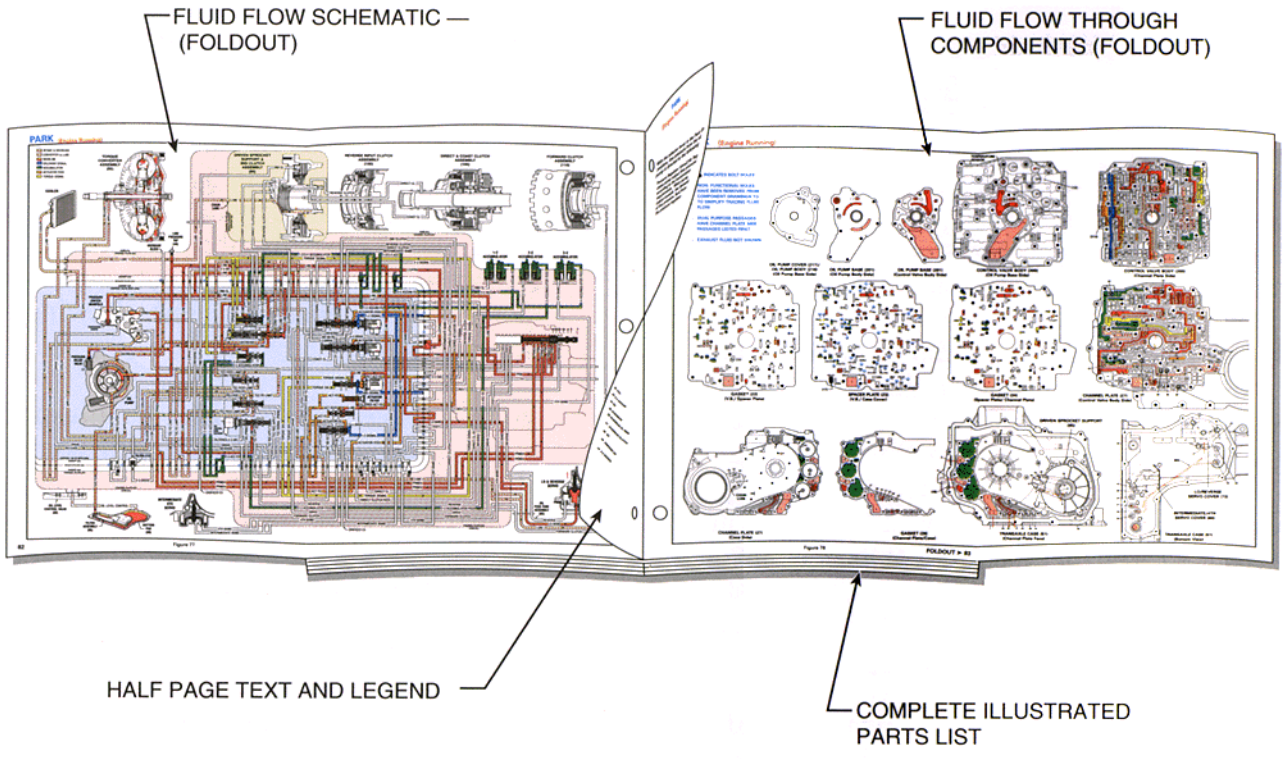


Figure 1

UNDERSTANDING THE GRAPHICS

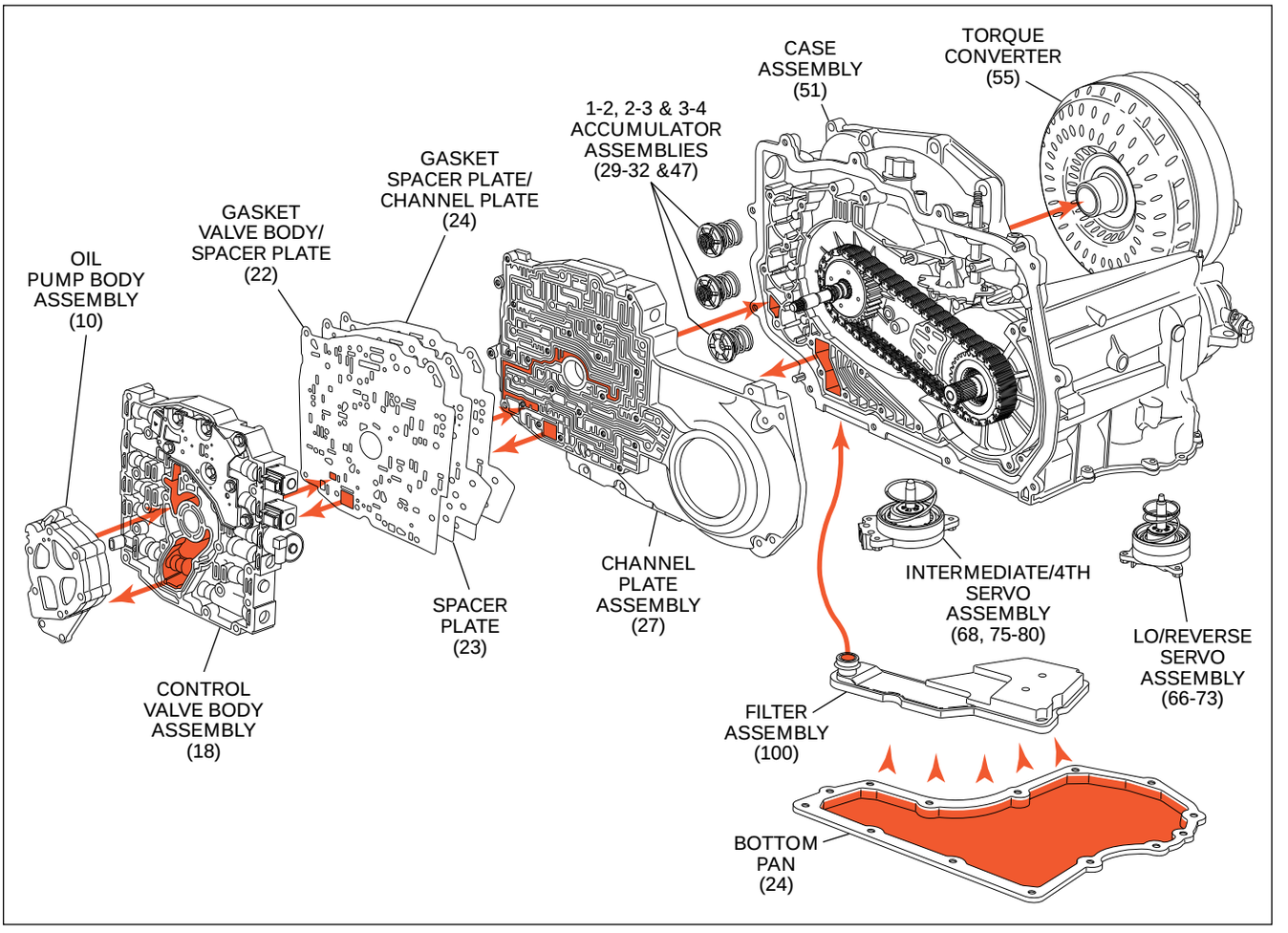


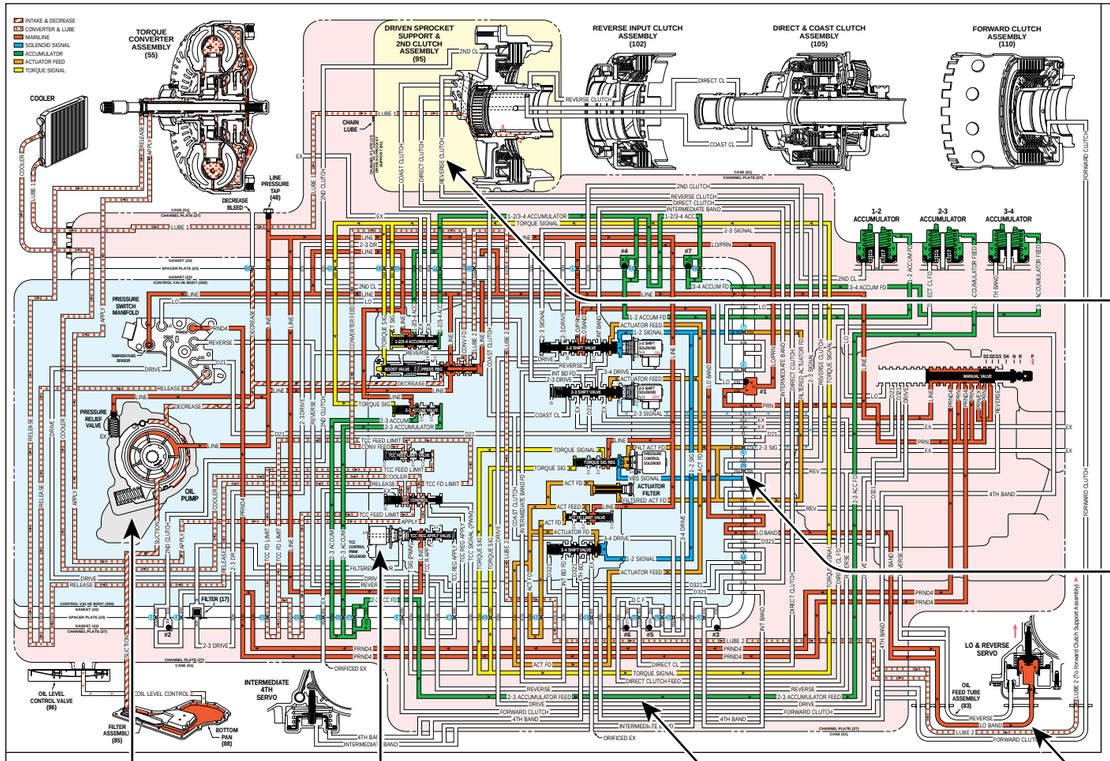
Figure 2

The flow of transaxle fluid starts in the bottom pan and is drawn through the filter, case assembly, channel plate assembly, spacer plate and gaskets, control valve assembly and into the oil pump assembly. This is a basic concept of fluid flow that is easily understood by reviewing the illustrations provided in Figure 2. However, fluid may pass between the valve body, spacer plate, channel plate and other components many times before reaching a valve or applying a clutch. For this reason, the graphics are designed to show the exact location where fluid passes through a component and into other passages for specific gear range operation.

To provide a better understanding of fluid flow in the Hydra-matic 4T40-E transaxle, the components involved with hydraulic control and fluid flow are illustrated in three major formats. Figure 3 (page 7-7A) provides an example of these formats which are:

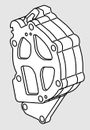
- A three dimensional line drawing of the component for easier part identification.
- A two dimensional line drawing of the component to indicate fluid passages and orifices.
- A graphic schematic representation that displays valves, checkballs, orifices and so forth, required for the proper function of the transaxle in a specific gear range. In the schematic drawings, fluid circuits are represented by straight lines and orifices are represented by indentations in a circuit. All circuits are labeled and color coded to provide reference points between the schematic drawing and the two dimensional line drawing of the components.
- Figure 4 (page 7B) provides an illustration of typical valve, bushing and valve train components. A brief description of valve operation is also provided to support the illustration.
- Figure 5 (page 7B) provides a color coded chart that references different fluid pressures used to operate the hydraulic control systems. A brief description of how fluid pressures affect valve operation is also provided.

UNDERSTANDING THE GRAPHICS



GRAPHIC SCHEMATIC REPRESENTATION

OIL PUMP BODY (10)

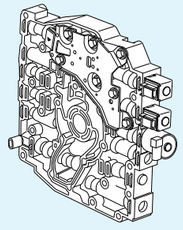


THREE DIMENSIONAL

PUMP COVER SIDE

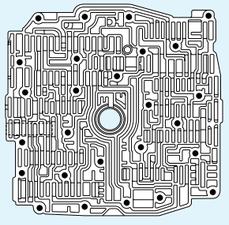
TWO DIMENSIONAL

CONTROL VALVE BODY ASSEMBLY (18)



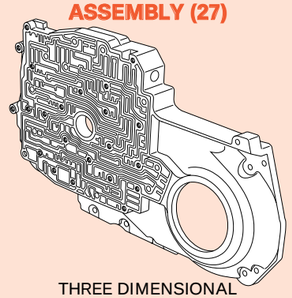
THREE DIMENSIONAL

CHANNEL PLATE SIDE



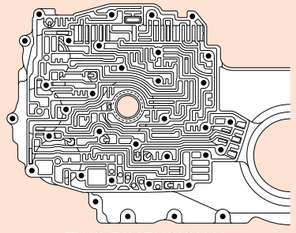
TWO DIMENSIONAL

CHANNEL PLATE ASSEMBLY (27)



THREE DIMENSIONAL

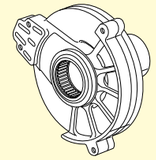
VALVE BODY SIDE



TWO DIMENSIONAL

DRIVEN SPROCKET SUPPORT ASSEMBLY (95)

CHANNEL PLATE SIDE



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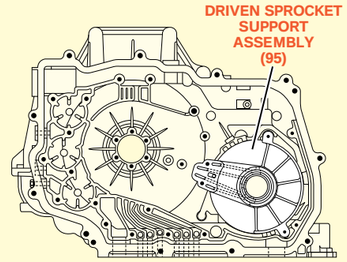
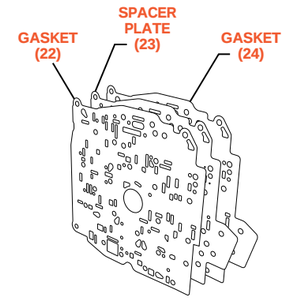


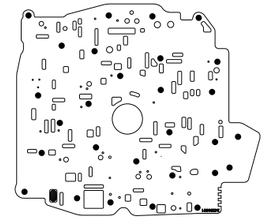
TWO DIMENSIONAL

VALVE BODY SPACER PLATE (23)



THREE DIMENSIONAL

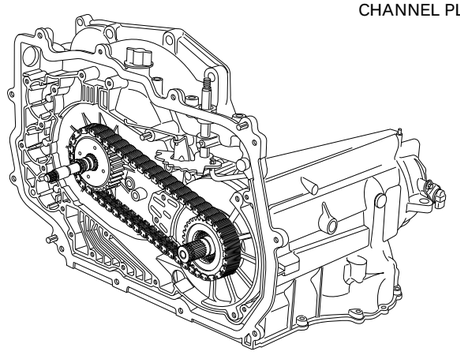
CONTROL VALVE BODY SIDE



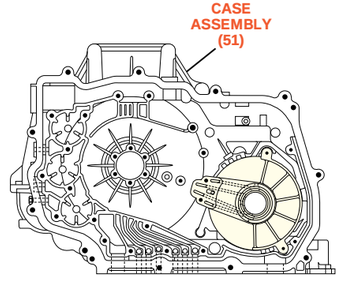
TWO DIMENSIONAL

CASE ASSEMBLY (51)

CHANNEL PLATE FACE



THREE DIMENSIONAL



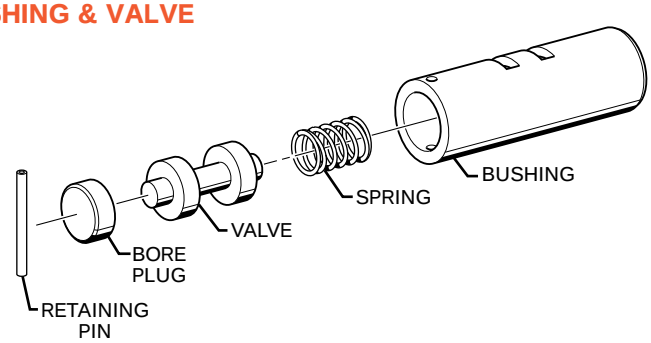
TWO DIMENSIONAL

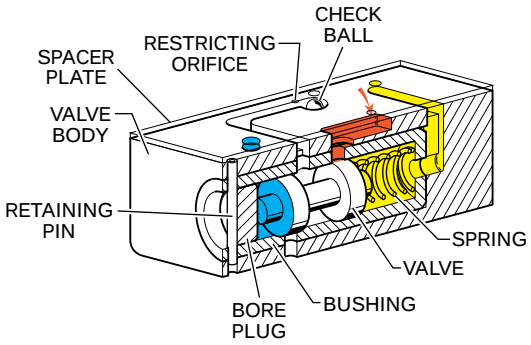
Figure 3

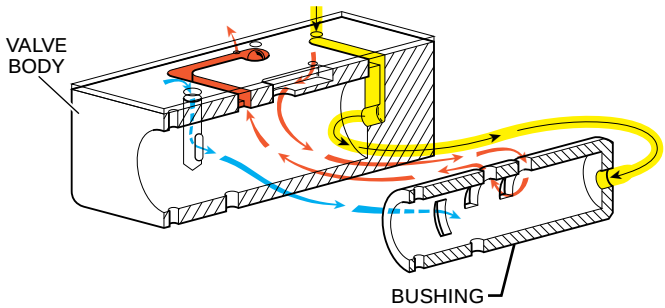
UNDERSTANDING THE GRAPHICS

TYPICAL BUSHING & VALVE

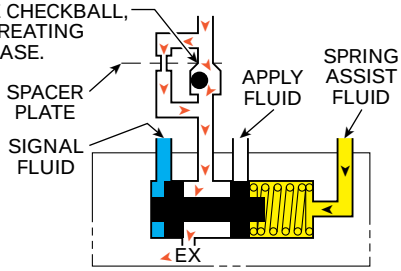
NOTE: NOT ALL VALVES ARE USED WITH A BUSHING







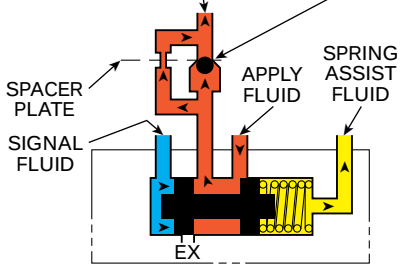
EXHAUST FROM THE APPLY COMPONENT UNSEATS THE CHECKBALL, THEREFORE CREATING A QUICK RELEASE.



WITH SIGNAL FLUID PRESSURE EQUAL TO OR LESS THAN SPRING AND SPRING ASSIST FLUID PRESSURE THE VALVE REMAINS IN CLOSED POSITION.

TO APPLY COMPONENT

APPLY FLUID SEATS THE CHECKBALL FORCING FLUID THROUGH AN ORIFICE IN THE SPACER PLATE, WHICH CREATES A SLOWER APPLY.

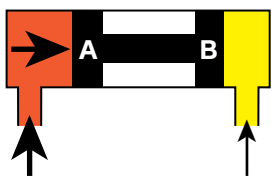


WITH SIGNAL FLUID PRESSURE GREATER THAN SPRING AND SPRING ASSIST FLUID PRESSURE THE VALVE MOVES OVER.

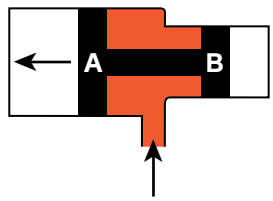
Figure 4

FLUID PRESSURES

- **INTAKE & DECREASE**
- **CONVERTER & LUBE**
- **MAINLINE**
- **SOLENOID SIGNAL**
- **ACCUMULATOR**
- **ACUATOR FEED**
- **TORQUE SIGNAL**
- **EXHAUST**
- **DIRECTION OF FLOW**



WITH EQUAL SURFACE AREAS ON EACH END OF THE VALVE, BUT FLUID PRESSURE "A" BEING GREATER THAN FLUID PRESSURE "B", THE VALVE WILL MOVE TO THE RIGHT.



WITH THE SAME FLUID PRESSURE ACTING ON BOTH SURFACE "A" AND SURFACE "B" THE VALVE WILL MOVE TO THE LEFT. THIS IS DUE TO THE LARGER SURFACE AREA OF "A" THAN "B".

Figure 5

HYDRA-MATIC 4T40-E

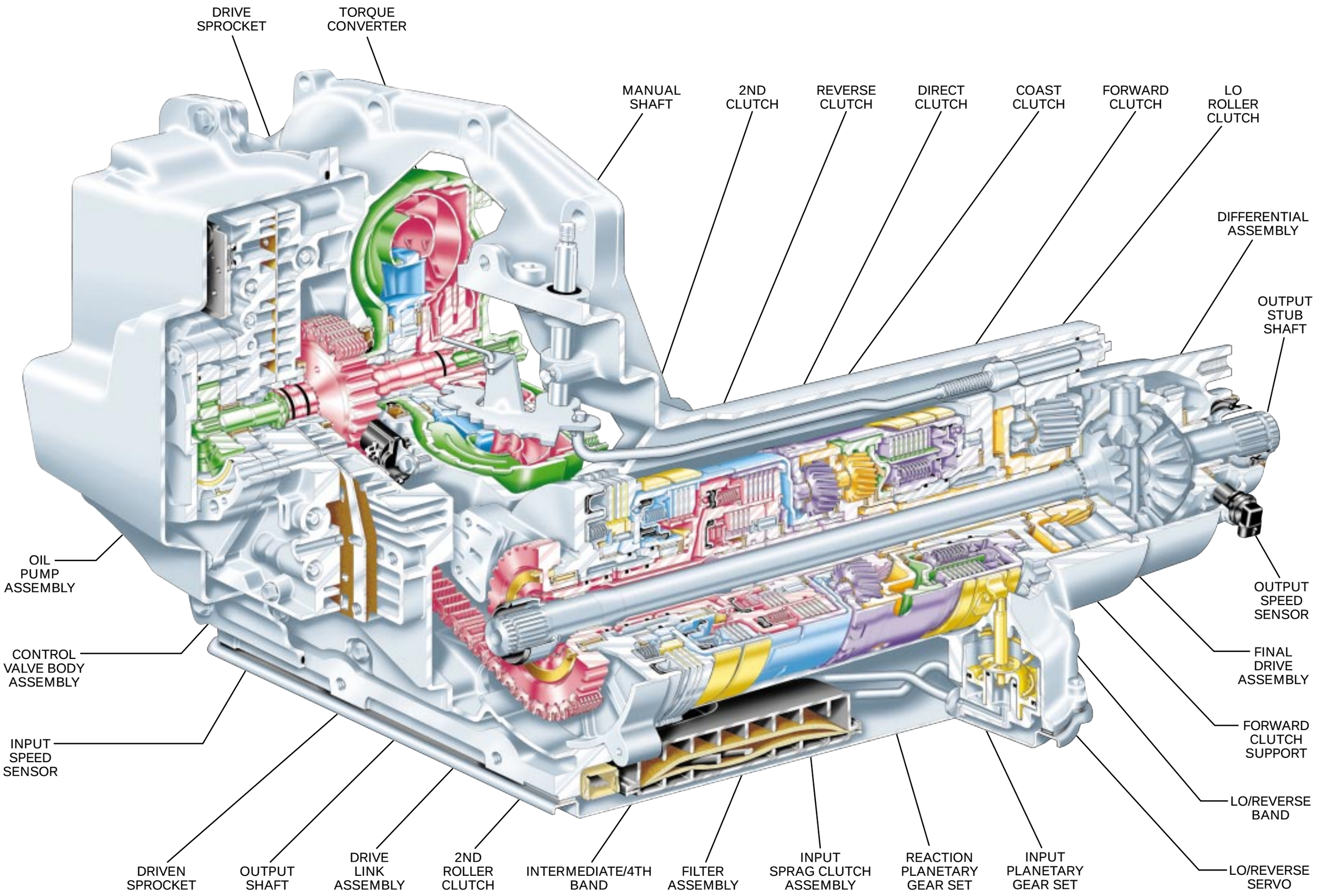


Figure 6

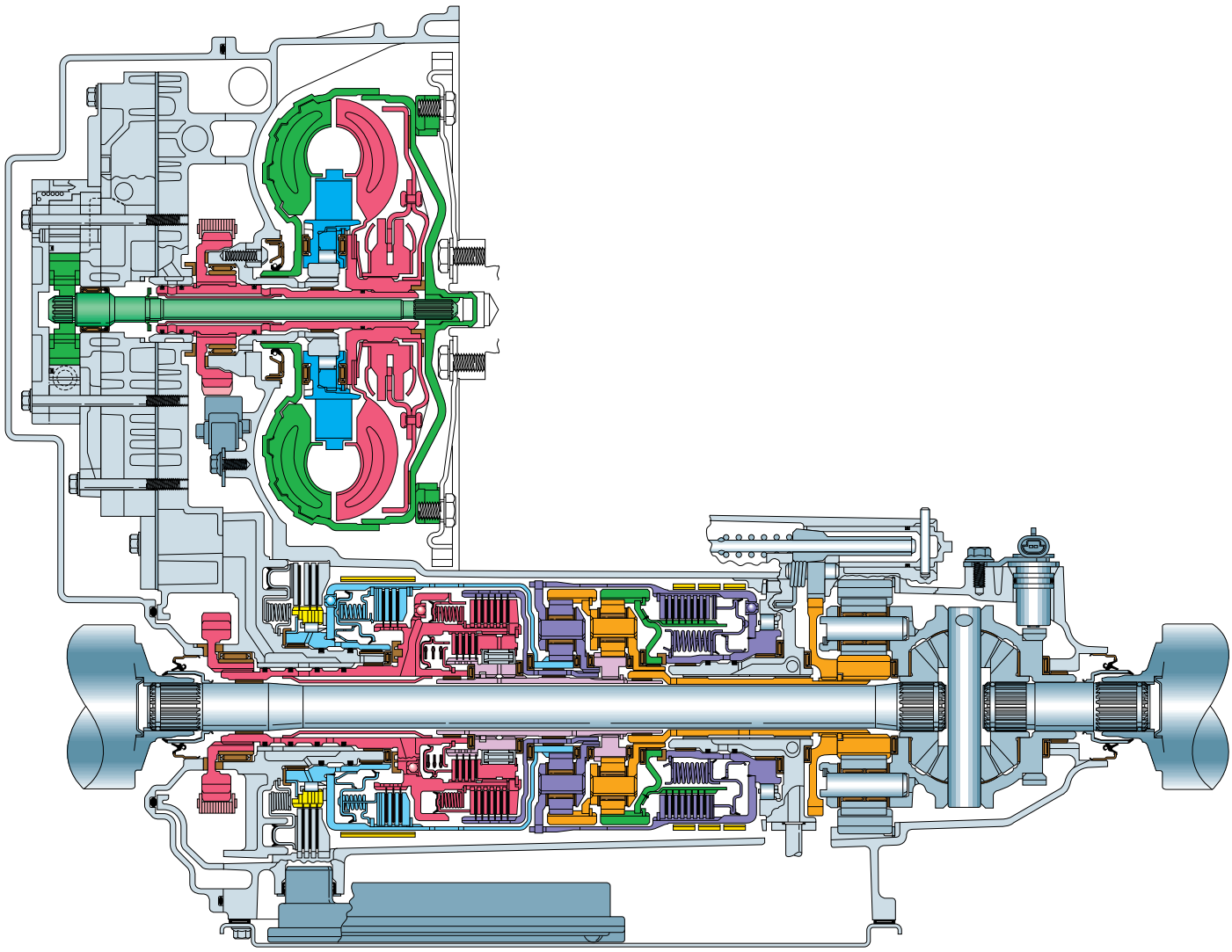


Figure 7

HYDRA-MATIC 4T40-E
CROSS SECTIONAL DRAWING

A cross sectional line drawing is typically the standard method for illustrating either an individual mechanical component or a complete transaxle assembly. However, unless a person is familiar with all the individual components of the transaxle, distinguishing components may be difficult in this type of drawing. For this reason, a three dimensional perspective illustration (shown on page 8) is the primary drawing used throughout this book.

The purpose for this type of illustration is to provide a more exacting graphic representation of each component and to show their relationship to other components within the transaxle assembly. It is also useful for understanding the cross sectional line drawing by comparing the same components from the three dimensional perspective illustration. In this regard it becomes an excellent teaching instrument.

Additionally, all the illustrations contained in this book use a color scheme that is consistent throughout this book. In other words, regardless of the type of illustration or drawing, all components have an assigned color and that color is used whenever that component is illustrated. This consistency not only helps to provide for easy component identification but it also enhances the graphic and color continuity between sections.

GENERAL DESCRIPTION

The Hydra-matic 4T40-E is a fully automatic, four speed, front wheel drive transaxle. It consists primarily of a four-element torque converter, two planetary gear sets, a hydraulic pressurization and control system, friction and mechanical clutches and, a final drive planetary gear set with a differential assembly.

The four-element torque converter contains a pump, a turbine, a pressure plate splined to the turbine, and a stator assembly. The torque converter acts as a fluid coupling to smoothly transmit power from the engine to the transaxle. It also hydraulically provides additional torque multiplication when required. The pressure plate, when applied, provides a mechanical "direct drive" coupling of the engine to the transaxle.

The two planetary gear sets provide the four forward gear ratios and reverse. Changing gear ratios is fully automatic and is accomplished through the use of a Powertrain Control Module (PCM). The PCM receives and monitors various electronic sensor inputs and uses this information to shift the transaxle at the optimum time.

The PCM commands shift solenoids, within the transaxle, on and off to control shift timing. The PCM also controls the apply and release of the torque converter clutch which allows the engine to deliver the maximum fuel efficiency without sacrificing vehicle performance.

The hydraulic system primarily consists of a vane type pump, control valve body and channel plate. The pump maintains the working pressures needed to stroke the servos and clutch pistons that apply or release the friction components. These friction components (when applied or released) support the automatic shifting qualities of the transaxle.

The friction components used in this transaxle consist of five multiple disc clutches and two bands. The multiple disc clutches combine with three mechanical components, two roller clutches and a sprag clutch, to deliver five different gear ratios through gear sets. The gear sets then transfer torque through the final drive differential and out to the drive axles.

EXPLANATION OF RANGES

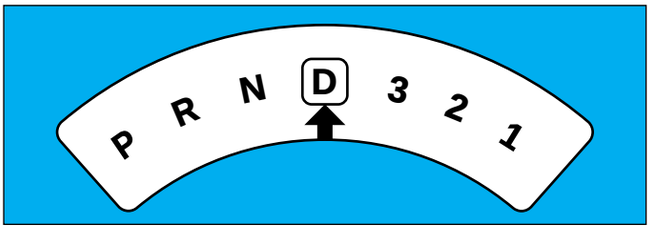


Figure 8

The transaxle can be operated in any one of the seven different positions shown on the shift quadrant (Figure 8).

P – Park position enables the engine to be started while preventing the vehicle from rolling either forward or backward. For safety reasons, the vehicle's parking brake should be used in addition to the transaxle "Park" position. Since the final drive differential and output shaft are mechanically locked to the case through the parking pawl and final drive internal gear, Park position should not be selected until the vehicle has come to a complete stop.

R – Reverse enables the vehicle to be operated in a rearward direction.

N – Neutral position enables the engine to start and operate without driving the vehicle. If necessary, this position should be selected to restart the engine while the vehicle is moving.

D – Overdrive range should be used for all normal driving conditions for maximum efficiency and fuel economy. Overdrive range allows the transaxle to operate in each of the four forward gear ratios. When operating in the Overdrive range, shifting to a lower or higher gear ratio is accomplished by depressing the accelerator.

It is not recommended that the transaxle be operated in Overdrive range when pulling heavy loads or driving on extremely hilly terrain. Typically these conditions put an extra load on the engine, therefore the transaxle should be driven in a lower manual range selection for maximum efficiency.

3 – Manual Third should be used when driving conditions dictate that it is desirable to use only three gear ratios. These conditions include towing a trailer or driving on hilly terrain as described above. This range is also helpful for engine braking when descending slight grades. If the vehicle is in fourth gear it will immediately shift to third when Manual Third is selected. Automatic shifting is the same as in Overdrive range for first, second and third gears except the transaxle will not shift into fourth gear.

2 – Manual Second should be used when driving conditions dictate that it is more desirable to use only two gear ratios. It has the same starting ratio (first gear) as Manual Third but the transaxle is prevented from shifting above second gear at normal throttle opening. If the transaxle is in third or fourth gear, when Manual Second is selected, it will shift to second gear below approximately 100 kmh (62 mph). Manual Second can be selected for engine braking as required.

1 – Manual First can be selected at any vehicle speed. If the transaxle is in second, third or fourth gear it will shift into first gear below approximately 60 kmh (37 mph). This is particularly beneficial for maintaining maximum engine braking when descending steep grades.

PRINCIPLES OF OPERATION

An automatic transaxle is the mechanical component of a vehicle that transfers power (torque) from the engine to the wheels. It accomplishes this task by providing a number of forward gear ratios that automatically change as the speed of the vehicle increases. The reason for changing forward gear ratios is to provide the performance and economy expected from vehicles manufactured today. On the performance end, a gear ratio that develops a lot of torque (through torque multiplication) is required in order to initially start a vehicle moving. Once the vehicle is in motion, less torque is required in order to maintain the vehicle at a certain speed. Once the vehicle has reached a desired speed, economy becomes the important factor and the transaxle will shift into overdrive. At this point output speed is greater than input speed, and, input torque is greater than output torque.

Another important function of the automatic transaxle is to allow the engine to be started and run without transferring torque to the wheels. This situation occurs whenever Park (**P**) or Neutral (**N**) range has been selected. Also, operating the vehicle in a rearward direction is possible whenever Reverse (**R**) range has been selected (accomplished by the gear sets).

The variety of ranges in an automatic transaxle are made possible through the interaction of numerous mechanically, hydraulically and electronically controlled components inside the transaxle. At the appropriate time and sequence, these components are either applied or released and operate the gear sets at a gear ratio consistent with the driver's needs. The following pages describe the theoretical operation of the mechanical, hydraulic and electrical components found in the Hydra-matic 4T40-E transaxle. When an understanding of these operating principles has been attained, diagnosis of these transaxle systems is made easier.

MAJOR MECHANICAL COMPONENTS

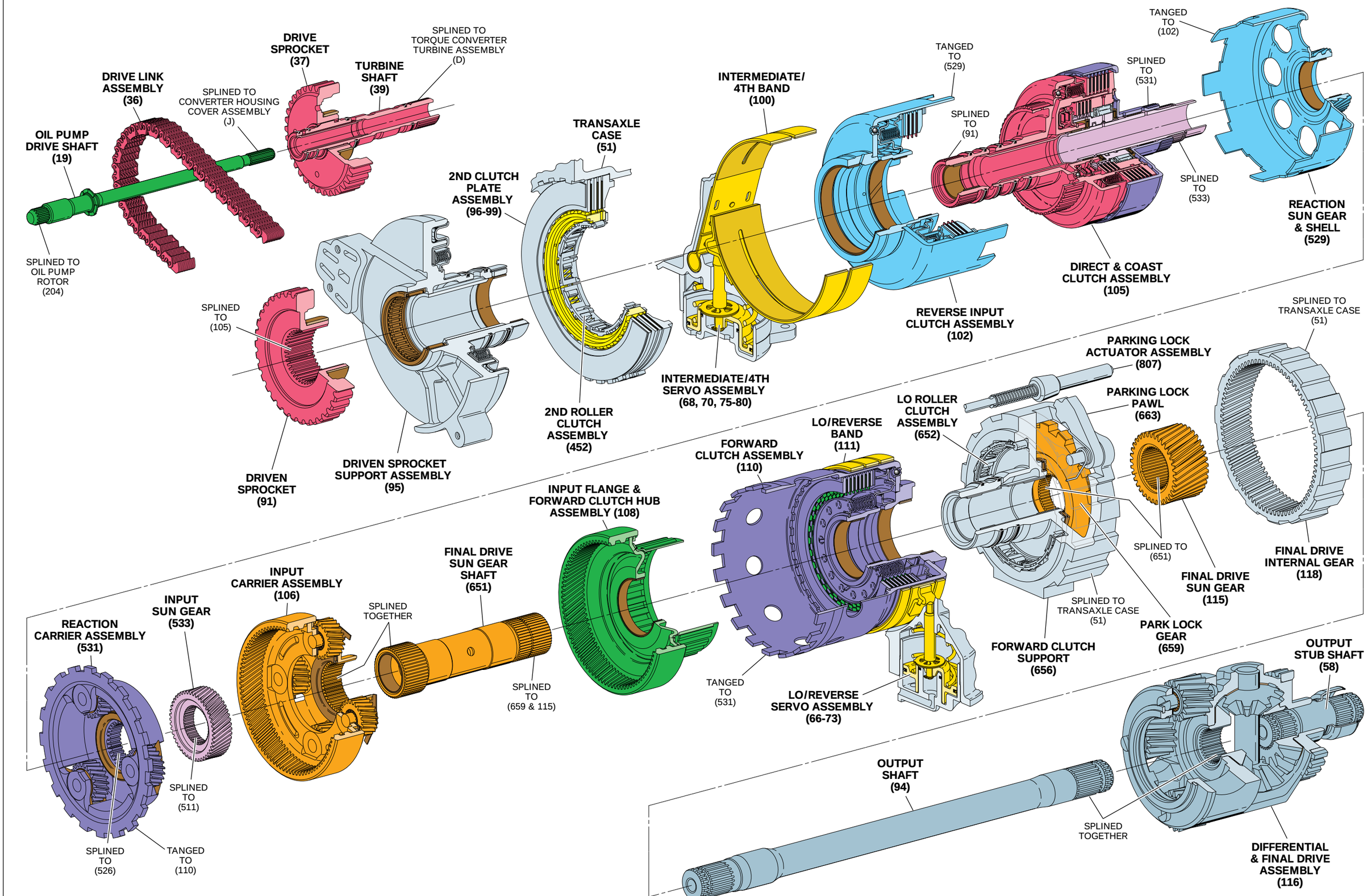


Figure 9

COLOR LEGEND

MAJOR MECHANICAL COMPONENTS

The foldout graphic on page 10 contains a disassembled drawing of the major components used in the Hydra-matic 4T40-E transaxle. This drawing, along with the cross sectional illustrations on pages 8 and 8A, shows the major mechanical components and their relationship to each other as a complete assembly. Therefore, color has been used throughout this book to help identify parts that are splined together, rotating at engine speed, held stationary, and so forth. Color differentiation is particularly helpful when using the Power Flow section for understanding the transaxle operation.

The color legend below provides the "general" guidelines that were followed in assigning specific colors to the major components. However, due to the complexity of this transaxle, some colors (such as grey) were used for artistic purposes rather than being restricted to the specific function or location of that component.

Components held stationary in the case or splined to the case. Examples: Driven Sprocket Support (95), Control Valve Body Asssembly (18).

Components that rotate at engine speed. Examples: Torque Converter Assembly (55) and Oil Pump Drive Shaft (19), Input Flange & Forward Clutch Hub Assembly (108).

Components that rotate at turbine speed. Examples: Converter Turbine, Drive Sprocket (37), Driven Sprocket (91) and Direct & Coast Clutch and Input Shaft Housing Assembly (502).

Components that rotate at transaxle output speed. Examples: Differential Carrier (116), Output Shaft (94).

Components such as the 2nd Clutch Fiber Plates (98), 2nd Roller Clutch Cam (451).

Components such as the Stator in the Torque Converter (55).

Components such as the Reverse Clutch Housing (454) and the Reaction Carrier Shaft Shell (526).

Components such as the Input Sun Gear Shaft and Inner Race Assembly (511), Input Sun Gear (533).

Components such as the Input Carrier (106), Forward Clutch Assembly (110).

Components such as the Reaction Carrier (531), Final Drive Sun Gear (115).

Accumulators, Servos and Bands.

All bearings and bushings.

All seals

COLOR LEGEND

APPLY COMPONENTS

The Range Reference Chart on page 11, provides another valuable source of information for explaining the overall function of the Hydra-matic 4T40-E transaxle. This chart highlights the major apply components that function in a selected gear range, and the specific gear operation within that gear range.

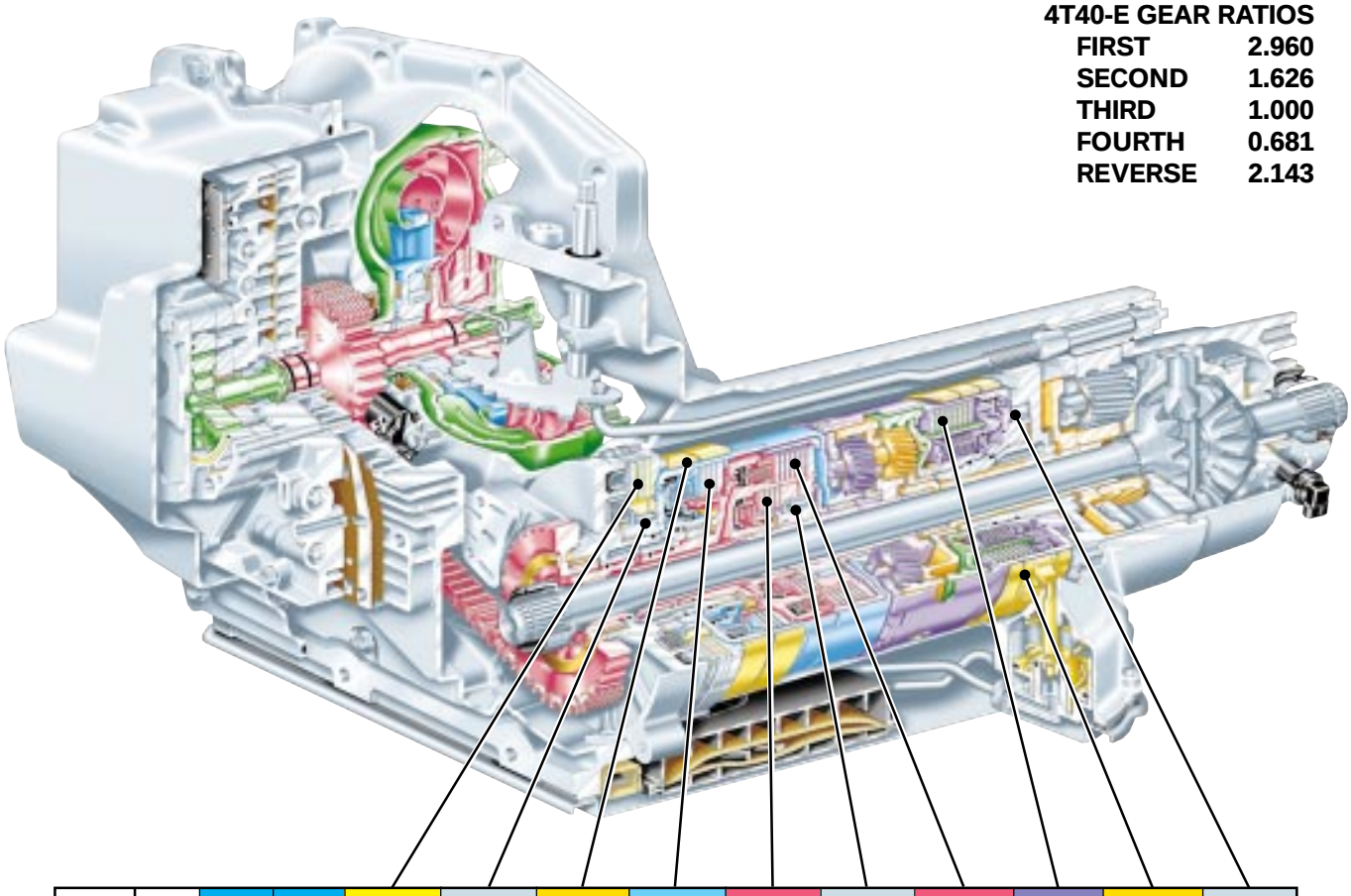
Included as part of this chart is the same color reference to each major component that was previously discussed. If a component is active in a specific gear range, a word describing its activity will be listed in the column below that component. The row where the activity occurs corresponds to the appropriate transaxle range and gear operation.

An abbreviated version of this chart can also be found at the top of the half pages of text located in the Power Flow section and at the bottom of the half pages of text located in the Complete Hydraulic Circuits section. This provides for a quick reference when reviewing the mechanical power flow information contained in those sections.

RANGE REFERENCE CHART

4T40-E GEAR RATIOS

FIRST	**2.960**
SECOND	**1.626**
THIRD	**1.000**
FOURTH	**0.681**
REVERSE	**2.143**

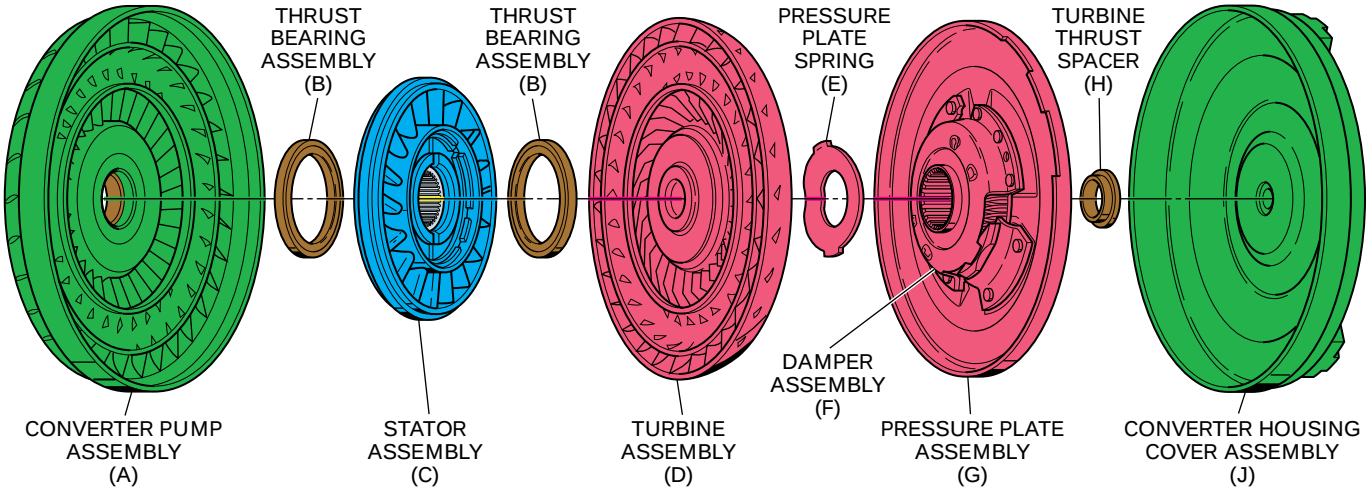


RANGE	GEAR	SHIFT "A" SOL	SHIFT "B" SOL	2ND CLUTCH	2ND ROLLER CLUTCH	INT/4TH BAND	REVERSE CLUTCH	COAST CLUTCH	INPUT SPRAG	DIRECT CLUTCH	FORWARD CLUTCH	LO/REV. BAND	LO ROLLER CLUTCH
PARK	N	ON	OFF						HOLDING*			APPLIED	
REV	R	ON	OFF				APPLIED					APPLIED	
NEU	N	ON	OFF						HOLDING*			APPLIED	
Ⓓ	1st	ON	OFF						HOLDING		APPLIED		HOLDING
	2nd	OFF	OFF	APPLIED	HOLDING				HOLDING		APPLIED		OVER-RUNNING
	3rd	OFF	ON	APPLIED*	OVER-RUNNING				HOLDING	APPLIED	APPLIED		OVER-RUNNING
	4th	ON	ON	APPLIED*		APPLIED			OVER-RUNNING	APPLIED	APPLIED*		OVER-RUNNING
3	1st	ON	OFF					APPLIED	HOLDING		APPLIED		HOLDING
	2nd	OFF	OFF	APPLIED	HOLDING			APPLIED	HOLDING		APPLIED		OVER-RUNNING
	3rd	OFF	ON	APPLIED*	OVER-RUNNING			APPLIED	HOLDING	APPLIED	APPLIED		OVER-RUNNING
2	1st	ON	OFF					APPLIED	HOLDING		APPLIED		HOLDING
	2nd	OFF	OFF	APPLIED	HOLDING	APPLIED		APPLIED	HOLDING		APPLIED		OVER-RUNNING
	3rd**	OFF	ON	APPLIED*	OVER-RUNNING			APPLIED	HOLDING	APPLIED	APPLIED		OVER-RUNNING
1	1st	ON	OFF					APPLIED	HOLDING		APPLIED	APPLIED	HOLDING
	2nd***	OFF	OFF	APPLIED	HOLDING	APPLIED		APPLIED	HOLDING		APPLIED		OVER-RUNNING
	3rd**	OFF	ON	APPLIED*	OVER-RUNNING			APPLIED	HOLDING	APPLIED	APPLIED		OVER-RUNNING

ON = SOLENOID ENERGIZED
OFF = SOLENOID DE-ENERGIZED
* = APPLIED WITH NO LOAD.
** = MANUAL FIRST AND SECOND – THIRD GEAR IS ONLY AVAILABLE ABOVE APPROXIMATELY 100 km/h (62 mph).
*** = MANUAL FIRST – SECOND GEAR IS ONLY AVAILABLE ABOVE APPROXIMATELY 60 km/h (37 mph).
NOTE: MANUAL FIRST – THIRD GEAR IS ALSO POSSIBLE AT HIGH VEHICLE SPEED AS A SAFETY FEATURE.

Figure 10

TORQUE CONVERTER



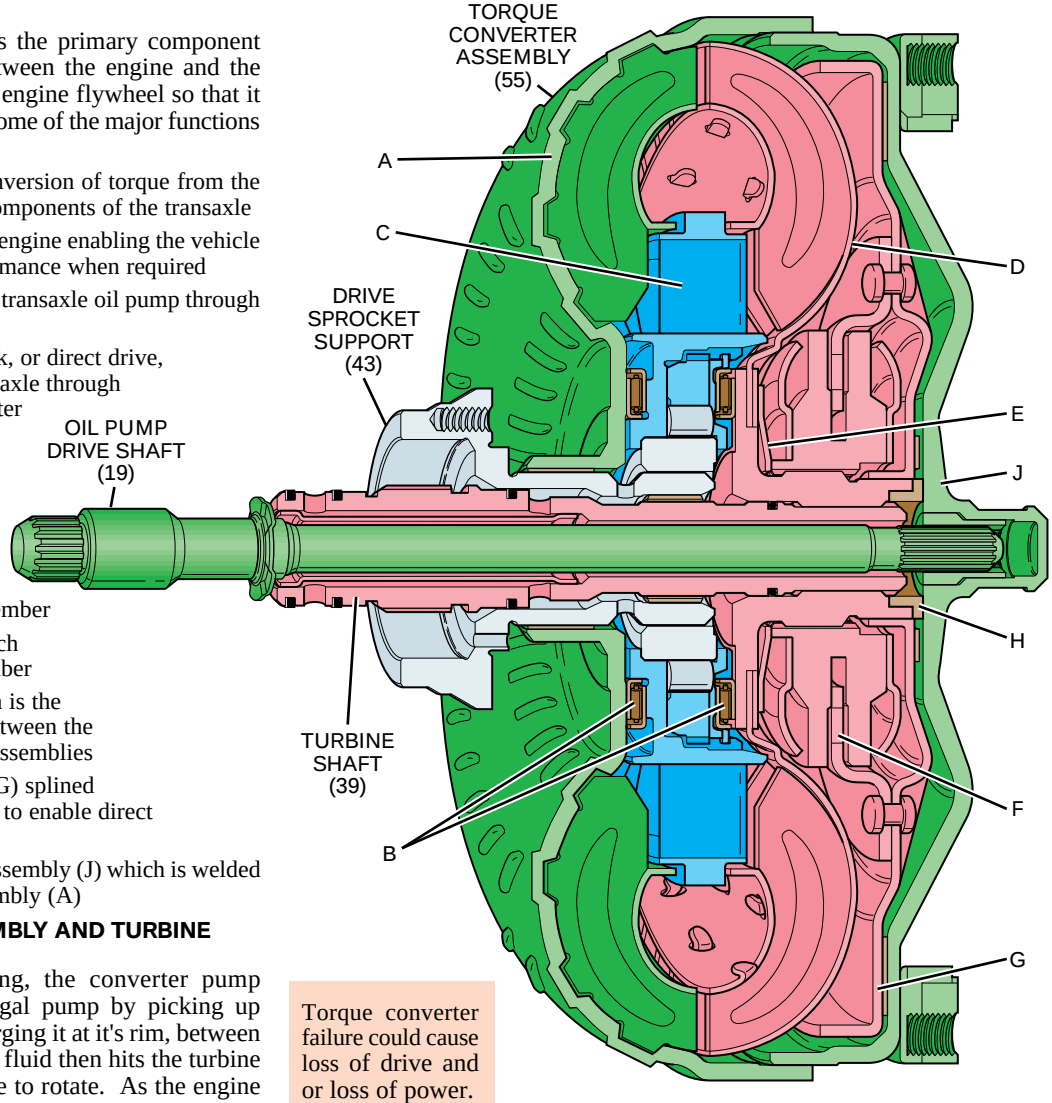
TORQUE CONVERTER

The torque converter (55) is the primary component for transmittal of power between the engine and the transaxle. It is bolted to the engine flywheel so that it will rotate at engine speed. Some of the major functions of the torque converter are:

- to provide for a smooth conversion of torque from the engine to the mechanical components of the transaxle
- to multiply torque from the engine enabling the vehicle to achieve additional performance when required
- to mechanically operate the transaxle oil pump through the pump drive shaft (19)
- to provide a mechanical link, or direct drive, from the engine to the transaxle through the use of a Torque Converter Clutch (TCC)

The torque converter assembly is made up of the following five main subassemblies:

- a converter pump assembly (A) which is the driving member
- a turbine assembly (D) which is the driven or output member
- a stator assembly (C) which is the reaction member located between the pump (A) and turbine (D) assemblies
- a pressure plate assembly (G) splined to the turbine assembly (D) to enable direct mechanical drive
- a converter housing cover assembly (J) which is welded to the converter pump assembly (A)



CONVERTER PUMP ASSEMBLY AND TURBINE ASSEMBLY

When the engine is running, the converter pump assembly acts as a centrifugal pump by picking up fluid at it's center and discharging it at it's rim, between the blades. The force of this fluid then hits the turbine blades and causes the turbine to rotate. As the engine and converter pump increase RPM, so does the turbine.

Torque converter failure could cause loss of drive and or loss of power.

PRESSURE PLATE, DAMPER AND CONVERTER HOUSING COVER ASSEMBLIES

The pressure plate is splined to the turbine hub and applies (engages) with the converter cover to provide a mechanical coupling of the engine to the transaxle. When the pressure plate assembly is applied, the small amount of slippage that occurs through a fluid coupling is eliminated, thereby providing a more efficient transfer of engine torque to the drive wheels.

To reduce torsional shock during the apply of the pressure plate to the converter cover, a spring loaded damper assembly (F) is used. The pressure plate is attached to the pivoting mechanism of the damper assembly which allows the pressure plate to rotate independently of the damper assembly up to approximately 45 degrees. During engagement, the springs in the damper assembly cushion the pressure plate engagement and also reduce irregular torque pulses from the engine or road surface.

Figure 11

TORQUE CONVERTER

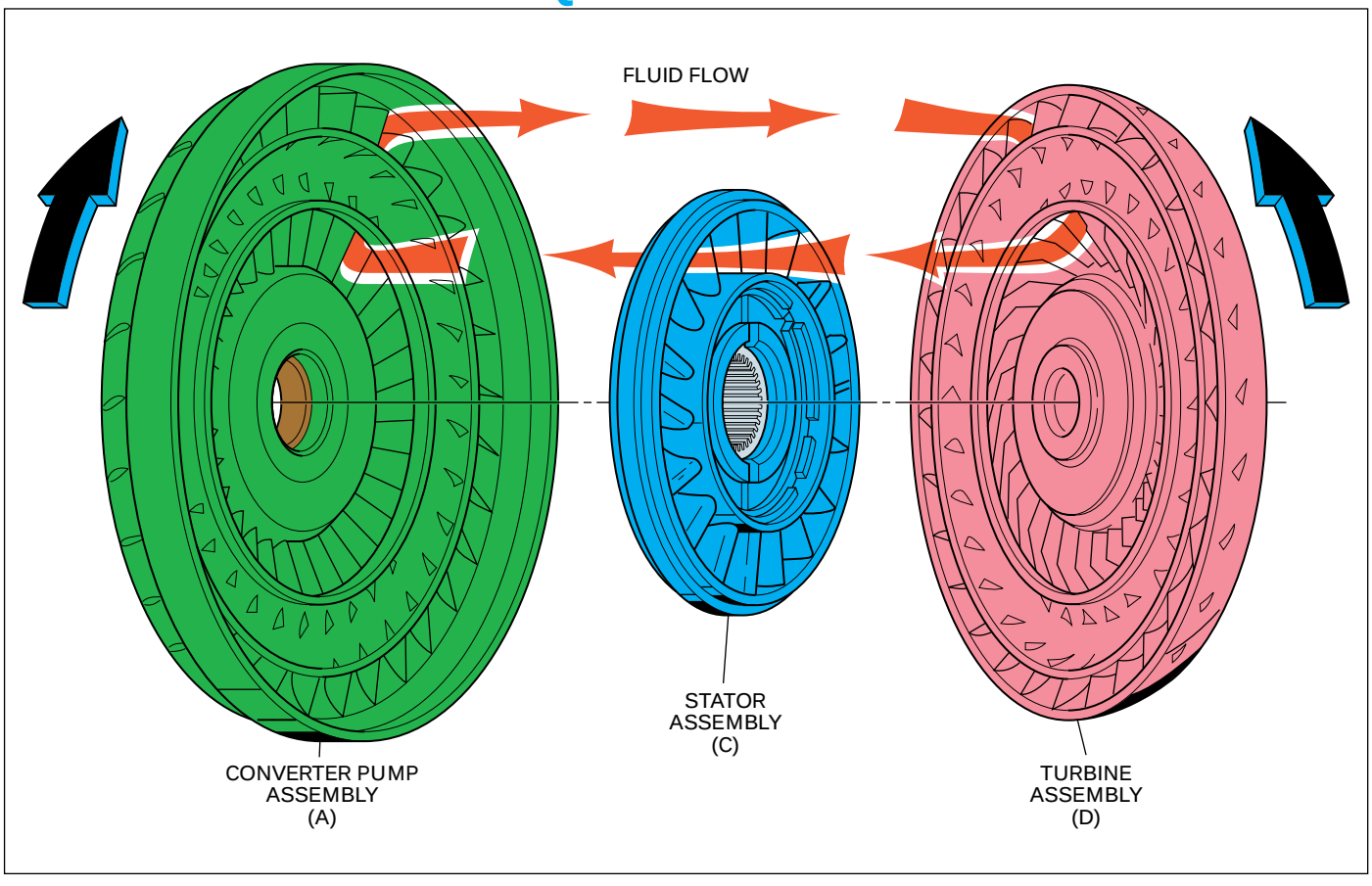


Figure 12

Stator roller clutch failure

- roller clutch freewheels in both directions can cause poor acceleration at low speed.
- roller clutch locks up in both directions can cause poor acceleration at high speed.
- Overheated fluid.

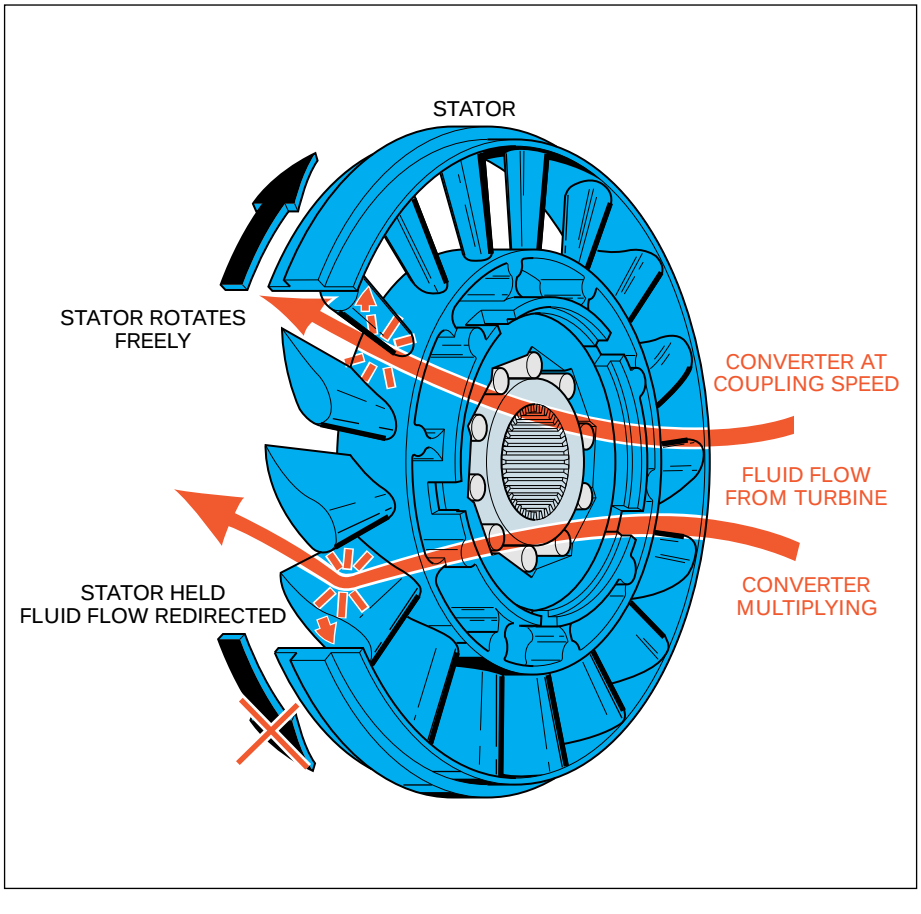


Figure 13

STATOR ASSEMBLY

The stator assembly is located between the pump assembly and turbine assembly, and is mounted on a one-way roller clutch. This one-way roller clutch allows the stator to rotate in one direction and prevents (holds) the stator from rotating in the other direction. The function of the stator is to redirect fluid returning from the turbine in order to assist the engine in turning the converter pump assembly.

At low vehicle speeds when greater torque is needed, fluid from the turbine hits the front side of the stator blades (the converter is multiplying torque). At this time, the one-way roller clutch prevents the stator from rotating in the same direction as the fluid flow, thereby redirecting fluid to assist the engine in turning the converter pump. In this mode, fluid leaving the converter pump has more force to turn the turbine assembly and multiply engine torque.

As vehicle speed increases and less torque is required, centrifugal force acting on the fluid changes the direction of the fluid leaving the turbine such that it hits the back side of the stator blades (converter at coupling speed). When this occurs, the roller clutch overruns and allows the stator to rotate freely. Fluid is no longer being redirected to the converter pump and engine torque is not being multiplied.

TORQUE CONVERTER

RELEASE

When the torque converter clutch is released, fluid is fed into the torque converter by the pump into the release fluid passage. The release fluid passage is located between the oil pump drive shaft (19) and the turbine shaft (39). Fluid travels between the shafts and enters the release side of the pressure plate at the end of the turbine shaft. The pressure plate is forced away from the converter cover and allows the torque converter turbine to rotate at speeds other than engine speed.

The release fluid then flows between the friction element on the pressure plate and the converter cover to enter the apply side of the torque converter. The fluid then exits the torque converter through the apply passage which goes into the drive sprocket support and on through an oil sleeve within the turbine shaft. This fluid now travels to the valve body and on to the oil cooler.

Once the TCC is applied there is no torque converter fluid coupling assistance. Engine or driveline vibration could be unnoticeable before TCC engagement.

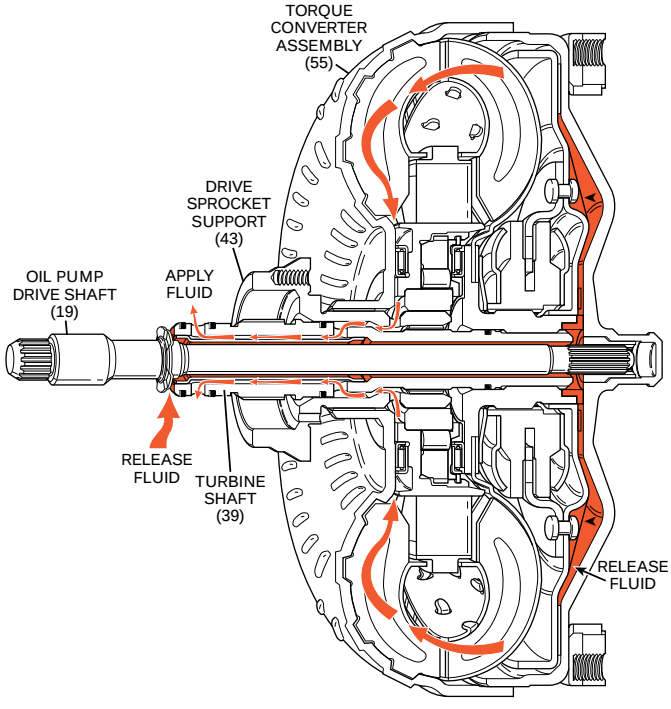
APPLY

When the PCM determines that the vehicle is at the proper speed for the torque converter clutch to apply it sends a signal to the TCC PWM solenoid. The TCC PWM solenoid then routes line fluid from the pump to the apply passage of the torque converter. The apply passage is a hole between two seals on the turbine shaft. The fluid flows inside the turbine shaft within an oil sleeve, then out of the sleeve and into the converter hub/drive sprocket support. Fluid passes through a hole in the support and into the torque converter on the apply side of the pressure plate assembly.

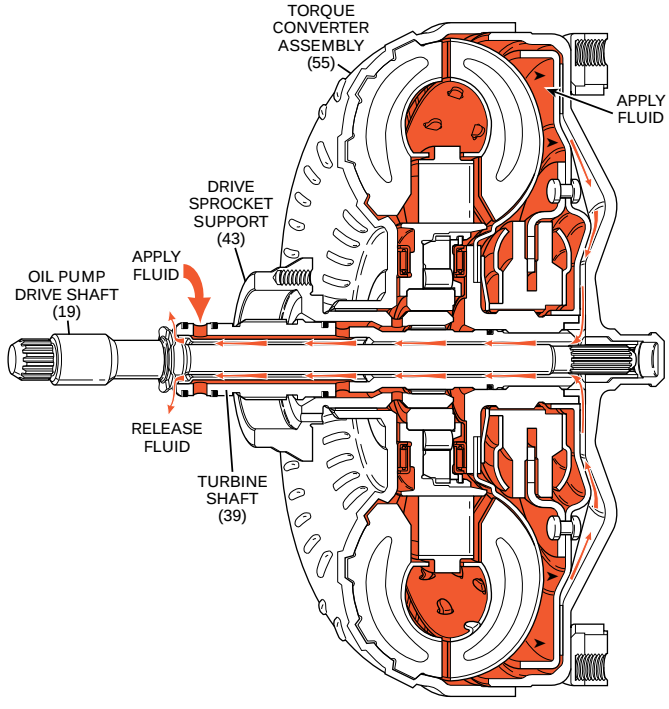
Apply fluid pressure forces the pressure plate against the torque converter cover to provide a mechanical link between the engine and the turbine. Release fluid is then routed out of the torque converter between the turbine shaft and the pump shaft.

The TCC apply should occur in fourth gear (also third gear in some applications), and should not apply until the transaxle fluid has reached a minimum operating temperature of 8°C (46°F) and the engine coolant temperature reaches 50°C (122°F).

For more information on TCC apply and release, see Overdrive Range – Fourth Gear TCC Released and Applied, pages 70-71.



TCC RELEASED



TCC APPLIED

Figure 14

APPLY COMPONENTS

The primary function of any apply component is to hold or cause to drive, a member of a planetary gear set.

The "Apply Components" section is designed to explain the function of the hydraulic and mechanical holding devices used in the Hydra-matic 4T40-E transaxle. Some of these apply components, such as clutches and bands, are hydraulically "applied" and "released" in order to provide automatic gear range shifting. Other components, such as a roller clutch or sprag clutch, often react to a hydraulically "applied" component by mechanically "holding" or "releasing" another member of the transaxle. This interaction between the hydraulically and mechanically applied components is explained in detail and supported with a graphic illustration. In addition, this section shows the routing of fluid pressure to the individual components and their internal operation when the component applies or releases.

The sequence in which the components in this section have been discussed coincides with their physical arrangement inside the transaxle. This order closely parallels the disassembly sequence used in the Hydra-matic 4T40-E Unit Repair Section located in Section 7 of the appropriate Service Manual. It also correlates with the components shown on the Range Reference Charts that are used throughout the Power Flow section of this book. The correlation of information between the sections of this book helps the user to more clearly understand the hydraulic and mechanical operating principles for this transaxle.

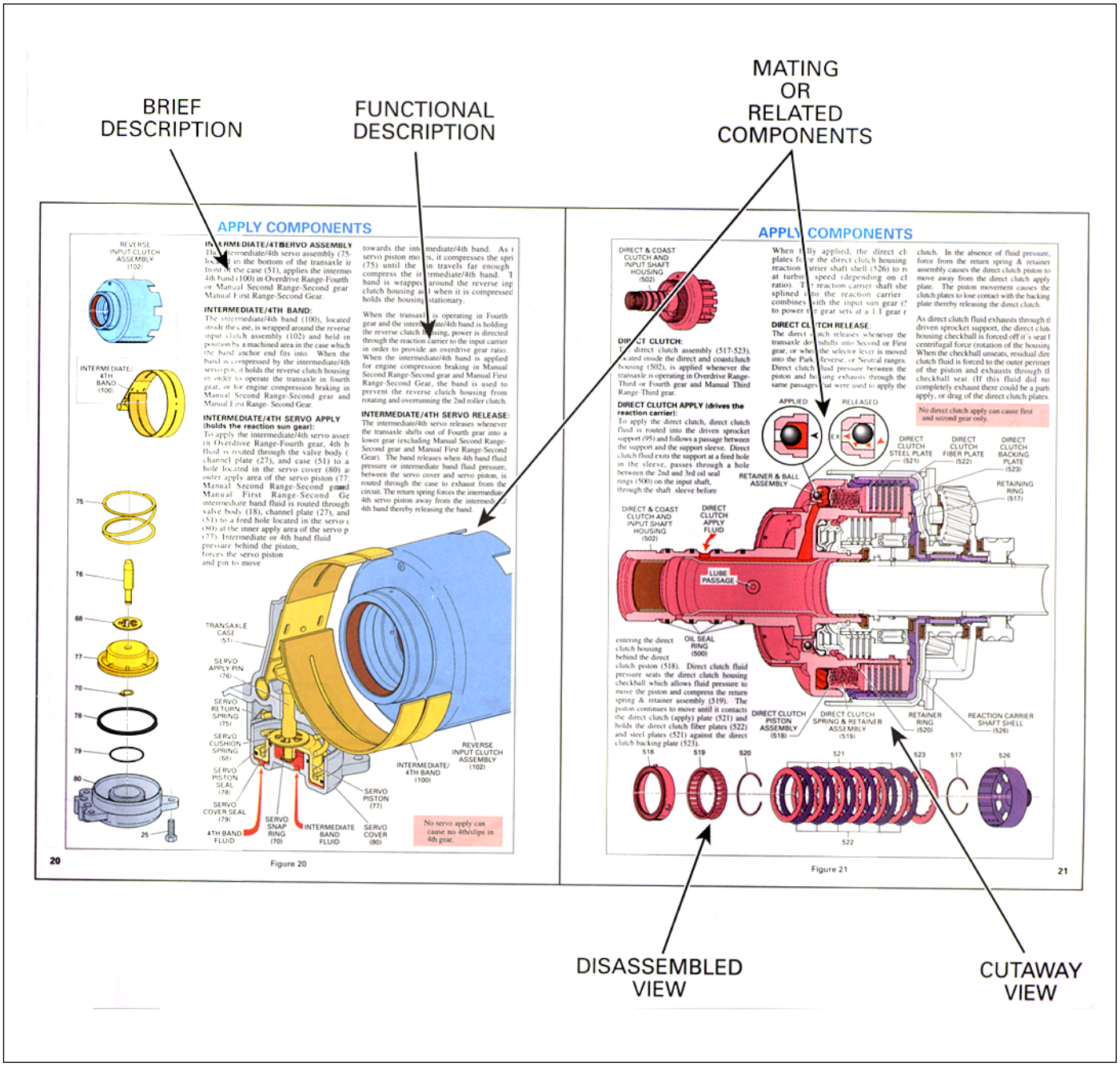


Figure 15

Driven Sprocket Support

Along with being the housing for the 2nd clutch and a support for the driven sprocket, the driven sprocket support acts as a stationary fluid routing component, delivering fluid to rotating components. This is accomplished through a series of passages and seals within the sprocket support, the reverse clutch assembly and the direct and coast clutch assembly.

Reverse Clutch Fluid Passage
Reverse clutch fluid flows through the driven sprocket support, exits through a hole, between the oil seal rings (403), and enters the reverse clutch housing to apply the reverse clutch.

Lube 1 Fluid Passages
Lube 1 fluid travels through the driven sprocket support and exits through a hole to lubricate bushings and parts in this region of the transaxle.

Lube 1 fluid also travels through another passage in the driven sprocket support to a hole, between the first and second oil seal rings (500), in the input housing shaft. This fluid lubricates the bushings in this area of the transaxle (see Lubrication Points page 104).

Direct Clutch Apply Fluid
Direct clutch apply fluid travels through the driven sprocket support to a hole in the input shaft, between the 2nd and 3rd oil seal rings (500), and into the direct clutch housing to apply the piston.

Coast Clutch Apply Fluid
This fluid travels through the driven sprocket support to a hole in the input shaft, between the 3rd and 4th oil seal rings (500), and on to the coast clutch to apply the piston.

Worn or improperly installed oil seal rings can greatly affect the apply force and lubrication capabilities of the fluid in the transaxle.

Damaged or leaking seals (500) can cause no third gear/slips in third, or no coast clutch apply/slipping in all manual ranges.

Porosity or leaking 2nd clutch piston seals can cause no second/slips in second.

Damaged or leaking seals (403) can cause no reverse gear/slips in reverse.

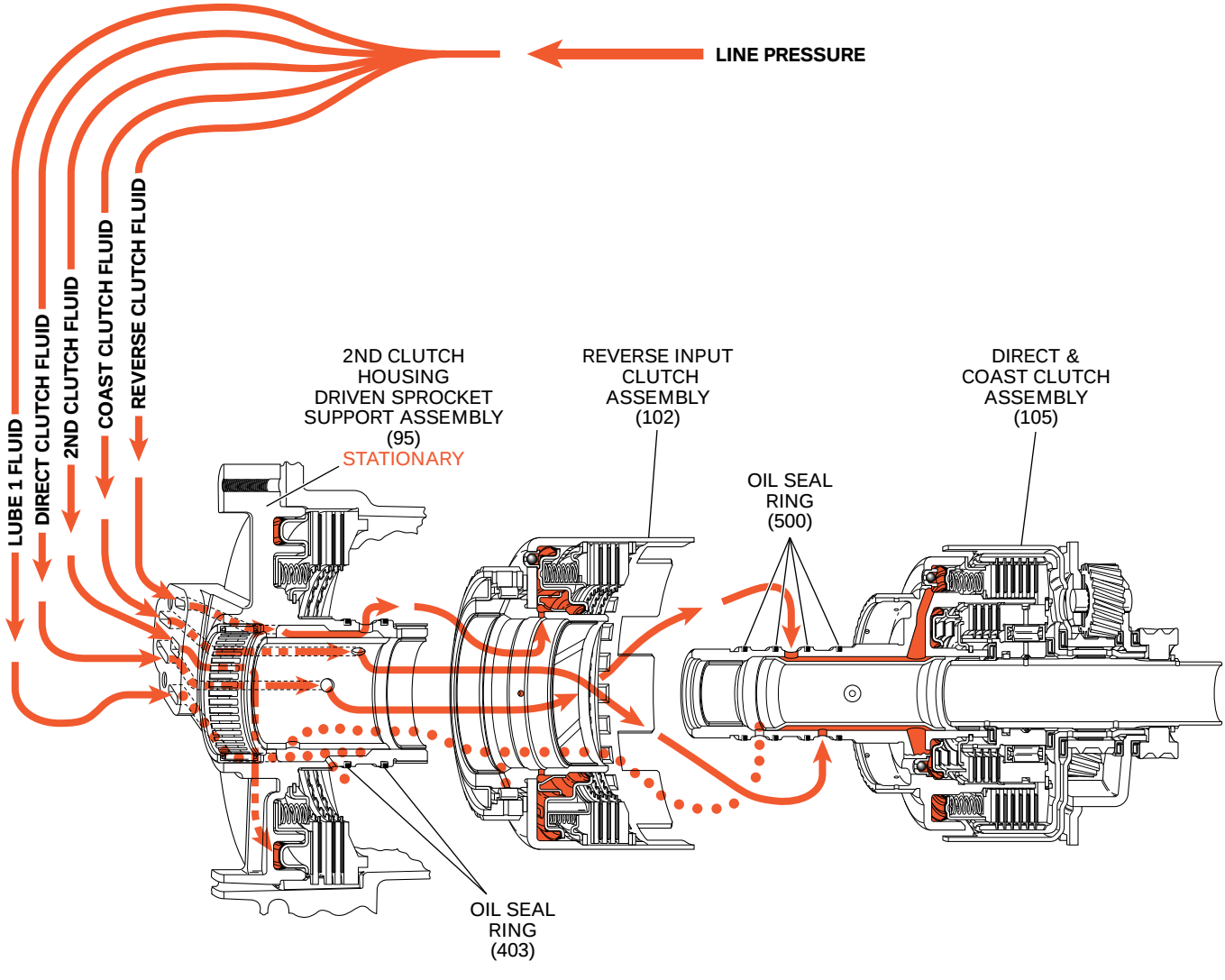
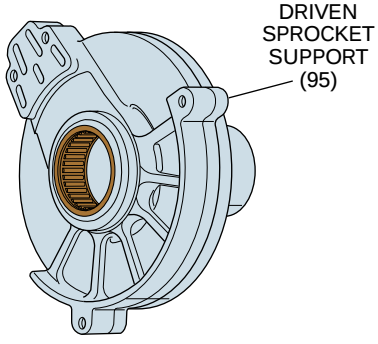


Figure 16

APPLY COMPONENTS



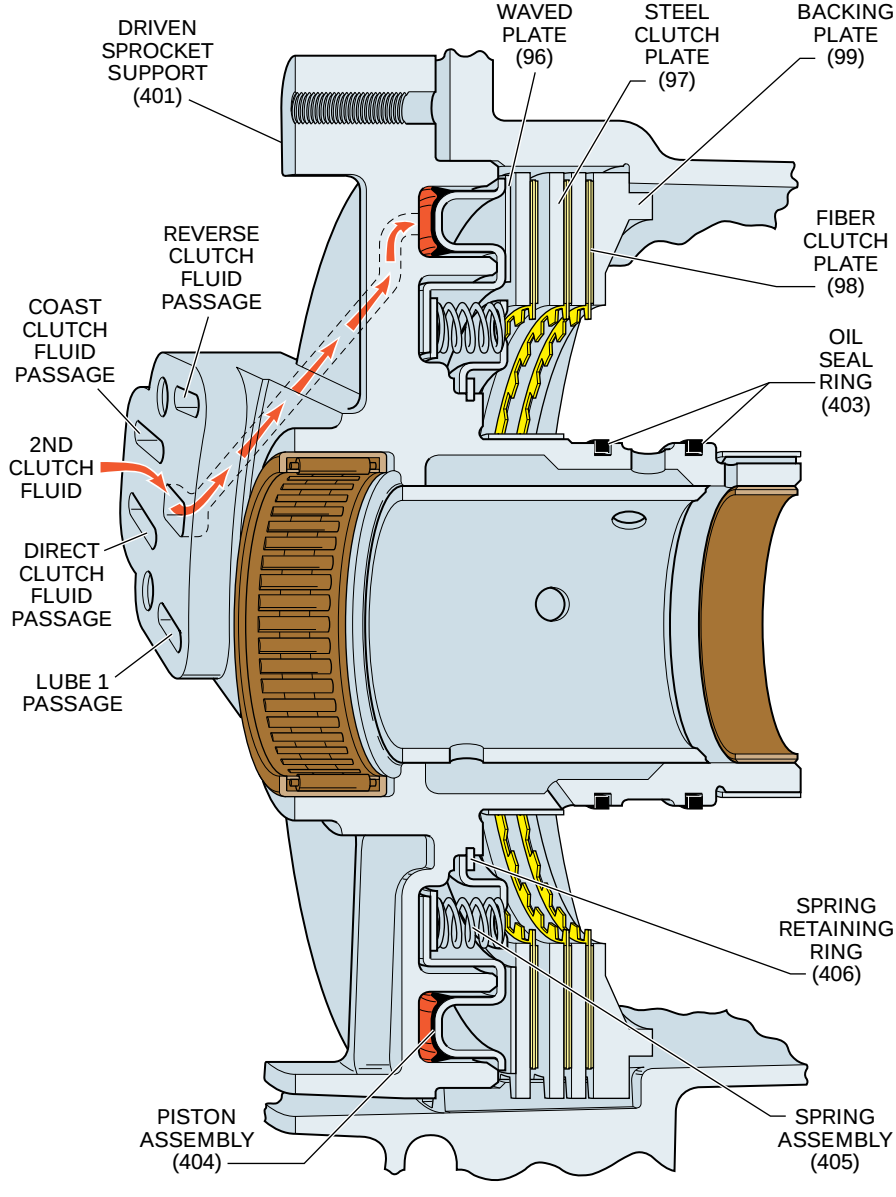
2ND CLUTCH RELEASE:
The 2nd clutch releases whenever the transaxle shifts into First gear, or when the selector lever is moved into the Park, Reverse, or Neutral ranges. As the 2nd clutch releases, 2nd clutch fluid pressure between the 2nd clutch piston assembly and driven sprocket support exhausts through the support. In the absence of fluid pressure, force from the spring assembly causes the 2nd clutch piston to move away from the clutch plates. The piston movement causes the clutch plates to lose contact with the backing plate thereby releasing the 2nd clutch.

Component failure can cause no second/slips in second.

2ND CLUTCH:
The 2nd clutch assembly (404-406 & 96-99), located between the driven sprocket support (401) and the reverse clutch housing and race assembly (102), is applied whenever the transaxle is operating in Overdrive Range Second, Third or Fourth gear. It is also applied in Manual Second Range-Second gear and Third gear, Manual Third Range-Second and Third gear and Manual First Range-Second and Third gear.

2ND CLUTCH APPLY:
To apply the 2nd clutch, 2nd clutch fluid is routed into the driven sprocket support (401) behind the 2nd clutch piston assembly (404). Fluid pressure moves the piston and compresses the spring assembly (405). The piston continues to move until it compresses the 2nd clutch waved plate (96) and holds the fiber plates (98) and steel plates (97) against the backing plate (99).

When fully applied, the 2nd clutch provides power through the planetary gear sets by holding the 2nd roller clutch cam (451) through the internal teeth on the fiber clutch plates. (The external teeth on the steel clutch plates are splined into the transaxle case.) This arrangement allows Second gear by redirecting power through the reaction carrier.



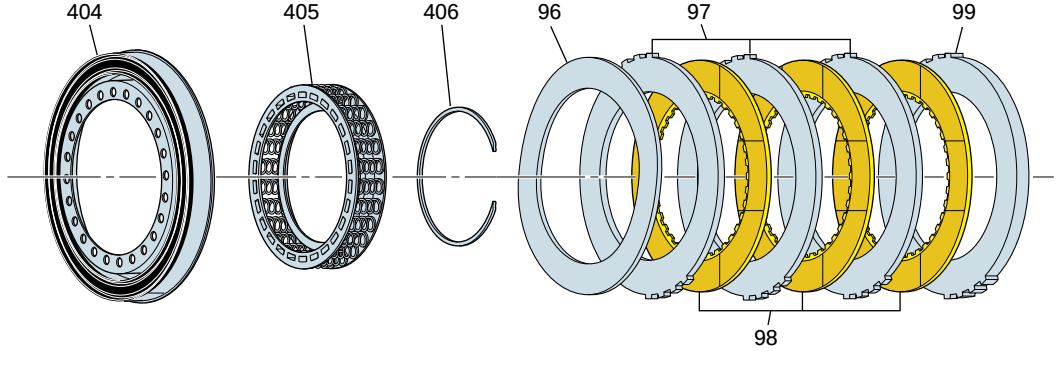


Figure 17

APPLY COMPONENTS

2ND ROLLER CLUTCH:
The 2nd roller clutch (450-452), located between the driven sprocket support (401) and reverse clutch housing (454), holds the reverse clutch housing whenever the transaxle is operating in Second gear.

2ND ROLLER CLUTCH ASSEMBLY HOLDING (the reaction sun gear):
The 2nd clutch assembly (96-99 & 404-406) has fiber plates with internal teeth splined to the 2nd roller clutch cam (451), and steel plates that are splined to the case. The 2nd roller clutch inner race is part of the reverse clutch housing (454), which rotates in the opposite direction of engine rotation during First gear operation. When the 2nd clutch applies, internal teeth on the 2nd clutch fiber plates hold the 2nd roller clutch cam stationary. The reverse clutch housing is then prevented from rotating in a direction opposite to engine rotation because the rollers are forced to wedge between the inner race and lowest part of the cam ramps.

When the 2nd roller clutch is mechanically locked up, it holds the reaction sun gear and shell assembly (529) through the reverse clutch housing. This arrangement directs power flow to the reaction carrier assembly in Second gear.

2ND ROLLER CLUTCH ASSEMBLY RELEASED:
The 2nd roller clutch assembly releases whenever the 2nd clutch releases, or its rollers "overrun" (freewheel). An overrunning condition occurs whenever the transaxle operates in Third gear where the 2nd clutch is not used for power flow through the gear sets. While operating in Third gear, the reverse clutch housing rotates in the direction of engine rotation. When this occurs, the rollers are forced to rotate in the opposite direction which disengages the inner race from the outer cam. The rollers freewheel when this condition occurs.

Roller clutch damaged, not holding can cause no Overdrive range second/slips in second.

Note: Manual second will be available.

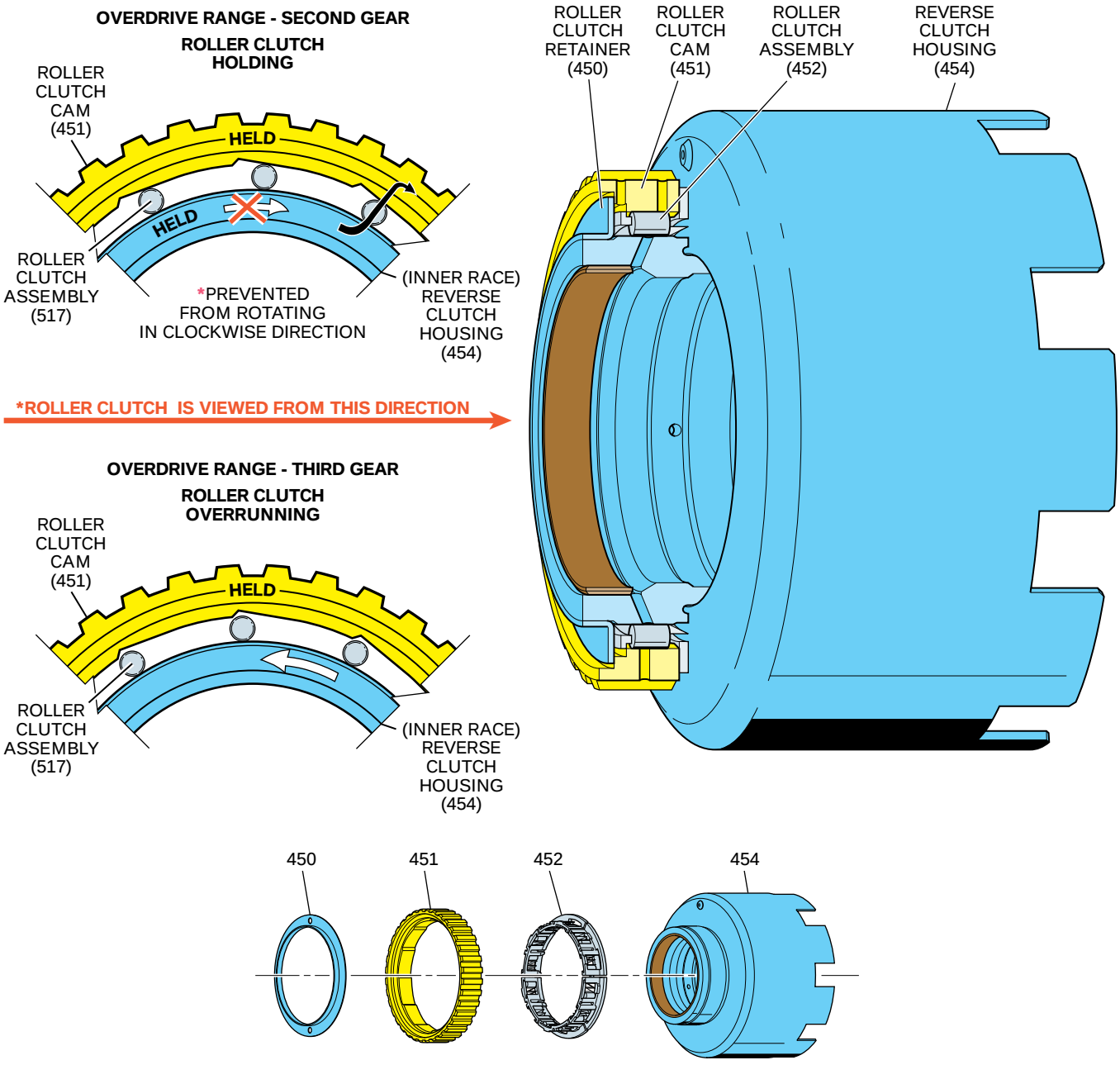
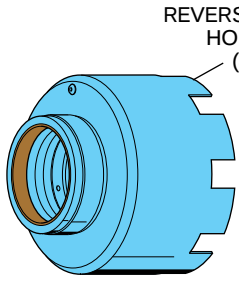


Figure 18

APPLY COMPONENTS



REVERSE CLUTCH:
The reverse input clutch assembly (102), is applied only when Reverse range is selected through the gear shift selector lever, but the reverse clutch housing acts as part of the holding member of the reaction sun gear.

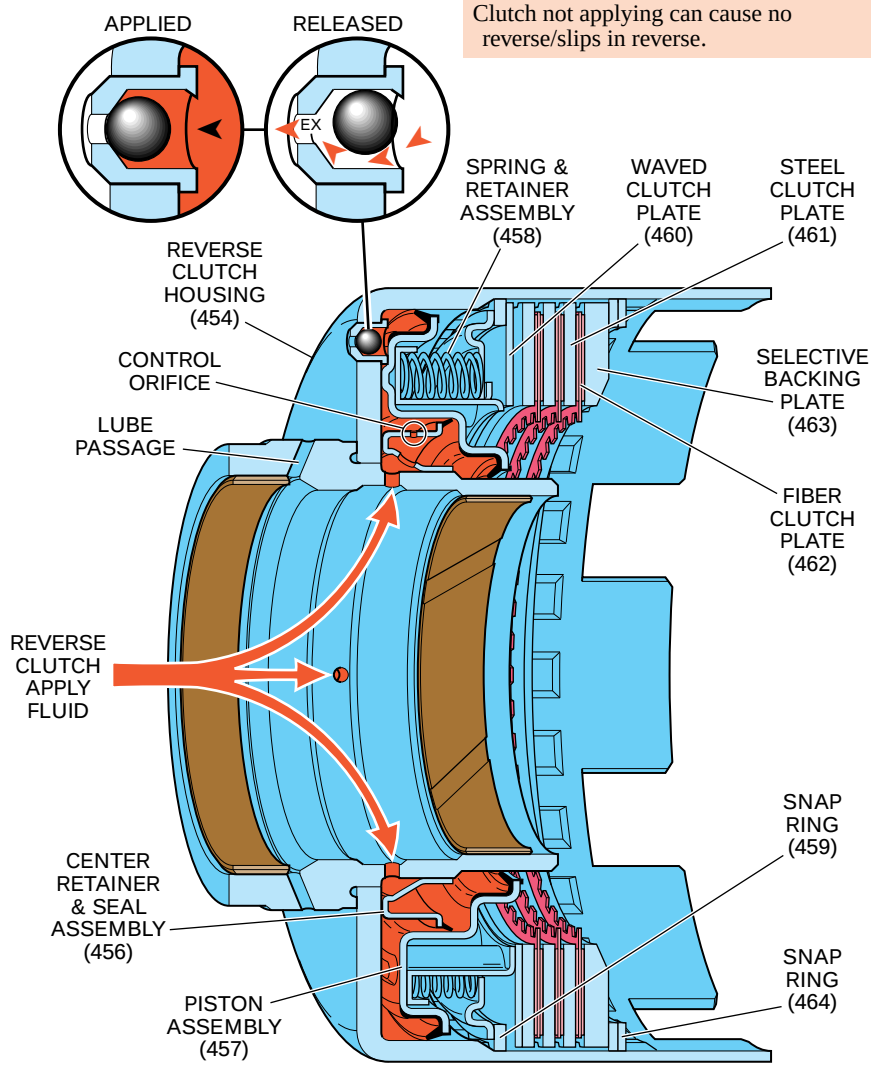
REVERSE CLUTCH APPLY (drives the reaction sun gear):
To apply the reverse clutch, reverse clutch fluid is routed into the driven sprocket support (401) and follows a passage between the support and support sleeve. Reverse clutch fluid exits the support at a feed hole located between two oil seal rings (403) and enters the reverse clutch housing through feed holes located in the reverse clutch housing between the two bearing surfaces. Reverse clutch fluid then enters the inner apply area between the piston (457) and center retainer & seal assembly (456). The center retainer & seal assembly (456) has an orifice that allows fluid to enter the outer area of the piston. This orifice system allows a controlled rate of apply to create a smoother shift feel. Reverse clutch fluid compresses the air trapped in the outer piston area until fluid and air pressure seat the ball, which allows fluid pressure to move the piston and compress the spring & retainer assembly (458). The piston continues to move until the spring & retainer assembly compresses the reverse clutch waved plate (460), and holds the steel clutch plates (461) and fiber clutch plates (462) against the selective backing plate (463).

When fully applied, the reverse clutch combines with the lo/reverse servo assembly (66-73) and lo/reverse band (111) to enable a reverse direction of rotation and power through the gear sets. (See Lo/ Reverse Servo and Lo/Reverse Band description on page 25.)

REVERSE CLUTCH RELEASE:
The reverse clutch releases whenever the selector lever is moved into another range and reverse clutch fluid, between the housing and reverse clutch piston, is forced back through the feed holes into the driven sprocket support. Release fluid is allowed to slip by the outer portion of the center retainer & seal assembly (456) to allow a quick release. In the absence of fluid pressure, force from the spring and retainer assembly causes the reverse clutch piston to move away from the clutch plates. The piston movement causes the clutch plates to lose contact with the backing plate thereby releasing the reverse clutch.

With the clutch released, the reverse clutch ball capsule is forced off it's seat by centrifugal force (rotation of the housing). When the checkball unseats, residual reverse clutch fluid is forced to the outer perimeter of the piston and exhausts through the checkball seat. (If this fluid did not completely exhaust there could be a partial apply, or drag of the reverse clutch plates.)

Clutch not releasing can cause drive in neutral.
Clutch not applying can cause no reverse/slips in reverse.



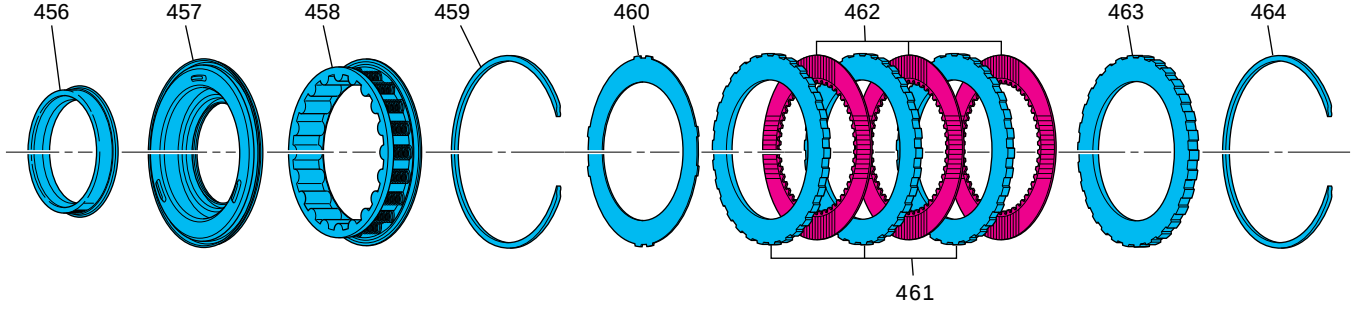
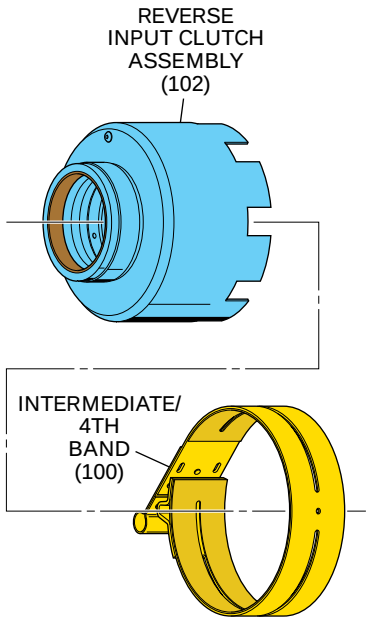
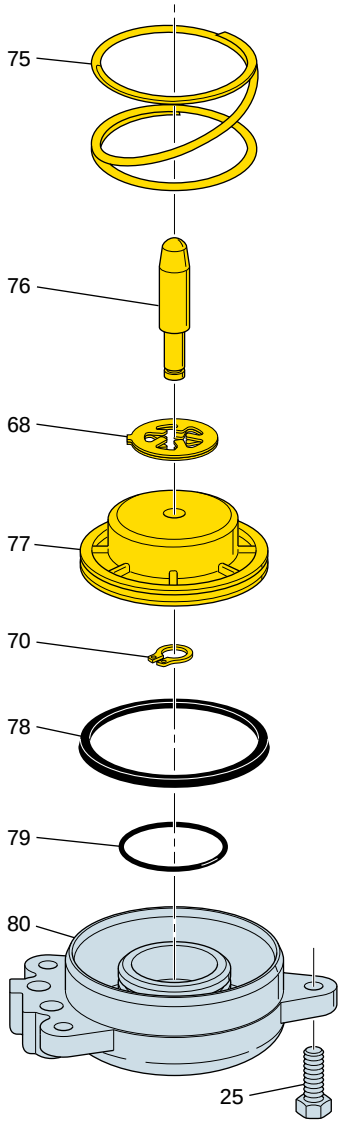


Figure 19

APPLY COMPONENTS





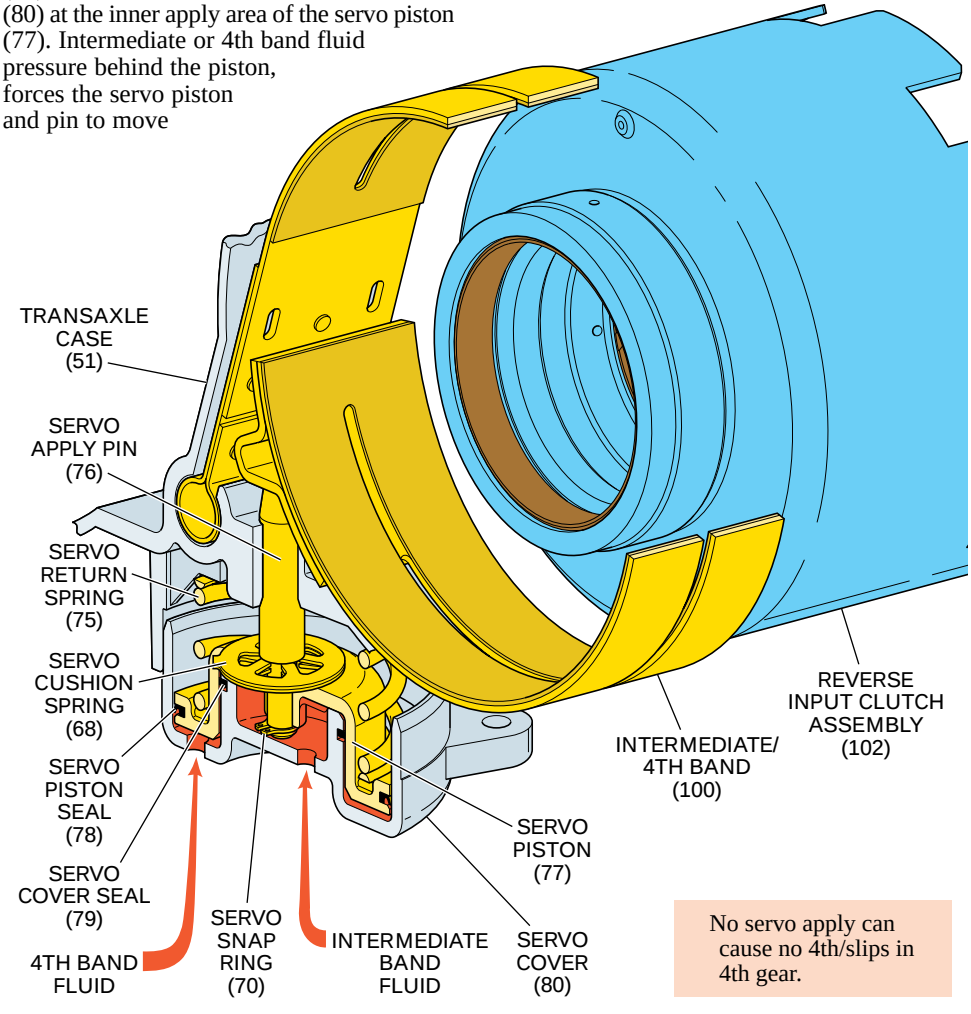
INTERMEDIATE/4TH SERVO ASSEMBLY:
The intermediate/4th servo assembly (75-80), located in the bottom of the transaxle in the front of the case (51), applies the intermediate/4th band (100) in Overdrive Range-Fourth gear or Manual Second Range-Second gear and Manual First Range-Second Gear.

INTERMEDIATE/4TH BAND:
The intermediate/4th band (100), located inside the case, is wrapped around the reverse input clutch assembly (102) and held in position by a machined area, in the case, in which the band anchor end fits. When the band is compressed by the intermediate/4th servo pin, it holds the reverse clutch housing in order to operate the transaxle in fourth gear, or for engine compression braking in Manual Second Range-Second gear and Manual First Range- Second Gear.

INTERMEDIATE/4TH SERVO APPLY (holds the reaction sun gear):
To apply the intermediate/4th servo assembly in Overdrive Range-Fourth gear, 4th band fluid is routed through the valve body (18), channel plate (27), and case (51) to a feed hole located in the servo cover (80) at the outer apply area of the servo piston (77). In Manual Second Range-Second gear and Manual First Range-Second Gear, intermediate band fluid is routed through the valve body (18), channel plate (27), and case (51) to a feed hole located in the servo cover (80) at the inner apply area of the servo piston (77). Intermediate or 4th band fluid pressure behind the piston, forces the servo piston and pin to move towards the intermediate/4th band. As the servo piston moves, it compresses the spring (75) until the pin travels far enough to compress the intermediate/4th band. The band is wrapped around the reverse input clutch housing and when it is compressed, it holds the housing stationary.

When the transaxle is operating in Fourth gear and the intermediate/4th band is holding the reverse clutch housing, power is directed through the reaction carrier to the input carrier in order to provide an overdrive gear ratio. When the intermediate/4th band is applied for engine compression braking in Manual Second Range-Second gear and Manual First Range-Second Gear, the band is used to prevent the reverse clutch housing from rotating and overrunning the 2nd roller clutch.

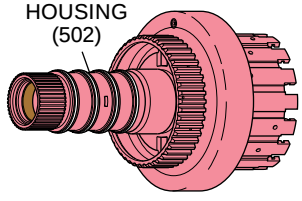
INTERMEDIATE/4TH SERVO RELEASE:
The intermediate/4th servo releases whenever the transaxle shifts out of Fourth gear into a lower gear (excluding Manual Second Range-Second gear and Manual First Range-Second Gear). The band releases when 4th band fluid pressure or intermediate band fluid pressure, between the servo cover and servo piston, is routed through the case to exhaust from the circuit. The return spring forces the intermediate/4th servo piston away from the intermediate/4th band thereby releasing the band.



No servo apply can cause no 4th/slips in 4th gear.

Figure 20

APPLY COMPONENTS



DIRECT CLUTCH:
The direct clutch assembly (517-523), located inside the direct and coast clutch housing (502), is applied whenever the transaxle is operating in Overdrive Range-Third or Fourth gear and Manual First, Second or Third Range-Third gear.

DIRECT CLUTCH APPLY (drives the reaction carrier):
To apply the direct clutch, direct clutch fluid is routed into the driven sprocket support (95) and follows a passage between the support and the support sleeve. Direct clutch fluid exits the support at a feed hole in the sleeve, passes through a hole between the 2nd and 3rd oil seal rings (500) on the input shaft, through the shaft sleeve before entering the direct clutch housing behind the direct clutch piston (518). Direct clutch fluid pressure seats the direct clutch housing checkball which allows fluid pressure to move the piston and compress the return spring & retainer assembly (519). The piston continues to move until it contacts the direct clutch (apply) plate (521) and holds the direct clutch fiber plates (522) and steel plates (521) against the direct clutch backing plate (523).

When fully applied, the direct clutch plates force the direct clutch housing and reaction carrier shaft shell (526) to rotate at turbine speed (depending on chain ratio). The reaction carrier shaft shell is splined into the reaction carrier and combines with the input sun gear (533) to power the gear sets at a 1:1 gear ratio.

DIRECT CLUTCH RELEASE:
The direct clutch releases whenever the transaxle downshifts into Second or First gear, or when the selector lever is moved into the Park, Reverse, or Neutral ranges. Direct clutch fluid pressure between the piston and housing exhausts through the same passages that were used to apply the clutch. In the absence of fluid pressure, force from the return spring & retainer assembly causes the direct clutch piston to move away from the direct clutch apply plate. The piston movement causes the clutch plates to lose contact with the backing plate thereby releasing the direct clutch.

As direct clutch fluid exhausts through the driven sprocket support, the direct clutch housing checkball is forced off it's seat by centrifugal force (rotation of the housing). When the checkball unseats, residual direct clutch fluid is forced to the outer perimeter of the piston and exhausts through the checkball seat. (If this fluid did not completely exhaust there could be a partial apply, or drag of the direct clutch plates.)

No direct clutch apply can cause first and second gear only.

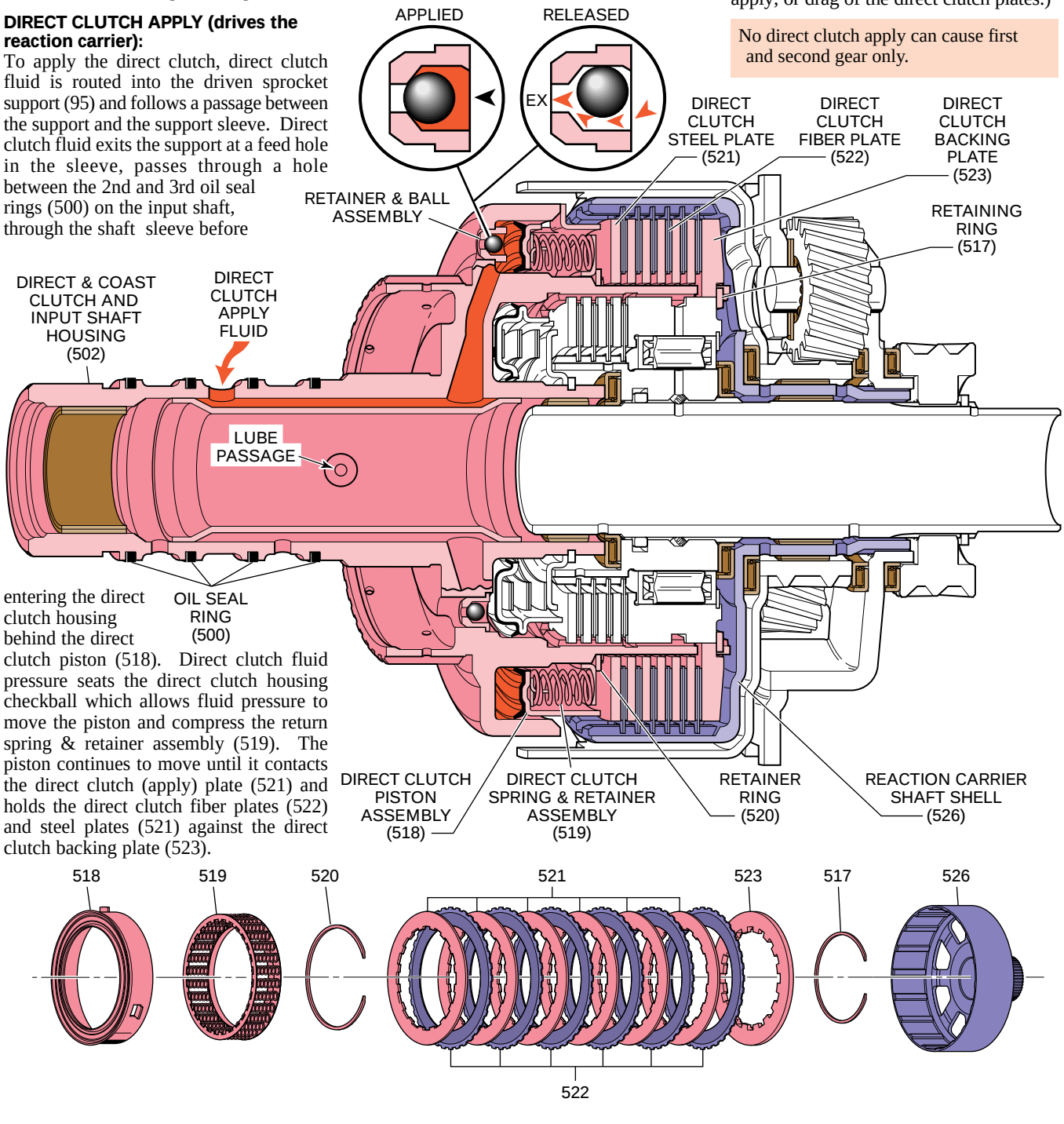
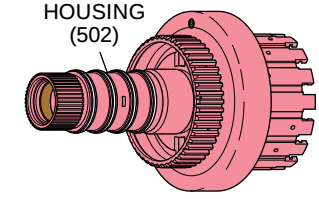


Figure 21

APPLY COMPONENTS



COAST CLUTCH:
The coast clutch assembly (504-512 & 517), located inside the direct and coast clutch input shaft housing (502), is applied whenever the transaxle is operating in a Manual Range (Refer to Range Reference Chart on page 11).

The coast clutch is responsible for holding the mechanical link from the gearsets to the engine in all manual ranges to achieve engine compression braking. In Overdrive Ranges First, Second and Third the transaxle is allowed to coast (through the input sprag overrunning) when the throttle is reduced and vehicle speed is greater than engine speed.

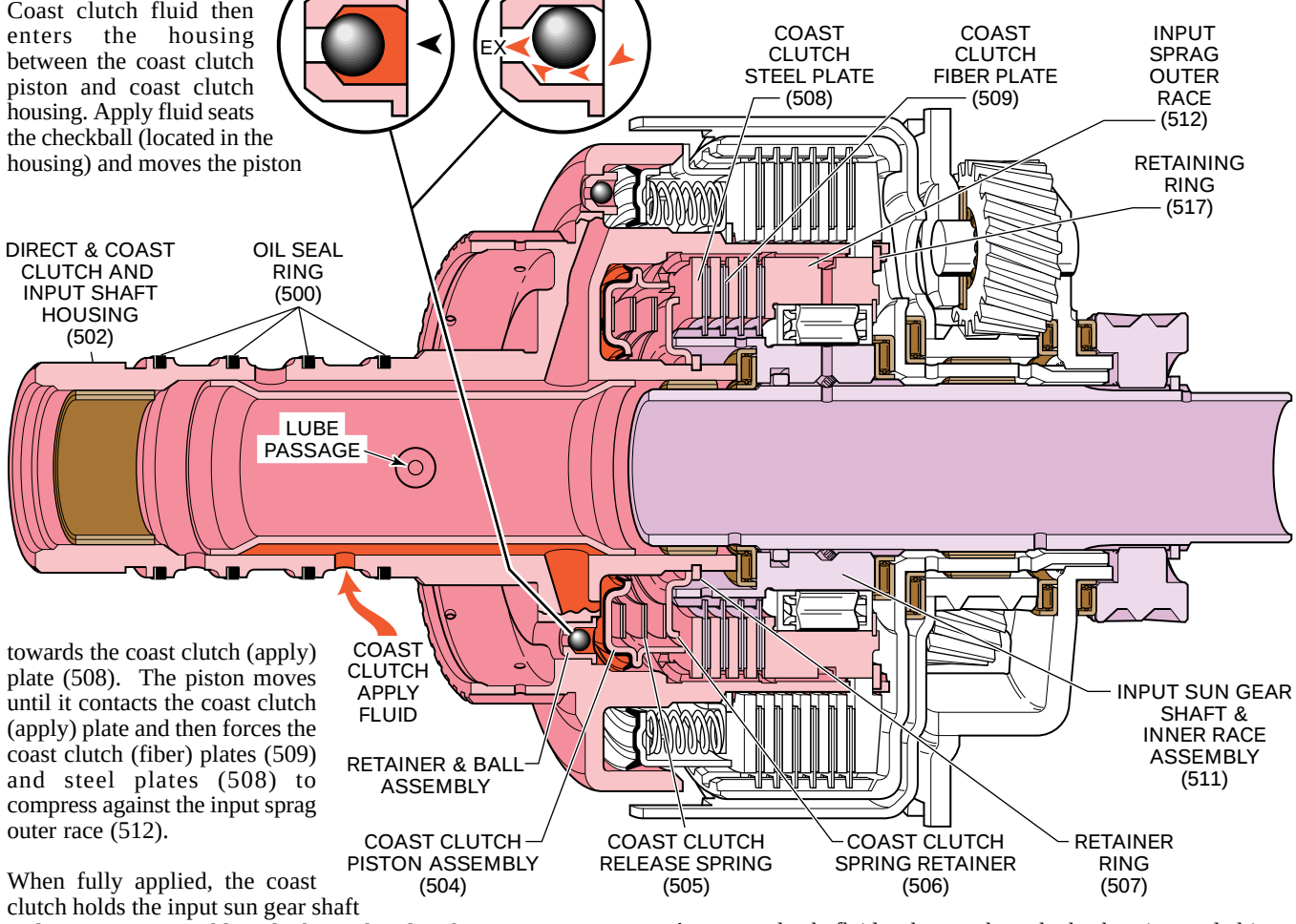
No coast clutch apply can cause no engine braking in all manual ranges.

COAST CLUTCH APPLY (drives the input sun gear during acceleration and allows engine compression braking during deceleration):
To apply the coast clutch, coast clutch fluid is routed into the driven sprocket support (95) and follows a passage between the support and an oil transfer sleeve. Coast clutch fluid then passes through a feed hole in the support and a feed hole between the 3rd and 4th oil seal rings (500) on the input shaft. The fluid then flows through an oil sleeve in the input shaft to the coast clutch housing. Coast clutch fluid then enters the housing between the coast clutch piston and coast clutch housing. Apply fluid seats the checkball (located in the housing) and moves the piston towards the coast clutch (apply) plate (508). The piston moves until it contacts the coast clutch (apply) plate and then forces the coast clutch (fiber) plates (509) and steel plates (508) to compress against the input sprag outer race (512).

When fully applied, the coast clutch holds the input sun gear shaft and inner race assembly, which is splined to the input sun gear. This arrangement prevents the input sprag elements from overrunning to provide engine compression braking in the Manual ranges.

COAST CLUTCH RELEASED:
The coast clutch releases whenever the selector lever is moved into Overdrive, Park, Reverse or Neutral ranges and coast clutch fluid pressure between the forward clutch piston (504) and coast clutch housing exhausts through the direct & coast clutch and input shaft. In the absence of fluid pressure, force from the coast clutch release spring assembly (505) causes the coast clutch piston to move away from the clutch plates. The piston movement causes the clutch plates to lose contact with the input sprag outer race thereby releasing the clutch.

As coast clutch fluid exhausts through the housing and driven sprocket support, the housing checkball is forced off its seat by centrifugal force. When the checkball unseats, residual coast clutch fluid is forced to the outer perimeter of the piston and exhausts through the checkball seat. (If this fluid did not completely exhaust there could be a partial apply or drag of the coast clutch plates.)



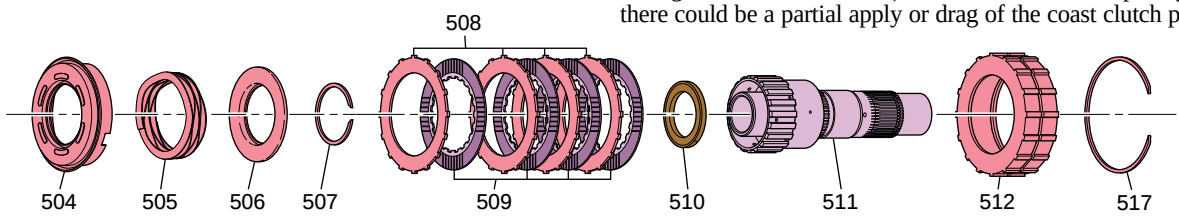


Figure 22

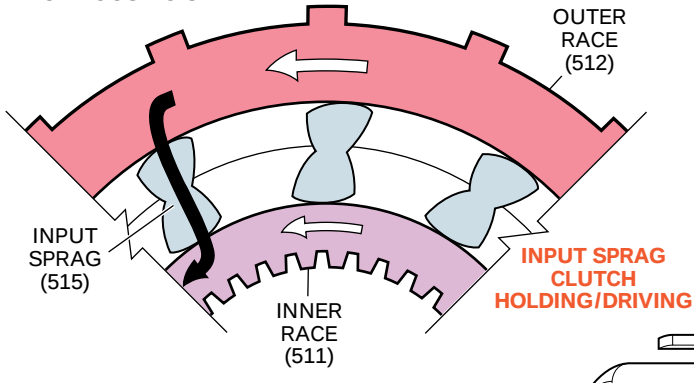
APPLY COMPONENTS

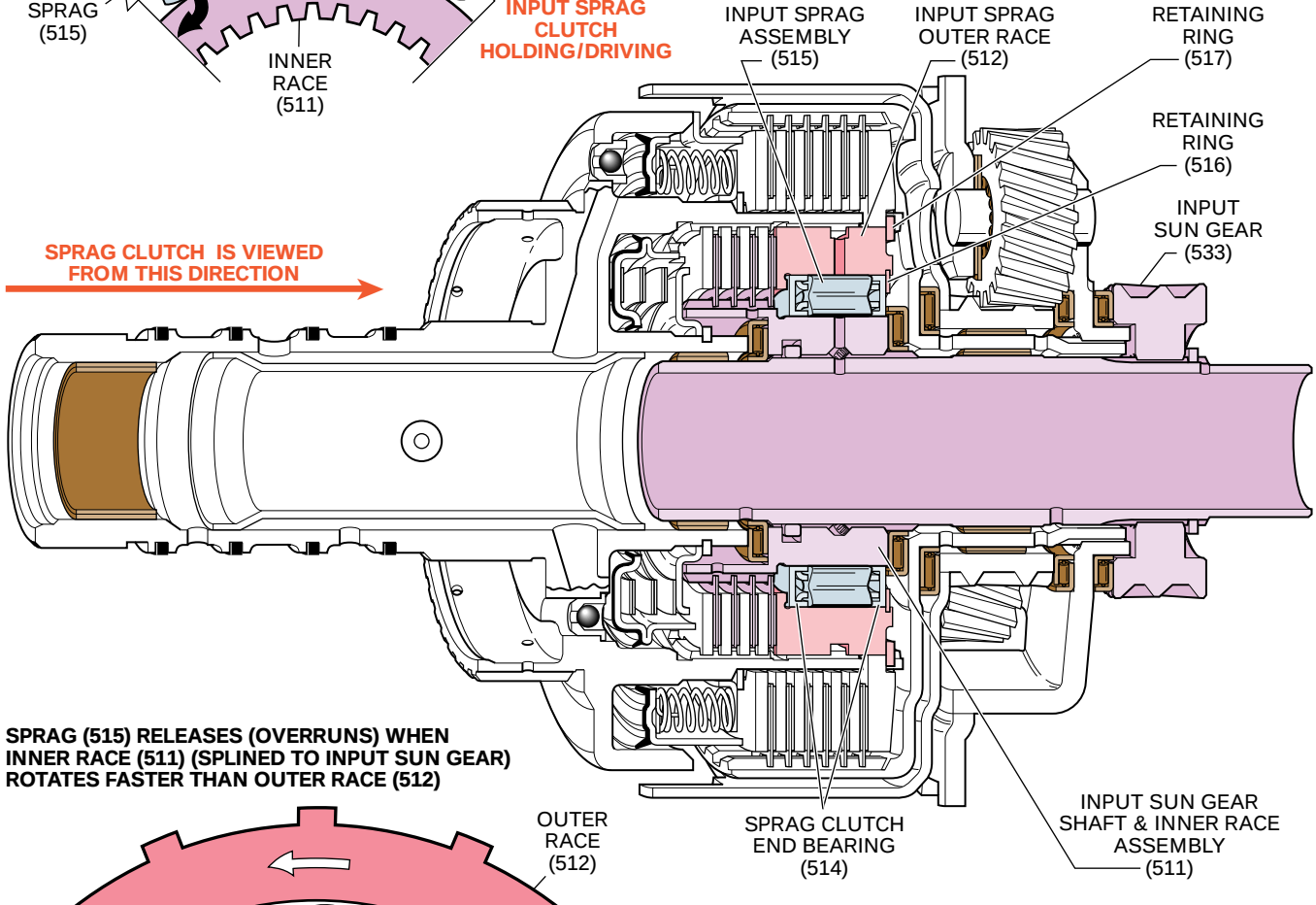
INPUT SPRAG:
The input sprag assembly (515), located between the input sprag outer race (512) [splined to the direct & coast clutch and input shaft housing (502)] and the input sun gear shaft & inner race assembly (511), drives (transfers torque) the input sun gear (533) in all forward gear ranges (except 4th gear) in order to transmit power to the gear sets. The sprag clutch is also designed to allow the vehicle to coast in all overdrive gear ranges (except 4th gear).

INPUT SPRAG ASSEMBLY HOLDING (drives the input sun gear):
The outer race (512) of the input sprag is splined to the direct & coast clutch and input shaft housing (502). The inner race is part of the input sun gear shaft assembly with the input sun gear splined to the other end. When the engine is running the direct and coast clutch and input shaft housing is always rotating. The input sprag holds when the housing is rotating, but is only effective when the transaxle is in the overdrive gear ranges (except 4th gear). In the manual ranges the coast clutch is applied and transfers the torque. When the input sprag holds, it drives the input sun gear in order to direct power flow through the gear sets.

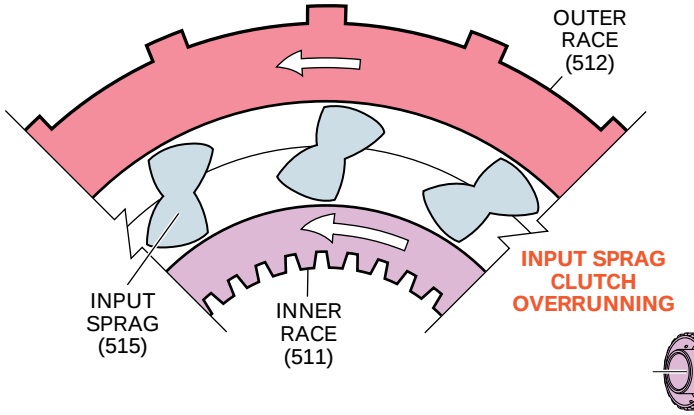
INPUT SPRAG RELEASED (allows coasting in overdrive gear ranges):
The input sprag assembly releases (overruns) whenever the vehicle speed is greater than engine speed (occurs during deceleration and in 4th gear). This is to allow coasting instead of engine braking when in the overdrive gear ranges (except fourth gear). An overrunning condition occurs only in the Overdrive Ranges when the input sun gear (input sprag inner race) rotates faster than the outer race. The faster rotation of the inner race causes the sprag elements to pivot and disengage with the outer race.

OUTER RACE (512) HELD - SPRAG (515) FORCES INNER RACE (511) TO ROTATE AT INPUT HOUSING SPEED





SPRAG (515) RELEASES (OVERRUNS) WHEN INNER RACE (511) (SPLINED TO INPUT SUN GEAR) ROTATES FASTER THAN OUTER RACE (512)



Input sprag clutch failure, not holding can cause no first, second or third gear/slips in first, second or third gear.

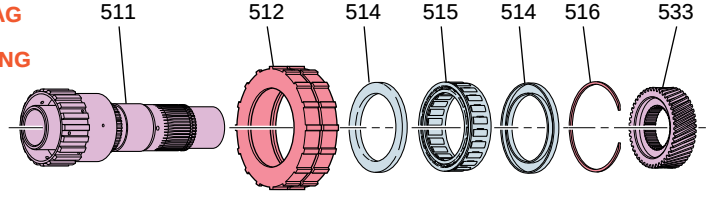
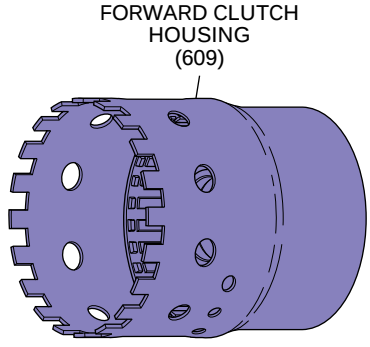


Figure 23



FORWARD CLUTCH:
The forward clutch assembly (600-608), located inside the forward clutch housing (609), is applied whenever the transaxle is operating in any forward range.

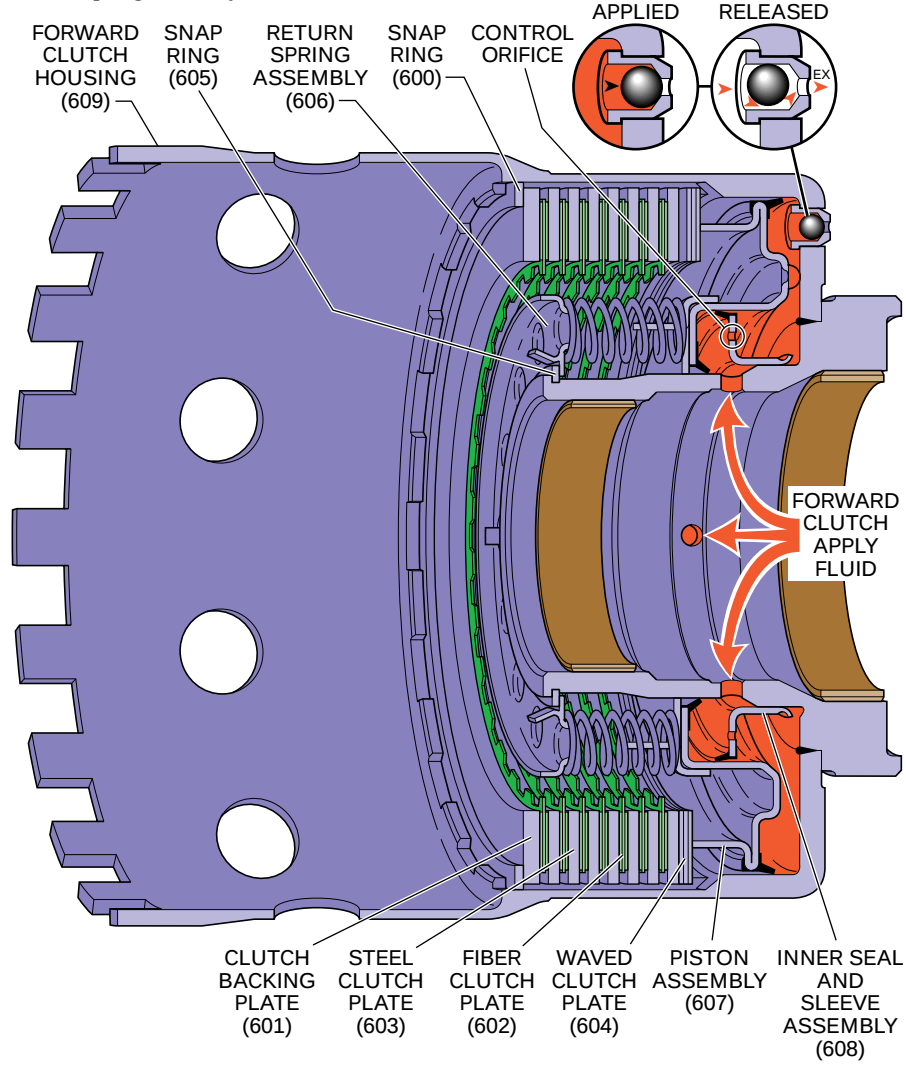
FORWARD CLUTCH APPLY (holds the input internal gear/drives the reaction carrier):
To apply the forward clutch, forward clutch fluid is routed into the forward clutch support (656) and follows a passage between the support and an oil transfer sleeve. Forward clutch fluid then passes from a hole in the support, between the oil seal rings, into a feed hole in the forward clutch housing, located between the two bearing surfaces. Forward clutch fluid then enters the inner apply area between the piston (607) and the seal and sleeve assembly (608). The seal and sleeve assembly (608) has an orifice that allows fluid to enter the outer area of the piston. This orifice system allows a controlled rate of apply to create a smoother shift feel. Forward clutch fluid compresses the air trapped in the outer piston area until fluid and air pressure seat the ball, which allows fluid pressure to move the forward clutch piston (607). As the piston moves, it compresses the forward clutch return spring assembly (606) until legs on the piston contact and hold the forward clutch waved plate (604), steel plates (603), and fiber plates (602) against the backing plate (601).

When fully applied, the forward clutch holds the input flange and forward clutch hub assembly (108) through the internal teeth on the fiber clutch plates. (External teeth on the steel clutch plates are splined to the forward clutch housing.) In first gear the forward clutch housing will be held by the lo roller clutch assembly or the lo/reverse band.

FORWARD CLUTCH RELEASED (no power transmitted through the input internal gear):
The forward clutch releases whenever the selector lever is moved into Park, Reverse or Neutral ranges (in Neutral the forward clutch releases only below a certain vehicle speed) and forward clutch fluid between the piston and housing exhausts through the forward clutch support. Release fluid is allowed to slip by the outer portion of the lip seal to allow a quick release. In the absence of fluid pressure, force from the forward clutch return spring assembly causes the forward clutch piston to move away from the clutch plates. The piston movement causes the clutch plates to lose contact with the backing plate, thereby releasing the forward clutch.

With the clutch released, the forward clutch housing ball capsule is forced off it's seat by centrifugal force (rotation of the housing). When the checkball unseats, residual forward clutch fluid is forced to the outer perimeter of the piston and exhausts through the checkball seat.

If this fluid did not completely exhaust there could be a partial apply, or drag of the forward clutch plates.



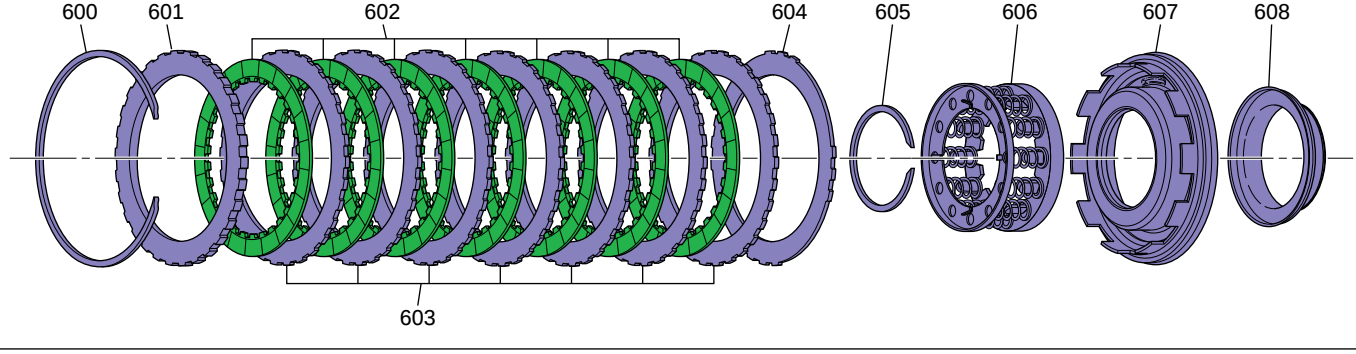
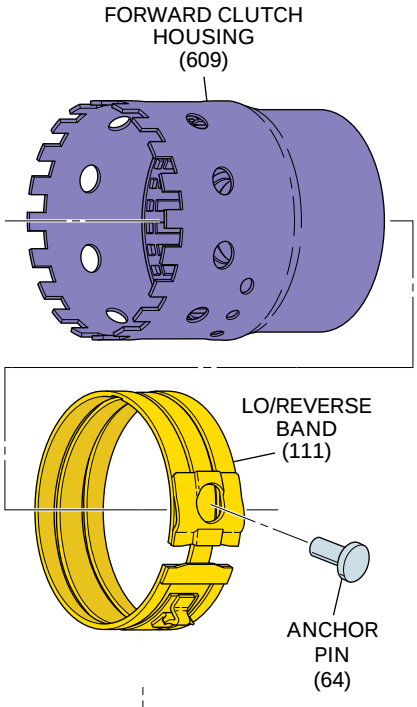


Figure 24

APPLY COMPONENTS



LO/REVERSE SERVO ASSEMBLY:
The lo/reverse servo assembly (66-73), located in the bottom of the transaxle in the rear of the case (51), applies the lo/reverse band in Park, Reverse and Neutral ranges, and Manual First Range - First gear.

LO/REVERSE BAND:
The lo/reverse band (111), located inside the case, is wrapped around the forward clutch housing and held in position by the lo/reverse band anchor pin (64). When the band is compressed by the lo/reverse servo pin, it holds the forward clutch housing stationary. *[Note: The band is not the primary holding member in Manual First Range - First gear acceleration operation (Refer to lo roller clutch, page 26.)]*

LO/REVERSE SERVO APPLY (holds the input internal gear in conjunction with the forward clutch/holds the reaction carrier):
To apply the lo/reverse servo assembly, reverse and/or lo band fluid is routed through a feed hole in the channel plate (27) to the bottom of the case (51) to the oil feed tube assembly (83). Fluid then flows through either the reverse or lo band feed tube to the servo cover (73). Reverse fluid enters the outer portion of the piston and lo band fluid enters the inner portion of the piston. Fluid pressure fills the cavity(s) between the servo piston and cover and forces the servo piston (69) and pin (67) to move towards the lo/reverse band (111). As the lo/reverse servo piston moves, it compresses the return spring (66) until the pin travels far enough to compress the lo/reverse band. When the band compresses, it holds the forward clutch housing stationary.

When the transaxle is operating in Park or Neutral ranges, the lo/reverse band is the only component holding the forward clutch housing. The reason for applying the band is to hydraulically and mechanically prepare the transaxle for a smooth garage shift (range selection from Park or Neutral into Reverse). In Manual First Range - First gear, the lo/reverse band is applied for engine compression braking.

LO/REVERSE SERVO RELEASE:
The lo/reverse servo releases, allowing the lo/reverse band to release, whenever the transaxle shifts out of P, R, N or Manual First Range - First Gear. The band releases when reverse and/or lo band fluid pressure between the servo piston and servo cover exhausts from the circuit. Spring force from the return spring moves the lo/reverse servo piston away from the lo/reverse band thereby releasing the band.

No apply of the lo/reverse servo can cause:

- No reverse or slips in reverse
- No engine braking in Manual First range.

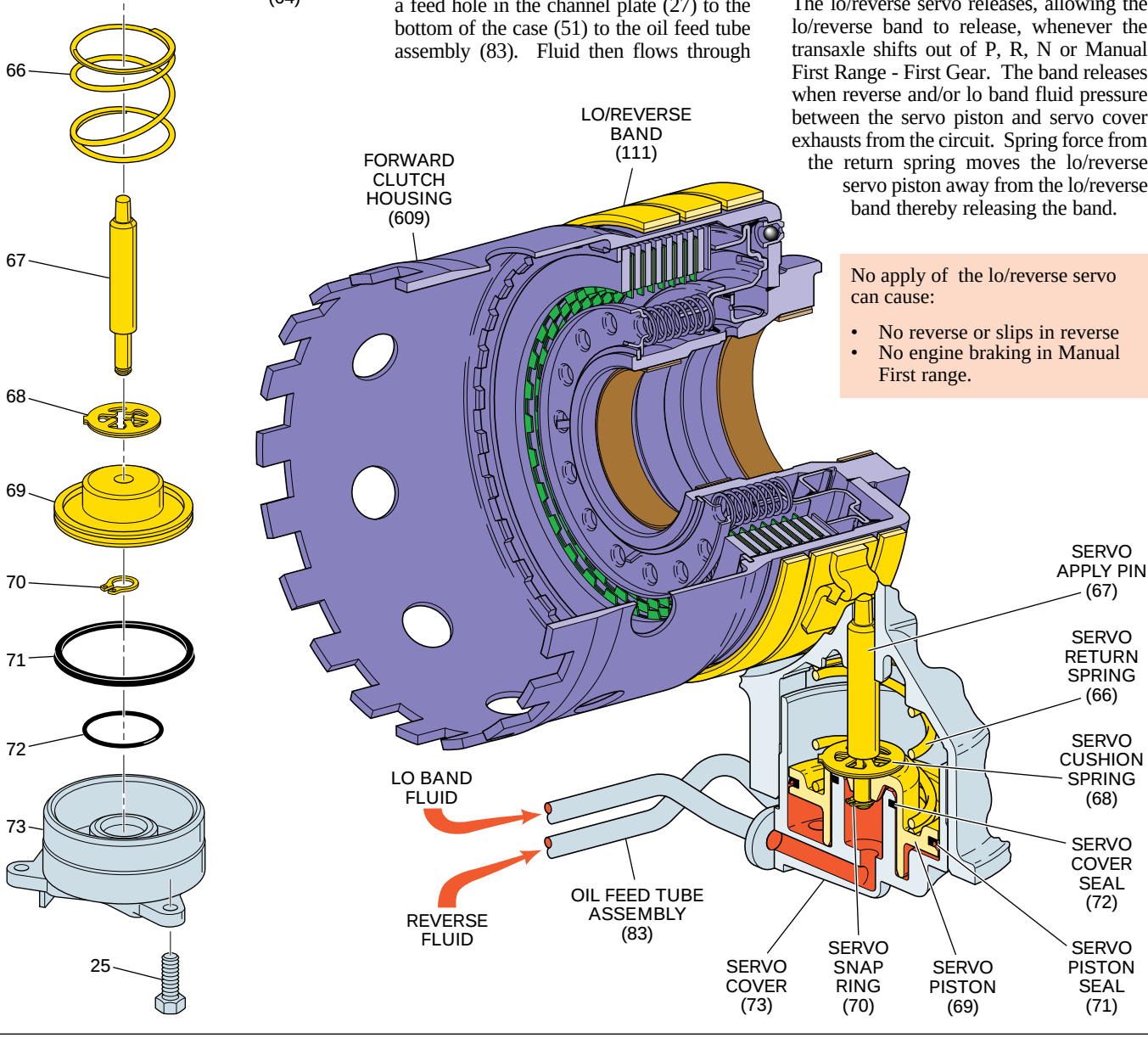


Figure 25

APPLY COMPONENTS

LO ROLLER CLUTCH:
The lo roller clutch assembly is made up of three major components: a cam which is part of the forward clutch support (656), the roller assembly (652), and the inner race which is part of the forward clutch housing (609). The lo roller clutch (652), located inside the forward clutch support, is the main component that holds the forward clutch housing whenever the transaxle is operating in First gear (Overdrive or Manual ranges).

LO ROLLER CLUTCH HOLDING (holds the input internal gear in conjunction with the forward clutch):
When the transaxle is operating in First gear, power flow through the gear sets attempts to rotate the forward clutch housing in the opposite direction of engine rotation. When the housing starts to rotate, the rollers are forced to the narrow end of the cam ramps and wedge between the inner race and ramps. When the rollers are in this position they hold the inner race (forward clutch housing) stationary and provide power to the gear sets.

LO ROLLER CLUTCH RELEASE:
The lo roller clutch releases when power flow through the gear sets drives the forward clutch housing in the same direction as engine rotation. When these two events occur, the lo roller clutch "freewheels" because the inner race (part of the forward clutch housing) rotates towards the wide end of the ramps on the cam. The rollers are also forced to the wide end of the ramps thereby allowing the forward clutch housing to rotate freely. *Overrunning occurs in the lo roller clutch during Second, Third or Fourth gear operation.*

Lo roller clutch not holding can cause no first gear (except in Manual First Range).

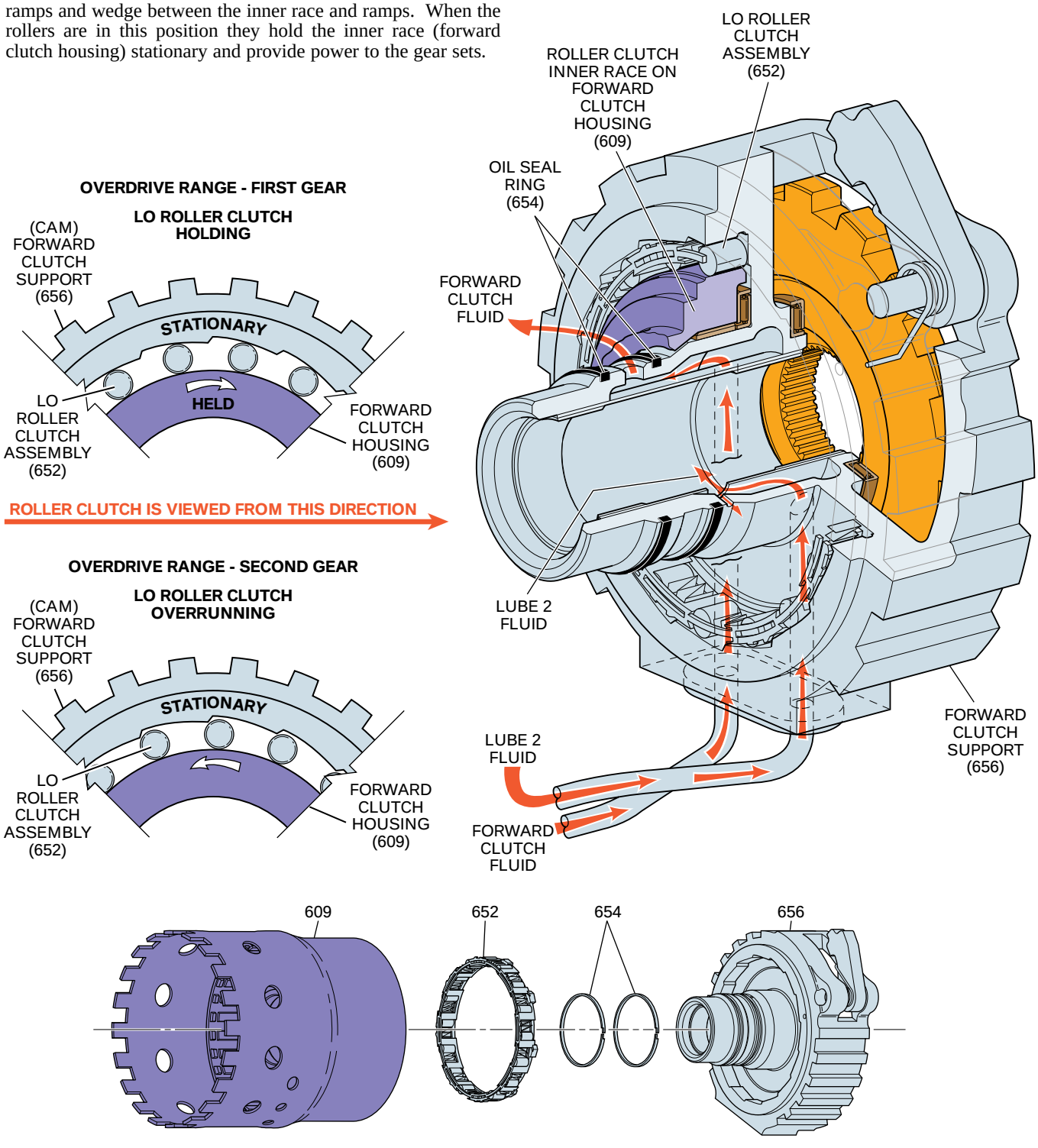


Figure 26

PLANETARY GEAR SETS

PLANETARY GEAR SETS:
Planetary gear sets are commonly used in an automatic transaxle and they are the main mechanical devices responsible for automatically changing gear ratios. The physical arrangement of the component parts of the gear set and their rotation around an axis (center line to the axles) is the primary reason why a planetary gear set was given this name. This physical arrangement not only provides for a strong and compact transaxle component, but it also evenly distributes the energy forces flowing through the gear set. Another benefit gained by this arrangement is that gear clash, a common occurrence with manual transaxles, is eliminated because the gear teeth are always in mesh.

General Component Arrangement and Function:
All planetary gear sets contain at least three main components:

- a sun gear
- a carrier assembly with planet pinion gears, and
- an internal gear.

One of the main components, the sun gear, is located at the center of the planetary gear set and has planet pinion gears revolving around it. These planet pinion gears have gear teeth that are in constant mesh with the sun gear and an internal ring gear that encompasses the entire gear set. Torque from the engine (input torque) is transferred to the gear set and forces at least one of these components to rotate. Since all three main components are in constant mesh with each other, the remaining components are often forced to rotate as a reaction to the input torque. After input torque passes through a gear set, it changes to a lower or higher torque value known as output torque. Output torque then becomes the force that is transmitted to the vehicle's drive axles.

As stated above, when engine torque is transferred through a gear set, the output torque from the gear set either increases or decreases. If output torque is higher than input torque, then the gear set is operating in reduction (typically 1st, 2nd or Reverse gears). On the other hand, if output torque is lower than input torque, then the gear set is operating in overdrive (4th gear). A third possible condition also exists and that is when input torque equals output torque. This condition is called direct drive (3rd gear) because neither reduction nor overdrive occurs through the gear set.

Torque vs Speed
Another transaxle operating condition directly affected by input and output torque through a gear set is the relationship of torque with output speed. As an automatic transaxle shifts from 1st to 2nd to 3rd to 4th gear, the overall output torque to the wheels decreases as the speed of the vehicle increases (when input speed and input torque are held constant). Higher output torque and lower output speed is used in 1st gear to provide the necessary power for moving heavy loads. However, once the vehicle is moving and the speed of the vehicle increases, less torque is required to maintain that speed. This arrangement provides for a more economical operation of the powertrain.

Hydra-matic 4T40-E Gear Sets:
The Hydra-matic 4T40-E transaxle combines two gear sets that provide five gear ratios (four forward and one reverse) for transferring torque to the drive axles. The five major assemblies used in these gear sets are:

- the reaction sun gear & shell assembly (529)
- the reaction carrier assembly (531)
- the reaction internal gear/input carrier assembly (560/562)
- the input sun gear (533)
- the input internal gear/input internal gear flange (560/577)

Another gear set used in the Hydra-matic 4T40-E transaxle is the final drive differential assembly (116). Information regarding its purpose and function is discussed on page 30.

Gearset failure can cause loss of drive.

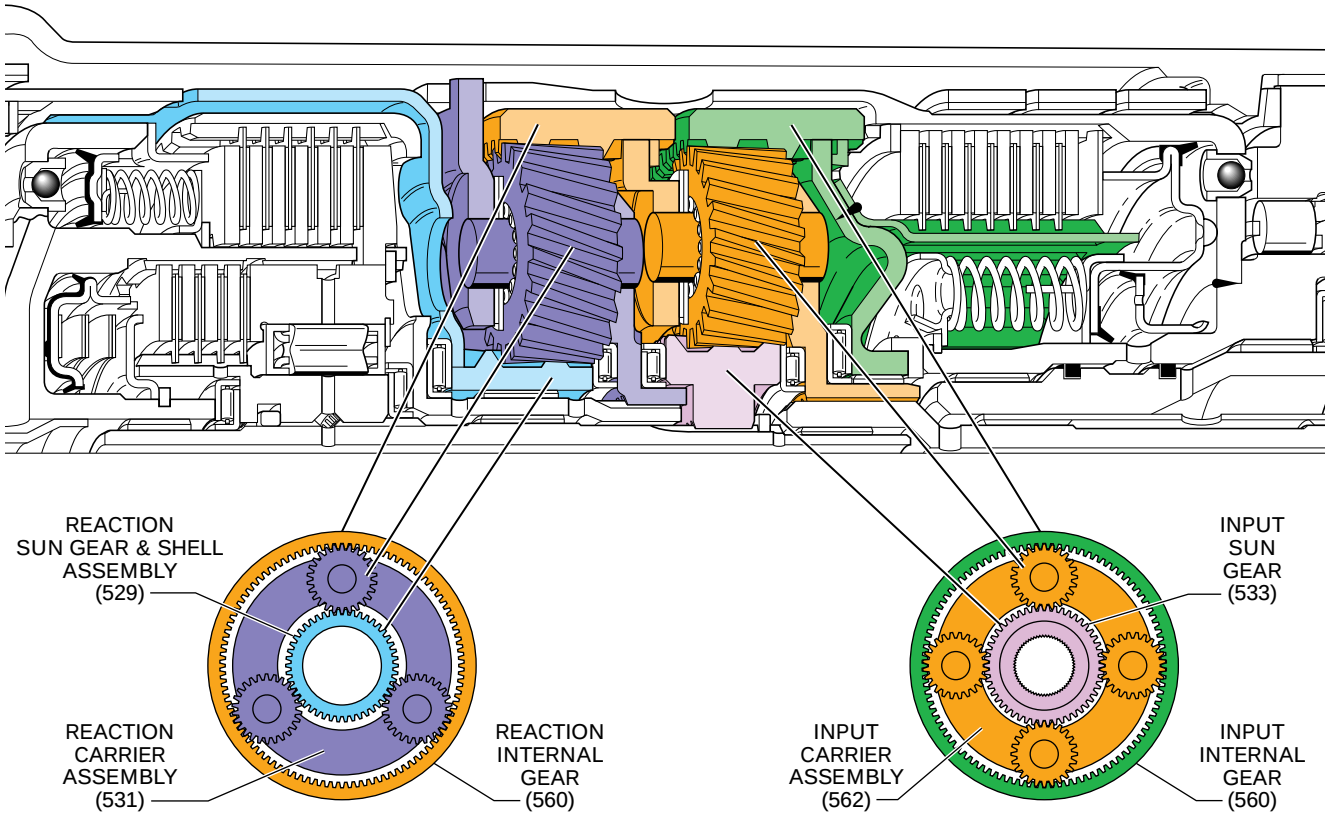
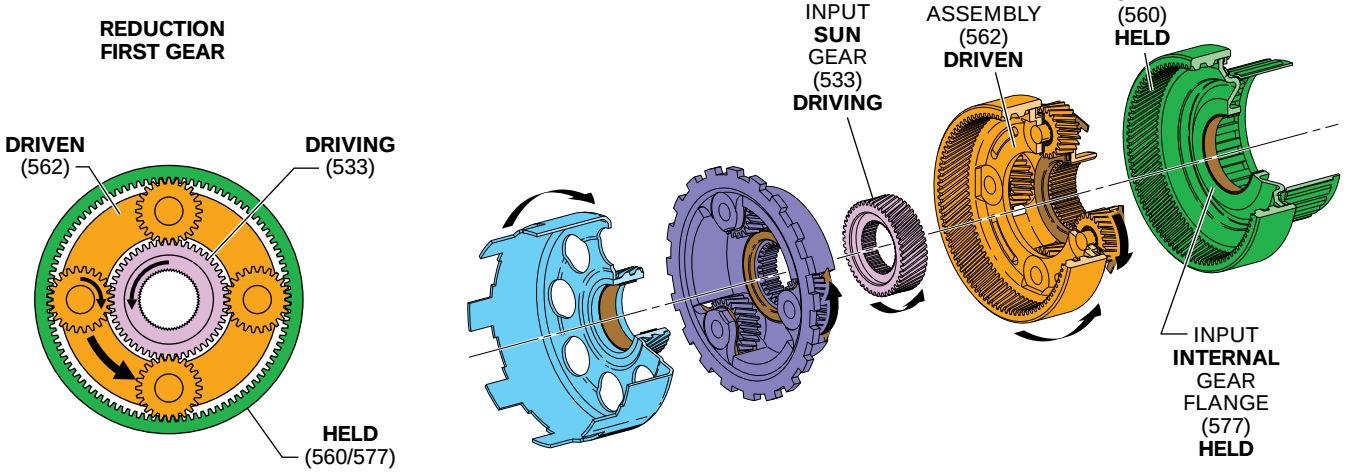


Figure 27

PLANETARY GEAR SETS

REDUCTION – FIRST GEAR



REDUCTION – SECOND GEAR

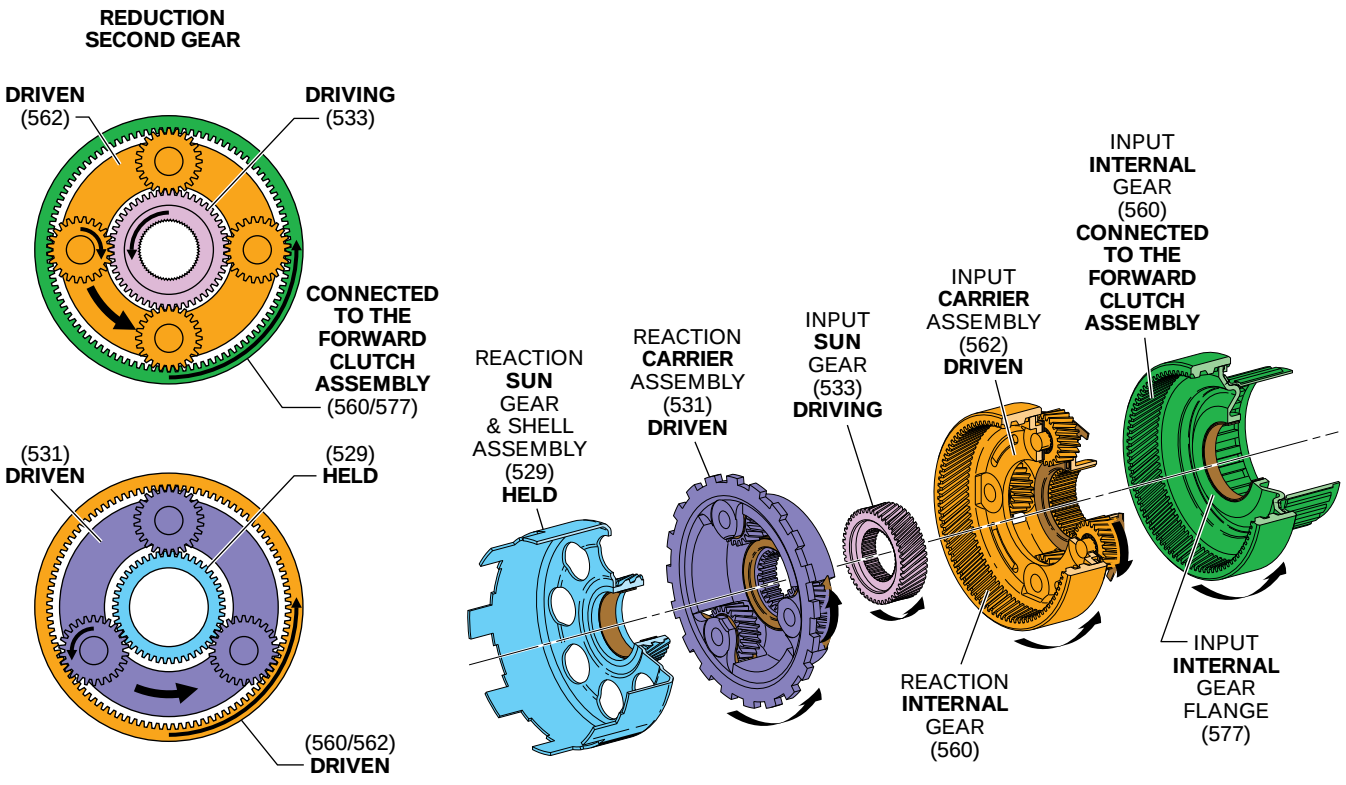


Figure 28

PLANETARY GEAR SETS

REDUCTION:
Planetary gear set reduction may be defined as the difference between a given input speed (rpm) that results in a lower output speed (rpm). Associated with the lower output speed is a higher output torque that enables the vehicle to begin moving. In the Hydra-matic 4T40-E, planetary gear set reduction occurs whenever the transaxle is operating in 1st or 2nd gear, as well as in reverse gear.

FIRST GEAR
Planetary gear set reduction in first gear occurs when engine torque is transferred to the input sun gear (533) and the sun gear becomes the driving member. Torque is then transferred from the input sun gear to the four input planetary pinion gears (568) which rotate inside the input internal gear (560). Since the input internal gear (560) and input internal gear flange (577) are held stationary, the reaction internal gear/input carrier assembly (562) is forced to rotate. (Reaction planetary pinion gears (556) act as idler gears as the reaction internal gear/input carrier assembly rotates.) By using one planetary gear set, the transaxle is operating in this mode with a gear reduction of 2.960:1.

SECOND GEAR
Planetary gear set reduction in second gear occurs when the 2nd clutch applies and the 2nd roller clutch holds the reaction sun gear & shell assembly (529). With the forward clutch applied, the reaction carrier assembly (531), through the forward clutch housing (609), is held together with the input internal gear (560). The reaction carrier will walk around the stationary reaction sun gear & shell assembly. The input sun gear (533) is the driving member. Because both planetary gear sets are used, the reaction internal gear and input carrier assembly become the output member. During this mode the transaxle reduction through the gear set is 1.626:1.

DIRECT DRIVE:

Direct drive may be defined as the operating condition where a given input speed (rpm) equals the output speed by using a 1:1 gear ratio. Direct drive is obtained when any two members of the planetary gear set rotate in the same direction at the same speed and force the third member to rotate at that same speed. In this mode of operation the planetary pinion gears do not rotate on their pins but act as wedges to drive the gear sets as one rotating part. When this occurs, the output speed of the transaxle is the same as the input speed from the torque converter turbine. However, output speed will not equal engine speed until the torque converter clutch applies (see torque converter, page 14).

THIRD GEAR

Direct drive occurs in third gear when the direct clutch applies and links the input shaft & direct clutch housing assembly (502) to the reaction carrier shaft shell (526). The direct clutch plates drive the input internal gear (560) through the reaction carrier assembly (531), reaction carrier shell (526), forward clutch housing (609), and forward clutch assembly (110) while the input sun gear (533) rotates in the same direction and at the same speed. When the gear set through the input carrier assembly (106) is operating in this mode there is no rpm reduction through the gear sets. The transaxle is therefore operating in direct drive at a 1:1 gear ratio.

OVERDRIVE:

Overdrive through a gear set may be defined as the operating condition where a given input speed (rpm) is less than the output speed. This mode of operation allows a vehicle to maintain a relatively high road speed while reducing engine speed for improved fuel economy. However, overdrive does result in lower output torque as compared to the input torque to the planetary gear set.

FOURTH GEAR

Overdrive occurs during fourth gear operation when the intermediate/4th band (100) applies and holds the reverse input clutch assembly (102). The reaction sun gear & shell assembly (529) is also held because it is tanged into the reverse input clutch housing. The reaction carrier assembly (531) rotates around the stationary reaction sun gear & shell assembly and its planetary pinions drive the reaction internal gear and input carrier assembly (106). When the planetary gear set is operating in this mode, the transaxle is in overdrive at a gear ratio of 0.681:1.

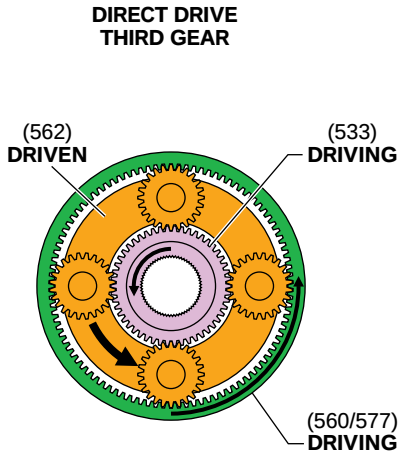
REVERSE DIRECTION OF ROTATION:

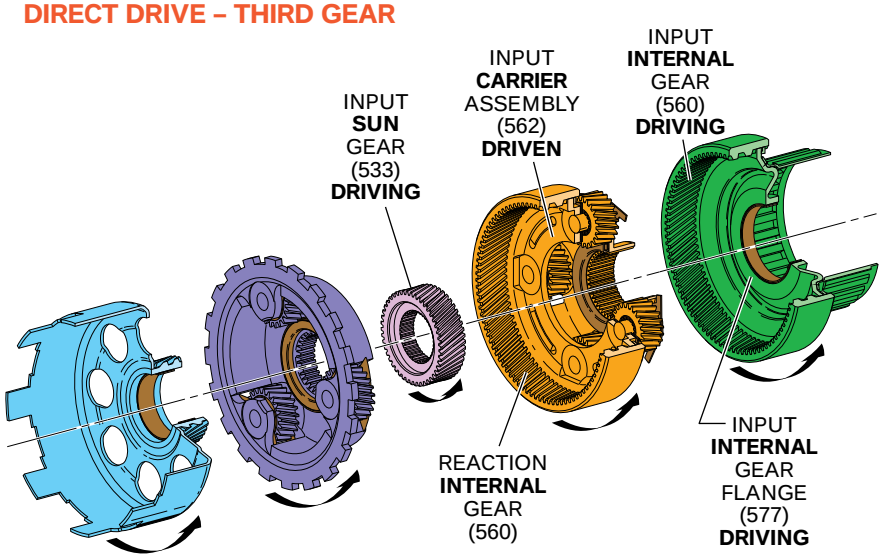
A reverse direction of rotation through a planetary gear set is simply defined as the direction of rotation opposite to the gear rotation used as input. This mode of operation allows a vehicle to move in a rearward direction as well as operating the gear set in reduction.

REVERSE GEAR

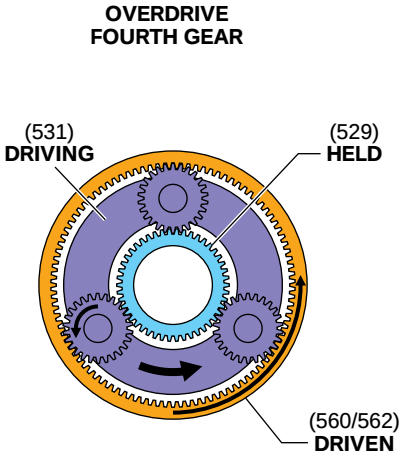
The planetary gear sets reverse their direction of rotation when the reverse clutch applies and drives the reverse input clutch housing & race assembly (102). The reaction sun gear & shell assembly (529) is therefore the driving member because it is tanged into the reverse input clutch housing. Since the lo/reverse band (111) is also applied, it holds the reaction carrier assembly (531) because it is tanged to the forward clutch housing (609). The reaction carrier planetary pinion gears are forced to rotate in a direction opposite of engine rotation and drive the reaction internal gear/input carrier assembly (106) in the same direction. The result is a reverse direction of rotation from that of engine input. Reduction through the gear sets is at a 2.143:1 ratio.

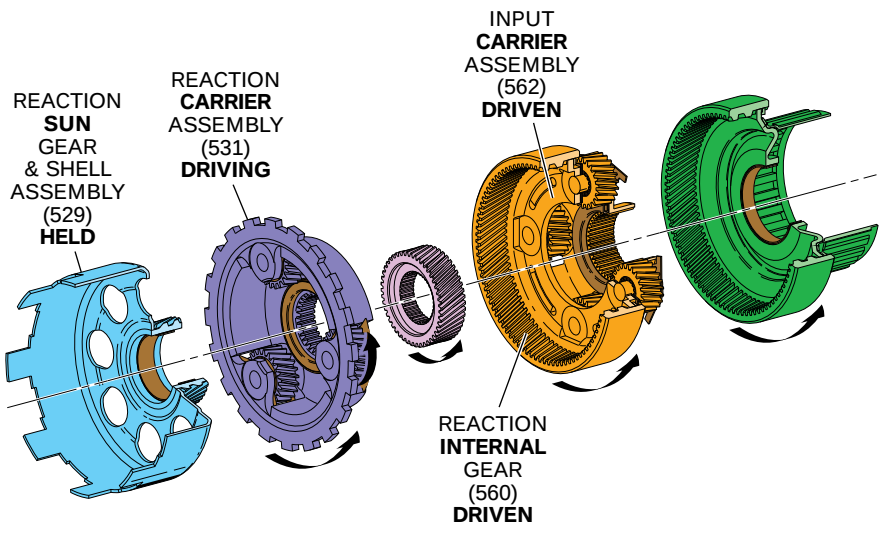
DIRECT DRIVE – THIRD GEAR



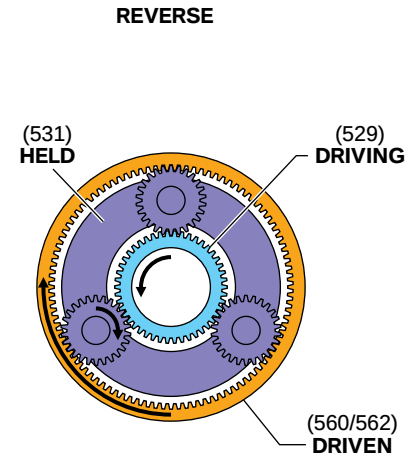


OVERDRIVE – FOURTH GEAR





REVERSE



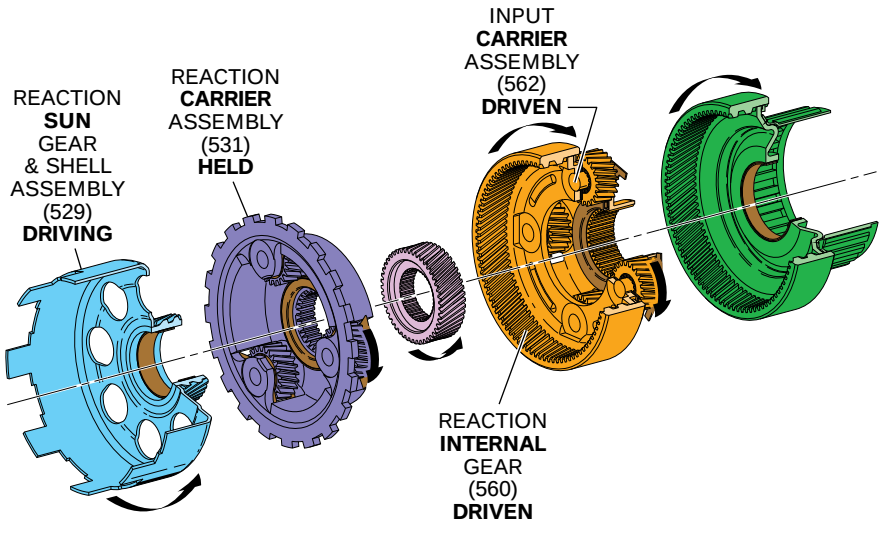
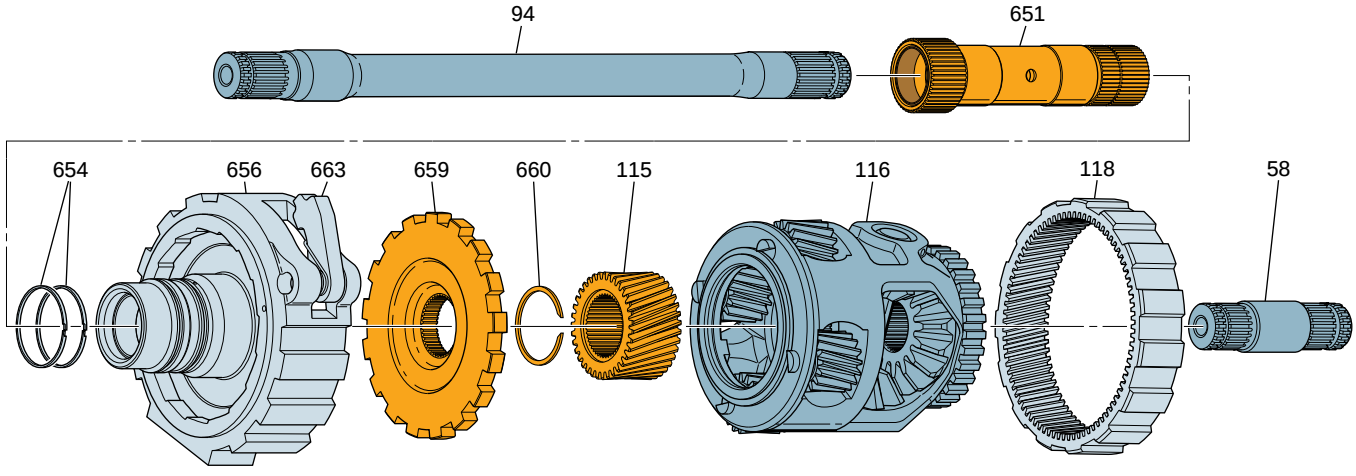


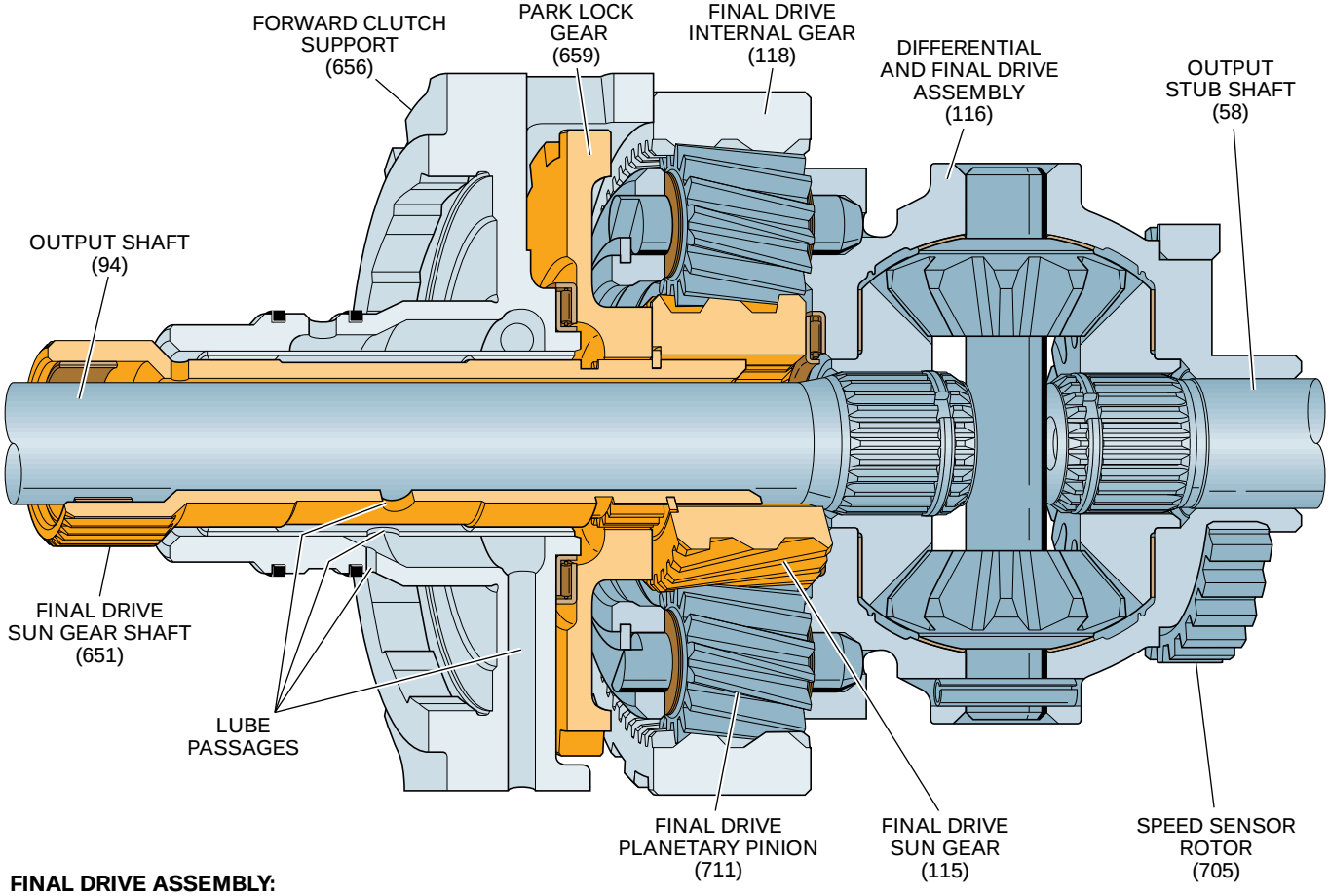
Figure 29

FINAL DRIVE COMPONENTS



FINAL DRIVE AND DIFFERENTIAL ASSEMBLIES

The Hydra-matic 4T40-E transaxle delivers torque from the engine to the drive axles by using a final drive assembly and differential components. These components, located at the output end of the gear train, perform the same function as the rear axle assembly found in rear wheel drive vehicles.



FINAL DRIVE ASSEMBLY:

The final drive assembly is a planetary gear set consisting of a final drive internal gear (118) which is splined to the case, a final drive sun gear (115) which is splined to the final drive sun gear shaft (651) and, a differential and final drive assembly (116).

The final drive planetary gear set operates in reduction at all times at a ratio determined by a relationship of the final drive internal gear (118) to the final drive sun gear (115). In all forward gear ranges, the final drive sun gear shaft (651) drives the final drive sun gear (115) in the same direction as engine rotation. Since the final drive sun gear teeth are in mesh with the final drive planetary pinion gears (711), the planetary pinion gears are driven in the opposite direction as they rotate inside the final drive internal gear (118). This causes the differential and final drive assembly (116) to be driven in the same direction as engine rotation, powering the vehicle forward.

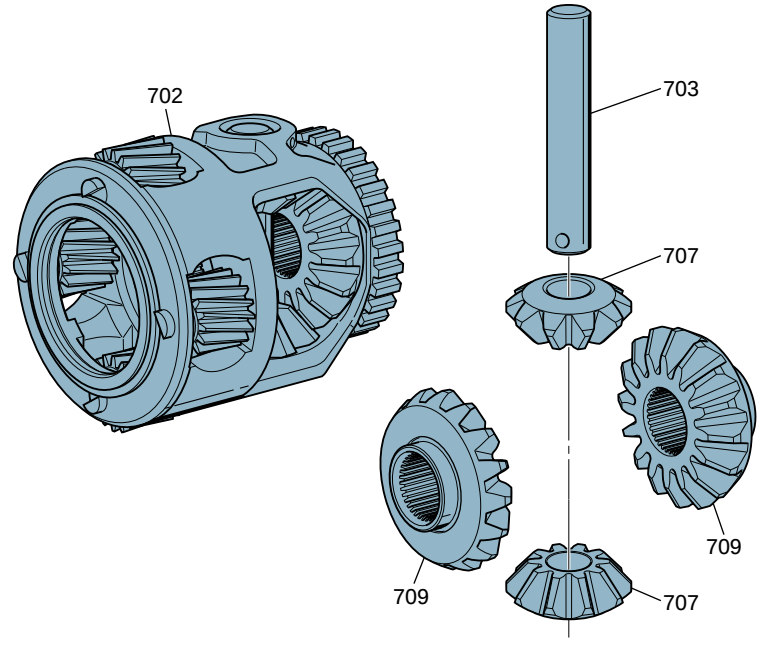
The gear ratio of the differential and final drive assembly (116) performs the same function as the ring and pinion gears in a rear wheel drive vehicle. It is a fixed ratio that matches a specific engine and vehicle combination in order to meet the performance requirements for all operating conditions.

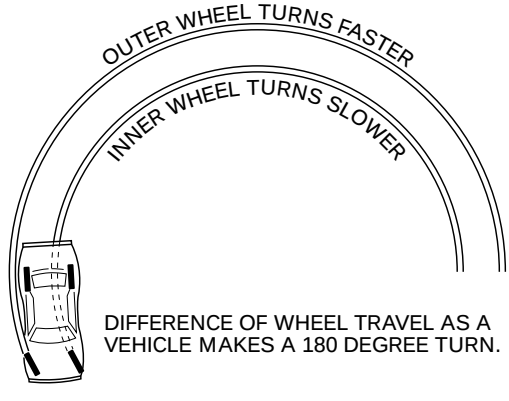
Figure 30

DIFFERENTIAL COMPONENTS

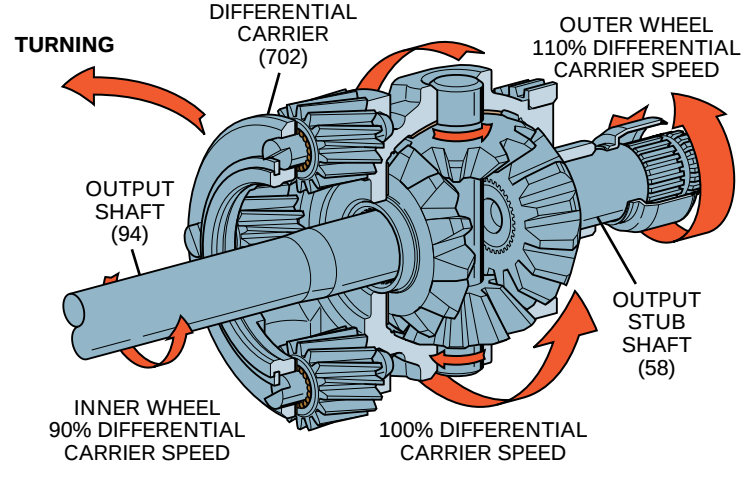
DIFFERENTIAL CARRIER ASSEMBLY:
The (final drive) differential carrier assembly (702) provides the means for allowing one driving wheel to travel faster than the other when the vehicle is going around corners or curves. (The wheel on the outside of the curve has to turn faster.) The differential carrier assembly (702) consists of: a differential and final drive carrier assembly; four bevelled gears (707 & 709); and a differential pinion shaft (703). Two bevelled gears, the differential side gears (709), are connected to the axle shafts. The left hand axle shaft is splined to the output shaft (94), which is splined to the left differential side gear. The right hand axle is splined to the stub shaft (58), which is splined to the right differential side gear. The other two bevelled gears, the differential pinion gears (707), act as idlers to transfer the power from the differential carrier (702) to the differential side gears (709). The differential pinion gears (707) also balance the power load between the differential side gears (709) while allowing unequal axle rotation speeds when the vehicle is in a curve.

Final drive/differential failure can cause loss of drive.

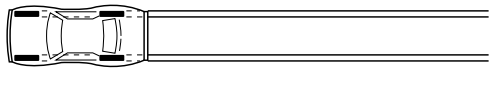




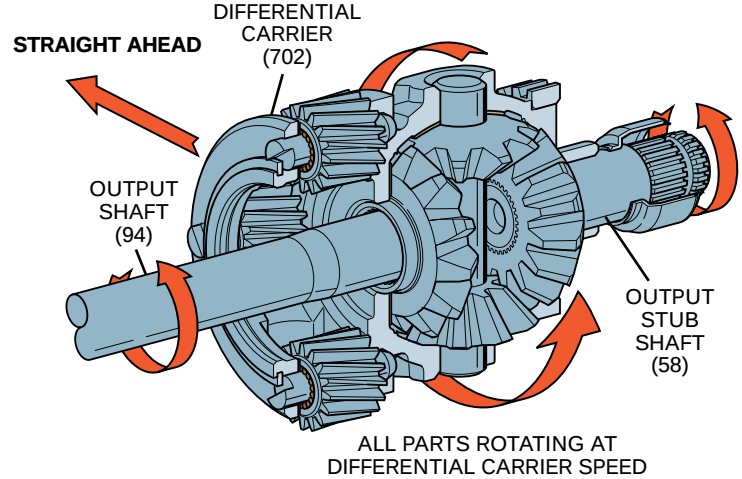
DIFFERENCE OF WHEEL TRAVEL AS A VEHICLE MAKES A 180 DEGREE TURN.



When the vehicle is driven in a straight line, the differential pinion gears (707), differential side gears (709) and differential carrier (702) rotate as a fixed unit. The end result is both axle shafts rotate in the same direction as engine rotation for all forward gear ranges.



BOTH WHEELS TURNING AT SAME SPEED



ALL PARTS ROTATING AT DIFFERENTIAL CARRIER SPEED

Figure 31

HYDRAULIC CONTROL COMPONENTS

The previous sections of this book were used to describe some of the mechanical component operation of the Hydra-matic 4T40-E. In the Hydraulic Control Components section a detailed description of individual components used in the hydraulic system will be presented. These hydraulic control components apply and release the clutch packs and bands to provide automatic shifting of the transaxle.

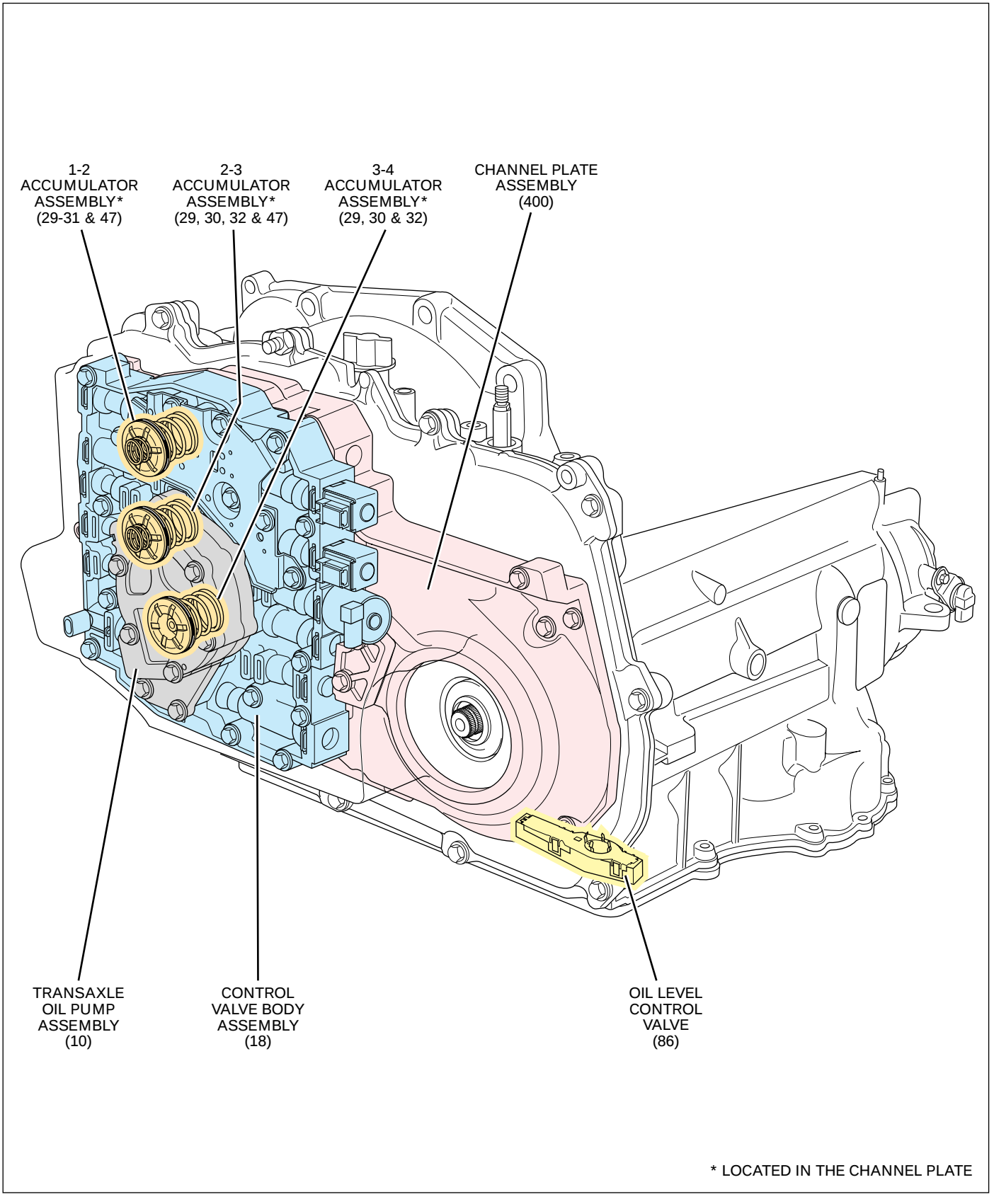
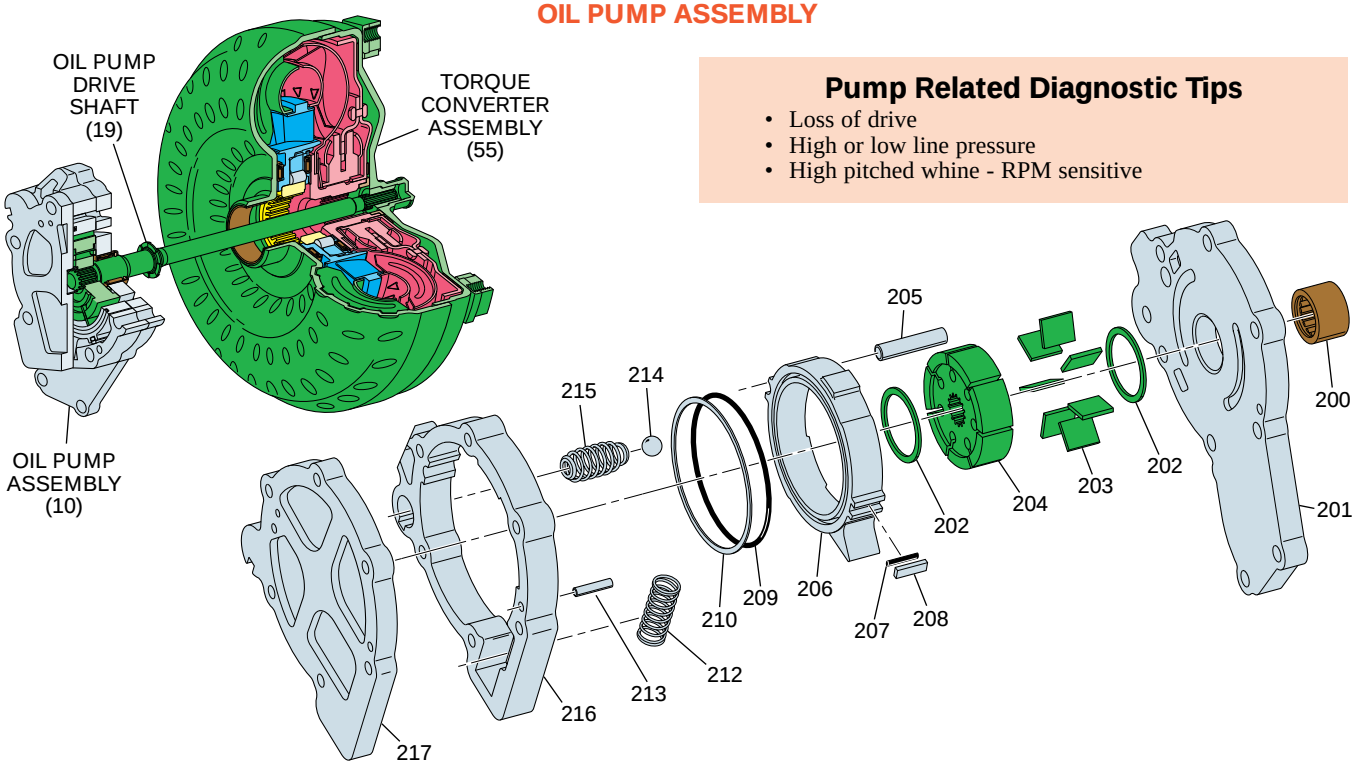


Figure 32

HYDRAULIC CONTROL COMPONENTS

OIL PUMP ASSEMBLY



Pump Related Diagnostic Tips

- Loss of drive
- High or low line pressure
- High pitched whine - RPM sensitive

The oil pump assembly (10) contains a variable displacement vane type pump located in the oil pump body (216). When the engine is running, the oil pump drive shaft assembly (19), which is splined to the torque converter cover, turns the oil pump rotor (204) at engine speed. As the oil pump rotor (204) and pump vanes (203) begin to rotate, the volume of fluid between the vanes expands to it's maximum, creating a vacuum at the pump intake port. This vacuum allows atmospheric pressure (acting on the fluid in the sump) to prime the pump quickly and pressurize the hydraulic system when the engine is running.

Fluid from the transaxle oil pan is drawn through the filter assembly and into the pump intake circuit. Fluid is then forced to rotate around the oil pump slide (206) to the pump outlet where the clearance between the oil pump slide (206) and oil pump rotor (204) decreases. Transaxle fluid is then forced out of the pump into the line fluid passage and called line pressure thereby providing the main supply of fluid to the various components and hydraulic circuits in the transaxle. Since the pump assembly (10) is bolted to the control valve body assembly (18), it also functions as a device that transfers fluids to other components within the transaxle.

The events described above occur when the pump is operating with maximum output. Since most normal driving conditions do not require maximum output, a calibrated decrease pressure from the pressure regulator valve (328) is applied to the backside of the oil pump slide (206). Decrease pressure moves the slide against the force of the pump priming spring to lower the output of the pump. When the pump priming spring (212) is compressed and the oil pump slide contacts the oil pump body, minimum pump output occurs.

The pressure relief ball (214) and spring (215) prevent line pressure from exceeding 1,690-2,480 kPa (245-360 psi).

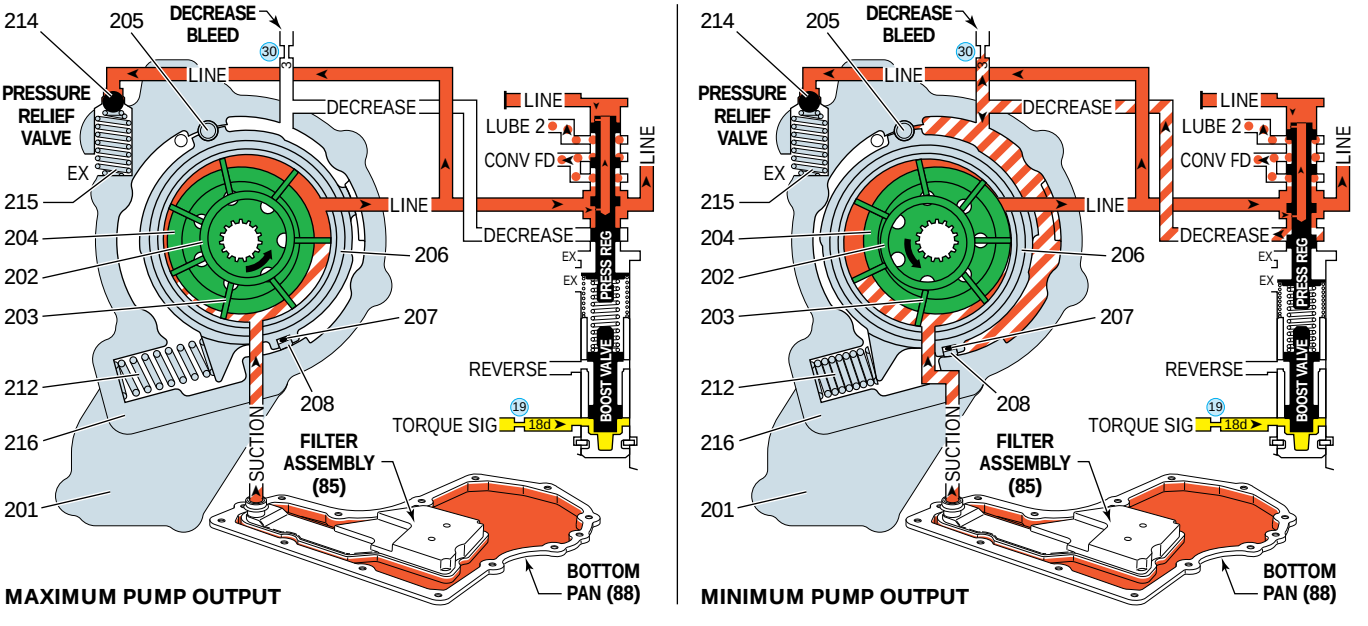


Figure 33

HYDRAULIC CONTROL COMPONENTS

PRESSURE REGULATION

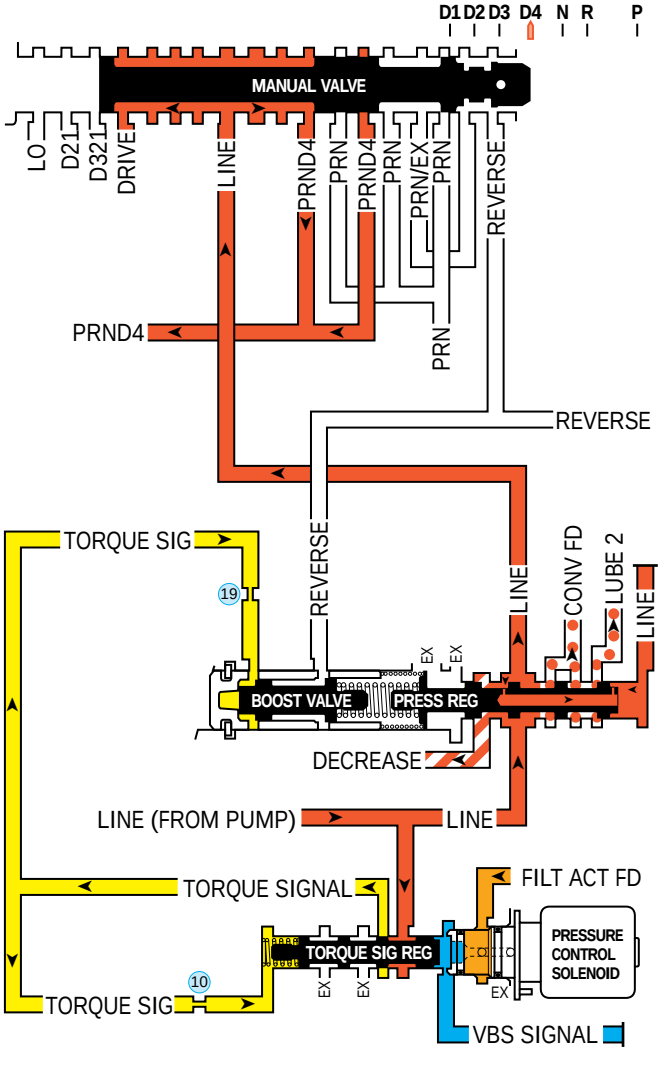
The main component that is used to control line pressure is the pressure regulator valve (328), located in the valve body (18). When the pump is operating at maximum output line pressure from the pump moves the pressure regulator valve against spring force. This allows line pressure to quickly fill the converter feed passage and also enter the decrease passage. Decrease fluid pressure acts on the pump slide to overcome the spring force of the pump priming spring (212) and moves the slide. As the slide moves towards the center of the pump body (216), clearance on the intake side of the oil pump slide (206) and oil pump rotor (204) decreases. This movement of the oil pump slide lowers the pump output capacity to maintain proper line pressures.

The position of the oil pump slide and pressure regulator valve constantly change depending on vehicle operation and the amount of fluid pressure and volume needed to operate the transaxle. The fluid pressure required to apply clutches and bands also varies in relation to throttle opening and engine torque. The pressure control solenoid (312) provides the means to regulate line pressure in response to PCM command.

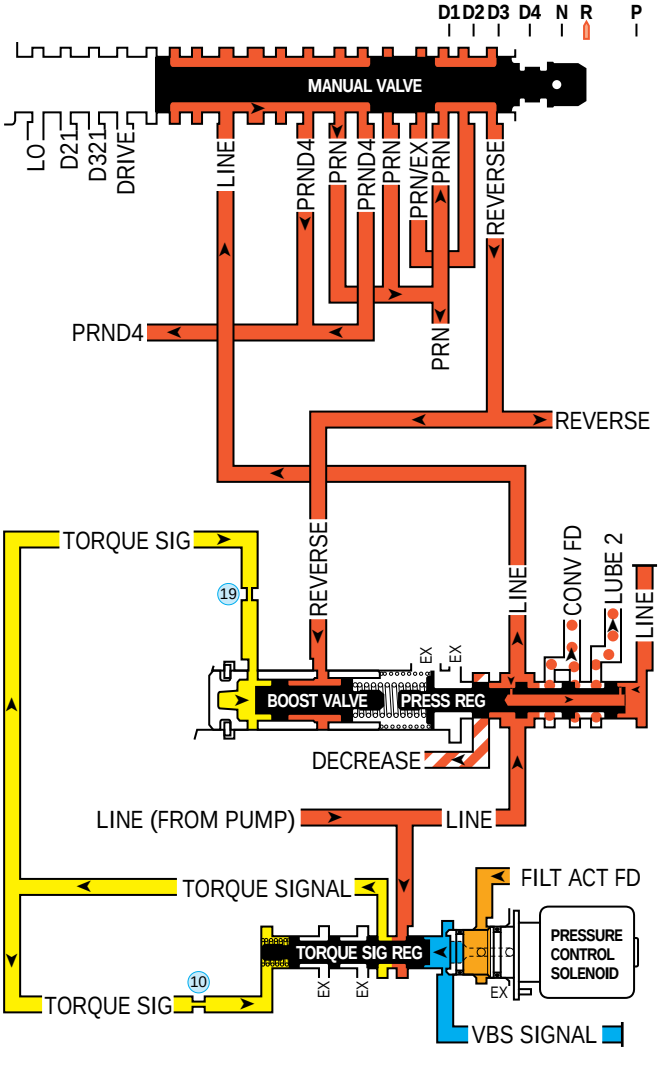
Pressure Regulator Related Diagnostic Tips

A stuck or damaged pressure regulator valve could cause:

- High or low line pressure
- Slipping clutches or bands
- Low or no cooler/lube flow



NORMAL PRESSURE



BOOSTED PRESSURE (REVERSE)

Figure 34

HYDRAULIC CONTROL COMPONENTS

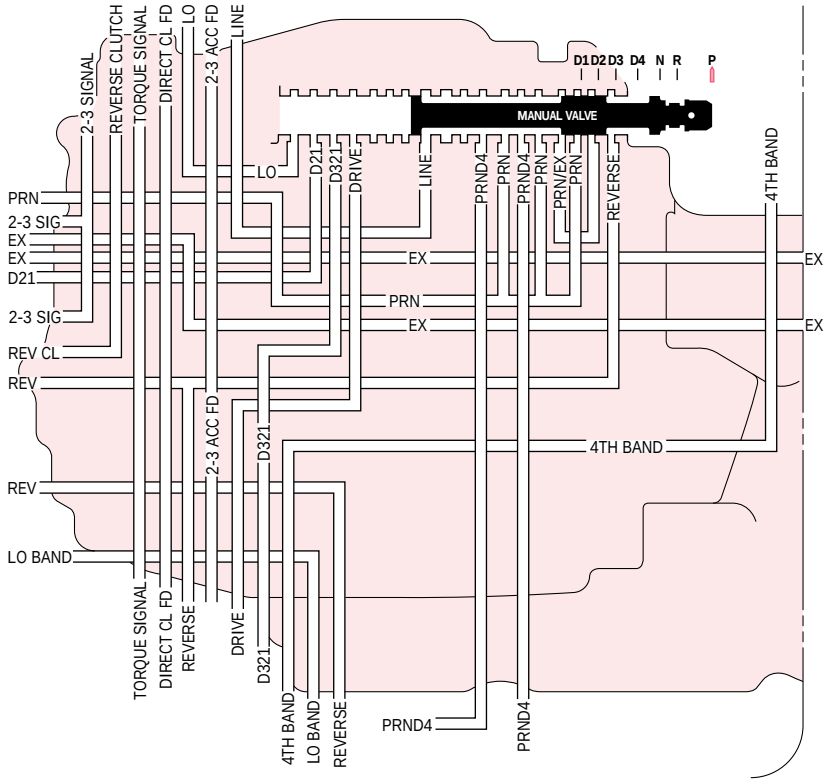
VALVES LOCATED IN THE CHANNEL PLATE

MANUAL VALVE (404):
The manual valve (800) is fed by line pressure from the pressure regulator valve and is mechanically linked to the gear selector lever. When a gear range is selected, the manual valve directs line pressure into the various circuits by opening and closing feed passages. The circuits that are fed by the manual valve are: Reverse, PRN, PRN/EX, PRND4, Drive, D321, D21 and Lo.

Manual Valve Related Diagnostic Tips

Stuck, misaligned or damaged valve and linkage could cause:

- No reverse or slips in reverse
- No first gear or slips in first gear
- No fourth gear or slips in fourth gear
- No Park
- No engine compression braking in all manual ranges
- Drives in neutral
- No gear selections
- Shift indicator indicates wrong gear selection



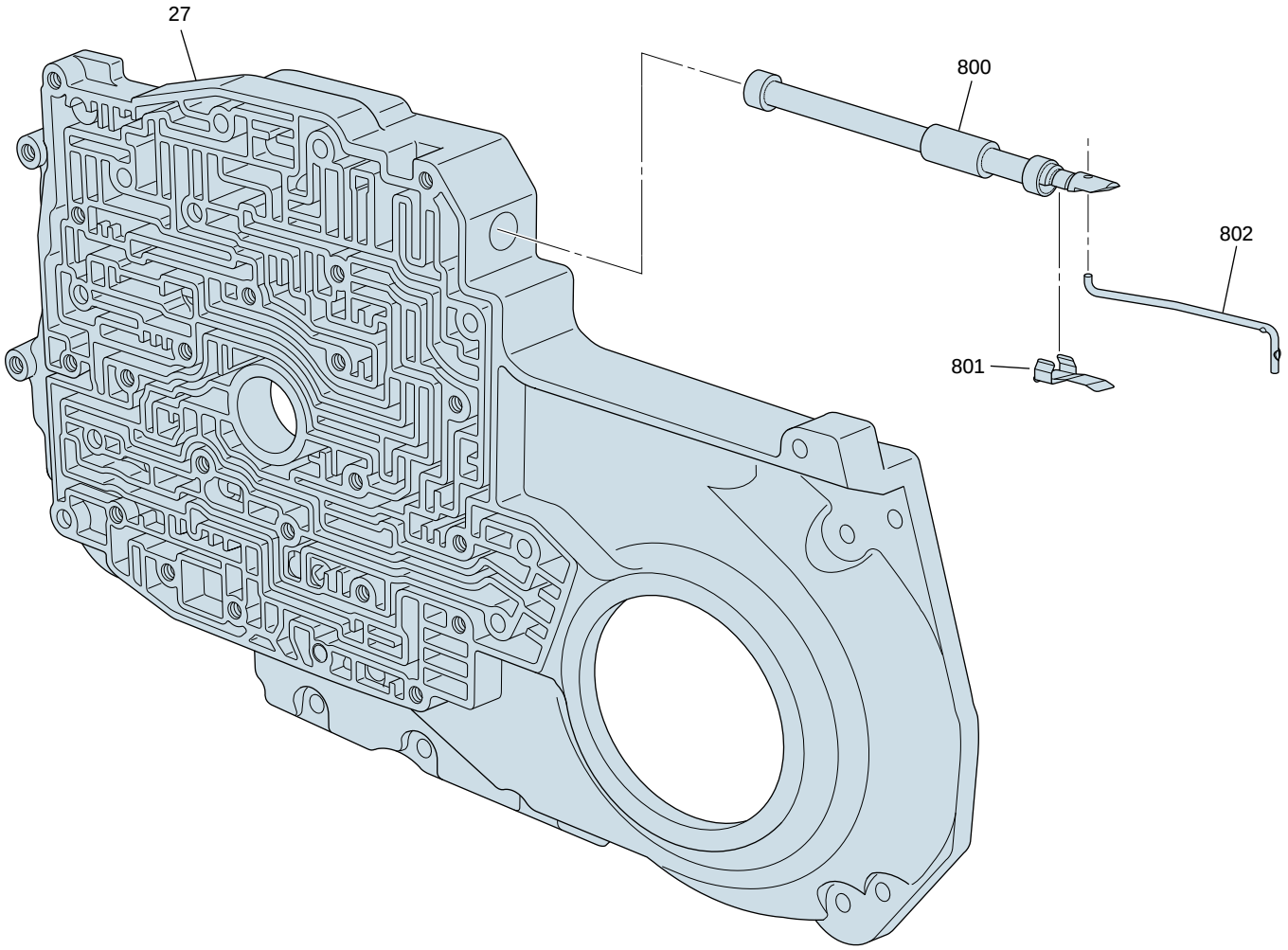


Figure 35

HYDRAULIC CONTROL COMPONENTS

ACCUMULATORS

In the Hydra-matic 4T40-E, accumulators are used in the 2nd, Direct and 4th clutch apply circuits to control shift feel. An accumulator is a spring-loaded device that absorbs a certain amount of fluid pressure in a circuit to cushion clutch engagement according to engine torque. The clutch apply fluid pressure acts against spring force and Torque Signal biased accumulator pressure to act like a shock absorber.

During the apply of the 2nd and Direct clutch packs apply fluid overcomes the clutch piston return springs and begins to compress the clutch plates. When the clearance between the clutch plates is taken up by piston travel and the clutch begins to apply, pressure in the circuit builds up rapidly. Without an accumulator in the circuit, this rapid buildup of fluid pressure would cause the clutch to grab very quickly and create a harsh shift. However, accumulator spring force and accumulator fluid pressure is designed to absorb some of the clutch apply fluid pressure allowing for a more gradual apply of the clutch. The same principle is true for the Fourth band. An accumulator is used to soften the servo piston apply to avoid a harsh apply of the band around the drum.

The force of the accumulator spring and accumulator fluid pressure together control the rate at which a clutch applies. In the Hydra-matic 4T40-E, accumulator pressure varies in proportion to the torque signal pressure acting on the accumulator valves. Therefore, when torque signal pressure is high, accumulator pressure will be high. Likewise, when torque signal pressure is low, accumulator pressure will be low. Since torque signal pressure is a function of throttle position and engine torque (through the pressure control solenoid), the accumulator valves regulate accumulator fluid pressure in proportion to throttle position and engine torque to control shift feel.

The three accumulators used in the 4T40-E are all located between the case (51) and the channel plate (27).

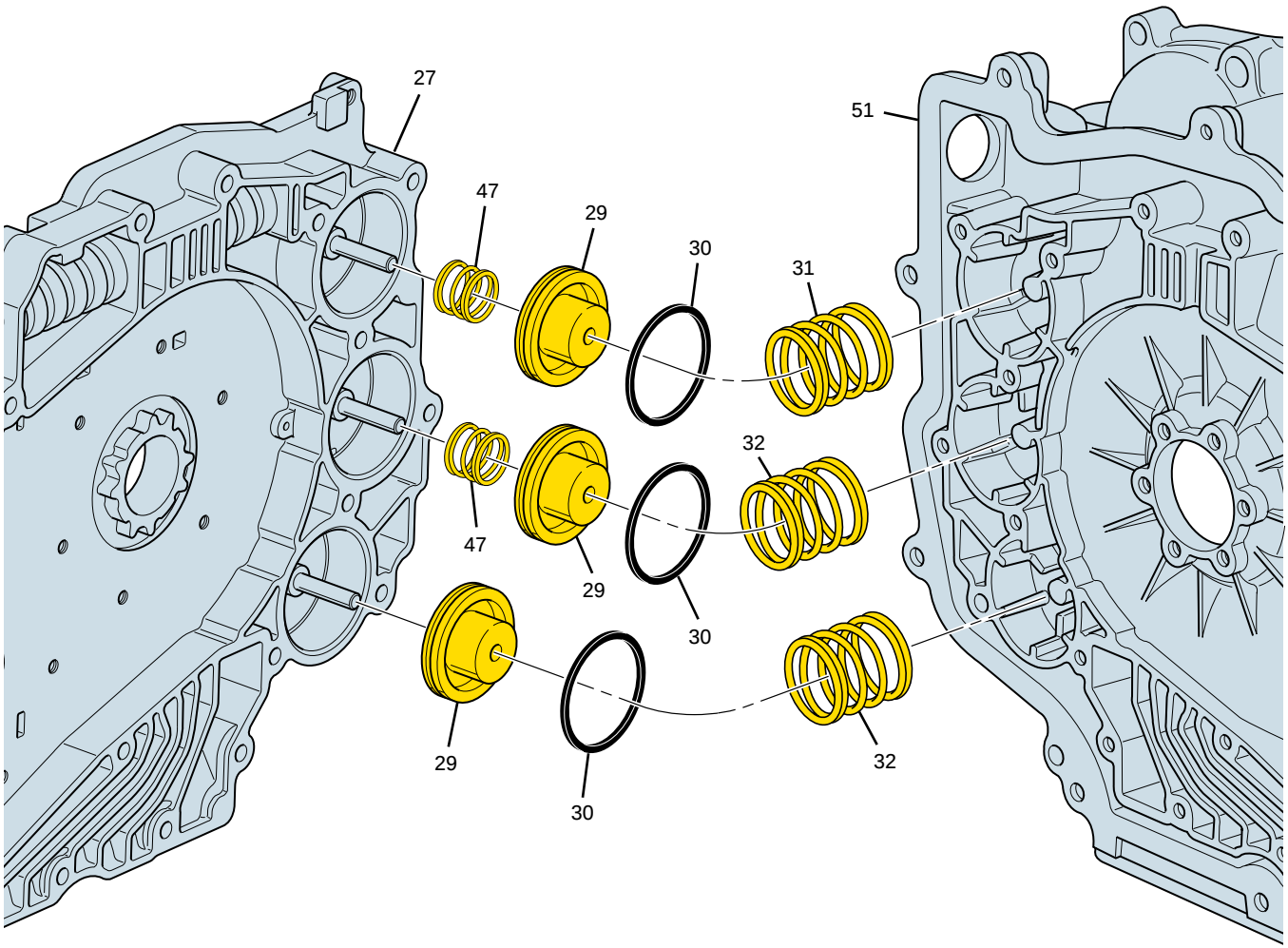


Figure 36

HYDRAULIC CONTROL COMPONENTS

ACCUMULATORS

1-2 ACCUMULATOR ASSEMBLY (29-31, 47):
Shift feel for a 1-2 shift and durability of the 2nd clutch is largely dependent upon 2nd clutch fluid pressure used to apply the clutch. To control 2nd clutch apply pressure and shift feel, a 1-2 accumulator assembly (29-31, 47) and 1-2 accumulator fluid pressure is used in addition to the 2nd clutch wave plate (96).

Fluid pressure in the 1-2 accumulator passage occurs when line fluid pressure is regulated at the 1-2/3-4 accumulator valve (323) by torque signal fluid pressure and spring force. Regulated line fluid pressure is then directed into the 1-2/3-4 accumulator passage where it is routed through orifice #18 to the other end of the accumulator valve where it will oppose torque signal fluid pressure and spring force to regulate 1-2/3-4 accumulator fluid pressure. 1-2/3-4 accumulator fluid is also routed to checkball #4 which now seats and forces the fluid through orifice #24 before entering the 1-2 accumulator housing on the return spring side of the piston.

When the 2nd clutch applies during a 1-2 shift, 2nd clutch fluid pressure is fed to the 1-2 accumulator piston (29) and compresses the 1-2 accumulator return spring (31). When this occurs, 1-2 accumulator fluid is forced out of the accumulator housing, unseats checkball #4 and then goes back to the 1-2/3-4 accumulator valve where it exhausts. Torque signal fluid pressure and spring force at the 1-2/3-4 accumulator valve regulate exhausting 1-2 accumulator fluid to control 2nd clutch apply.

1-2 Accumulator Related Diagnostic Tips

- A leak at the accumulator piston seal or porosity in the case or channel plate could cause no second gear/slips in second gear
- A stuck accumulator piston would cause harsh shifts

2-3 ACCUMULATOR ASSEMBLY (29, 30, 32, 47):
Shift feel for a 2-3 shift and durability of the direct clutch is regulated the same as 1-2 shift feel, except the accumulator spring (32) is calibrated for 3rd gear. To control direct clutch apply pressure and shift feel, a 2-3 accumulator assembly (29, 30, 32, 47) and 2-3 accumulator fluid pressure is used.

Fluid pressure in the 2-3 accumulator passage occurs when line fluid pressure is regulated at the 2-3 accumulator valve (330) by torque signal fluid pressure and spring force. Regulated line fluid pressure is then directed into the 2-3 accumulator passage where it is routed through orifice #20 to the other end of the accumulator valve where it will oppose torque signal fluid pressure and spring force to regulate 2-3 accumulator fluid pressure. 2-3 accumulator fluid is also routed to the 1-2 accumulator housing on the return spring side of the piston.

When the direct clutch applies during a 2-3 shift, direct clutch fluid pressure is fed to the 2-3 accumulator piston (29) and compresses the 2-3 accumulator return spring (32). When this occurs, 2-3 accumulator fluid is forced out of the accumulator housing, and goes back to the 2-3 accumulator valve where it exhausts. Torque signal fluid pressure and spring force at the 2-3 accumulator valve regulate exhausting 2-3 accumulator fluid to control direct clutch apply.

2-3 Accumulator Related Diagnostic Tips

- A leak at the accumulator piston seal or porosity in the case or channel plate could cause no third gear/slips in third gear
- A stuck accumulator piston would cause harsh shifts

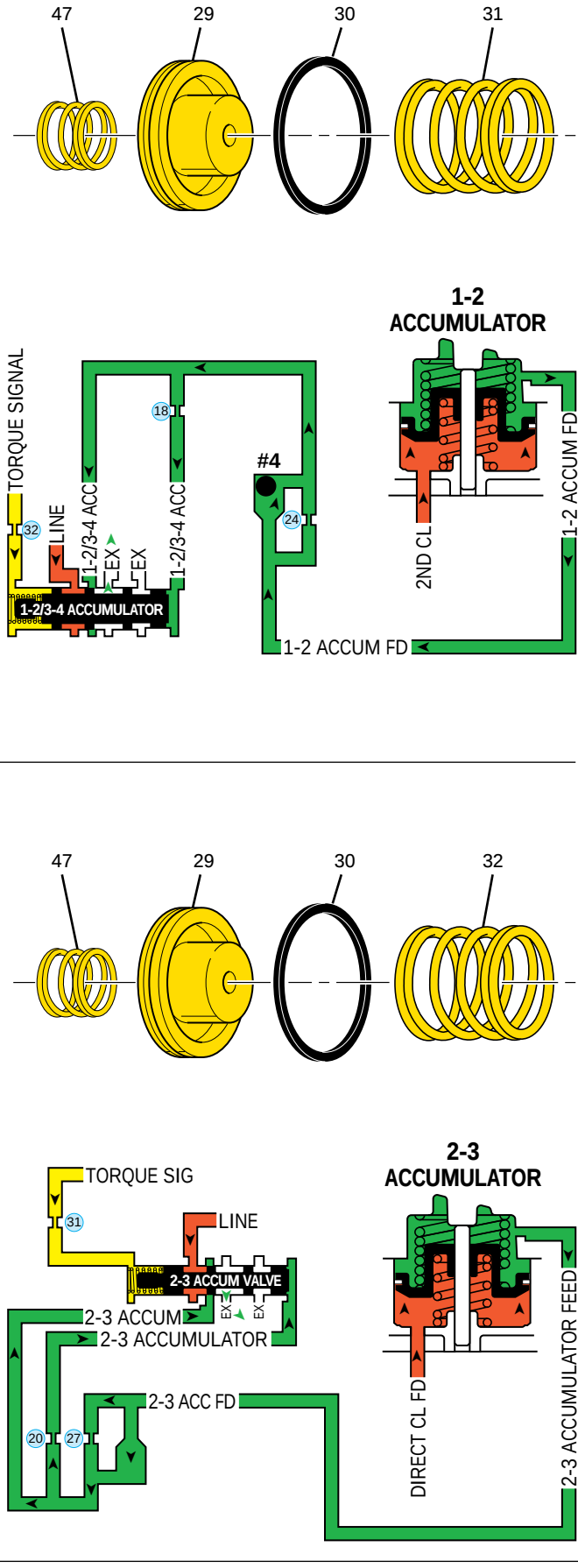


Figure 37

HYDRAULIC CONTROL COMPONENTS

ACCUMULATORS

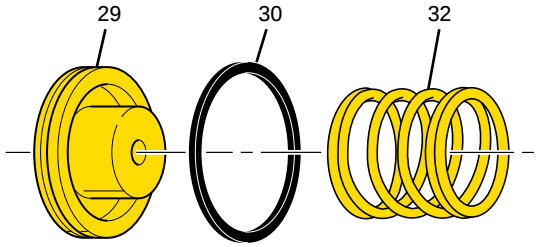
3-4 ACCUMULATOR ASSEMBLY (29, 30, 32):
Shift feel for a 3-4 shift and durability of the intermediate/4th band is regulated in the same way as 1-2 and 2-3 shift feel. In fact, it shares the 1-2/3-4 accumulator valve and fluid circuit with the 1-2 accumulator up to their respective checkballs. It is able to use the same valve and circuit because the 1-2 shift has already occurred and the second clutch is now holding, so there will be no pressure interference from 3-4 accumulator regulation.

Fluid pressure in the 3-4 accumulator passage occurs when line fluid pressure is regulated at the 1-2/3-4 accumulator valve (323) by torque signal fluid pressure and spring force. Regulated line fluid pressure is then directed into the 1-2/3-4 accumulator passage where it is routed through orifice #18 to the other end of the accumulator valve where it will oppose torque signal fluid pressure and spring force to regulate 3-4 accumulator fluid pressure. 3-4 accumulator fluid is also routed to checkball #7 which now seats and forces the fluid through orifice #28 before entering the 3-4 accumulator housing on the return spring side of the piston.

When the intermediate/4th servo applies during a 3-4 shift, 4th band fluid pressure is fed to the 3-4 accumulator piston (29) and compresses the 3-4 accumulator return spring (32). When this occurs, 3-4 accumulator fluid is forced out of the accumulator housing, and goes back to the 1-2/3-4 accumulator valve where it exhausts. Torque signal fluid pressure and spring force at the 1-2/3-4 accumulator valve regulate exhausting 1-2/3-4 accumulator fluid to control intermediate/4th servo apply.

3-4 Accumulator Related Diagnostic Tips

- A leak at the accumulator piston seal or porosity in the case or channel plate could cause no fourth gear/slips in fourth gear
- A stuck accumulator piston would cause harsh shifts



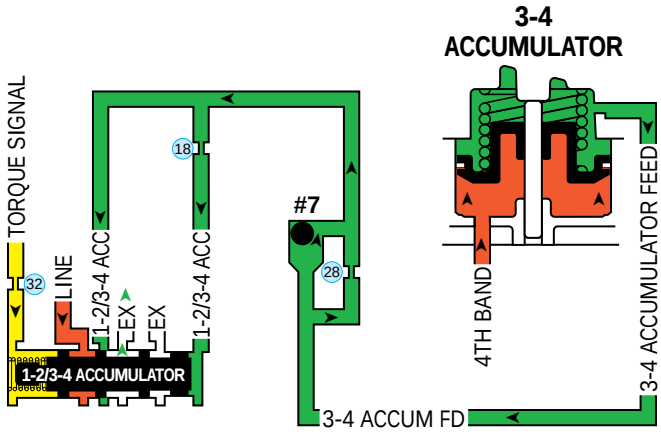


Figure 38

HYDRAULIC CONTROL COMPONENTS

VALVES LOCATED IN THE VALVE BODY

1-2/3-4 Accumulator Valve (323):
The 1-2/3-4 accumulator is biased by torque signal fluid pressure on one end and 1-2/3-4 accumulator fluid pressure on the other. The valve allows line fluid to enter the 1-2/3-4 accumulator fluid circuit and also allows 1-2/3-4 accumulator fluid to exhaust when the 1-2 or 3-4 accumulators are stroked.

- If stuck, the 1-2/3-4 accumulator valve could cause harsh or soft 1-2 or 3-4 upshifts.

PRESSURE REGULATOR VALVE TRAIN (324-328)

Pressure Regulator Valve (328):
The pressure regulator valve (328) regulates line pressure to: the manual valve, the converter feed circuit and the decrease passage to regulate pump output.

- A stuck pressure regulator valve could cause harsh or soft shifts
- Slipping or soft TCC apply

Pressure Regulator Boost Valve (325):
Acted on by reverse fluid from the manual valve and torque signal fluid, it moves against pressure regulator valve spring (326) pressure. Torque signal fluid increases line pressure in response to a high percentage of throttle travel. In reverse range, reverse fluid moves the valve to boost line pressures.

2-3 Accumulator Valve (330):
The 2-3 accumulator is biased by torque signal fluid pressure on one end and 2-3 accumulator fluid pressure on the other. The valve allows line fluid to enter the 2-3 accumulator fluid circuit and also allows 2-3 accumulator fluid to exhaust when the 2-3 accumulator is stroked.

- If stuck, the 2-3 accumulator valve could cause harsh or soft 2-3 upshifts.

CONVERTER CLUTCH VALVE SYSTEM

TCC Feed Limit Valve (332):
The torque converter clutch feed limit valve limits the maximum fluid pressure in the TCC feed limit fluid circuit and the torque converter.

- Stuck valve could cause low cooler/lube flow.

TCC Control Valve (334):
The torque converter clutch control valve is basically an on/off control valve. It is held in the TCC off position by spring force and is shuttled to the on position by TCC signal fluid pressure.

- Stuck in the release position would cause no TCC apply.
- Stuck in the apply position would cause apply fluid to exhaust and an overheated torque converter.

TCC Regulated Apply Valve (339):
Regulates line pressure into the TCC regulated apply circuit during TCC apply. Filtered 2-3 drive fluid pressure through the TCC PWM solenoid acts on one end, and TCC regulated apply fluid and spring force on the other.

- Stuck in the release position would cause no TCC/soft/slip apply.
- Stuck in the apply position would cause soft/harsh TCC applies.

TCC Control PWM Solenoid (335):
An electronically controlled pressure regulator that regulates filtered 2-3 drive fluid pressure into the TCC signal fluid circuit to shuttle the TCC control valve to the apply position. Regulated filtered 2-3 drive fluid pressure also shuttles the TCC regulator apply valve to allow line pressure into the TCC regulated apply circuit for a controlled apply and release of the torque converter clutch.

- Stuck on, exhaust plugged, would cause no TCC release in 2nd, 3rd or 4th gear.
- Stuck off, leaking o-ring, no voltage, would cause no TCC/slip or soft apply.

1-2 SHIFT VALVE TRAIN (301-305)

1-2 Shift Solenoid (305):
The 1-2 Shift Solenoid (305) is a normally open ON/OFF type solenoid that receives its voltage supply through the ignition switch. The PCM controls the solenoid by providing a ground to energize it in: Park, Reverse, Neutral, First and Fourth Gear. When energized (ON), it's exhaust port closes and, depending on range, 1-2 signal fluid shuttles the 1-2 shift valve.

- 1-2 solenoid stuck off or leaking could cause 2nd or 3rd gear only condition.
- 1-2 solenoid stuck on could cause 1st and 4th gears only.

1-2 Shift Valve (302):
The 1-2 shift valve responds to 1-2 signal fluid pressure, force from the 1-2 shift valve spring (301) and 2-3 signal fluid pressure. Directs fluid for 1-2 and 2-1 shifts.

- 1-2 shift valve stuck in the downshift position could cause no 2nd or slips in 2nd gear.
- 1-2 shift valve stuck in the upshift position could cause no 1st gear.

2-3 SHIFT VALVE TRAIN (303-307)

2-3 Shift Solenoid (305):
The 2-3 Shift Solenoid (305) is a normally open ON/OFF type solenoid that receives its voltage supply through the ignition switch. The PCM controls the solenoid by providing a ground to energize it in: Third and Fourth Gear. When energized (ON), it's exhaust port closes and, depending on range, 2-3 signal fluid shuttles the 2-3 shift valve.

- 2-3 solenoid stuck off or leaking could cause no 3rd gear.
- 2-3 solenoid stuck on could cause loss of power or 3rd and 4th gears only.

2-3 Shift Valve (307):
The 2-3 shift valve (307) is controlled by 2-3 signal fluid pressure, force from the 2-3 shift valve spring (306) and actuator feed fluid pressure. Directs fluid for 2-3 and 3-2 shifts.

- 2-3 shift valve stuck in the upshift position could cause 3rd or 4th gear only.
- 2-3 shift valve stuck in the downshift position could cause no 3rd gear.

TORQUE SIGNAL REGULATOR VALVE TRAIN (308-312)

Torque Signal Regulator Valve (309):
Regulates torque signal fluid, fed by line fluid pressure. The pressure control solenoid, a variable bleed solenoid, acts on one end of the valve (relative to throttle position) against torque signal fluid and spring pressure on the other end.

- A stuck torque signal regulator valve can cause high or low line pressure.

HYDRAULIC CONTROL COMPONENTS

VALVES LOCATED IN THE VALVE BODY

Pressure Control Solenoid (312):
An electronically controlled pressure regulator that regulates the torque signal regulator valve against torque signal fluid and spring force.

- A leaking/damaged o-ring or bad electrical connection can cause high or low line pressure.

Actuator Feed Limit Valve (315):
Is a spool type regulating valve that regulates line fluid pressure into actuator feed fluid pressure. Actuator feed fluid then feeds the shift solenoids after passing through a filter.

- If stuck in the exhaust position it could cause 2nd gear only and low line pressure.

3-4 Shift Valve (319):
The 3-4 shift valve (319) is controlled by 1-2 signal fluid pressure on one end of the valve and D321 fluid and spring (318) pressure at the other. When conditions are correct for a fourth gear shift the 1-2 solenoid is energized and 1-2 signal fluid pressure shuttles the 3-4 shift valve to allow 3-4 drive fluid to enter into the 4th band fluid circuit to apply the intermediate/4th servo.

- 3-4 shift valve stuck in the upshift position could cause no 3rd or slips in 3rd gear.
- 3-4 shift valve stuck in the downshift position could cause no 4th or slips in 4th gear.

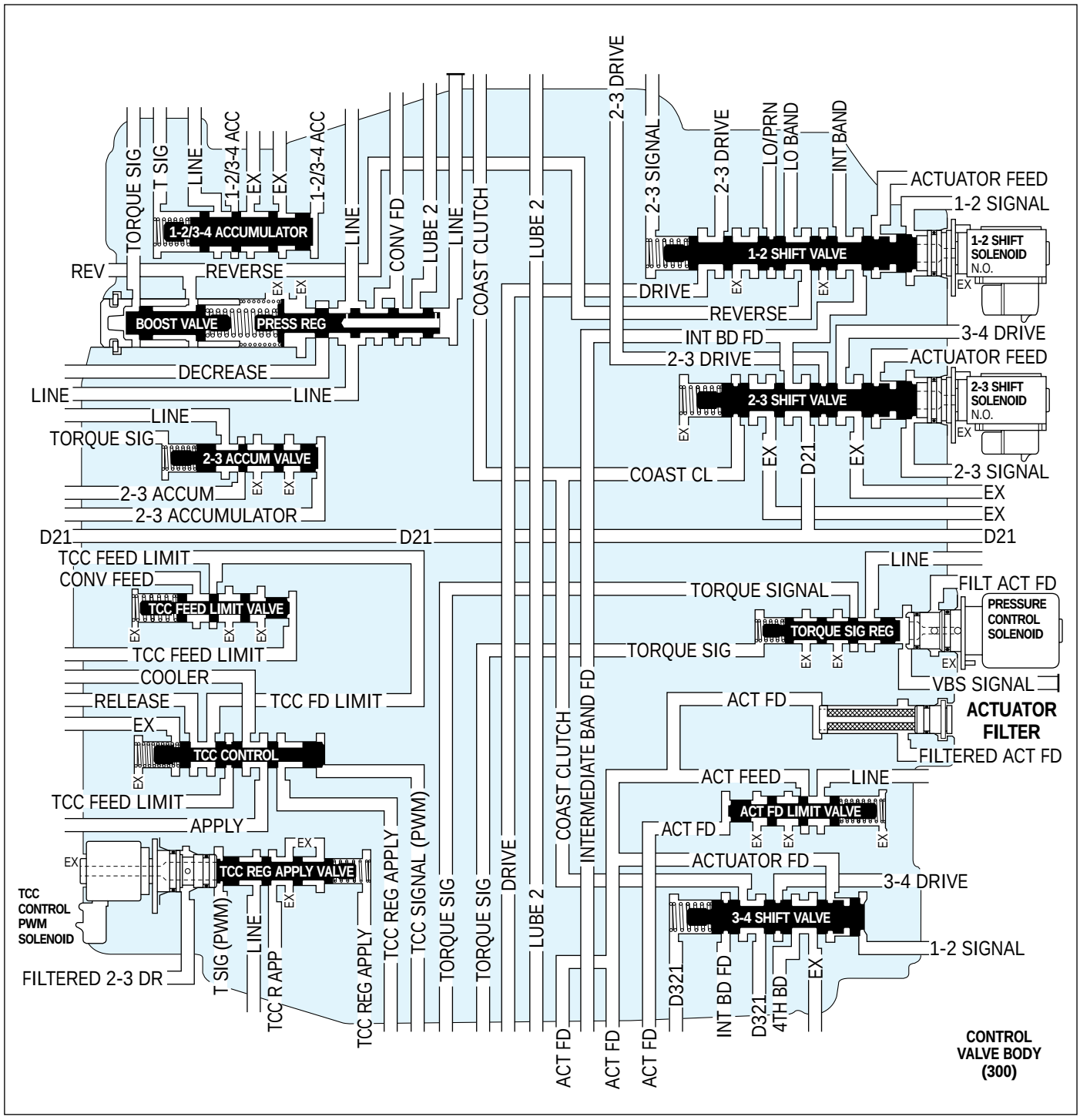


Figure 39

HYDRAULIC CONTROL COMPONENTS

CHECKBALL LOCATION AND FUNCTION

All of the checkballs in the 4T40-E are located in the channel plate, on the spacer plate side. Checkball #1 is used for direction control, while all of the other checkballs are designed to control shift feel, in conjunction with an orifice in the spacer plate.

#1 - Lo/PRN:
In Park, Reverse and Neutral this checkball directs PRN fluid to the Lo/PRN circuit. In manual first it directs Lo fluid to the Lo/PRN circuit.

#2 - 2-3 Drive/2nd Clutch:
Orificed 2-3 Drive fluid seats the checkball during a 1-2 upshift forcing fluid to pass through orifice #3 for a controlled apply of the second clutch. When 2nd fluid exhausts during a 2-1 downshift it unseats the checkball for a quick release of the second clutch.

#3 - Intermediate Band:
In manual second, Intermediate Band fluid seats the checkball and fluid must pass through orifice #8. When the manual valve is moved to any other gear range after being in second gear, in Manual Second or Manual First Ranges, the checkball will be unseated and exhausting Intermediate Band fluid will bypass the #8 orifice.

#4 - 1-2 Accumulator:
This checkball is seated during a 2-1 downshift, therefore 1-2 Accumulator fluid is forced to pass through orifice #24. During a 1-2 upshift the 1-2 accumulator is stroked by second clutch fluid. This forces 1-2 accumulator fluid to unseat the checkball and bypass orifice #24.

#5 - Direct Clutch Feed:
This checkball is used for shift apply control. It is seated by 3-4 Drive fluid during a 2-3 upshift. 3-4 Drive fluid is forced through orifice #26, into the Direct Clutch Feed circuit. The checkball is unseated during a 3-2 downshift and fluid exhausts quickly, as it has already been controlled by checkball #6, which is designed for release control.

#6 - Direct Clutch Exhaust:
This checkball is used for shift release control by seating during a 3-2 downshift to control exhausting Direct Clutch fluid. The exhausting fluid then flows through orifice #25.

#7 - 3-4 Accumulator:
This checkball is seated by 3-4 Accumulator fluid during a 4-3 downshift, thus forcing 3-4 Accumulator fluid to pass through orifice #26. During a 3-4 upshift the 3-4 accumulator is stroked by 4th Band fluid. This forces 3-4 Accumulator fluid to unseat the checkball and bypass orifice #26.

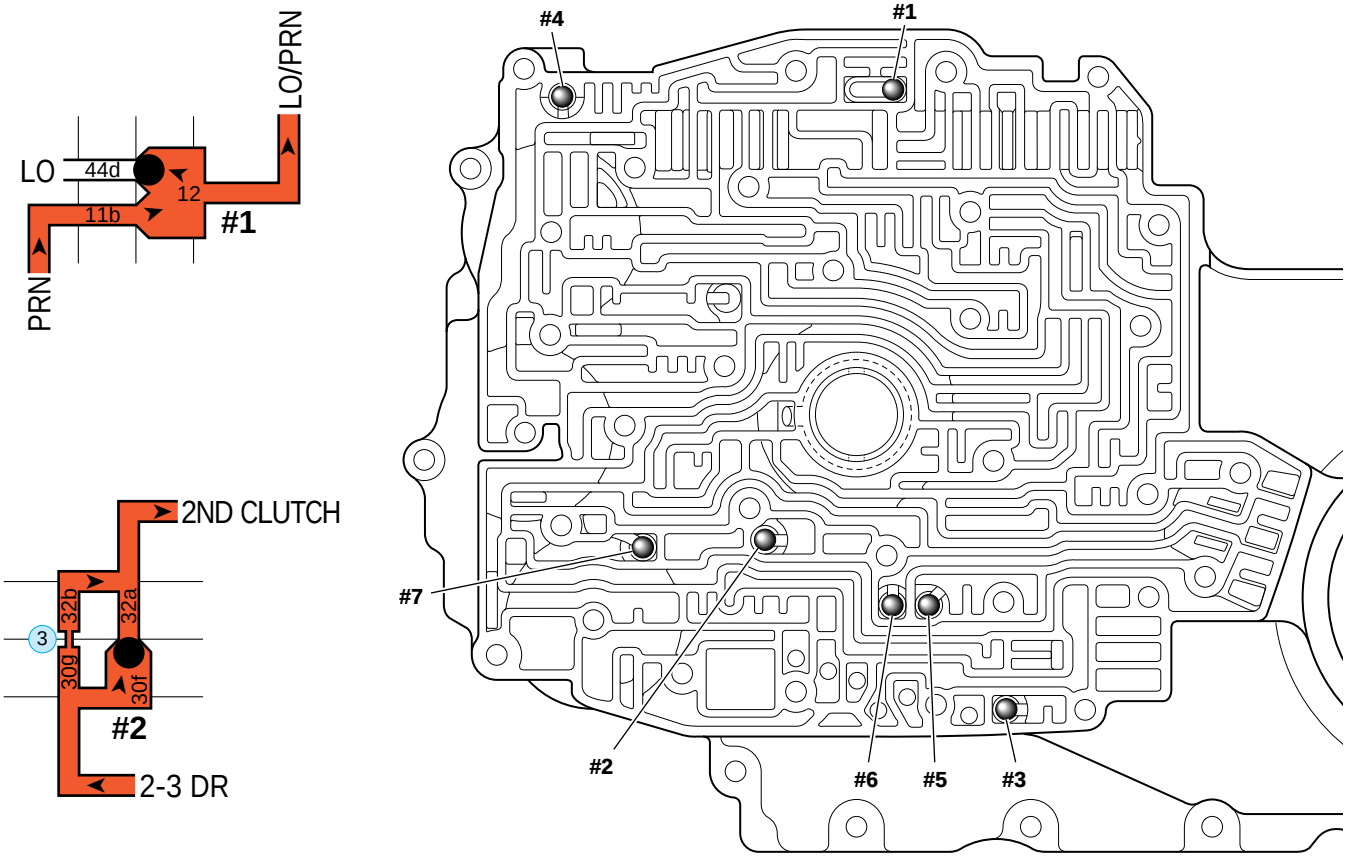
Checkball Related Diagnostic Tips

Understanding the design principle of each checkball will help in the diagnosis of hydraulic related problems. For example:

- a harsh shift complaint could be a stuck or missing checkball
- no reverse or slips in reverse could be the #1 checkball stuck or missing.
- no engine compression braking in manual first could also be a missing or stuck checkball #1.

HYDRAULIC CONTROL COMPONENTS

CHECKBALL LOCATION AND FUNCTION



CHANNEL PLATE (27)

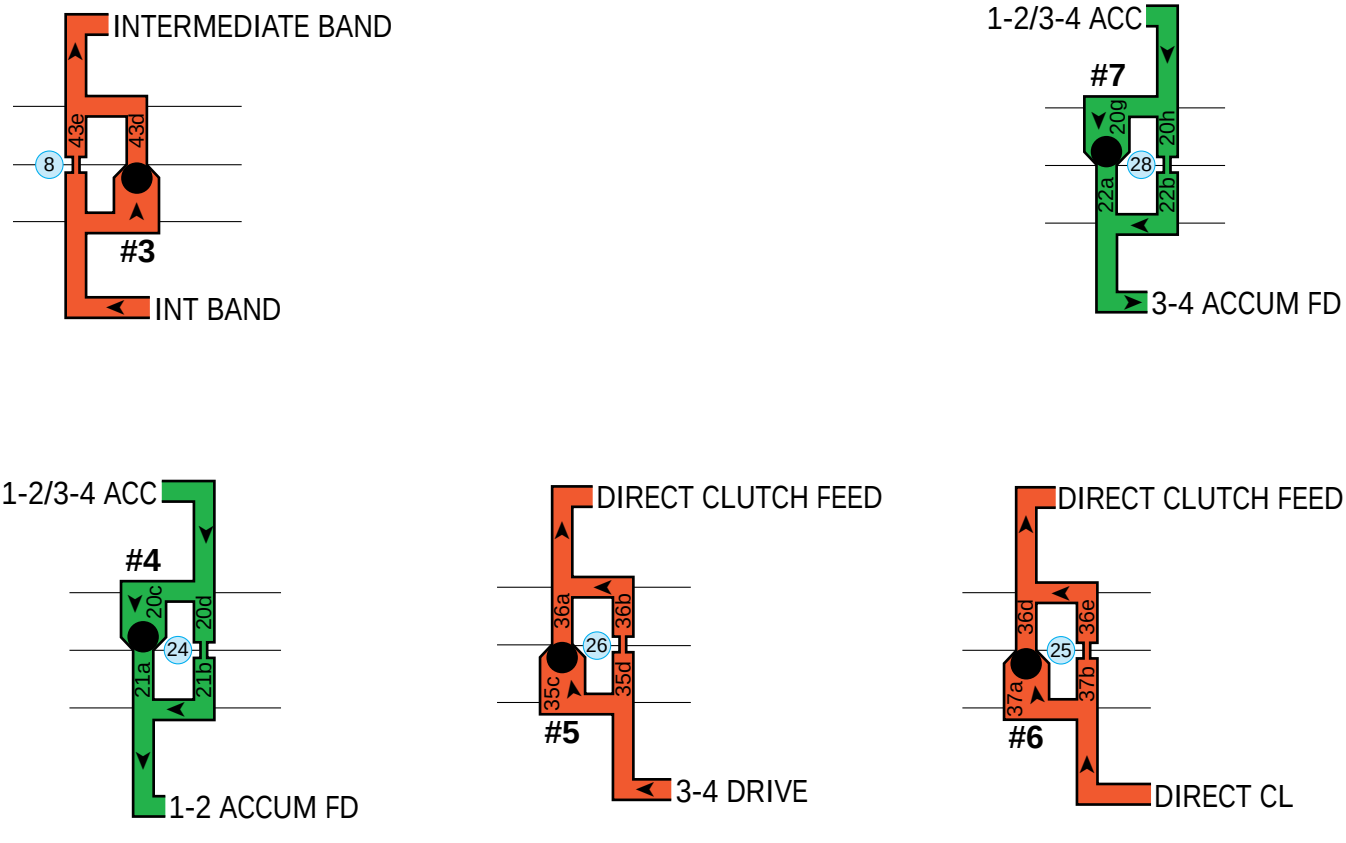
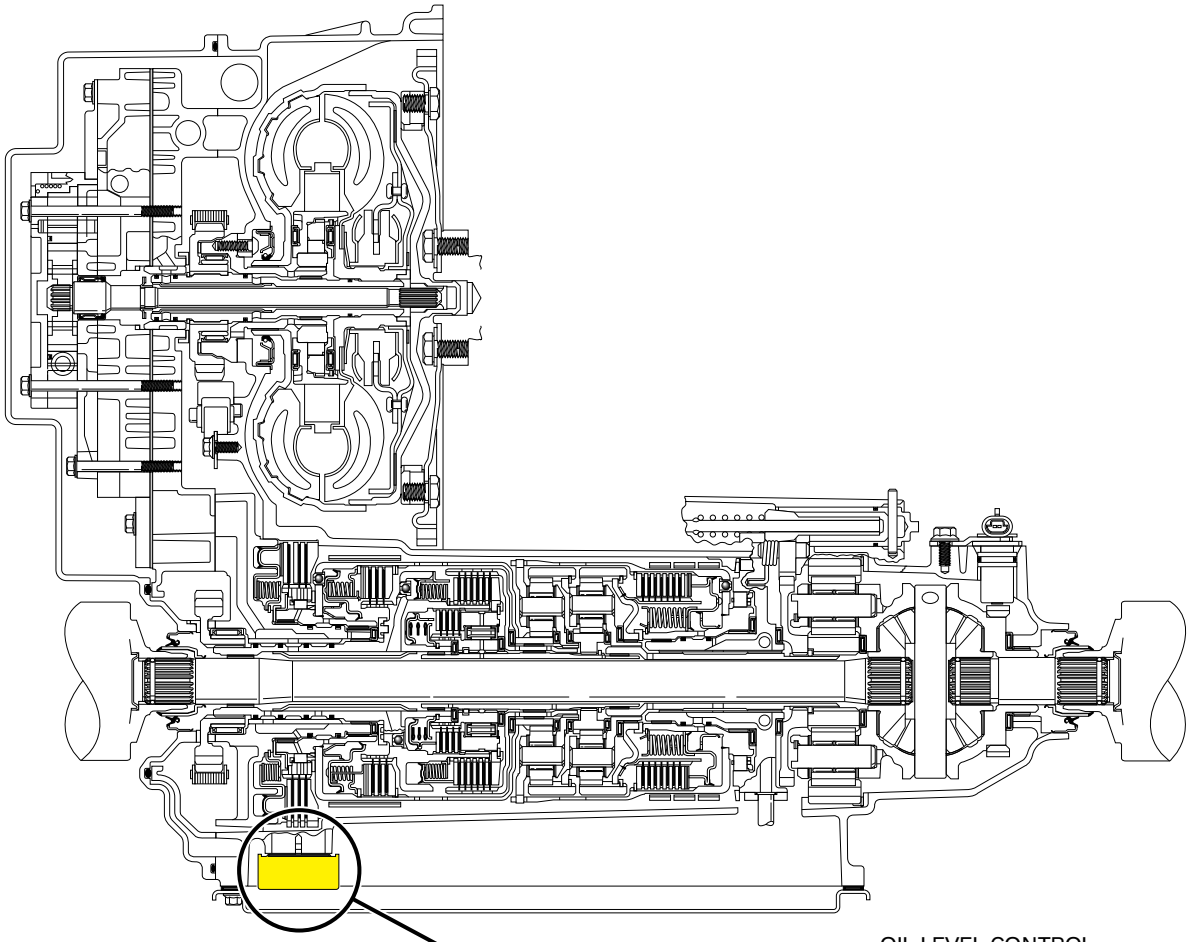
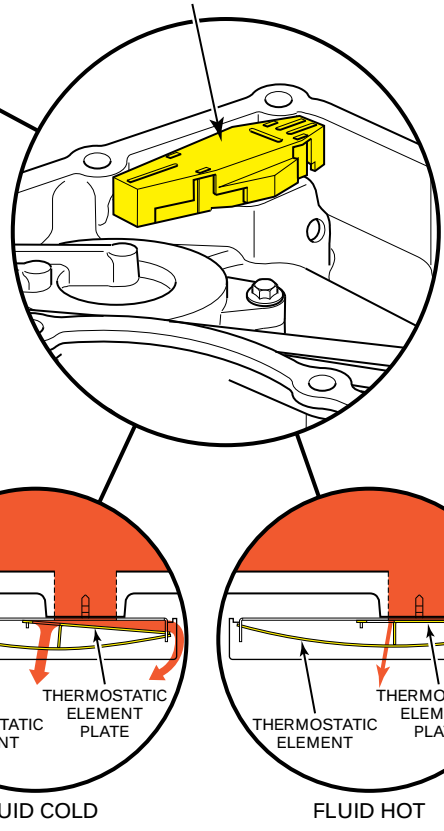


Figure 40

HYDRAULIC CONTROL COMPONENTS

THERMOSTATIC ELEMENTS





OIL LEVEL CONTROL VALVE:
The Oil Level Control Valve (86) is located on the case bottom pan side, and is designed to control the fluid level in the case side cover pan (1). At low temperatures, the thermostatic element exerts little pressure on the thermostatic element plate allowing fluid to drain into the sump. As the temperature of the fluid increases, the thermostatic element begins to apply pressure to the thermostatic element plate, thereby trapping fluid in the case side cover pan (1). This level of transaxle fluid is required in order to maintain the operation of the hydraulic system in the transaxle.

It should be noted that when checking the fluid level in a Hydra-matic 4T40-E transaxle, it will be higher when the transaxle is cold. Conversely, the fluid level will drop when checked at operating temperatures. This event is a result of the case Oil Level Control Valve (86) functioning as explained.

Oil Level Control Valve Related Diagnostic Tips

A damaged or loose oil level control valve could cause fluid foaming or incorrect fluid level.

Figure 41

ELECTRICAL COMPONENTS

The Hydra-matic 4T40-E transaxle incorporates electronic controls that utilize a Powertrain Control Module (PCM). The PCM gathers vehicle operating information from a variety of sensors and control components located throughout the powertrain (engine and transaxle). The PCM then processes this information for proper control of the following:

- transaxle shift points - through the use of shift solenoids
- transaxle shift feel - by adjusting line pressure through the use of a pressure control solenoid
- Torque converter clutch (TCC) apply and release feel - through the use of a TCC control solenoid

Electronic control of these transaxle operating characteristics provides for consistent and precise shift points based on the operating conditions of both the engine and transaxle.

FAIL-SAFE MODE

"Fail-safe mode" is an operating condition where the transaxle will partially function if a portion of the electronic control system becomes disabled. For example, if the wiring harness becomes disconnected, the PCM commands the fail-safe mode causing some transaxle electrical components to "default" to OFF. While the transaxle is operating in the fail-safe mode example given, the following operating changes occur:

- the pressure control solenoid is OFF, allowing line pressure to increase to its maximum pressure in order to prevent clutch or band slippage
- the TCC control solenoid is OFF, preventing TCC apply
- the shift solenoids are OFF, allowing the vehicle to be driven in second gear.

When both shift solenoids are OFF, the transaxle will operate in Second gear regardless of the forward gear selected (i.e. Overdrive, 3, 2, or 1). However, the transaxle will operate in Reverse, if selected, as well as Park and Neutral. (The fail-safe mode described above is only one of the operating modes associated with this transaxle. Refer to the appropriate Service Repair Manual when diagnosing these conditions.)

NOTE: This section of the book contains "general" information about electrical components that provide input information to the PCM. Since this "input" information may vary from carline to carline, it is important that the appropriate General Motors Service Manual is used during repair or diagnosis of this transaxle.

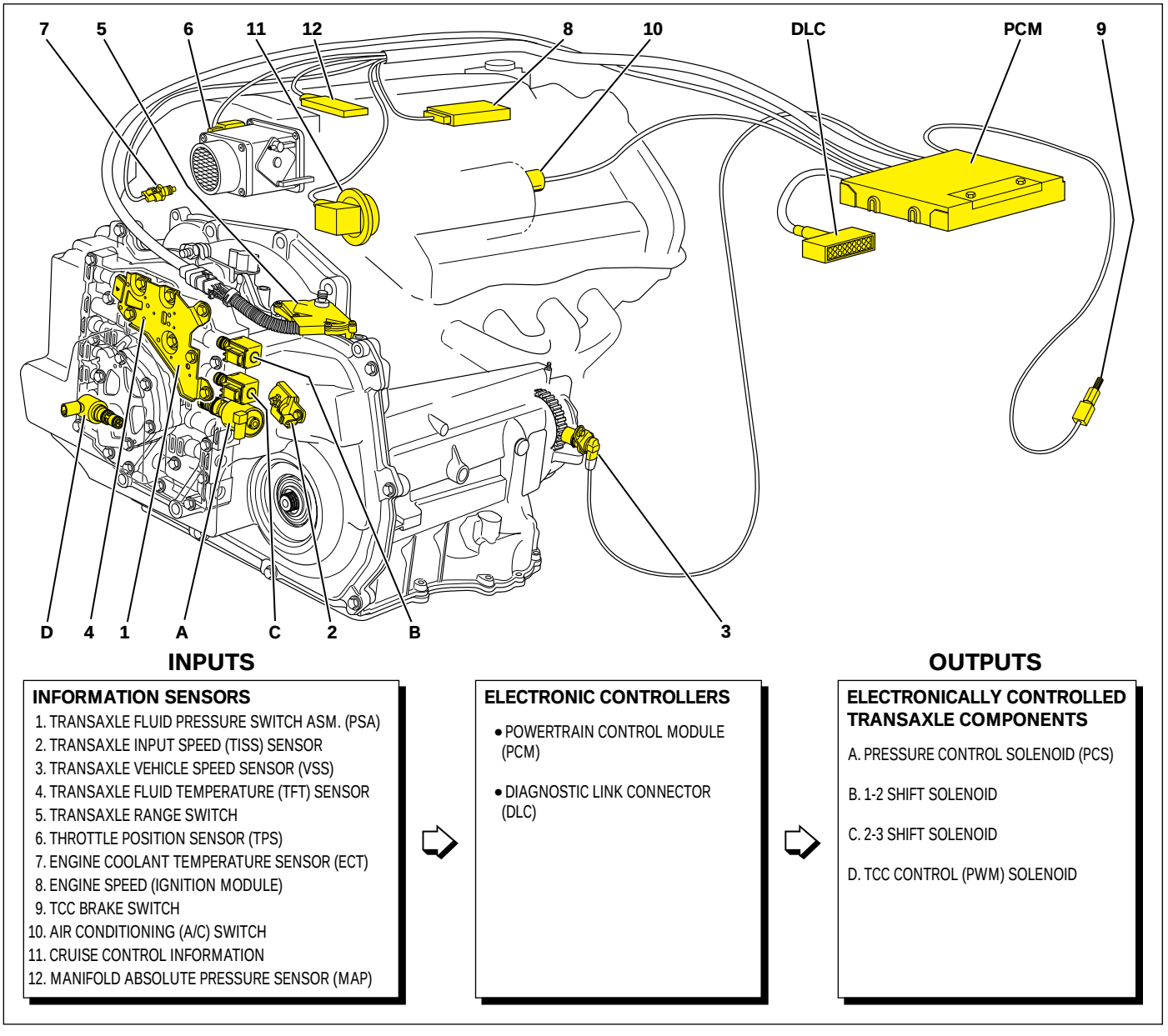
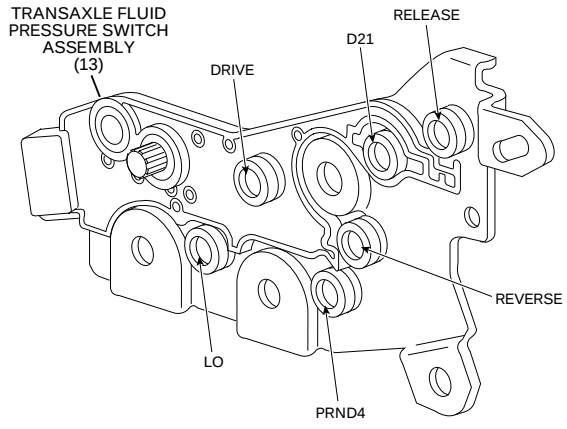
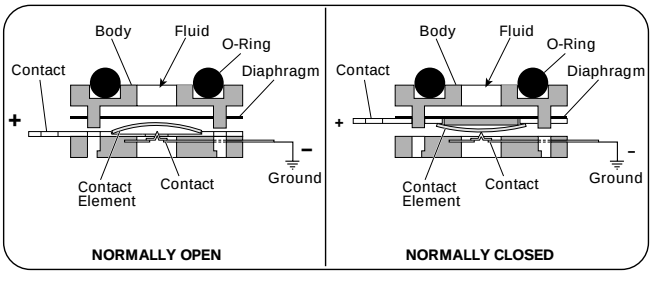


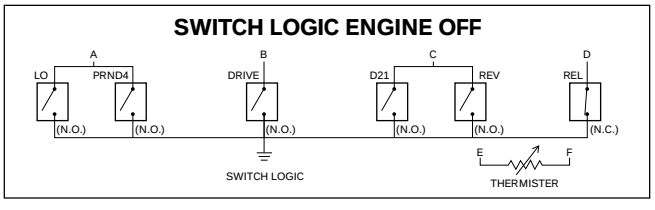
Figure 42



A Transaxle Fluid Pressure Switch Assembly malfunction will set a DTC P1810 and the PCM will command the following default actions:

- DTC P1810 will be stored in PCM history.
- Freeze shift adapts.
- Assume D4 shift pattern.
- Inhibit TCC engagement.
- Elevate line pressure.

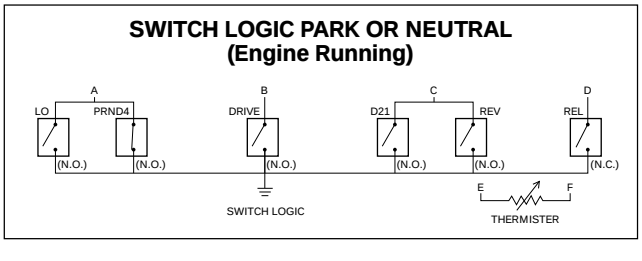




RANGE INDICATOR	FLUID*					CIRCUIT+		
	REV	PRND4	DR	D21	LO	A	B	C
Park/Neutral	0	1	0	0	0	1	0	0
Reverse	1	1	0	0	0	1	0	1
Overdrive	0	1	1	0	0	1	1	0
Manual Third	0	0	1	0	0	0	1	0
Manual Second	0	0	1	1	0	0	1	1
Manual First	0	0	1	1	1	1	1	1

*: 1 = Pressurized
0 = Exhausted

+: 1 = Grounded (Resistance <50 ohms, 0 volts)
0 = Open (Resistance >50k ohms, 12 volts)



Transaxle Fluid Pressure Switch Assembly (13)
The pressure switch assembly (PSA) is attached to the valve body and contains six fluid pressure switches and the transaxle temperature sensor (refer to the separate description of the temperature sensor). Five of the fluid pressure switches (PRND4, DRIVE, LO, D21, REV) are normally open and are used to indicate the position of the manual valve. The PCM uses this information to control line pressure, TCC apply and release and shift solenoid operation.

The RELEASE pressure switch is a normally closed pressure switch. This switch is used as a diagnostic tool to confirm that the TCC is actually OFF when it has been commanded OFF by the PCM.

Each fluid pressure switch produces either an open or ground to the PCM depending on the presence of fluid pressure at the switches. The sequence of open and closed switches produces a combination of voltage readings that are monitored by the PCM (see chart and switch logic diagram). The PCM measures PSA signal voltage from each pin to ground and compares the voltage to a PSA combination chart stored in the PCM memory. If the PCM does not recognize the switch sequence a diagnostic code will be set as a result. A diagnostic code may also be set if the PSA switch sequence indicates a gear range selection that conflicts with other sensory inputs to the PCM.

Normally Open Pressure Switch Operation: (PRND4, DRIVE, LO, D21, REV)
When the engine is started and fluid is routed to a switch, fluid pressure moves a diaphragm and contact element until the contact touches both the positive (+) and ground (⏚) contacts. The switch is now in a closed position and it allows current to flow from the positive contact through the switch to ground. The completed circuit changes the switch state thereby electronically signalling the PCM the position of the manual valve.

Normally Closed Pressure Switch Operation: (RELEASE)
The release switch is in a closed position and allows current to flow from the positive contact through the switch to ground when no fluid is present. Release fluid pressure moves the diaphragm to disconnect the positive and ground contacts, opening the switch and stopping current flow.

Example: (Park or Neutral Range)
The hydraulic and electrical schematics below illustrate the system operation when the manual valve is positioned in the Park position. As shown, the PRND4 switch has fluid pressure holding it in the closed position allowing current to flow through Pin "A" (transaxle pass-thru connector pin) to ground. When the circuit is closed, the digital logic signal in the PCM is "1" indicating that the circuit is grounded. The normally closed RELEASE switch has fluid pressure holding it open, the digital logic signal in the PCM is "0". Thus when Pins "B", "C" and "D" are open and Pin "A" is grounded, the PCM interprets the manual valve position as being in Park or Neutral and that the TCC is released.

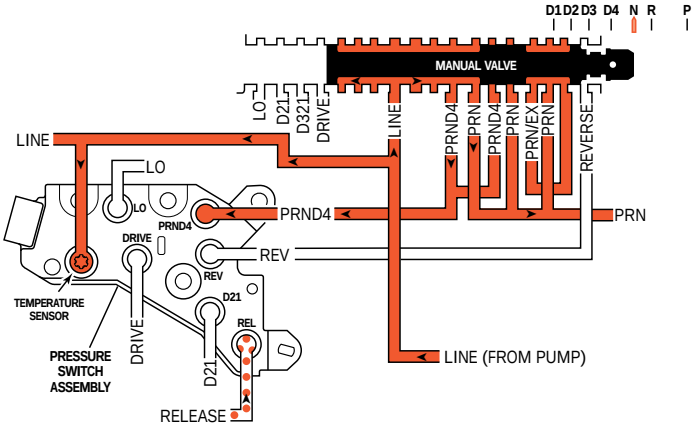
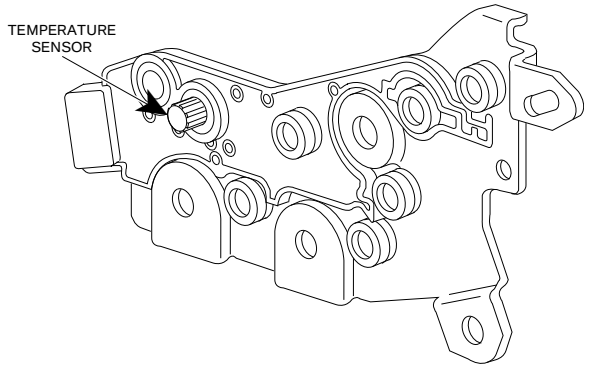


Figure 43



Transaxle Fluid Temperature Sensor

The temperature sensor is a negative temperature coefficient thermistor (temperature sensitive resistor) that provides information to the PCM regarding transmission fluid temperature. The temperature sensor is integrated in the pressure switch assembly (PSA) which is bolted to the valve body. The sensor monitors pressurized main line fluid from the inside of the valve body to determine the operating temperature of the transaxle fluid. The sensor, similar to each of the PSA fluid pressure switches, uses an o-ring seal to maintain fluid pressure in the valve body.

The internal electrical resistance of the sensor varies in relation to the operating temperature of the transmission fluid (see chart). The PCM sends a 5 volt reference signal to the temperature sensor and measures the voltage drop in the electrical circuit. A lower fluid temperature creates a higher resistance in the temperature sensor, thereby measuring a higher voltage signal.
The PCM measures this voltage as another input to help control line pressure, shift schedules and TCC apply. When transaxle fluid temperature reaches 140°C (284°F) the PCM enters “hot mode”. Above this temperature the PCM modifies transmission shift schedules and TCC apply in an attempt to reduce fluid temperature by reducing transmission heat generation. During hot mode the PCM applies the TCC more often in Third and Fourth gears (TCC is also applied in 2nd gear in some models). Also, the PCM will perform 2-3 and 3-4 shifts earlier to help reduce fluid heat generation.

Transmission Fluid Temperature Sensor Circuit Low Input will set a DTC P0712 and the PCM will command the following default actions:

- DTC P0712 will be stored in PCM history.
- Freeze shift adapts.
- Transaxle will assume a default temperature.

Transmission Fluid Temperature Sensor Circuit High Input will set a DTC P0713 and the PCM will command the following default actions:

- DTC P0713 will be stored in PCM history.
- Freeze shift adapts.
- Transaxle will assume a default temperature.

Transmission Fluid Over Temperature will set a DTC P1812 and the PCM will command the following default actions:

- DTC P1812 will be stored in PCM history.
- Freeze shift adapts.

TRANSAXLE SENSOR – TEMPERATURE TO RESISTANCE TO VOLTAGE (approximate)

°C	R low (ohms)	R high (ohms)
0	7987	10859
10	4934	6407
20	3106	3923
30	1991	2483
40	1307	1611
50	878	1067
60	605	728
70	425	507
80	304	359
90	221	259
100	163	190

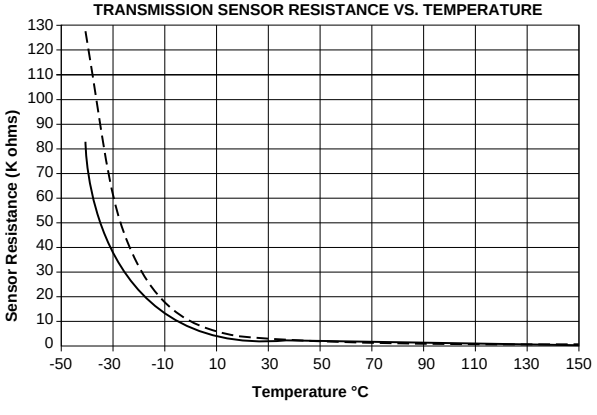
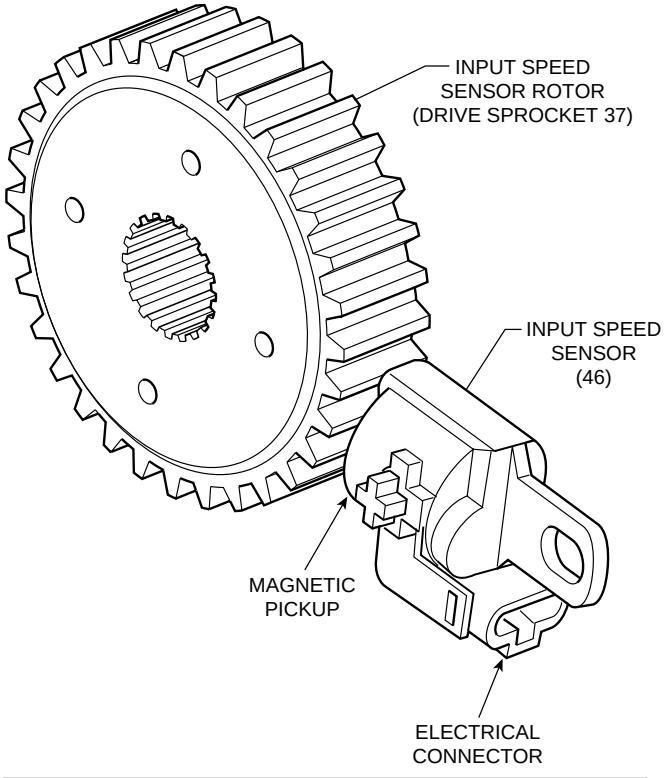


Figure 44



Sensor resistance should measure between 625 - 725 ohms at 20°C (68°F). Output voltage will vary with vehicle speed from a minimum of 0.5 Volts AC at 550 RPM, to 200 Volts at 7000 RPM.

Transaxle Input Speed Sensor (46):
The Transaxle Input Speed (TISS) sensor is a magnetic inductive pickup that relays information relative to transaxle input speed to the PCM. This information is used to calculate the appropriate operating gear ratios and TCC slippage.

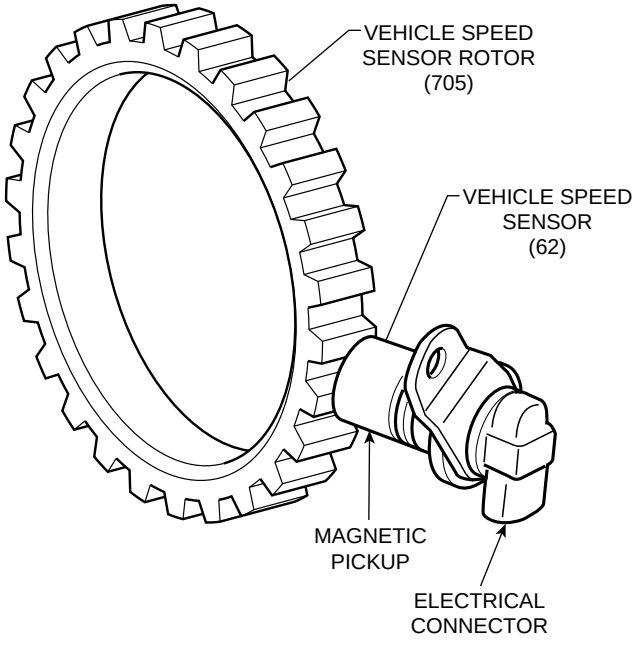
The input speed sensor mounts on the transaxle case under the channel plate and next to the drive sprocket. An air gap of 0.26 - 2.90 mm (0.010 - 0.114 inch) is maintained between the sensor and the teeth on the drive sprocket. The sensor consists of a permanent magnet surrounded by a coil of wire. As the drive sprocket is driven by the turbine shaft, an AC signal is induced in the input speed sensor. Higher engine speeds induce a higher frequency and voltage measurement at the sensor.

Input/Turbine Speed Sensor Circuit Range/Performance will set DTC P0716 and and the PCM will command the following default actions:

- DTC P0716 will be stored in PCM history.
- Inhibit TCC engagement.
- Freeze shift adapts.
- Maximum line pressure.

Input/Turbine Speed Sensor Circuit No Signal will set DTC P0717 and and the PCM will command the following default actions:

- DTC P0717 will be stored in PCM history.
- Inhibit TCC engagement.
- Freeze shift adapts.
- Maximum line pressure.



Vehicle Speed Sensor (62):
The Vehicle Speed Sensor (VSS) is a magnetic inductive pickup that relays information relative to vehicle speed to the PCM. Vehicle speed information is used by the PCM to control shift pattern, line pressure, and TCC apply and release.

The vehicle speed sensor mounts in the case at the speed sensor rotor which is pressed onto the differential. An air gap of 0.27 - 1.57 mm (0.011 - 0.062 inch) is maintained between the sensor and the teeth on the speed sensor rotor. The sensor consists of a permanent magnet surrounded by a coil of wire. As the differential rotates, an AC signal is induced in the vehicle speed sensor. Higher vehicle speeds induce a higher frequency and voltage measurement at the sensor.

Vehicle Speed Sensor (VSS) Circuit Low Input will set DTC P0502 and and the PCM will command the following default actions:

- DTC P0502 will be stored in PCM history.
- Inhibit TCC engagement.
- Freeze shift adapts.
- Maximum line pressure.
- Immediate landing to 2nd gear.

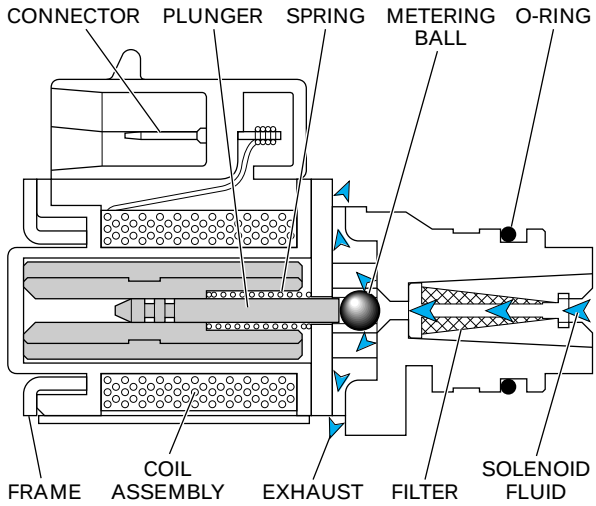
Sensor resistance should measure between 1500 - 1750 ohms at 20°C (68°F). Output voltage will vary with vehicle speed from a minimum of 0.5 Volts AC at 25 RPM, to 200 Volts at 1728 RPM.

Figure 45

SHIFT SOLENOIDS

Description:
The Hydra-matic 4T40-E transaxle uses two identical, normally open electronic shift solenoids (referred to as 1-2 and 2-3) for controlling upshifts and downshifts in all forward ranges. These shift solenoids work together in a combination of ON and OFF sequences to control fluid that is routed to the 1-2 shift valve, 2-3 shift valve and 3-4 shift valve. The PCM monitors numerous inputs and determines the appropriate gear ratio for the vehicle by commanding the solenoids either ON or OFF. Fluid pressure is then routed to the shift valves (or exhausted through the solenoids) in order to change the position of a valve and hydraulically enable a gear change. The following table shows the solenoid state combination that is required to obtain each gear:

GEAR	SOLENOID "A"	SOLENOID "B"
Park, Reverse, Neutral	ON	OFF
First	ON	OFF
Second	OFF	OFF
Third	OFF	ON
Fourth	ON	ON



4T40-E SHIFT SOLENOID (OFF)

Shift Solenoids De-energized (OFF):
The shift solenoids are OFF when the PCM opens the path to ground for the solenoid's electrical circuit. When OFF, the solenoid plunger is forced away from the metering ball by a spring. This action allows the 1-2 or 2-3 signal fluid to push past the metering ball to exhaust from a port on the side of the solenoid.

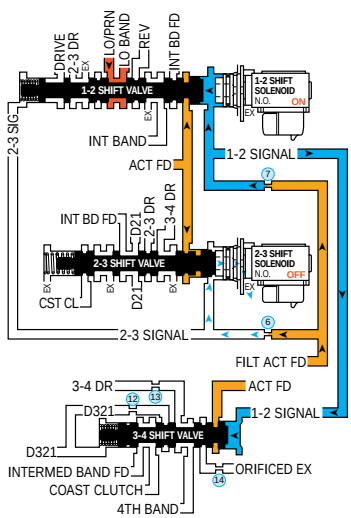
Shift Solenoids Energized (ON):
To energize the shift solenoids, the PCM provides a path to ground and completes the solenoid's electrical circuit. Electrical current passing through the coil assembly in the solenoid creates a magnetic field that magnetizes the solenoid core. The magnetized core repels the plunger which seats the metering ball against the fluid inlet port. Solenoid signal fluid is then blocked by the metering ball thereby creating a fluid pressure in the 1-2 or 2-3 signal fluid circuits.

1-2 Shift Solenoid (305):
The 1-2 shift solenoid is located at the end of the 1-2 shift valve (302) and controls the position of the 1-2 and 3-4 shift valves. 1-2 signal fluid that is routed to the solenoid is created by filtered actuator feed as it passes through orifice #7. When energized in Park, Reverse, Neutral and First gear, the solenoid blocks 1-2 signal fluid from exhausting thereby creating pressure in the 1-2 signal fluid circuit. 1-2 signal fluid pressure then holds the 1-2 shift valve against spring force in the downshifted position. At the same time, 1-2 signal fluid is routed to the 3-4 shift valve (319) where it holds the valve against spring force in the upshifted position. During Fourth gear operation, 2-3 signal fluid pressure combines with spring force and holds the 1-2 shift valve in the upshifted position.

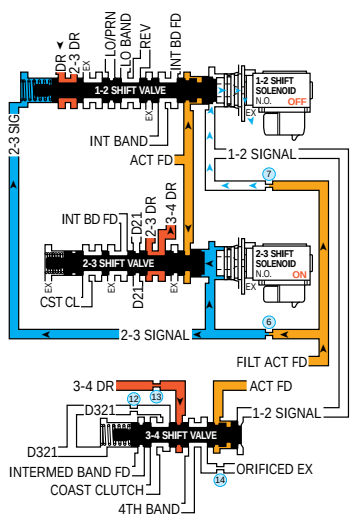
When the1-2 shift solenoid is de-energized during Second and Third gear operation, 1-2 signal fluid exhausts through the solenoid. Spring force acting on the 1-2 shift valve keeps the valve in the upshifted position, and spring force at the 3-4 shift valve keeps the valve in the downshifted position.

2-3 Shift Solenoid (305):
The 2-3 shift solenoid is located at the end of the 2-3 shift valve (307) and controls the position of the 1-2 and 2-3 shift valves. 2-3 signal fluid that feeds to the solenoid is created by filtered actuator feed as it passes through orifice #6. When energized in Third and Fourth gear, the solenoid blocks 2-3 signal fluid from exhausting thereby creating pressure in the 2-3 signal fluid circuit. 2-3 signal fluid pressure then holds the 2-3 shift valve against spring force in the upshifted position. At the same time, 2-3 signal fluid is routed to the 1-2 shift valve (302) to combine with spring force in holding the valve in the upshifted position.

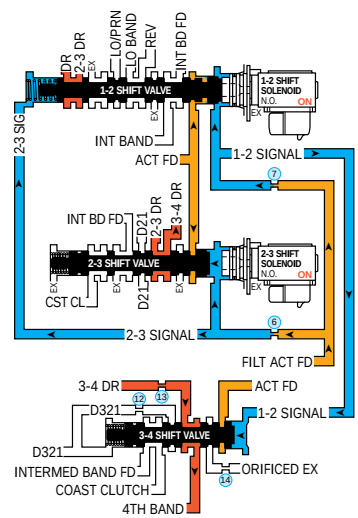
When the 2-3 shift solenoid is de-energized during Park, Reverse, Neutral, First and Second gear operation, 2-3 signal fluid exhausts through the solenoid. Spring force acting on the 2-3 shift valve keeps the valve in the downshifted position while 1-2 shift valve position is dependent upon the 1-2 shift solenoid state.



PARK/REVERSE/NEUTRAL/FIRST GEAR

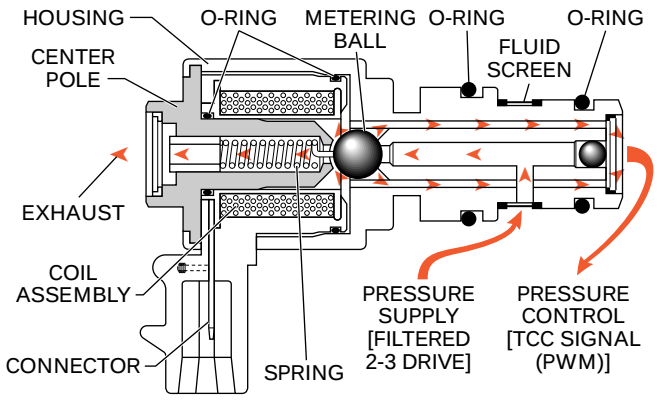


THIRD GEAR

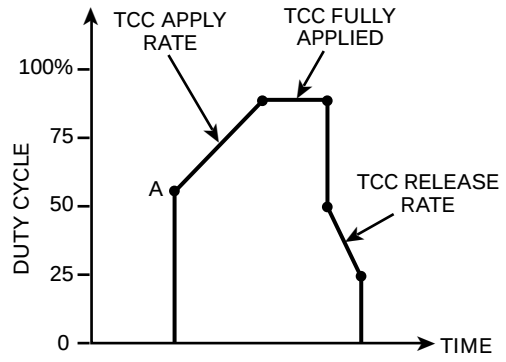


FOURTH GEAR

Figure 46



TCC CONTROL PWM SOLENOID



Torque Converter Clutch Circuit Stuck Off will set a DTC P0741 and the PCM will command the following default actions:
- DTC P0741 will be stored in PCM history.
- Inhibit TCC engagement.

Torque Converter Clutch Circuit Stuck On will set a DTC P0742 and the PCM will command the following default actions:
- DTC P0742 will be stored in PCM history.
- Freeze shift adapts.
- TCC commanded on always.

Torque Converter Clutch Control PWM Solenoid (335):
The TCC Control PWM solenoid is a normally closed, pulse width modulated (PWM) solenoid used to control the apply and release of the converter clutch. The PCM operates the solenoid with a varying duty cycle at a fixed frequency of 42 Hz to control the rate of TCC apply/release. The solenoid's ability to "ramp" the TCC apply and release pressures results in a smoother TCC operation.

When vehicle operating conditions are appropriate to apply the TCC the PCM immediately increases the duty cycle to approximately 68% (see point A on graph). The PCM then ramps the duty cycle up to approximately 93% to achieve full TCC apply pressure. The rate at which the PCM increases the duty cycle controls the TCC apply. Similarly, the PCM also ramps down the TCC solenoid duty cycle to control TCC release. There are some operating conditions that prevent or enable TCC apply under various conditions (refer to the temperature sensor description). Also, if the PCM receives a high voltage signal from the brake switch, signalling that the brake pedal is depressed, the PCM immediately releases the TCC.
Note: Duty cycles given are for example only. Actual duty cycles will vary depending on vehicle application and vehicle operating conditions.

TCC Control PWM solenoid resistance should measure between 10.4 and 10.8 ohms when measured at 20°C (68°F). The resistance should measure approximately 16 ohms at 150°C (300°F).

Torque Converter Clutch Control PWM Solenoid Operation:
The TCC Control PWM Solenoid is the electronic control component of the TCC apply and release system (the TCC release switch is a failsafe device). The other components are all hydraulic control or regulating valves. The illustration below shows all the valves and the TCC Control PWM solenoid that make up the TCC control system. (For more information on system operation see pages 70 and 71 in the Powerflow section).

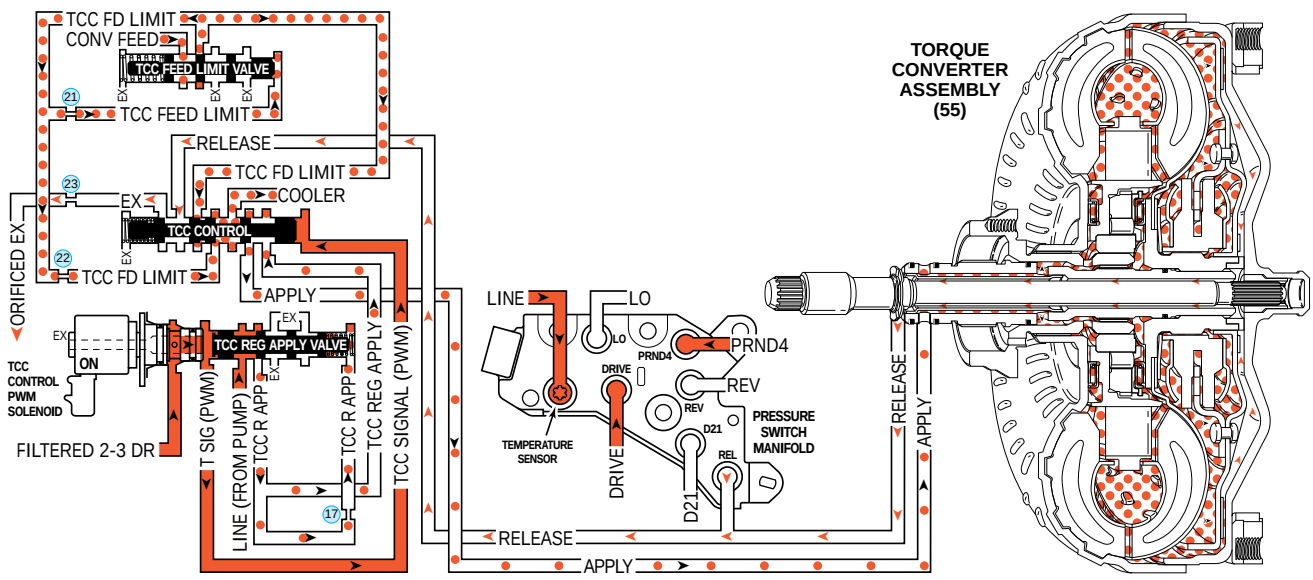
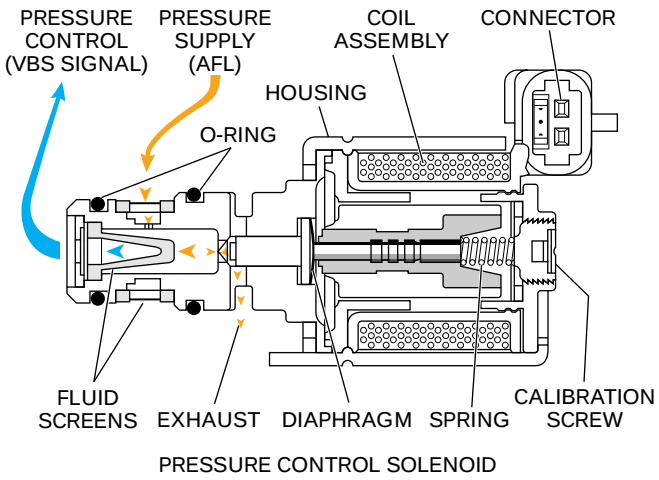


Figure 47

Transaxle Pressure Control Solenoid (312):
The pressure control solenoid (PCS) is a precision electronic pressure regulator that controls transaxle line pressure based on current flow through its coil windings. As current flow is increased the magnetic field produced by the coil moves the solenoid's plunger further away from the exhaust port. Opening the exhaust port decreases the output fluid pressure regulated by the PCS, which ultimately decreases line pressure. The PCM controls the PCS based on various inputs including throttle position, fluid temperature, MAP sensor and gear state.

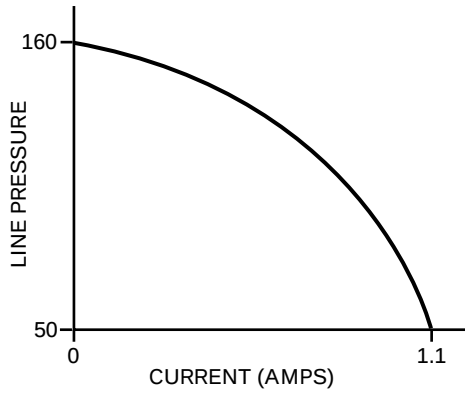
Duty Cycle, Frequency and Current Flow:
A "duty cycle" may be defined as the percent of time current is flowing through a solenoid coil during each cycle. The number of cycles that occur within a specified amount of time, usually measured in seconds, is called "frequency". Typically, the operation of an electronically controlled pulse width modulated solenoid is explained in terms of duty cycle and frequency.



PRESSURE CONTROL SOLENOID

The PCM controls the PCS on a positive duty cycle at a fixed frequency of 614 Hz (cycles per second). Duty cycle is defined as the percent of time current is flowing through the solenoid coil during each cycle. A higher duty cycle provides a greater current flow through the solenoid. The high (positive) side of the PCS electrical circuit at the PCM controls the PCS operation. The PCM provides a ground path for the circuit, monitors average current and continuously varies the PCS duty cycle to maintain the correct average current flowing through the PCS.

Approximate Duty Cycle	Current	Line Pressure
+ 5%	.02 Amps	Maximum
+40%	1.1 Amps	Minimum



Pressure control solenoid resistance should measure between 3.5 and 4.6 ohms when measured at 20°C (68°F).

The duty cycle and current flow to the PCS are mainly affected by throttle position (engine torque) and they are inversely proportional to throttle angle (engine torque). In other words, as the throttle angle (engine torque increases), the duty cycle is decreased by the PCM which decreases current flow to the PCS. Current flow to the PCS creates a magnetic field that moves the solenoid armature toward the push rod and against spring force.

Transaxle Adapt Function:
Programming within the PCM also allows for automatic adjustments in shift pressure that are based on the changing characteristics of the transaxle components. As the apply components within the transaxle wear, shift time (time required to apply a clutch or band) increases. In order to compensate for this wear, the PCM adjusts trim pressure by controlling the PCS in order to maintain the originally calibrated shift timing. The automatic adjusting process is referred to as "adaptive learning" and it is used to assure consistent shift feel plus increase transaxle durability. The PCM monitors the TISS sensor and VSS during commanded shifts to determine if a shift is occurring too fast (harsh) or too slow (soft) and adjusts the Transaxle Pressure Control Solenoid signal to maintain a set shift feel.

Pressure Control Solenoid electrical problem will set a DTC P0748 and the PCM will command the following default actions:

- DTC P0748 will be stored in PCM history.
- Freeze shift adapts.
- Maximum line pressure.

Figure 48

POWER FLOW

This section of the book describes how torque from the engine is transferred through the Hydra-matic 4T40-E transaxle allowing the vehicle to move either in a forward or reverse direction. The information that follows details the specific mechanical operation, electrical, hydraulic and apply components that are required to achieve a gear operating range.

The full size, left hand pages throughout this section contain drawings of the mechanical components used in a specific range and gear. Facing this full page is a half page insert containing a color coded range reference chart at the top. This chart is one of the key items used to understand the mechanical operation of the transaxle in each range and gear. The text below this chart provides a detailed explanation of what is occurring mechanically in that range and gear.

The full size, right hand pages contain a simplified version of the Complete Hydraulic Circuit that is involved for that range and gear. Facing this full page is a half page insert containing text and a detailed explanation of what is occurring hydraulically in that range and gear. A page number located at the bottom of the half page of text provides a ready reference to the complete Hydraulic Circuits section of this book if more detailed information is desired.

It is the intent of this section to provide an overall simplified explanation of the mechanical, hydraulic and electrical operation of the Hydra-matic 4T40-E transaxle. If the operating principle of a clutch, band or valve is unclear, refer to the previous sections of this book for individual components descriptions.

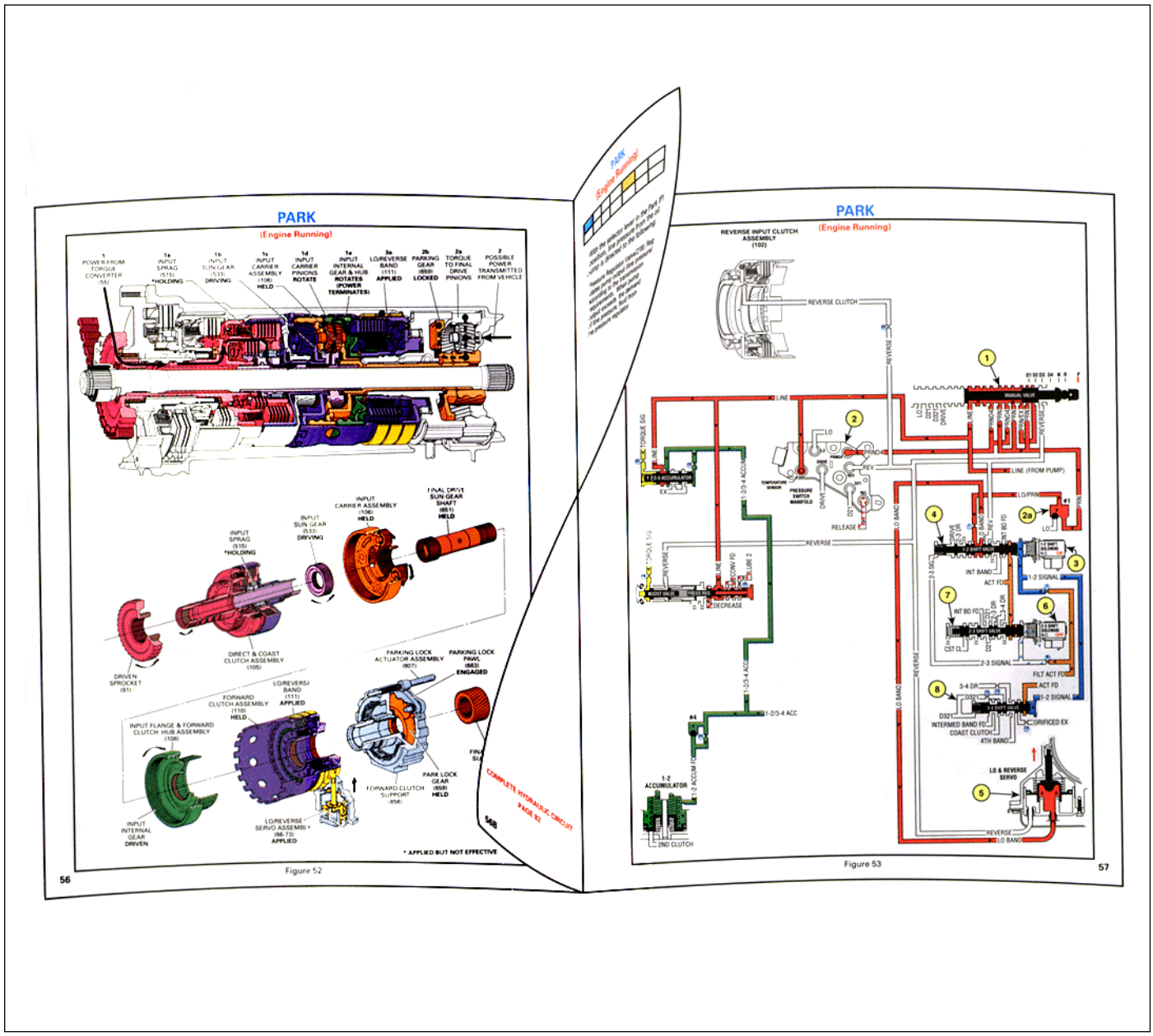


Figure 49

MECHANICAL POWERFLOW FROM THE TORQUE CONVERTER TO THE DRIVEN SPROCKET

(Engine Running)

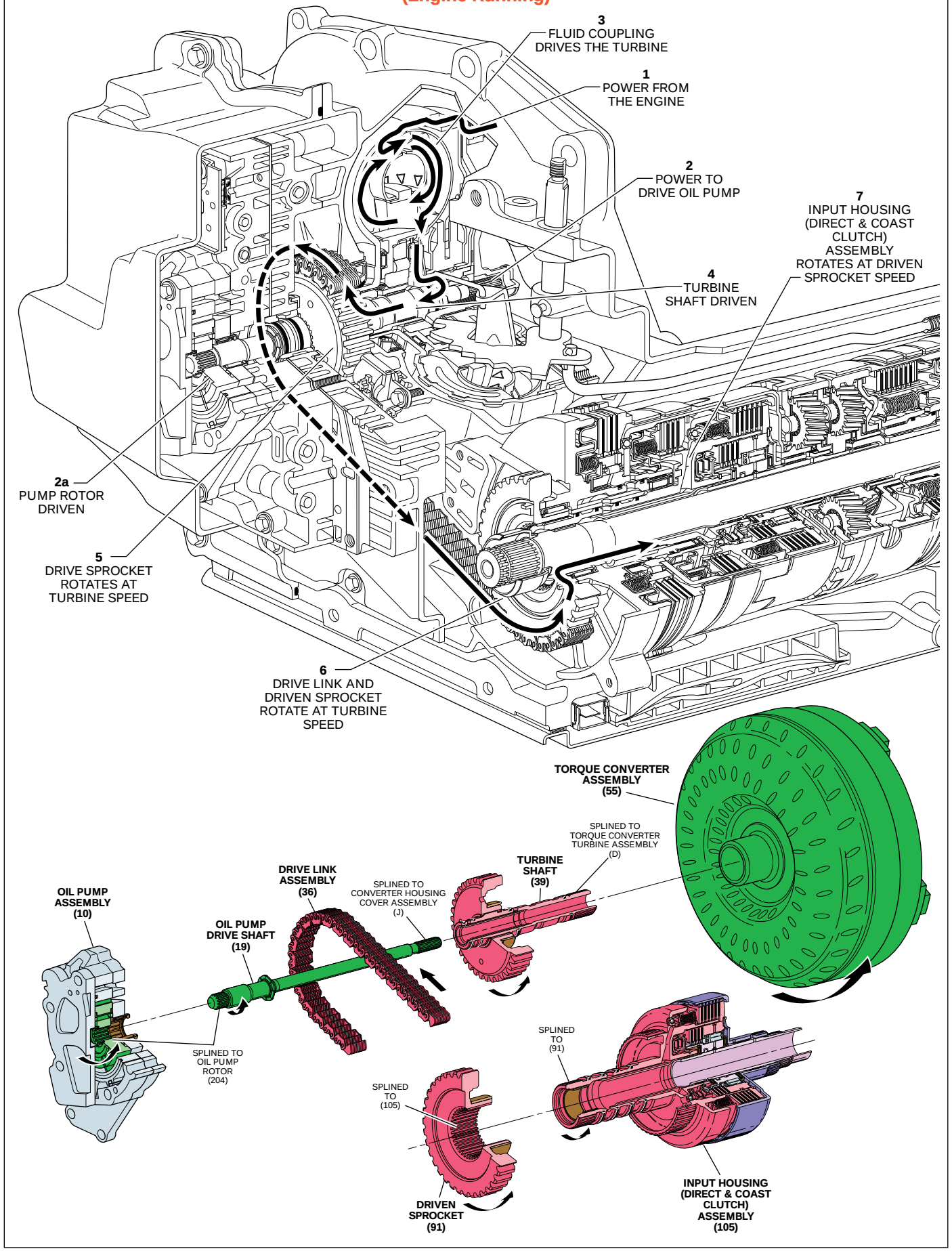


Figure 50

MECHANICAL POWERFLOW FROM THE TORQUE CONVERTER TO THE DRIVEN SPROCKET

(Engine Running)

The mechanical power flow in the Hydra-matic 4T40-E transaxle begins at the point of connection between the torque converter and the engine flywheel. When the engine is running, the torque converter cover (pump) is forced to rotate at engine speed. As the torque converter rotates it multiplies engine torque and transmits it to the turbine shaft (39). The turbine shaft, which is connected to the drive sprocket (37), thus provides the primary link to the mechanical operation of the transaxle.

1 Power from the Engine
Torque from the engine is transferred to the transaxle through the engine flywheel which is bolted to the engine crankshaft.

2 Power to Drive the Oil Pump
The oil pump drive shaft (19) is splined to the torque converter cover at one end and to the pump rotor (204) at the other end.

2a Pump Rotor Driven
When the engine is running, the oil pump drive shaft (19) and the pump rotor (204) are forced to rotate at engine speed.

3 Fluid Coupling Drives the Turbine
Transaxle fluid inside the torque converter (55) creates a fluid coupling which in turn drives the torque converter turbine.

4 Turbine Shaft Driven
As the torque converter turbine rotates, the turbine shaft (39), which is splined to the torque converter turbine, is also forced to rotate at turbine speed.

5 Drive Sprocket Rotates at Turbine Speed
The opposite end of the turbine shaft (39) is splined to the drive sprocket (37), which forces the drive sprocket to rotate in the same direction and speed as the torque converter turbine.

6 Drive Link and Driven Sprocket Rotate at Turbine Speed
Teeth on the drive sprocket (37) are in mesh with the drive link assembly (36) and the drive link is also in mesh with the teeth on the driven sprocket (91). When the engine is running, all three components will rotate in the same direction and possibly at the same speed depending on drive and driven sprocket ratio (see basic specifications page 118).

7 Input Housing Assembly Rotates at Driven Sprocket Speed
The driven sprocket (91) is splined to the input shaft & direct/coast clutch housing assembly (502) and forces the input housing to rotate at driven sprocket speed.

NOTE: To minimize the amount of repetitive text, the remaining mechanical power flow descriptions will begin with the driven sprocket (91). The transfer of torque from the engine through the torque converter and to the driven sprocket is identical in all gear ranges.

HYDRAULIC POWERFLOW - COMMON FUNCTIONS FOR ALL RANGES

(Engine Running)

When the gear selector lever is in the Park (P) position and the engine is running, fluid is drawn into the oil pump and line pressure is directed to the pressure regulator valve.

1 PRESSURE REGULATION

1a Pressure Regulator Valve:
Regulates pump output (line pressure) in response to torque signal fluid pressure acting on the boost valve, spring force, and line pressure acting on the end of the valve. Line pressure is directed to the manual valve, both accumulator valves, torque signal regulator valve, TCC regulated apply valve, the temperature sensor in the pressure switch assembly (PSA) and the actuator feed limit valve. Also, line pressure feeds the converter feed and lube 2 fluid circuit through the pressure regulator valve.

1b Actuator Feed Limit (AFL) Valve:
Line pressure is routed through the valve and into the actuator feed fluid circuit. The valve limits actuator feed fluid pressure to a maximum pressure. Actuator feed fluid is routed to the pressure control solenoid, each of the shift valves, and also feeds the 1-2 signal and 2-3 signal fluid circuits.

1c Pressure Control Solenoid (PCS):
Controlled by the PCM, the PCS regulates filtered actuator feed fluid pressure acting on the end of the torque signal regulating valve.

1d Torque Signal Regulating Valve:
Regulates line pressure into the torque signal fluid circuit. This regulation is controlled by regulated VBS signal fluid pressure from the PCS. Torque signal fluid pressure is routed to the accumulator valves and the boost valve to control shift feel.

2 SHIFT ACCUMULATION

2a 1-2/3-4 and 2-3 Accumulator Valves:
Line pressure is regulated into accumulator fluid pressure. This regulation is basically controlled by torque signal fluid pressure acting on the end of the valve.

2b 1-2, 2-3 and 3-4 Accumulator Assemblies:
Accumulator fluid is routed to each of the accumulator assemblies in preparation for upshifts and downshifts. The fluid routed to the 1-2 and 3-4 accumulators is orificed by the #4 and #7 checkballs. The 2-3 accumulator fluid circuit does not use a checkball to orifice accumulator fluid to the 2-3 accumulator.

3 TORQUE CONVERTER (RELEASED POSITION ONLY)

3a Pressure Regulator Valve:
Line pressure is routed through the PR valve and into the converter feed fluid circuit. Converter feed fluid is routed to the TCC feed limit valve.

3b TCC Feed Limit Valve:
Converter feed fluid is routed through the valve and into the TCC feed limit fluid circuit. The TCC feed limit valve limits the maximum fluid pressure in the TCC feed limit fluid circuit and the torque converter.

3c TCC Regulated Apply Valve:
Spring force holds the valve in the release position, thereby blocking line pressure.

3d TCC Control Valve:
Spring force holds the valve in the release position and TCC feed limit fluid is routed into the release fluid circuit. Also, fluid returning from the converter in the apply fluid circuit is routed through the valve and into the cooler fluid circuit.

3e Torque Converter:
Release fluid pressure is routed to the torque converter to keep the TCC released. Fluid leaves the converter in the apply fluid circuit.

COMMON HYDRAULIC FUNCTIONS FOR ALL RANGES

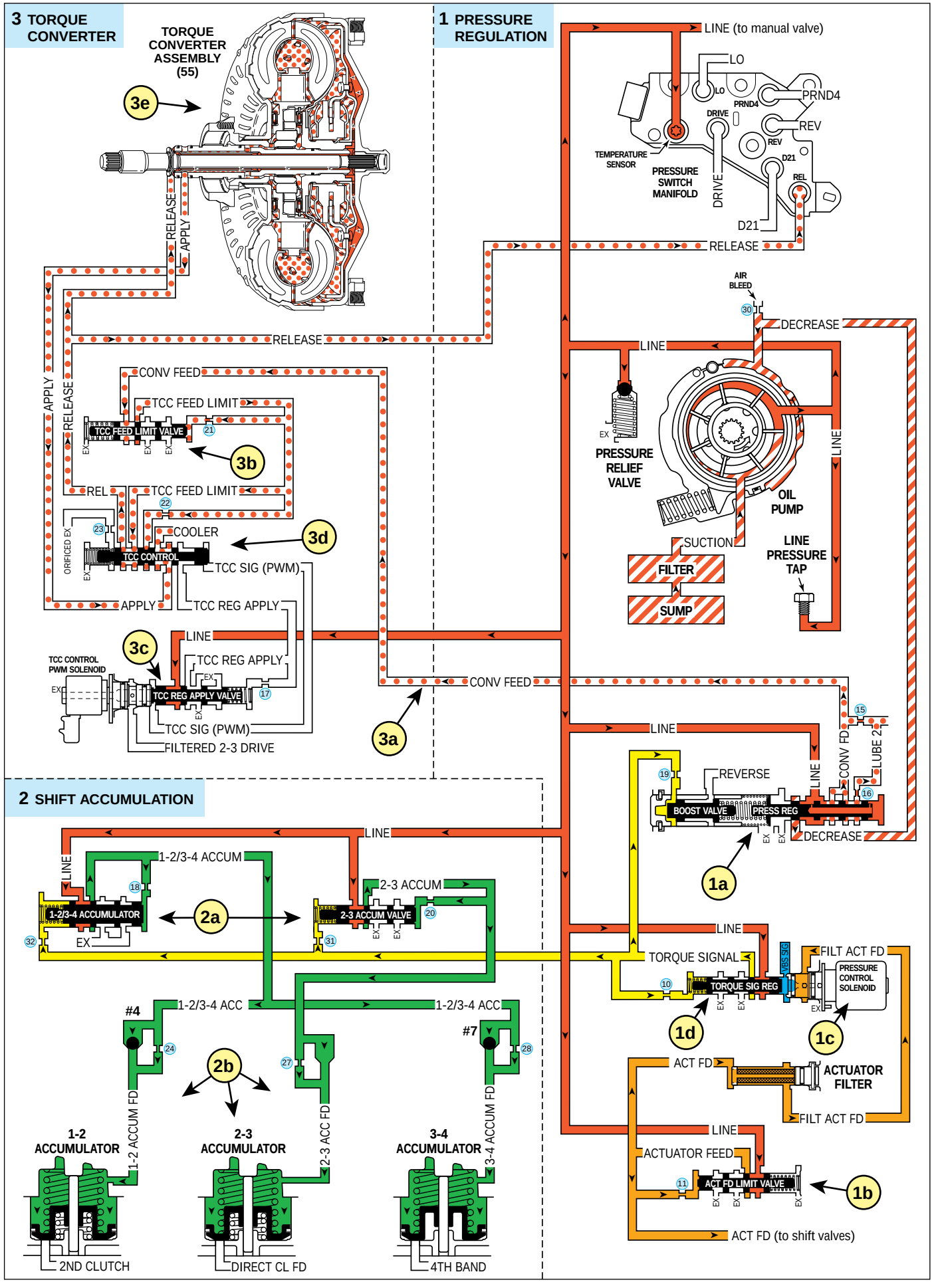


Figure 51

PARK

(Engine Running)

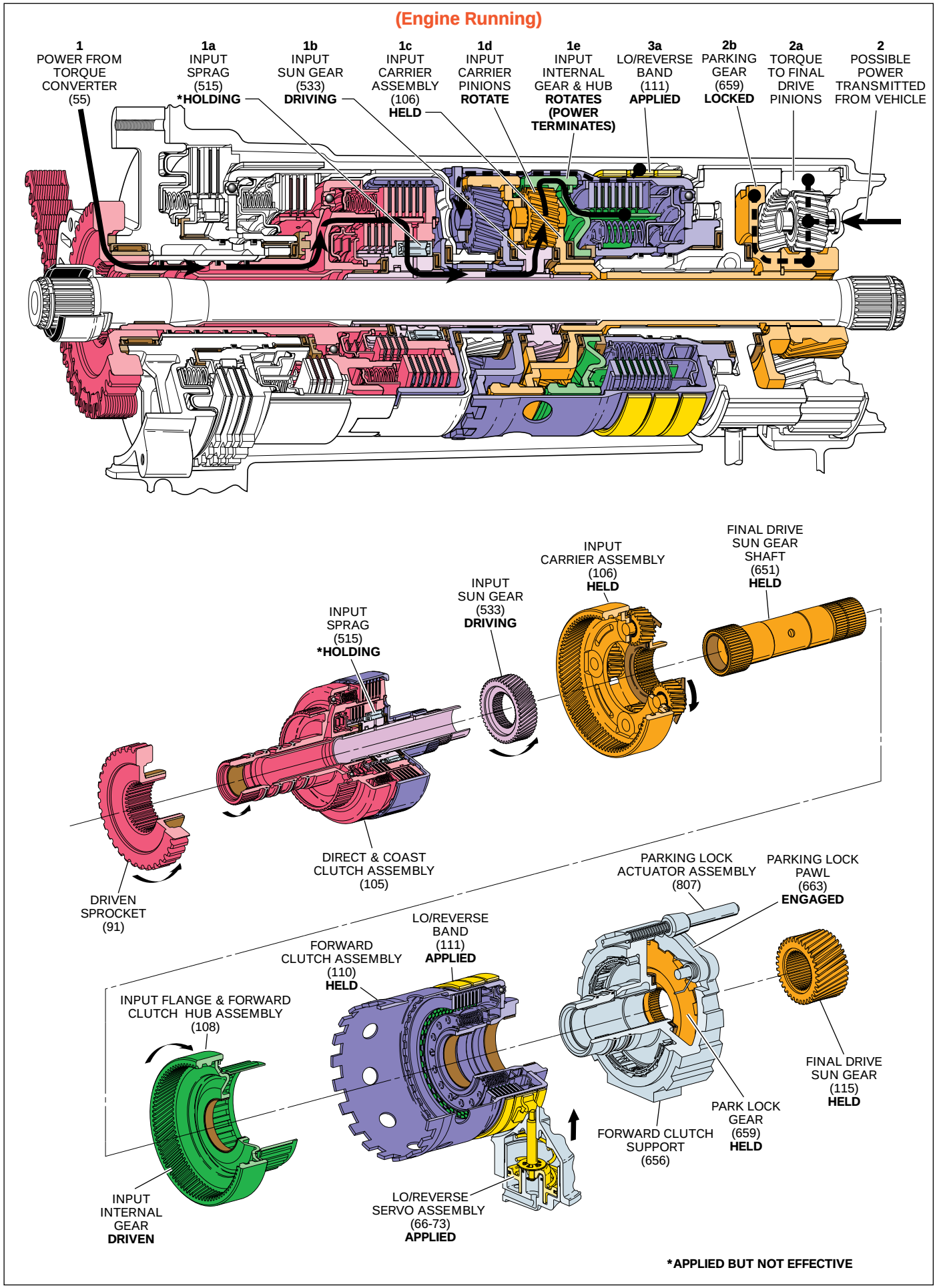


Figure 52

PARK

(Engine Running)

SHIFT "A" SOL	SHIFT "B" SOL	2ND CLUTCH	2ND ROLLER CLUTCH	INT/4TH BAND	REVERSE CLUTCH	COAST CLUTCH	INPUT SPRAG	DIRECT CLUTCH	FORWARD CLUTCH	LO/REV. BAND	LO ROLLER CLUTCH
ON	OFF						HOLDING *			APPLIED	

* APPLIED BUT NOT EFFECTIVE

In Park range, there are three levels of powerflow coexisting.

The graphics will follow each flow separately by numerical designation, which relates to the following text.

1 Power from Torque Converter
Power from the torque converter turbine transfers to the driven sprocket (91) which is splined to the input shaft.

1a Input Sprag Holding
Power continues from the input shaft and direct and coast clutch housing (502) to the input sprag (515). The input sprag holds when torque comes from the engine, and overruns when torque comes from the wheels, allowing the vehicle to coast.

1b Input Sun Gear Driving
Power continues from the sprag through the input sun gear shaft to the input sun gear, which then drives the input planetary pinions.

1c Input Carrier Assembly Held
The input planetary carrier (700) is held stationary by the final drive sun gear shaft being held by the weight of the vehicle. This forces the input planetary pinions to rotate the opposite direction of the sun gear.

1d Input Carrier Pinions Rotate
The input planetary pinions rotate and force the input internal gear to rotate.

1e Input Internal Gear Rotates/Powerflow Terminates
The input internal gear is splined to the forward clutch hub but the forward clutch is not applied so powerflow is terminated.

2 Torque from the vehicle. Possibly parked on an incline (force of gravity).

2a Torque from Wheels to Planetary Pinions
Torque from the vehicle travels through the wheels to the differential, into the final drive planetary pinions.

2b Parking Gear Locked/Torque Terminated at Final Drive Gear Set
The final drive internal gear is held stationary in the case and the final drive sun gear is held by the parking lock gear which is held by the parking lock pawl. Two members of the planetary gear set are held stationary, powerflow is terminated.

NOTE: If Park is selected while the vehicle is moving, the parking pawl will ratchet in and out of the lugs on the parking gear until the vehicle slows to approximately 5 km/h (3 mph). At that speed the parking gear will engage and stop the vehicle from moving. The vehicle should be completely stopped before selecting Park range or internal damage to the transaxle could occur.

3 Preparation for a shift into reverse

3a Lo/Reverse Band Applied
The lo/reverse band is applied and holds the forward clutch housing. The forward clutch housing is tanged to one end of the reaction carrier which prevents the carrier from rotating.

PARK

(Engine Running)

SHIFT "A" SOL	SHIFT "B" SOL	2ND CLUTCH	2ND ROLLER CLUTCH	INT/4TH BAND	REVERSE CLUTCH	COAST CLUTCH	INPUT SPRAG	DIRECT CLUTCH	FORWARD CLUTCH	LO/REV. BAND	LO ROLLER CLUTCH
ON	OFF						HOLDING *			APPLIED	

* APPLIED BUT NOT EFFECTIVE

LO/REVERSE BAND APPLIES

1 Manual Valve:
Mechanically controlled by the gear selector lever, the manual valve is in the Park (P) position and directs line pressure into the PRND4 and PRN fluid circuits.

2 Pressure Switch Assembly (PSA):
PRND4 fluid is routed to the PRND4 fluid pressure switch in the PSA and the PSA signals the PCM that the transaxle is in the Park (P) or Neutral (N) position. Also, line pressure is routed to the temperature sensor in the PSA.

2a #1 Checkball
PRN fluid shuttles the #1 checkball to block the LO passage. The fluid pressure enters the LO/PRN passage and continues to the 1-2 Shift valve through orifice #1.

3 1-2 Shift Solenoid:
Energized by the PCM, the normally open 1-2 shift solenoid is ON and blocks 1-2 signal fluid from exhausting. 1-2 Signal fluid pressure acts on the 1-2 and 3-4 shift valves.

4 1-2 Shift Valve:
1-2 Signal fluid pressure holds the valve in the downshifted position against spring force. Lo/PRN fluid is routed through the 1-2 shift valve and into the lo band fluid circuit.

5 Lo & Reverse Servo:
Lo band fluid is routed to the inner area of the servo piston. Lo band fluid pressure moves the servo piston and pin assembly against spring force to apply the lo/reverse band.

6 2-3 Shift Solenoid:
The normally open 2-3 shift solenoid is OFF and 2-3 signal fluid is exhausted through the solenoid.

7 2-3 Shift Valve:
Spring force holds the 2-3 shift valve in the downshifted position.

8 3-4 Shift Valve:
1-2 Signal fluid pressure holds the 3-4 shift valve against spring force during the First and Fourth gear command.

COMPLETE HYDRAULIC CIRCUIT
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PARK

(Engine Running)

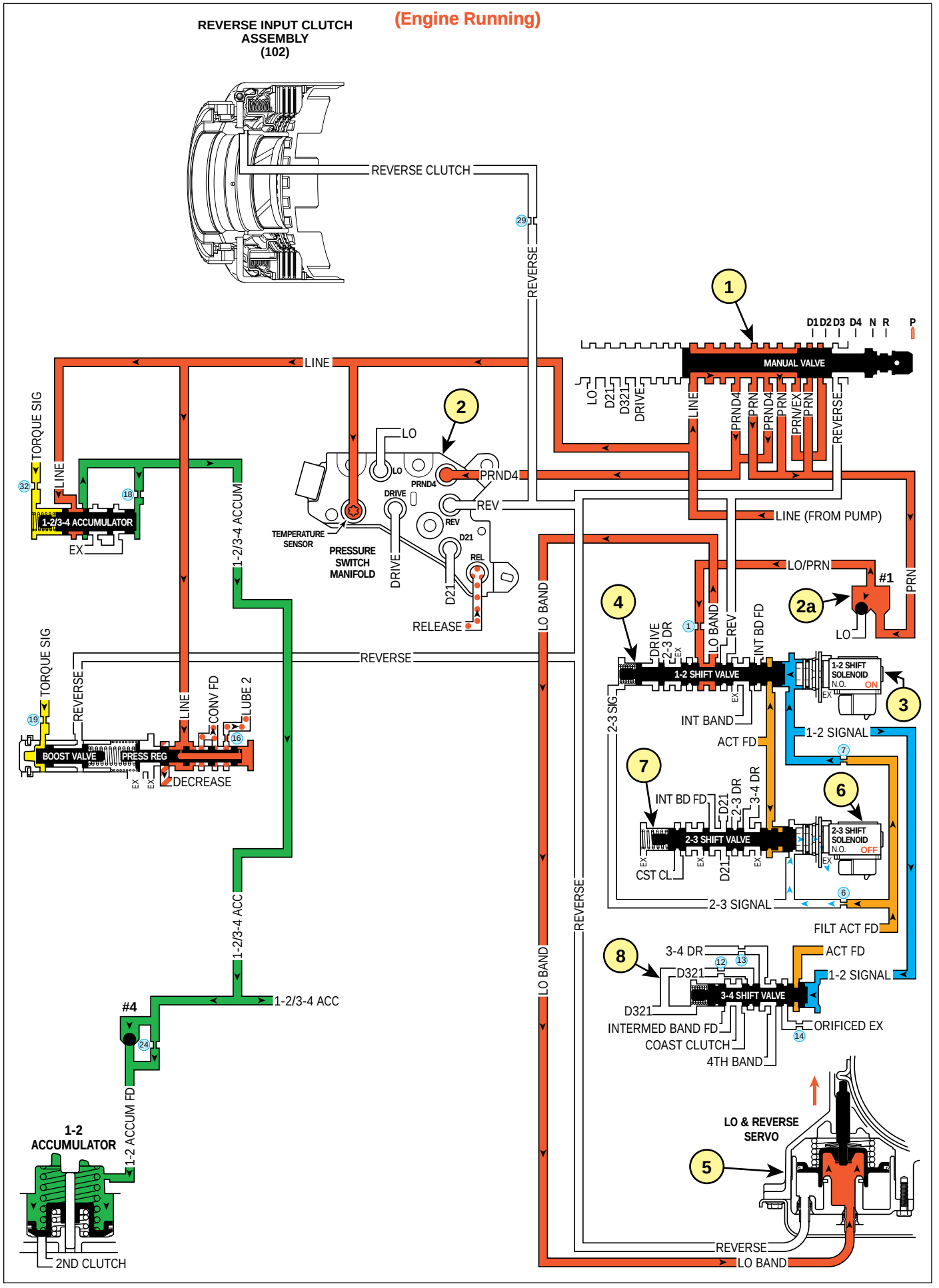

Figure 53

REVERSE

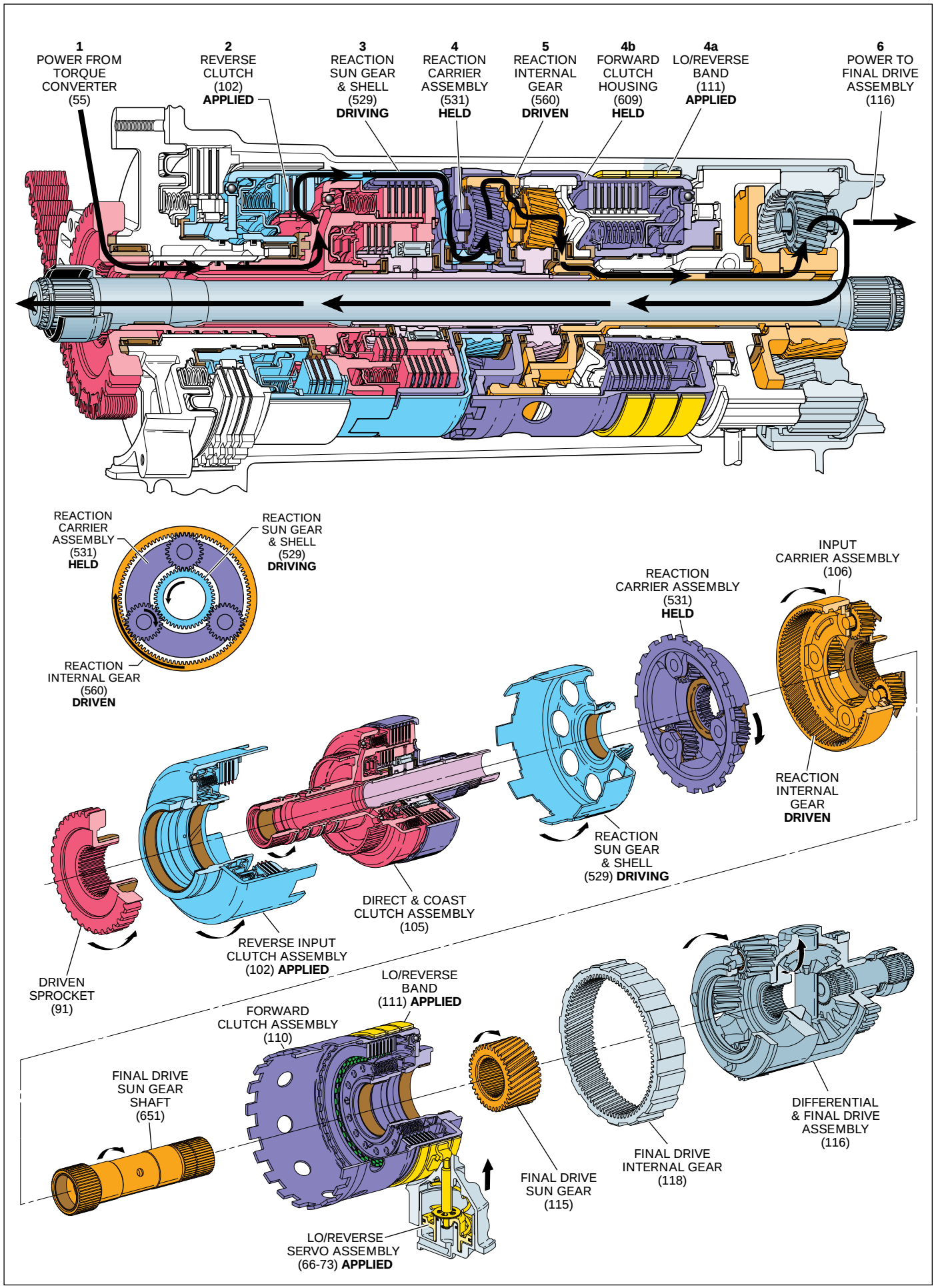

Figure 54

REVERSE

SHIFT "A" SOL	SHIFT "B" SOL	2ND CLUTCH	2ND ROLLER CLUTCH	INT/4TH BAND	REVERSE CLUTCH	COAST CLUTCH	INPUT SPRAG	DIRECT CLUTCH	FORWARD CLUTCH	LO/REV. BAND	LO ROLLER CLUTCH
ON	OFF				APPLIED					APPLIED	

In Reverse (R), torque from the engine is multiplied through the torque converter (55), the transaxle gear train, the final drive assembly and the output shaft (94) thereby sending power to the vehicle's drive axles. The planetary gear sets operate in reduction and in a reverse direction of the input torque. The gear ratio for Reverse gear range is 2.14:1.

- When the gear selector lever is moved into the Reverse (R) gear range, the parking pawl disengages from the parking gear (659) allowing the final drive sun gear shaft (651) to rotate.
- The manual shaft and detent lever assembly (806) and manual valve (800) are also moved into the Reverse gear position in order to channel the transaxle fluid.

1 Power from Torque Converter
The driven sprocket (91) is splined to the input shaft and direct & coast clutch housing assembly (502) and forces the housing to rotate at driven sprocket speed.

2 Reverse Clutch Applied
The reverse clutch plates (460-463), splined to the input shaft and direct & coast clutch housing (502), force the reverse clutch housing (454) to rotate.

3 Reaction Sun Gear & Shell Driving
The reaction sun shell is tanged to the reverse clutch housing and rotates in the same direction and speed as the input shaft and direct & coast clutch housing.

4 Reaction Carrier Assembly Held

4a Lo/Reverse Band Applied
The lo/reverse band (111) is applied and prevents the forward clutch housing (609) from rotating.

4b Forward Clutch Housing Held
The forward clutch housing (609) is tanged to one end of the reaction carrier assembly (531) which prevents the reaction carrier from rotating.

Since the reverse clutch is driving the reaction sun shell (529) while the reaction carrier (531) is held, the reaction carrier planet pinion gears (556) are forced to rotate opposite of engine direction.

5 Reaction Internal Gear Driven
The reaction carrier planet pinion gears (556) force the reaction internal gear (560) and input carrier (562) to rotate opposite engine rotation.

6 Power to Final Drive Assembly
The input carrier assembly (106), connected to the final drive sun gear (115) through the final drive sun gear shaft (651), forces the final drive sun gear shaft and sun gear to rotate.

Torque transfers through the final drive sun gear to the final drive planet pinion gears (711).

The final drive planet pinion gears (711) rotate inside the final drive internal gear (118), which is held stationary by the case, and transfers torque to the final drive differential gears (707 & 709).

The output shaft (94), splined into the differential side gear (709), provides the torque to the left hand drive axle while the right differential side gear (709) transfers torque to the output stub shaft (58) and then to the right hand drive axle.

REVERSE

When the gear selector lever is moved to the Reverse (R) position (from the Park position) the following changes occur in the transaxle's hydraulic and electrical systems.

1 PRESSURE REGULATION

1a Manual Valve:
With the manual valve in the reverse position, line pressure is directed into the reverse fluid circuit in addition to the PRND4 and PRN fluid circuits already pressurized in Park.

1b Pressure Regulator and Boost Valves:
Reverse fluid is routed to the boost valve and assists torque signal fluid pressure. The addition of reverse fluid pressure increases the operating range of line pressure in Reverse.

1c Pressure Switch Assembly:
Reverse fluid is routed through the 1-2 shift valve and to the PSA. The PSA signals the PCM that the transaxle is in Reverse.

2 REVERSE CLUTCH APPLIES

Reverse Clutch:
Reverse clutch fluid pressure applies the reverse clutch.

3 LO & REVERSE BAND REMAINS APPLIED

3a 1-2 Shift Solenoid:
The PCM keeps the solenoid energized in Reverse and 1-2 signal fluid pressure acts on the 1-2 shift valve.

3b 1-2 Shift Valve:
1-2 Signal fluid pressure keeps the 1-2 shift valve in the downshifted position. Lo/PRN fluid continues to feed the lo band fluid circuit.

3c Lo & Reverse Servo:
Reverse fluid is routed to the outer area of the servo to increase the servo apply force in Reverse.

COMPLETE HYDRAULIC CIRCUIT
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REVERSE

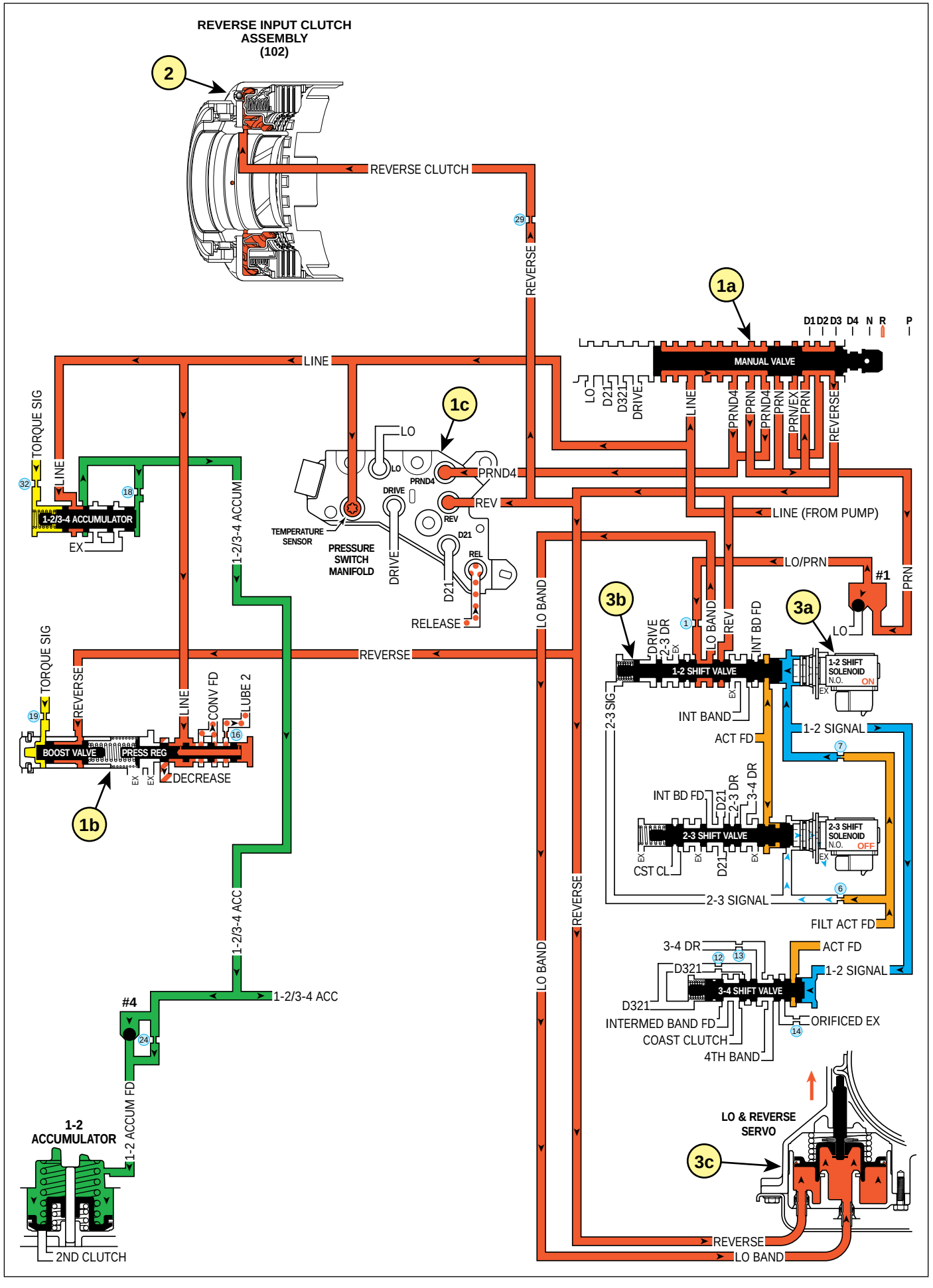

Figure 55

NEUTRAL

(Engine Running)

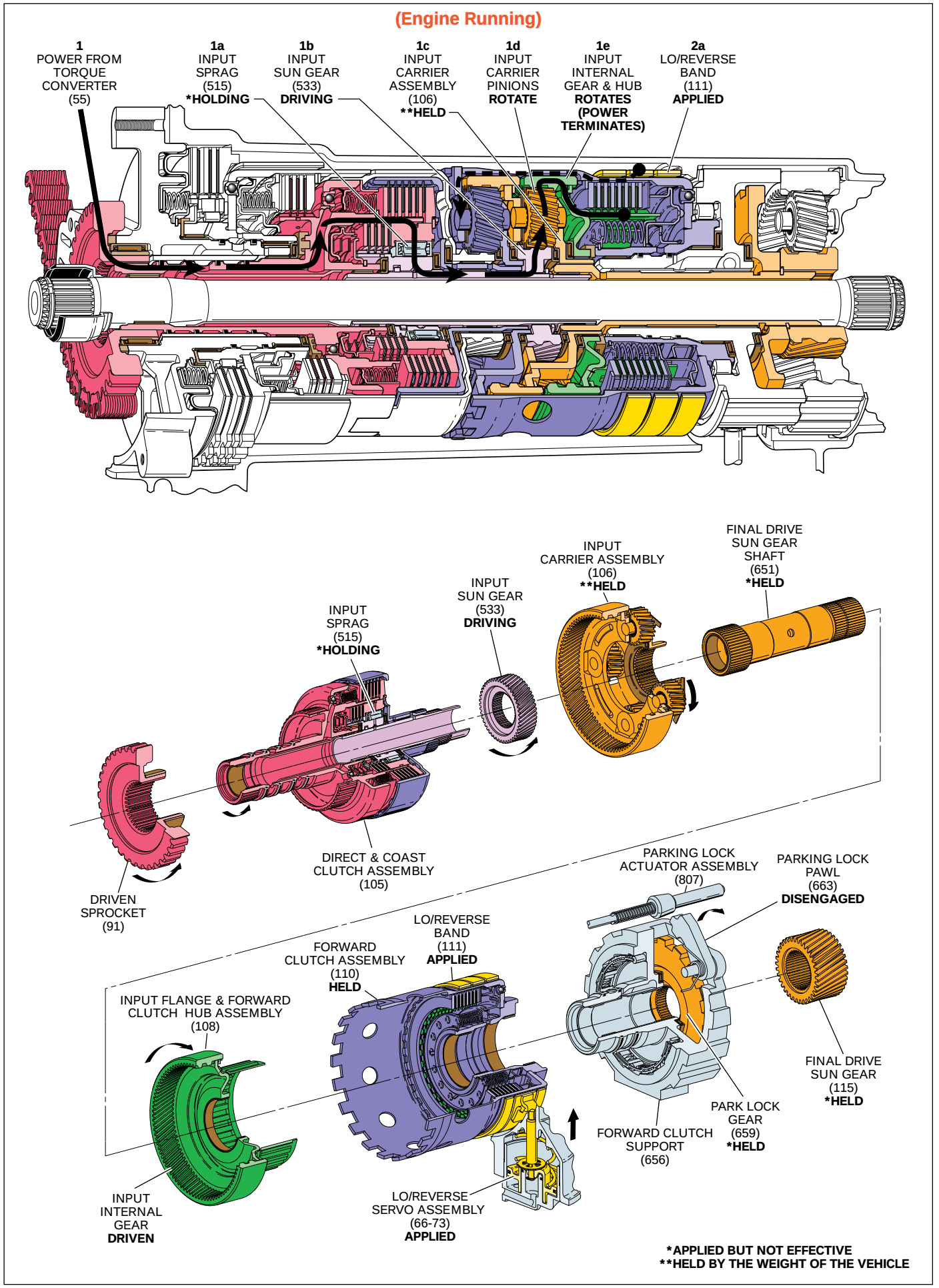

Figure 56

NEUTRAL

(Engine Running)

SHIFT "A" SOL	SHIFT "B" SOL	2ND CLUTCH	2ND ROLLER CLUTCH	INT/4TH BAND	REVERSE CLUTCH	COAST CLUTCH	INPUT SPRAG	DIRECT CLUTCH	FORWARD CLUTCH	LO/REV. BAND	LO ROLLER CLUTCH
ON	OFF						HOLDING *			APPLIED	

* APPLIED BUT NOT EFFECTIVE

When the gear selector lever is placed in the Neutral (N) position, the mechanical power flow through the transaxle is similar to Park gear range. The primary difference is the parking pawl (663) is not engaged with the parking gear (659), which allows the final drive sun gear shaft (651) to rotate freely in either direction. Assuming that the vehicle is on level ground, the weight of the vehicle (transferred through the drive axles) holds the final drive sun gear shaft. Under these conditions, power flow through the transaxle is the same as in Park.

- The manual shaft and detent lever assembly (806) and manual valve (800) are moved into Neutral (N) range position.

1 Power from Torque Converter
Power from the torque converter turbine transfers to the driven sprocket (91) which is splined to the input shaft.

1a Input Sprag Holding
Power continues from the input shaft and direct and coast clutch housing (502) to the input sprag (515). The input sprag holds when torque comes from the engine, and overruns when torque comes from the wheels, allowing the vehicle to coast.

1b Input Sun Gear Driving
Power continues from the sprag through the input sun gear shaft to the input sun gear, which then drives the input planetary pinions.

1c Input Carrier Assembly Held
The input planetary carrier (106) is held stationary by the final drive sun gear shaft being held by the weight of the vehicle. This forces the input planetary pinions to rotate the opposite direction of the sun gear.

1d Input Carrier Pinions Rotate
The input planetary pinions rotate and force the input internal gear to rotate.

1e Input Internal Gear Rotates/Powerflow Terminates
The input internal gear is splined to the forward clutch hub but the forward clutch is not applied so powerflow is terminated.

2 Preparation for a shift (forward or reverse)

2a Lo/Reverse Band Applied
The lo/reverse band is applied and holds the forward clutch housing. The forward clutch housing is tanged to one end of the reaction carrier which prevents the carrier from rotating.

NOTE: Whenever adjustments or repairs are being performed and the gear selector lever is in Neutral, it is important that the vehicle's parking brake is applied and the wheels are blocked. A slight incline will cause the vehicle to roll either forward or backwards potentially causing injury or damage.

NEUTRAL
(Engine Running)

When the gear selector lever is moved from the Reverse position to the Neutral position the following changes occur to the hydraulic and electrical systems.

1 REVERSE CLUTCH RELEASES

1a Manual Valve:
The manual valve is moved to the Neutral position and blocks line pressure from entering the Reverse fluid circuit. The reverse fluid circuit is opened to an exhaust at the manual valve.

1b Reverse Clutch:
Reverse fluid exhausts from the reverse clutch and the clutch releases, shifting the transaxle into Neutral.

1c Boost Valve:
Reverse fluid exhausts from the boost valve and line pressure regulation returns to the normal operating range.

1d Pressure Switch Assembly:
Reverse fluid pressure exhausts from the PSA, thereby signalling the PCM that the transaxle is in Neutral (N) or Park (P).

2 LO & REVERSE BAND REMAINS APPLIED

2a 1-2 Shift Solenoid:
As in Park and Reverse, the solenoid is energized and 1-2 signal fluid pressure acts on the 1-2 shift valve.

2b 1-2 Shift Valve:
1-2 Signal fluid pressure keeps the 1-2 shift valve in the downshifted position. Lo/PRN fluid continues to feed the lo band fluid circuit.

2c Lo & Reverse Servo:
Reverse fluid exhausts from the servo. However, lo band fluid pressure continues to act on the inner area of the servo piston to keep the band applied.

Note: *In Park, Reverse and Neutral the shift solenoids are shown in the First gear state. This is the normal operating state when the vehicle is stationary or at low vehicle speeds. However, the PCM will change the shift solenoid states depending on vehicle speed. For example, if Neutral range is selected when the vehicle is operating in Second gear, the shift solenoids will remain in a Second gear state. But with the manual valve in Neutral, line pressure is blocked, drive fluid exhausts and the transmission will shift into Neutral.*

COMPLETE HYDRAULIC CIRCUIT
Page 86

NEUTRAL
(Engine Running)

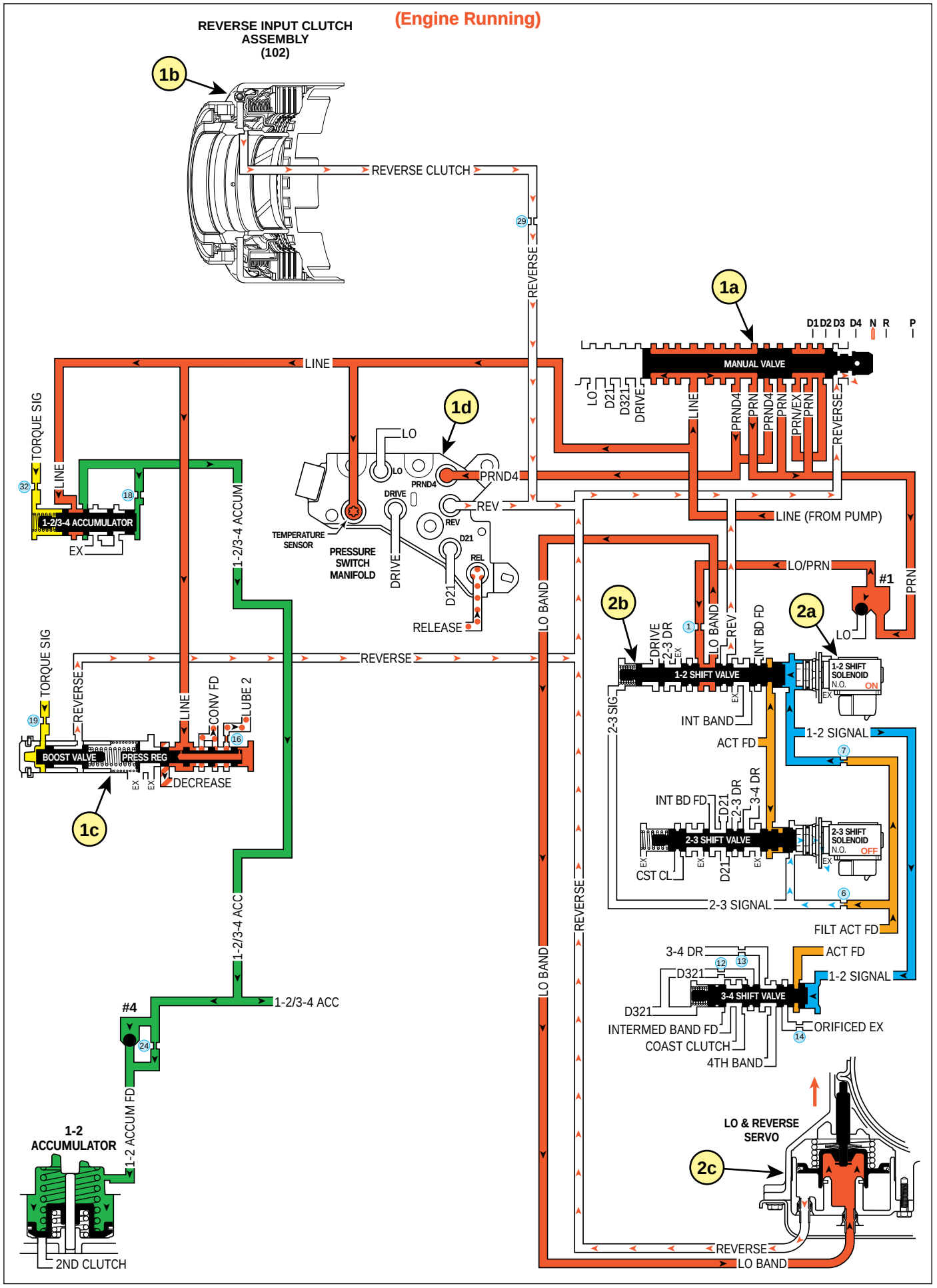

Figure 57

OVERDRIVE RANGE - FIRST GEAR

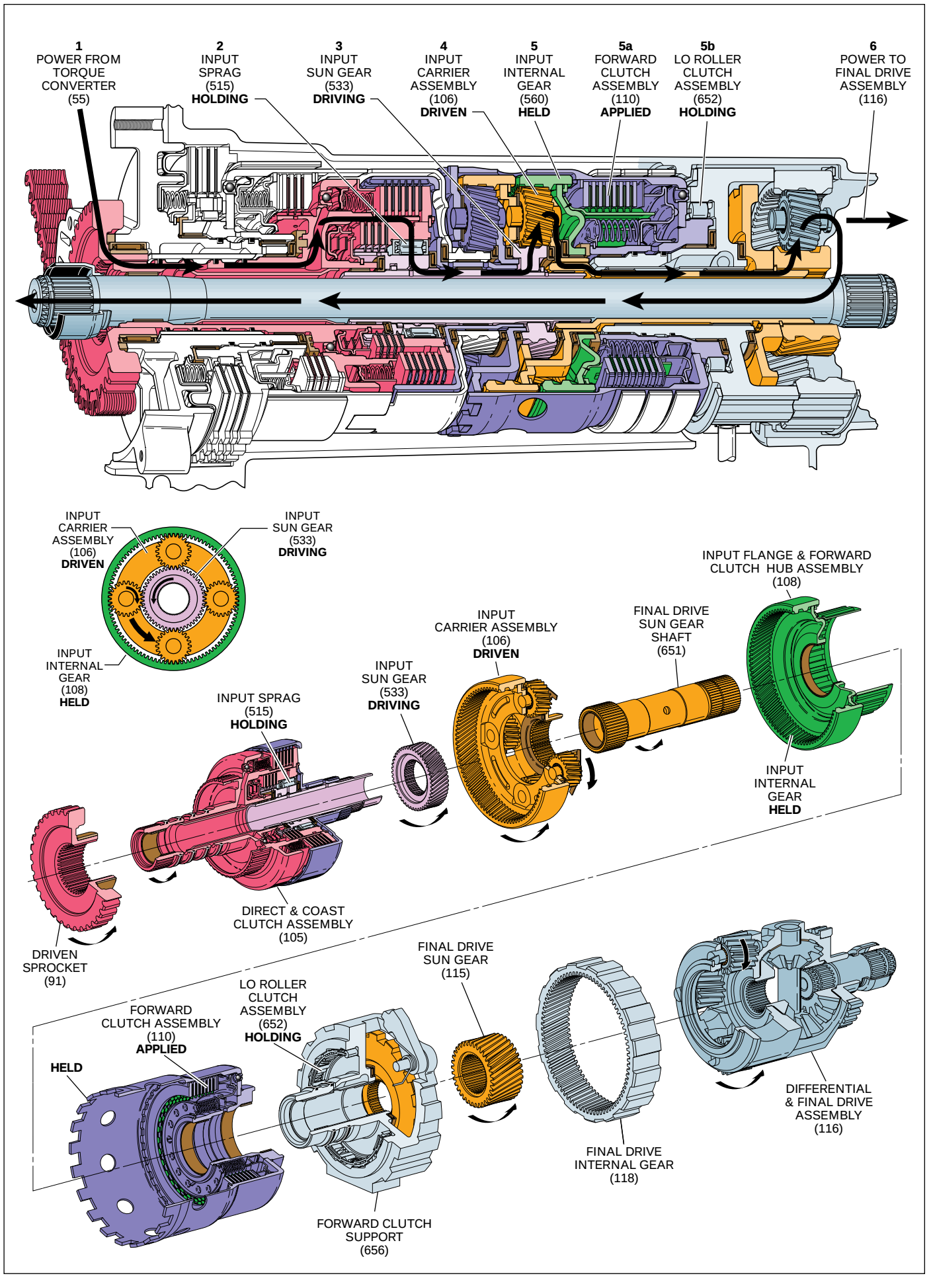

Figure 58

OVERDRIVE RANGE - FIRST GEAR

SHIFT "A" SOL	SHIFT "B" SOL	2ND CLUTCH	2ND ROLLER CLUTCH	INT/4TH BAND	REVERSE CLUTCH	COAST CLUTCH	INPUT SPRAG	DIRECT CLUTCH	FORWARD CLUTCH	LO/REV. BAND	LO ROLLER CLUTCH
ON	OFF						HOLDING		APPLIED		HOLDING

In Overdrive Range - First Gear Ⓓ, torque from the engine is multiplied through the torque converter (55) and transaxle gear sets to the drive axles. The planetary gear sets operate in reduction to achieve a first gear starting ratio of 2.96:1.

- The manual shaft, detent lever and manual valve are moved into Overdrive - the Ⓓ range position on the shift quadrant.

1 Power from Torque Converter
The driven sprocket (91) is splined to the input shaft and direct & coast clutch housing assembly (502) and forces the housing to rotate at driven sprocket speed.

The input shaft and direct & coast clutch housing assembly (502) is splined to the input sprag outer race (512) and rotates both components in the same direction (engine rotation) and at the same speed.

2 Input Sprag Holding
The sprag clutch (515) holds and power transfers to the input sun gear shaft and inner race assembly (511).

3 Input Sun Gear Driving
The input sun gear shaft and inner race assembly is splined to the input sun gear (533) and rotates both components in the same direction (engine rotation) and at the same speed.

4 Input Carrier Assembly Driven
Teeth on the input sun gear (533), in constant mesh with the input carrier planet pinion gears (568), force the input carrier assembly (106) to rotate in the same direction as engine rotation.

5 Input Internal Gear Held

5a Forward Clutch Applied
The forward clutch plates (601-604), splined to the forward clutch housing (609) and the input flange and forward clutch hub (577), hold the input internal gear (560) which is splined to the input flange and forward clutch hub.

5b Lo/Reverse Band Released/Lo Roller Clutch Holding
The lo/reverse band (111) is released and the forward clutch housing (609) would be able to rotate, but at this point the lo roller clutch is holding and prevents the forward clutch housing from rotating.

6 Power to Final Drive Assembly
The input carrier assembly (106), connected to the final drive sun gear (115) through the final drive sun gear shaft (651), forces the final drive sun gear shaft and sun gear to rotate.

Torque transfers through the final drive sun gear to the final drive planet pinion gears (711).

The final drive planet pinion gears (711) rotate inside the final drive internal gear (118), which is held stationary by the case, and transfers torque to the final drive differential gears (707 & 709).

The output shaft (94), splined into the differential side gear (709), provides the torque to the left hand drive axle while the right differential side gear (709) transfers torque to the right hand drive axle.

When the differential and final drive carrier (116) rotates, the vehicle begins to move and first gear is achieved. As the speed of the vehicle increases, less torque is required to maintain a constant vehicle speed. In order to provide maximum powertrain efficiency, a lower input to output gear ratio is desirable. This lower gear ratio is automatically achieved when the transaxle shifts into second gear.

OVERDRIVE RANGE - FIRST GEAR

When the gear selector lever is moved to the Overdrive (Ⓓ) position from the Neutral (N) position the following changes occur to shift the transaxle into Overdrive Range - First Gear.

1 MANUAL VALVE:

In the Overdrive position the manual valve routes line pressure into the DRIVE and PRND4 fluid circuits. The manual valve also blocks line pressure from entering the PRN fluid circuit and opens the PRN fluid circuit to exhaust.

2 LO & REVERSE BAND RELEASES

2a Lo & Reverse Servo:
Lo band fluid pressure exhausts from the servo, thereby releasing the servo and the lo & reverse band.

3 FORWARD CLUTCH APPLIES

3a Forward Clutch:
Drive fluid is orificed into the forward clutch fluid circuit. Forward clutch fluid pressure applies the forward clutch.

3b 1-2 Shift Solenoid:
In first gear 1-2 shift solenoid remains energized by the PCM and 1-2 signal fluid pressure acts on the 1-2 shift valve.

3c 1-2 Shift Valve:
1-2 Signal fluid pressure keeps the 1-2 shift valve in the downshifted position against spring force. Drive fluid is routed through the 1-2 shift valve.

3d Pressure Switch Assembly:
Drive fluid is routed to the PSA and the PSA signals the PCM that the transaxle is in the Overdrive range.

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OVERDRIVE RANGE - FIRST GEAR

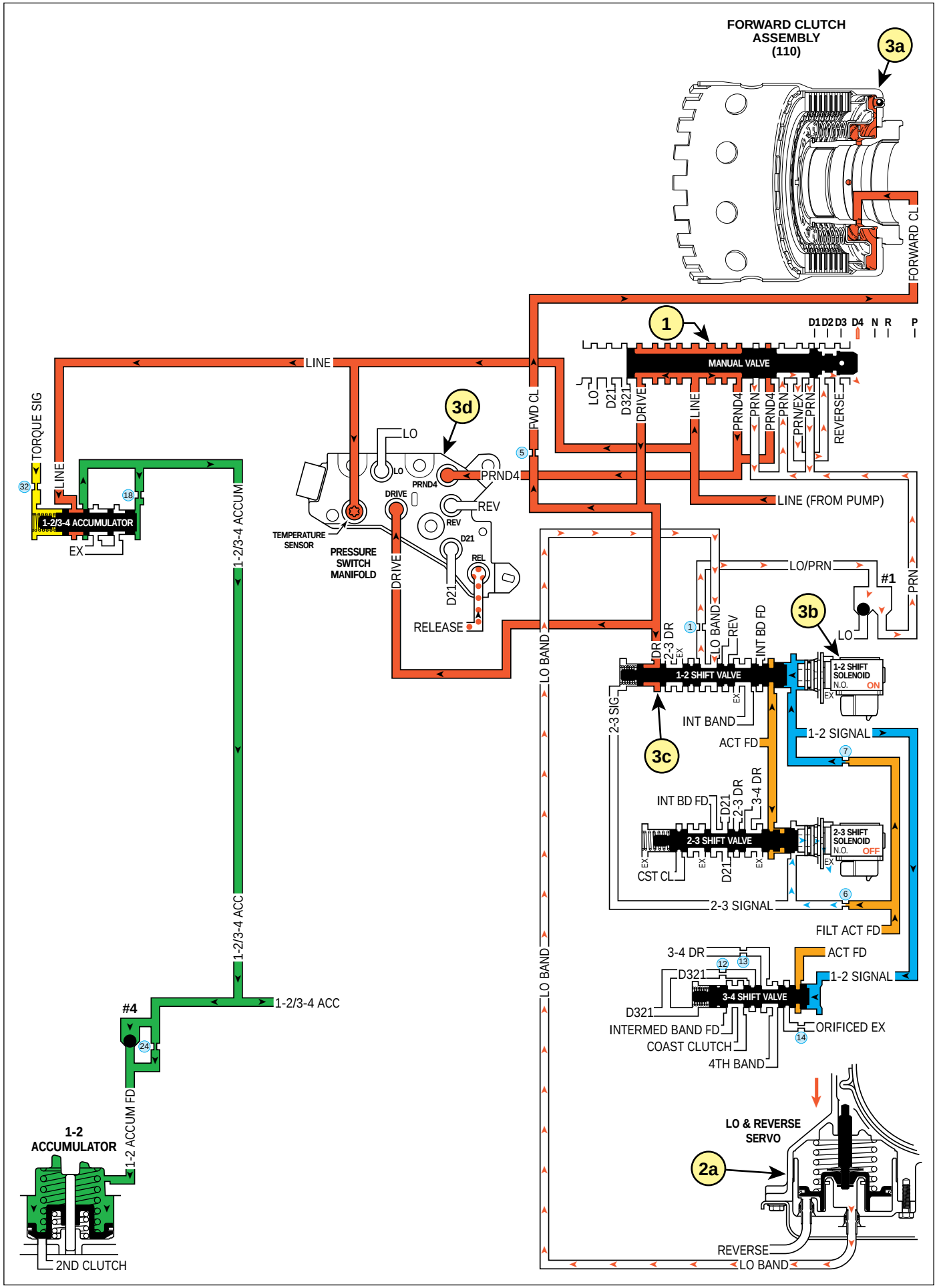

Figure 59

OVERDRIVE RANGE - SECOND GEAR

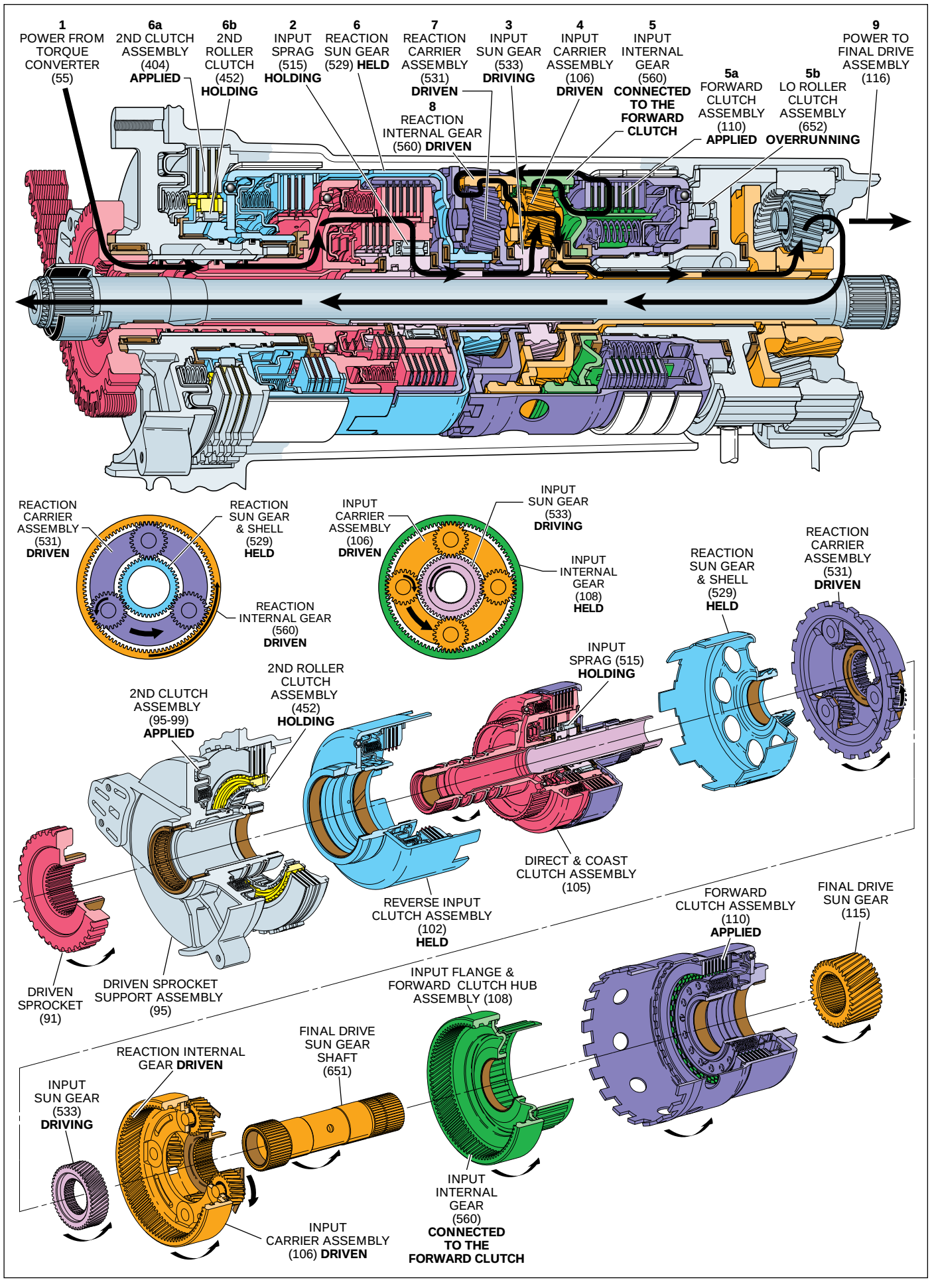

Figure 60

OVERDRIVE RANGE - SECOND GEAR

SHIFT "A" SOL	SHIFT "B" SOL	2ND CLUTCH	2ND ROLLER CLUTCH	INT/4TH BAND	REVERSE CLUTCH	COAST CLUTCH	INPUT SPRAG	DIRECT CLUTCH	FORWARD CLUTCH	LO/REV. BAND	LO ROLLER CLUTCH
OFF	OFF	APPLIED	HOLDING				HOLDING		APPLIED		OVER-RUNNING

As the speed of the vehicle increases, input signals from the vehicle speed sensor (VSS), throttle position sensor (TPS) and other sensors are sent to the powertrain control module (PCM). The PCM uses this information to manage engine torque as the transaxle shifts from first to second gear. In Overdrive Range - second gear, the planetary gear sets continue to operate in reduction but at a gear ratio of 1.62:1.

1 Power from Torque Converter
The driven sprocket (91) is splined to the input shaft and direct & coast clutch housing assembly (502) and forces the housing to rotate at driven sprocket speed.

The input shaft and direct & coast clutch housing assembly (502) is splined to the input sprag outer race (512) and rotates both components in the same direction (engine rotation) and at the same speed.

2 Input Sprag Holding
The sprag clutch (515) holds and power transfers to the input sun gear shaft and inner race assembly (511).

3 Input Sun Gear Driving
The input sun gear shaft and inner race assembly is splined to the input sun gear (533) and rotates both components in the same direction (engine rotation) and at the same speed.

4 Input Carrier Assembly Driven
Teeth on the input sun gear (533), in constant mesh with the input carrier planet pinion gears (568), force the input carrier assembly (106) to rotate in the same direction as engine rotation.

5 Input Internal Gear (Connected to the Forward Clutch)

5a Forward Clutch Applied
When applied, the forward clutch plates (601-604), splined to the forward clutch housing (609) and the input flange and forward clutch hub (577), connect to the input internal gear (560) which is splined to the input flange and forward clutch hub. Engine torque is transferred through the hub to the forward clutch housing.

5b Lo Roller Clutch Overruns
The lo roller clutch (652) overruns allowing the forward clutch housing (609) to rotate.

6 Reaction Sun Gear Held

6a 2nd Clutch Applied
The 2nd clutch plates (96-99), splined to the 2nd roller clutch cam (451) and the case (51), hold the roller clutch outer cam.

6b 2nd Roller Clutch Holding
The inner race of the 2nd roller clutch is part of the reverse clutch housing. The reverse clutch housing (454) is tanged to the reaction sun shell (529). The 2nd roller clutch holds and prevents the reaction sun gear from rotating.

7 Reaction Carrier Assembly Driven
The reaction carrier assembly, driven by the forward clutch housing (609), is forced to rotate around the stationary reaction sun shell/gear (529).

8 Reaction Internal Gear Driven
The reaction carrier pinion gears (556), in constant mesh with the reaction internal gear/input carrier assembly (106), force the reaction internal gear/input carrier assembly to rotate.

9 Power to Final Drive Assembly
The reaction internal gear/input carrier assembly (106), splined to the final drive sun gear shaft (651), drives the final drive sun gear (115). Final drive is achieved.

NOTE: To minimize the amount of repetitive text, the remaining description of mechanical power flow from the final drive sun gear (115) to the drive axles is omitted as it is identical to first gear. All of the following forward gear ranges also have the same description of final drive powerflow as first gear.

As the speed of the vehicle increases, less torque multiplication is required to move the vehicle efficiently thus making it desirable to shift the transaxle to a lower gear ratio, or third gear.

OVERDRIVE RANGE - SECOND GEAR

As vehicle speed increases and operating conditions become appropriate, the PCM de-energizes the 1-2 shift solenoid to shift the transaxle into Second gear. The manual valve remains in the Overdrive (D) position and line pressure is routed into the DRIVE and PRND4 fluid circuits.

1 SECOND CLUTCH APPLIES

1a 1-2 Shift Solenoid:
The normally open shift solenoid is de-energized and 1-2 signal fluid exhausts through the open solenoid.

Note: *Filtered actuator feed fluid continues to feed the 1-2 signal fluid circuit through orifice #7. However, the exhaust port through the solenoid is larger than orifice #7 to prevent a pressure increase in the 1-2 signal fluid circuit.*

1b 1-2 Shift Valve:
With 1-2 signal fluid pressure exhausted, spring force moves the valve into the upshifted position and drive fluid is routed into the 2-3 drive fluid circuit. Drive fluid also continues to the PSA.

1c #2 Checkball (Second Clutch Apply):
2-3 drive fluid seats the #2 checkball, forces 2-3 drive fluid through the #3 orifice and feeds the 2nd clutch fluid circuit. The #3 orifice helps control the apply feel of the second clutch.

1d Second Clutch:
2nd clutch fluid pressure applies the Second clutch to shift the transaxle into Second gear.

2 SHIFT ACCUMULATION

2a 1-2 Accumulator:
2nd clutch fluid is also routed to the 1-2 accumulator piston. 2nd clutch fluid pressure, in addition to 1-2 assist spring force, moves the piston against spring force and 1-2 accumulator feed fluid pressure. This action absorbs initial 2nd clutch fluid pressure to cushion the second clutch apply. The movement of the 1-2 accumulator piston forces some accumulator fluid out of the accumulator.

2b 1-2 Accumulator Valve:
1-2 accumulator feed fluid forced from the 1-2 accumulator unseats the #4 checkball and is routed back to the 1-2 accumulator valve. This pressure forces the 1-2 accumulator valve against spring force and torque signal fluid pressure to regulate the exhaust of excess accumulator fluid. This regulation provides additional control for the second clutch apply. *Figure 37 shows the exhaust of accumulator fluid during the shift by the arrow directions in the accumulator fluid circuit.*

2c 2-3 Shift Solenoid:
2-3 Shift solenoid remains OFF in Second gear and 2-3 signal fluid exhausts through the normally open solenoid.

2d 2-3 Shift Valve:
Spring force keeps the 2-3 shift valve in the downshifted position. In this position the valve blocks 2-3 drive fluid in preparation for the upshift to Third gear.

TCC Control - Pulse Width Modulated (PWM) Solenoid:
Filtered 2-3 drive fluid is routed to the TCC control solenoid. Under normal operating conditions the TCC control solenoid is OFF in Second gear and blocks filtered 2-3 drive fluid from entering the TCC signal fluid circuit.

Torque Converter Clutch:
With the TCC control solenoid OFF the converter clutch is released in Second gear.

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OVERDRIVE RANGE - SECOND GEAR

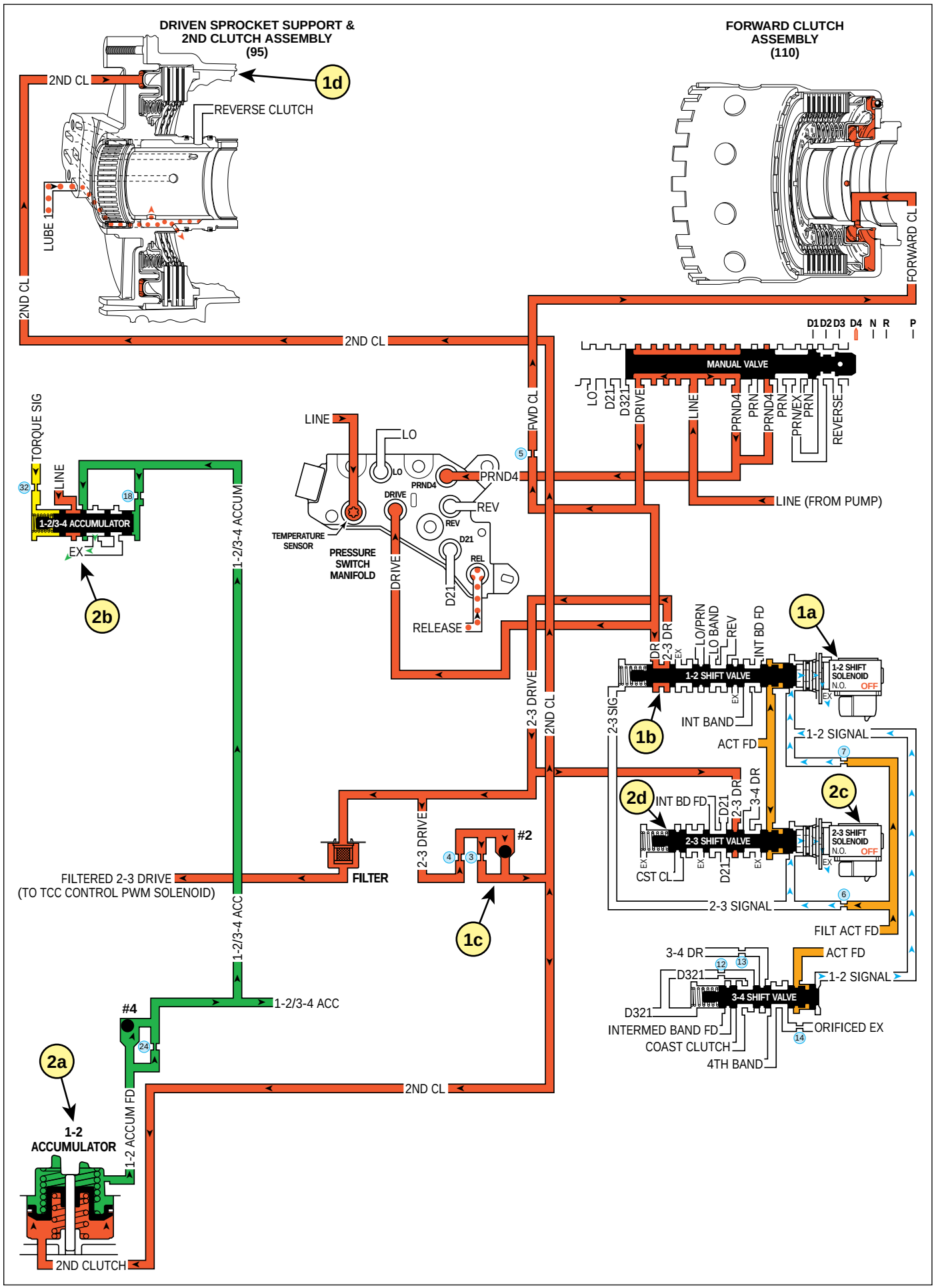

Figure 61

OVERDRIVE RANGE - THIRD GEAR

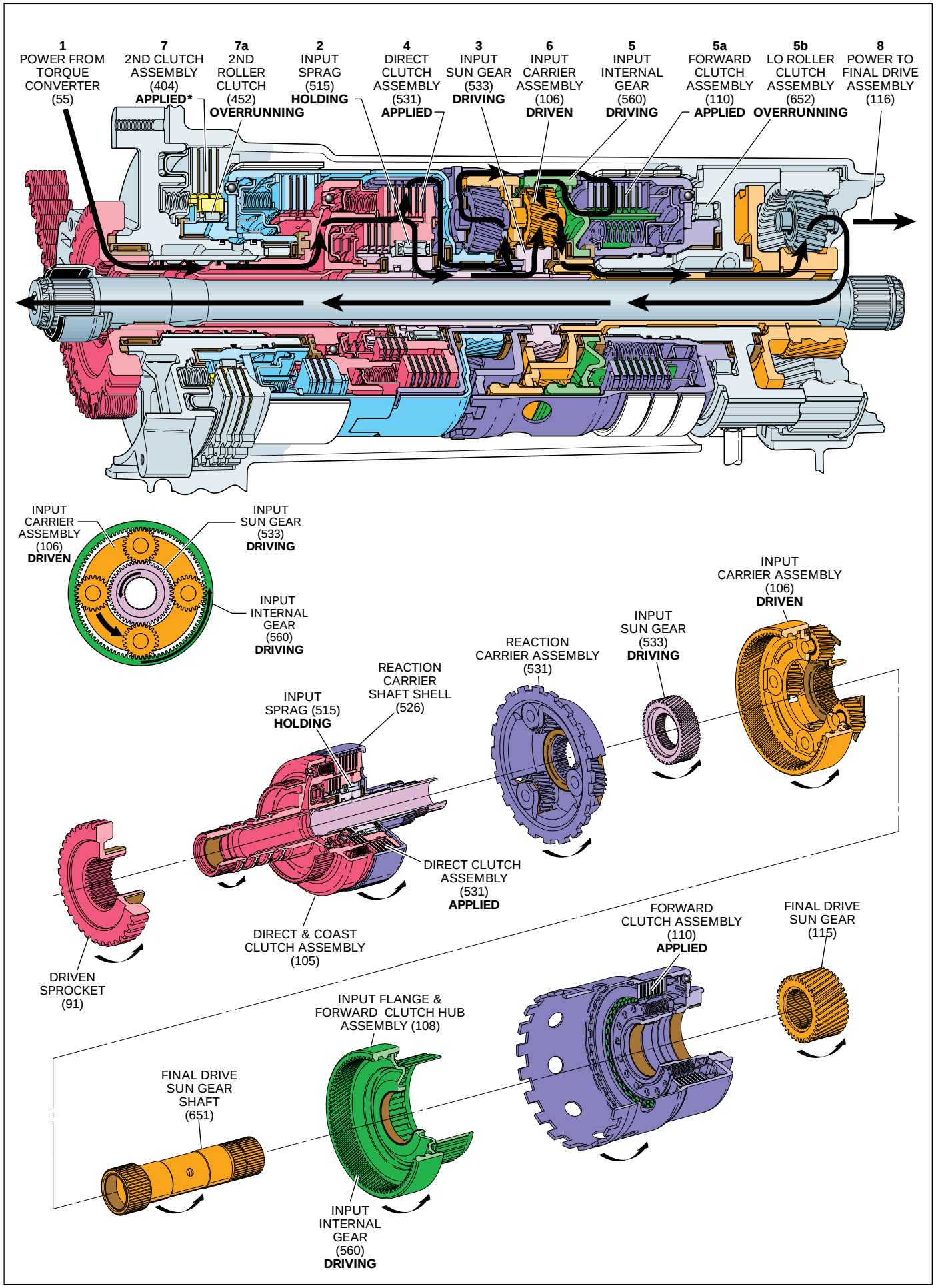

Figure 62

OVERDRIVE RANGE - THIRD GEAR

SHIFT "A" SOL	SHIFT "B" SOL	2ND CLUTCH	2ND ROLLER CLUTCH	INT/4TH BAND	REVERSE CLUTCH	COAST CLUTCH	INPUT SPRAG	DIRECT CLUTCH	FORWARD CLUTCH	LO/REV. BAND	LO ROLLER CLUTCH
OFF	ON	APPLIED *	OVER-RUNNING				HOLDING	APPLIED	APPLIED		OVER-RUNNING

As the speed of the vehicle increases, input signals from the vehicle speed sensor (VSS), throttle position sensor (TPS) and other sensors are sent to the powertrain control module (PCM). The PCM uses this information to manage engine torque as the transaxle shifts from second to third gear. In third gear, the input internal gear (560) and the input sun gear (533) rotate at the same speed providing a 1:1 gear ratio to the final drive assembly (116).

1 Power from Torque Converter
The driven sprocket (91) is splined to the input shaft and direct & coast clutch housing assembly (502) and forces the housing to rotate at driven sprocket speed.

The input shaft and direct & coast clutch housing assembly (502) is splined to the input sprag outer race (512) and rotates both components in the same direction (engine rotation) and at the same speed (turbine speed).

2 Input Sprag Holding
The sprag clutch (515) holds and power transfers to the input sun gear shaft and inner race assembly (511).

3 Input Sun Gear Driving
The input sun gear shaft and inner race assembly is splined to the input sun gear (533) and rotates both components in the same direction (engine rotation) and at the same speed.

4 Direct Clutch Applied
The direct clutch applies and directs power flow through the input shaft and direct & coast clutch housing (502) and direct clutch plates (521-523).

The direct clutch plates, splined to the reaction carrier shaft shell (526), force the reaction carrier shaft shell to rotate at the same speed as the input shaft and direct & coast clutch housing assembly (502).

The reaction carrier shaft shell (526), splined to the reaction carrier assembly (531), forces the carrier to rotate in the same direction and speed as the input shaft and direct & coast clutch housing assembly (502).

Torque transfers through the reaction carrier to the forward clutch housing (609).

5 Input Internal Gear Driving

5a Forward Clutch Applied
Engine torque is transferred from the forward clutch housing, through the forward clutch plates (601-604), splined to the forward clutch housing (609) and the input flange and forward clutch hub (577), to drive the input internal gear (560).

5b Lo Roller Clutch Overrunning
The inner race of the lo roller clutch is part of the forward clutch housing. The housing and race assembly rotates in the direction that allows the lo roller clutch assembly (652) to overrun.

6 Input Carrier Assembly Driven
With the input internal gear and input sun gear rotating in the same direction and at the same speed, the input carrier assembly (106) is forced to rotate in the same direction and speed. When this event occurs the gear sets are operating in direct drive.

7 2nd Clutch Applied
The 2nd clutch is applied but the 2nd roller clutch elements are overrunning.

7a 2nd Roller Clutch Overrunning
The reverse clutch housing and race assembly (454) is driven by the reaction sun gear & shell assembly (529) in the opposite direction of holding.

8 Power to Final Drive Assembly
The reaction internal gear/input carrier assembly (106), splined to the final drive sun gear shaft (651), drives the final drive sun gear (115). Final drive is achieved.

OVERDRIVE RANGE - THIRD GEAR

As vehicle speed increases and operating conditions become appropriate, the PCM energizes the 2-3 shift solenoid to shift the transaxle into Third gear. The manual valve remains in the Overdrive (D) position and line pressure continues to feed the DRIVE and PRND4 fluid circuits.

1 DIRECT CLUTCH APPLIES

1a 2-3 Shift Solenoid:
The normally open shift solenoid is energized by the PCM and blocks 2-3 signal fluid from exhausting. 2-3 Signal fluid pressure is routed to both the 1-2 and 2-3 shift valves.

1b 2-3 Shift Valve:
2-3 Signal fluid pressure moves the valve against spring force to initiate the 2-3 upshift. 2-3 drive fluid is routed through the valve and into the 3-4 drive fluid circuit.

1c #5 Checkball (Direct Clutch Apply):
3-4 drive fluid pressure seats the #5 checkball and 3-4 drive fluid is forced through the #26 orifice and into the direct clutch feed fluid circuit. The #26 orifice helps control the direct clutch apply.

1d Direct Clutch:
Direct clutch fluid pressure applies the direct clutch and the transaxle shifts into Third gear.

1e 3-4 Shift Valve:
3-4 drive fluid is also routed to the 3-4 shift valve in preparation for a 3-4 upshift.

2 SHIFT ACCUMULATION

2a 2-3 Accumulator:
Direct clutch feed fluid is also routed to the 2-3 accumulator piston. This fluid pressure moves the piston against spring force and 2-3 accumulator feed fluid pressure. This action absorbs initial direct clutch fluid pressure to cushion the direct clutch apply. The movement of the 2-3 accumulator piston forces some accumulator fluid out of the accumulator.

2b 2-3 Accumulator Valve:
Excess 2-3 accumulator feed fluid is routed back to the 2-3 accumulator valve. This fluid pressure moves the accumulator valve against spring force and torque signal fluid pressure to regulate the exhaust of excess accumulator fluid. This regulation provides additional control for the direct clutch apply. *Figure 37 shows the exhaust of accumulator fluid during the shift by the arrow directions in the accumulator fluid circuit.*

Note: *The 2-3 accumulator fluid circuit does not include a checkball. However, a checkball pocket is included in the channel plate casting.*

2c Pressure Switch Assembly:
Release fluid pressure routed to the PSA signals the PCM that the TCC is released.

Torque Converter Clutch:
Under normal operating conditions the TCC is released in Third gear. However, TCC apply could vary depending on vehicle application and may be calibrated to apply in Overdrive Range - Third Gear.

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OVERDRIVE RANGE - THIRD GEAR

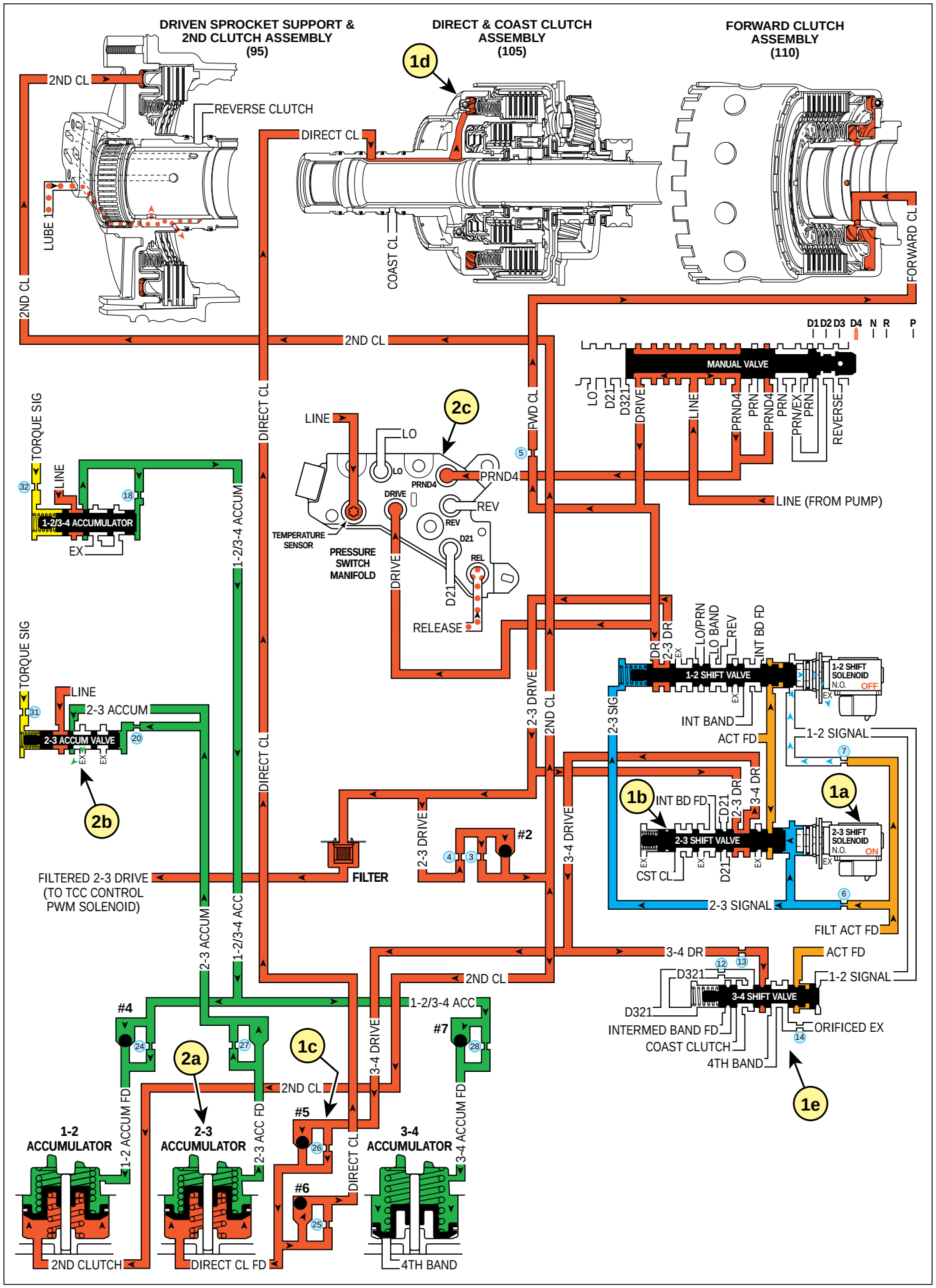

Figure 63

OVERDRIVE RANGE - FOURTH GEAR

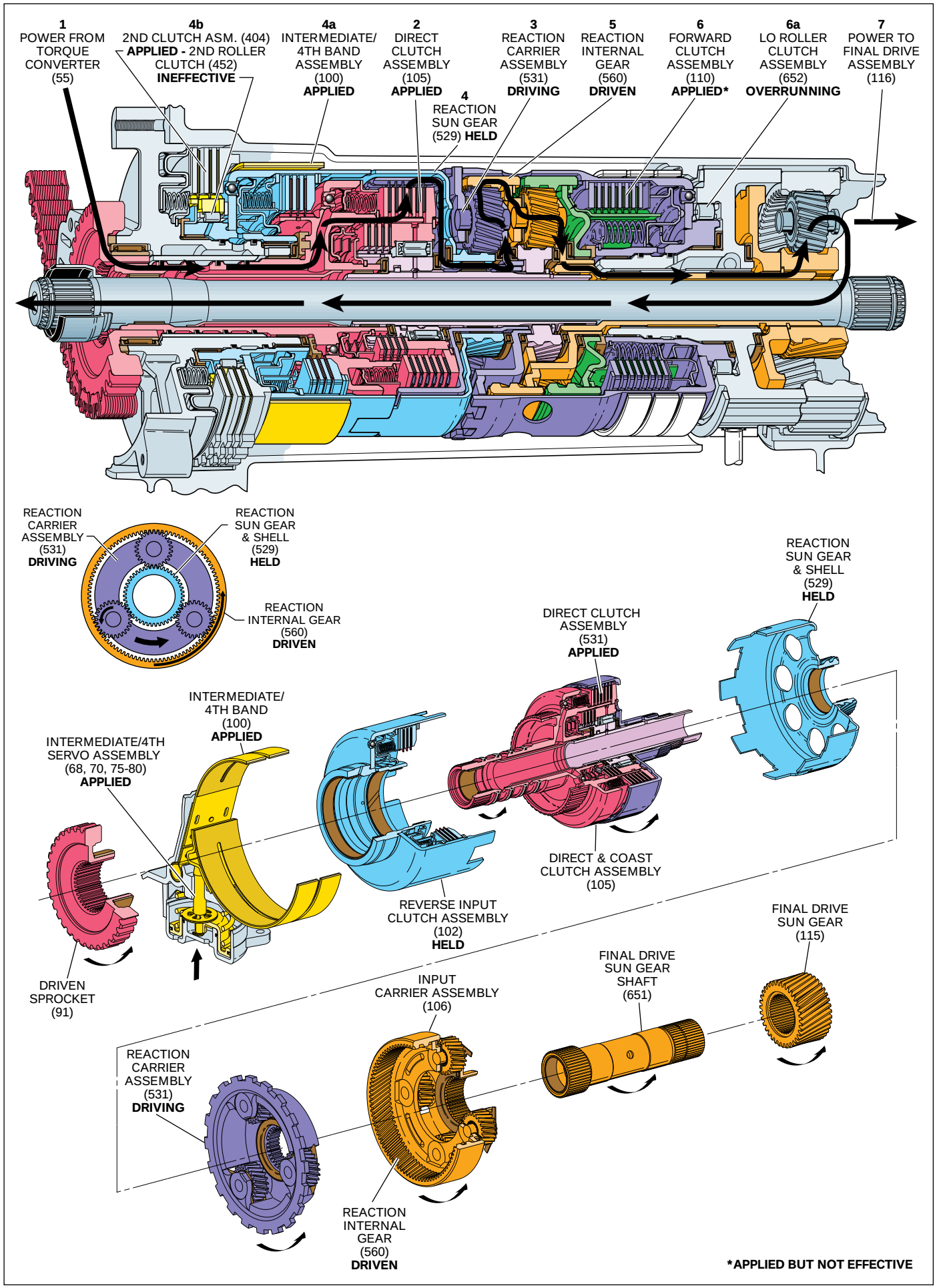

Figure 64

OVERDIVE RANGE - FOURTH GEAR

SHIFT "A" SOL	SHIFT "B" SOL	2ND CLUTCH	2ND ROLLER CLUTCH	INT/4TH BAND	REVERSE CLUTCH	COAST CLUTCH	INPUT SPRAG	DIRECT CLUTCH	FORWARD CLUTCH	LO/REV. BAND	LO ROLLER CLUTCH
ON	ON	APPLIED		APPLIED			OVER-RUNNING	APPLIED	APPLIED *		OVER-RUNNING

As the speed of the vehicle increases, input signals from the vehicle speed sensor (VSS), throttle position sensor (TPS) and other sensors are sent to the powertrain control module (PCM). The PCM uses this information to manage engine torque as the transaxle shifts from third to fourth gear. The transaxle is now operating in overdrive at a gear ratio of 0.68:1.

1 Power from Torque Converter
The driven sprocket (91) is splined to the input shaft and direct & coast clutch housing assembly (502) and forces the housing to rotate at driven sprocket speed.

2 Direct Clutch Applied
The direct clutch is applied and directs power flow through the input shaft and direct & coast clutch housing (502) and direct clutch plates (521-523).

The direct clutch plates, splined to the reaction carrier shaft shell (526), force the reaction carrier shaft shell to rotate at the same speed as the input shaft and direct & coast clutch housing assembly (502).

3 Reaction Carrier Driving
The reaction carrier shaft shell (526), splined to the reaction carrier assembly (531), forces the carrier to rotate in the same direction and speed as the input shaft and direct & coast clutch housing assembly (502).

4 Reaction Sun Gear & Shell Held.

4a Intermediate/4th Band Applied
The intermediate/4th band (100) applies and holds the reverse clutch housing (454), which is also tanged into the reaction sun gear & shell (529).

4b 2nd Clutch Applied/2nd Roller Clutch Ineffective
The 2nd clutch is applied but the 2nd roller clutch is ineffective because the reverse clutch housing (102) is held stationary by the intermediate/4th band.

5 Reaction Internal Gear Driven
Torque transfers through the reaction carrier to the reaction carrier pinions which walk around the stationary reaction sun gear. The reaction carrier is driving at driven sprocket speed and the planetary pinions drive the reaction internal gear faster than driven sprocket speed.

6 Forward Clutch Applied
The forward clutch is applied but ineffective because the reaction sun gear & shell (529) is driving the reaction carrier assembly.

7 Power to Final Drive Assembly
The reaction internal gear/input carrier assembly (106), splined to the final drive sun gear shaft (651), drives the final drive sun gear (115). Final drive is achieved.

Whenever the throttle is released while the vehicle is in motion, the direction of powerflow changes as the wheels provide torque input to the transaxle. When the vehicle is operating in Overdrive Range - Fourth gear and the throttle is released, engine compression braking slows the vehicle instead of initiating a coast condition. Since there are no roller or sprag clutches used in driving the vehicle during fourth gear acceleration there are no elements to overrun during coast. Engine rpm may be too low to provide noticeable engine braking.

In fourth gear and with zero throttle, the reaction carrier assembly (531) is driven around the stationary reaction sun gear & shell assembly (529) by the reaction internal gear (560). This attempts to drive the reaction carrier shaft shell (526) which is held to the input shaft and direct & coast clutch housing (502) by the direct clutch being applied. Since the driven sprocket (91) is splined to the input shaft, engine compression provides resistance to the powerflow input from the wheels.

OVERDRIVE RANGE - FOURTH GEAR

When operating conditions are appropriate, the PCM energizes the 1-2 shift solenoid to shift the transaxle into Fourth gear. In addition, the TCC is applied in Fourth gear. The manual valve remains in the Overdrive position and line pressure continues to feed the DRIVE and PRND4 fluid circuits.

1 INTERMEDIATE/4TH BAND APPLIED

1a 1-2 Shift Solenoid:
The normally open shift solenoid is energized by the PCM and blocks 1-2 signal fluid from exhausting. 1-2 Signal fluid pressure is routed to both the 1-2 and 3-4 shift valves.

1b 1-2 Shift Valve:
1-2 Signal fluid pressure does not affect the 1-2 shift valve. Spring force and 2-3 signal fluid pressure keep the 1-2 shift valve in the upshifted position.

1c 3-4 Shift Valve:
1-2 Signal fluid pressure moves the valve against spring force and into the Fourth gear position. 3-4 drive fluid is routed into the 4th band fluid circuit.

1d Intermediate/4th Servo:
4th band fluid pressure acts on the outer area of the servo piston to move the servo pin and apply the Intermediate/4th band.

2 SHIFT ACCUMULATION

2a 3-4 Accumulator:
4th band fluid is also routed to the 3-4 accumulator piston. 4th band fluid pressure moves the piston against spring force and 3-4 accumulator feed fluid pressure. This action absorbs initial 4th band fluid pressure to cushion the intermediate/4th band apply. The movement of the 3-4 accumulator piston forces some accumulator fluid out of the accumulator.

2b 3-4 Accumulator Valve:
3-4 accumulator feed fluid forced from the 3-4 accumulator unseats the #7 checkball and is routed back to the 1-2/3-4 accumulator valve. This pressure forces the 1-2/3-4 accumulator valve against spring force and torque signal fluid pressure to regulate the exhaust of excess accumulator fluid. This regulation provides additional control for the intermediate/4th band apply. *Figure 38 shows the exhaust of accumulator fluid during the shift by the arrow directions in the accumulator fluid circuit.*

TORQUE CONVERTER CLUTCH APPLIED

TCC Control Solenoid:
When conditions are appropriate, the PCM energizes the TCC control solenoid to initiate the TCC apply. The solenoid is pulse width modulated (PWM) to provide a smooth TCC apply. (See Overdrive Range – Fourth Gear TCC Released & Applied pages 70-71.)

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OVERDRIVE RANGE - FOURTH GEAR

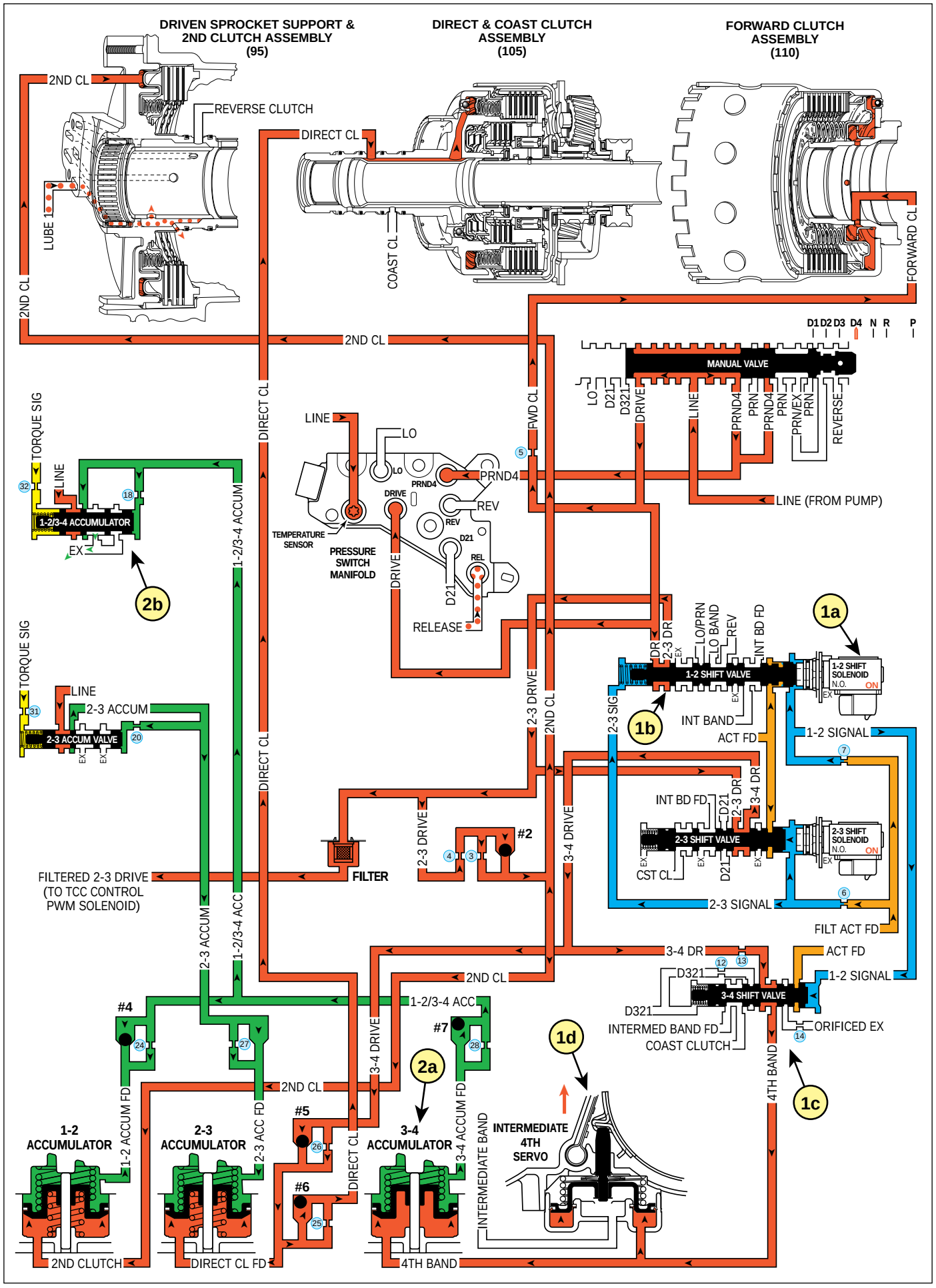
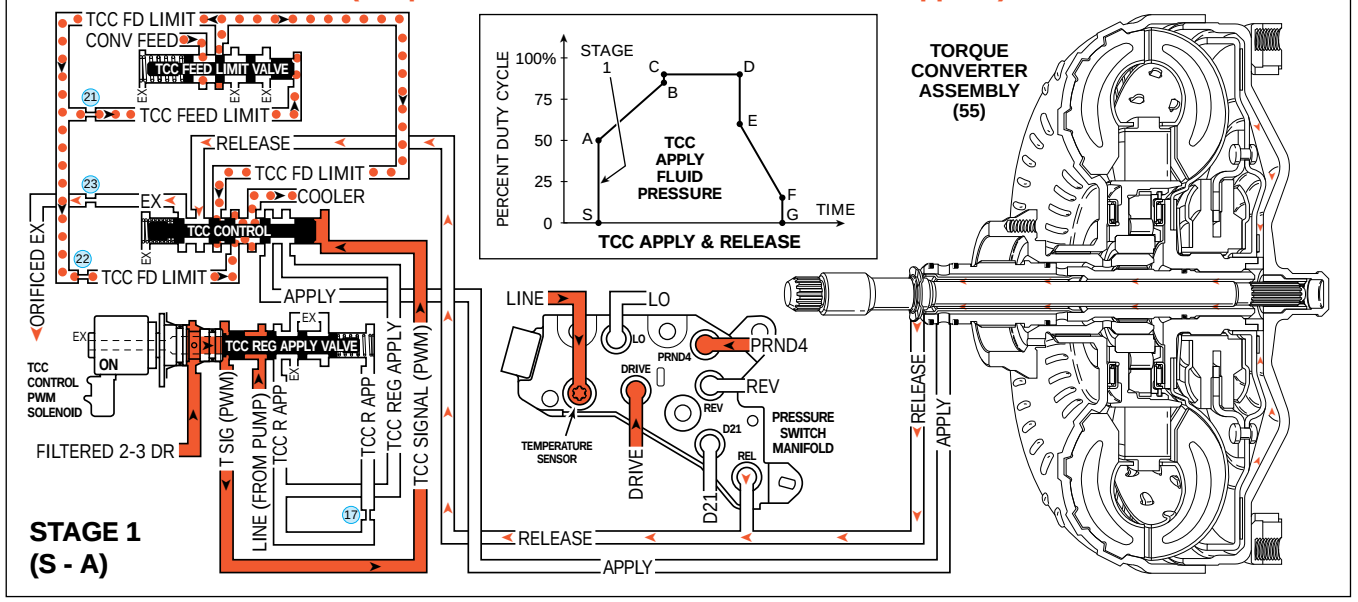
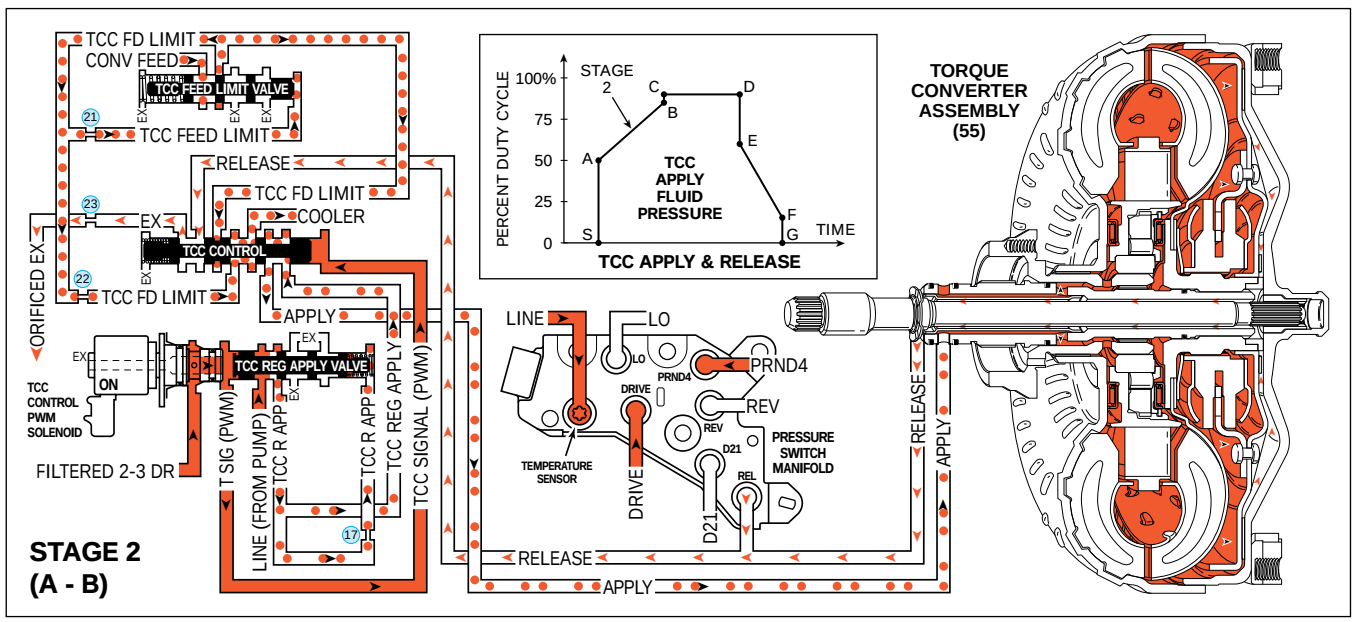


Figure 65

OVERDRIVE RANGE - FOURTH GEAR

(Torque Converter Clutch from Released to Applied)





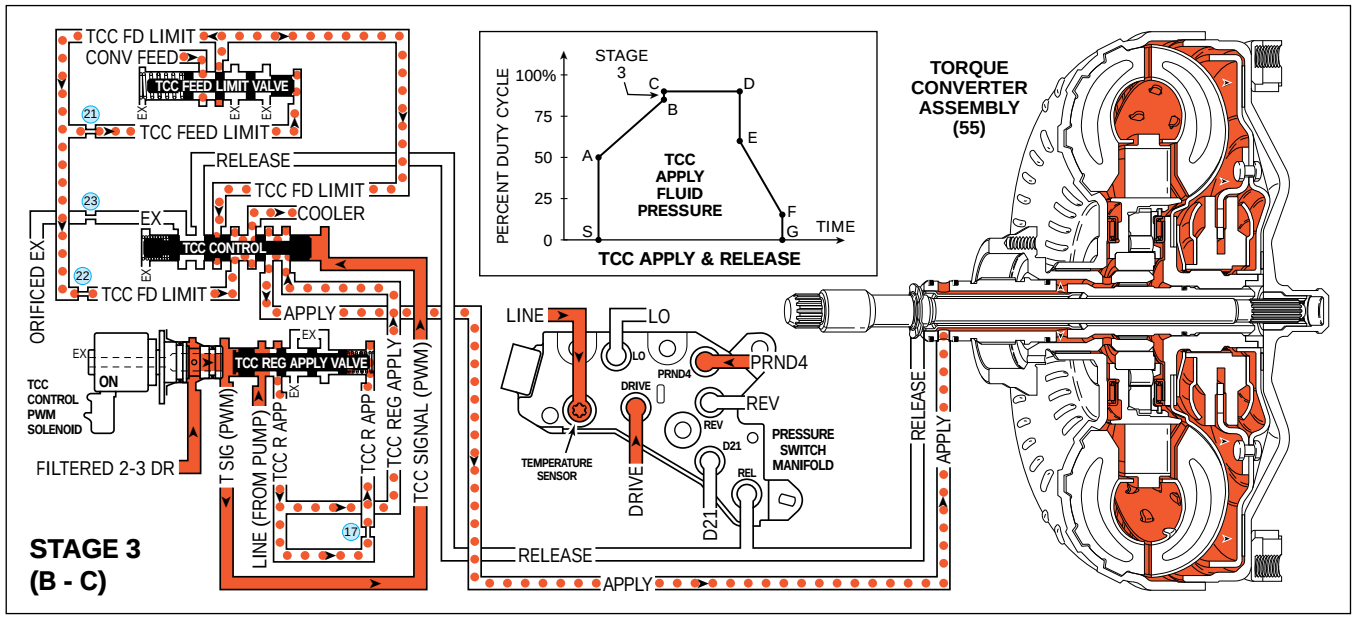


Figure 66

OVERDRIVE RANGE - FOURTH GEAR

(Torque Converter Clutch from Released to Applied)

When the Powertrain Control Module (PCM) determines that the engine and transaxle are operating properly to engage the Torque Converter Clutch (TCC), the PCM energizes the torque converter clutch control (PWM) solenoid. The following events occur in order to apply the torque converter clutch:

OFF At this time the Torque Converter Clutch is considered to be disengaged (OFF).

PCM decision to apply TCC (see page 50, in the Electrical Components section, for more information).

Stage 1 The PCM pulses the TCC control PWM solenoid to approximately 50% duty cycle from point **S** to point **A**. Filtered 2-3 Drive fluid at the TCC control solenoid is "pulsed" into the TCC Signal fluid circuit. The TCC Signal fluid pressure at point **A** is strong enough to move the Converter Clutch Control valve against the spring. With the TCC Control valve in the apply position Release fluid can exhaust and TCC Regulator Apply fluid is sent to the Torque Converter Clutch. This stage is designed to move the TCC Control valve from the released to the applied position; there is not enough pressure to apply the TCC.

Stage 2 The TCC control solenoid duty cycle is ramped up from point **A** to point **B** to approximately 85%. Line pressure from the pump is also able to enter the TCC Regulated Apply circuit at the TCC Regulator Valve. The pressure value in the Regulated Apply circuit should now be high enough to fully apply the converter clutch pressure plate. Slip speed should be at the correct value (near "0").

Stage 3 Now the Regulated Apply pressure is increased. This is caused by the TCC control solenoid duty cycle being increased from point **B** to point **C,** approximately 90%. This extra pressure ensures that the apply force on the converter clutch pressure plate is not at the slip threshold, but a little above it. TCC plate material is therefore protected from damage due to slippage.

TCC Release Switch

The Torque Converter Clutch (TCC) release switch is part of the Pressure Switch Assembly (PSA) that is mounted to the valve body. The switch is a normally closed switch. The purpose of the switch is to provide a signal to the Powertrain Control Module (PWM) that the TCC is released. This is accomplished by the Release fluid pressure acting on the switch contact and opening the circuit. When the voltage is high the PCM recognizes that the TCC is not engaged. When the release fluid pressure is low the switch is in the normally closed state, the TCC is in the engaged position.

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OVERDRIVE RANGE - FOURTH GEAR

(Torque Converter Clutch from Applied to Released)

When the torque converter clutch pressure plate is applied, it is held against the torque converter cover. Since it is splined to the converter turbine hub, it provides a mechanical coupling (direct drive) of the engine to the transaxle gear sets. This mechanical coupling eliminates the small amount of slippage that occurs in the fluid coupling of a torque converter, resulting in a more efficient transfer of engine torque through the transaxle and to the drive wheels.

ON At this time the Torque Converter Clutch is considered to be engaged (ON).

PCM decision to release TCC (see page 50, in the Electrical Components section, for more information).

Stage 4 During this stage, the apply pressure from the Converter Clutch Regulator valve is decreased by the TCC control solenoid duty cycle dropping from point **D** to point **E,** approximately 60%. This reduces the apply force on the converter clutch pressure plate to the slip threshold. This gets the converter clutch pressure plate ready for a smooth release.

Stage 5 The TCC control solenoid duty cycle is ramped down from point **E** to point **F** through this stage. This action allows the Regulated Apply pressure to start at the slip threshold, and decrease to near "0" pressure over a very short time to point **F**. The Regulated Apply pressure value from the Converter Clutch Regulator valve at this duty cycle (point **F**) should fully release the converter clutch pressure plate. Slip speed should be at the maximum value.

Stage 6 The PCM pulses the TCC control solenoid to a value of "0". Now the TCC Regulator Valve and the Converter Clutch Control valve return to the released position (away from their springs). Release fluid is now directed back to the torque converter. This stage is designed to move the TCC Control valve to the released position.

OFF At this time the Torque Converter Clutch is considered to be disengaged (OFF).

Release fluid pressure also opens the normally closed TCC release switch located in the Pressure Switch Assembly (PSA). The switch sends a signal to the PCM that the TCC is released. If the switch does not open, the PCM will command the TCC on in 2nd, 3rd, and 4th gears with 100% duty cycle to the TCC control (PWM) Solenoid. Also a Diagnostic Trouble Code (DTC) 742 will set and the PCM will illuminate the Malfunction Indicator Lamp (MIL). The DTC 742 will then be stored in PCM history and the PCM will freeze shift adapts from being updated.

(Some PCM calibrations may allow stages 4 - 6 to happen very rapidly in almost a straight line down from point **D** to point **G**.)

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OVERDRIVE RANGE - FOURTH GEAR

(Torque Converter Clutch from Applied to Released)

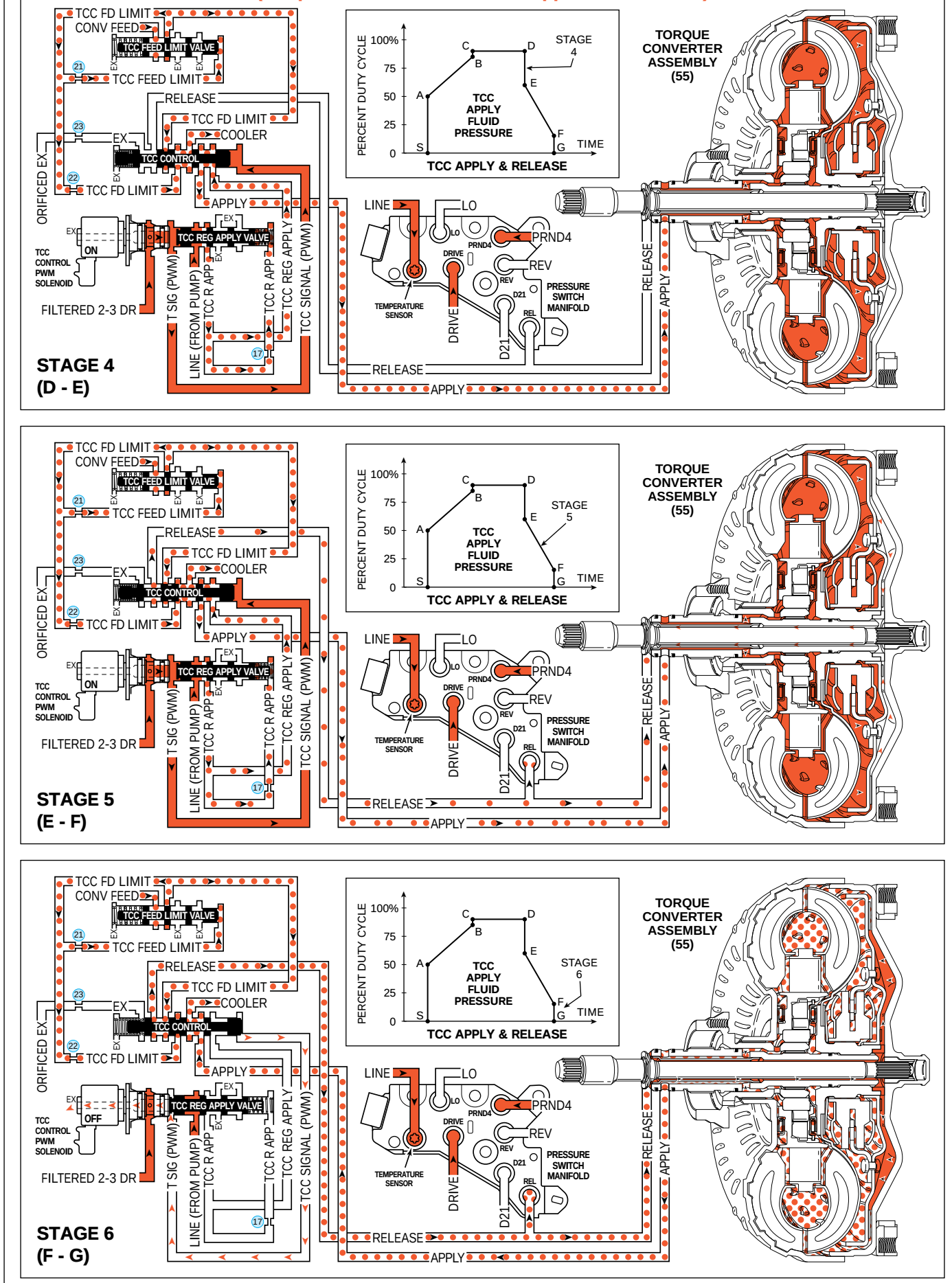

Figure 67

OVERDRIVE RANGE - 4-3 DOWNSHIFT

(Torque Converter Clutch Released)

When the transaxle is operating in Overdrive Range - Fourth Gear a forced 4-3 downshift will occur if there is a significant increase in throttle position. At minimum throttle, vehicle speed will decrease gradually (coastdown) and the PCM will command a 4-3 downshift. The PCM will also initiate a 4-3 downshift if engine load is increased with throttle position remaining the same (for example, driving up a steep hill).

1 LINE PRESSURE INCREASES

1a Pressure Control Solenoid (PCS):
During the downshift, except for a coastdown, the PCM senses the increase in throttle position or engine load and decreases the PCS duty cycle. The decrease in duty cycle increases output fluid pressure from the PCS, thereby increasing torque signal fluid pressure at the torque signal regulator valve.

1b Pressure Regulator Valve:
Increased torque signal fluid pressure acting on the boost valve increases line pressure at the pressure regulator valve.

2 INTERMEDIATE / 4TH BAND RELEASES

2a 1-2 Shift Solenoid:
The PCM de-energizes the normally open solenoid and 1-2 signal fluid exhausts.

2b 3-4 Shift Valve:
1-2 Signal fluid pressure exhausts from the 3-4 shift valve and spring force moves the valve into the Third gear position. This opens the 4th band fluid circuit to an orificed exhaust to help control the band release.

2c Intermediate / 4th Servo:
4th band fluid exhausts from the servo and spring force moves the servo to the release position, thereby releasing the band.

2d 3-4 Accumulator:
4th band fluid exhausts from the accumulator. Spring force and 3-4 accumulator feed fluid pressure move the accumulator piston to the Third gear position.

2e 1-2/3-4 Accumulator Valve:
The accumulator valve regulates line pressure into the 1-2/3-4 accumulator fluid circuit to fill the 3-4 accumulator. This regulation is basically controlled by torque signal fluid pressure. Increased torque signal fluid pressure regulates accumulator fluid to a higher pressure.

2f #7 Checkball (3-4 Accumulator):
1-2/3-4 Accumulator fluid pressure seats the #7 checkball and forces accumulator fluid through orifice #28.

TORQUE CONVERTER CLUTCH

The PCM commands TCC release prior to initiating a 4-3 downshift. When the TCC is in the release position release fluid pressure is routed to the pressure switch assembly. This fluid pressure signals the PCM that the TCC is in the release position. The TCC is not applied under normal operating conditions in Third gear (except for some applications)

3-2 and 2-1 DOWNSHIFTS

Refer to the Manual range explanations for a description of the 3-2 and 2-1 downshifts with respect to the clutches releasing.

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OVERDRIVE RANGE - 4-3 DOWNSHIFT

(Torque Converter Clutch Released)

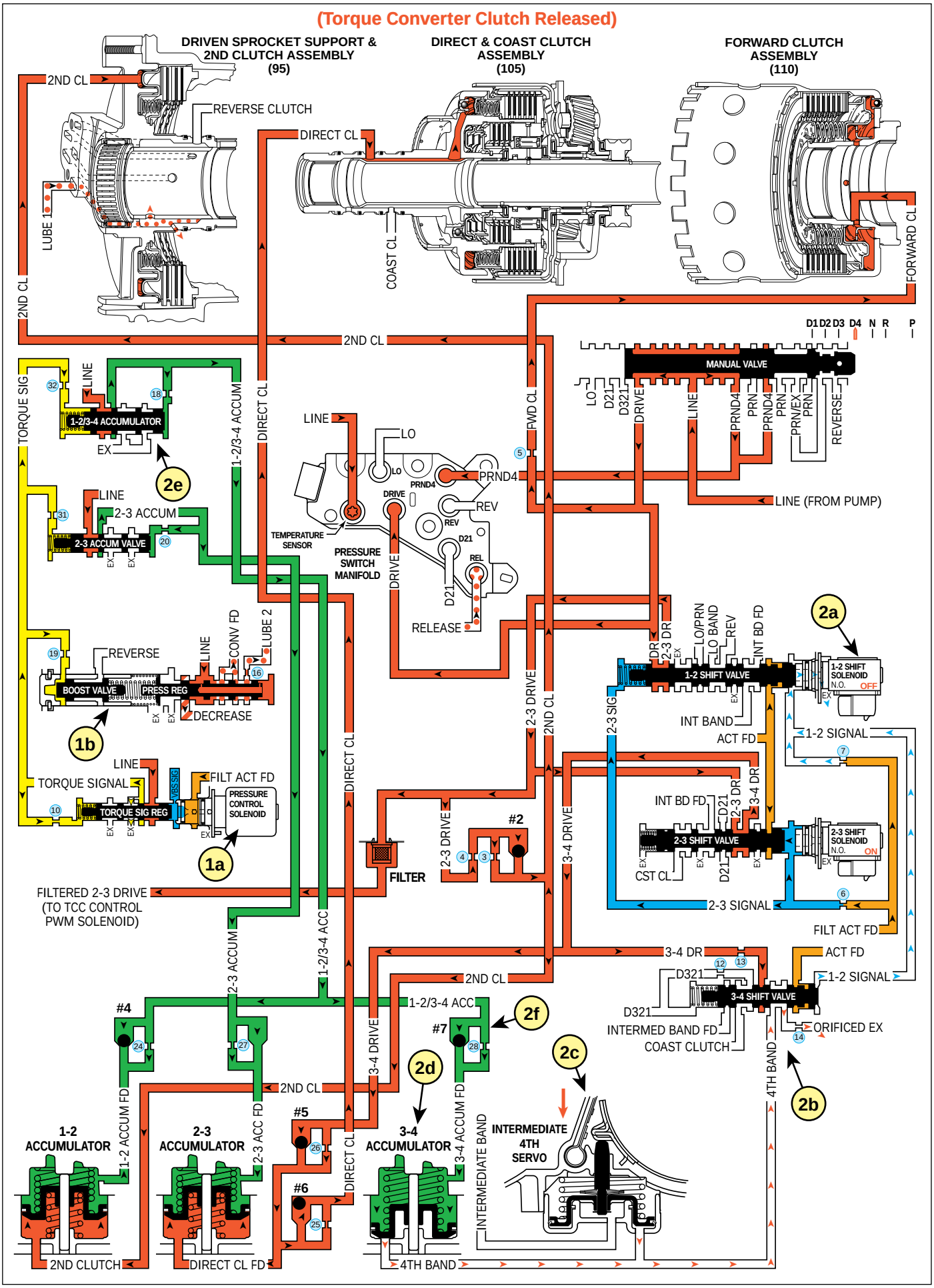

Figure 68

MANUAL THIRD - THIRD GEAR

(From Overdrive Range - Fourth Gear; Engine Compression Braking Shown)

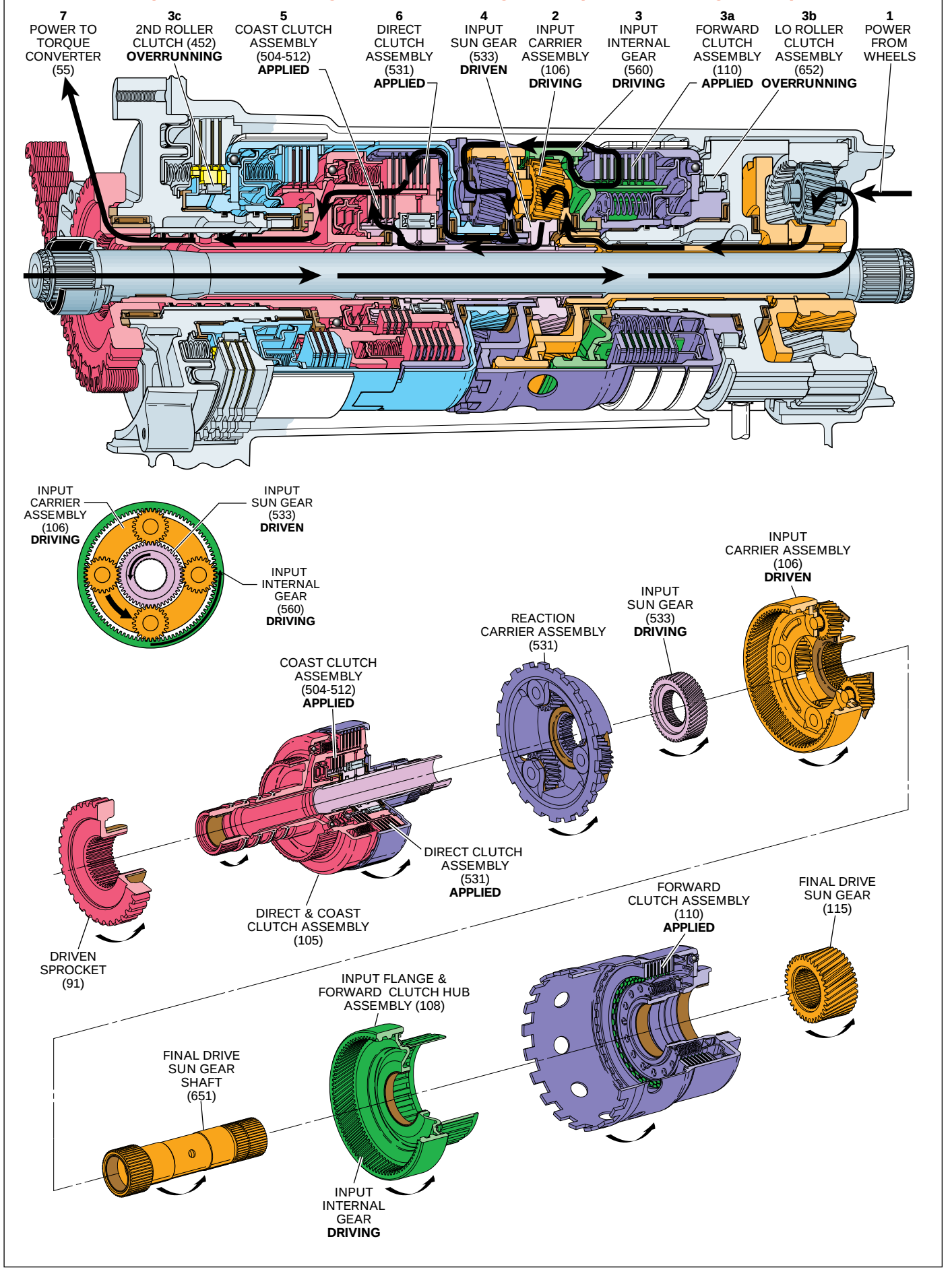

Figure 69

MANUAL THIRD - THIRD GEAR

(From Overdrive Range - Fourth Gear)

SHIFT "A" SOL	SHIFT "B" SOL	2ND CLUTCH	2ND ROLLER CLUTCH	INT/4TH BAND	REVERSE CLUTCH	COAST CLUTCH	INPUT SPRAG	DIRECT CLUTCH	FORWARD CLUTCH	LO/REV. BAND	LO ROLLER CLUTCH
OFF	ON	APPLIED *	OVER-RUNNING			APPLIED	HOLDING	APPLIED	APPLIED		OVER-RUNNING

Manual Third - Third gear (3) is available to the driver when vehicle operating conditions make it desirable to use only three gear ratios. Some of these conditions include city driving, where speeds are generally below 72 kmh (45 mph), towing a trailer, or driving in hilly terrain. Manual Third gear also provides for engine compression breaking when descending slight grades and provides a direct drive ratio of 1:1 through the gear sets.

When Manual Third range is selected, the transaxle can automatically upshift or downshift between first, second and third gear. However, the transaxle is prevented from shifting into fourth gear while operating in this mode. If the transaxle is in Overdrive Range - Fourth gear when Manual Third is selected for engine braking, the transaxle will shift immediately into third gear.

The acceleration powerflow for Manual Third is exactly the same as Overdrive Range Third gear, therefore we will discuss and illustrate deceleration (engine braking). You will note that the powerflow is backwards from the powerflow in Overdrive Range Third gear, with power coming from the wheels and going to the torque converter.

- The manual shaft and detent lever assembly (806) and manual valve (800) are moved into the “3” range position - manual third.

  If manual third range is selected for engine compression braking after the vehicle was operating in overdrive range fourth gear, the Int/4th band releases. When the band is released the reverse clutch housing and the reaction sun gear & shell assembly rotate.

1 Power from the Wheels
Power from the wheels travels through the final drive differential assembly to the final drive sun gear shaft.

2 Input Carrier Assembly Driving
Power continues to the input carrier assembly, which is splined to the final drive sun gear shaft.

3 Input Internal Gear Driving
At the input carrier the torque drives the input internal gear which is splined to the forward clutch hub. The input internal gear drives the reaction carrier shaft shell.

3a Forward Clutch Assembly Applied
The forward clutch applies and holds the input flange and forward clutch hub assembly (108). Torque is now transferred to the forward clutch housing (609) through the forward clutch plates (601-604). The forward clutch assembly is now rotating at the same speed as the input from the wheels through the final drive assembly.

3b Lo Roller Clutch Overrunning
The forward clutch is rotating in the direction that allows the lo roller clutch to overrun, so torque continues to the reaction carrier assembly which is splined to the reaction carrier shaft shell.

3c 2nd Roller Clutch Overrunning
The 2nd clutch is applied but ineffective since the 2nd roller clutch will overrun. Power then goes from the reaction carrier to the direct clutch housing.

4 Input Sun Gear Driven
Torque delivered through the input carrier assembly forces the input sun gear, which is traveling at a slower speed, to try to speed up.

5 Coast Clutch Assembly Applied
This is where the key element of manual third comes into play. The coast clutch holds the inner race of the input sprag which would normally overrun in a coast situation. Now, power can flow through the coast clutch and the input shaft assembly to the torque converter for engine compression braking.

6 Direct Clutch Assembly Applied
The direct clutch is applied so power from the input internal gear also goes to the input shaft.

7 Power to Torque Converter
With two members of the same gear set driving we have a 1:1 ratio through the gear sets to the torque converter for engine braking.

MANUAL THIRD - THIRD GEAR

(From Overdrive Range - Fourth Gear)

A manual 4-3 downshift is accomplished by moving the gear selector lever to the Manual Third (3) position. In Manual Third the transaxle is hydraulically prevented from upshifting into Fourth gear under any conditions. Also, the coast clutch is applied in all manual ranges to provide engine compression braking when appropriate. The following information explains the additional changes during a Manual 4-3 downshift as compared to a forced 4-3 downshift. *Refer to Overdrive Range – 4-3 Downshift for a complete description of a 4-3 downshift.*

1 FOURTH GEAR HYDRAULICALLY PREVENTED

1a Manual Valve:
The manual valve moves into the Manual Third (3) position and line pressure enters the D321 fluid circuit. Also, the manual valve blocks line pressure from the PRND4 fluid circuit and PRND4 fluid exhausts past the manual valve.

1b 3-4 Shift Valve:
D321 fluid pressure assists spring force to keep the valve in the Third gear position under any conditions. This opens the 4th band fluid circuit to an orificed exhaust and the intermediate / 4th band releases, thereby preventing Fourth gear.

Note: *The operating states for the shift solenoids follow normal operation, depending on vehicle driving conditions. Figure 46 shows the solenoids in the Third gear position.*

1c Pressure Switch Assembly:
PRND4 fluid exhausts from the PSA and the PSA signals the PCM that the manual valve is in the Manual Third position.

2 COAST CLUTCH APPLIES

2a 3-4 Shift Valve:
D321 fluid is routed through the 3-4 shift valve and into the coast clutch fluid circuit.

2b Coast Clutch:
Coast clutch fluid pressure applies the coast clutch. With the coast clutch applied, engine compression braking is available in Manual Third - Third Gear to slow the vehicle when the throttle is released.

MANUAL THIRD – SECOND and FIRST GEARS

The transmission operates the same in Manual Third as in Overdrive range with the exception of Fourth gear being prevented. The transaxle will upshift and downshift between First, Second and Third gears as in Overdrive range. However, engine compression braking is not available in Overdrive Range – Third, First and Second gears and the vehicle will coast when the throttle is released.

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MANUAL THIRD - THIRD GEAR
(From Overdrive Range - Fourth Gear)

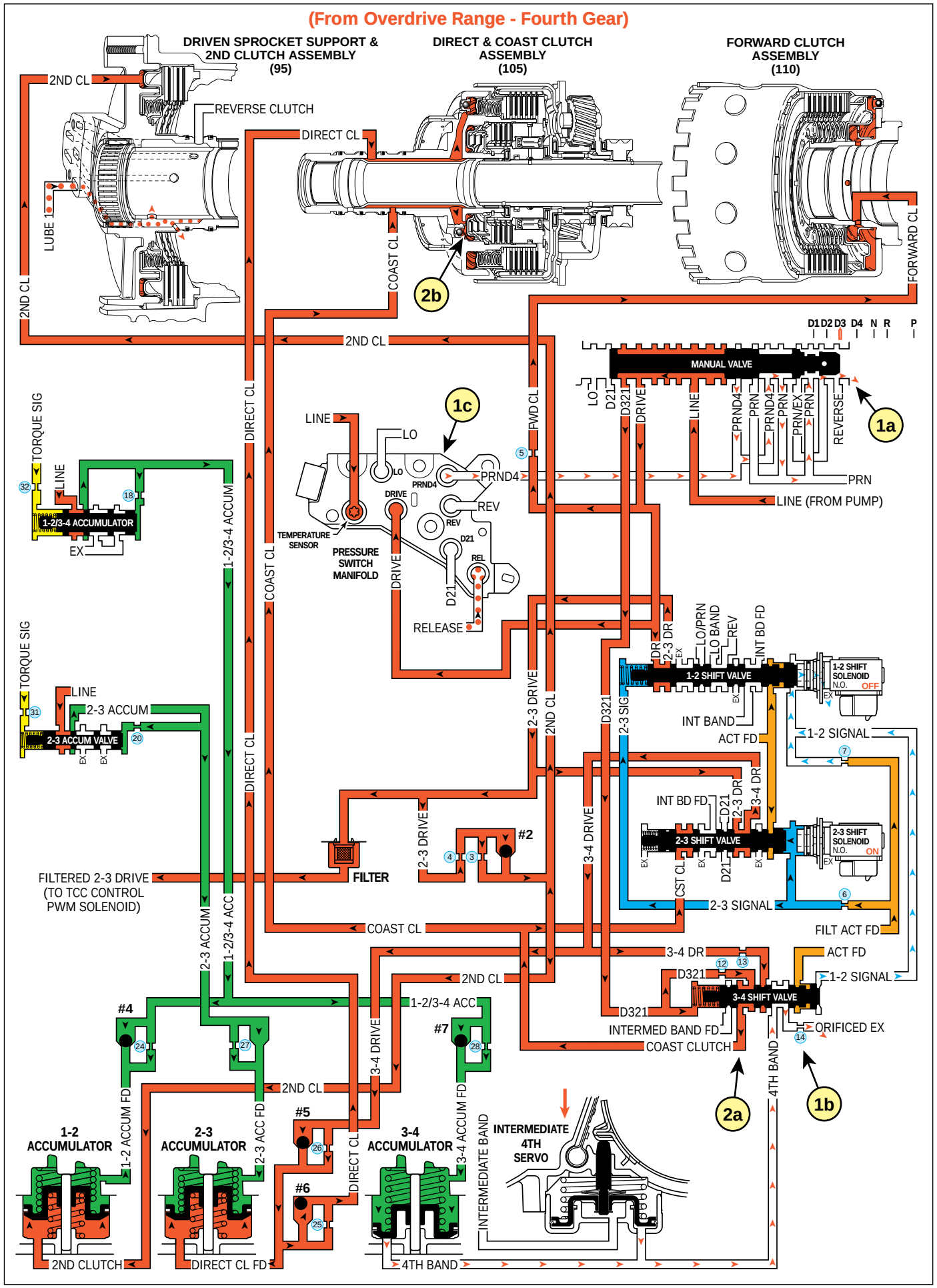

Figure 70

MANUAL SECOND - SECOND GEAR

(From Drive Range - Manual Third; Engine Compression Braking Shown)

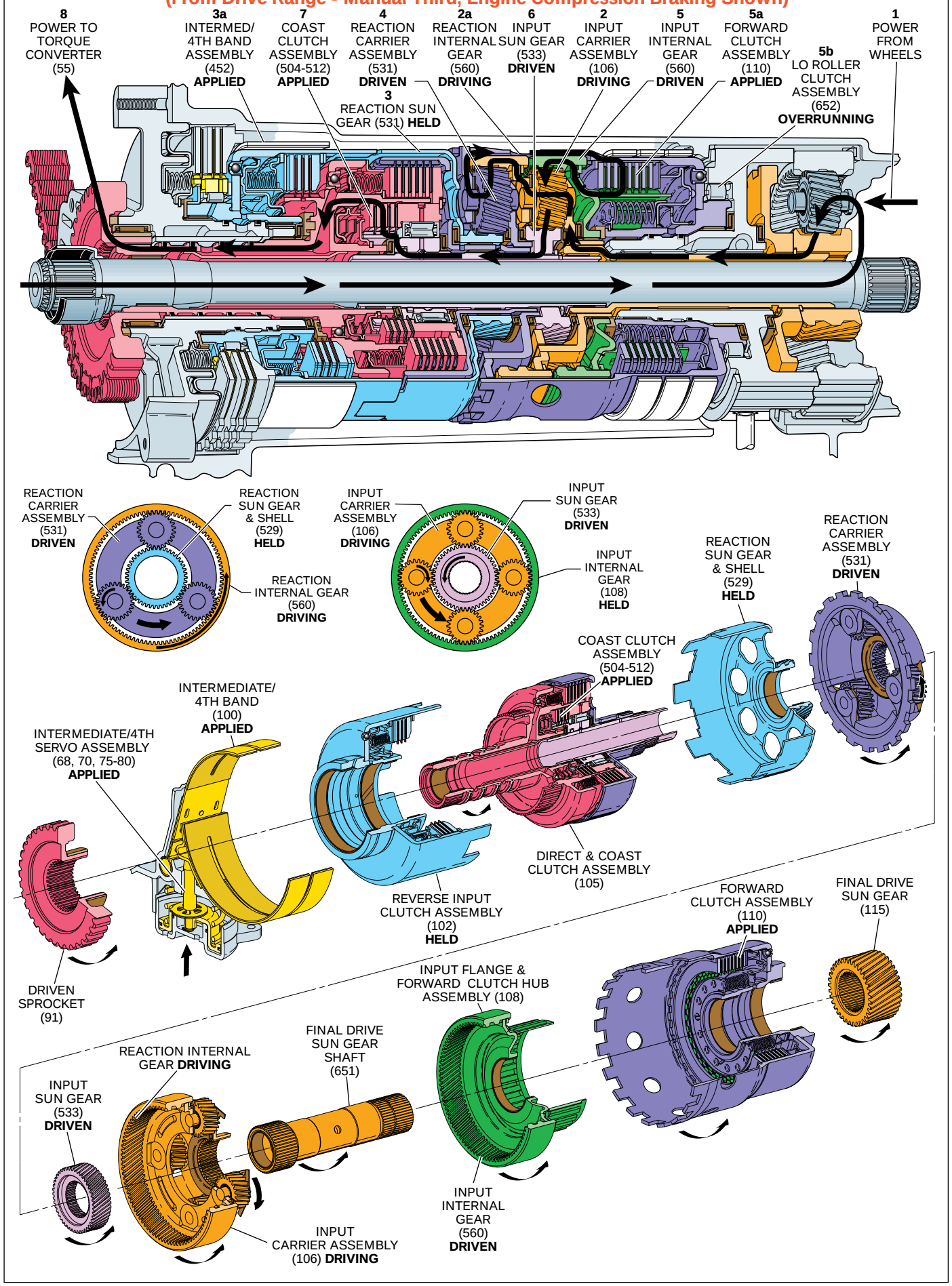

Figure 71

MANUAL SECOND - SECOND GEAR

(From Manual Third - Third Gear)

SHIFT "A" SOL	SHIFT "B" SOL	2ND CLUTCH	2ND ROLLER CLUTCH	INT/4TH BAND	REVERSE CLUTCH	COAST CLUTCH	INPUT SPRAG	DIRECT CLUTCH	FORWARD CLUTCH	LO/REV. BAND	LO ROLLER CLUTCH
OFF	OFF	APPLIED	HOLDING	APPLIED		APPLIED	HOLDING		APPLIED		OVER-RUNNING

Manual Second – Second Gear (2) is available when vehicle operating conditions or road conditions make it desirable to use only two gear ratios. Some of these vehicle operating conditions include descending a steep grade to provide engine compression braking or, ascending a steep grade for additional engine performance.

When manual second gear range is selected, the transaxle will upshift and downshift between first, second and third gear but, it is prevented from shifting into fourth gear. If the transaxle is operating in Manual Third or Overdrive Range – Fourth gear when Manual Second is selected, the transaxle will shift immediately into second gear [below 113 kmh (70 mph)]. Power flow through the transaxle is the same as described in Overdrive Range - Second gear with the exception that the intermediate/4th band and coast clutch are applied, which allows the transmission to achieve engine braking during deceleration instead of coasting.

The mechanical power flow graphics show the transfer of power through the components during deceleration. When selecting Manual Second to slow the vehicle, vehicle speed provides the input from the wheels through the transaxle and attempts to overrun engine speed (rpm). However, engine compression braking slows the vehicle when the coast clutch and 4th band are applied, resulting in a 1.62:1 gear ratio through the gear sets.

- The manual shaft and detent lever assembly (806) and manual valve (800) are moved into manual second - the “2” range position on the shift quadrant.

1 Power from the Wheels
During deceleration, input torque from the wheels is transferred from the wheels through the final drive assembly (116) to the final drive sun gear shaft (651).

2 Input Carrier Assembly Driving

2a Reaction Internal Gear Driving
The final drive sun gear shaft forces the input carrier assembly (106) and reaction internal gear (560) to rotate and transfer torque to the reaction carrier assembly (531).

3 Reaction Sun Gear & Shell Held

3a Intermediate/4th Band Applied
During deceleration, input torque from the wheels tries to rotate the reverse clutch housing & race assembly (102) in the same direction as engine rotation. This condition would allow the 2nd roller clutch elements and the reaction sun gear & shell assembly to freewheel, resulting in a loss of torque through the gear sets. Therefore, the intermediate/4th band is applied and holds the sun gear during acceleration and deceleration.

4 Reaction Carrier Assembly Driven
The reaction carrier assembly rotates around the stationary reaction sun gear & shell assembly (529) and transfers torque through the reaction carrier to the forward clutch housing (609).

5 Input Internal Gear Driven

5a Forward Clutch Assembly Applied
Torque from the reaction carrier transferred to the forward clutch housing passes through the forward clutch plates (601-604), then drives the input internal gear (560) at a reduced speed from the final drive.

5b Lo Roller Clutch Overrunning
The forward clutch is rotating in the direction that allows the lo roller clutch to overrun, so torque continues to the input carrier planetary pinions.

6 Input Sun Gear Driven
The input internal gear drives the input carrier planetary pinions which will now drive the input sun gear at a reduced rate of speed but, still faster than engine speed.

7 Coast Clutch Assembly Applied
The coast clutch holds the inner race of the input sprag which would normally overrun in a coast situation. Now power can flow through the coast clutch and on to the input shaft assembly.

8 Power to Torque Converter
From the input shaft, power continues to the torque converter for engine compression braking.

MANUAL SECOND - SECOND GEAR

(From Manual Third - Third Gear)

A manual 3-2 downshift is initiated by moving the gear selector lever to the Manual Second (2) position. However, the transaxle will not downshift into Second gear until vehicle speed is below approximately 113 Km/h (70 mph). At higher vehicle speeds, the PCM will keep the 2-3 shift solenoid energized (ON) and the transaxle will operate in Manual Second - Third Gear as a safety precaution. In Manual Second, the transaxle is hydraulically prevented from upshifting into Fourth gear under any conditions. Also, the coast clutch remains applied as in Manual Third and provides engine compression braking in Third and Second gears. The transaxle upshifts and downshifts between First and Second gears as in Overdrive range.

1 MANUAL VALVE:
Line pressure is routed into the D21 fluid circuit when the selector lever is moved into the Manual Second (2) position.

2 2-3 SHIFT SOLENOID:
The PCM de-energizes the 2-3 shift solenoid. With the solenoid OFF, 2-3 signal fluid exhausts through the 2-3 shift solenoid.

3 2-3 SHIFT VALVE:
Spring force moves the 2-3 shift valve into the Second gear position when 2-3 signal fluid exhausts. D21 fluid continues through the valve and is also routed into the intermediate band feed fluid circuit. 3-4 drive fluid, which feeds the direct clutch, exhausts past the 2-3 shift valve.

4 DIRECT CLUTCH RELEASES

4a Direct Clutch: Direct clutch fluid exhausts and the direct clutch releases.

4b #6 Checkball (Direct Clutch Release): Exhausting direct clutch fluid seats the #6 checkball and is forced through the #25 orifice to help control the direct clutch release.

4c 2-3 Accumulator: Direct clutch feed fluid exhausts from the 2-3 accumulator, unseats the #5 checkball, enters the 3-4 drive circuit and exhausts past the 2-3 shift valve. 2-3 accumulator feed fluid fills the 2-3 accumulator as direct clutch feed fluid exhausts.

4d 2-3 Accumulator Valve: The accumulator valve regulates line pressure into the 2-3 accumulator fluid circuit to fill the 2-3 accumulator. This regulation is basically controlled by torque signal fluid pressure. Accumulator fluid pressure is regulated to a higher pressure with greater torque signal fluid pressure.

5 INTERMEDIATE / 4TH BAND APPLIES

5a 1-2 Shift Valve: 1-2 Shift solenoid is OFF, when the PCM commands Second gear, and spring force holds the 1-2 shift valve in the upshifted position. Intermediate band feed fluid is routed through the valve and into the intermediate band fluid circuit.

5b #3 Checkball (Intermediate Band Apply): Intermediate band fluid pressure seats the #3 checkball and is forced through the #8 orifice. This orifice helps control the intermediate band apply.

5c Intermediate/4th Servo: Intermediate band fluid pressure is routed to the inner area of the intermediate/4th servo piston. This fluid pressure moves the servo piston and apply pin to apply the intermediate/4th band. The band provides engine compression braking in Manual Second – Second Gear.

6 PRESSURE CONTROL

6a Pressure Switch Assembly: D21 fluid from the manual valve is routed to the PSA. The PSA signals the PCM that the manual valve is in the Manual Second position.

Pressure Control Solenoid: The PCM decreases the PCS duty cycle to increase the operating range of torque signal fluid pressure in Manual Second. This provides increased line pressure for the additional torque requirements during engine compression braking and increased engine load in Manual Second.

Torque Converter Clutch: The PCM will release the TCC before downshifting into Manual Second. The TCC will not re-apply in Second gear under normal operating conditions.

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MANUAL SECOND - SECOND GEAR

(From Manual Third - Third Gear)

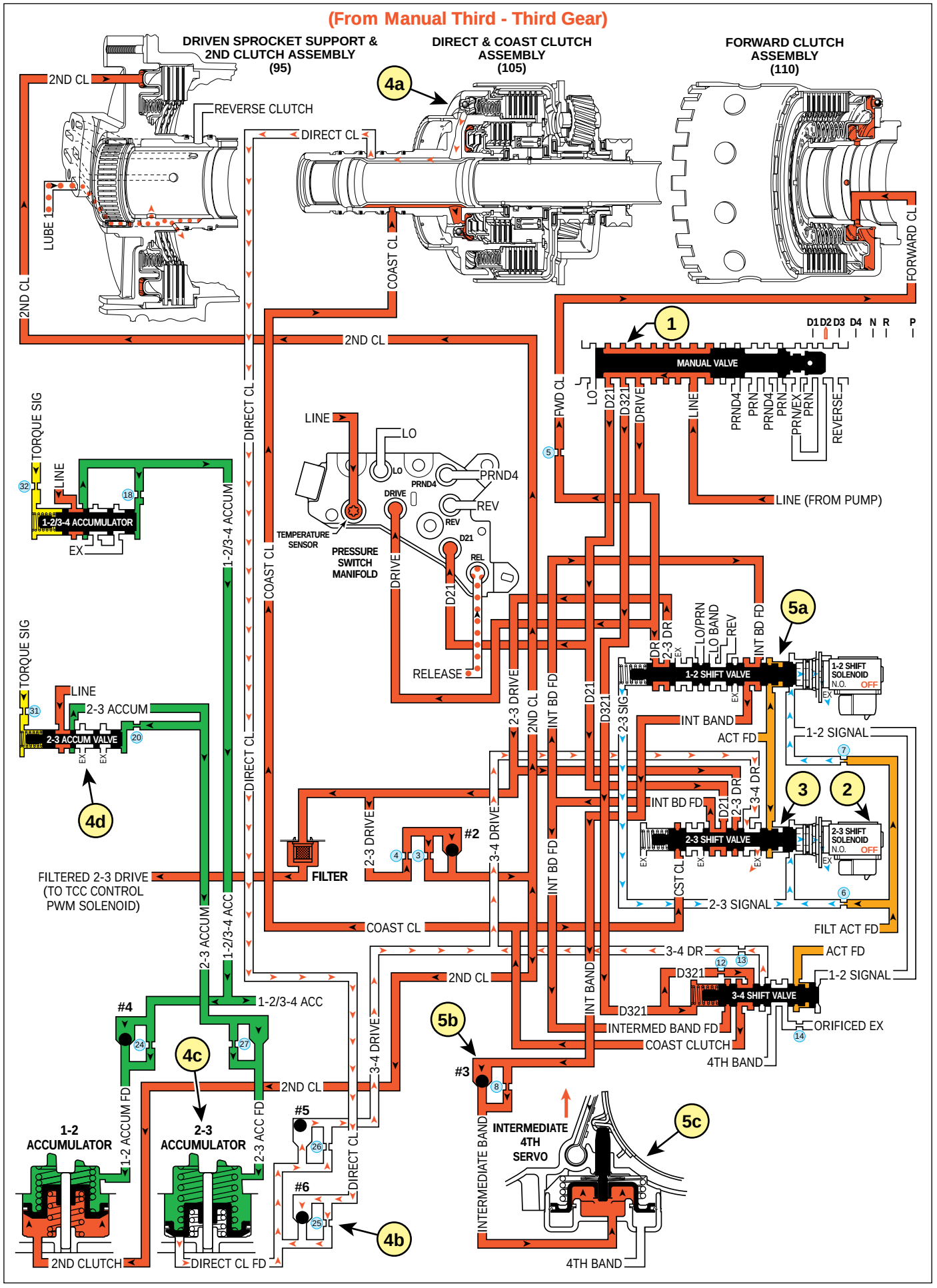

Figure 72

MANUAL FIRST - FIRST GEAR

(From Drive Range - Manual Second; Engine Compression Braking Shown)

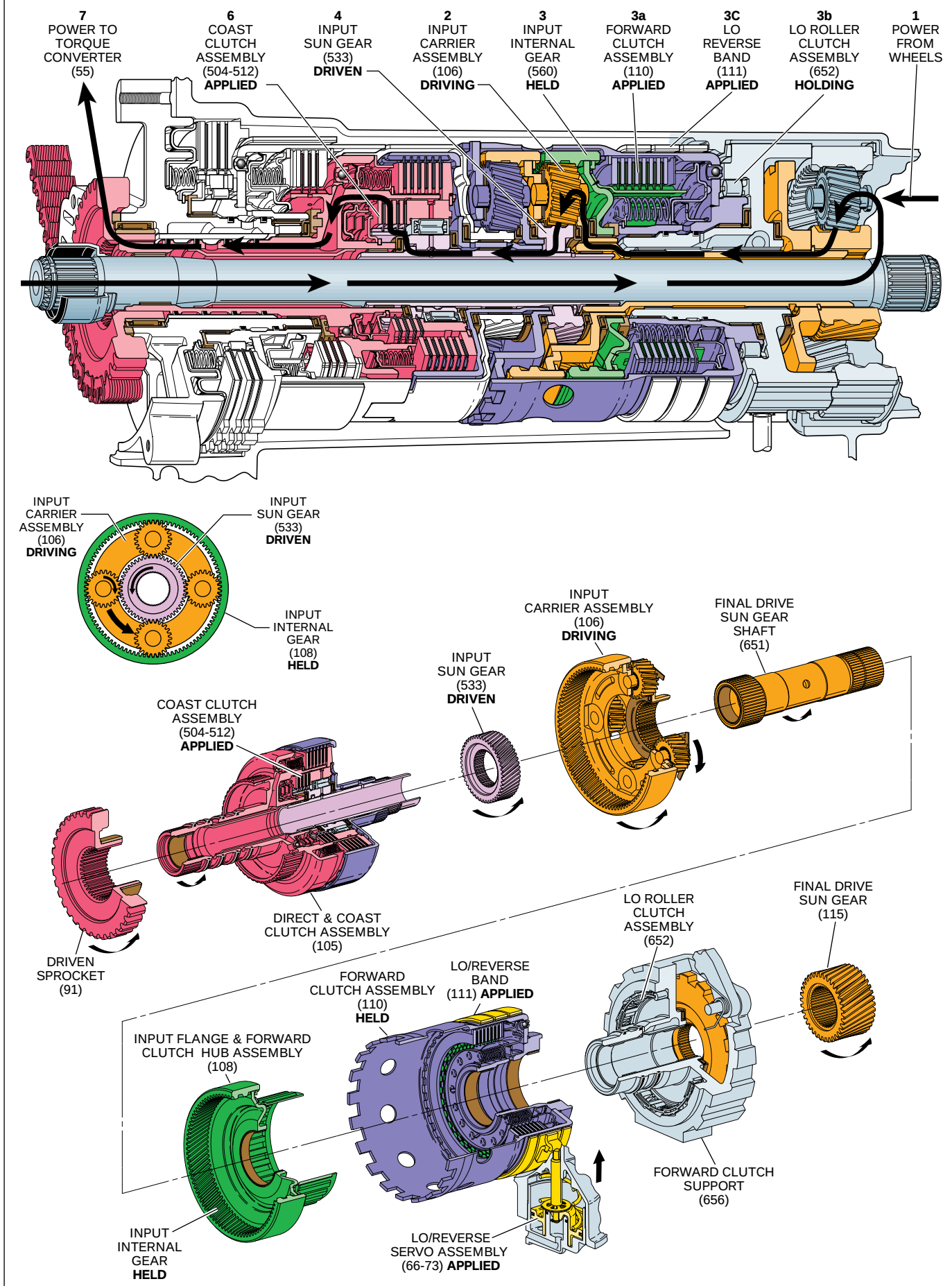

Figure 73

MANUAL FIRST - FIRST GEAR

(From Manual Second - Second Gear)

SHIFT "A" SOL	SHIFT "B" SOL	2ND CLUTCH	2ND ROLLER CLUTCH	INT/4TH BAND	REVERSE CLUTCH	COAST CLUTCH	INPUT SPRAG	DIRECT CLUTCH	FORWARD CLUTCH	LO/REV. BAND	LO ROLLER CLUTCH
ON	OFF					APPLIED	HOLDING		APPLIED	APPLIED	HOLDING

Manual First – First Gear (1) is available when vehicle operating conditions require maximum engine compression braking for slowing the vehicle or maximum engine torque transfer to the wheels in a forward gear range. Some of these vehicle operating conditions include descending a steep grade to provide maximum engine compression braking or, for ascending a steep grade for maximum engine power. Manual First range should also be used to start the vehicle in motion when pulling a heavy load.

While operating in manual first range the transaxle can upshift into second gear at 61 km/h (38 mph), and third gear at 113 km/h (70 mph) and each range has engine braking. If the transaxle is operating in any other forward gear range when manual first is selected, the transaxle will not shift into first gear until vehicle speed slows to approximately 56 km/h (35 mph). Power flow through the transaxle is the same as overdrive range first gear with the exception that the coast clutch and the lo/reverse band are applied. Therefore we will look at powerflow from deceleration (engine compression braking).

- The manual shaft and detent lever assembly (806) and manual valve (800) are moved into manual first - the "1" range position on the shift quadrant.

  If manual first range is selected for engine compression braking after the vehicle was operating in manual second gear, the 2nd clutch and intermediate/4th band release.

1 Power from the Wheels
During deceleration, input torque from the wheels is transferred from the wheels through the final drive assembly (116) to the final drive sun gear shaft (651).

2 Input Carrier Driving
Torque transfers from the final drive sun gear shaft to the input carrier and to the input carrier planetary pinion gears.

3 Input Internal Gear Held

3a Forward Clutch Applied
The forward clutch is applied and links the input internal gear with the forward clutch housing.

3b Lo Roller Clutch Holding
The lo roller clutch is holding and prevents the forward clutch housing from rotating during acceleration.

3c Lo/Reverse Band Applied
The lo/reverse band is applied and holds the forward clutch housing from rotating during deceleration.

4 Input Sun Gear Driven
The input sun gear is splined to the input sun gear shaft and inner race assembly (511). The coast clutch hub is part of this assembly.

6 Coast Clutch Assembly Applied
The coast clutch holds the inner race of the coast clutch sprag which would normally overrun in a coast situation. Now power can flow through the coast clutch and on to the input shaft assembly.

7 Power to Torque Converter
From the input shaft, power continues to the torque converter for engine compression braking.

When selecting manual first range to slow the vehicle, the speed of the vehicle provides input through the transaxle and attempts to overrun engine speed (rpm). However, engine compression braking slows the vehicle down when the lo/reverse band and the coast clutch are applied, thereby causing a 2.96:1 gear ratio through the gear sets.

MANUAL FIRST - FIRST GEAR

(From Manual Second - Second Gear)

A manual 2-1 downshift is initiated by moving the gear selector lever to the Manual First (1) position. However, the transaxle will not downshift into First gear until vehicle speed is below approximately 61 km/h (38 mph). At higher vehicle speeds the PCM will keep the 1-2 shift solenoid de-energized (OFF) and the transaxle will operate in Manual First - Second or Third Gear. In Manual First the transaxle is hydraulically prevented from upshifting into Fourth gear under any conditions. Also, the coast clutch remains applied, as in Manual Third and Manual Second, and provides engine compression braking in First, Second and Third gears.

1 MANUAL VALVE:
Line pressure is routed into the LO fluid circuit when the selector lever is moved into the Manual First (1) position. Line pressure continues to feed the Drive, D321 and D21 fluid circuits as in Manual Second.

2 PRESSURE SWITCH ASSEMBLY:
LO fluid pressure is routed to the PSA and the PSA signals the PCM that the manual valve is in the Manual First position.

3 #1 CHECKBALL (LO/PRN):
LO fluid pressure seats the #1 checkball against the PRN fluid circuit and fills the LO/PRN fluid circuit. LO/PRN fluid is routed to the 1-2 shift valve.

4 1-2 SHIFT SOLENOID:
The 1-2 Shift solenoid is energized by the PCM when vehicle speed is below approximately 61 km/h (38 mph). 1-2 Signal fluid is blocked from exhausting through the solenoid.

5 1-2 SHIFT VALVE:
1-2 Signal fluid pressure shifts the valve into the downshifted position, against spring force, and the following changes occur:
- The 2-3 drive fluid circuit is open to exhaust past the valve.
- Intermediate band fluid is exhausted past the valve.
- LO/PRN fluid is routed into the lo band fluid circuit.

6 SECOND CLUTCH RELEASES

6a Second Clutch:
2nd clutch fluid exhausts from behind the clutch piston through the 2-3 drive fluid circuit. This releases the 2nd clutch and the transaxle operates in First gear.

6b 1-2 Accumulator:
2nd clutch fluid exhausts from the 1-2 accumulator, exhausts past the #2 checkball and through the 2-3 drive fluid circuit. 1-2 accumulator feed fluid fills the 1-2 accumulator as 2nd clutch fluid exhausts.

6c 1-2/3-4 Accumulator Valve:
The accumulator valve regulates line pressure into the 1-2/3-4 accumulator fluid circuit to fill the 1-2 accumulator. This regulation is basically controlled by torque signal fluid pressure. Accumulator fluid pressure is regulated to a higher pressure with greater torque signal fluid pressure.

TCC Control Solenoid:
Filtered 2-3 drive fluid exhausts from the solenoid through the 2-3 drive fluid circuit.

7 INTERMEDIATE/4TH BAND RELEASES

7a Intermediate/4th Servo:
Intermediate Band fluid exhausts from the servo piston, spring force moves the piston and apply pin and the intermediate/4th band releases. However, the intermediate/4th band remains applied in Manual First - Second Gear to achieve engine compression braking.

8 LO/REVERSE BAND APPLIES

8a Lo/Reverse Servo:
Lo band fluid pressure is routed to the inner area of the lo/reverse servo to apply the lo/reverse band. The lo/reverse band provides engine compression braking when the throttle is released in Manual First - First Gear.

Note: *Manual First - Third Gear is also possible at high speeds as a safety feature.*

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MANUAL FIRST - FIRST GEAR

(From Manual Second - Second Gear)

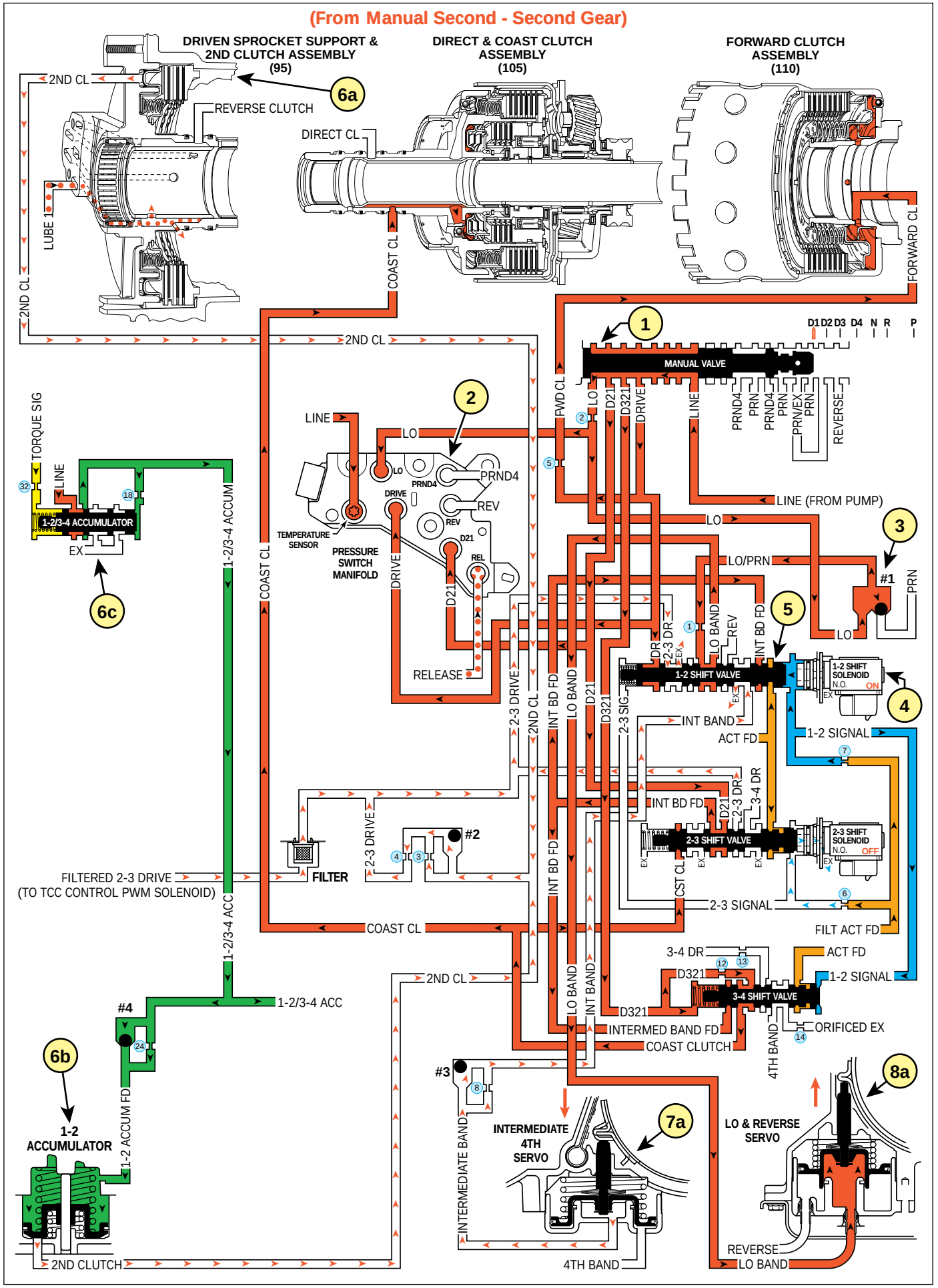


Figure 74

OPERATING CONDITIONS

RANGE REFERENCE CHART

				1	2	3	4	5	6	7	8	9	10
RANGE	**GEAR**	**SHIFT "A" SOL**	**SHIFT "B" SOL**	**2ND CLUTCH**	**2ND ROLLER CLUTCH**	**INT/4TH BAND**	**REVERSE CLUTCH**	**COAST CLUTCH**	**INPUT SPRAG**	**DIRECT CLUTCH**	**FORWARD CLUTCH**	**LO/REV. BAND**	**LO ROLLER CLUTCH**
PARK	N	ON	OFF						HOLDING*			APPLIED	
REV	R	ON	OFF				APPLIED					APPLIED	
NEU	N	ON	OFF						HOLDING*			APPLIED	
(D)	1st	ON	OFF						HOLDING		APPLIED		HOLDING
	2nd	OFF	OFF	APPLIED	HOLDING				HOLDING		APPLIED		OVER-RUNNING
	3rd	OFF	ON	APPLIED*	OVER-RUNNING				HOLDING	APPLIED	APPLIED		OVER-RUNNING
	4th	ON	ON	APPLIED*		APPLIED			OVER-RUNNING	APPLIED	APPLIED*		OVER-RUNNING
3	1st	ON	OFF					APPLIED	HOLDING		APPLIED		HOLDING
	2nd	OFF	OFF	APPLIED	HOLDING			APPLIED	HOLDING		APPLIED		OVER-RUNNING
	3rd	OFF	ON	APPLIED*	OVER-RUNNING			APPLIED	HOLDING	APPLIED	APPLIED		OVER-RUNNING
2	1st	ON	OFF					APPLIED	HOLDING		APPLIED		HOLDING
	2nd	OFF	OFF	APPLIED	HOLDING	APPLIED		APPLIED	HOLDING		APPLIED		OVER-RUNNING
	3rd**	OFF	ON	APPLIED*	OVER-RUNNING			APPLIED	HOLDING	APPLIED	APPLIED		OVER-RUNNING
1	1st	ON	OFF					APPLIED	HOLDING		APPLIED	APPLIED	HOLDING
	2nd***	OFF	OFF	APPLIED	HOLDING	APPLIED		APPLIED	HOLDING		APPLIED		OVER-RUNNING
	3rd**	OFF	ON	APPLIED*	OVER-RUNNING			APPLIED	HOLDING	APPLIED	APPLIED		OVER-RUNNING

ON = SOLENOID ENERGIZED
OFF = SOLENOID DE-ENERGIZED
* = APPLIED WITH NO LOAD.
** = MANUAL FIRST AND SECOND – THIRD GEAR IS ONLY AVAILABLE ABOVE APPROXIMATELY 100 km/h (62 mph).
*** = MANUAL FIRST – SECOND GEAR IS ONLY AVAILABLE ABOVE APPROXIMATELY 60 km/h (37 mph).
NOTE: MANUAL FIRST – THIRD GEAR IS ALSO POSSIBLE AT HIGH VEHICLE SPEED AS A SAFETY FEATURE.

EXPECTED OPERATING CONDITION IF COMPONENT IN COLUMN NUMBER IS INOPERATIVE:

COLUMN #	CONDITION
1	NO 2ND GEAR IN (D) OR 3 RANGE.
2	NO 2ND GEAR IN (D) OR 3 RANGE.
4	NO REVERSE GEAR – ALL DRIVE RANGES OK.
7	NO 3RD OR 4TH GEAR.
3	NO 4TH GEAR OR MANUAL 2ND ENGINE BRAKING.
6	NO 1ST, 2ND OR 3RD GEAR. MAY SLIP IN MANUAL RANGES UNDER MODERATE TO HEAVY ACCELERATION.
8	NO DRIVE IN ANY FORWARD RANGES - 1ST, 2ND OR 3RD GEAR. MAY SLIP IN 1 RANGE - 1ST GEAR UNDER UNDER MODERATE TO HEAVY ACCELERATION.
5	NO ENGINE BRAKING IN MANUAL 1ST, MANUAL 2ND, MANUAL 3RD.
9	NO REVERSE – NO ENGINE BRAKING IN MANUAL 1ST.
10	NO DRIVE IN (D), 3 OR 2.

Figure 75

COMPLETE HYDRAULIC CIRCUITS

The hydraulic circuitry of the Hydra-matic 4T40-E transaxle is better understood when fluid flow can be related to the specific components in which the fluid travels. In the Power Flow section, a simplified hydraulic schematic was given to show what hydraulically occurs in a specific gear range. The purpose was to isolate the hydraulics used in each gear range in order to provide the user with a basic understanding of the hydraulic system.

In contrast, this section shows a complete hydraulic schematic with fluid passages active in the appropriate component for each gear range. This is accomplished using two opposing foldout pages that are separated by a half page of supporting information.

The left side foldout contains the complete color coded hydraulic circuit used in that gear range along with the relative location of valves, checkballs and orifices within specific components. A broken line is also used to separate components such as the pump, valve body, channel plate and case to assist the user when following the hydraulic circuits as they pass between them. The half page of information facing this foldout identifies the components involved in this gear range and a description of how they function.

The right side foldout shows a two-dimensional line drawing of the fluid passages within each component. The active fluid passages for each gear range are appropriately colored to correspond with the hydraulic schematic used for that range. The half page of information facing this foldout identifies the various fluid circuits with numbers that correspond to the circuit numbers used on the foldout page.

For a more complete understanding of the different hydraulic systems used in a specific gear range, refer to the Hydraulic Control Components section and/or Power Flow section.

PASSAGE A IS LOCATED IN THE OIL PUMP BODY (GREY AREA)
PASSAGE B IS LOCATED IN THE CONTROL VALVE BODY (LIGHT BLUE AREA)
PASSAGE C IS LOCATED ON THE SPACER PLATE (DASHED LINE)
PASSAGE D IS LOCATED IN THE CHANNEL PLATE (LIGHT RED AREA)
PASSAGE E IS LOCATED IN THE DRIVEN SPROCKET SUPPORT (LIGHT YELLOW AREA)
PASSAGE F IS LOCATED IN THE CASE (WHITE AREA)

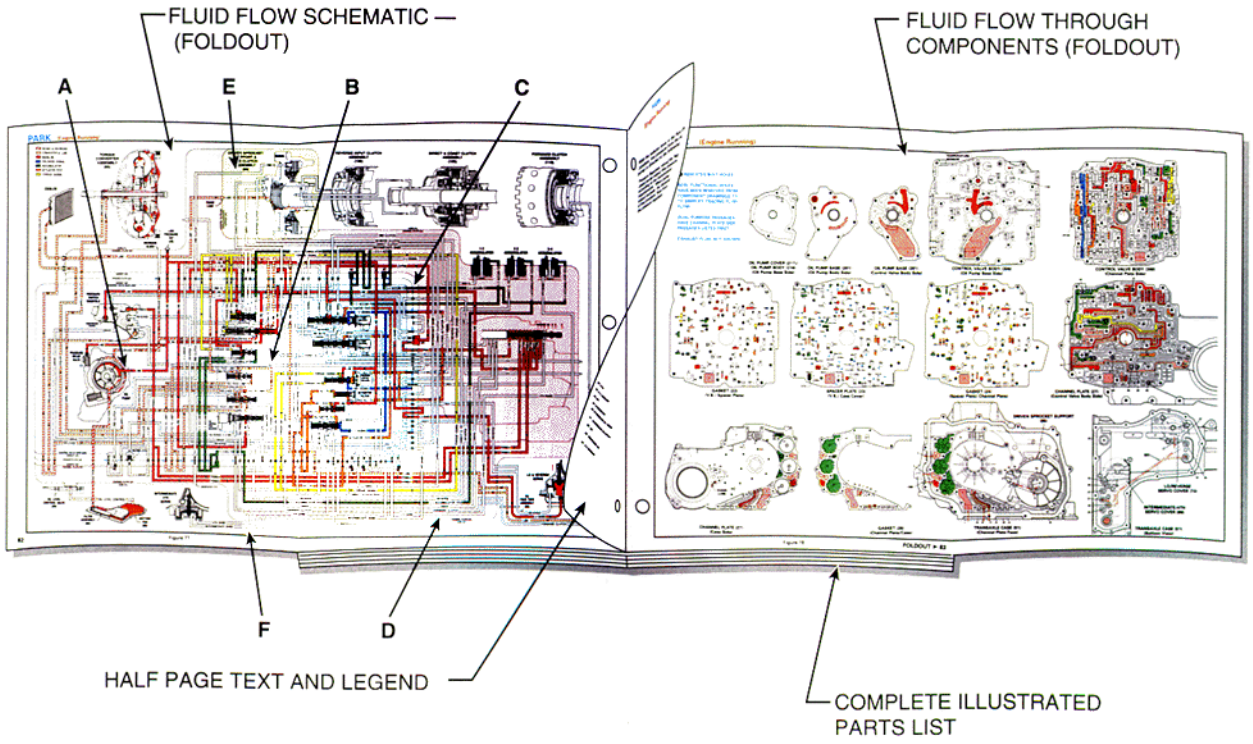


Figure 76

PARK (Engine Running)

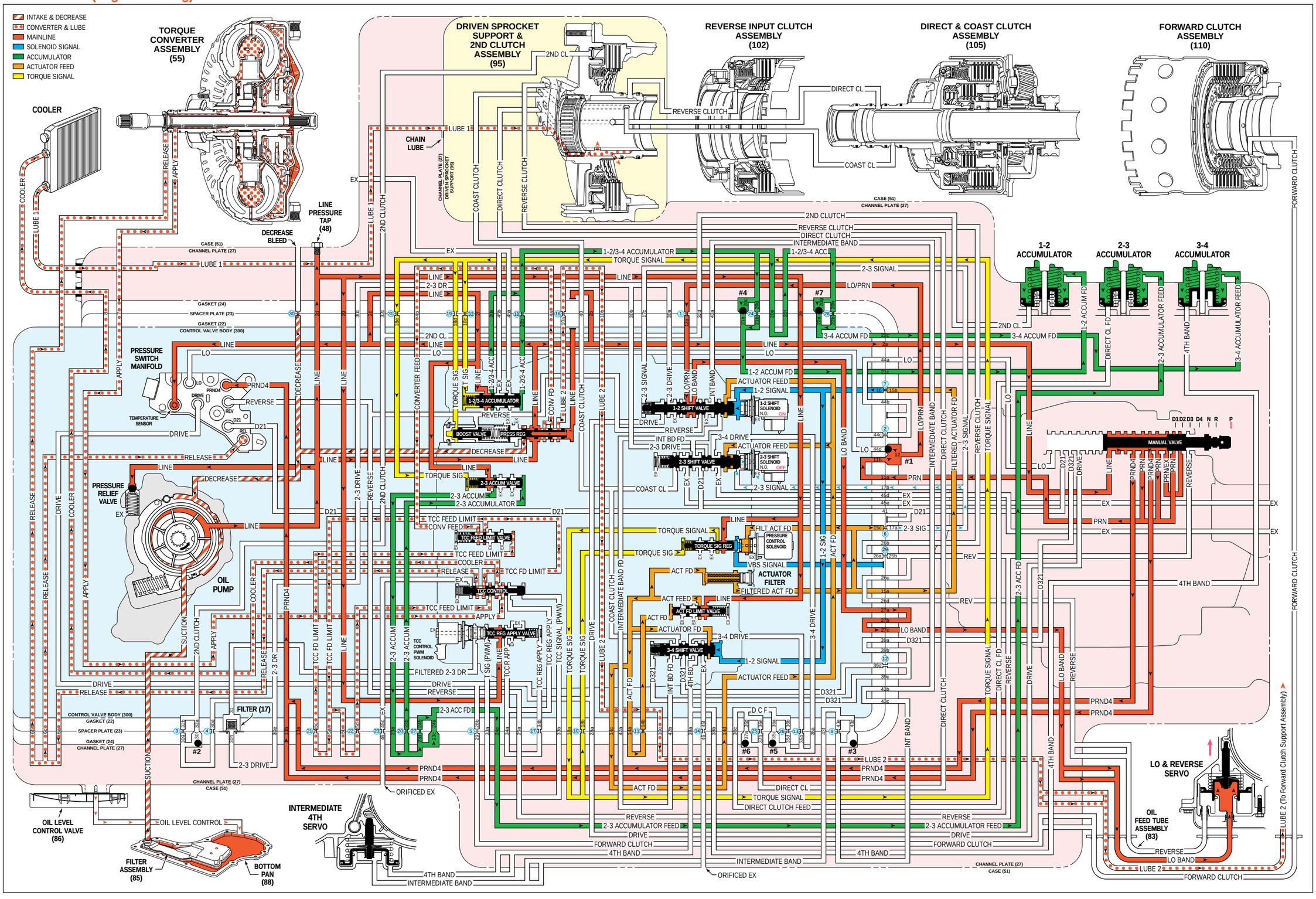


Figure 77

PARK
(Engine Running)

The following conditions and component problems could happen in any gear range, and are only some of the possibilities recommended to diagnose hydraulic problems. Always refer to the appropriate vehicle platform service manual when diagnosing specific concerns.

HIGH OR LOW LINE PRESSURE

- **Pressure Regulator Valve (328), Springs (326, 327) and Boost Valve (325)**
  - – Stuck.
- **Pressure Control Solenoid (312)**
  - – Leak, o-rings damaged.
  - – Loose connector, pins damaged.
  - – Contaminated.
- **Torque Signal Regulator Valve (309)**
  - – Stuck.
- **Pressure Switch Assembly (13)**
  - – Loose connector.
  - – Damaged or missing o-ring.
- **Oil Filter (85)**
  - – Clogged, broken, loose.
- **Oil Filter Seal (84)**
  - – Leaking.
- **Cooler Lines**
  - – Clogged or restricted.
- **Cooler Line Seals (49)**
  - – Leaking.
- **Oil Pump (10)**
  - – Damaged, sticking, porosity, leaking.
- **Oil Pump Drive Shaft (19)**
  - – Damaged.
- **Pressure Relief Valve (214)**
  - – Damaged spring, ball missing.
- **Transaxle Case (51), Valve Body (18), Channel Plate (27)**
  - – Porosity, leaking circuits.
  - – Flatness of machined surfaces.

SHIFT "A" SOL	SHIFT "B" SOL	2ND CLUTCH	2ND ROLLER CLUTCH	INT/4TH BAND	REVERSE CLUTCH	COAST CLUTCH	INPUT SPRAG	DIRECT CLUTCH	FORWARD CLUTCH	LO/REV. BAND	LO ROLLER CLUTCH
ON	OFF						HOLDING *			APPLIED	

* APPLIED BUT NOT EFFECTIVE

PARK
(Engine Running)

PASSAGES

1 SUCTION
2 LINE
3 DECREASE
4 CONVERTER FEED
5 TCC FEED LIMIT
6 RELEASE
7 APPLY
8 COOLER
9 LUBE 1
10 LUBE 2
11 PRN
12 LO/PRN
13 PRND4
14 ACTUATOR FEED
15 FILTERED ACTUATOR FEED
16 1-2 SIGNAL
17 2-3 SIGNAL
18 TORQUE SIGNAL
19 VBS SIGNAL
20 1-2/3-4 ACCUMULATOR
21 1-2 ACCUMULATOR FEED
22 3-4 ACCUMULATOR FEED
23 2-3 ACCUMULATOR
24 2-3 ACCUMULATOR FEED
25 REVERSE
26 REVERSE CLUTCH
27 LO BAND
28 DRIVE
29 FORWARD CLUTCH
30 2-3 DRIVE
31 FILTERED 2-3 DRIVE
32 2ND CLUTCH
33 TCC SIGNAL (PWM)
34 TCC REGULATED APPLY
35 3-4 DRIVE
36 DIRECT CLUTCH FEED
37 DIRECT CLUTCH
38 4TH BAND
39 D321
40 COAST CLUTCH
41 D21
42 INTERMEDIATE BAND FEED
43 INTERMEDIATE BAND
44 LO
45 EXHAUST
46 ORIFICED EXHAUST
47 VOID
48 OIL LEVEL CONTROL

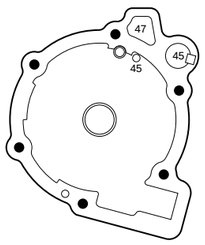
COMPONENTS ( )

(13) TRANSAXLE FLUID PRESSURE SWITCH ASSEMBLY (PSA)
(17) FILTER
(26) CHECKBALLS #1, 2, 3, 4, 5, 6 & 7
(48) PLUG, LINE PRESSURE TAP
(83) TUBE ASSEMBLY, OIL FEED
(314) FILTER, ACTUATOR OIL

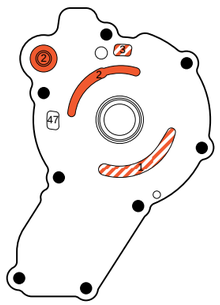
PARK (Engine Running)

NOTE:

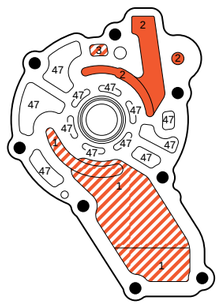
- ● INDICATES BOLT HOLES
- NON- FUNCTIONAL HOLES HAVE BEEN REMOVED FROM COMPONENT DRAWINGS TO TO SIMPLIFY TRACING FLUID FLOW.
- DUAL PURPOSE PASSAGES HAVE CHANNEL PLATE SIDE PASSAGES LISTED FIRST
- EXHAUST FLUID NOT SHOWN



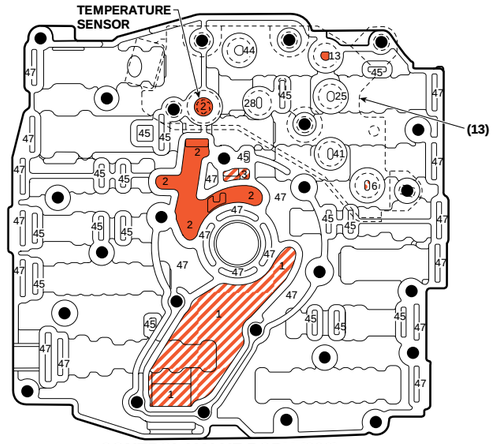
OIL PUMP COVER (217)/
OIL PUMP BODY (216)
(Oil Pump Base Side)



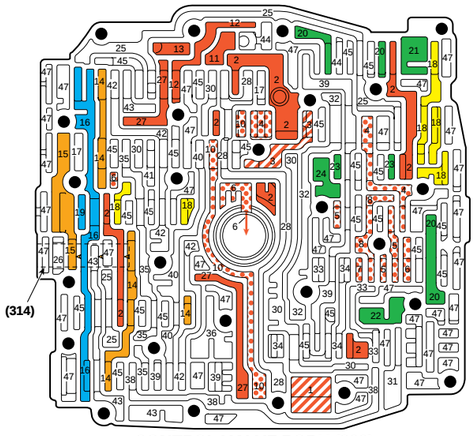
OIL PUMP BASE (201)
(Oil Pump Body Side)



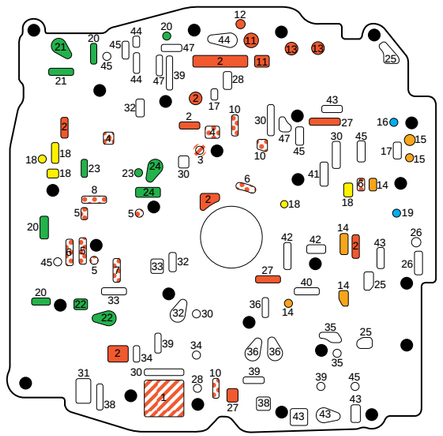
OIL PUMP BASE (201)
(Control Valve Body Side)



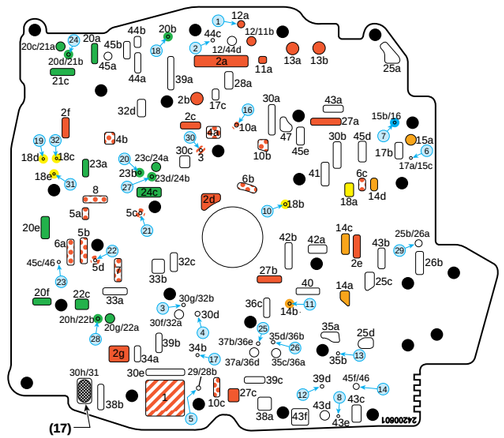
CONTROL VALVE BODY (300)
(Oil Pump Base Side)



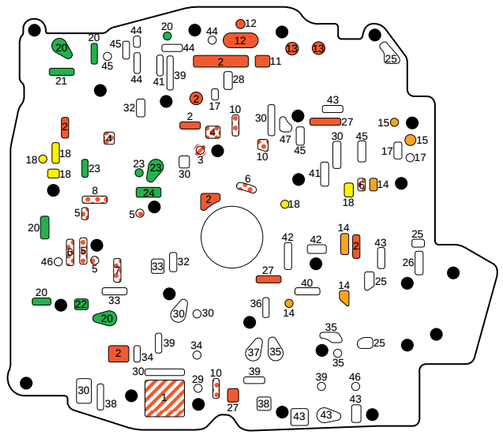
CONTROL VALVE BODY (300)
(Channel Plate Side)



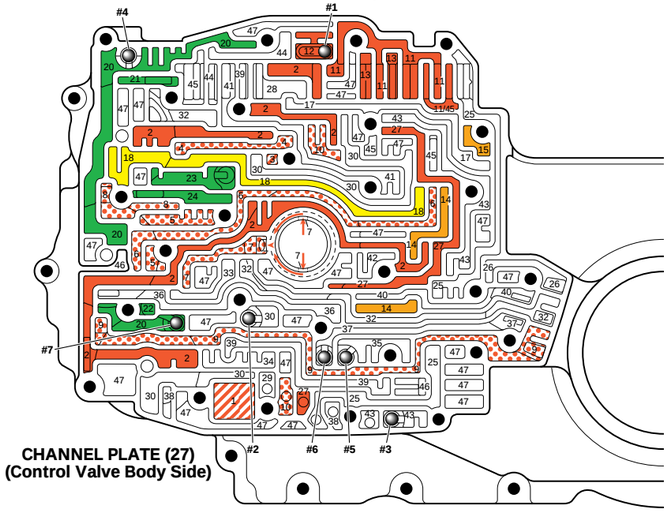
GASKET (22)
(V.B./ Spacer Plate)



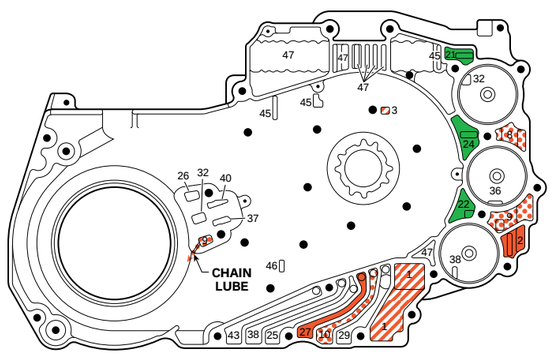
SPACER PLATE (23)
(V.B./ Case Cover)



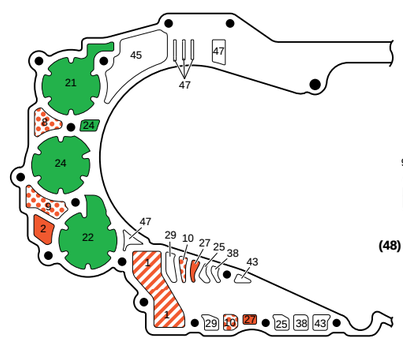
GASKET (24)
(Spacer Plate/ Channel Plate)



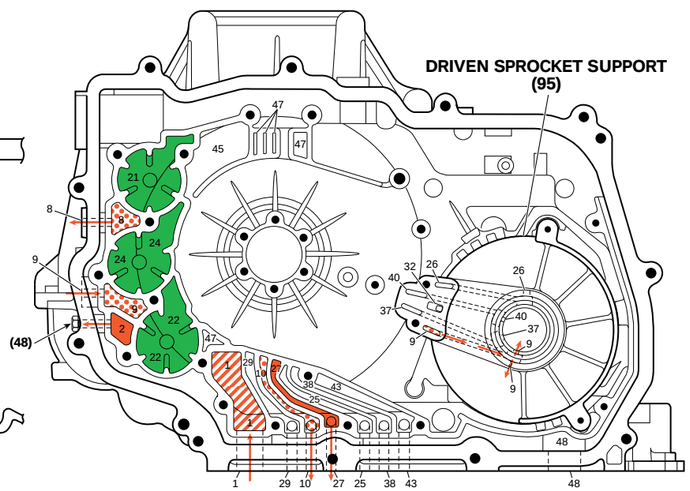
CHANNEL PLATE (27)
(Control Valve Body Side)



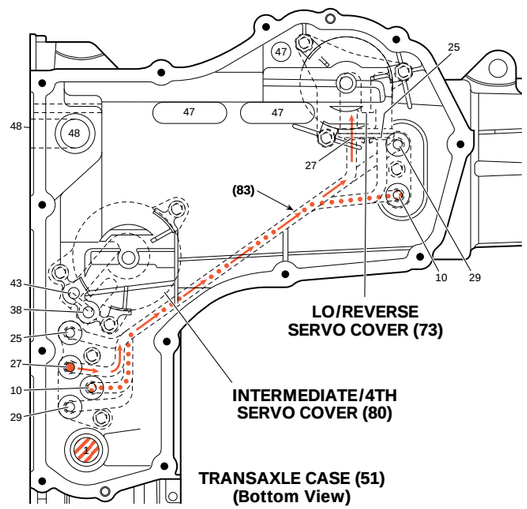
CHANNEL PLATE (27)
(Case Side)



GASKET (28)
(Channel Plate/Case)



TRANSAXLE CASE (51)
(Channel Plate Face)



TRANSAXLE CASE (51)
(Bottom View)

Figure 78

FOLDOUT ➤ 83

REVERSE

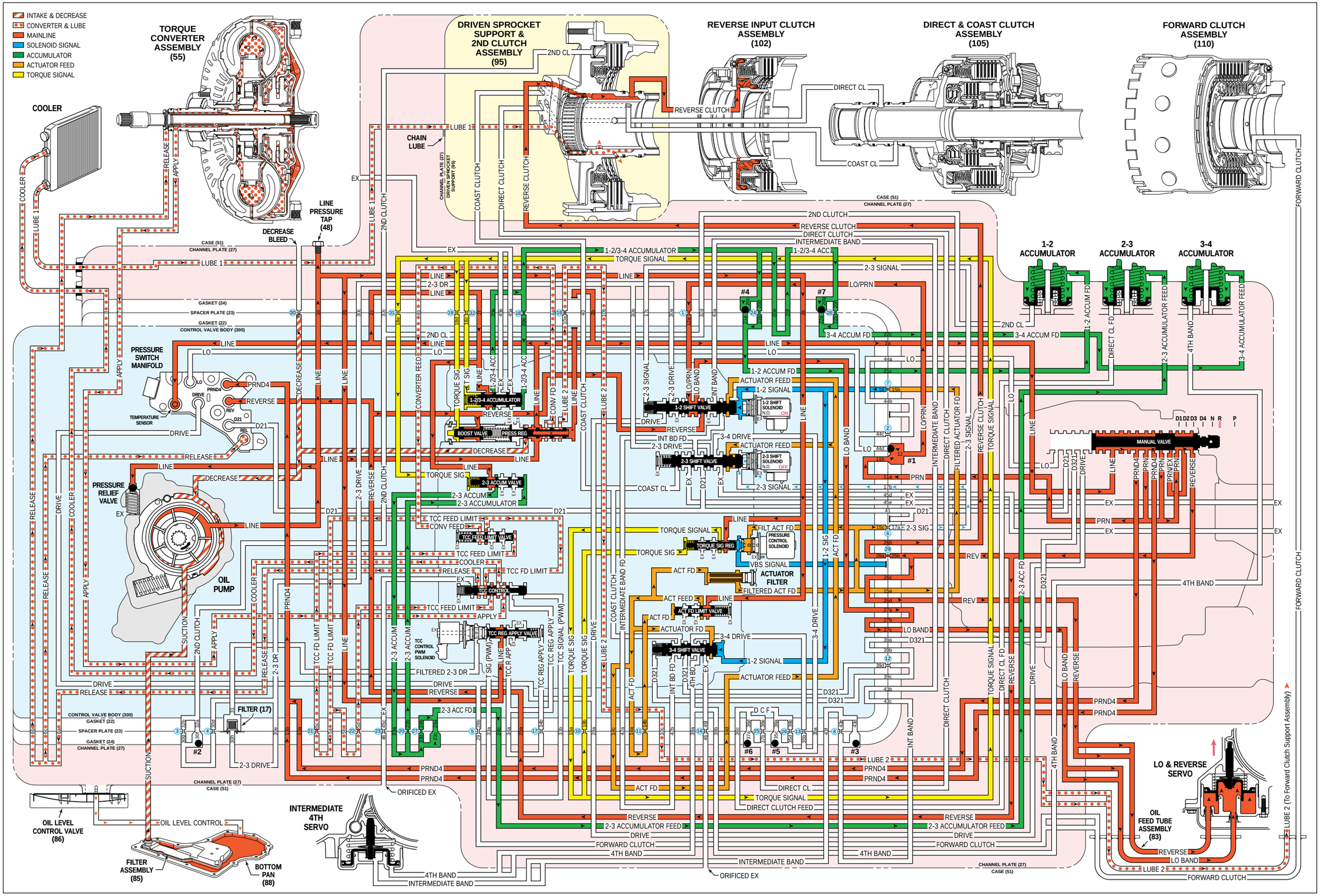


Figure 79

REVERSE

NO REVERSE OR SLIPS IN REVERSE

- **Reverse Clutch**
  - Piston and Seal Assembly (457) – Binding, cracked, leaking.
  - Inner Seal (456) – Leaking, orifice plugged.
  - Clutch Plates (460-463) – Friction material worn, splines broken.
  - Snap Rings (459, 464) – Out of position.
  - Housing (454) – Cracked, feed holes plugged, tangs broken.
  - Housing Retainer and Ball Assembly – Missing, out of position, plugged.
  - Springs (458) – Binding, broken.

- **Reverse Clutch Fluid Routing**
  - Fluid leak / restriction.
  - Driven Sprocket Support (95) – Seal rings leaking, porosity, damaged, misaligned.
  - Channel Plate & Gasket, and Valve Body, Gaskets and Spacer Plate – Porosity, fluid leak across channels, misaligned, damaged, fluid restriction.

- **Lo & Reverse Band and Servo**
  - Servo Piston (69) – Broken, binding.
  - Servo Piston Seals (71, 72) – Leaking.
  - Servo Pin (67) and Springs (66, 68) – Binding, broken.
  - Servo Cover (73) – Broken, loose, leaking.
  - Lo & Reverse Band (111) – Broken, worn, out of position.
  - Anchor Pin (64) – Broken.
  - Fluid Feed Tubes (83) – Broken, bent, plugged, seal rings missing / leaking.
  - Transaxle Case (51) – Porosity, fluid leak or restriction.

- **Shift Linkage**
  - Disconnected, misaligned.

- **Manual Valve (800) and Link (802)**
  - Disconnected, misaligned.

- **#1 Checkball (LO/PRN)**
  - Missing (No Lo Band Fluid).

- **Fluid Level**
  - Low.

- **Fluid Pressure**
  - Low (See PARK page 82A).

SHIFT "A" SOL	SHIFT "B" SOL	2ND CLUTCH	2ND ROLLER CLUTCH	INT/4TH BAND	REVERSE CLUTCH	COAST CLUTCH	INPUT SPRAG	DIRECT CLUTCH	FORWARD CLUTCH	LO/REV. BAND	LO ROLLER CLUTCH
ON	OFF				APPLIED					APPLIED	

REVERSE

PASSAGES

1 SUCTION
2 LINE
3 DECREASE
4 CONVERTER FEED
5 TCC FEED LIMIT
6 RELEASE
7 APPLY
8 COOLER
9 LUBE 1
10 LUBE 2
11 PRN
12 LO/PRN
13 PRND4
14 ACTUATOR FEED
15 FILTERED ACTUATOR FEED
16 1-2 SIGNAL
17 2-3 SIGNAL
18 TORQUE SIGNAL
19 VBS SIGNAL
20 1-2/3-4 ACCUMULATOR
21 1-2 ACCUMULATOR FEED
22 3-4 ACCUMULATOR FEED
23 2-3 ACCUMULATOR
24 2-3 ACCUMULATOR FEED
25 REVERSE
26 REVERSE CLUTCH
27 LO BAND
28 DRIVE
29 FORWARD CLUTCH
30 2-3 DRIVE
31 FILTERED 2-3 DRIVE
32 2ND CLUTCH
33 TCC SIGNAL (PWM)
34 TCC REGULATED APPLY
35 3-4 DRIVE
36 DIRECT CLUTCH FEED
37 DIRECT CLUTCH
38 4TH BAND
39 D321
40 COAST CLUTCH
41 D21
42 INTERMEDIATE BAND FEED
43 INTERMEDIATE BAND
44 LO
45 EXHAUST
46 ORIFICED EXHAUST
47 VOID
48 OIL LEVEL CONTROL

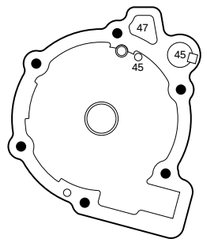
COMPONENTS ( )

(13) TRANSAXLE FLUID PRESSURE SWITCH ASSEMBLY (PSA)
(17) FILTER
(26) CHECKBALLS #1, 2, 3, 4, 5, 6 & 7
(48) PLUG, LINE PRESSURE TAP
(83) TUBE ASSEMBLY, OIL FEED
(314) FILTER, ACTUATOR OIL

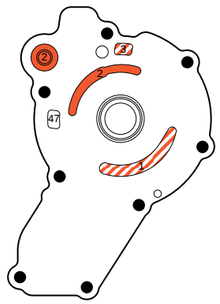
REVERSE

NOTE:

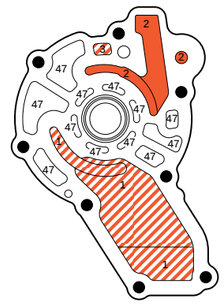
- ● INDICATES BOLT HOLES
- NON- FUNCTIONAL HOLES HAVE BEEN REMOVED FROM COMPONENT DRAWINGS TO TO SIMPLIFY TRACING FLUID FLOW.
- DUAL PURPOSE PASSAGES HAVE CHANNEL PLATE SIDE PASSAGES LISTED FIRST
- EXHAUST FLUID NOT SHOWN



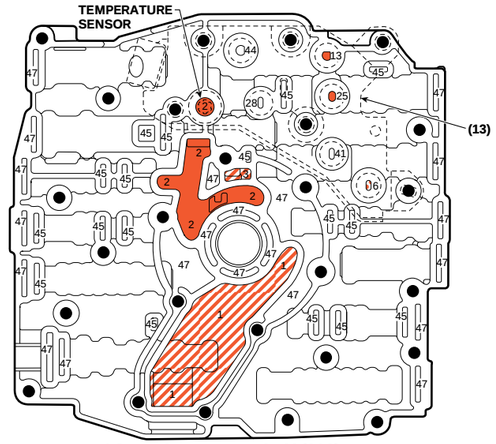
OIL PUMP COVER (217)/
OIL PUMP BODY (216)
(Oil Pump Base Side)



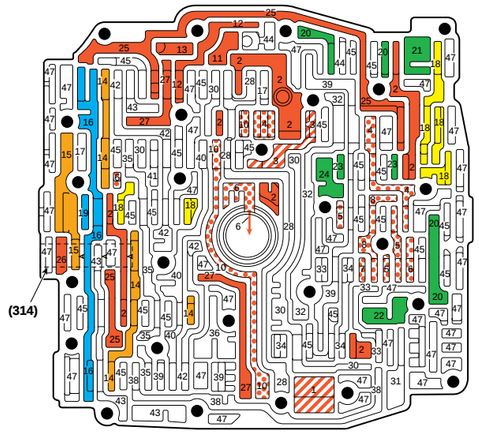
OIL PUMP BASE (201)
(Oil Pump Body Side)



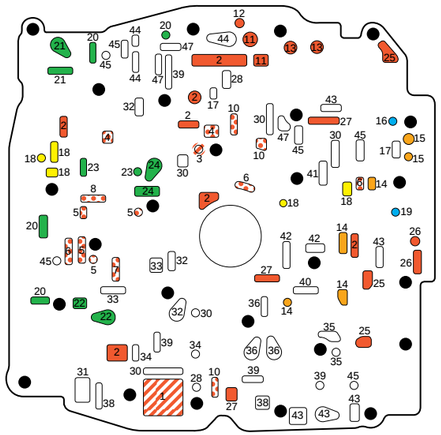
OIL PUMP BASE (201)
(Control Valve Body Side)



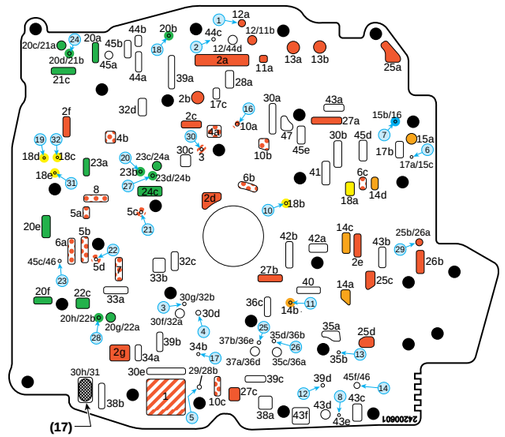
CONTROL VALVE BODY (300)
(Oil Pump Base Side)



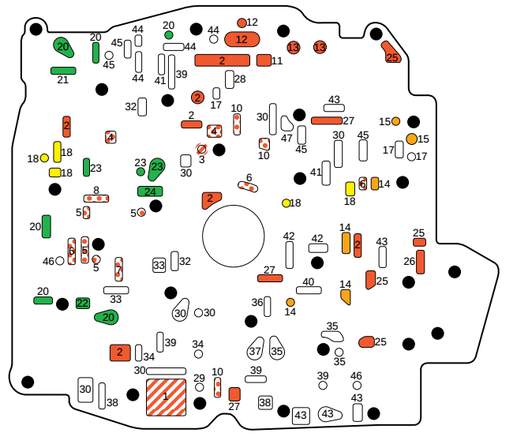
CONTROL VALVE BODY (300)
(Channel Plate Side)



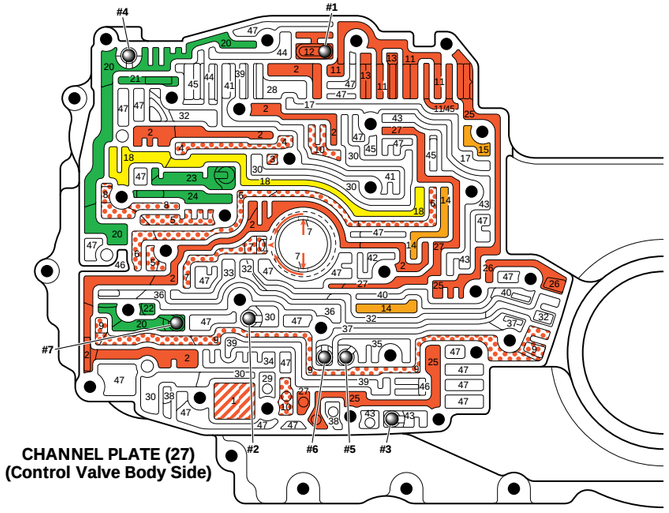
GASKET (22)
(V.B./ Spacer Plate)



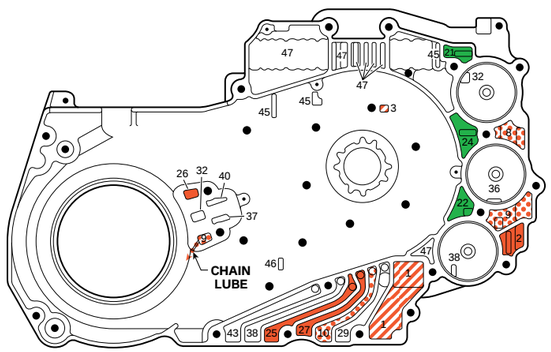
SPACER PLATE (23)
(V.B./ Case Cover)



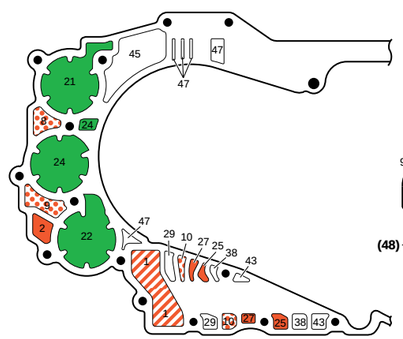
GASKET (24)
(Spacer Plate/ Channel Plate)



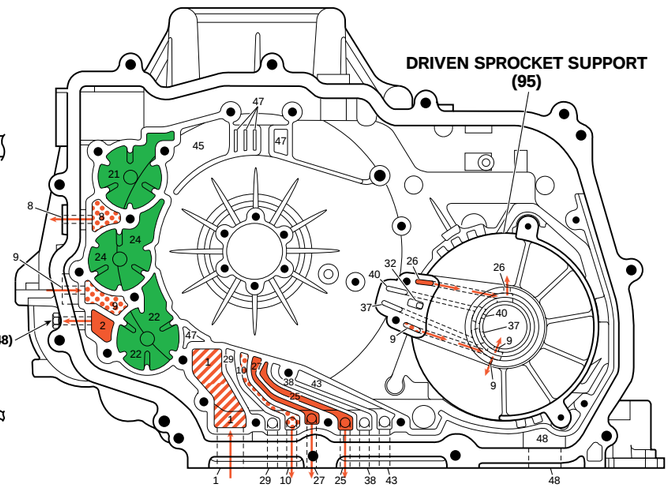
CHANNEL PLATE (27)
(Control Valve Body Side)



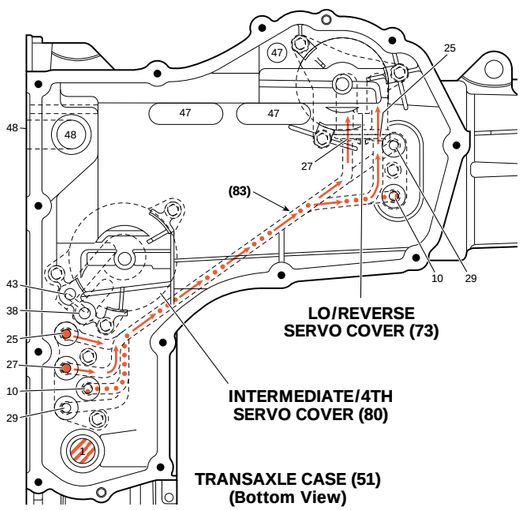
CHANNEL PLATE (27)
(Case Side)



GASKET (28)
(Channel Plate/Case)



TRANSAXLE CASE (51)
(Channel Plate Face)



TRANSAXLE CASE (51)
(Bottom View)

Figure 80

FOLDOUT ➤ 85

NEUTRAL (Engine Running)

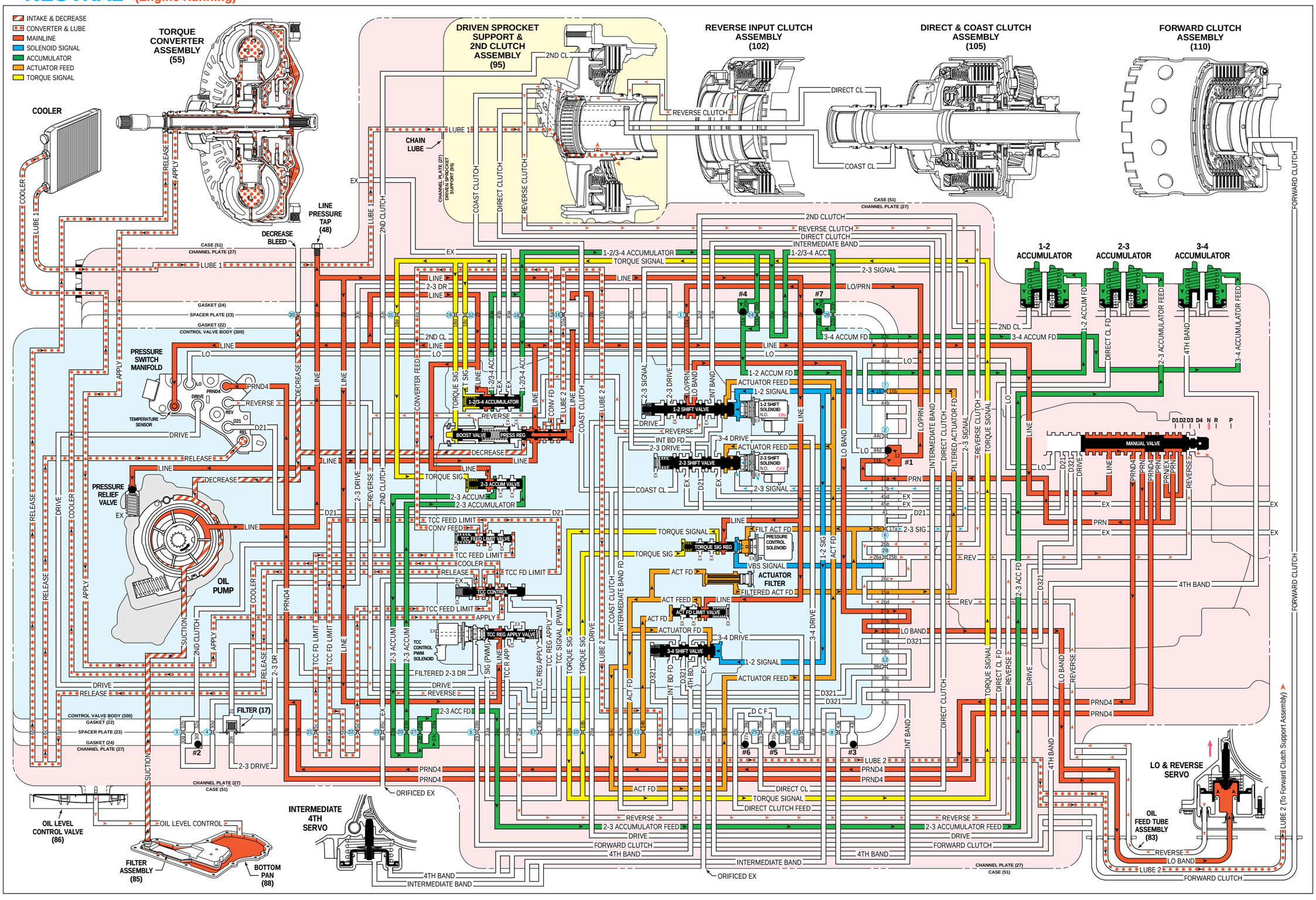


Figure 81

NEUTRAL
(Engine Running)

DRIVES IN NEUTRAL

- **Forward Clutch**
  - Not releasing.
- **Reverse Clutch and Lo & Reverse Servo**
  - Both not releasing.
- **Manual Valve (800) / Shift Linkage**
  - Misaligned.

SHIFT "A" SOL	SHIFT "B" SOL	2ND CLUTCH	2ND ROLLER CLUTCH	INT/4TH BAND	REVERSE CLUTCH	COAST CLUTCH	INPUT SPRAG	DIRECT CLUTCH	FORWARD CLUTCH	LO/REV. BAND	LO ROLLER CLUTCH
ON	OFF						HOLDING *			APPLIED	

* APPLIED BUT NOT EFFECTIVE

NEUTRAL
(Engine Running)

PASSAGES

1 SUCTION
2 LINE
3 DECREASE
4 CONVERTER FEED
5 TCC FEED LIMIT
6 RELEASE
7 APPLY
8 COOLER
9 LUBE 1
10 LUBE 2
11 PRN
12 LO/PRN
13 PRND4
14 ACTUATOR FEED
15 FILTERED ACTUATOR FEED
16 1-2 SIGNAL
17 2-3 SIGNAL
18 TORQUE SIGNAL
19 VBS SIGNAL
20 1-2/3-4 ACCUMULATOR
21 1-2 ACCUMULATOR FEED
22 3-4 ACCUMULATOR FEED
23 2-3 ACCUMULATOR
24 2-3 ACCUMULATOR FEED
25 REVERSE
26 REVERSE CLUTCH
27 LO BAND
28 DRIVE
29 FORWARD CLUTCH
30 2-3 DRIVE
31 FILTERED 2-3 DRIVE
32 2ND CLUTCH
33 TCC SIGNAL (PWM)
34 TCC REGULATED APPLY
35 3-4 DRIVE
36 DIRECT CLUTCH FEED
37 DIRECT CLUTCH
38 4TH BAND
39 D321
40 COAST CLUTCH
41 D21
42 INTERMEDIATE BAND FEED
43 INTERMEDIATE BAND
44 LO
45 EXHAUST
46 ORIFICED EXHAUST
47 VOID
48 OIL LEVEL CONTROL

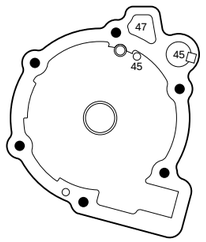
COMPONENTS ( )

(13) TRANSAXLE FLUID PRESSURE SWITCH ASSEMBLY (PSA)
(17) FILTER
(26) CHECKBALLS #1, 2, 3, 4, 5, 6 & 7
(48) PLUG, LINE PRESSURE TAP
(83) TUBE ASSEMBLY, OIL FEED
(314) FILTER, ACTUATOR OIL

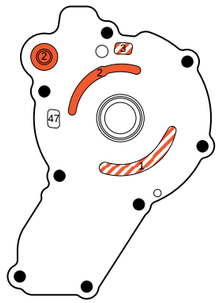
NEUTRAL (Engine Running)

NOTE:

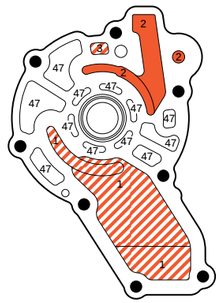
- ● INDICATES BOLT HOLES
- NON- FUNCTIONAL HOLES HAVE BEEN REMOVED FROM COMPONENT DRAWINGS TO TO SIMPLIFY TRACING FLUID FLOW.
- DUAL PURPOSE PASSAGES HAVE CHANNEL PLATE SIDE PASSAGES LISTED FIRST
- EXHAUST FLUID NOT SHOWN



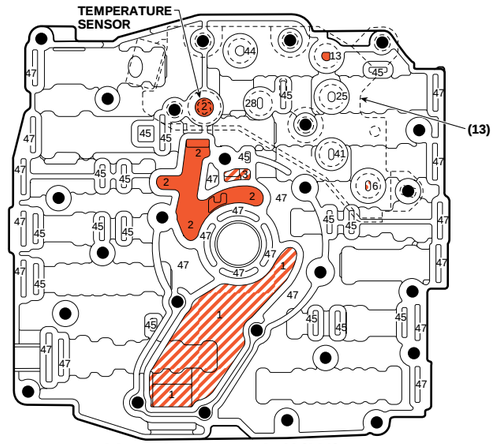
OIL PUMP COVER (217)/
OIL PUMP BODY (216)
(Oil Pump Base Side)



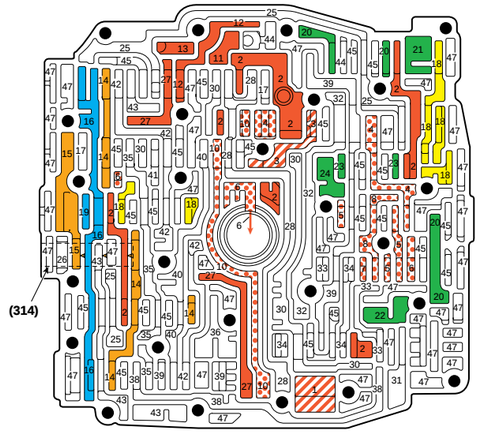
OIL PUMP BASE (201)
(Oil Pump Body Side)



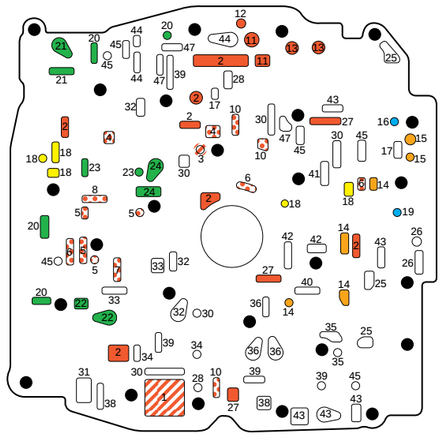
OIL PUMP BASE (201)
(Control Valve Body Side)



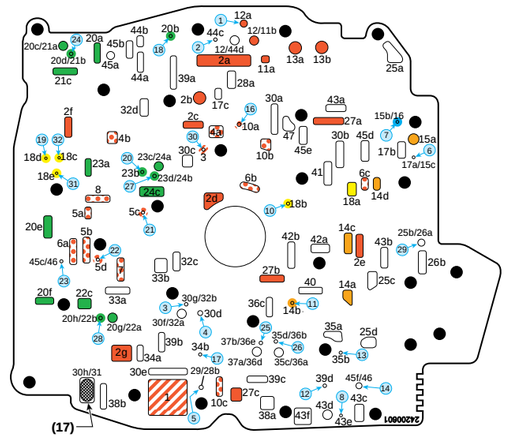
CONTROL VALVE BODY (300)
(Oil Pump Base Side)



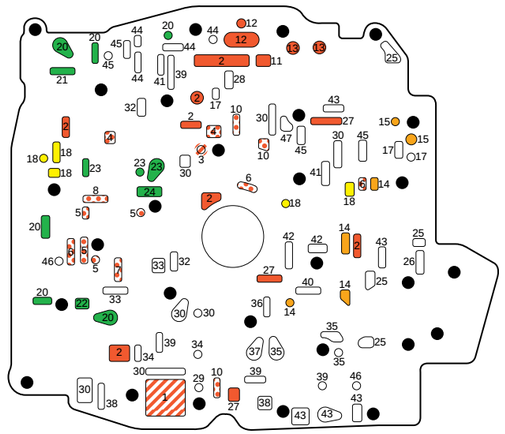
CONTROL VALVE BODY (300)
(Channel Plate Side)



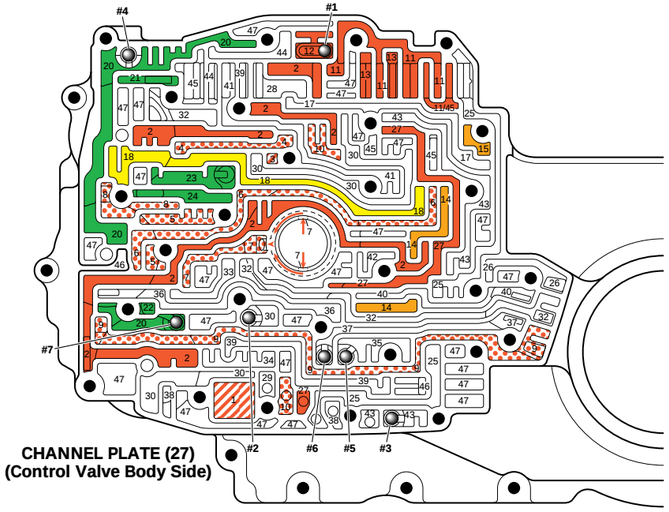
GASKET (22)
(V.B./ Spacer Plate)



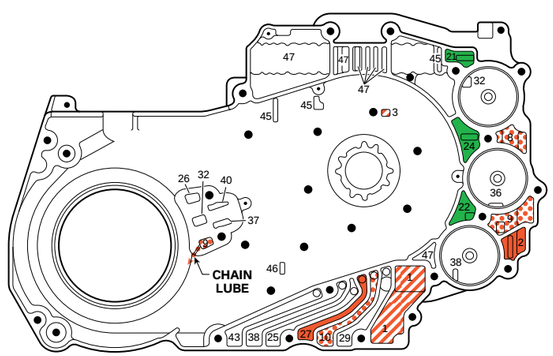
SPACER PLATE (23)
(V.B./ Case Cover)



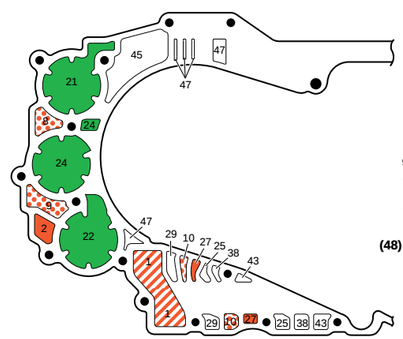
GASKET (24)
(Spacer Plate/ Channel Plate)



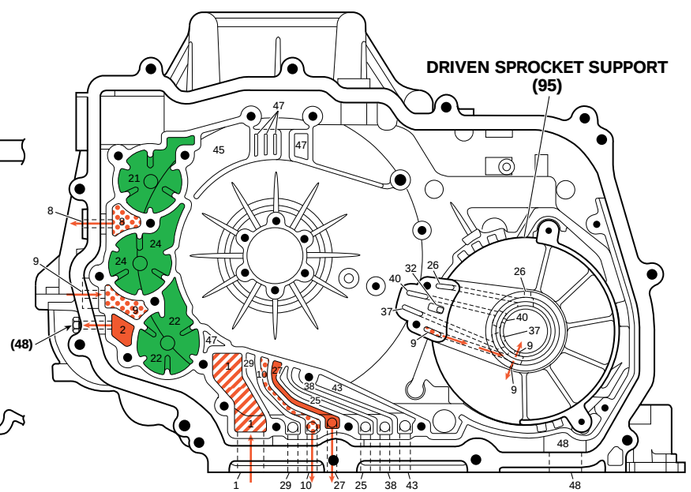
CHANNEL PLATE (27)
(Control Valve Body Side)



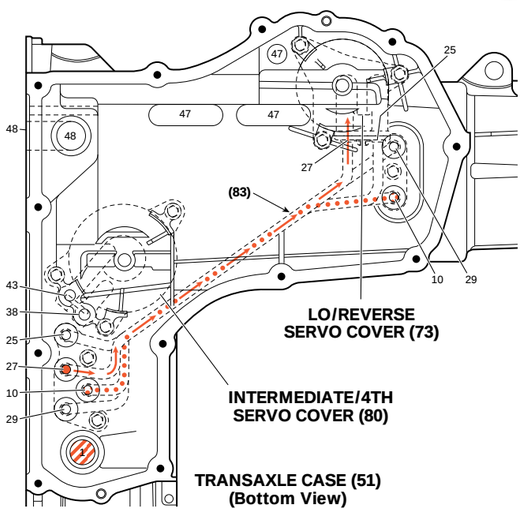
CHANNEL PLATE (27)
(Case Side)



GASKET (28)
(Channel Plate/Case)



TRANSAXLE CASE (51)
(Channel Plate Face)



TRANSAXLE CASE (51)
(Bottom View)

Figure 82

FOLDOUT ➤ 87

OVERDRIVE RANGE – FIRST GEAR

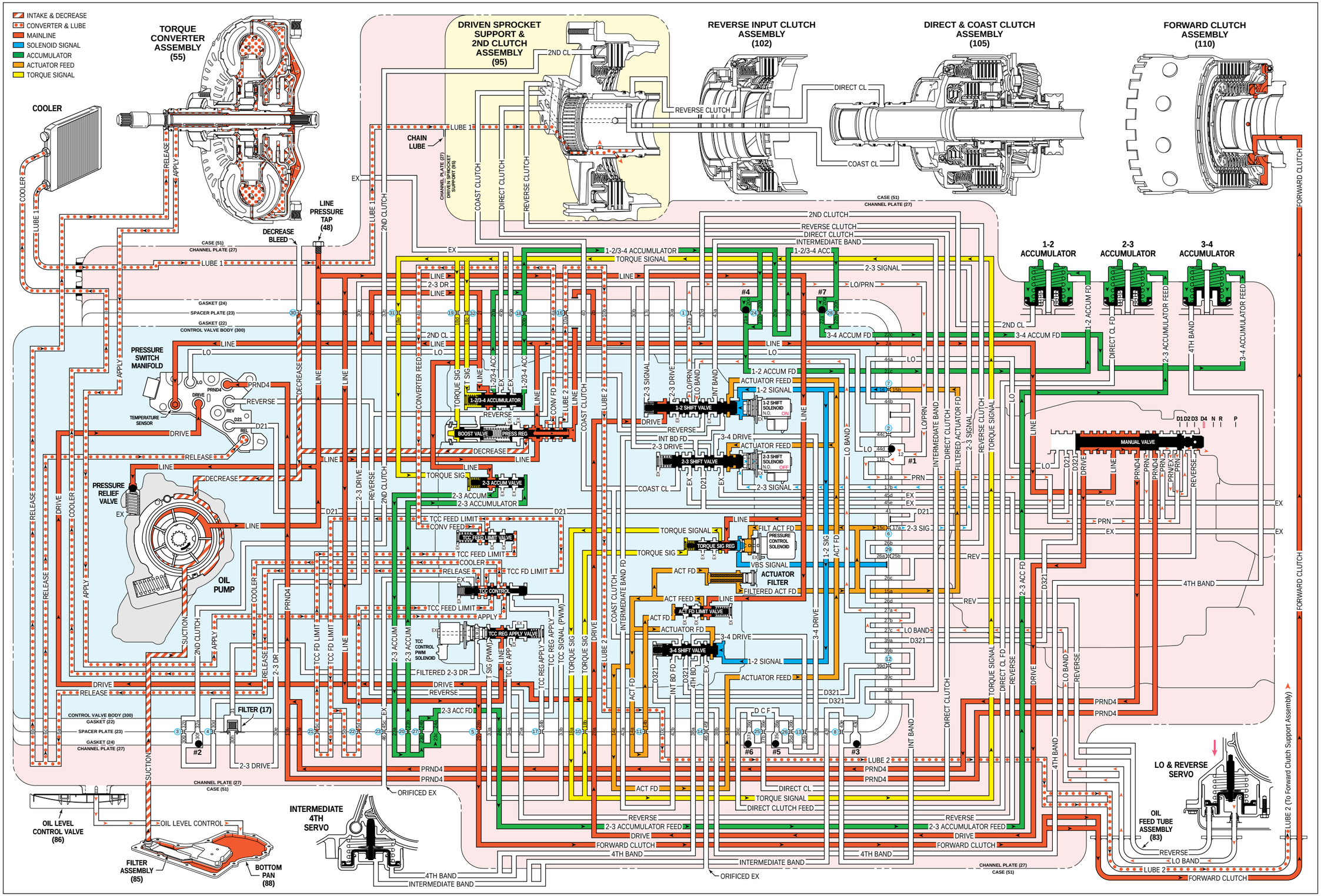


Figure 83

OVERDRIVE RANGE - FIRST GEAR

NO FIRST GEAR/SLIPS IN FIRST

- **Forward Clutch**
  - Piston and Seal Assembly (607) – Binding, cracked, leaking.
  - Inner Seal (608) – Leaking, orifice plugged.
  - Clutch Plates (601-604) – Splines broken, friction material worn.
  - Snap Rings (600, 605) – Out of position.
  - Housing (609) – Cracked, feed holes plugged.
  - Housing Retainer and Ball Assembly – Missing, out of position, plugged.
  - Springs (606) – Binding, broken.

- **Forward Clutch Fluid Routing**
  - Fluid leak or restriction.
  - Oil Feed Tubes (83) – Bent, broken, seal rings leaking, plugged.
  - Forward Clutch Support (114) – Porosity, seal rings leaking, damaged, feed holes plugged.
  - Channel Plate (27) and Gasket (28) – Porosity, misaligned, fluid leak across channels or restriction.
  - PSA (13) – Drive switch o-ring leaking.

- **1-2 Shift Solenoid (305)**
  - Failed “OFF”, leaking.

- **1-2 Shift Valve (302)**
  - Stuck in upshifted position.

- **2-3 Shift Solenoid (305)**
  - Failed “ON”, exhaust plugged.

- **Manual Valve (800) / Shift Linkage**
  - Misaligned.

- **Torque Converter (55)**
  - Stator roller clutch not holding.

- **Line Pressure**
  - Low (See PARK page 82A).

SHIFT "A" SOL	SHIFT "B" SOL	2ND CLUTCH	2ND ROLLER CLUTCH	INT/4TH BAND	REVERSE CLUTCH	COAST CLUTCH	INPUT SPRAG	DIRECT CLUTCH	FORWARD CLUTCH	LO/REV. BAND	LO ROLLER CLUTCH
ON	OFF						HOLDING		APPLIED		HOLDING

OVERDRIVE RANGE - FIRST GEAR

PASSAGES

1 SUCTION
2 LINE
3 DECREASE
4 CONVERTER FEED
5 TCC FEED LIMIT
6 RELEASE
7 APPLY
8 COOLER
9 LUBE 1
10 LUBE 2
11 PRN
12 LO/PRN
13 PRND4
14 ACTUATOR FEED
15 FILTERED ACTUATOR FEED
16 1-2 SIGNAL
17 2-3 SIGNAL
18 TORQUE SIGNAL
19 VBS SIGNAL
20 1-2/3-4 ACCUMULATOR
21 1-2 ACCUMULATOR FEED
22 3-4 ACCUMULATOR FEED
23 2-3 ACCUMULATOR
24 2-3 ACCUMULATOR FEED
25 REVERSE
26 REVERSE CLUTCH
27 LO BAND
28 DRIVE
29 FORWARD CLUTCH
30 2-3 DRIVE
31 FILTERED 2-3 DRIVE
32 2ND CLUTCH
33 TCC SIGNAL (PWM)
34 TCC REGULATED APPLY
35 3-4 DRIVE
36 DIRECT CLUTCH FEED
37 DIRECT CLUTCH
38 4TH BAND
39 D321
40 COAST CLUTCH
41 D21
42 INTERMEDIATE BAND FEED
43 INTERMEDIATE BAND
44 LO
45 EXHAUST
46 ORIFICED EXHAUST
47 VOID
48 OIL LEVEL CONTROL

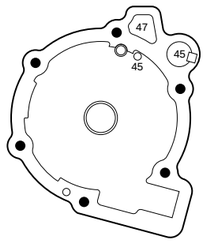
COMPONENTS ( )

(13) TRANSAXLE FLUID PRESSURE SWITCH ASSEMBLY (PSA)
(17) FILTER
(26) CHECKBALLS #1, 2, 3, 4, 5, 6 & 7
(48) PLUG, LINE PRESSURE TAP
(83) TUBE ASSEMBLY, OIL FEED
(314) FILTER, ACTUATOR OIL

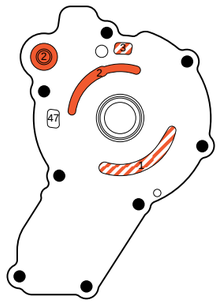
OVERDRIVE RANGE – FIRST GEAR

NOTE:

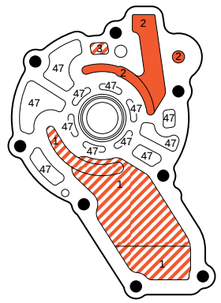
- ● INDICATES BOLT HOLES
- NON- FUNCTIONAL HOLES HAVE BEEN REMOVED FROM COMPONENT DRAWINGS TO TO SIMPLIFY TRACING FLUID FLOW.
- DUAL PURPOSE PASSAGES HAVE CHANNEL PLATE SIDE PASSAGES LISTED FIRST
- EXHAUST FLUID NOT SHOWN



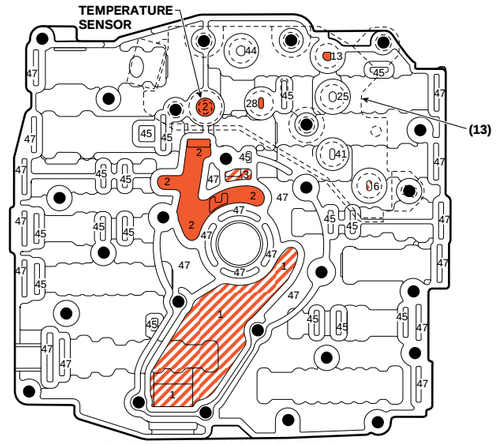
OIL PUMP COVER (217)/
OIL PUMP BODY (216)
(Oil Pump Base Side)



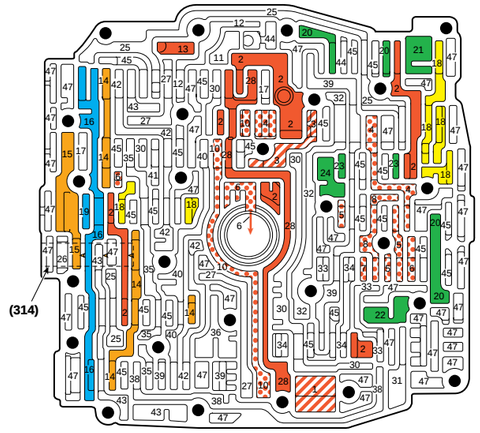
OIL PUMP BASE (201)
(Oil Pump Body Side)



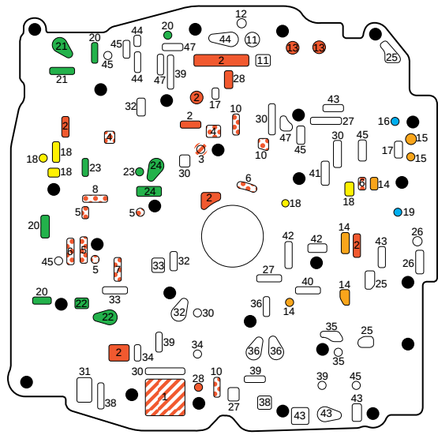
OIL PUMP BASE (201)
(Control Valve Body Side)



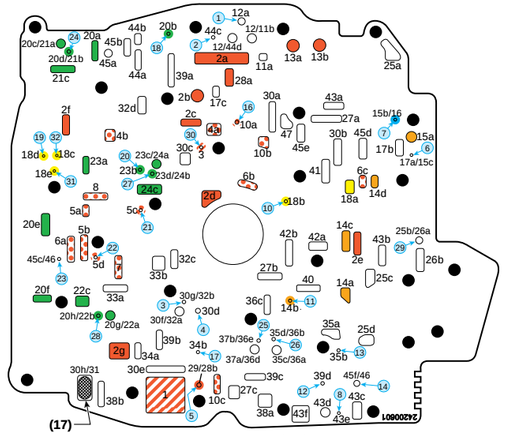
CONTROL VALVE BODY (300)
(Oil Pump Base Side)



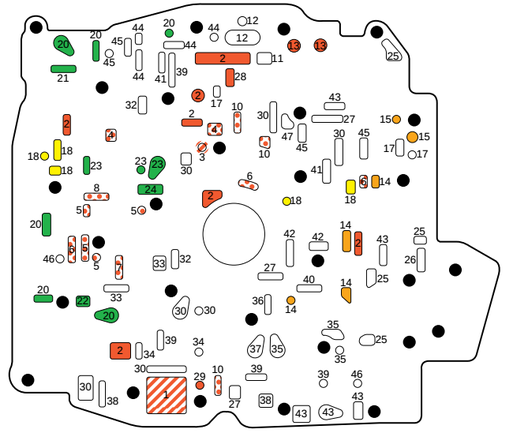
CONTROL VALVE BODY (300)
(Channel Plate Side)



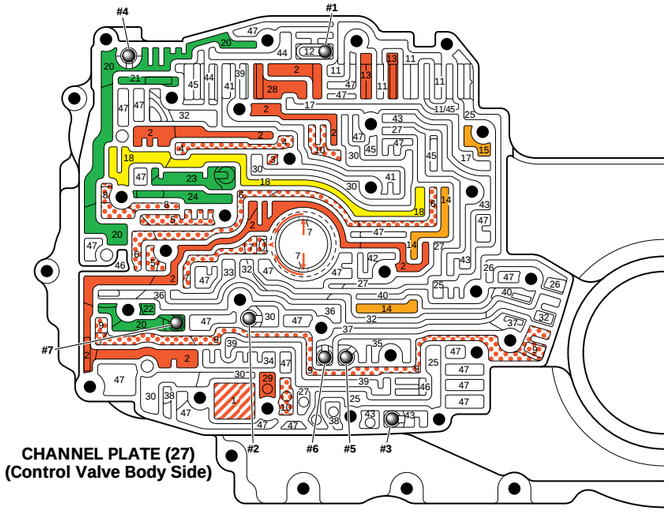
GASKET (22)
(V.B./ Spacer Plate)



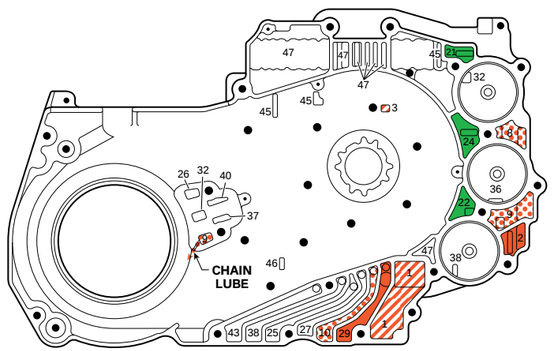
SPACER PLATE (23)
(V.B./ Case Cover)



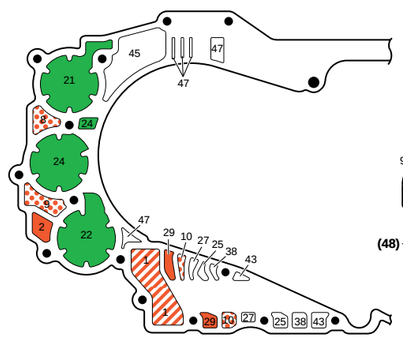
GASKET (24)
(Spacer Plate/ Channel Plate)



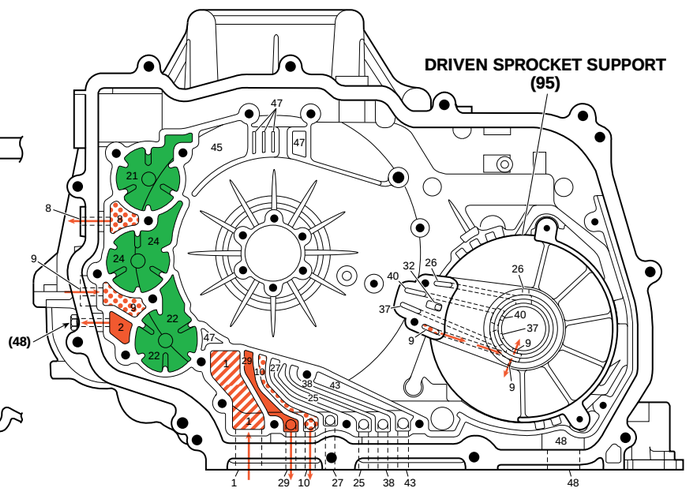
CHANNEL PLATE (27)
(Control Valve Body Side)



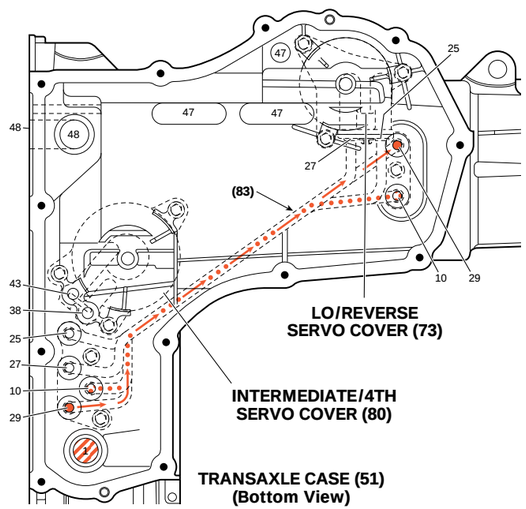
CHANNEL PLATE (27)
(Case Side)



GASKET (28)
(Channel Plate/Case)



TRANSAXLE CASE (51)
(Channel Plate Face)



TRANSAXLE CASE (51)
(Bottom View)

Figure 84

FOLDOUT ➤ 89

OVERDRIVE RANGE – SECOND GEAR

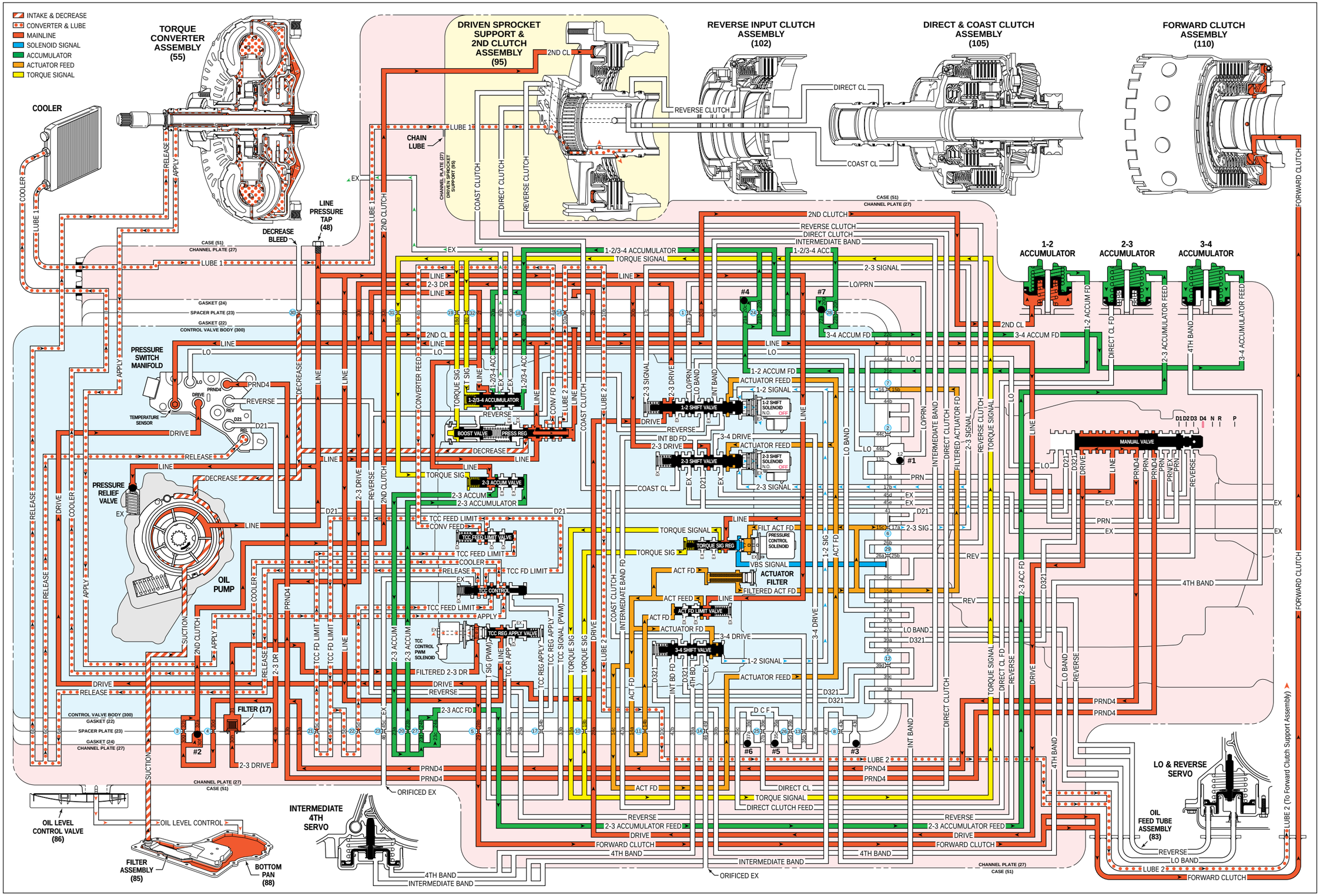


Figure 85

OVERDRIVE RANGE - SECOND GEAR

NO SECOND GEAR/SLIPS IN SECOND

- **2nd Clutch**
  - Piston and Seal Assembly (404) – Binding, cracked, leaking.
  - Clutch Plates (96-99) – Friction material worn, splines broken.
  - Snap Ring (406) – Out of position.
  - Springs (405) – Binding, broken.
  - Driven Sprocket Support (95) – Damaged, leaking, porosity.
- **2nd Clutch Fluid Routing**
  - Fluid leak or restriction.
  - Valve Body, Gaskets & Spacer Plate; Channel Plate & Gasket; and Driven Sprocket Support – Porosity, misaligned, loose, restriction, fluid leak across channels.
- **1-2 Shift Solenoid (305)**
  - Stuck "ON", plugged.
- **Forward Clutch**
  - Low Capacity shows up in Second Gear.
- **Line Pressure**
  - Low (See PARK page 82A).
- **1-2 Accumulator (29-31)**
  - Leak at piston seal.
  - Channel plate / case porosity.
- **1-2 Accumulator Valve (323)**
  - Stuck.
- **2-3 Shift Valve (306)**
  - Stuck in upshifted position.
- **PSA**
  - Malfunction (Electrical or Hydraulic)

HARSH SHIFT

- **Line Pressure**
  - High (See PARK page 82A).
- **Accumulator**
  - Spring or piston binding; no accumulation
  - Accumulator valve stuck.

SECOND GEAR ONLY

- **1-2 Shift Valve**
  - Stuck in downshifted position.

SHIFT "A" SOL	SHIFT "B" SOL	2ND CLUTCH	2ND ROLLER CLUTCH	INT/4TH BAND	REVERSE CLUTCH	COAST CLUTCH	INPUT SPRAG	DIRECT CLUTCH	FORWARD CLUTCH	LO/REV. BAND	LO ROLLER CLUTCH
OFF	OFF	APPLIED	HOLDING				HOLDING		APPLIED		OVER-RUNNING

OVERDRIVE RANGE - SECOND GEAR

PASSAGES

1 SUCTION
2 LINE
3 DECREASE
4 CONVERTER FEED
5 TCC FEED LIMIT
6 RELEASE
7 APPLY
8 COOLER
9 LUBE 1
10 LUBE 2
11 PRN
12 LO/PRN
13 PRND4
14 ACTUATOR FEED
15 FILTERED ACTUATOR FEED
16 1-2 SIGNAL
17 2-3 SIGNAL
18 TORQUE SIGNAL
19 VBS SIGNAL
20 1-2/3-4 ACCUMULATOR
21 1-2 ACCUMULATOR FEED
22 3-4 ACCUMULATOR FEED
23 2-3 ACCUMULATOR
24 2-3 ACCUMULATOR FEED
25 REVERSE
26 REVERSE CLUTCH
27 LO BAND
28 DRIVE
29 FORWARD CLUTCH
30 2-3 DRIVE
31 FILTERED 2-3 DRIVE
32 2ND CLUTCH
33 TCC SIGNAL (PWM)
34 TCC REGULATED APPLY
35 3-4 DRIVE
36 DIRECT CLUTCH FEED
37 DIRECT CLUTCH
38 4TH BAND
39 D321
40 COAST CLUTCH
41 D21
42 INTERMEDIATE BAND FEED
43 INTERMEDIATE BAND
44 LO
45 EXHAUST
46 ORIFICED EXHAUST
47 VOID
48 OIL LEVEL CONTROL

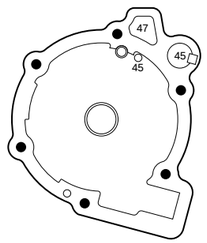
COMPONENTS ( )

(13) TRANSAXLE FLUID PRESSURE SWITCH ASSEMBLY (PSA)
(17) FILTER
(26) CHECKBALLS #1, 2, 3, 4, 5, 6 & 7
(48) PLUG, LINE PRESSURE TAP
(83) TUBE ASSEMBLY, OIL FEED
(314) FILTER, ACTUATOR OIL

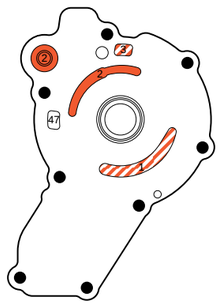
OVERDRIVE RANGE – SECOND GEAR

NOTE:

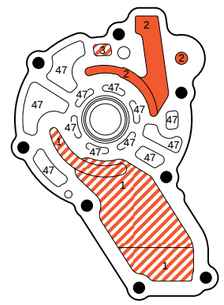
- ● INDICATES BOLT HOLES
- NON- FUNCTIONAL HOLES HAVE BEEN REMOVED FROM COMPONENT DRAWINGS TO TO SIMPLIFY TRACING FLUID FLOW.
- DUAL PURPOSE PASSAGES HAVE CHANNEL PLATE SIDE PASSAGES LISTED FIRST
- EXHAUST FLUID NOT SHOWN



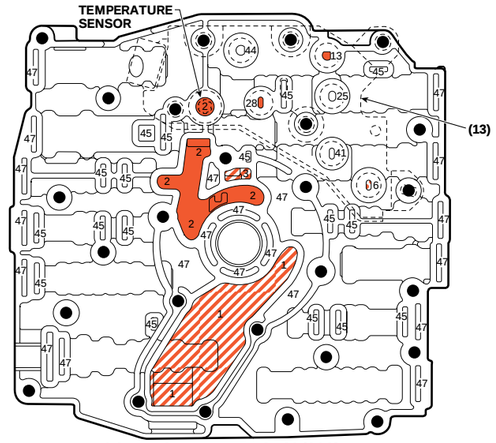
OIL PUMP COVER (217)/
OIL PUMP BODY (216)
(Oil Pump Base Side)



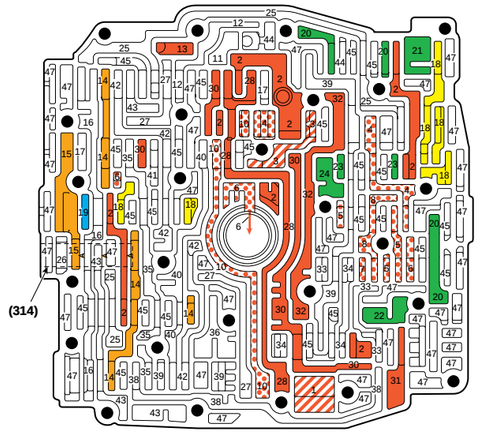
OIL PUMP BASE (201)
(Oil Pump Body Side)



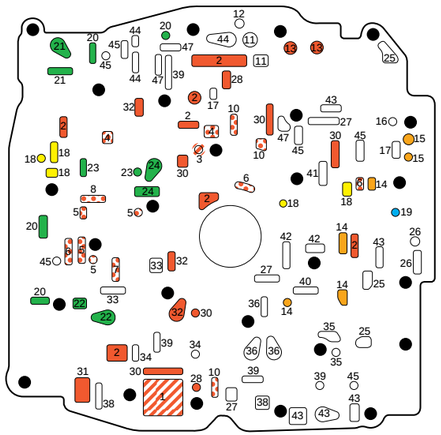
OIL PUMP BASE (201)
(Control Valve Body Side)



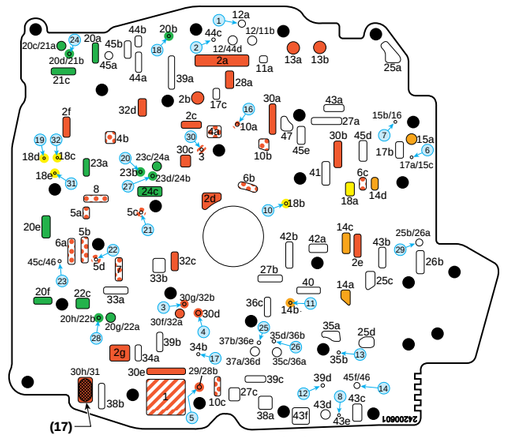
CONTROL VALVE BODY (300)
(Oil Pump Base Side)



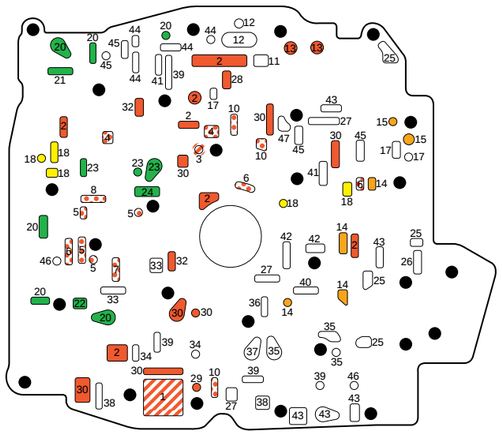
CONTROL VALVE BODY (300)
(Channel Plate Side)



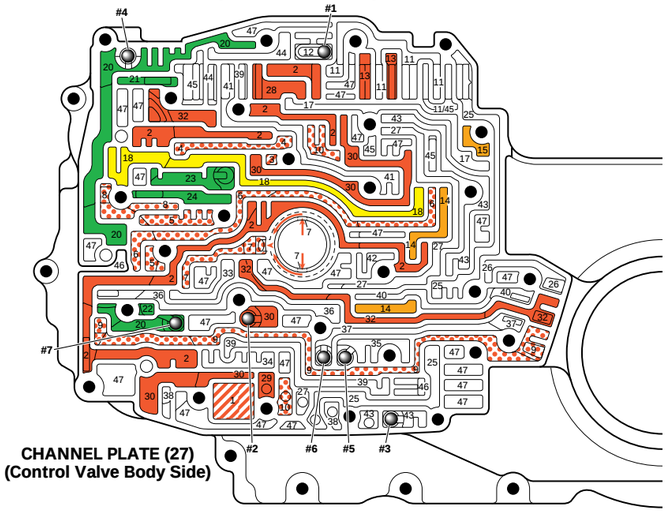
GASKET (22)
(V.B./ Spacer Plate)



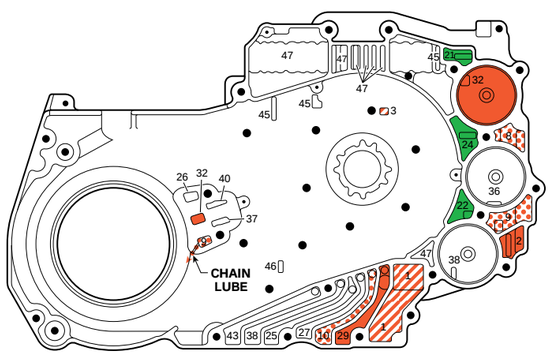
SPACER PLATE (23)
(V.B./ Case Cover)



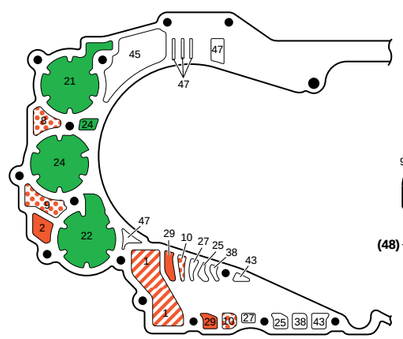
GASKET (24)
(Spacer Plate/ Channel Plate)



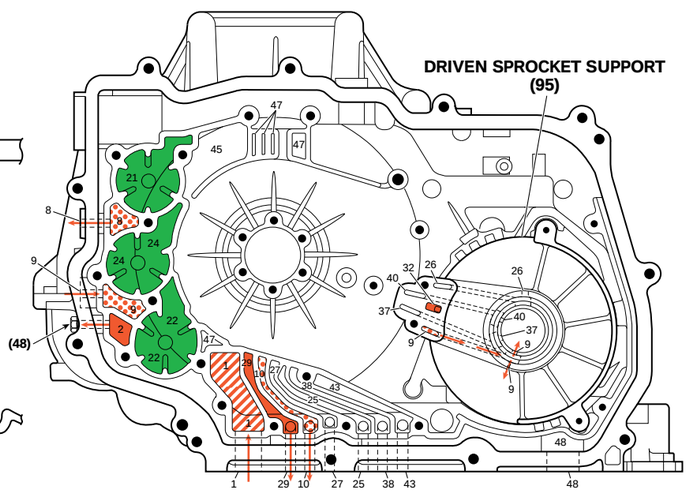
CHANNEL PLATE (27)
(Control Valve Body Side)



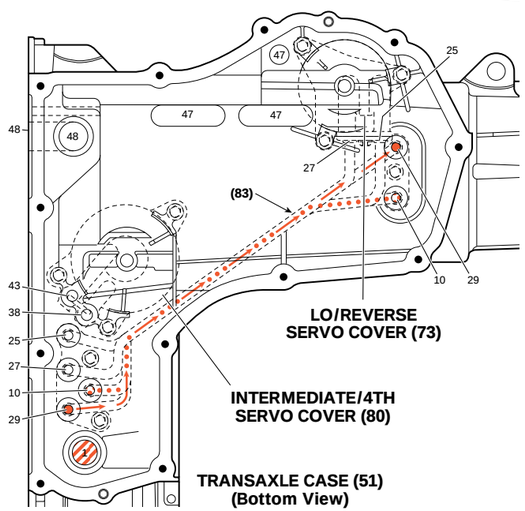
CHANNEL PLATE (27)
(Case Side)



GASKET (28)
(Channel Plate/Case)



TRANSAXLE CASE (51)
(Channel Plate Face)



TRANSAXLE CASE (51)
(Bottom View)

Figure 86

FOLDOUT ➤ 91

OVERDRIVE RANGE – THIRD GEAR

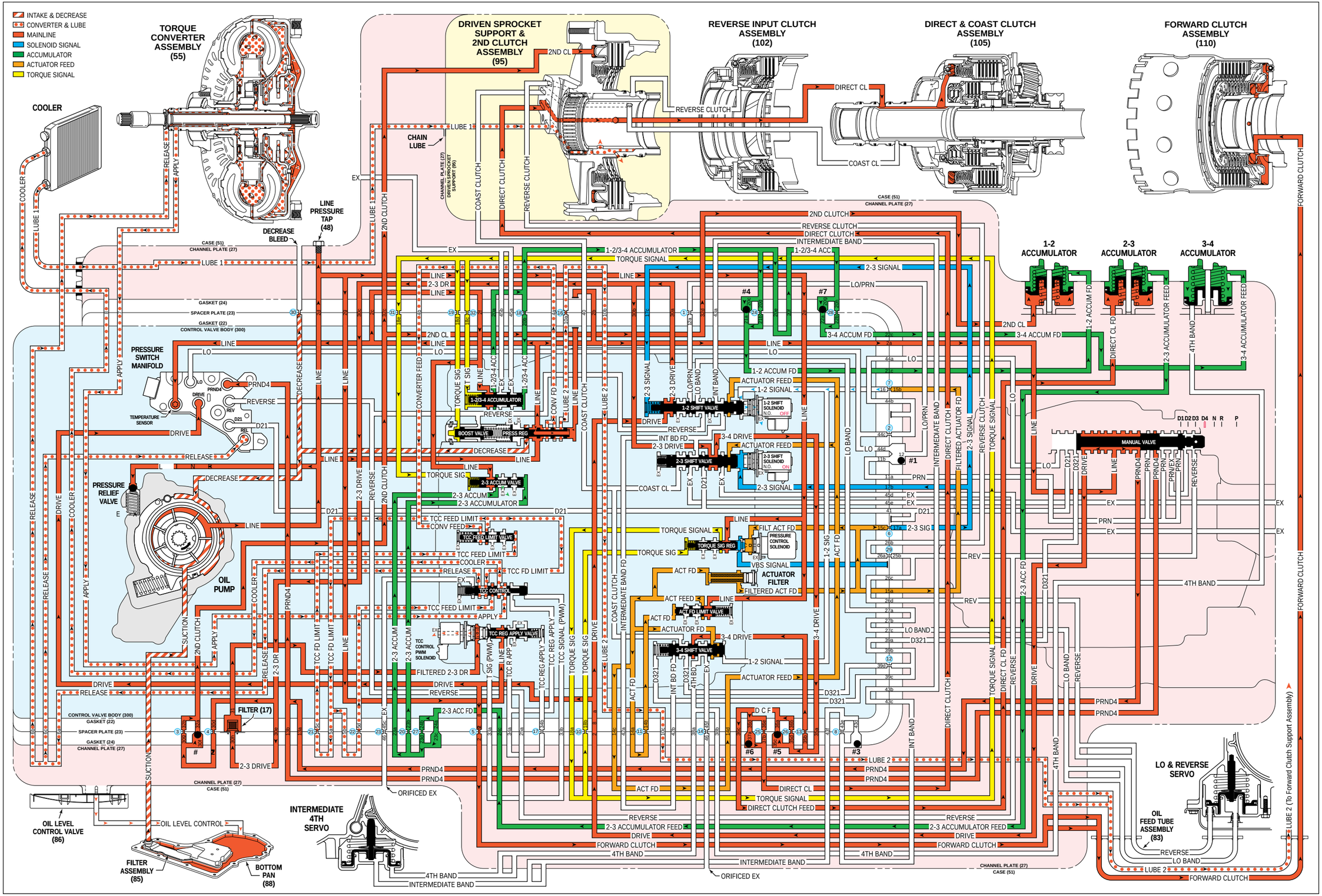


Figure 87

OVERDRIVE RANGE - THIRD GEAR

NO THIRD GEAR/SLIPS IN THIRD

- **Direct Clutch**
  - Piston and Seal Assembly (518) – Binding, cracked, leaking.
  - Clutch Plates (521 - 523) – Friction material worn, splines broken.
  - Snap Rings (517, 520) – Out of position.
  - Springs (519) – Binding, broken.
  - Direct & Coast Housing and Input Shaft (520) – Damaged, cracked, feed holes restricted.
  - Housing Retainer and Ball Assembly – Missing, plugged.

- **Direct Clutch Fluid Routing**
  - Valve Body, Gaskets & Spacer Plate; Channel Plate & Gasket; Driven Sprocket Support – Porosity, misaligned, loose, fluid restriction, fluid leak across channels.
  - Driven Sprocket Support Seals – Leaking.
  - Input Shaft – Seals leaking – Sleeve damaged; misaligned.

- **2-3 Shift Solenoid (305)**
  - Stuck “OFF”, leaking.

- **2-3 Accumulator**
  - Leak at piston seal.
  - Channel plate / case porosity.

- **2-3 Accumulator Valve (330)**
  - Stuck.

- **Line Pressure**
  - Low (See PARK page 82A).

- **3-4 Shift Valve (319)**
  - Stuck in upshifted position.

- **PSA (13)**
  - Malfunction (Electrical or Hydraulic).

HARSH SHIFT

- **Line Pressure**
  - High (See PARK page 82A).

- **Accumulator**
  - 2-3 Spring broken or piston binding; no accumulation
  - 2-3 Accumulator valve stuck.

SHIFT "A" SOL	SHIFT "B" SOL	2ND CLUTCH	2ND ROLLER CLUTCH	INT/4TH BAND	REVERSE CLUTCH	COAST CLUTCH	INPUT SPRAG	DIRECT CLUTCH	FORWARD CLUTCH	LO/REV. BAND	LO ROLLER CLUTCH
OFF	ON	APPLIED *	OVER-RUNNING				HOLDING	APPLIED	APPLIED		OVER-RUNNING

OVERDRIVE RANGE - THIRD GEAR

PASSAGES

1 SUCTION
2 LINE
3 DECREASE
4 CONVERTER FEED
5 TCC FEED LIMIT
6 RELEASE
7 APPLY
8 COOLER
9 LUBE 1
10 LUBE 2
11 PRN
12 LO/PRN
13 PRND4
14 ACTUATOR FEED
15 FILTERED ACTUATOR FEED
16 1-2 SIGNAL
17 2-3 SIGNAL
18 TORQUE SIGNAL
19 VBS SIGNAL
20 1-2/3-4 ACCUMULATOR
21 1-2 ACCUMULATOR FEED
22 3-4 ACCUMULATOR FEED
23 2-3 ACCUMULATOR
24 2-3 ACCUMULATOR FEED
25 REVERSE
26 REVERSE CLUTCH
27 LO BAND
28 DRIVE
29 FORWARD CLUTCH
30 2-3 DRIVE
31 FILTERED 2-3 DRIVE
32 2ND CLUTCH
33 TCC SIGNAL (PWM)
34 TCC REGULATED APPLY
35 3-4 DRIVE
36 DIRECT CLUTCH FEED
37 DIRECT CLUTCH
38 4TH BAND
39 D321
40 COAST CLUTCH
41 D21
42 INTERMEDIATE BAND FEED
43 INTERMEDIATE BAND
44 LO
45 EXHAUST
46 ORIFICED EXHAUST
47 VOID
48 OIL LEVEL CONTROL

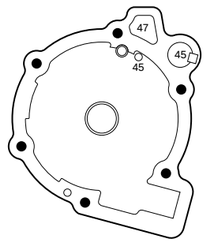
COMPONENTS ( )

(13) TRANSAXLE FLUID PRESSURE SWITCH ASSEMBLY (PSA)
(17) FILTER
(26) CHECKBALLS #1, 2, 3, 4, 5, 6 & 7
(48) PLUG, LINE PRESSURE TAP
(83) TUBE ASSEMBLY, OIL FEED
(314) FILTER, ACTUATOR OIL

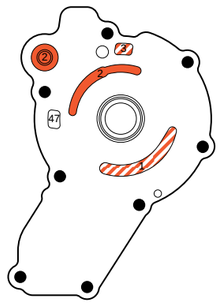
OVERDRIVE RANGE – THIRD GEAR

NOTE:

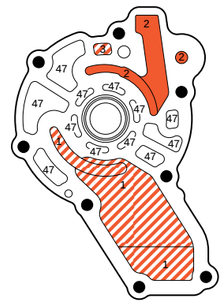
- ● INDICATES BOLT HOLES
- NON- FUNCTIONAL HOLES HAVE BEEN REMOVED FROM COMPONENT DRAWINGS TO TO SIMPLIFY TRACING FLUID FLOW.
- DUAL PURPOSE PASSAGES HAVE CHANNEL PLATE SIDE PASSAGES LISTED FIRST
- EXHAUST FLUID NOT SHOWN



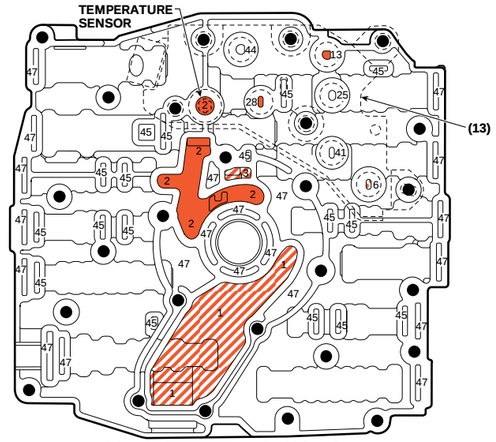
OIL PUMP COVER (217)/
OIL PUMP BODY (216)
(Oil Pump Base Side)



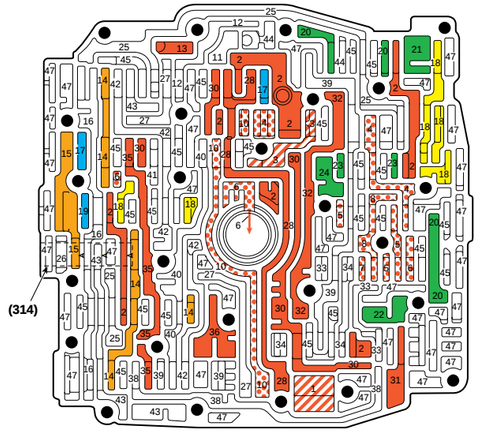
OIL PUMP BASE (201)
(Oil Pump Body Side)



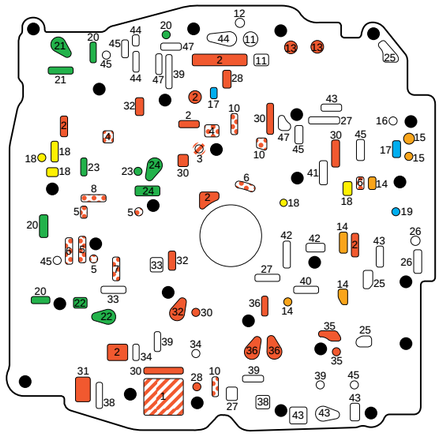
OIL PUMP BASE (201)
(Control Valve Body Side)



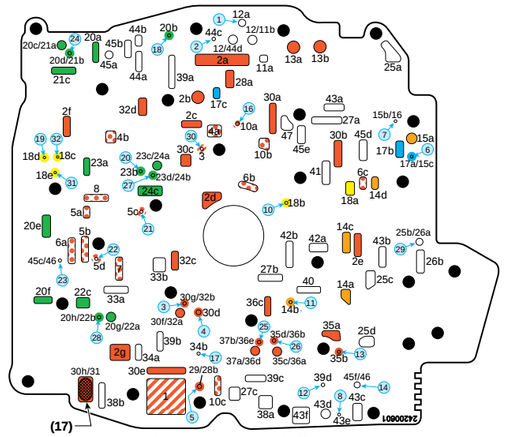
CONTROL VALVE BODY (300)
(Oil Pump Base Side)



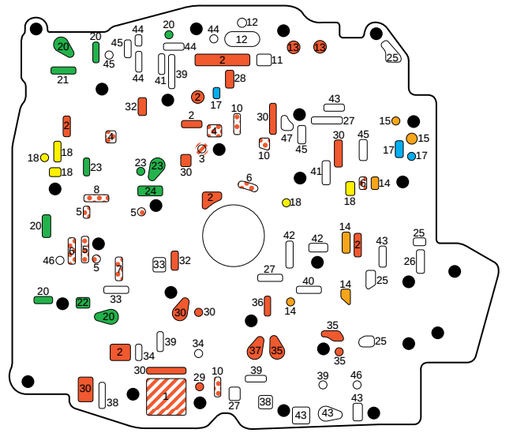
CONTROL VALVE BODY (300)
(Channel Plate Side)



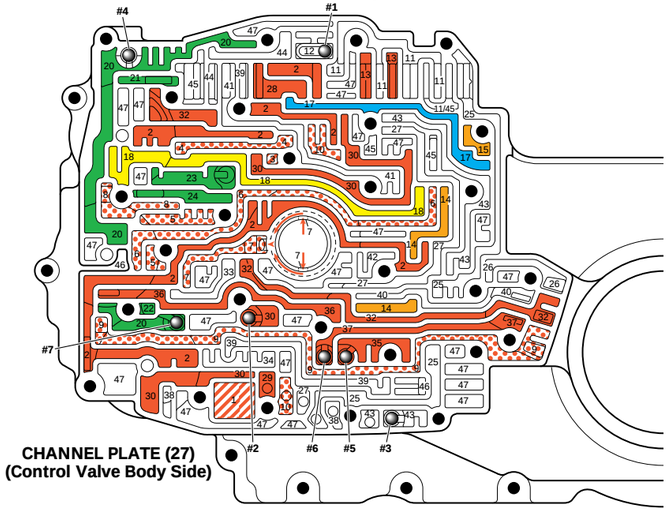
GASKET (22)
(V.B./ Spacer Plate)



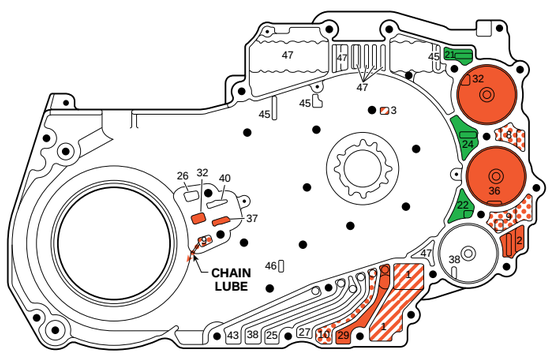
SPACER PLATE (23)
(V.B./ Case Cover)



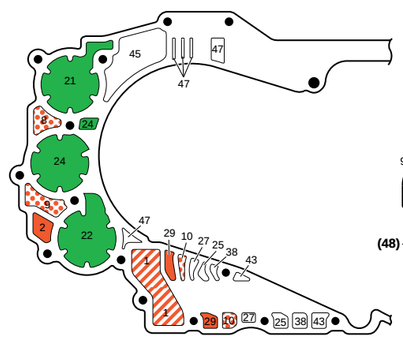
GASKET (24)
(Spacer Plate/ Channel Plate)



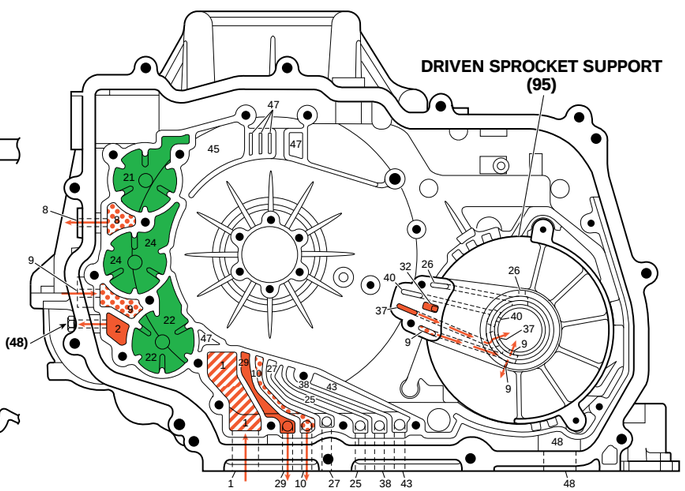
CHANNEL PLATE (27)
(Control Valve Body Side)



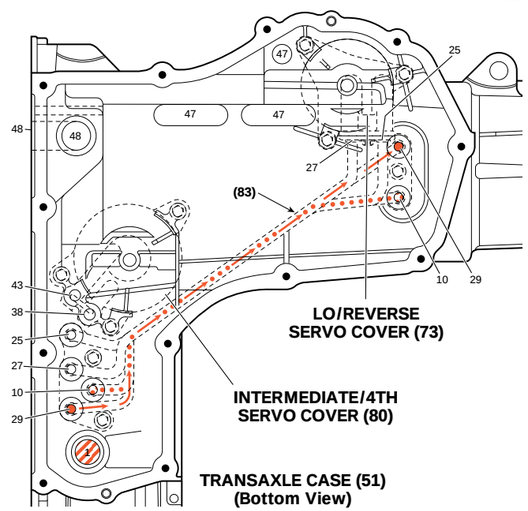
CHANNEL PLATE (27)
(Case Side)



GASKET (28)
(Channel Plate/Case)



TRANSAXLE CASE (51)
(Channel Plate Face)



TRANSAXLE CASE (51)
(Bottom View)

Figure 88

FOLDOUT ➤ 93

OVERDRIVE RANGE – FOURTH GEAR (Torque Converter Clutch Applied)

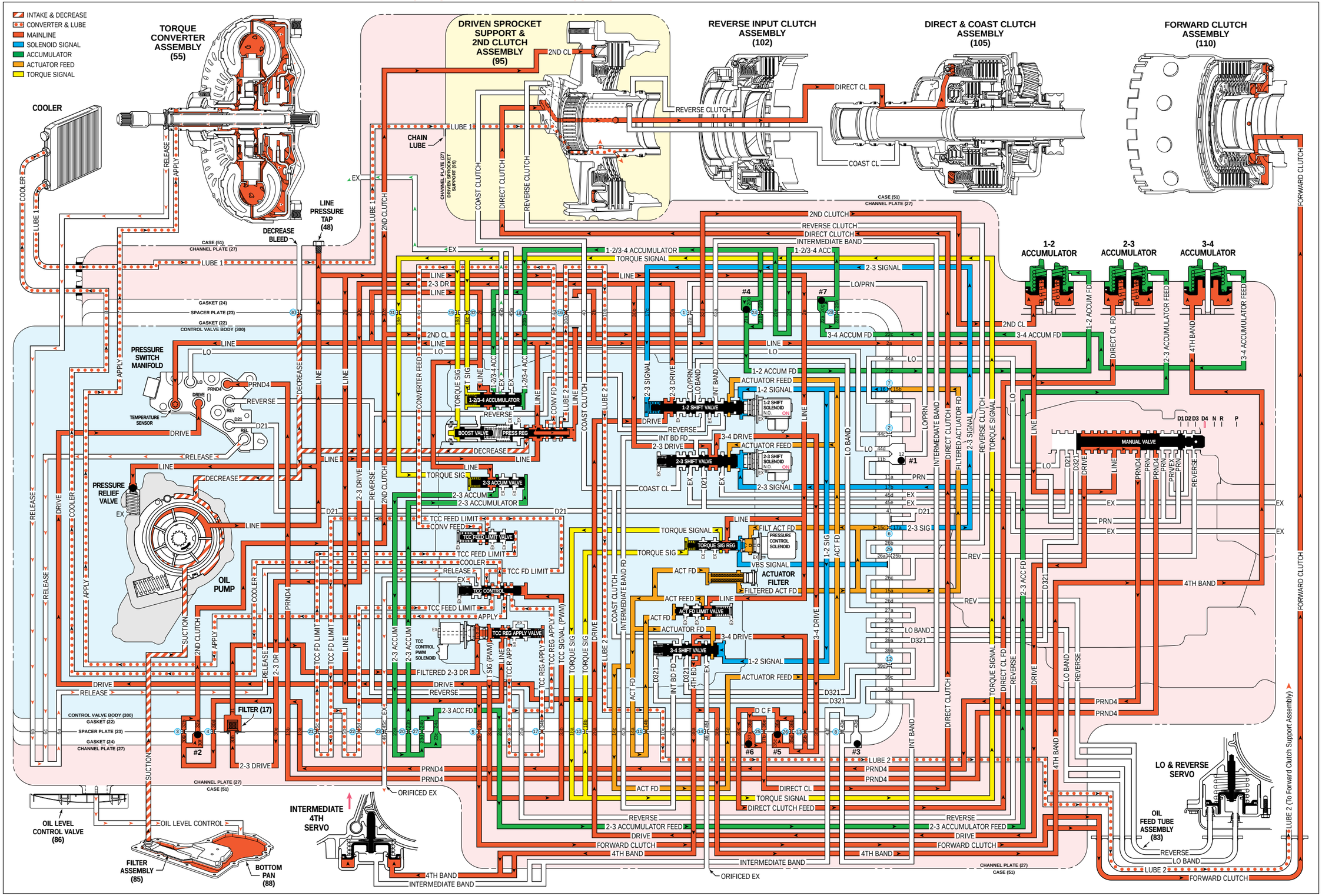


Figure 89

OVERDRIVE RANGE - FOURTH GEAR
(Torque Converter Clutch Applied)

NO FOURTH GEAR/SLIPS IN FOURTH

- **Intermediate / 4th Band & Servo**
  - No apply / slipping.
  - Servo Piston (77) – Broken, binding.
  - Servo Piston Seals (78, 79) – Leaking.
  - Servo Pin (76) and Springs (75, 68) – Binding, broken.
  - Servo Cover (80) – Broken, loose, leaking.
  - Band (100) – Broken, worn, out of position.
  - Case (51) – Cracked at band seat.
- **Band Apply Fluid Routing**
  - Valve Body, Gaskets & Spacer Plate; Channel Plate; Case – Porosity, misaligned, loose, fluid restriction, fluid leak across channels.
- **1-2 Shift Solenoid (305)**
  - Stuck “OFF”, leaking.
- **3-4 Shift Valve (319)**
  - Stuck in downshifted position.
- **Manual Valve (800)**
  - Misaligned (in Manual Third).
- **3-4 Accumulator**
  - Leak at piston seal.
  - Channel plate / case porosity.
- **3-4 Accumulator Valve (323)**
  - Stuck.
- **Line Pressure**
  - Low (See PARK page 82A).
- **Direct Clutch**
  - Low capacity will cause failure in Fourth gear.
- **PSA**
  - Malfunction (Hydraulic or Electrical)

HARSH SHIFT

- **Line Pressure**
  - High (See PARK page 82A).
- **Accumulator**
  - Spring broken or piston binding; no accumulation
  - Accumulator valve stuck.

NO TCC APPLY OR RELEASE

- **See 4-3 downshift page 96A.**

SHIFT "A" SOL	SHIFT "B" SOL	2ND CLUTCH	2ND ROLLER CLUTCH	INT/4TH BAND	REVERSE CLUTCH	COAST CLUTCH	INPUT SPRAG	DIRECT CLUTCH	FORWARD CLUTCH	LO/REV. BAND	LO ROLLER CLUTCH
ON	ON	APPLIED		APPLIED			OVER-RUNNING	APPLIED	APPLIED +		OVER-RUNNING

OVERDRIVE RANGE - FOURTH GEAR
(Torque Converter Clutch Applied)

PASSAGES

1 SUCTION
2 LINE
3 DECREASE
4 CONVERTER FEED
5 TCC FEED LIMIT
6 RELEASE
7 APPLY
8 COOLER
9 LUBE 1
10 LUBE 2
11 PRN
12 LO/PRN
13 PRND4
14 ACTUATOR FEED
15 FILTERED ACTUATOR FEED
16 1-2 SIGNAL
17 2-3 SIGNAL
18 TORQUE SIGNAL
19 VBS SIGNAL
20 1-2/3-4 ACCUMULATOR
21 1-2 ACCUMULATOR FEED
22 3-4 ACCUMULATOR FEED
23 2-3 ACCUMULATOR
24 2-3 ACCUMULATOR FEED
25 REVERSE
26 REVERSE CLUTCH
27 LO BAND
28 DRIVE
29 FORWARD CLUTCH
30 2-3 DRIVE
31 FILTERED 2-3 DRIVE
32 2ND CLUTCH
33 TCC SIGNAL (PWM)
34 TCC REGULATED APPLY
35 3-4 DRIVE
36 DIRECT CLUTCH FEED
37 DIRECT CLUTCH
38 4TH BAND
39 D321
40 COAST CLUTCH
41 D21
42 INTERMEDIATE BAND FEED
43 INTERMEDIATE BAND
44 LO
45 EXHAUST
46 ORIFICED EXHAUST
47 VOID
48 OIL LEVEL CONTROL

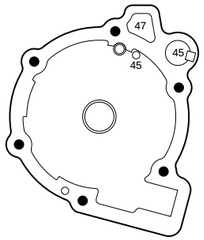
COMPONENTS ( )

(13) TRANSAXLE FLUID PRESSURE SWITCH ASSEMBLY (PSA)
(17) FILTER
(26) CHECKBALLS #1, 2, 3, 4, 5, 6 & 7
(48) PLUG, LINE PRESSURE TAP
(83) TUBE ASSEMBLY, OIL FEED
(314) FILTER, ACTUATOR OIL

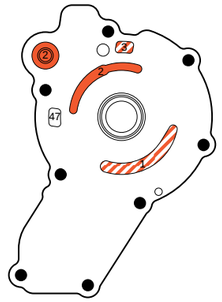
OVERDRIVE RANGE – FOURTH GEAR (Torque Converter Clutch Applied)

NOTE:

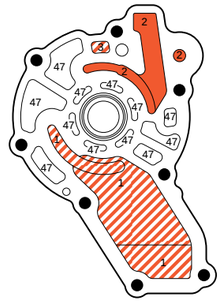
- ● INDICATES BOLT HOLES
- NON- FUNCTIONAL HOLES HAVE BEEN REMOVED FROM COMPONENT DRAWINGS TO TO SIMPLIFY TRACING FLUID FLOW.
- DUAL PURPOSE PASSAGES HAVE CHANNEL PLATE SIDE PASSAGES LISTED FIRST
- EXHAUST FLUID NOT SHOWN



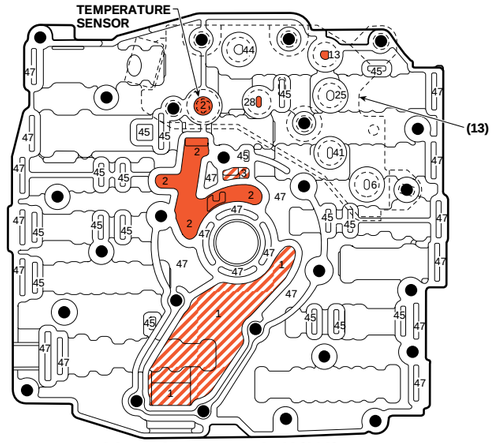
OIL PUMP COVER (217)/
OIL PUMP BODY (216)
(Oil Pump Base Side)



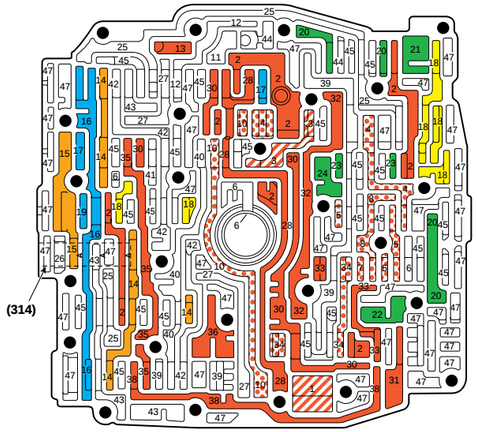
OIL PUMP BASE (201)
(Oil Pump Body Side)



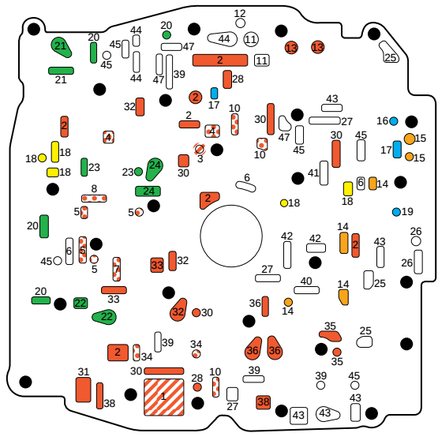
OIL PUMP BASE (201)
(Control Valve Body Side)



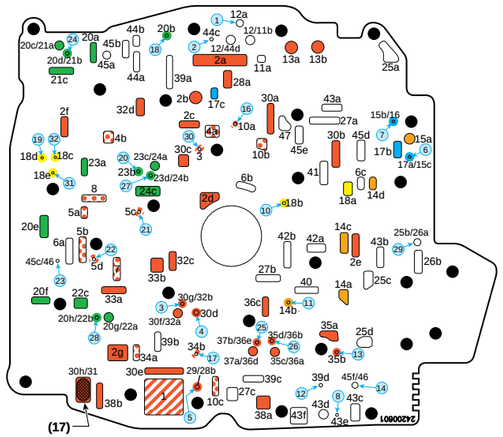
CONTROL VALVE BODY (300)
(Oil Pump Base Side)



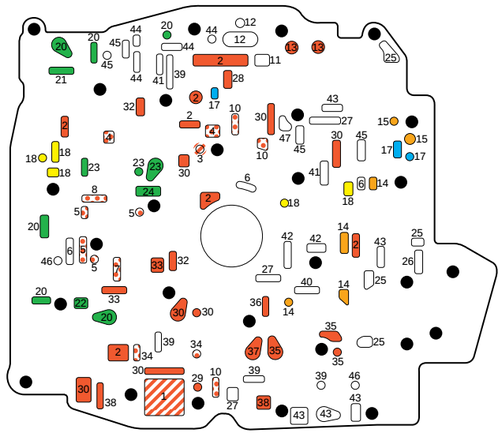
CONTROL VALVE BODY (300)
(Channel Plate Side)



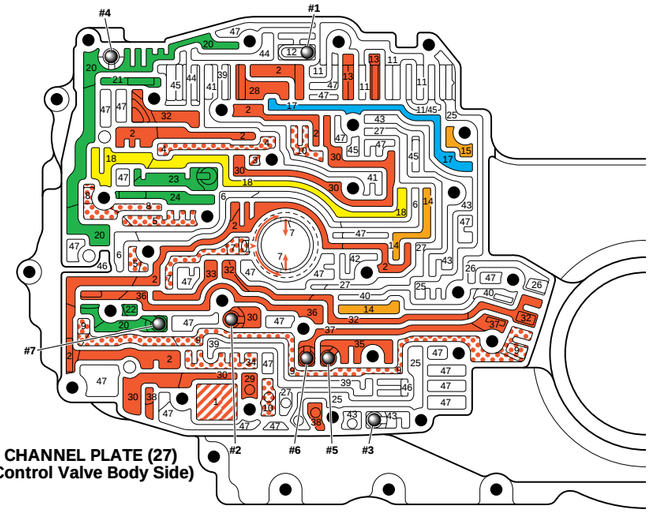
GASKET (22)
(V.B./ Spacer Plate)



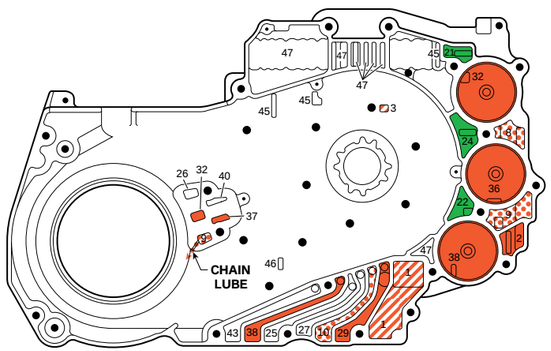
SPACER PLATE (23)
(V.B./ Case Cover)



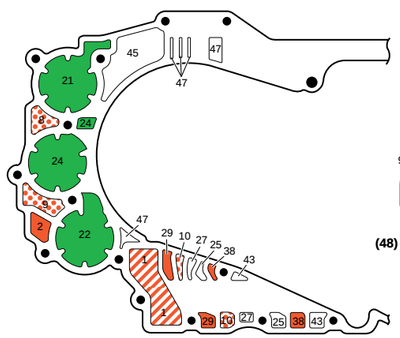
GASKET (24)
(Spacer Plate/ Channel Plate)



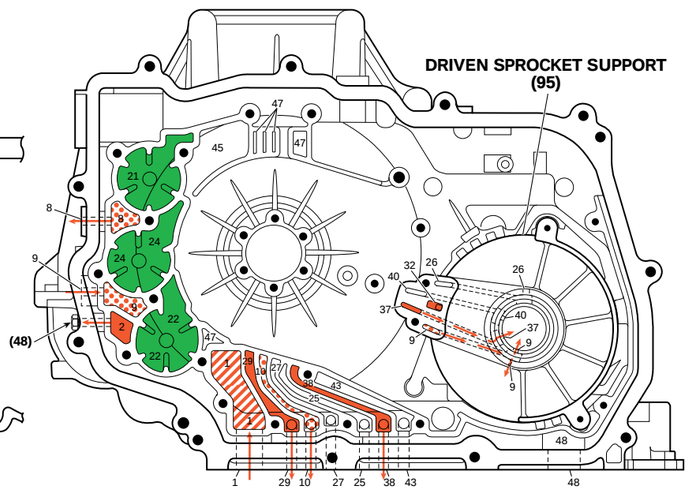
CHANNEL PLATE (27)
(Control Valve Body Side)



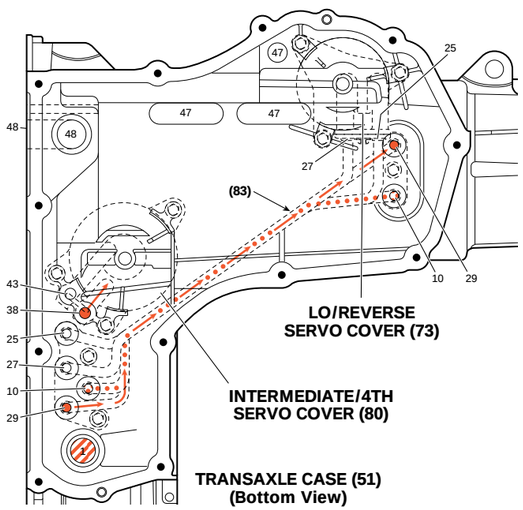
CHANNEL PLATE (27)
(Case Side)



GASKET (28)
(Channel Plate/Case)



TRANSAXLE CASE (51)
(Channel Plate Face)



TRANSAXLE CASE (51)
(Bottom View)

Figure 90

FOLDOUT ➤ 95

OVERDRIVE RANGE – 4-3 DOWNSHIFT (Torque Converter Clutch Released)

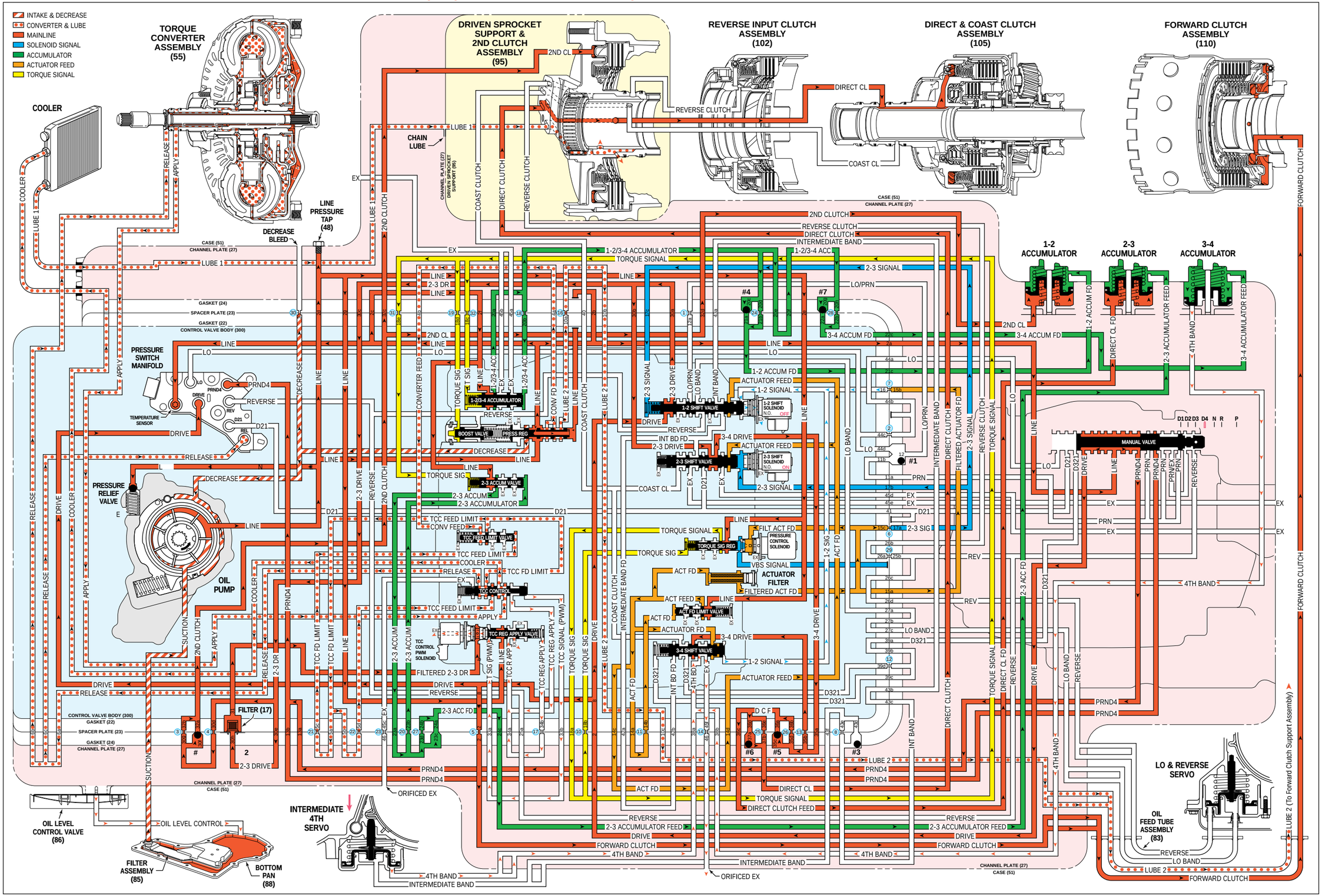


Figure 91

OVERDRIVE RANGE - 4-3 DOWNSHIFT
(Torque Converter Clutch Released)

NO THIRD GEAR/SLIPS IN THIRD

See Overdrive Range – Third Gear (page 92A) for possible faults and conditions related to normal third gear operation.

NO TCC APPLY / SLIPPING / SOFT APPLY

- **TCC Solenoid (335)**
  - Stuck “OFF” – O-ring leaking.
  - No voltage to solenoid.
  - Poor electrical connection.
- **Wiring Harness (11)**
  - Pinched wire (electrical short).
  - Damaged electrical connector.
- **PCM**
  - No signal to solenoid.
- **Brake Switch**
  - Not functioning (open).
- **Pressure Regulator Valve**
  - Stuck.
- **Torque Converter (55)**
  - Internal failure.
- **TCC Fluid Circuits**
  - Leaks.
  - Plugged Release Exhaust Orifice #23.
- **TCC Regulated Apply Valve (339) and TCC Control Valve (334)**
  - Stuck in TCC release position.
- **TCC Feed Limit Valve**
  - Stuck.
- **Fluid Level or Pressure**
  - Low.
- **Cooler Lines**
  - Plugged.

NO TCC RELEASE

- **TCC Solenoid (335)**
  - Internal failure.
  - Fluid exhaust plugged.
  - External Ground.
- **Torque Converter (55)**
  - Internal Failure.
- **TCC Regulated Apply Valve (339) and TCC Control Valve (334)**
  - Stuck in TCC apply position.

SHIFT "A" SOL	SHIFT "B" SOL	2ND CLUTCH	2ND ROLLER CLUTCH	INT/4TH BAND	REVERSE CLUTCH	COAST CLUTCH	INPUT SPRAG	DIRECT CLUTCH	FORWARD CLUTCH	LO/REV. BAND	LO ROLLER CLUTCH
OFF	ON	APPLIED *	OVER-RUNNING				HOLDING	APPLIED	APPLIED		OVER-RUNNING

OVERDRIVE RANGE - 4-3 DOWNSHIFT
(Torque Converter Clutch Released)

PASSAGES

1 SUCTION
2 LINE
3 DECREASE
4 CONVERTER FEED
5 TCC FEED LIMIT
6 RELEASE
7 APPLY
8 COOLER
9 LUBE 1
10 LUBE 2
11 PRN
12 LO/PRN
13 PRND4
14 ACTUATOR FEED
15 FILTERED ACTUATOR FEED
16 1-2 SIGNAL
17 2-3 SIGNAL
18 TORQUE SIGNAL
19 VBS SIGNAL
20 1-2/3-4 ACCUMULATOR
21 1-2 ACCUMULATOR FEED
22 3-4 ACCUMULATOR FEED
23 2-3 ACCUMULATOR
24 2-3 ACCUMULATOR FEED
25 REVERSE
26 REVERSE CLUTCH
27 LO BAND
28 DRIVE
29 FORWARD CLUTCH
30 2-3 DRIVE
31 FILTERED 2-3 DRIVE
32 2ND CLUTCH
33 TCC SIGNAL (PWM)
34 TCC REGULATED APPLY
35 3-4 DRIVE
36 DIRECT CLUTCH FEED
37 DIRECT CLUTCH
38 4TH BAND
39 D321
40 COAST CLUTCH
41 D21
42 INTERMEDIATE BAND FEED
43 INTERMEDIATE BAND
44 LO
45 EXHAUST
46 ORIFICED EXHAUST
47 VOID
48 OIL LEVEL CONTROL

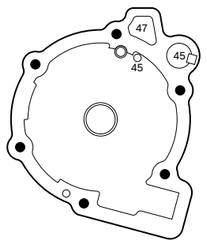
COMPONENTS ( )

(13) TRANSAXLE FLUID PRESSURE SWITCH ASSEMBLY (PSA)
(17) FILTER
(26) CHECKBALLS #1, 2, 3, 4, 5, 6 & 7
(48) PLUG, LINE PRESSURE TAP
(83) TUBE ASSEMBLY, OIL FEED
(314) FILTER, ACTUATOR OIL

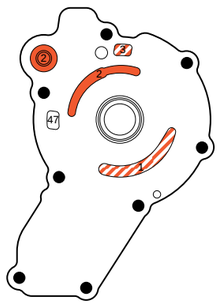
OVERDRIVE RANGE – 4-3 DOWNSHIFT (Torque Converter Clutch Released)

NOTE:

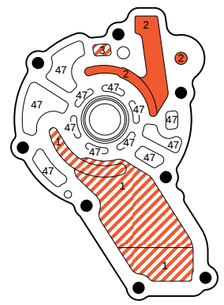
- ● INDICATES BOLT HOLES
- NON- FUNCTIONAL HOLES HAVE BEEN REMOVED FROM COMPONENT DRAWINGS TO TO SIMPLIFY TRACING FLUID FLOW.
- DUAL PURPOSE PASSAGES HAVE CHANNEL PLATE SIDE PASSAGES LISTED FIRST
- EXHAUST FLUID NOT SHOWN



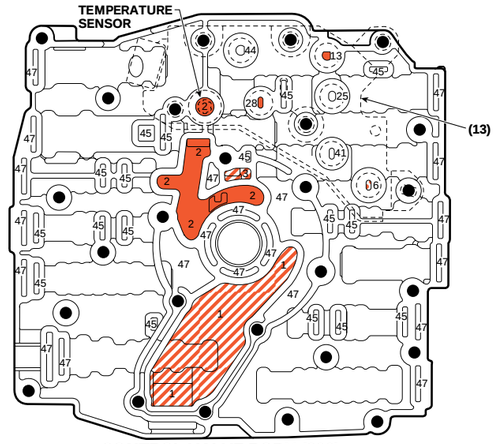
OIL PUMP COVER (217)/
OIL PUMP BODY (216)
(Oil Pump Base Side)



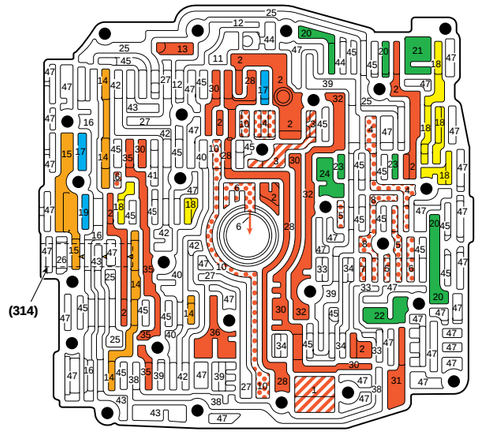
OIL PUMP BASE (201)
(Oil Pump Body Side)



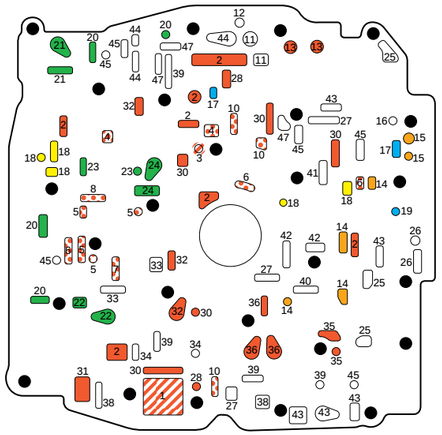
OIL PUMP BASE (201)
(Control Valve Body Side)



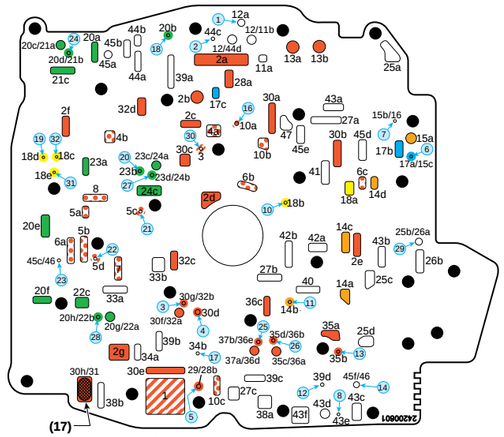
CONTROL VALVE BODY (300)
(Oil Pump Base Side)



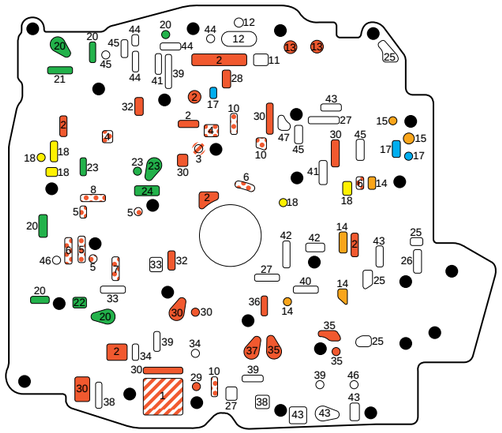
CONTROL VALVE BODY (300)
(Channel Plate Side)



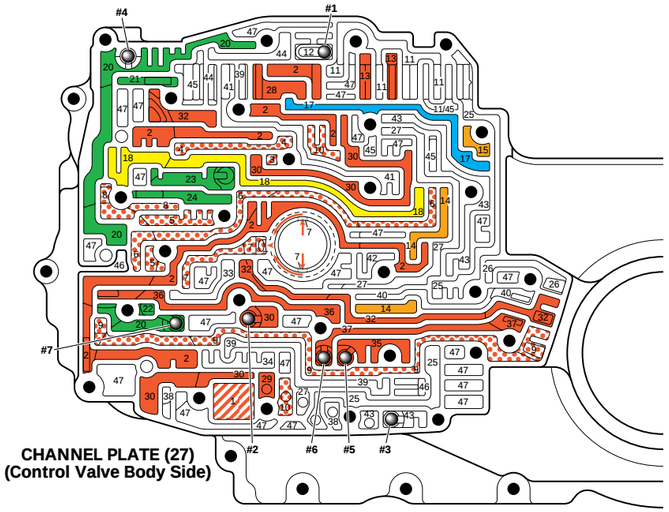
GASKET (22)
(V.B./ Spacer Plate)



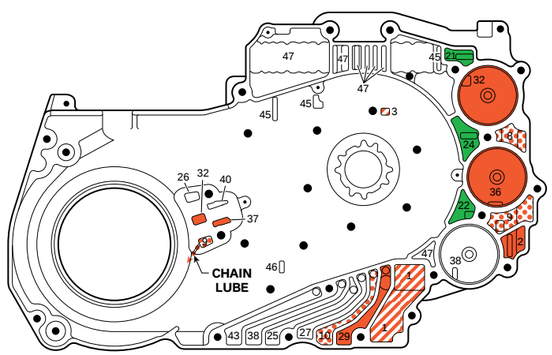
SPACER PLATE (23)
(V.B./ Case Cover)



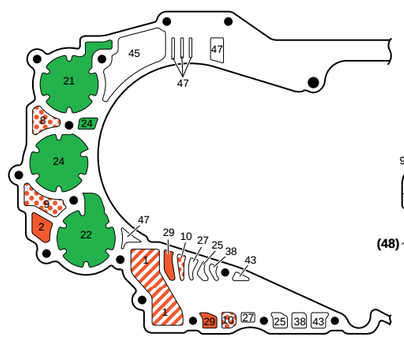
GASKET (24)
(Spacer Plate/ Channel Plate)



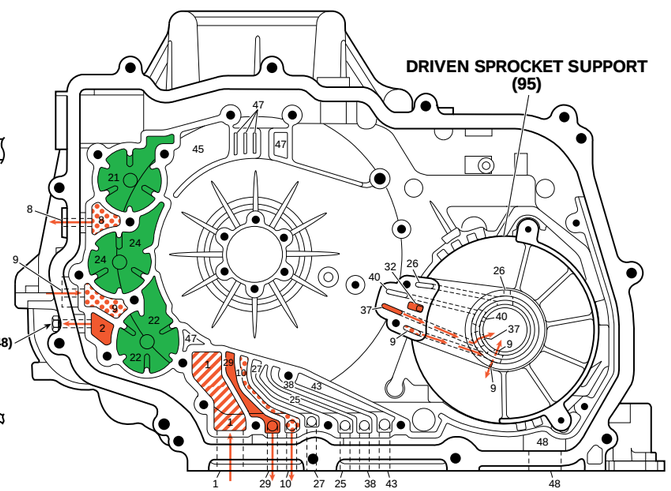
CHANNEL PLATE (27)
(Control Valve Body Side)



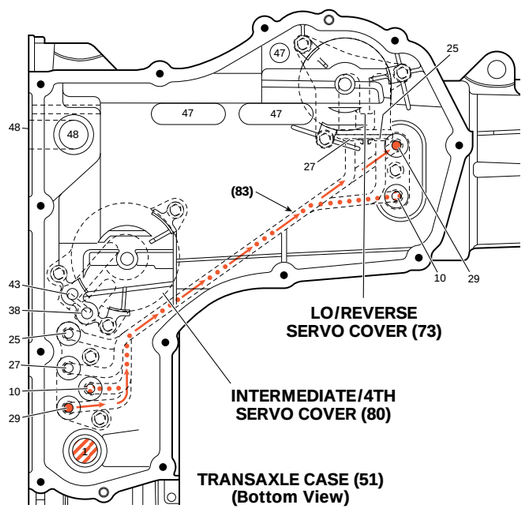
CHANNEL PLATE (27)
(Case Side)



GASKET (28)
(Channel Plate/Case)



TRANSAXLE CASE (51)
(Channel Plate Face)



TRANSAXLE CASE (51)
(Bottom View)

Figure 92

FOLDOUT ➤ 97

MANUAL THIRD – THIRD GEAR (From Overdrive Range – Fourth Gear)

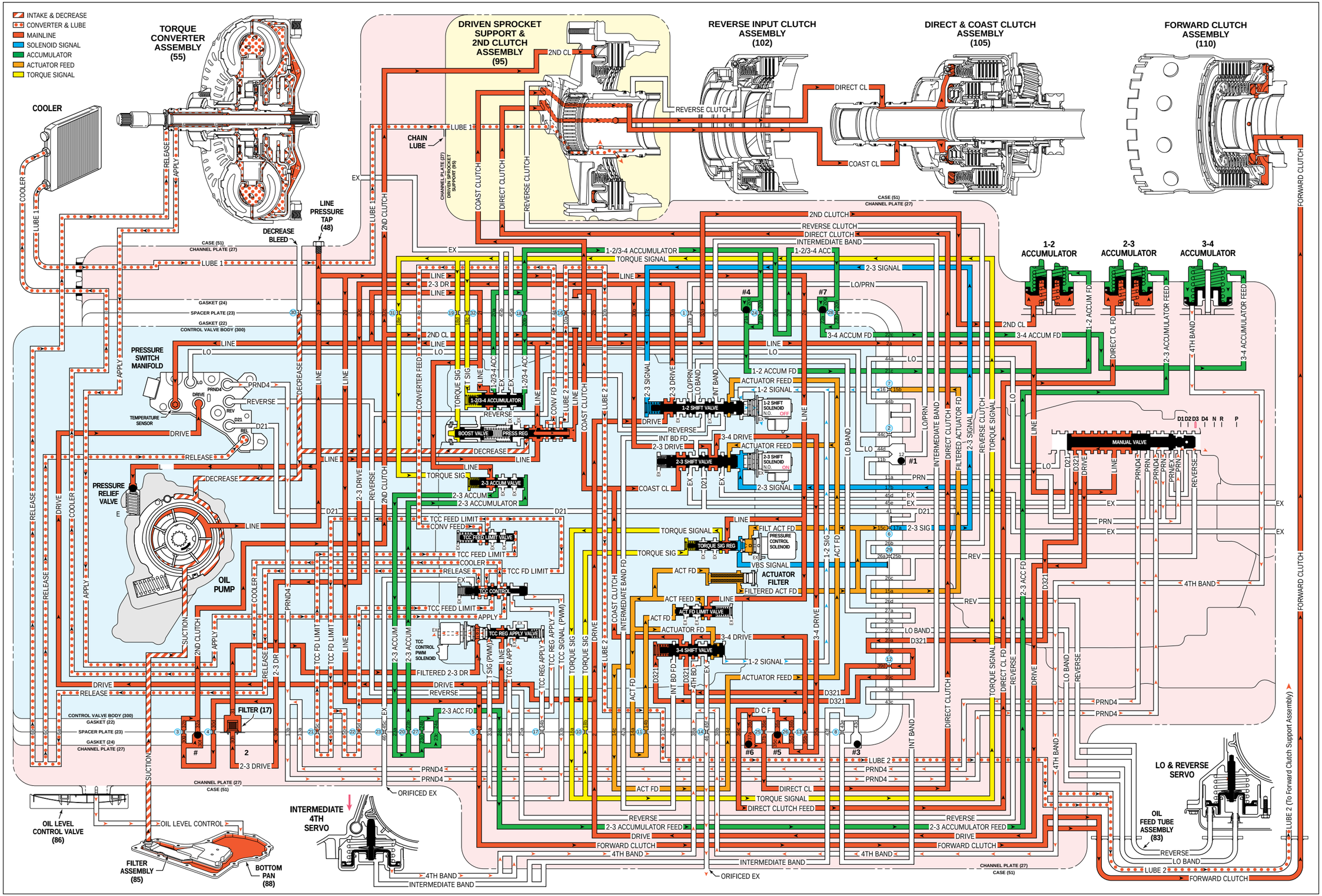


Figure 93

MANUAL THIRD - THIRD GEAR
(From Overdrive Range - Fourth Gear)

NO THIRD GEAR/SLIPS IN THIRD

See Overdrive Range – Third Gear (page 92A) for possible faults and conditions related to normal third gear operation.

NO ENGINE COMPRESSION BRAKING

- **Coast Clutch**
  - – Piston and Seal Assembly (504) – Binding, cracked, leaking.
  - – Clutch Plates (508, 509) – Friction material worn, splines broken.
  - – Springs (505) – Binding, broken.
  - – Direct & Coast Clutch Housing and Input Shaft (502) – Damaged, cracked, fluid feed holes restricted, seal rings leaking.
  - – Housing Retainer and Ball Assembly – Missing, loose, plugged.
- **Coast Clutch Fluid Routing**
  - – Valve Body Gaskets and Spacer Plate; Channel Plate and Gasket; Driven Sprocket Support – Porosity, misaligned, loose, fluid restriction, fluid leak across channels.
  - – Driven Sprocket Support Seals – Leaking.
  - – Input Shaft (502) – Seals leaking, Sleeve damaged, misaligned.
- **Fluid Level or Pressure**
  - – Low (See PARK page 82A).
- **3-4 Shift Valve (319)**
  - – Stuck in 4th gear position. (No coast clutch apply).
- **Manual Valve (800) / Shift Linkage**
  - – Misaligned.

SHIFT "A" SOL	SHIFT "B" SOL	2ND CLUTCH	2ND ROLLER CLUTCH	INT/4TH BAND	REVERSE CLUTCH	COAST CLUTCH	INPUT SPRAG	DIRECT CLUTCH	FORWARD CLUTCH	LO/REV. BAND	LO ROLLER CLUTCH
OFF	ON	APPLIED *	OVER-RUNNING			APPLIED	HOLDING	APPLIED	APPLIED		OVER-RUNNING

MANUAL THIRD - THIRD GEAR
(From Overdrive Range - Fourth Gear)

PASSAGES

1 SUCTION
2 LINE
3 DECREASE
4 CONVERTER FEED
5 TCC FEED LIMIT
6 RELEASE
7 APPLY
8 COOLER
9 LUBE 1
10 LUBE 2
11 PRN
12 LO/PRN
13 PRND4
14 ACTUATOR FEED
15 FILTERED ACTUATOR FEED
16 1-2 SIGNAL
17 2-3 SIGNAL
18 TORQUE SIGNAL
19 VBS SIGNAL
20 1-2/3-4 ACCUMULATOR
21 1-2 ACCUMULATOR FEED
22 3-4 ACCUMULATOR FEED
23 2-3 ACCUMULATOR
24 2-3 ACCUMULATOR FEED
25 REVERSE
26 REVERSE CLUTCH
27 LO BAND
28 DRIVE
29 FORWARD CLUTCH
30 2-3 DRIVE
31 FILTERED 2-3 DRIVE
32 2ND CLUTCH
33 TCC SIGNAL (PWM)
34 TCC REGULATED APPLY
35 3-4 DRIVE
36 DIRECT CLUTCH FEED
37 DIRECT CLUTCH
38 4TH BAND
39 D321
40 COAST CLUTCH
41 D21
42 INTERMEDIATE BAND FEED
43 INTERMEDIATE BAND
44 LO
45 EXHAUST
46 ORIFICED EXHAUST
47 VOID
48 OIL LEVEL CONTROL

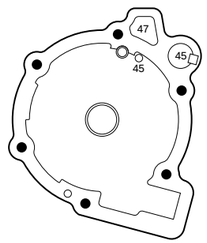
COMPONENTS ( )

(13) TRANSAXLE FLUID PRESSURE SWITCH ASSEMBLY (PSA)
(17) FILTER
(26) CHECKBALLS #1, 2, 3, 4, 5, 6 & 7
(48) PLUG, LINE PRESSURE TAP
(83) TUBE ASSEMBLY, OIL FEED
(314) FILTER, ACTUATOR OIL

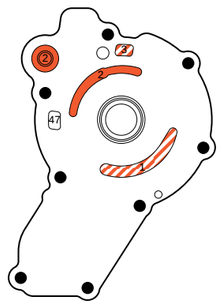
MANUAL THIRD – THIRD GEAR (From Overdrive Range – Fourth Gear)

NOTE:

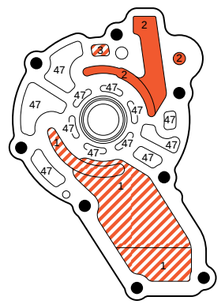
- ● INDICATES BOLT HOLES
- NON- FUNCTIONAL HOLES HAVE BEEN REMOVED FROM COMPONENT DRAWINGS TO TO SIMPLIFY TRACING FLUID FLOW.
- DUAL PURPOSE PASSAGES HAVE CHANNEL PLATE SIDE PASSAGES LISTED FIRST
- EXHAUST FLUID NOT SHOWN



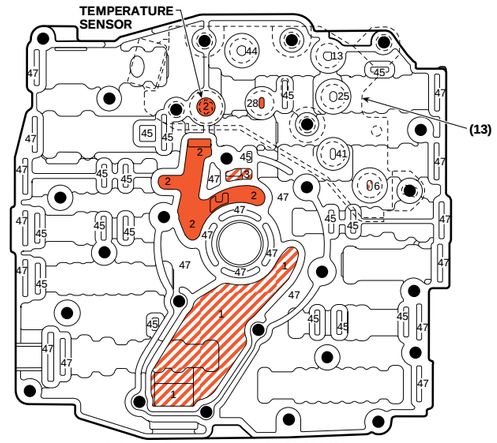
OIL PUMP COVER (217)/
OIL PUMP BODY (216)
(Oil Pump Base Side)



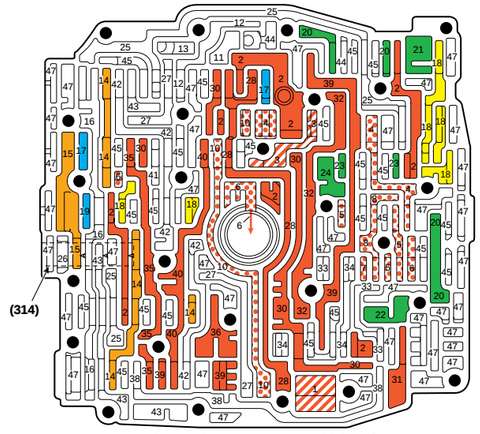
OIL PUMP BASE (201)
(Oil Pump Body Side)



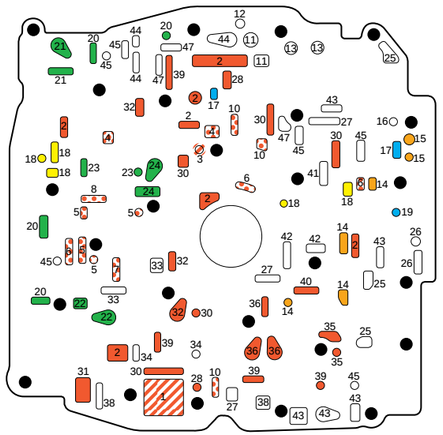
OIL PUMP BASE (201)
(Control Valve Body Side)



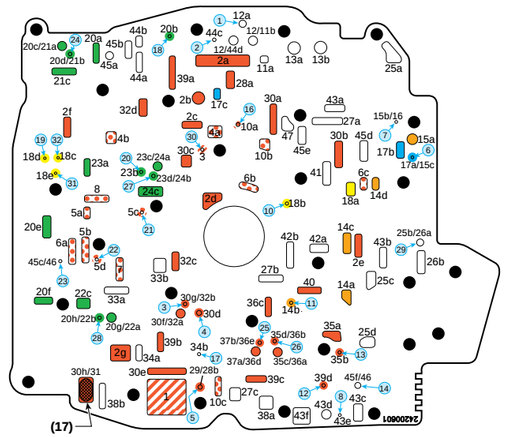
CONTROL VALVE BODY (300)
(Oil Pump Base Side)



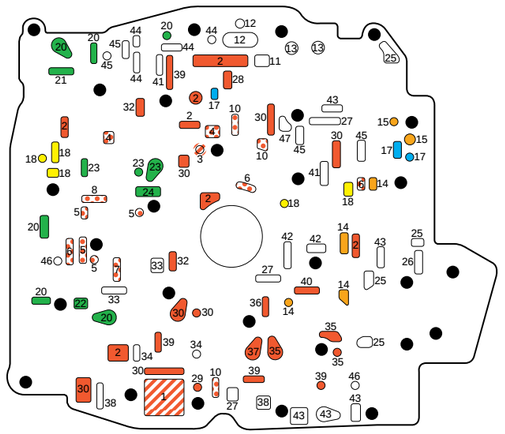
CONTROL VALVE BODY (300)
(Channel Plate Side)



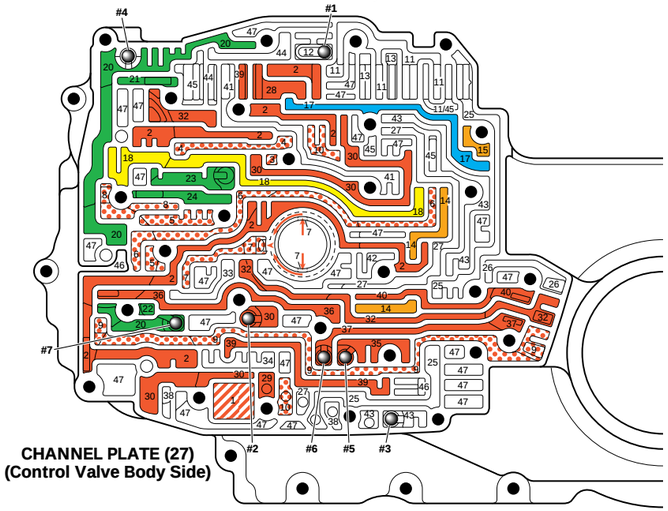
GASKET (22)
(V.B./ Spacer Plate)



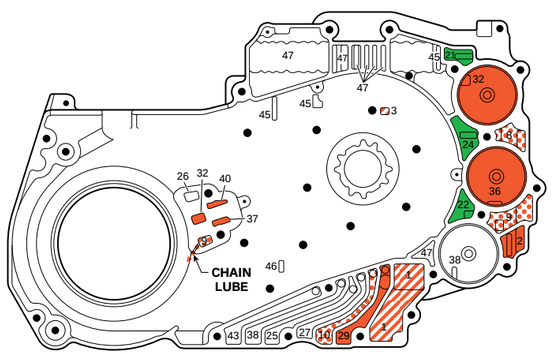
SPACER PLATE (23)
(V.B./ Case Cover)



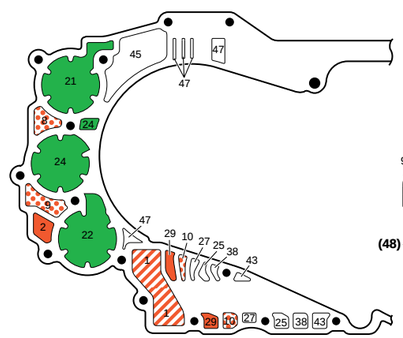
GASKET (24)
(Spacer Plate/ Channel Plate)



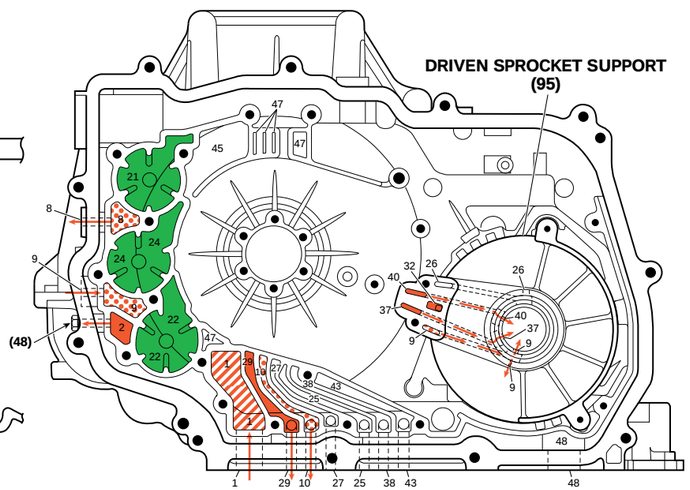
CHANNEL PLATE (27)
(Control Valve Body Side)



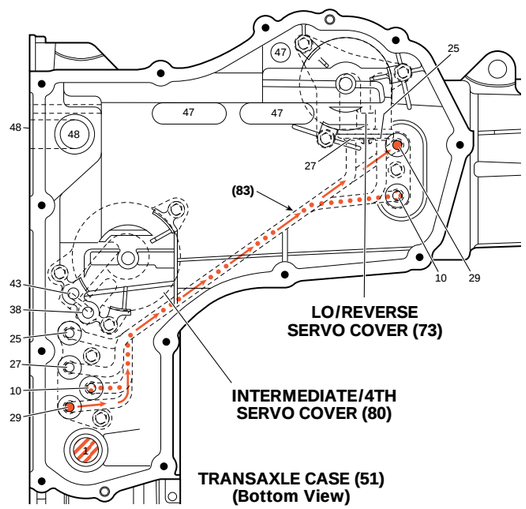
CHANNEL PLATE (27)
(Case Side)



GASKET (28)
(Channel Plate/Case)



TRANSAXLE CASE (51)
(Channel Plate Face)



TRANSAXLE CASE (51)
(Bottom View)

Figure 94

FOLDOUT ➤ 99

MANUAL SECOND – SECOND GEAR (From Manual Third – Third Gear)

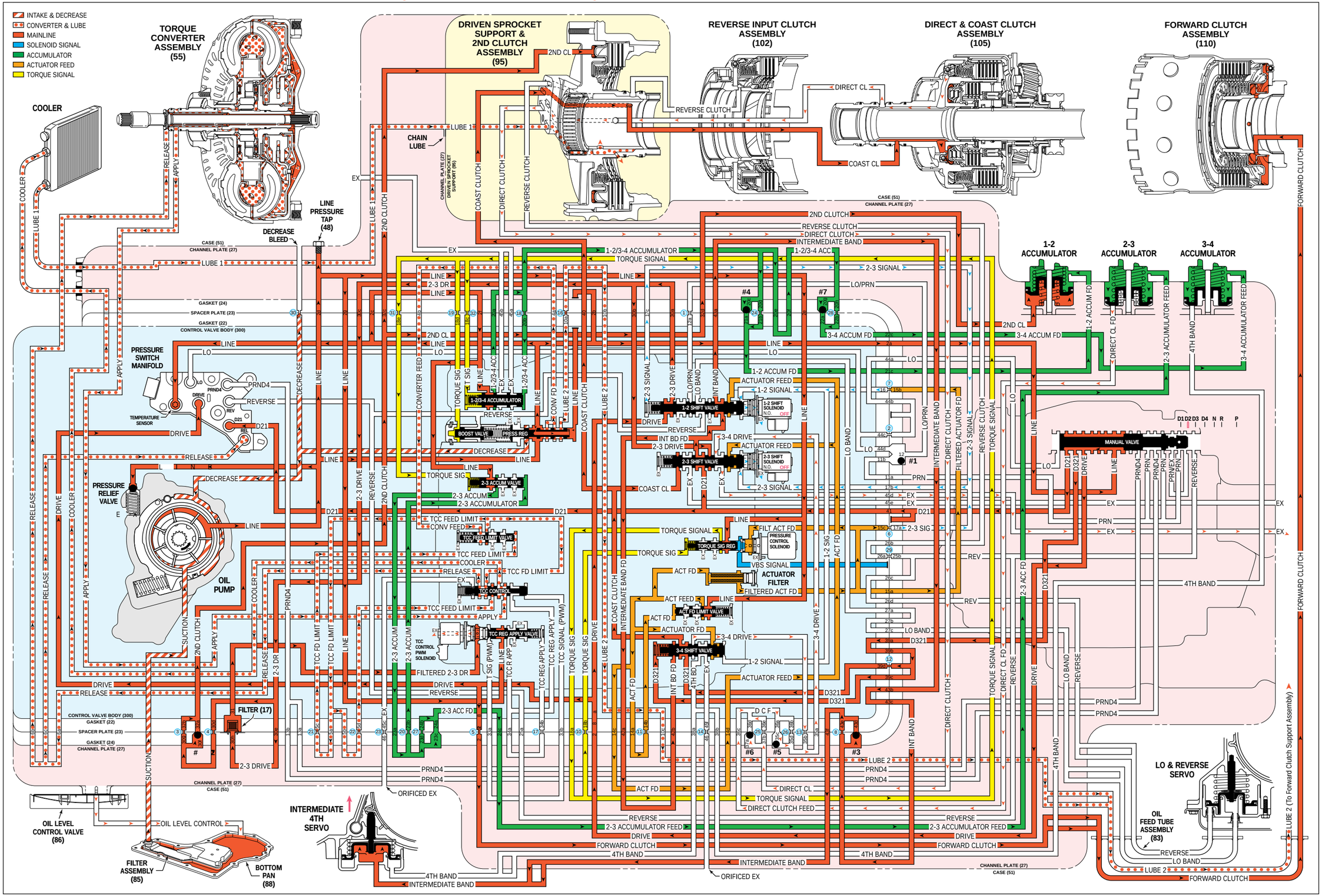


Figure 95

MANUAL SECOND - SECOND GEAR
(From Manual Third - Third Gear)

NO MANUAL SECOND GEAR

See Overdrive Range – Second Gear (page 90A) for possible faults and conditions related to normal second gear operation.

NO ENGINE COMPRESSION BRAKING

- **Coast Clutch**
  - No apply / slipping (See MANUAL THIRD page 98A)
- **Intermediate / 4th Band & Servo**
  - No apply / slipping.
  - Servo Piston (77) – Broken, binding.
  - Servo Piston Seals (78, 79) – Leaking.
  - Servo Pin (76) and Springs (75, 68) – Binding, broken.
  - Servo Cover (80) – Broken, loose, leaking.
  - Band (100) – Broken, worn, out of position.
  - Case (51) – Cracked at band seat.
- **Band Apply Fluid Routing**
  - Valve Body, Gaskets & Spacer Plate; Channel Plate; Case – Porosity, misaligned, loose, fluid restriction, fluid leak across channels.
- **Pressure Switch Assembly (13)**
  - Leaking, inoperative.

SHIFT "A" SOL	SHIFT "B" SOL	2ND CLUTCH	2ND ROLLER CLUTCH	INT/4TH BAND	REVERSE CLUTCH	COAST CLUTCH	INPUT SPRAG	DIRECT CLUTCH	FORWARD CLUTCH	LO/REV. BAND	LO ROLLER CLUTCH
OFF	OFF	APPLIED	HOLDING	APPLIED		APPLIED	HOLDING		APPLIED		OVER-RUNNING

MANUAL SECOND - SECOND GEAR
(From Manual Third - Third Gear)

PASSAGES

1 SUCTION
2 LINE
3 DECREASE
4 CONVERTER FEED
5 TCC FEED LIMIT
6 RELEASE
7 APPLY
8 COOLER
9 LUBE 1
10 LUBE 2
11 PRN
12 LO/PRN
13 PRND4
14 ACTUATOR FEED
15 FILTERED ACTUATOR FEED
16 1-2 SIGNAL
17 2-3 SIGNAL
18 TORQUE SIGNAL
19 VBS SIGNAL
20 1-2/3-4 ACCUMULATOR
21 1-2 ACCUMULATOR FEED
22 3-4 ACCUMULATOR FEED
23 2-3 ACCUMULATOR
24 2-3 ACCUMULATOR FEED
25 REVERSE
26 REVERSE CLUTCH
27 LO BAND
28 DRIVE
29 FORWARD CLUTCH
30 2-3 DRIVE
31 FILTERED 2-3 DRIVE
32 2ND CLUTCH
33 TCC SIGNAL (PWM)
34 TCC REGULATED APPLY
35 3-4 DRIVE
36 DIRECT CLUTCH FEED
37 DIRECT CLUTCH
38 4TH BAND
39 D321
40 COAST CLUTCH
41 D21
42 INTERMEDIATE BAND FEED
43 INTERMEDIATE BAND
44 LO
45 EXHAUST
46 ORIFICED EXHAUST
47 VOID
48 OIL LEVEL CONTROL

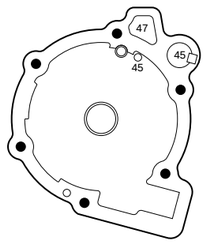
COMPONENTS ( )

(13) TRANSAXLE FLUID PRESSURE SWITCH ASSEMBLY (PSA)
(17) FILTER
(26) CHECKBALLS #1, 2, 3, 4, 5, 6 & 7
(48) PLUG, LINE PRESSURE TAP
(83) TUBE ASSEMBLY, OIL FEED
(314) FILTER, ACTUATOR OIL

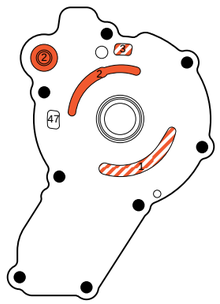
MANUAL SECOND – SECOND GEAR (From Manual Third – Third Gear)

NOTE:

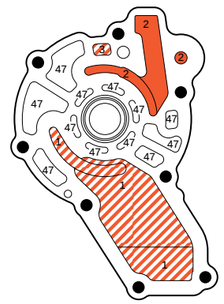
- ● INDICATES BOLT HOLES
- NON- FUNCTIONAL HOLES HAVE BEEN REMOVED FROM COMPONENT DRAWINGS TO TO SIMPLIFY TRACING FLUID FLOW.
- DUAL PURPOSE PASSAGES HAVE CHANNEL PLATE SIDE PASSAGES LISTED FIRST
- EXHAUST FLUID NOT SHOWN



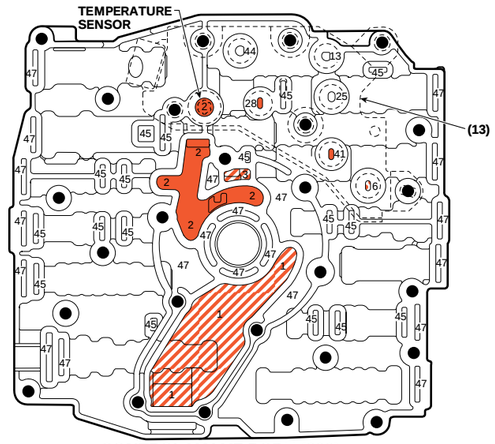
OIL PUMP COVER (217)/
OIL PUMP BODY (216)
(Oil Pump Base Side)



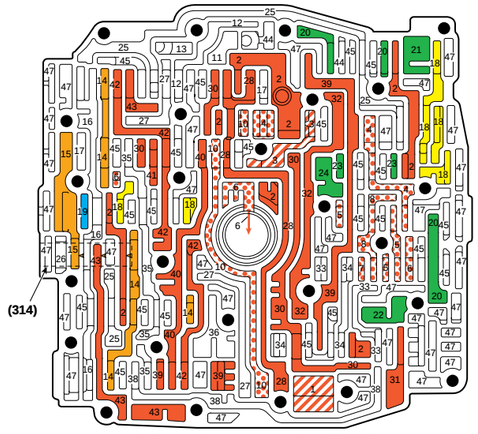
OIL PUMP BASE (201)
(Oil Pump Body Side)



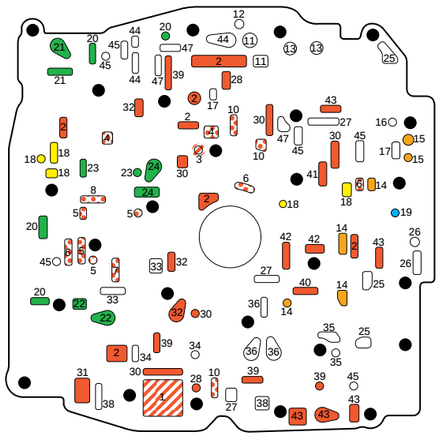
OIL PUMP BASE (201)
(Control Valve Body Side)



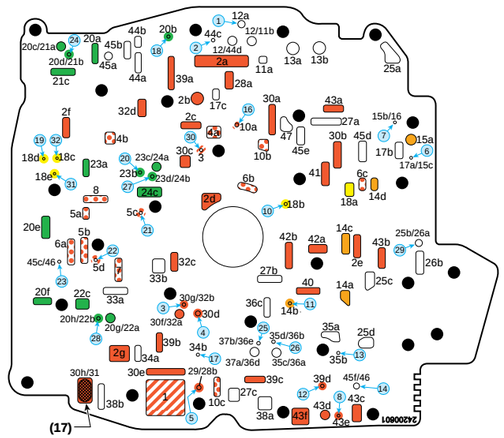
CONTROL VALVE BODY (300)
(Oil Pump Base Side)



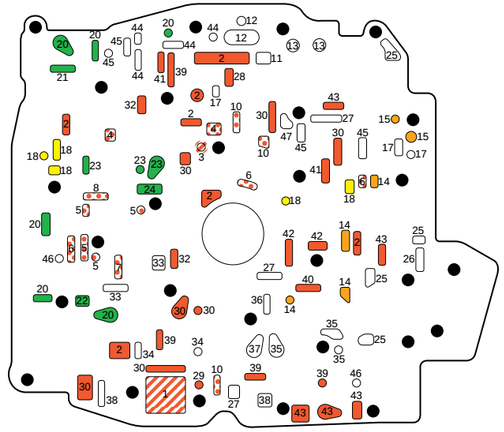
CONTROL VALVE BODY (300)
(Channel Plate Side)



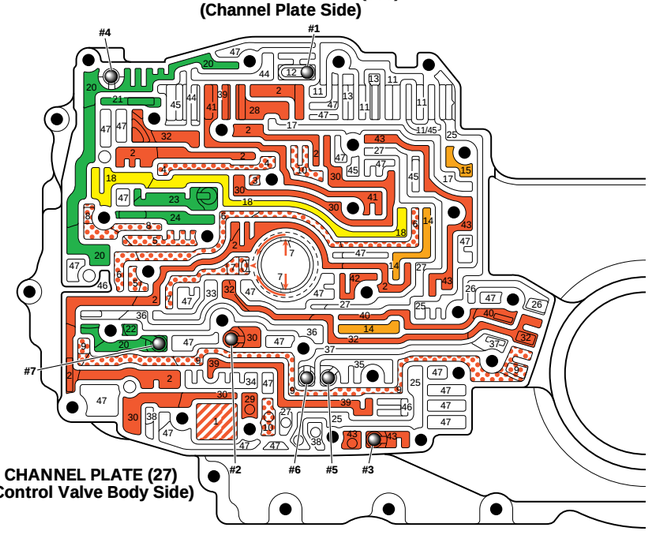
GASKET (22)
(V.B./ Spacer Plate)



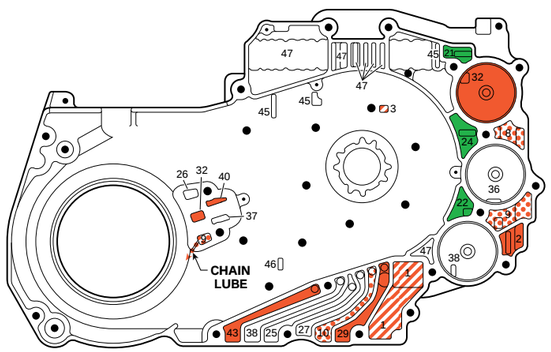
SPACER PLATE (23)
(V.B./ Case Cover)



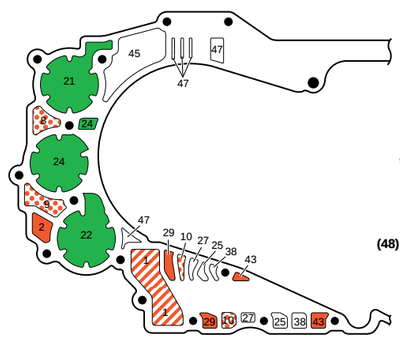
GASKET (24)
(Spacer Plate/ Channel Plate)



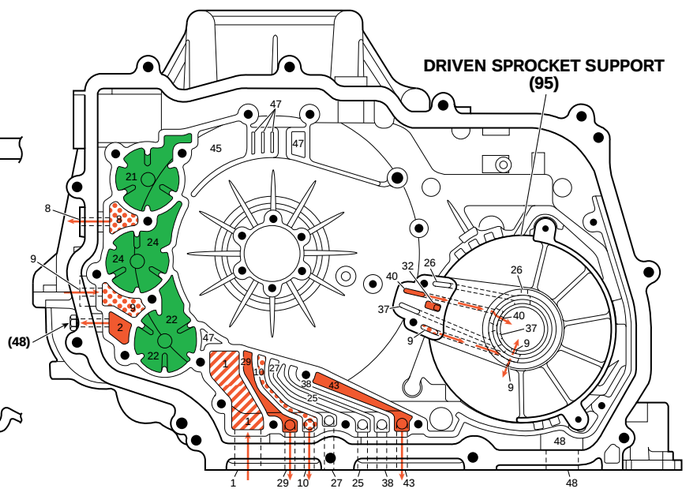
CHANNEL PLATE (27)
(Control Valve Body Side)



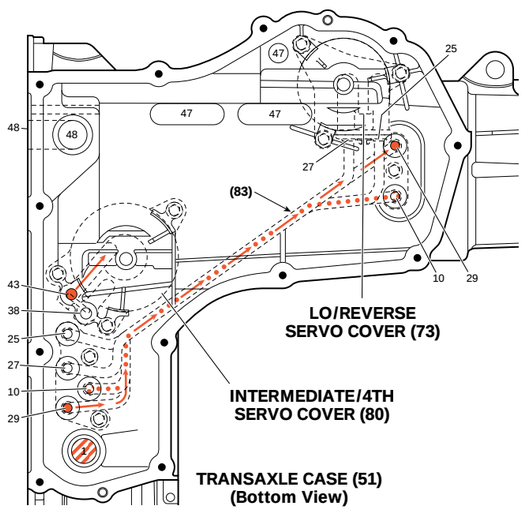
CHANNEL PLATE (27)
(Case Side)



GASKET (28)
(Channel Plate/Case)



TRANSAXLE CASE (51)
(Channel Plate Face)



TRANSAXLE CASE (51)
(Bottom View)

Figure 96

FOLDOUT ➤ 101

MANUAL FIRST – FIRST GEAR (From Manual Second – Second Gear)

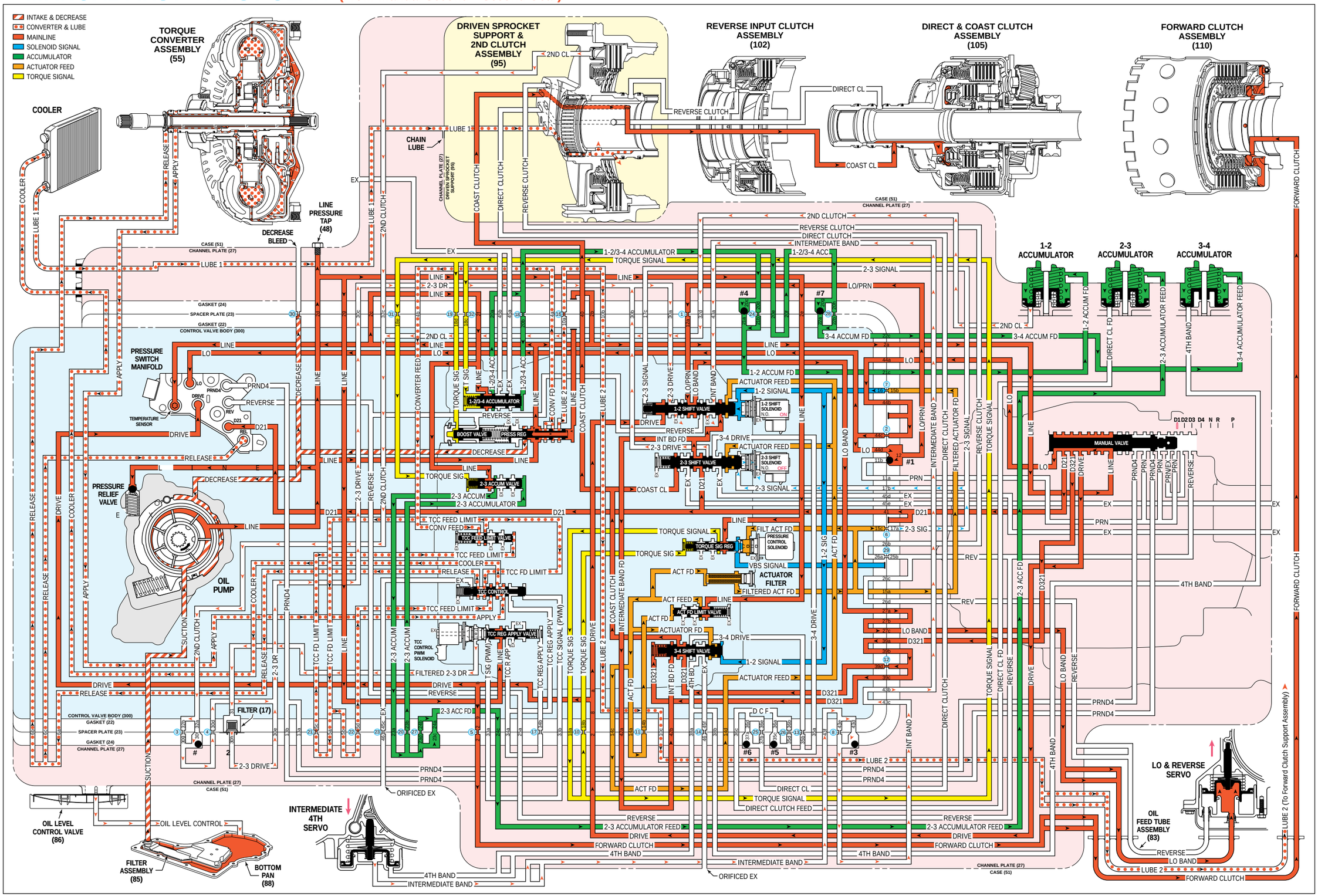


Figure 97

MANUAL FIRST - FIRST GEAR
(From Manual Second - Second Gear)

NO MANUAL FIRST GEAR

See Overdrive Range – First Gear (page 88A) for possible faults and conditions related to normal first gear operation.

NO ENGINE COMPRESSION BRAKING

- **Coast Clutch**
  - No apply / slipping (See MANUAL THIRD page 98A)
- **Lo & Reverse Band and Servo**
  - Servo Piston (69) – Broken, binding.
  - Servo Piston Seals (71, 72) – Leaking.
  - Servo Pin (67) and Springs (66, 68) – Binding, broken.
  - Servo Cover (73) – Broken, loose, leaking.
  - Lo & Reverse Band (111) – Broken, worn, out of position.
  - Anchor Pin (64) – Broken.
  - Fluid Feed Tubes (83) – Broken, bent, plugged, seal rings missing / leaking.
  - Transaxle Case (51) – Porosity, fluid leak or restriction.
- **Pressure Switch Assembly (13)**
  - Leaking, inoperative.
- **#1 Checkball (LO/PRN)**
  - Missing.

SHIFT "A" SOL	SHIFT "B" SOL	2ND CLUTCH	2ND ROLLER CLUTCH	INT/4TH BAND	REVERSE CLUTCH	COAST CLUTCH	INPUT SPRAG	DIRECT CLUTCH	FORWARD CLUTCH	LO/REV. BAND	LO ROLLER CLUTCH
ON	OFF					APPLIED	HOLDING		APPLIED	APPLIED	HOLDING

MANUAL FIRST - FIRST GEAR
(From Manual Second - Second Gear)

PASSAGES

1 SUCTION
2 LINE
3 DECREASE
4 CONVERTER FEED
5 TCC FEED LIMIT
6 RELEASE
7 APPLY
8 COOLER
9 LUBE 1
10 LUBE 2
11 PRN
12 LO/PRN
13 PRND4
14 ACTUATOR FEED
15 FILTERED ACTUATOR FEED
16 1-2 SIGNAL
17 2-3 SIGNAL
18 TORQUE SIGNAL
19 VBS SIGNAL
20 1-2/3-4 ACCUMULATOR
21 1-2 ACCUMULATOR FEED
22 3-4 ACCUMULATOR FEED
23 2-3 ACCUMULATOR
24 2-3 ACCUMULATOR FEED
25 REVERSE
26 REVERSE CLUTCH
27 LO BAND
28 DRIVE
29 FORWARD CLUTCH
30 2-3 DRIVE
31 FILTERED 2-3 DRIVE
32 2ND CLUTCH
33 TCC SIGNAL (PWM)
34 TCC REGULATED APPLY
35 3-4 DRIVE
36 DIRECT CLUTCH FEED
37 DIRECT CLUTCH
38 4TH BAND
39 D321
40 COAST CLUTCH
41 D21
42 INTERMEDIATE BAND FEED
43 INTERMEDIATE BAND
44 LO
45 EXHAUST
46 ORIFICED EXHAUST
47 VOID
48 OIL LEVEL CONTROL

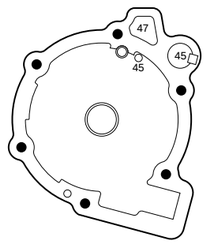
COMPONENTS ( )

(13) TRANSAXLE FLUID PRESSURE SWITCH ASSEMBLY (PSA)
(17) FILTER
(26) CHECKBALLS #1, 2, 3, 4, 5, 6 & 7
(48) PLUG, LINE PRESSURE TAP
(83) TUBE ASSEMBLY, OIL FEED
(314) FILTER, ACTUATOR OIL

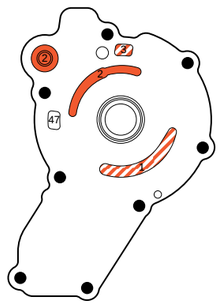
MANUAL FIRST – FIRST GEAR (From Manual Second – Second Gear)

NOTE:

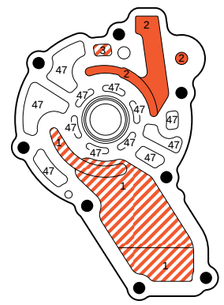
- ● INDICATES BOLT HOLES
- NON- FUNCTIONAL HOLES HAVE BEEN REMOVED FROM COMPONENT DRAWINGS TO TO SIMPLIFY TRACING FLUID FLOW.
- DUAL PURPOSE PASSAGES HAVE CHANNEL PLATE SIDE PASSAGES LISTED FIRST
- EXHAUST FLUID NOT SHOWN



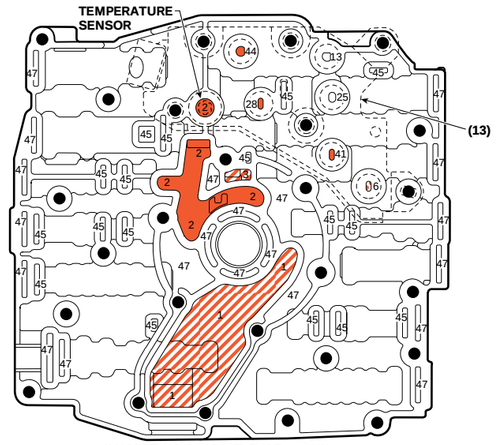
OIL PUMP COVER (217)/
OIL PUMP BODY (216)
(Oil Pump Base Side)



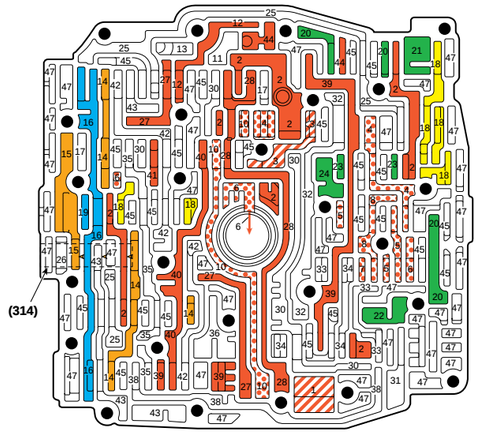
OIL PUMP BASE (201)
(Oil Pump Body Side)



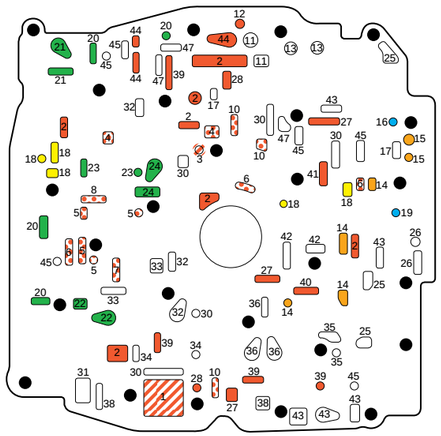
OIL PUMP BASE (201)
(Control Valve Body Side)



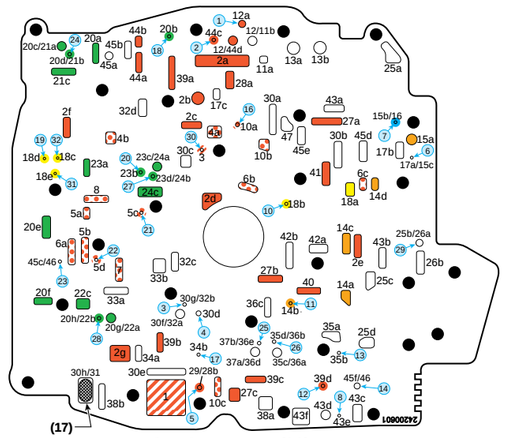
CONTROL VALVE BODY (300)
(Oil Pump Base Side)



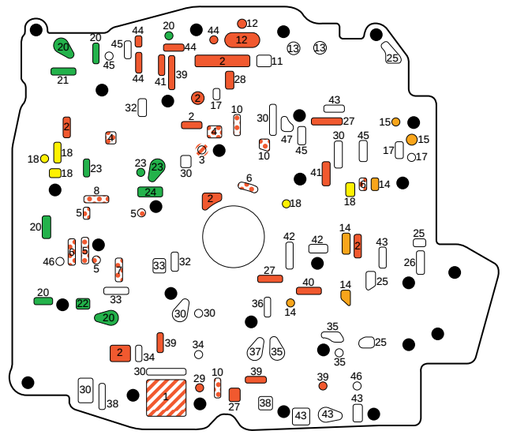
CONTROL VALVE BODY (300)
(Channel Plate Side)



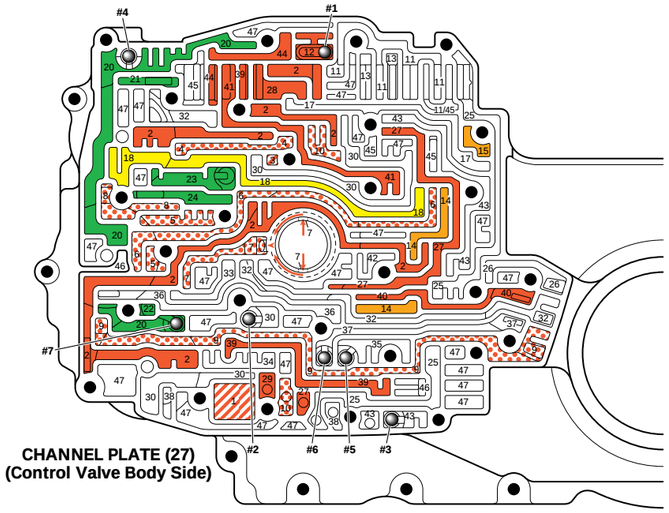
GASKET (22)
(V.B./ Spacer Plate)



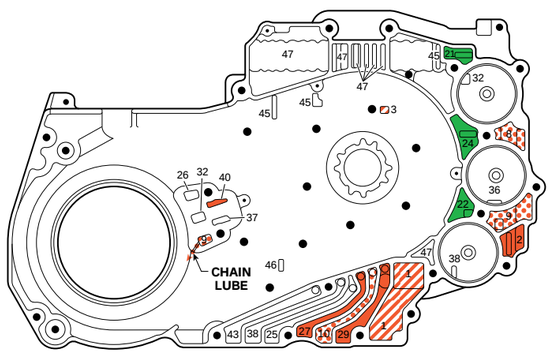
SPACER PLATE (23)
(V.B./ Case Cover)



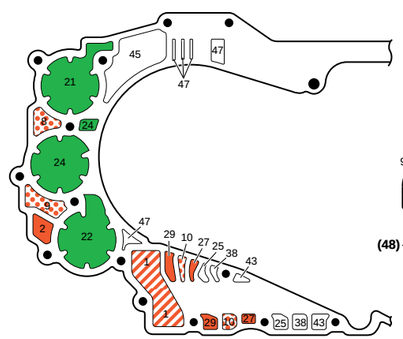
GASKET (24)
(Spacer Plate/ Channel Plate)



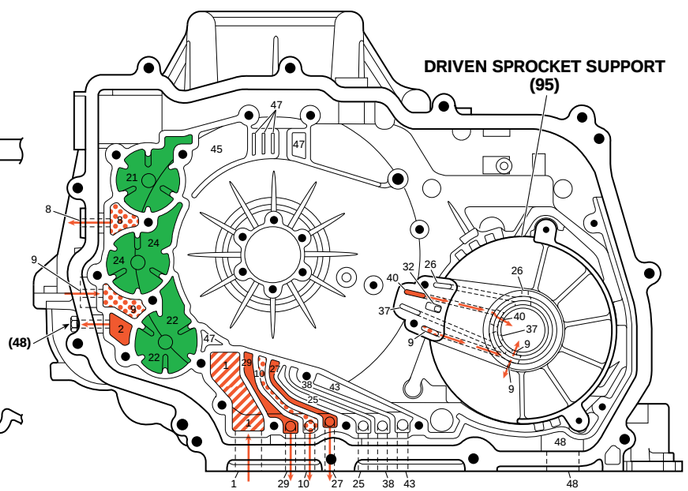
CHANNEL PLATE (27)
(Control Valve Body Side)



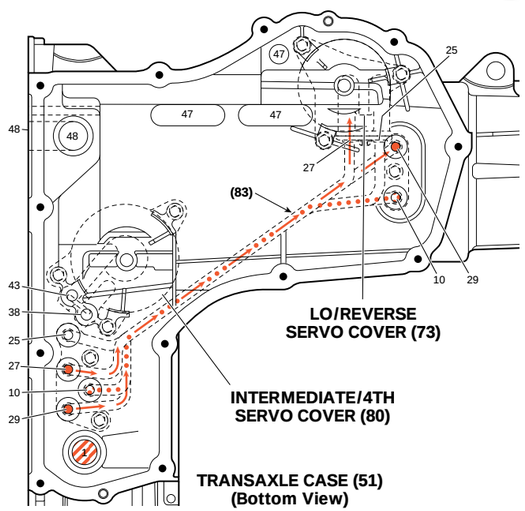
CHANNEL PLATE (27)
(Case Side)



GASKET (28)
(Channel Plate/Case)



TRANSAXLE CASE (51)
(Channel Plate Face)

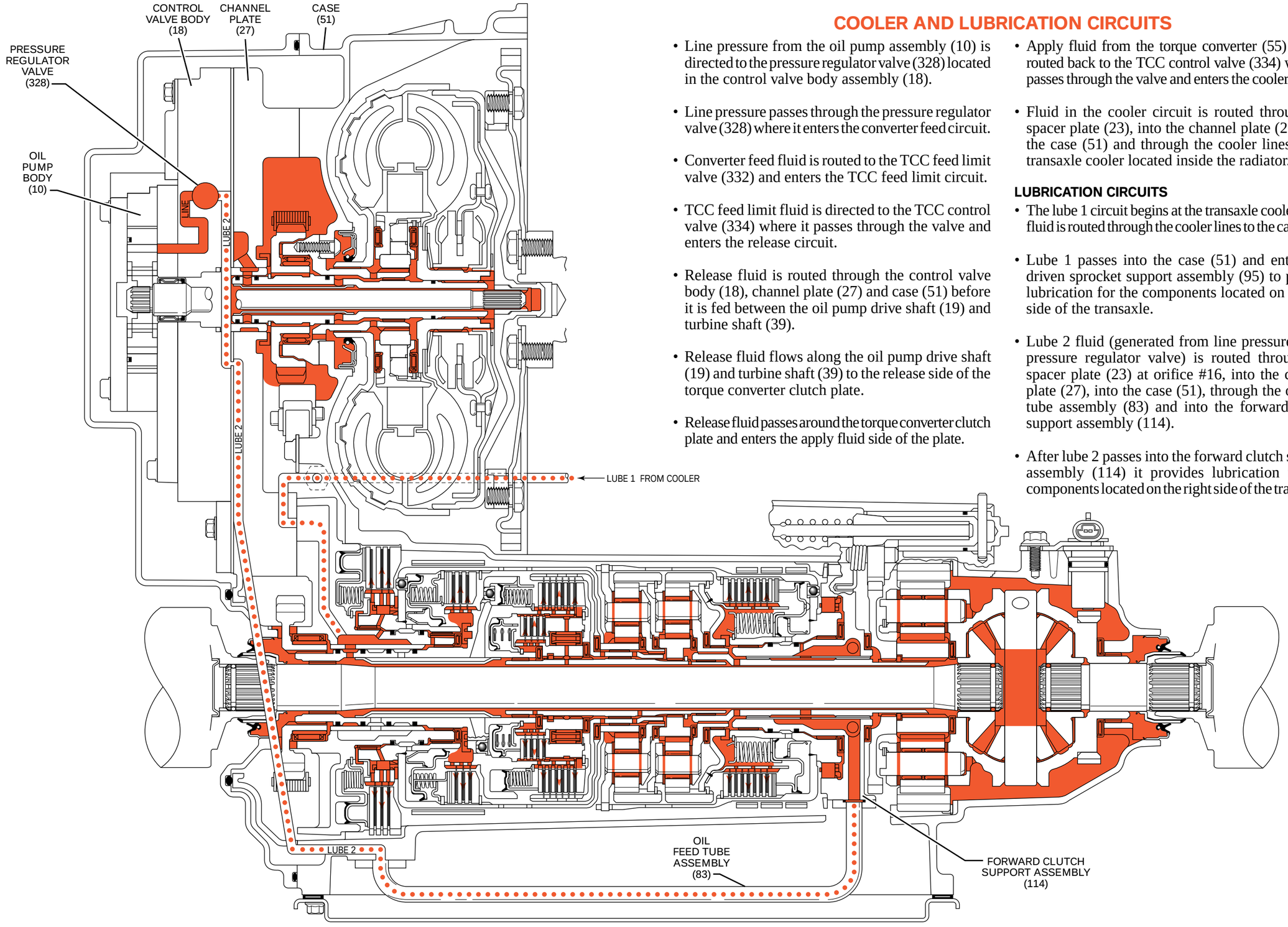


TRANSAXLE CASE (51)
(Bottom View)

Figure 98

FOLDOUT ➤ 103

LUBRICATION POINTS



COOLER AND LUBRICATION CIRCUITS

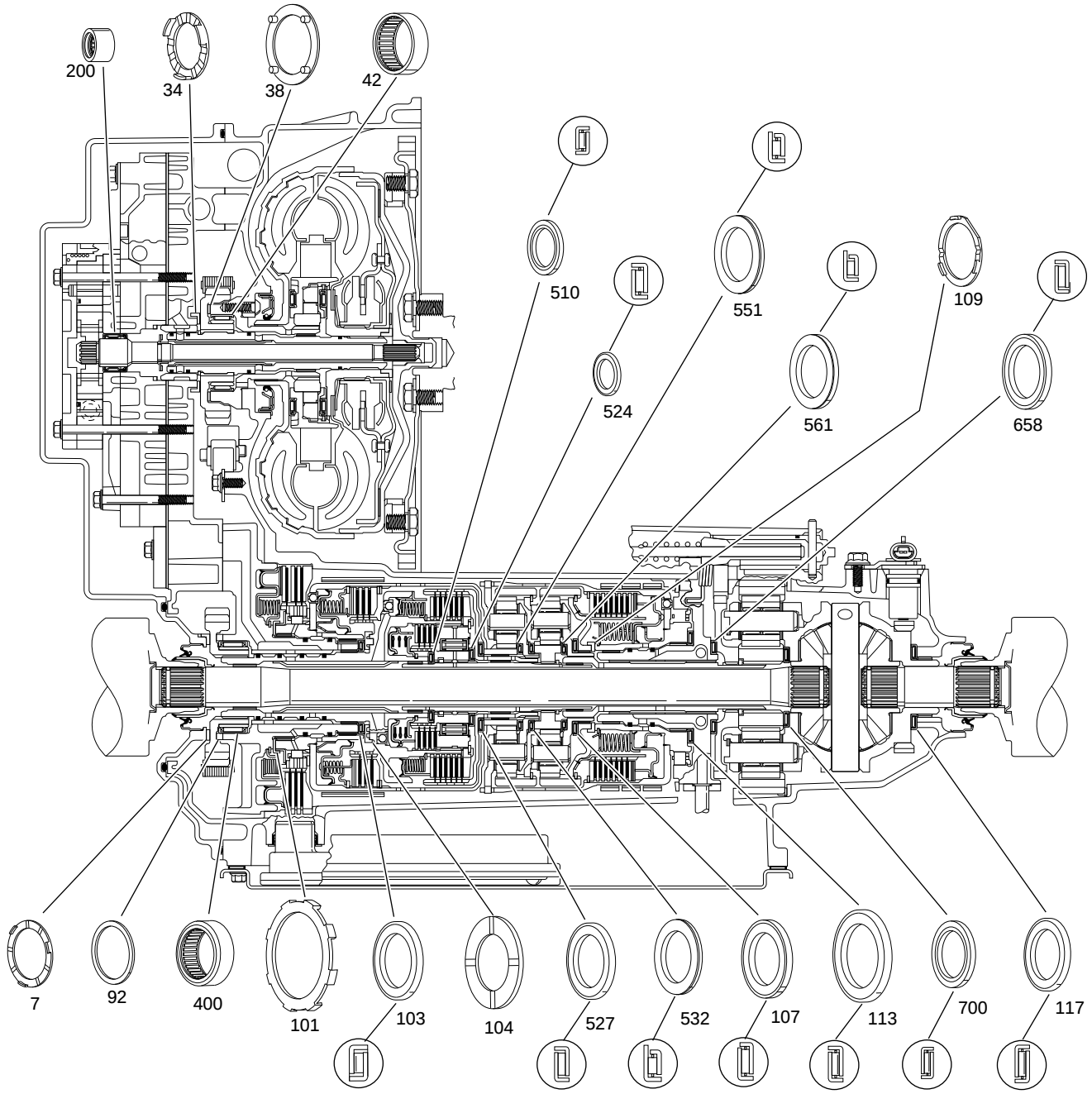
- Line pressure from the oil pump assembly (10) is directed to the pressure regulator valve (328) located in the control valve body assembly (18).
- Line pressure passes through the pressure regulator valve (328) where it enters the converter feed circuit.
- Converter feed fluid is routed to the TCC feed limit valve (332) and enters the TCC feed limit circuit.
- TCC feed limit fluid is directed to the TCC control valve (334) where it passes through the valve and enters the release circuit.
- Release fluid is routed through the control valve body (18), channel plate (27) and case (51) before it is fed between the oil pump drive shaft (19) and turbine shaft (39).
- Release fluid flows along the oil pump drive shaft (19) and turbine shaft (39) to the release side of the torque converter clutch plate.
- Release fluid passes around the torque converter clutch plate and enters the apply fluid side of the plate.
- Apply fluid from the torque converter (55) is then routed back to the TCC control valve (334) where it passes through the valve and enters the cooler circuit.
- Fluid in the cooler circuit is routed through the spacer plate (23), into the channel plate (27), into the case (51) and through the cooler lines to the transaxle cooler located inside the radiator.

LUBRICATION CIRCUITS

- The lube 1 circuit begins at the transaxle cooler when fluid is routed through the cooler lines to the case (51).
- Lube 1 passes into the case (51) and enters the driven sprocket support assembly (95) to provide lubrication for the components located on the left side of the transaxle.
- Lube 2 fluid (generated from line pressure at the pressure regulator valve) is routed through the spacer plate (23) at orifice #16, into the channel plate (27), into the case (51), through the oil feed tube assembly (83) and into the forward clutch support assembly (114).
- After lube 2 passes into the forward clutch support assembly (114) it provides lubrication for the components located on the right side of the transaxle.

Figure 99

BUSHING, BEARING & WASHER LOCATIONS



7 WASHER, THRUST (SIDE COVER TO DRIVEN SPROCKET)
34 WASHER, THRUST (CHANNEL PLATE TO DRIVE SPROCKET)
38 WASHER, THRUST (DRIVE SPROCKET TO SUPPORT)
42 BEARING, DRIVE SPROCKET SUPPORT
92 WASHER, THRUST (DRIVEN SPROCKET TO SUPPORT)
101 WASHER, THRUST (SUPPORT TO REVERSE INPUT CLUTCH)
103 BEARING, THRUST
104 WASHER, THRUST (SELECTIVE)
107 BEARING, THRUST
109 WASHER, THRUST
113 BEARING, THRUST
117 BEARING, THRUST
200 BEARING & SEAL ASSEMBLY, OIL PUMP
400 BEARING, DRIVEN SPROCKET SUPPORT
510 BEARING, THRUST
524 BEARING, THRUST
527 BEARING, THRUST (CARRIER SHAFT TO SHELL)
532 BEARING, THRUST (REACTION CARRIER TO SUN GEAR)
551 BEARING, THRUST
561 BEARING, THRUST
658 BEARING, THRUST (FORWARD SUPPORT TO PARK GEAR)
700 BEARING, THRUST

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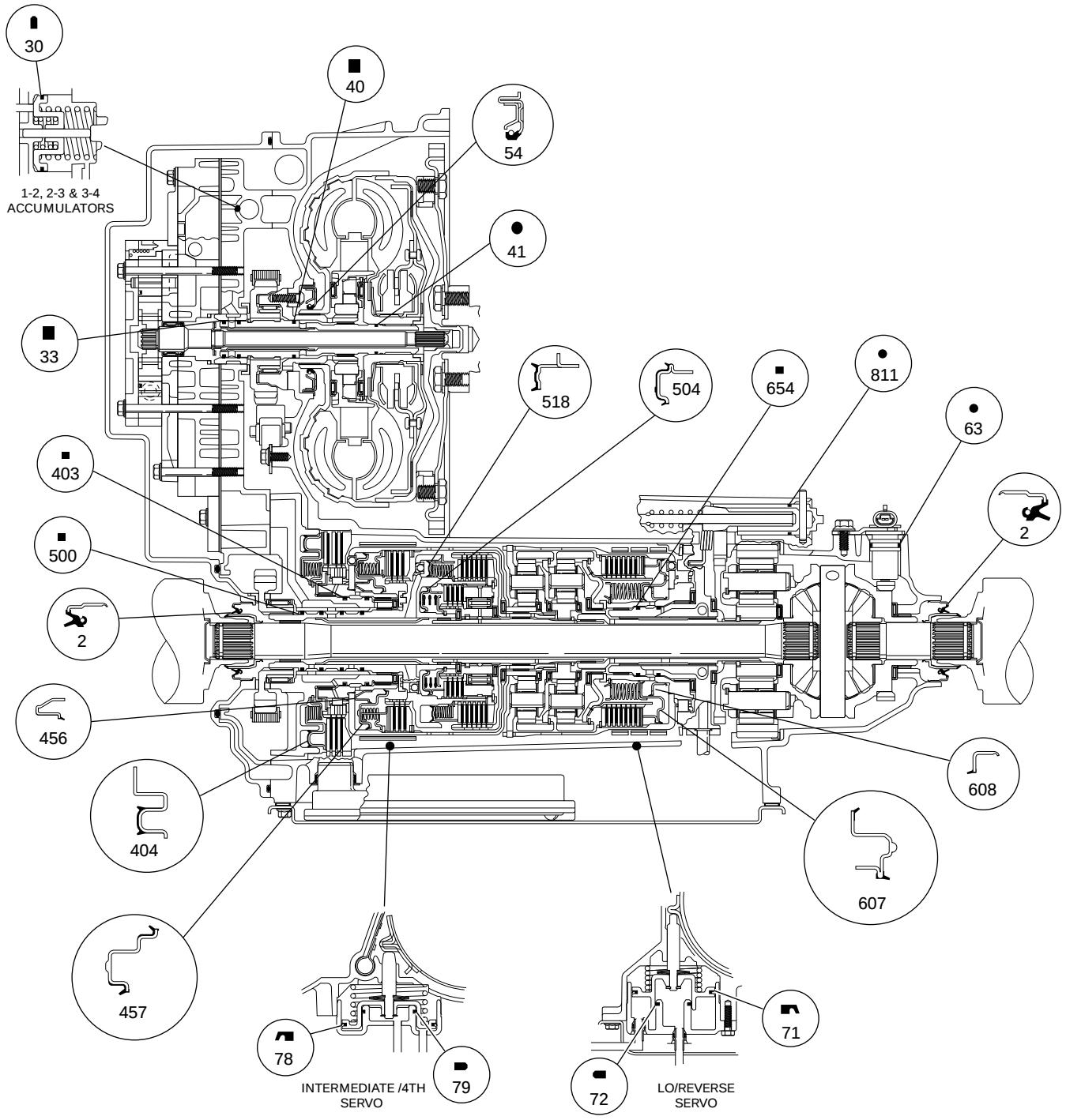
Figure 100

SEAL LOCATIONS



2 SEAL, AXLE OIL
30 SEAL, ACCUMULATOR PISTON (1-2, 2-3 AND 3-4)
39 SHAFT, TURBINE
40 SEAL, O-RING (TURBINE SHAFT TO SUPPORT)
41 SEAL, O-RING (TORQUE CONVERTER)
54 SEAL, CONVERTER
63 SEAL, O-RING (OUTPUT SPEED SENSOR)
71 SEAL, SERVO PISTON (LO/REVERSE)
72 SEAL, SERVO COVER (LO/REVERSE)
78 SEAL, SERVO PISTON (INTERMEDIATE/4TH)
79 SEAL, SERVO COVER (INTERMEDIATE/4TH)
403 RING, OIL SEAL
404 PISTON ASSEMBLY, 2ND CLUTCH
456 RETAINER & SEAL ASSEMBLY, REVERSE CLUTCH CENTER
457 PISTON ASSEMBLY, REVERSE CLUTCH
500 RING, OIL SEAL - INPUT SHAFT
504 PISTON ASSEMBLY, COAST CLUTCH
518 PISTON ASSEMBLY, DIRECT CLUTCH
607 PISTON ASSEMBLY, FORWARD CLUTCH
608 SEAL AND SLEEVE ASSEMBLY,FORWARD CLUTCH INNER
654 RING, OIL SEAL (FORWARD CLUTCH SUPPORT)
811 SEAL, ACTUATOR GUIDE

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Figure 101

ILLUSTRATED PARTS LIST

CASE AND ASSOCIATED PARTS

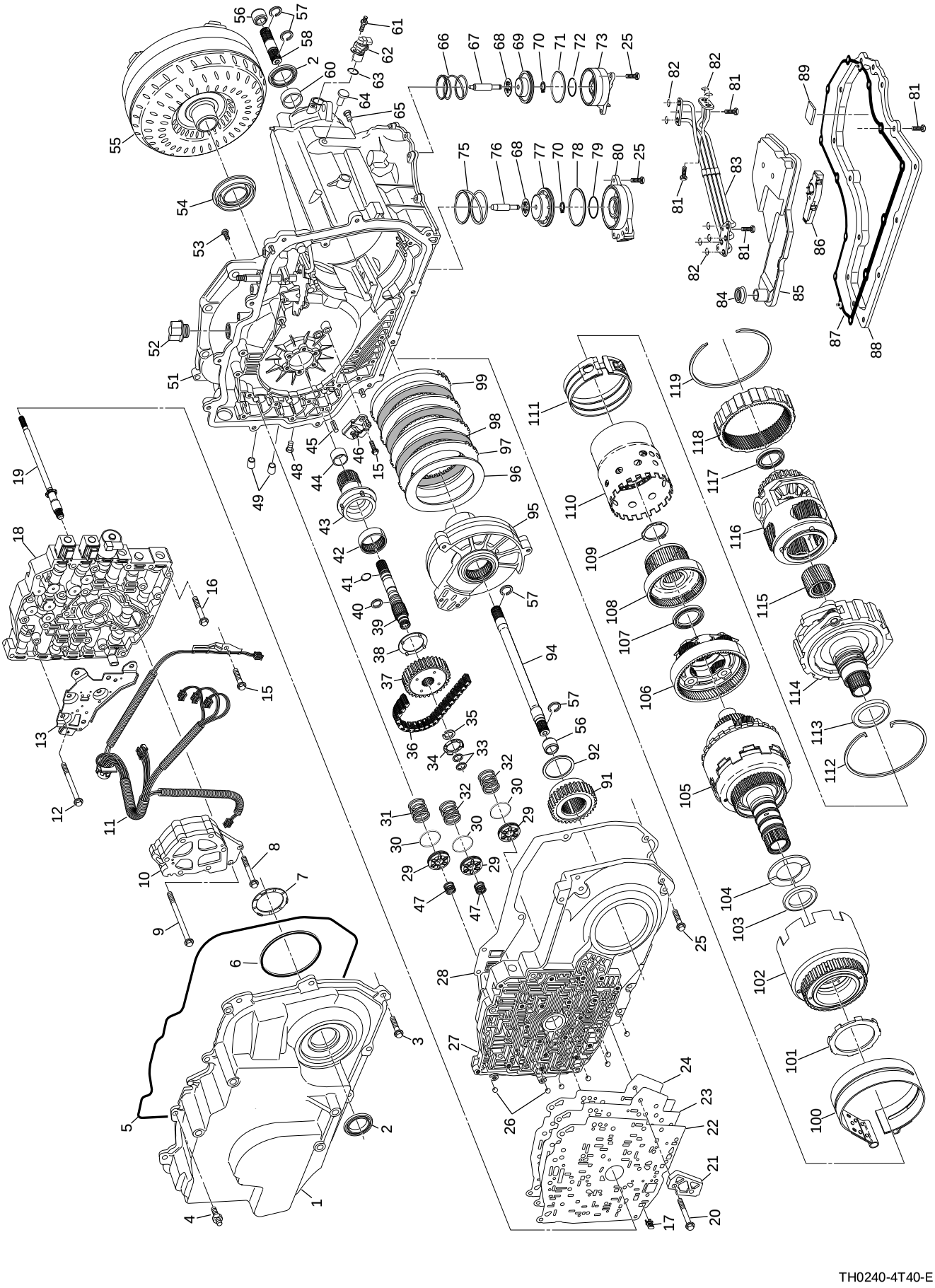


Figure 102

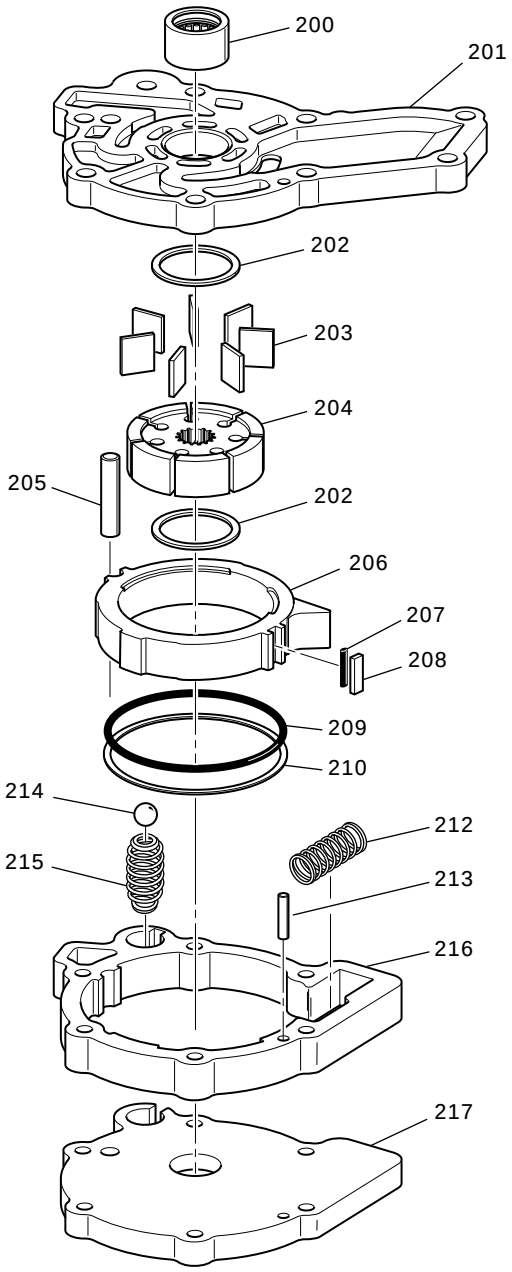
CASE AND ASSOCIATED PARTS

1 COVER, SIDE (STRUCTURAL)
2 SEAL, AXLE OIL
3 BOLT, SIDE COVER
4 STUD, SIDE COVER
5 GASKET, SIDE COVER
6 GASKET, SIDE COVER OIL LEVEL CONTROL
7 WASHER, THRUST (SIDE COVER TO DRIVEN SPROCKET)
8 BOLT, OIL PUMP
9 BOLT, OIL PUMP
10 PUMP ASSEMBLY, TRANSAXLE OIL
11 WIRING ASSEMBLY, TRANSAXLE
12 BOLT, PRESSURE SWITCH ASSEMBLY
13 PRESSURE SWITCH ASSEMBLY (PSA)
15 BOLT, WIRING HARNESS BRACKET
BOLT, INPUT SPEED SENSOR
16 BOLT, VALVE BODY
17 FILTER
18 BODY ASSEMBLY, CONTROL VALVE
19 SHAFT, OIL PUMP DRIVE
20 BOLT, SPACER PLATE SUPPORT
21 SUPPORT, SPACER PLATE
22 GASKET, VALVE BODY TO SPACER PLATE
23 PLATE, VALVE BODY SPACER
24 GASKET, SPACER PLATE TO CHANNEL PLATE
25 BOLT, CHANNEL PLATE
BOLT, SERVO COVER
26 CHECKBALLS (7)
27 PLATE, CHANNEL
28 GASKET, CASE TO CHANNEL PLATE
29 PISTON, ACCUMULATOR (1-2, 2-3 AND 3-4)
30 SEAL, ACCUMULATOR PISTON (1-2, 2-3 AND 3-4)
31 SPRING, 1-2 ACCUMULATOR PISTON
32 SPRING, 2-3 AND 3-4 ACCUMULATOR PISTON
33 SEAL, (TURBINE SHAFT TO CHANNEL PLATE SLEEVE)
34 WASHER, THRUST (CHANNEL PLATE TO DRIVE SPROCKET)
35 RING, SNAP (TURBINE SHAFT TO DRIVE SPROCKET)
36 LINK ASSEMBLY, DRIVE
37 SPROCKET, DRIVE
38 WASHER, THRUST (DRIVE SPROCKET TO SUPPORT)
39 SHAFT, TURBINE
40 SEAL, (TURBINE SHAFT TO SUPPORT)
41 SEAL, O-RING (TORQUE CONVERTER)
42 BEARING, DRIVE SPROCKET SUPPORT
43 SUPPORT, DRIVE SPROCKET
44 BUSHING, DRIVE SPROCKET SUPPORT
45 PIN, DOWEL (CHANNEL PLATE TO CASE)
46 SENSOR, INPUT SPEED
47 SPRINGS, 1-2 AND 2-3 ACCUMULATOR PISTON CUSHION
48 PLUG, LINE PRESSURE TAP
49 SEAL, COOLER PIPE
51 CASE, TRANSAXLE
52 CAP, VENT
53 SCREW, DRIVE SPROCKET SUPPORT
54 SEAL, CONVERTER
55 TORQUE CONVERTER ASSEMBLY
56 SLEEVE, OUTPUT/STUB SHAFT
57 RING, OUTPUT/STUB SHAFT SNAP
58 SHAFT, OUTPUT STUB
60 BUSHING, CASE TO FINAL DRIVE
61 STUD, OUTPUT SPEED SENSOR
62 SENSOR, OUTPUT SPEED
63 SEAL, O-RING (OUTPUT SPEED SENSOR)
64 PIN, BAND ANCHOR - LO/REVERSE
65 PLUG, OIL LEVEL CONTROL
66 SPRING, SERVO RETURN (LO/REVERSE)
67 PIN, SERVO APPLY (LO/REVERSE)
68 SPRING, SERVO CUSHION
69 PISTON, SERVO (LO/REVERSE)
70 RING, SERVO SNAP
71 SEAL, SERVO PISTON (LO/REVERSE)
72 SEAL, SERVO COVER (LO/REVERSE)
73 COVER, SERVO (LO/REVERSE)
75 SPRING, SERVO RETURN (INTERMEDIATE/4TH)
76 PIN, SERVO APPLY (INTERMEDIATE/4TH)
77 PISTON, SERVO (INTERMEDIATE/4TH)
78 SEAL, SERVO PISTON (INTERMEDIATE/4TH)
79 SEAL, SERVO COVER (INTERMEDIATE/4TH)
80 COVER, SERVO (INTERMEDIATE/4TH)
81 BOLT, TUBE ASSEMBLY
BOLT, BOTTOM PAN
82 SEAL, OIL FEED TUBE ASSEMBLY
83 TUBE ASSEMBLY, OIL FEED
84 SEAL, TRANSAXLE OIL FILTER
85 FILTER ASSEMBLY, TRANSAXLE OIL
86 VALVE, OIL LEVEL CONTROL
87 GASKET, TRANSAXLE BOTTOM PAN
88 PAN, TRANSAXLE OIL
89 MAGNET, CHIP COLLECTOR
91 SPROCKET, DRIVEN
92 WASHER, THRUST (DRIVEN SPROCKET TO SUPPORT)
94 SHAFT, OUTPUT
95 SUPPORT ASSEMBLY, DRIVEN SPROCKET
96 PLATE, 2ND CLUTCH WAVED
97 PLATE, 2ND CLUTCH STEEL
98 PLATE, 2ND CLUTCH FIBER
99 PLATE, 2ND CLUTCH BACKING
100 BAND, INTERMEDIATE/4TH
101 WASHER, THRUST (SUPPORT TO REVERSE INPUT CLUTCH)
102 CLUTCH ASSEMBLY, REVERSE INPUT
103 BEARING, THRUST
104 WASHER, THRUST (SELECTIVE)
105 CLUTCH ASSEMBLY, DIRECT & COAST
106 CARRIER ASSEMBLY, INPUT
107 BEARING, THRUST
108 INPUT FLANGE & FORWARD CLUTCH HUB ASSEMBLY
109 WASHER, THRUST
110 CLUTCH ASSEMBLY, FORWARD
111 BAND, LO/REVERSE
112 RING, SNAP (FORWARD CLUTCH SUPPORT TO CASE)
113 BEARING, THRUST
114 SUPPORT ASSEMBLY, FORWARD CLUTCH
115 GEAR, SUN (FINAL DRIVE)
116 DIFFERENTIAL AND FINAL DRIVE ASSEMBLY
117 BEARING, THRUST
118 GEAR, FINAL DRIVE INTERNAL
119 RING, FRETTING (INTERNAL GEAR TO CASE)

TH0241-4T40-E-R1

Figure 103

OIL PUMP ASSEMBLY



200 BEARING & SEAL ASSEMBLY, OIL PUMP
201 BASE, OIL PUMP
202 RING, OIL PUMP VANE
203 VANE, OIL PUMP
204 ROTOR, OIL PUMP
205 PIN, PIVOT (OIL PUMP SLIDE)
206 SLIDE, OIL PUMP
207 SUPPORT, OIL PUMP SLIDE SEAL
208 SEAL, OIL PUMP SLIDE
209 SEAL, O-RING (OIL PUMP SLIDE)
210 RING, FLUID SEAL (SLIDE TO BODY)
212 SPRING, OIL PUMP PRIMING
213 PIN, LOCATING
214 BALL, PRESSURE RELIEF
215 SPRING, PRESSURE RELIEF
216 BODY, OIL PUMP
217 COVER, PUMP

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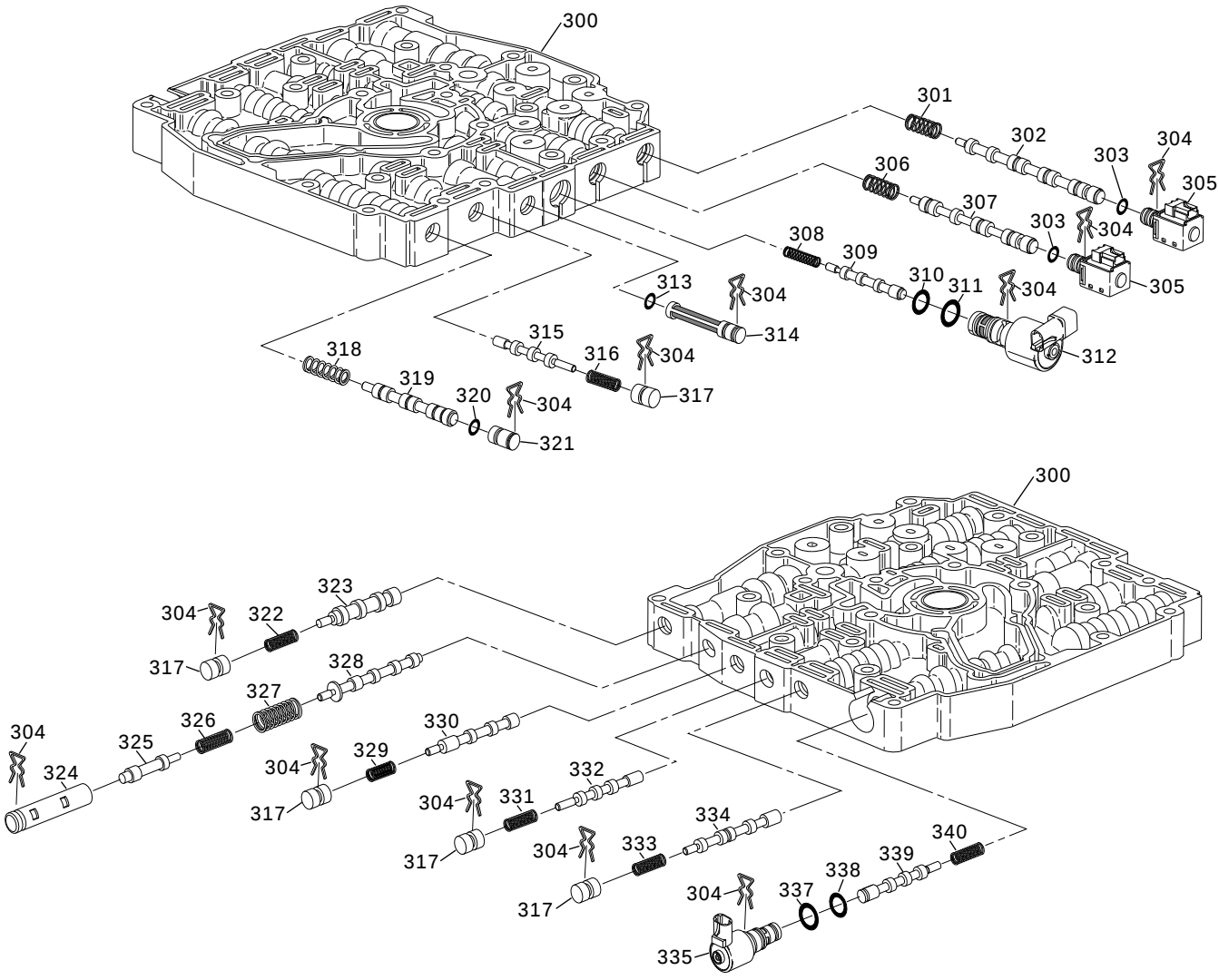
Figure 104

CONTROL VALVE ASSEMBLY

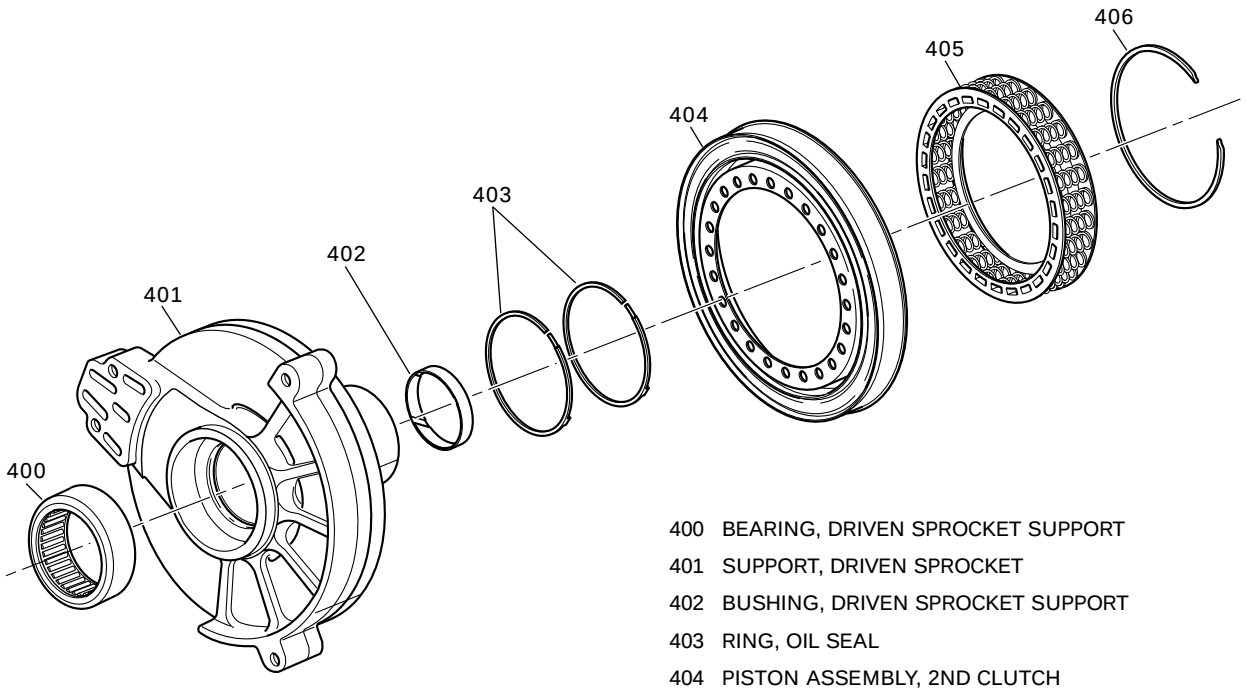


300 BODY, CONTROL VALVE ASSEMBLY
301 SPRING, 1-2 SHIFT VALVE
302 VALVE, 1-2 SHIFT
303 O-RING, SHIFT SOLENOID A AND B
304 RETAINER CLIP
305 SOLENOID, SHIFT (A AND B)
306 SPRING, 2-3 SHIFT VALVE
307 VALVE, 2-3 SHIFT
308 SPRING, TORQUE SIGNAL REGULATOR VALVE
309 VALVE, TORQUE SIGNAL REGULATOR
310 O-RING, PRESSURE CONTROL SOLENOID
311 O-RING, PRESSURE CONTROL SOLENOID
312 SOLENOID, PRESSURE CONTROL
313 O-RING, ACTUATOR OIL FILTER
314 FILTER, ACTUATOR OIL
315 VALVE, ACTUATOR FEED LIMIT
316 SPRING, ACTUATOR FEED LIMIT VALVE
317 PLUG, BORE
318 SPRING, 3-4 SHIFT VALVE
319 VALVE, 3-4 SHIFT
320 O-RING, 3-4 SHIFT VALVE PLUG
321 PLUG, BORE
322 SPRING, 1-2/3-4 ACCUMULATOR VALVE
323 VALVE, 1-2/3-4 ACCUMULATOR
324 BUSHING, PRESSURE REGULATOR BOOST
325 VALVE, PRESSURE REGULATOR BOOST
326 SPRING, ISOLATOR
327 SPRING, PRESSURE REGULATOR VALVE
328 VALVE, PRESSURE REGULATOR
329 SPRING, 2-3 ACCUMULATOR VALVE
330 VALVE, 2-3 ACCUMULATOR
331 SPRING, TCC FEED LIMIT VALVE
332 VALVE, TCC FEED LIMIT
333 SPRING, TCC CONTROL VALVE
334 VALVE, TCC CONTROL
335 SOLENOID, TCC CONTROL
337 O-RING, TCC CONTROL SOLENOID
338 O-RING, TCC CONTROL SOLENOID
339 VALVE, TCC REGULATED APPLY
340 SPRING, TCC REGULATED APPLY VALVE

SH0243-4T40-E

Figure 105

DRIVEN SPROCKET SUPPORT ASSEMBLY/2ND CLUTCH

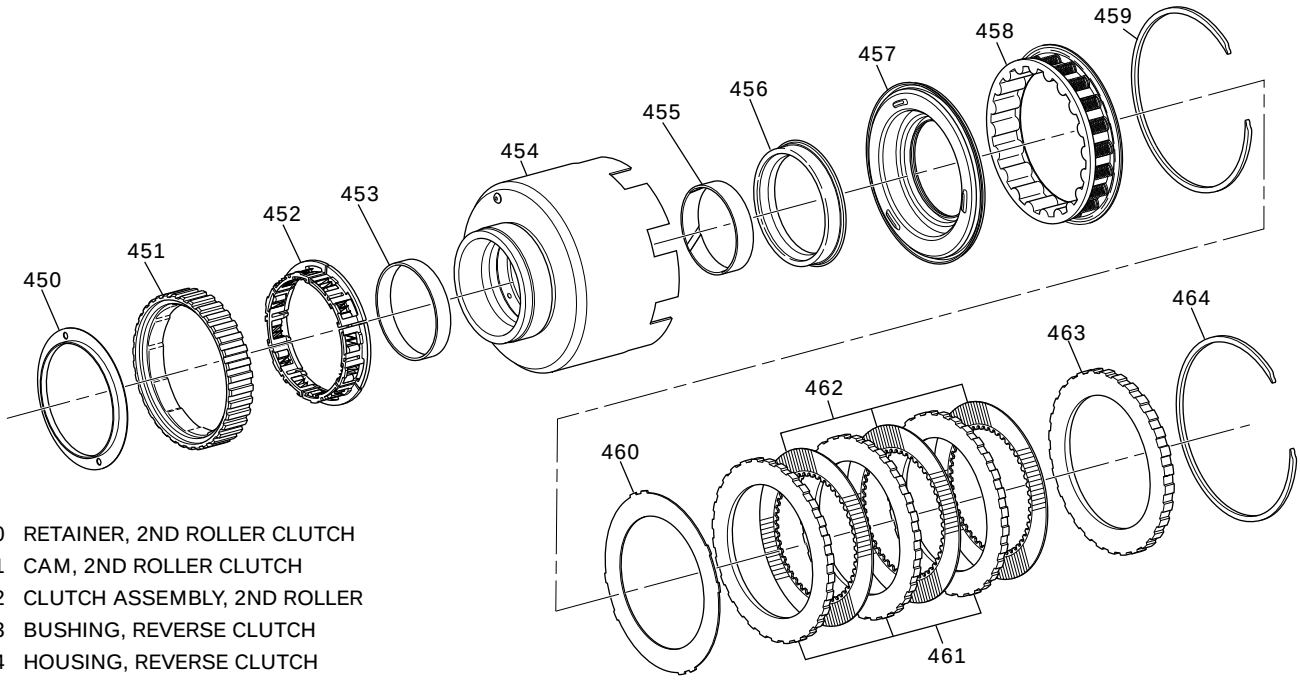


400 BEARING, DRIVEN SPROCKET SUPPORT
401 SUPPORT, DRIVEN SPROCKET
402 BUSHING, DRIVEN SPROCKET SUPPORT
403 RING, OIL SEAL
404 PISTON ASSEMBLY, 2ND CLUTCH
405 SPRING ASSEMBLY, 2ND CLUTCH
406 RING, 2ND CLUTCH SPRING RETAINING

SH0244-4T40-E

Figure 106

REVERSE INPUT CLUTCH ASSEMBLY

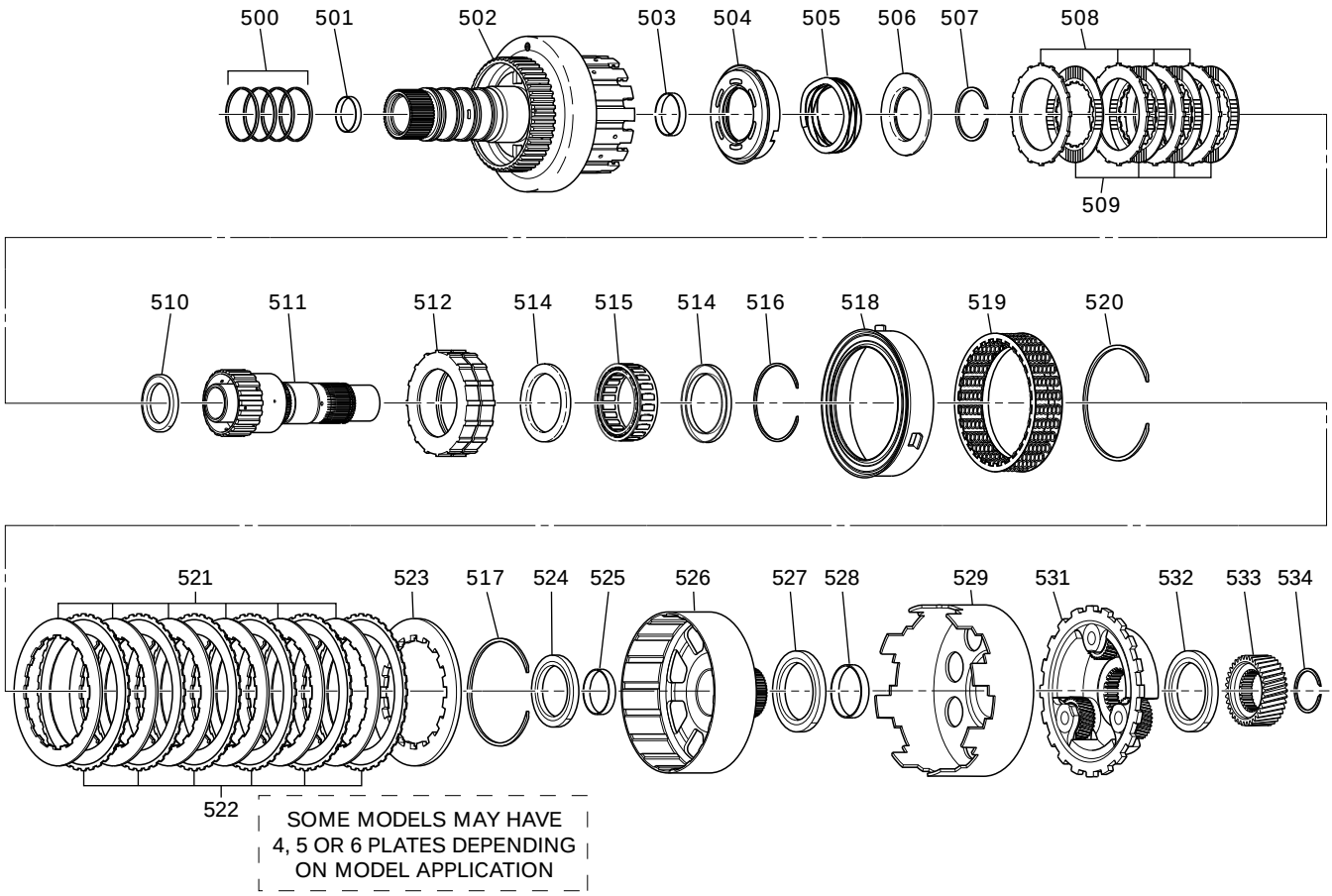


450 RETAINER, 2ND ROLLER CLUTCH
451 CAM, 2ND ROLLER CLUTCH
452 CLUTCH ASSEMBLY, 2ND ROLLER
453 BUSHING, REVERSE CLUTCH
454 HOUSING, REVERSE CLUTCH
455 BUSHING, REVERSE CLUTCH
456 RETAINER & SEAL ASSEMBLY, REVERSE CLUTCH CENTER
457 PISTON ASSEMBLY, REVERSE CLUTCH
458 SPRING & RETAINER ASSEMBLY, REVERSE CLUTCH
459 RING, SNAP (REVERSE CLUTCH SPRING RETAINER)
460 PLATE, REVERSE CLUTCH (WAVED)
461 PLATE, REVERSE CLUTCH (STEEL)
462 PLATE, REVERSE CLUTCH (FIBER)
463 PLATE, REVERSE CLUTCH (BACKING)
464 RING, SNAP (REVERSE CLUTCH)

SH0245-4T40-E

Figure 107

DIRECT AND COAST CLUTCH ASSEMBLIES

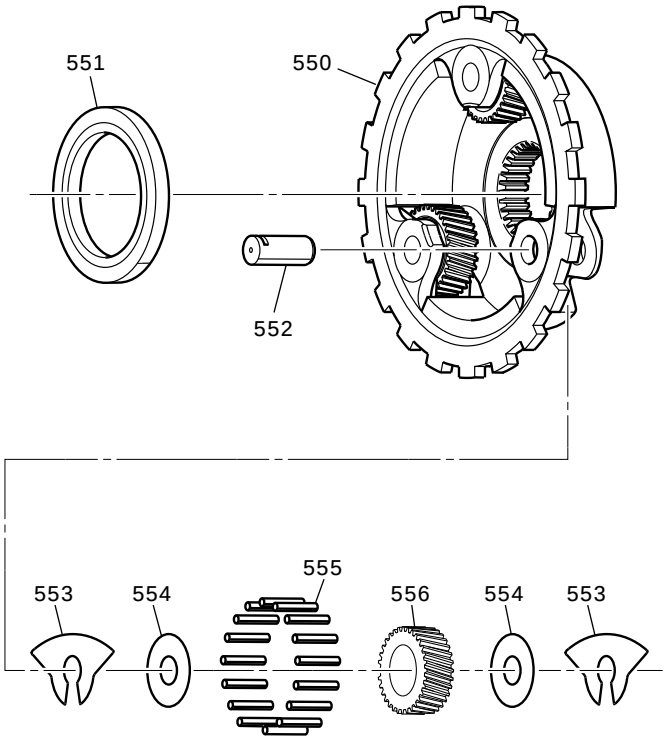


500 RING, OIL SEAL - INPUT SHAFT
501 BUSHING, INPUT SHAFT
502 HOUSING, DIRECT & COAST CLUTCH AND INPUT SHAFT
503 BUSHING, DIRECT CLUTCH HOUSING TO OUTPUT SHAFT
504 PISTON ASSEMBLY, COAST CLUTCH
505 SPRING, COAST CLUTCH RELEASE
506 RETAINER, COAST CLUTCH SPRING
507 RING, SNAP (COAST CLUTCH SPRING RETAINER)
508 PLATE, COAST CLUTCH (STEEL)
509 PLATE, COAST CLUTCH (FIBER)
510 BEARING, THRUST
511 SHAFT AND INNER RACE ASSEMBLY, INPUT SUN GEAR
512 RACE, OUTER (INPUT SPRAG)
514 END BEARINGS, SPRAG CLUTCH (2)
515 SPRAG ASSEMBLY, INPUT
516 RING, SNAP (OUTER RACE TO SPRAG ASSEMBLY)
517 RING, SNAP (DIRECT/COAST CLUTCH RETAINING)
518 PISTON ASSEMBLY, DIRECT CLUTCH
519 SPRING AND RETAINER ASSEMBLY, DIRECT CLUTCH
520 RING, DIRECT CLUTCH SPRING RETAINER
521 PLATE, DIRECT CLUTCH (STEEL)
522 PLATE, DIRECT CLUTCH (FIBER)
523 PLATE, DIRECT CLUTCH (BACKING)
524 BEARING, THRUST
525 BUSHING, REACTION CARRIER SHAFT
526 SHELL, REACTION CARRIER SHAFT
527 BEARING, THRUST (CARRIER SHAFT TO SHELL)
528 BUSHING, REACTION SUN GEAR
529 SHELL, REACTION SUN
531 CARRIER ASSEMBLY, REACTION
532 BEARING, THRUST (REACTION CARRIER TO SUN GEAR)
533 GEAR, INPUT SUN
534 RING, SNAP

TH0246-4T40-E

Figure 108

REACTION CARRIER ASSEMBLY

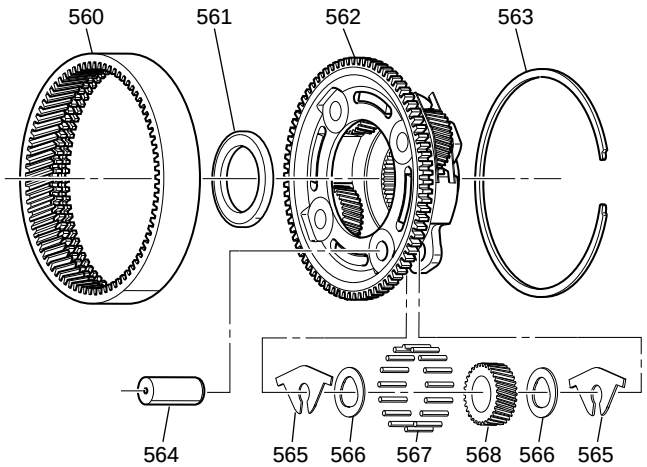


550 CARRIER, REACTION
551 BEARING, THRUST
552 PIN, PLANET PINION
553 WASHER, PINION THRUST REACTION
554 WASHER, PINION THRUST INNER
555 ROLLER NEEDLE BEARING
556 GEAR, REACTION PLANET PINION

SH0247-4T40-E

Figure 109

INPUT CARRIER ASSEMBLY

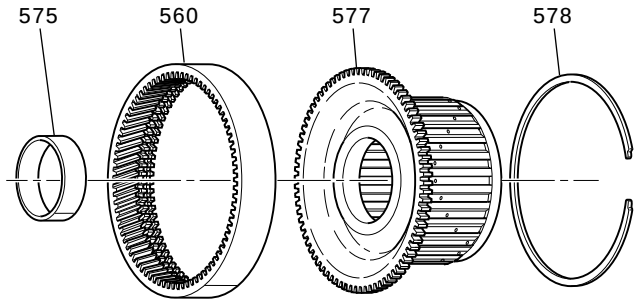


560 GEAR, INTERNAL (INPUT AND REACTION)
561 BEARING, THRUST
562 CARRIER, INPUT
563 RING, SNAP (INPUT CARRIER TO INTERNAL GEAR)
564 PIN, PLANET PINION
565 WASHER, PINION THRUST INPUT
566 WASHER, PINION THRUST INNER
567 ROLLER NEEDLE BEARING
568 GEAR, PINION

SH0248-4T40-E

Figure 110

INPUT INTERNAL GEAR AND FORWARD CLUTCH HUB

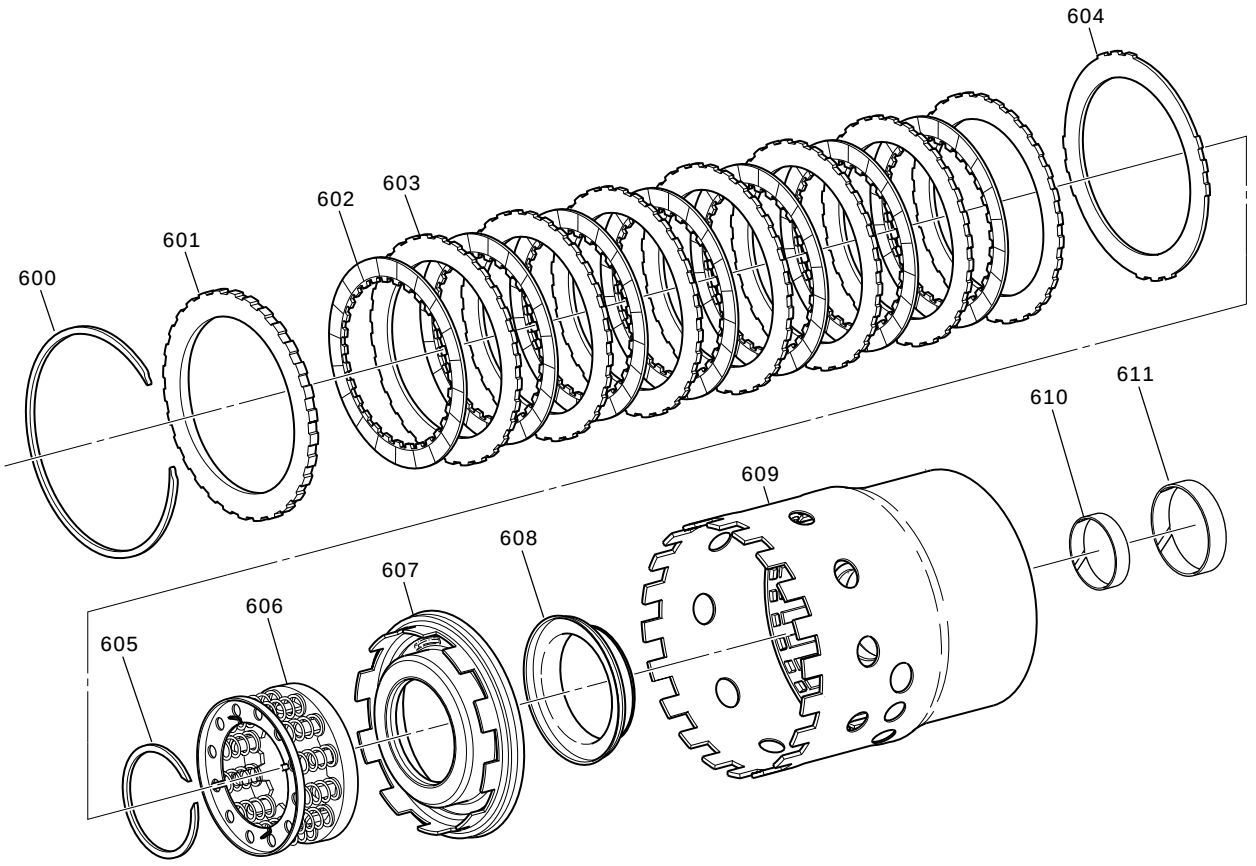


575 BUSHING, INPUT FLANGE
560 GEAR, INTERNAL (INPUT AND REACTION)
577 INPUT FLANGE AND FORWARD CLUTCH HUB
578 RING, SNAP (INPUT INTERNAL GEAR TO INPUT FLANGE)

SH0249-4T40-E

Figure 111

FORWARD CLUTCH ASSEMBLY



600 RING, SNAP (FORWARD CLUTCH)
601 PLATE, FORWARD CLUTCH (BACKING)
602 PLATE, FORWARD CLUTCH (FIBER)
603 PLATE, FORWARD CLUTCH (STEEL)
604 PLATE, FORWARD CLUTCH (WAVED)
605 RING, SNAP (FORWARD CLUTCH SPRING ASSEMBLY)
606 SPRING ASSEMBLY, FORWARD CLUTCH RETURN
607 PISTON ASSEMBLY, FORWARD CLUTCH
608 SEAL AND SLEEVE ASSEMBLY,FORWARD CLUTCH INNER
609 HOUSING, FORWARD CLUTCH
610 BUSHING, FORWARD CLUTCH SUPPORT
611 BUSHING, FORWARD CLUTCH SUPPORT

SH0250-4T40-E

Figure 112

FORWARD CLUTCH SUPPORT ASSEMBLY

650 BUSHING, FINAL DRIVE SUN SHAFT
651 SHAFT, FINAL DRIVE SUN
652 CLUTCH ASSEMBLY, LO ROLLER
653 BEARING, THRUST
654 RING, OIL SEAL (FORWARD CLUTCH SUPPORT)
656 SUPPORT, FORWARD CLUTCH
658 BEARING, THRUST (FORWARD SUPPORT TO PARK GEAR)
659 GEAR, PARK LOCK
660 RING, SNAP (FINAL DRIVE SUN SHAFT)
661 SHAFT, PARKING LOCK PAWL
662 SPRING, PARKING LOCK PAWL RETURN
663 PAWL, PARKING LOCK

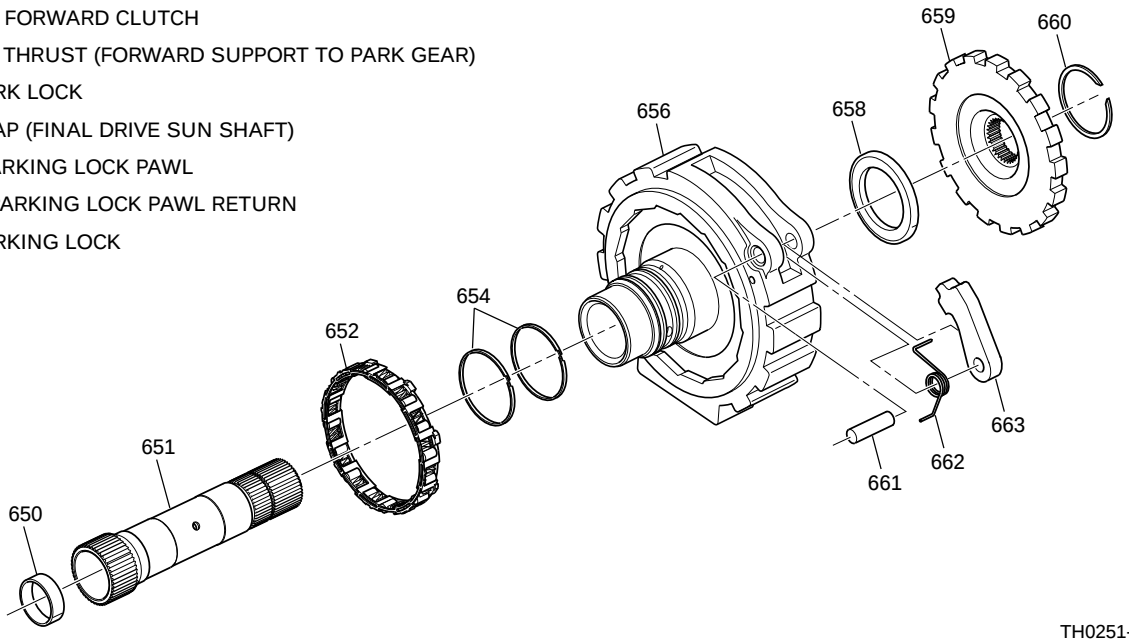


Figure 113

FINAL DRIVE AND DIFFERENTIAL ASSEMBLY

700 BEARING, THRUST
701 RING, SPIRAL PIN RETAINING
702 CARRIER, DIFFERENTIAL & FINAL DRIVE
703 SHAFT, DIFFERENTIAL PINION
704 PIN, DIFFERENTIAL PINION SHAFT RETAINING
705 ROTOR, SPEED SENSOR
706 WASHER, THRUST (DIFFERENTIAL PINION)
707 GEAR, DIFFERENTIAL PINION
708 WASHER, THRUST (DIFFERENTIAL SIDE GEAR)
709 GEAR, DIFFERENTIAL SIDE
710 WASHER, PINION THRUST
711 GEAR, PINION (FINAL DRIVE PLANET)
712 ROLLER NEEDLE BEARING
713 SPACER, PINION NEEDLE BEARING
714 PIN, PLANET PINION

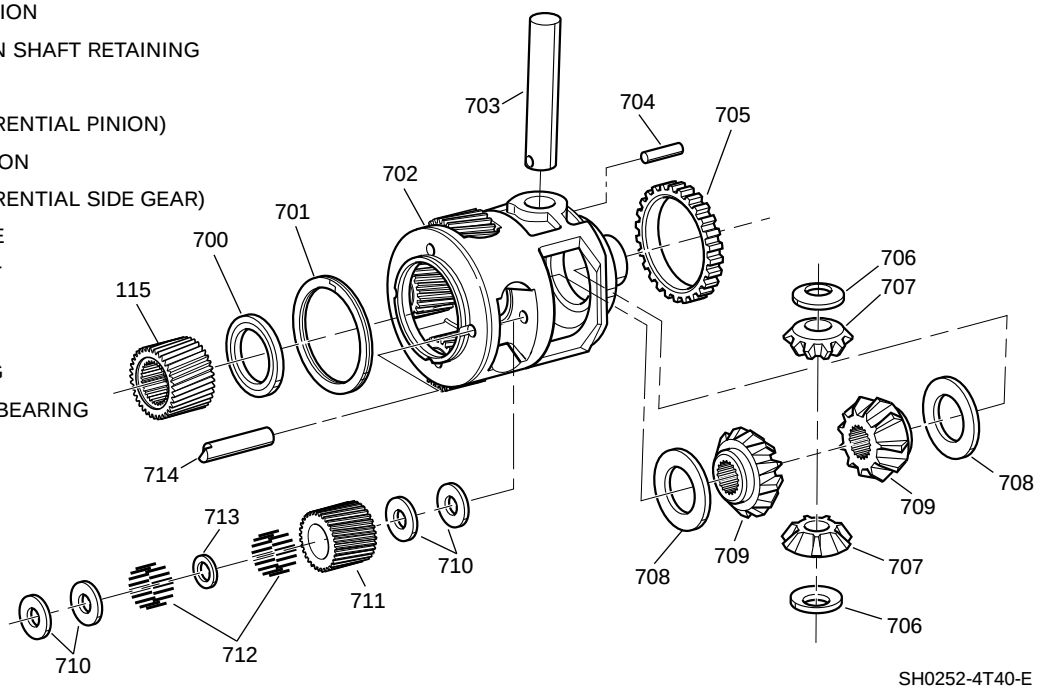
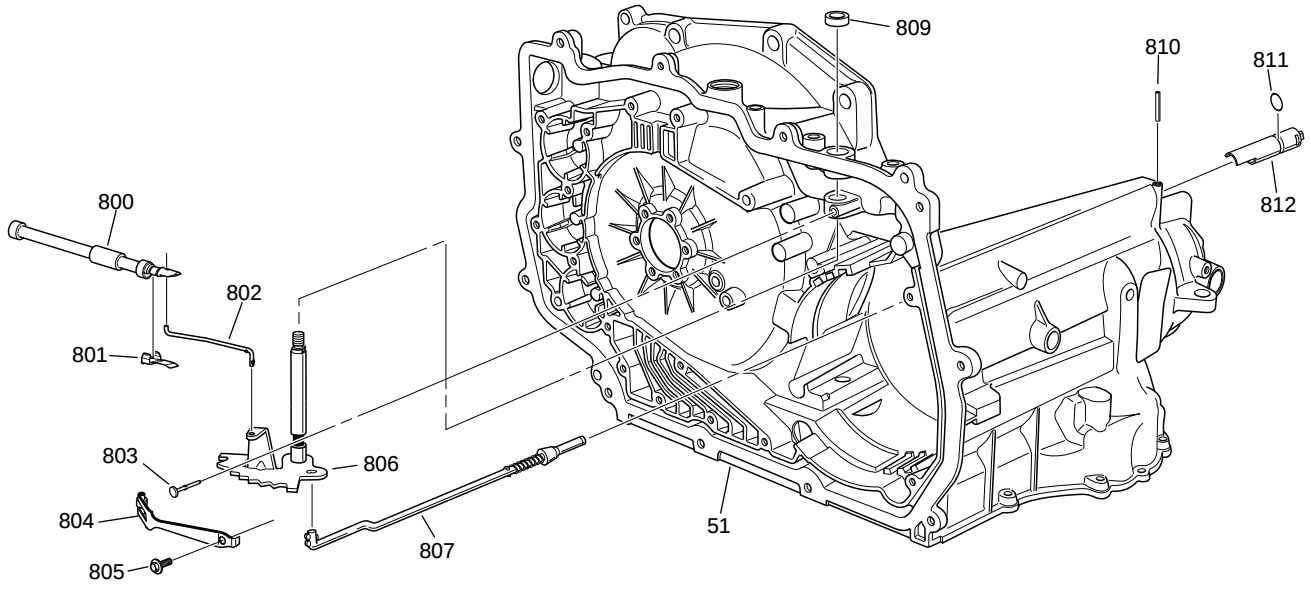


Figure 114

MANUAL SHAFT, PARKING PAWL AND ACTUATOR ASSEMBLY



51 CASE, TRANSAXLE
800 VALVE, MANUAL
801 CLIP, MANUAL VALVE TO LINK
802 LINK, MANUAL VALVE TO DETENT LEVER
803 PIN, MANUAL SHAFT TO CASE
804 SPRING AND ROLLER ASSEMBLY, MANUAL DETENT
805 BOLT, SPRING AND ROLLER ASSEMBLY TO CHANNEL PLATE
806 MANUAL SHAFT AND DETENT LEVER ASSEMBLY
807 PARKING LOCK ACTUATOR ASSEMBLY
809 SEAL, MANUAL SHAFT TO CASE
810 PIN, SPRING (ACTUATOR GUIDE)
811 SEAL, ACTUATOR GUIDE
812 ACTUATOR GUIDE

TH0253-4T40-E

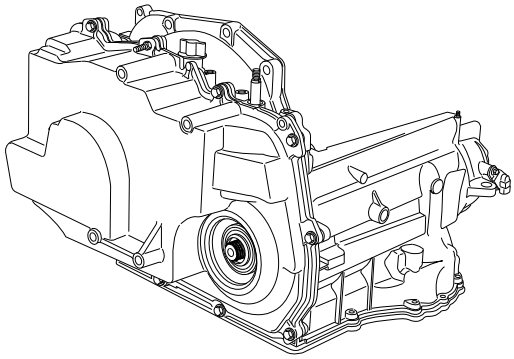
Figure 115

BASIC SPECIFICATIONS

HYDRA-MATIC 4T40-E TRANSAXLE

RPO MN4

Produced at: Windsor, Ontario
Canada



HYDRA-MATIC 4T40-E
(FOUR-SPEED)

Vehicles used in:

	CHEVROLET	PONTIAC
J Body	CAVALIER	SUNFIRE

Current GM NAO Vehicle Platforms
J

Current Engine Range
2.4L Gasoline

Transaxle Drive
Transverse Front Wheel Drive

Transaxle Type
4T40-E = 4: Four Speed
T: Transverse Mount
40: Product Series
E: Electronically Controlled

Automatic Overdrive with a Torque Converter Clutch Assembly.

Gear Ratios

1st	2.960
2nd	1.626
3rd	1.000
4th	0.681
Rev	2.143

Maximum Gross Vehicle Weight
1,860 Kg (4,100 LB)

Transaxle Fluid Capacity (Approximate)
Bottom Pan Removal: 7.0L (7.4 qt)
Complete Overhaul: 9.5L (10.0 qt)
Dry: 12.7L (13.4 qt)

Transaxle Fluid Type
Dexron®-III

Transaxle Weight
Dry: 74.7 Kg (164 LB)
Wet: 85.0 Kg (187 LB)

Converter Size
245 mm (Reference)
(Diameter of Torque Converter Turbine)

Seven Position Quadrant
(P, R, N, OD , 3, 2, 1)

Pressure Taps Available
Line Pressure

Case Material
Die Cast Aluminum

Chain Ratios*	**35/35**	**33/37**	**32/38**
Final Drive Ratios	**Overall Final Drive Ratios Available**		
3.05	3.05	3.42	3.63
3.29	3.29	3.69	3.91

*Designates the number of teeth on the drive/driven sprockets, respectively.

Information may vary with application. All information, illustrations and specifications contained in this brochure are based on the latest product information available at the time of publication approval. The right is reserved to make changes at any time without notice.

HYDRA-MATIC PRODUCT DESIGNATION SYSTEM

The product designation system used for all Hydra-matic transaxles and transmissions consists of a series of numbers and letters that correspond with the special features incorporated in that product line. The first character is a number that designates the number of forward gear ranges available in that unit. For example: 4 = four forward gear ranges.

The second character is a letter that designates how the unit is mounted in the vehicle. When the letter "T" is used, it designates that the unit is transversely mounted and is used primarily for front wheel drive vehicles. The letter "L" designates that it is longitudinally mounted in the vehicle and it is used primarily for rear wheel drive vehicles. The letter "M" designates that the unit is a manual transaxle or transmission but not specific to a front or rear wheel drive vehicle application.

The third and fourth characters consists of a set of numbers, (i.e. "40"), that designate the transaxle or transmission "Series" number. This number signifies the relative torque capacity of the unit.

The fifth character designates the major features incorporated into this unit. For example, the letter "E" designates that the unit has electronic controls.

By using this method of classification, the HYDRA-MATIC 4T40-E is a 4-speed, transversely mounted, 40 series unit, with electronic controls.

HYDRA-MATIC 4T40-E

HYDRA-MATIC	4	T	40	E
	Number of Speeds: 3 4 5 V (CVT)	Type: T - Transverse L - Longitudinal M - Manual	Series: Based on Relative Torque Capacity	Major Features: E - Electronic Controls A - All Wheel Drive HD - Heavy Duty

GLOSSARY OF TECHNICAL TERMS

Accumulator: A component of the transaxle that absorbs hydraulic pressure during the apply of clutch or band. Accumulators are designed to control the quality of a shift from one gear range to another.

Adaptive Learning: Programming within the PCM that automatically adjusts hydraulic pressures in order to compensate for changes in the transaxle (i.e. component wear).

Applied: An apply component that is holding another component to which it is splined or assembled with. Also referred to as "engaged".

Apply Components: Hydraulically operated clutches, servos, bands, and mechanical one-way roller or sprag clutches that drive or hold members of a planetary gear set.

Apply Plate: A steel clutch plate in a clutch pack located next to the (apply) piston.

Backing Plate: A steel plate in a clutch pack that is usually the last plate in that clutch assembly (farthest from the clutch piston).

Band: An apply component that consists of a flexible strip of steel and friction material that wraps around a drum. When applied, it tightens around the drum and prevents the drum from rotating.

Brake Switch: An electrical device that provides signals to the Powertrain Control Module (PCM) based on the position of the brake pedal. The PCM uses this information to apply or release the torque converter clutch (TCC).

Centrifugal Force: A force that is imparted on an object (due to rotation) that increases as that object moves further away from a center/point of rotation.

Checkball: A spherical hydraulically controlled component (usually made of steel) that either seals or opens fluid circuits. It is also referred to as a check valve.

Clutch Pack: An assembly of components generally consisting of clutch plates, an apply plate and a backing plate.

Clutch Plate: A hydraulically activated component that has two basic designs: (1) all steel, or (2) a steel core with friction material bonded to one or two sides of the plate.

Component: Any physical part of the transaxle/transmission.

Control Valve Body: A machined metal casting that contains valve trains and other hydraulically controlled components that shift the transaxle.

Converter: (See Torque Converter)

Coupling Speed: The speed at which a vehicle is traveling and no longer requires torque multiplication through the torque converter. At this point the stator free wheels to allow fluid leaving the turbine to flow directly to the pump. (See torque converter)

De-energize(d): To interrupt the electrical current that flows to an electronically controlled device making it electrically inoperable.

Direct Drive: A condition in a gear set where the input speed and torque equals the output speed and torque. The gear ratio through the gear set is 1:1.

Downshift: A change in a gear ratio where input speed and torque increases.

Duty Cycle: In reference to an electronically controlled solenoid, it is the amount of time (expressed as a percentage) that current flows through the solenoid coil.

Energize(d): To supply a current to an electronically controlled device enabling it to perform its designed function.

Engine Compression Braking: A condition where compression from the engine is used with the transaxle/transmission to decrease vehicle speed. Braking (slowing of the vehicle) occurs when a lower gear ratio is manually selected by moving the gear selector lever.

Exhaust: The release of fluid pressure from a hydraulic circuit. (The words exhausts and exhausting are also used and have the same intended meaning.)

Fail-Safe Mode: A condition whereby a component (i.e. engine or transaxle) will partially function even if its electrical system is disabled.

Fluid: Generally considered a liquid or gas. In this publication fluid refers primarily to "transaxle/transmission fluid".

Fluid Pressure: A pressure (in this textbook usually transaxle/transmission fluid) that is consistent throughout its circuit.

Force: A measurable effort that is exerted on an object (component).

Freewheeling: A condition where power is lost through a driving or holding device (i.e. roller or sprag clutches).

GLOSSARY OF TECHNICAL TERMS

Friction Material: A heat and wear resistant fibrous material bonded to clutch plates and bands.

Gear: A round, toothed device that is used for transmitting torque through other components.

Gear Range: A specific speed to torque ratio at which the transmission is operating (i.e. 1st gear, 2nd gear etc.)

Gear Ratio: Revolutions of an input gear as compared to the revolutions of an output gear. It can also be expressed as the number of teeth on a gear as compared to the number of teeth on a gear that it is in mesh with.

Hydraulic Circuit: A fluid passage which often includes the mechanical components in that circuit designed to perform a specific function.

Input: A starting point for torque, revolutions or energy into another component of the transmission.

Internal Gear: The outermost member of a gear set that has gear teeth in constant mesh with planetary pinion gears of the gear set.

Internal Leak: Loss of fluid pressure in a hydraulic circuit.

Land (Valve Land): The larger diameters of a spool valve that contact the valve bore or bushing.

Line Pressure: The main fluid pressure in a hydraulic system created by the pump and pressure regulator valve.

Manual Valve: A spool valve that distributes fluid to various hydraulic circuits and is mechanically linked to the gear selector lever.

Orifice: A restricting device (usually a hole in the spacer plate) for controlling pressure build up into another circuit.

Overdrive: An operating condition in the gear set allowing output speed to be higher than input speed and output torque to be lower than input torque.

Overrunning: The function of a one-way mechanical clutch that allows the clutch to freewheel during certain operating conditions of the transmission.

Pinion Gear: A small toothed gear that meshes with a larger gear.

Planet Pinion Gears: Pinion gears (housed in a carrier) that are in constant mesh with a circumferential internal gear and centralized sun gear.

Planetary Gear Set: An assembly of gears that consists of an internal gear, planet pinion gears with carrier, and a sun gear.

Powertrain Control Module: An electronic device that manages most of the electrical systems throughout the vehicle.

Pressure: A measurable force that is exerted on an area and expressed as kilopascals (kPa) or pounds per square inch (psi).

Pulse Width Modulated: An electronic signal that continuously cycles the ON and OFF time of a device (such as a solenoid) while varying the amount of ON time.

Race (Inner or Outer): A highly polished steel surface that contacts bearings or sprag elements.

Reduction (Gear Reduction): An operating condition in the gear set allowing output speed to be lower than input speed and output torque to be higher than input torque.

Residual Fluid Pressure: Excess pressure contained within an area after the supply pressure has been terminated.

Roller Clutch: A mechanical clutch (holding device) consisting of roller bearings assembled between a race and a cam.

Servo: A spring loaded device consisting of a piston in a bore that is operated (stroked) by hydraulic pressure to apply or release a band.

Solenoid: An electronic device used to control transaxle shift patterns or regulate fluid pressure.

Spool Valve: A cylindrical hydraulic control device, having a variety of land and valley diameters, used to control fluid flow.

Sprag Clutch: A mechanical clutch (holding device) consisting of figure eight like elements assembled between inner and outer races.

Throttle Position: The travel of the throttle plate that is expressed in percentages.

Torque: A measurable twisting force expressed in terms of Newton- meters (N.m), pounds feet (lbs. ft.) or pounds inches (lbs. in.).

Torque Converter: A component of an automatic transmission, (attached to the engine flywheel) that transfers torque from the engine to the transmission through a fluid coupling.

ABBREVIATIONS

LIST OF ABBREVIATIONS WHICH MAY BE USED IN THIS BOOK

AC - Alternating Current
A/ - Air Conditioning
ACC or ACCUM - Accumulator
ACT FD - Actuator Feed (circuit)
APP - Apply
ASM - Assembly

BD - Band

°**C** - Degrees Celsius
CL - Clutch
CONV - Converter
CST CL - Coast Clutch (circuit)
CTS - Coolant Temperature Switch

DCF - Direct Clutch Feed (circuit)
DLC - Diagnostic Link Connector
DR - Drive (circuit)
DTC - Diagnostic Trouble Code
D21 - Drive 21 (circuit)
D321 - Drive 321 (circuit)

ECT - Engine Coolant Temperature Sensor
EX - Exhaust (circuit)

°**F** - Degrees Fahrenheit
FD - Feed (circuit)
FILT ACT FD - Filtered Actuator Feed
FWD CL - Forward Clutch

Hg - Mercury
Hz - Hertz

INT BAND - Intermediate Band (circuit)
INT BD FD - Intermediate Band Feed (circuit)

KMH - Kilometers Per Hour
kPa - KiloPascals

LBS. FT. - Pounds Foot
LBS. IN. - Pounds Inch
LIM - Limit (circuit)

MAF - Mass Air Flow Sensor
MAP - Manifold Absolute Pressure Sensor
MM - Millimeter(s)
MPH - Miles Per Hour

N - Neutral
N.C. - Normally Closed
N.m - Newton Meters
N.O. - Normally Open

P - Park
PCM - Powertrain Control Module
PCS - Pressure Control Solenoid
PRESS REG - Pressure Regulator
PRN - Park, Reverse, Neutral (circuit)
PRND4 - Park, Reverse, Neutral, Drive 4 (circuit)
PSA - Pressure Switch Assembly
PSI - Pounds per Square Inch
PWM - Pulse Width Modulated

R - Reverse
REG - Regulated (circuit)
REL - Release (circuit)
REV - Reverse
RPM - Revolutions per Minute

SIG - Signal
SOL - Solenoid

TCC - Torque Converter Clutch
TCC R APP - TCC Regulated Apply (circuit)
TFT - Transaxle Fluid Temperature Sensor
TISS - Transaxle Input Speed Sensor
TOSS - Transaxle Output Speed Sensor
TPS - Throttle Position Sensor
TRANS - Transaxle or Transmission
T SIG - Torque Signal
T SIG (PWM) - Torque Signal (PWM)

V - Volts
VSS - Vehicle Speed Sensor

2ND CL - Second Clutch

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INDEX

TECHNICAL SERVICE INFORMATION

THM 4T40-E

INTRODUCTION

We wish to thank General Motors Corporation for the information and illustrations that have made this booklet possible. This booklet contains general description and the overhaul procedures necessary to repair, overhaul, or service the new THM 4T40-E electronic overdrive automatic transaxle. This unit will first be found in 1995 Chevrolet Cavalier and Pontiac Sunfire vehicles.

The THM 4T40-E is a fully automatic front wheel drive transaxle. It provides park, reverse, neutral, and 4 forward speeds including overdrive. The shift pattern is controlled electronically with 2 shift solenoids that recieve a ground signal from the PCM (Powertrain Control Module). The PCM will vary shift points, as it is constantly interpreting numerous electronic signals from various operational sensors located on the vehicle. The PCM also controls apply and release of the Torque Converter Clutch. Line pressure and shift feel are also controlled electronically with an EPC (Electronic Pressure Control) solenoid located on the valve body and is dependent on TPS and VSS signals.

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

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THM 4T40-E
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MIAMI, FLORIDA 33156
(305) 670-4161

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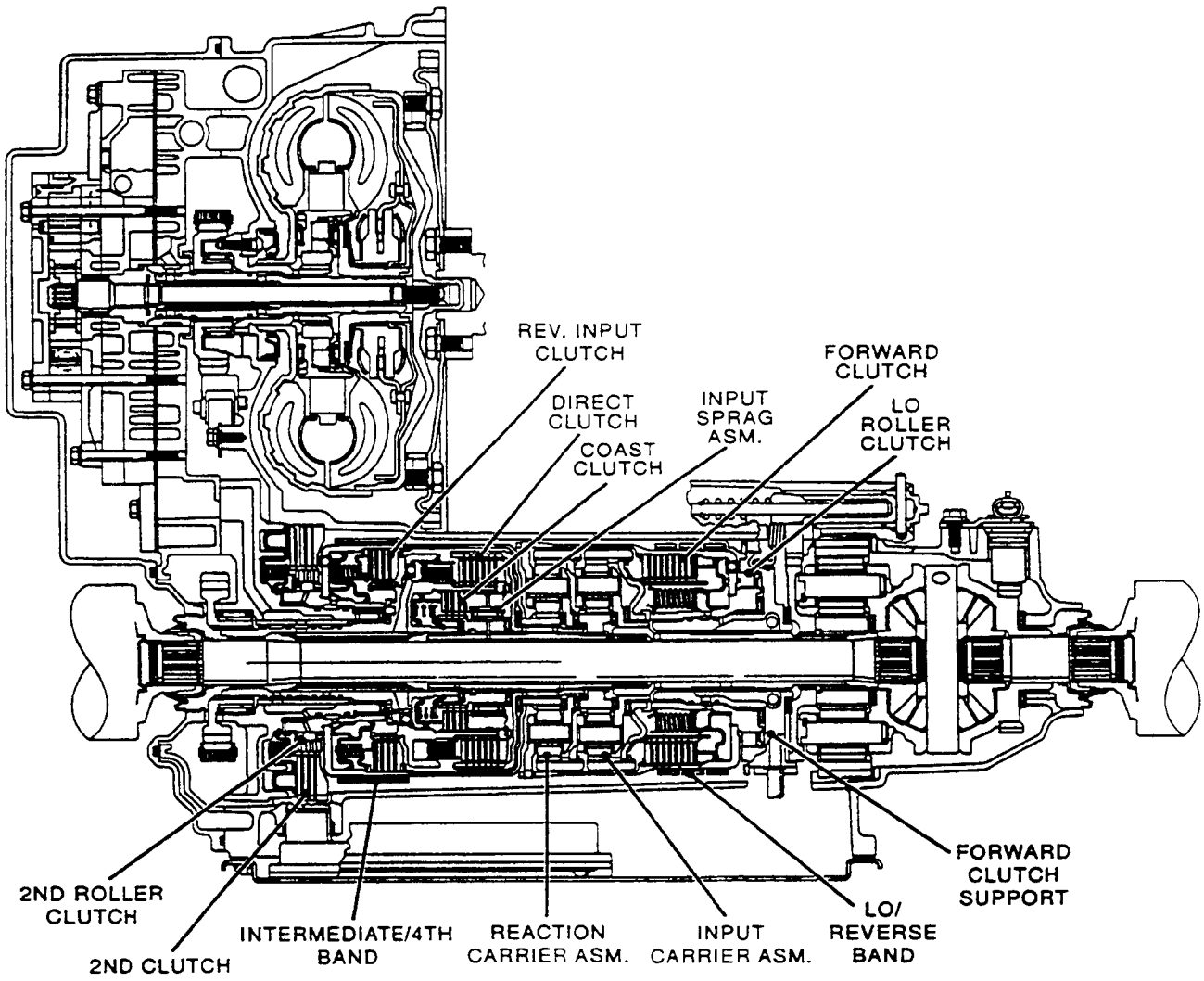
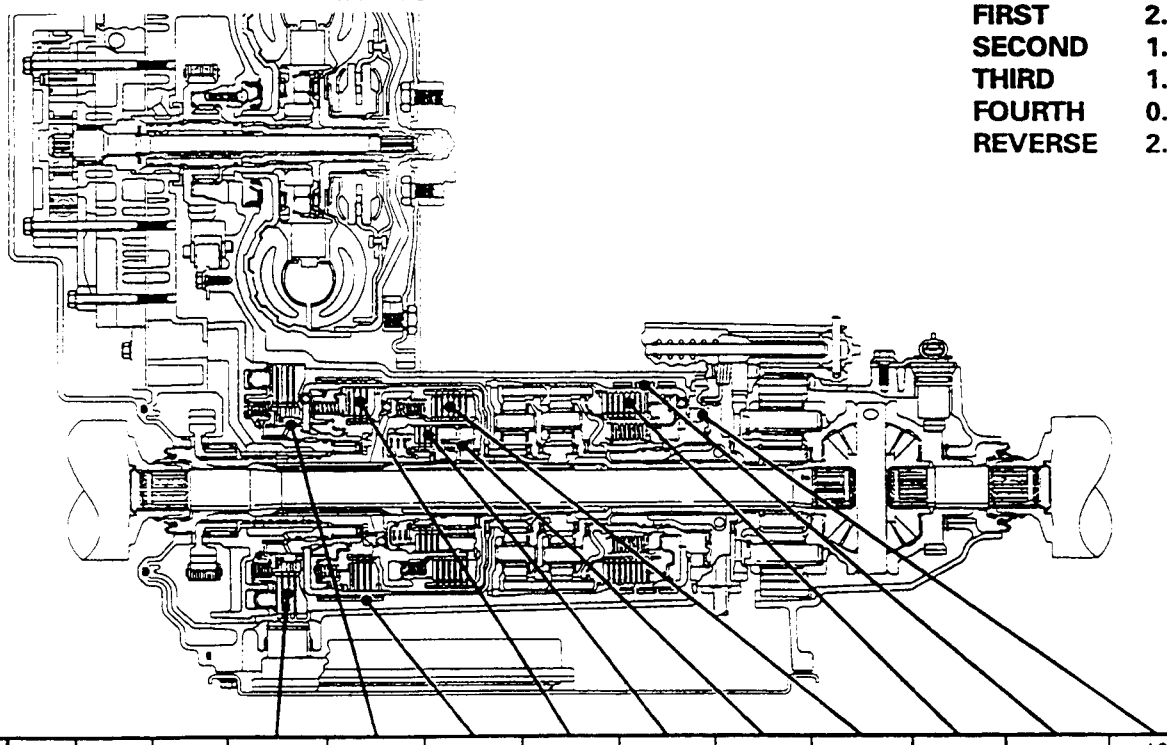
HYDRA-MATIC 4T40-E TRANSAXLE



RANGE REFERENCE CHART

4T40-E GEAR RATIOS

FIRST	2.96
SECOND	1.62
THIRD	1.00
FOURTH	0.68
REVERSE	2.14



RANGE	GEAR	1-2 SHIFT SOL	2-3 SHIFT SOL	2ND CLUTCH	2ND ROLLER CLUTCH	INT./4TH BAND	REVERSE CLUTCH	COAST CLUTCH	INPUT SPRAG	DIRECT CLUTCH	FORWARD CLUTCH	LO/REV. BAND	LO ROLLER CLUTCH
PARK	N	ON	OFF									APPLIED	
REV	R	ON	OFF				APPLIED					APPLIED	
NEU	N	ON	OFF									APPLIED	
D	1st	ON	OFF						HOLDING		APPLIED		HOLDING
	2nd	OFF	OFF	APPLIED	HOLDING				HOLDING		APPLIED		OVER-RUNNING
	3rd	OFF	ON	APPLIED*	OVER-RUNNING				HOLDING	APPLIED	APPLIED		OVER-RUNNING
	4th	ON	ON	APPLIED*		APPLIED			OVER-RUNNING	APPLIED	APPLIED*		OVER-RUNNING
3	1st	ON	OFF					APPLIED	HOLDING		APPLIED		HOLDING
	2nd	OFF	OFF	APPLIED	HOLDING			APPLIED	HOLDING		APPLIED		OVER-RUNNING
	3rd	OFF	ON	APPLIED*	OVER-RUNNING			APPLIED	HOLDING	APPLIED	APPLIED		OVER-RUNNING
2	1st	ON	OFF					APPLIED	HOLDING		APPLIED		HOLDING
	2nd	OFF	OFF	APPLIED	HOLDING	APPLIED		APPLIED	HOLDING		APPLIED		OVER-RUNNING
	3rd**	OFF	ON	APPLIED*	OVER-RUNNING			APPLIED	HOLDING	APPLIED	APPLIED		OVER-RUNNING
1	1st	ON	OFF					APPLIED	HOLDING		APPLIED	APPLIED	HOLDING
	2nd***	OFF	OFF	APPLIED	HOLDING	APPLIED		APPLIED	HOLDING		APPLIED		OVER-RUNNING

ON = SOLENOID ENERGIZED (CLOSED)
OFF = SOLENOID DE-ENERGIZED (OPEN)
* = APPLIED, BUT INEFFECTIVE
** = MANUAL SECOND - THIRD GEAR IS ONLY AVAILABLE ABOVE APPROXIMATELY 100 KM/H (62 MPH).
*** = MANUAL FIRST - SECOND GEAR IS ONLY AVAILABLE ABOVE APPROXIMATELY 60 KM/H (37 MPH).
NOTE: MANUAL FIRST - THIRD GEAR IS ALSO POSSIBLE AT HIGH VEHICLE SPEED AS A SAFETY FEATURE.

Figure 1

TRANSAXLE GENERAL DESCRIPTION

The 4T40-E is a fully automatic, electronically controlled, front wheel drive transaxle. It provides four forward gear ranges with 4th being overdrive, and one reverse gear range. Shift patterns are controlled by the PCM through two shift solenoids. Oil pressure is supplied by a vane type oil pump and is controlled electronically by the PCM through the pressure control solenoid (PCS) located on the valve body.

The transaxle can be operated in any one of the following seven gear selector positions.

P - Park position prevents the vehicle from rolling either forward or backward. ***For safety reasons the parking brake should be used in addition to the Park position.***

R - Reverse allows the vehicle to be operated in a rearward direction.

N - Neutral allows the engine to be started and to be operated while driving the vehicle. If necessary this position may be selected if the engine must be restarted while the vehicle is still moving.

D - Drive range position is used for all normal driving conditions. This range provides four gear ratios forward, plus converter clutch operation. Full and part throttle downshifts are available for safe passing by depressing the accelerator pedal.

3 - This drive range position is used for city traffic, hilly terrain and trailer towing. It provides three gear ratios forward and prevents the transaxle from shifting into 4th gear overdrive. Again, downshifts are available by depressing the accelerator pedal.

2 - Manual second range only provides two gear ratios forward, ***under most operating conditions.*** It is used to provide acceleration and engine braking. This range may be selected at any vehicle speed, but will not downshift to 2nd gear until vehicle speed drops below approximately 100 KMH (62MPH). However, the transaxle will upshift into 3rd gear with the selector in Manual 2nd, at high vehicle speeds, as a safety factor.

1 - Manual Lo Range is used to provide maximum engine braking. This range may also be selected at any vehicle speed, but the transaxle will not downshift into 1st gear until vehicle speed drops below approximately 60 KMH (37 MPH).
NOTE: Third gear is also possible while in Manual Lo Range, at high vehicle speeds as a safety factor.

TRANSAXLE COMPONENTS

Mechanical

- Five Multiple Disc Clutch Assemblies:
  - (1) Second Clutch
  - (2) Reverse Input Clutch
  - (3) Direct Clutch
  - (4) Coast Clutch
  - (5) Forward Clutch
- Two Band Assemblies:
  - (1) Intermediate/4th Band
  - (2) Lo/Reverse Band
- Three One-Way Clutches:
  - (1) Second Roller Clutch
  - (2) Lo Roller Clutch
  - (3) Input Sprag Clutch
- Two Compound Planetary Gear Sets.
- Final Drive and Differential Assembly.

Electronic

- Two Shift Solenoids:
  - (1) Shift Solenoid "A"
  - (2) Shift Solenoid "B"
- Pressure Control Solenoid (PCS).
- Pulse Width Modulated (PWM) TCC Solenoid.
- Two Speed Sensors:
  - (1) Turbine Shaft Speed Sensor
  - (2) Output Speed Sensor
- Transmission Fluid Temperature (TFT) Sensor
- Pressure Switch Assembly (PSA)

FLUID LEVEL CHECKING PROCEDURE

The fluid level should be checked before a road test is performed, and when the fluid temperature is above 40°C (104°F). This temperature can be reached by performing the following procedure.

1. Park the vehicle on a hoist, inspection pit or a similar raised level surface. ***The vehicle must be level to obtain correct fluid level reading.***
2. Place a fluid container below the fluid level plug which is an 1/8" pipe plug, located in the case near the final drive, as shown in Figure 2.
3. Start the engine and allow the engine to idle for approximately 5 minutes, or if possible drive the vehicle for a few miles to warm up the transaxle fluid.
4. With the brake pedal depressed, move the shift lever through the gear ranges, pausing a few seconds in each range, and then return the shift lever to the Park position.
5. Remove the fluid level plug (1/8" pipe plug), as shown in Figure 2. Because the transaxle works correctly over a range of fluid levels, fluid may or may not drain out of the plug hole in the case when the plug is removed.

CAUTION: Removal of the fluid level plug when the transaxle fluid is hot may cause injury if fluid drains from the plug hole.

6. If fluid does drain through the plug hole in case, the transaxle may have been overfilled. When the fluid stops draining, the fluid level is correct. Install the fluid level plug and torque to proper specification (12 N.m) or (10 ft.lb.)
7. If fluid does not drain through the plug hole in case, the transaxle fluid may be low. Add fluid through the fill cap located on top of the transaxle as shown in Figure 2. Add fluid in 1/2 Qt. increments, up to 1.5 quarts maximum, until the fluid drains through the plug hole. If the fluid drains through the plug hole the fluid level was in the correct operating range. Allow the fluid to finish draining through the plug hole and install the plug and torque to 12 N.m (10 ft.lb.).
   If fluid does not drain through the plug hole in case after adding a total of 1.5 quarts, then the transaxle was either underfilled or is leaking. The transaxle should be inspected for fluid leaks and any leaks should be corrected before setting the transaxle fluid level.
8. When the fluid level checking procedure is completed, wipe any access fluid from transaxle case with a rag or shop towel. Also check that the fluid fill cap/breather is properly installed.

SETTING FLUID LEVEL, AFTER SERVICE

1. Depending on the service performed, add the following amounts of fluid through the fill cap hole ***before*** adjusting fluid level:
   Bottom pan removal or filter change = 7 quarts.
   New torque converter only = 2.6 quarts.
   Complete overhaul or rebuild = 10.6 quarts.
2. Follow steps 1 through 4 of the Fluid Level Checking Procedure.
3. Add additional fluid through the fill cap in 1 pint increments until fluid comes out the plug hole in case by the final drive (See Figure 2).
4. Allow the fluid to finish draining out plug hole, install the fluid level plug and torque to 10 ft.lb.
5. When the fluid level setting procedure is done wipe any fluid from the transaxle with a rag or shop towel. Also check that the fluid fill cap and vent are properly installed.

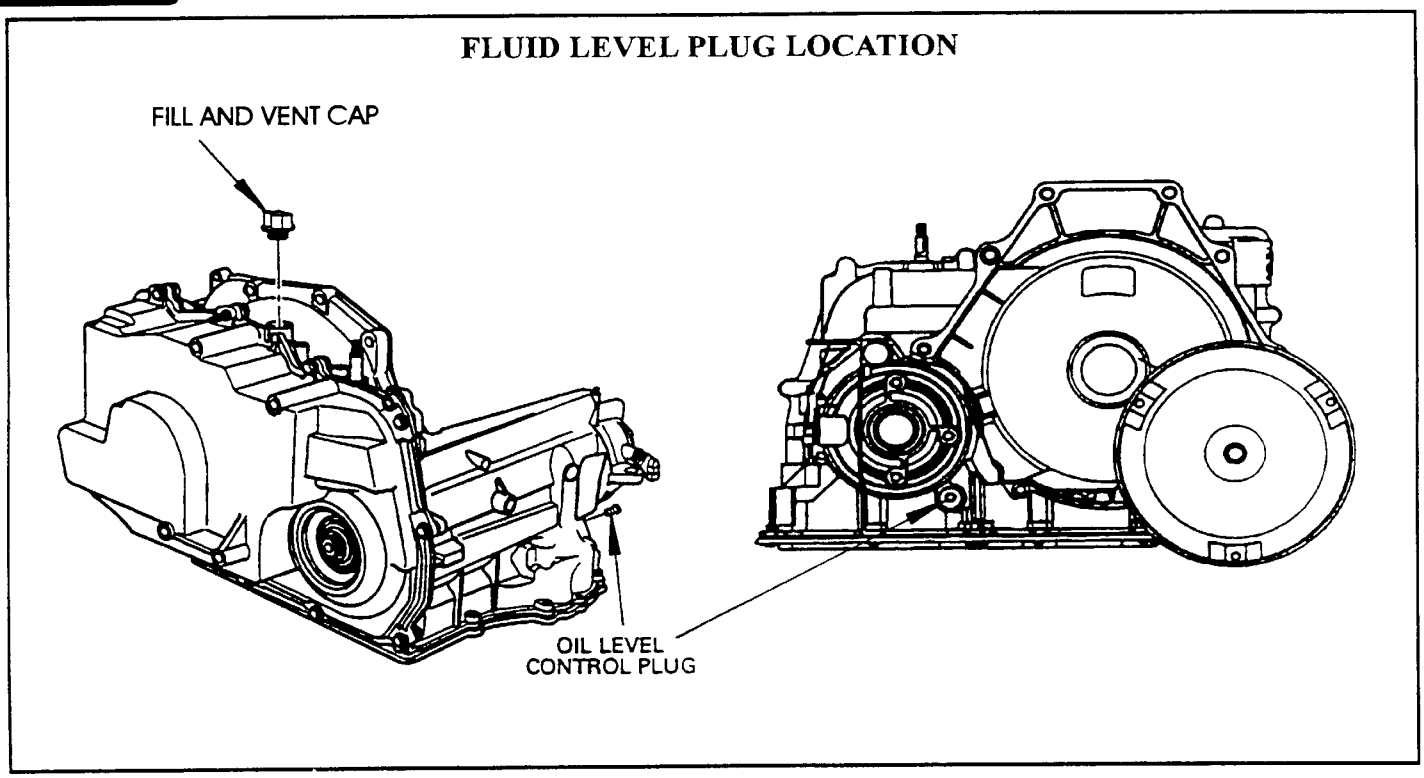

FLUID LEVEL PLUG LOCATION
FILL AND VENT CAP
OIL LEVEL
CONTROL PLUG

Figure 2

ABBREVIATIONS

AC Alternating Current
A/C Air Conditioning
CKT Circuit
DC Direct Current
DLC Diagnositc Link Connector
DTC Diagnostic Trouble Code
DVM Digital Volt Meter
ECT Engine Coolant Temperature Sensor
EGR Exhaust Gas Regulator
MAP Manifold Absolute Pressure
MIL Malfunction Indicator Light
NC Normally Closed
NO Normally Open
OBD On Board Diagnostics
OSS Output Speed Sensor
PM Permanent Magnent
PCM Powertrain Control Module
PCS Pressure Control Solenoid
PSA Pressure Switch Assembly
PWM Pulse Width Modulated
RPM Revolutions Per Minute
TCC Torque Converter Clutch
TCM Transmission Control Module
TFT Transmission Fluid Temperature
TIS Transaxle Input Speed Sensor
TPS Throttle Position Sensor
VSS Vehicle Speed Sensor
WOT Wide Open Throttle

ROAD TEST PROCEDURE

- Perform the road test using a scan tool.
- This test should be performed when traffic and road conditions permit.
- Observe all traffic regulations.

The PCM calculates upshift points based primarily on two inputs. They are ***throttle angle*** and ***vehicle speed***. When the PCM says a shift should occur, an electrical signal is sent to the shift solenoids which in turn moves the valves to perform the upshift. The shift speed charts in Figure 3 reference ***throttle angle*** instead of "Min Throttle" or "WOT" to make shift speed diagnosis more uniform and accurate. A scan tool should be used to moniter ***throttle angle***. Some scan tools have been programmed to record shift point information. Check the instruction manual on yours to see if this test is available.

GARAGE SHIFT CHECK

1. Start the engine.
2. Depress the service brake.
3. Move the gear selector lever to the Reverse (R) position, and then to the Neutral (N) position, and then to the Drive (D) position. Gear selections should be immediate, but should not be harsh.

UPSHIFTS AND TCC APPLY

1. Place the selector lever into the Overdrive (D) position.
2. Look at the shift speed chart in Figure 3, choose a percent throttle angle of 10% or 25%.
3. Set up the scan tool to moniter throttle angle and vehicle speed.
4. Accelerate to the chosen throttle angle and hold the throttle steady.
5. As the transaxle upshifts, note the shift speeds and commanded gear changes for second gear, third gear and fourth gear.
6. Shift speeds may vary due to slight hydraulic delays responding to electronic controls. Any change from the original equipment tire size also affects shift speeds.
7. Note when the TCC applies. This should occur in fourth gear, and is noticed by an RPM drop. The TCC should not apply unless the transaxle temperature has reached a Min. of 46°F ***AND*** engine coolant temperature of 122°F.

PART THROTTLE DOWNSHIFT

1. At vehicle speeds of 40-55 MPH (64-88 KPH) in 4th gear, quickly increase throttle angle to greater than 50%.
2. The converter clutch should release.
3. Transaxle should downshift to 3rd gear.
4. 1-2 shift solenoid should turn off, and the 2-3 shift solenoid should remain on.

FULL THROTTLE DOWNSHIFTS

1. At vehicle speeds of 40-55 MPH (64-88KPH) in 4th gear, quickly increase throttle angle to greater than 100%.
2. The converter clutch should release.
3. Transaxle should downshift into second gear immediately
4. Both shift solenoids should be off.

MANUAL DOWNSHIFTS

1. At vehicle speeds of 40-55 MPH (64-88 KPH) in 4th gear, release the accelerator pedal while moving the selector lever to Manual 3rd (3) position.
2. The converter clutch should release.
3. Transaxle should downshift to 3rd immediately, and the engine should slow the vehicle down.
4. Move the selector lever back to Overdrive (D) position and accelerate to 40-45 MPH. Release the accelerator pedal while moving the selector lever to the Manual Second (2) position.
5. The converter clutch should release.
6. Transaxle should downshift to 2nd immediately, and the engine should slow the vehicle down.
7. Move the selector lever back to Overdrive (D) position and accelerate to 40 MPH. Release the accelerator pedal while moving selector lever to the Manual 1st (1) position.
8. The converter clutch should release.
9. Transaxle should downshift to 2nd immediately, and the engine should slow the vehicle down.
10. Once the vehicle speed drops below 37 MPH, the transaxle should downshift to 1st gear, and the engine should continue to slow the vehicle.

NOTE: A shift into 3rd gear will occur at high vehicle speeds as a safety feature, while in the Manual 1st position. Do not attempt to perform this shift.

COASTING DOWNSHIFT

1. With the selector in the Overdrive (D) position, accelerate to 4th gear and TCC applied.
2. Release the accelerator pedal and lightly apply the brakes.
3. The converter clutch should release.
4. Downshifts should occur at the speeds shown in the shift speed chart in Figure 3.

REVERSE OPERATION

1. With vehicle stopped, move the selector lever to the Reverse (R) position, and slowly accelerate to observe reverse operation.
2. 1-2 shift solenoid should be ON, and the 2-3 shift solenoid should be OFF.

CONVERTER CLUTCH OPERATION

1. Install a tachometer or scan tool.
2. Operate the vehicle until proper operating temp has been reached. TCC operation requires that transaxle temperature has reached Min of 46°F, ***AND*** engine coolant temperature of 122°F.
3. At vehicle speeds of 50-55 MPH (80-88 KPH) and maintaining a light throttle, lightly touch the brake pedal and check for release of TCC and a slight increase in engine RPM.
4. Release the brake pedal, slowly accelerate, and check for a re-apply of the converter clutch and a slight decrease in engine RPM.

1995 HYDRA-MATIC 4T40-E SHIFT SPEED CHART

UPSHIFT SPEED INFORMATION

MODEL	1-2 SHIFT (+/- 3 MPH)				2-3 SHIFT (+/- 4 MPH)				3-4 SHIFT (+/- 5 MPH)		
	10% TPS	25% TPS	50% TPS	100% TPS	10% TPS	25% TPS	50% TPS	100% TPS	10% TPS	25% TPS	50% TPS
WAR	8.0	12.5	20.0	28.5	16.0	25.0	39.0	54.0	26.0	36.0	57.0
WLR	10.0	14.5	20.5	38.5	19.0	27.0	39.0	65.5	31.0	41.0	57.0

TRANSAXLE USAGE AND DOWNSHIFT SPEED INFORMATION

MODEL	SERIES	ENGINE		DOWNSHIFTS (+/- 4 MPH)			TCC APPLY 4TH GEAR		TCC RELEASE 4TH GEAR	
		DISP.	RPO	4-3 COAST	3-2 COAST	2-1 COAST	10% TPS	25% TPS	10% TPS	25% TPS
WLR	J	2.3	LD2	27	14.0	7	39	54	37	42

Figure 3

LINE PRESSURE CHECK

The THM 4T40-E uses a vane type oil pump to produce hydraulic pressure, and a pressure control solenoid to control that pressure at the pressure regulator valve after it leaves the pump.

The pressure control solenoid is controlled by an electrical signal from the PCM that ranges from 0 to 1.1 amps, with 1.1 amps corresponding to minimum line pressure (45-55 PSI), and 0 amps corresponds to maximum line pressure (140-180 PSI), when the selector lever is in Overdrive (D) position.

Refer to Figure 4 for the line pressure tap location and the procedure to perform line pressure test.

HYDRA-MATIC 4T40-E LINE PRESSURE CHECK PROCEDURE

Line pressures are calibrated for two sets of gear ranges – Drive-Park-Neutral and Reverse. This allows the transaxle line pressure to be appropriate for different pressure needs in different gear ranges:

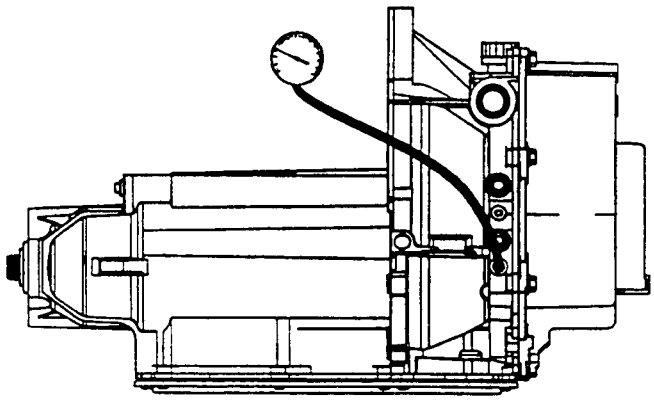
Gear Range	Nominal Line Pressure Range
Drive, Park or Neutral	50 - 160 PSI 345 – 1103 KPA
Reverse	58 - 186 PSI 400 – 1282 KPA

Before performing a line pressure check, verify that the pressure control solenoid is receiving the correct electrical signal from the PCM:

1. **Install a scan tool.**
2. **Start the engine and set parking brake.**
3. **Check for a stored pressure control solenoid diagnostic trouble code, and other diagnostic trouble codes.**
4. **Repair vehicle if necessary.**

Inspect
- **Fluid level**
- **Manual linkage**

Install or Connect
- **TECH 1 Scan tool**
- **Oil pressure gage at line pressure tap**



5. **Put gear selector in Park and set the parking brake.**
6. **Start engine and allow it to warm up at idle.**
7. **Access the "PCS Control" test on the TECH 1 scan tool.**
8. **Increase DESIRED PCS in 0.1 Amp increments and read the corresponding line pressure on the pressure gage. (Allow pressure to stabilize for 5 seconds after each current change.)**
9. **Compare data to the Drive-Park-Neutral line pressure chart below.**

***NOTICE** Total test running time should not exceed 2 minutes, or transaxle damage could occur.

CAUTION Brakes must be applied at all times to prevent unexpected vehicle motion.

If pressure readings differ greatly from the line pressure chart, refer to the Diagnosis Charts contained in this section.

The TECH 1 scan tool is only able to control the pressure control solenoid in Park and Neutral with the vehicle stopped. This protects the clutches from extremely high or low pressures in Drive or Reverse ranges.

Pressure Control Solenoid Current (Amp)	Approximate Line Pressure (PSI)
0.00	152 - 160
0.10	149 - 151
0.30	141 - 143
0.50	124 - 127
0.60	111 - 115
0.70	97 - 101
0.80	81 - 84
0.90	64 - 67
0.95	56 - 58
1.00	50 - 51
1.05	50
1.10	50

NOTE: Pressures are at 70°C and vary with temperature. Pressure drops as temperature increases.

Figure 4

TROUBLE CODE RETRIEVAL

To read Diagnostic Trouble Codes (DTC), a scan tool MUST be used. Diagnostic Trouble Codes cannot be flashed by grounding the DLC.
To clear the Diagnostic Trouble Codes from the PCM memory, install a scan tool and select the clear DTC function.

DIAGNOSTIC CONNECTOR LOCATION

The Diagnostic Link Connector (DLC) is a multiple cavity connector. The DLC provides the means to access serial data from the PCM to aid in the Powertrain diagnosis. The DLC allows technicians to use a scan tool to moniter various systems and display Diagnostic Trouble Codes.
The Diagnostic Link Connector is located within the drivers compartment, directly below the steering column (See Figure 5).

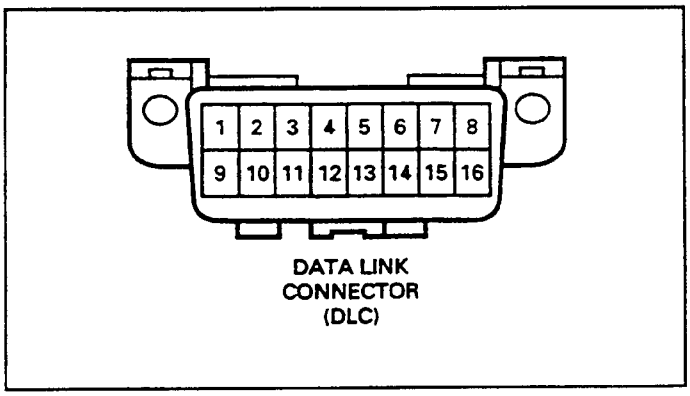


Figure 5

POWERTRAIN CONTROL MODULE

The Powertrain Control Module (PCM) is an electronic device which moniters inputs to control various transaxle functions including shift quality and transaxle diagnostics. The PCM recieves input information from sensors, switches, and various components to process for use within its control program. Based on this input information, the PCM controls various transaxle output functions and devices.

The PCM is mounted forward of the right front wheel housing, behind the front fascia cavity splash shield, as shown in Figure 6

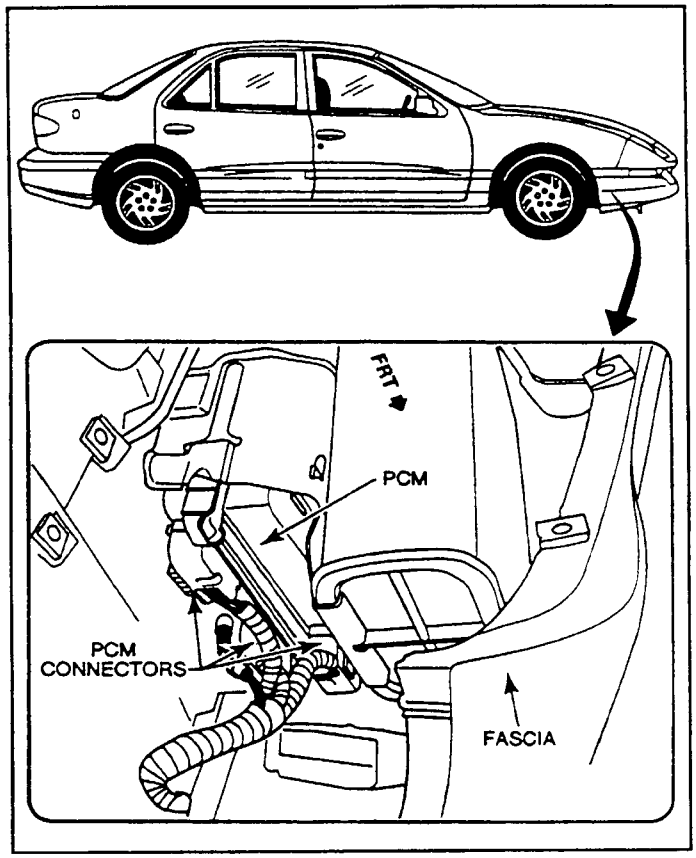


Figure 6

DIAGNOSTIC TROUBLE CODE (DTC) IDENTIFICATION
DIAGNOSTIC TYPES

DTC	DESCRIPTION	DTC TYPE	DEFAULT ACTION
P0502	Vehicle Speed Sensor (VSS) Circuit Low Input	A	– DTC P0502 will be stored in PCM memory. – Freeze shift adapts. – Maximum line pressure. – Immediate landing to 2nd gear. – Inhibit TCC engagement.
P0503	Vehicle Speed Sensor (VSS) Circuit Intermittent/Erratic	A	– DTC P0503 will be stored in PCM memory. – Freeze shift adapts. – Commands maximum line pressure. – Commands soft landing to 2nd gear. – Inhibit TCC engagement.
P0703	Torque Converter/Brake Switch Circuit Malfunction	A	– DTC P0703 will be stored in PCM memory. – Inhibit TCC engagement.
P0712	Transmission Fluid Temperature Sensor Circuit Low Input	A	– DTC P0712 will be stored in PCM memory. – Freeze shift adapts. – Transaxle default temperature 0°C (32°F).
P0713	Transmission Fluid Temperature Sensor Circuit High Input	A	– DTC P0713 will be stored in PCM memory. – Freeze shift adapts. – Transaxle default temperature 0°C (32°F).
P0716	Input/Turbine Speed Sensor Circuit Range/Performance	A	– DTC P0716 will be stored in PCM memory. – Inhibit TCC engagement. – Freeze shift adapts. – Maximum line pressure.
P0717	Input/Turbine Speed Sensor Circuit No Signal	A	– DTC P0717 will be stored in PCM memory. – Shift adapts maintained at current levels. – Inhibit TCC engagement. – Freeze shift adapts. – Maximum line pressure.
P0741	Torque Converter Clutch Circuit Stuck Off	A	– DTC P0741 will be stored in PCM memory. – Inhibit TCC engagement.
P0742	Torque Converter Clutch Circuit Stuck On	A	– DTC P0742 will be stored in PCM memory – Freeze shift adapts. – TCC commanded for 1-2, 2-3 and 3-4 shifts.

DTC Type
A – Emission related, turn on MIL on 1st failure
B – Emission related, turn on MIL after 2 consecutive trips with failure
C – Non-emission related, turn on service lamp on 1st failure
D – Non-emission related, no lamps

Figure 7

DIAGNOSTIC TROUBLE CODE (DTC) IDENTIFICATION
DIAGNOSTIC TYPES

DTC	DESCRIPTION	DTC TYPE	DEFAULT ACTION
P0748	Pressure Control Solenoid Electrical	D	– DTC P0748 will be stored in PCM memory. – Freeze shift adapts. – Maximum line pressure. – Will **NOT** illuminate the Malfunction – Indicator Lamp (MIL).
P0751	"A" (1-2) Shift Solenoid Performance	A	– DTC P0751 will be stored in PCM memory. – Freeze shift adapts. – Inhibit TCC engagement. – Maximum line pressure. – Commands soft landing to 2nd gear.
P0753	"A" (1-2) Shift Solenoid Electrical	A	– DTC P0753 will be stored in PCM memory. – Freeze shift adapts. – Maximum line pressure. – Inhibit TCC engagement. – Commands soft landing to 2nd gear.
P0756	"B" (2-3) Shift Solenoid Performance	A	– DTC P0756 will be stored in PCM memory. – Freeze shift adapts. – Inhibit TCC engagement. – Maximum line pressure. – Immediate landing to 2nd gear.
P0758	"B" (2-3) Shift Solenoid Electrical	A	– DTC P0758 will be stored in PCM memory. – Freeze shift adapts. – Maximum line pressure. – Inhibit TCC engagement. – Commands immediate landing to 2nd gear.
P1560	System Voltage Malfunction	B	– DTC P1560 will be stored in PCM memory. – Will **NOT** illuminate the Malfunction Indicator Lamp (MIL). – Inhibit TCC engagement. – Freeze shift adapts. – Maximum line pressure. – Condition 1, commands soft landing to 2nd gear. – Condition 2 and 3, commands immediate landing to 2nd gear.

DTC Type
A – Emission related, turn on MIL on 1st failure
B – Emission related, turn on MIL after 2 consecutive trips with failure
C – Non-emission related, turn on service lamp on 1st failure
D – Non-emission related, no lamps

Figure 8

DIAGNOSTIC TROUBLE CODE (DTC) IDENTIFICATION
DIAGNOSTIC TYPES

DTC	DESCRIPTION	DTC TYPE	DEFAULT ACTION
P1810	Pressure Switch Assembly (PSA) Malfunction	A	– DTC P1810 will be stored in PCM memory. – Freeze shift adapts. – Assume D4 shift pattern. – Inhibit TCC engagement. – Elevate line pressure.
P1811	Maximum Adapt and Long Shift	D	– DTC P1811 will be stored in PCM memory. – Will **NOT** illuminate the Malfunction Indicator Lamp (MIL). – Maximum line pressure. – Freeze shift adapts.
P1812	Transmission Fluid Overtemperature	D	– DTC P1812 will be stored in PCM memory. – Will **NOT** illuminate the Malfunction Indicator Lamp (MIL). – Freeze shift adapts.
P1871	Undefined Gear Ratio	D	– DTC P1871 will be stored in PCM memory. – Maximum line pressure. – Freeze shift adapts. – Will **NOT** illuminate the Malfunction Indicator Lamp (MIL).
P1887	TCC Release Switch Circuit Malfunction	A	– DTC P1887 will be stored in PCM memory. – Maximum line pressure. – Freeze shift adapts. – Inhibits TCC operation.

DTC Type
A – Emission related, turn on MIL on 1st failure
B – Emission related, turn on MIL after 2 consecutive trips with failure
C – Non-emission related, turn on service lamp on 1st failure
D – Non-emission related, no lamps

Figure 9

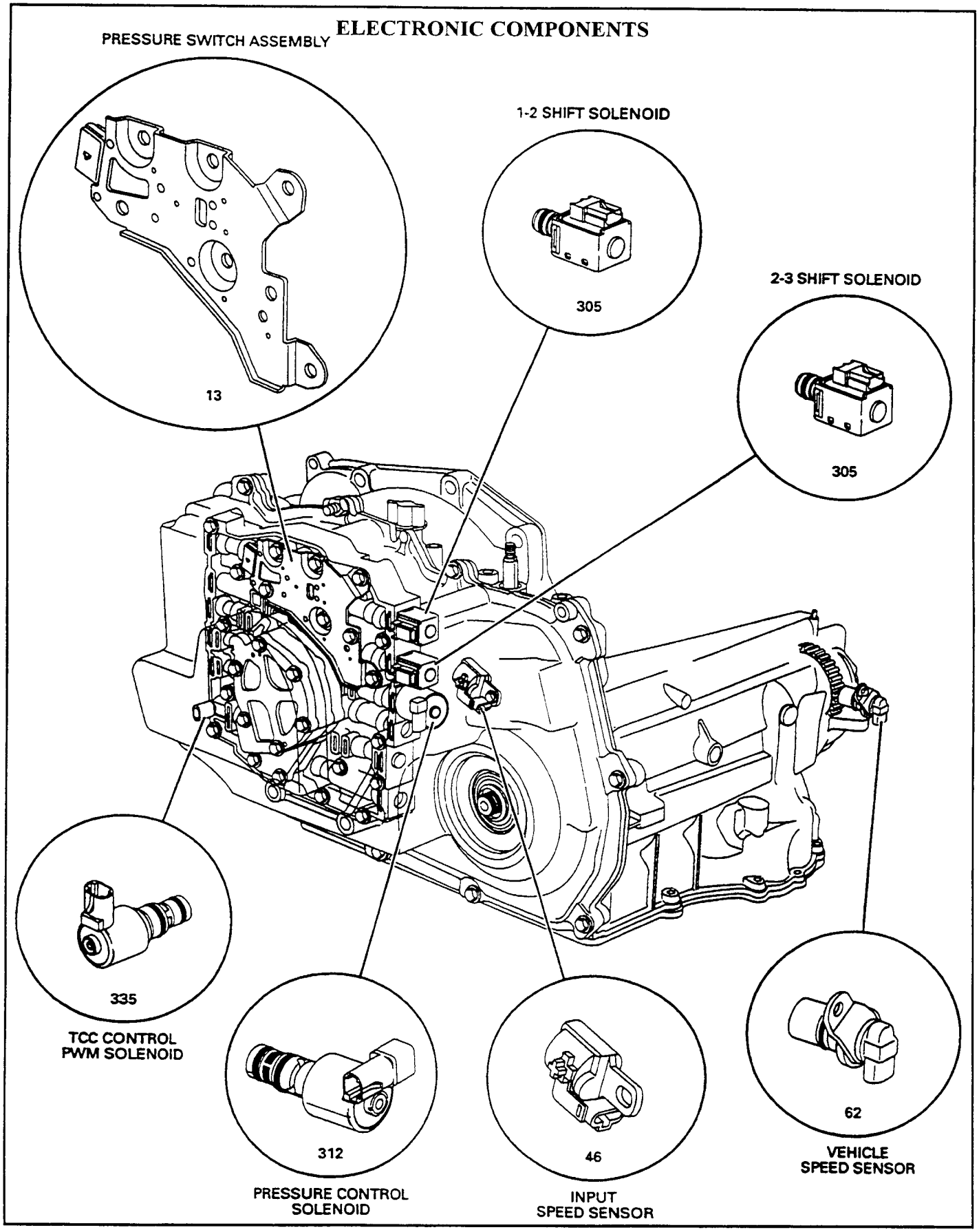
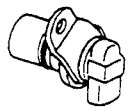

ELECTRONIC COMPONENTS
PRESSURE SWITCH ASSEMBLY
13
1-2 SHIFT SOLENOID
305
2-3 SHIFT SOLENOID
305
335
TCC CONTROL
PWM SOLENOID
312
PRESSURE CONTROL
SOLENOID
46
INPUT
SPEED SENSOR
62
VEHICLE
SPEED SENSOR

Figure 10

Vehicle Speed Sensor



The vehicle speed sensor is a magnetic inductive pickup that relays information relative to vehicle speed to the PCM. Vehicle speed information is used by the PCM to control shift timing, line pressure, and TCC apply and release.

The vehicle speed sensor mounts in the case at the speed sensor rotor which is pressed onto the differential. An air gap of 0.27 - 1.57 mm (0.011 - 0.062 inch) is maintained between the sensor and the teeth on the speed sensor rotor. The sensor consists of a permanent magnet surrounded by a coil of wire. As the differential rotates, an AC signal is induced in the vehicle speed sensor. Higher vehicle speeds induce a higher frequency and voltage measurement at the sensor.

Sensor resistance should measure between 1500 - 1750 ohms at 20°C (68°F). Output voltage will vary with vehicle speed from a minimum of 0.5 Volts AC at 25 RPM, to 200 Volts at 1728 RPM.

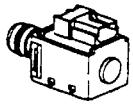
Transaxle Input Speed Sensor

The input speed sensor is a magnetic inductive pickup that relays information relative to transaxle input speed to the PCM. The PCM uses transaxle input speed information to control line pressure, TCC apply and release and transaxle shift patterns. This information is also used to calculate the appropriate operating gear ratios and TCC slippage.

The vehicle speed sensor mounts on the transaxle case under the channel plate and next to the drive sprocket. An air gap of 0.26 - 2.90 mm (0.010 - 0.114 inch) is maintained between the sensor and the teeth on the drive sprocket. The sensor consists of a permanent magnet surrounded by a coil of wire. As the drive sprocket is driven by the turbine shaft, an AC signal is induced in the input speed sensor. Higher vehicle speeds induce a higher frequency and voltage measurement at the sensor.

Sensor resistance should measure between 625 - 725 ohms at 20°C (68°F). Output voltage will vary with vehicle speed from a minimum of 0.5 Volts AC at 550 RPM, to 200 Volts at 7000 RPM.

Shift Solenoids: 1-2 and 2-3



The shift solenoids are two identical, normally open electronic exhaust valves that control upshifts and downshifts in all forward gear ranges. These shift solenoids work together in a combination of ON and OFF sequences to control the positions of the 1-2, 2-3 and 3-4 shift valve trains. The PCM monitors numerous inputs to determine the appropriate solenoid state combination and transmission gear for the vehicle operating conditions.

GEAR	SOLENOID 1-2	SOLENOID 2-3
Park, Reverse, Neutral*	ON	OFF
First	ON	OFF
Second	OFF	OFF
Third	OFF	ON
Fourth	ON	ON

The PCM energizes the shift solenoids by providing a ground to the solenoid's electrical circuit. This sends current through the coil winding of the solenoid, thereby creating a magnetic field. The magnetic field repels the plunger inside the solenoid which seats the solenoid metering ball against the fluid inlet port. This action prevents the exhaust of fluid through the solenoid and provides an increase in fluid pressure at the end of the shift valves. This fluid pressure initiates an upshift by moving the shift valves (refer to the oil flow diagrams for a complete description of the hydraulic control of the shift valves for each gear range).

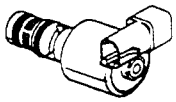
Shift solenoid resistance should measure between 19 - 24 ohms when measured at 20°C (68°F) and between 24 - 31 ohms when measured at 88°C (190°F).

The shift solenoids should energize when the voltage is greater than 7.5 volts. The shift solenoids should de-energize when the voltage is less than one volt.

* NOTE: THE SOLENOID STATES ARE NORMALLY ON (1-2) AND OFF (2-3) IN P, R, N. HOWEVER. THESE MAY CHANGE BASED ON VEHICLE SPEED AND THROTTLE POSITION.

Figure 11

Transaxle Pressure Control Solenoid



The pressure control solenoid (PCS) is a precision electronic pressure regulator that controls transaxle line pressure based on current flow through its coil windings. As current flow is increased the magnetic field produced by the coil moves the solenoid's plunger further away from the exhaust port. Opening the exhaust port decreases the output fluid pressure regulated by the PCS, which ultimately decreases line pressure. The PCM controls the PCS based on various inputs including throttle position, fluid temperature, MAP sensor and gear state.

The PCM controls the PCS on a positive duty cycle at a fixed frequency of 614 Hz (cycles per second). Duty cycle is defined as the percent of time current is flowing through the solenoid coil during each cycle. A higher duty cycle provides a greater current flow through the solenoid. The high (positive) side of the PCS electrical circuit at the PCM controls the PCS operation. The PCM provides a ground path for the circuit, monitors average current and continuously varies the PCS duty cycle to maintain the correct average current flowing through the PCS.

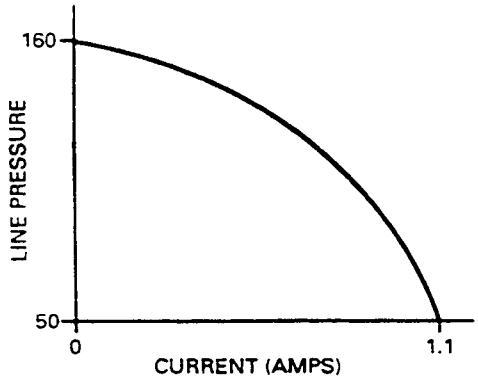
Duty Cycle	Current	Line Pressure
+ 5%	.02 Amps	Maximum
+40%	1.1 Amps	Minimum

Pressure control solenoid resistance should measure between 3.5 and 4.6 ohms when measured at 20°C (68°F).

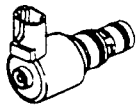
Transaxle Adapt Function

The 4T40-E uses a line pressure control system which has the ability to continuously adapt the system's line pressure (increase as needed) to compensate for normal wear of clutch fiber plates, seals, springs, etc. This "learning" feature is similar to what is used for fuel control (integrator/block learn) and throttle position (idle learn). The PCM maintains several adapt parameters for the transaxle:

- **Upshift Adapt** – The PCM monitors the TIS Sensor and VSS during commanded shifts to determine if a shift is occurring too fast (harsh) or too slow (soft) and adjusts the Transaxle Pressure Control Solenoid signal to maintain a set shift feel.



Torque Converter Clutch Solenoid



The TCC solenoid is a normally closed, pulse width modulated (PWM) solenoid used to control the apply and release of the converter clutch. The PCM operates the solenoid with a negative duty cycle at a fixed frequency of 42 Hz to control the rate of TCC apply/release. The solenoid's ability to "ramp" the TCC apply and release pressures results in a smoother TCC operation.

When vehicle operating conditions are appropriate to apply the TCC the PCM immediately increases the duty cycle to approximately 68% (see point a on graph). The PCM then ramps the duty cycle up to approximately 93% to achieve full TCC apply pressure. The rate at which the PCM increases the duty cycle controls the TCC apply. Similarly, the PCM also ramps down the TCC solenoid duty cycle to control TCC release.

There are some operating conditions that prevent or enable TCC apply under various conditions (refer to the temperature sensor description). Also, if the PCM receives a high voltage signal from the brake switch, signalling that the brake pedal is depressed, the PCM immediately releases the TCC.

Note: Duty cycles given are for example only. Actual duty cycles will vary depending on vehicle application and vehicle operating conditions.

TCC solenoid resistance should measure between 10.4 and 10.8 ohms when measured at 20°C (68°F). The resistance should measure approximately 16 ohms at 150°C (300°F).

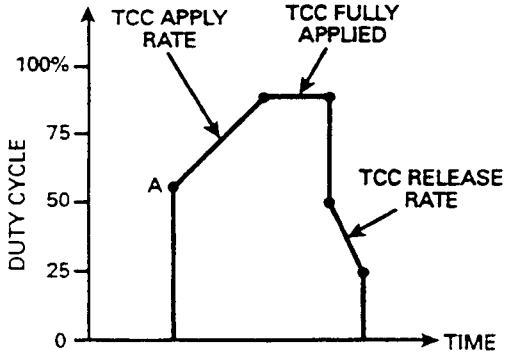


Figure 12

Transaxle Fluid Pressure Switch Assembly

The pressure switch assembly (PSA) is attached to the valve body and contains six fluid pressure switches and the transaxle temperature sensor (refer to the separate description of the temperature sensor). Five of the fluid pressure switches (PRND4, DRIVE, LO, D21, REV) are normally open and are used to indicate the position of the manual valve. The PCM uses this information to control line pressure, TCC apply and release and shift solenoid operation.

The RELEASE pressure switch is a normally closed pressure switch. This switch is used as a diagnostic tool to confirm that the TCC is actually OFF when it has been commanded OFF by the PCM.

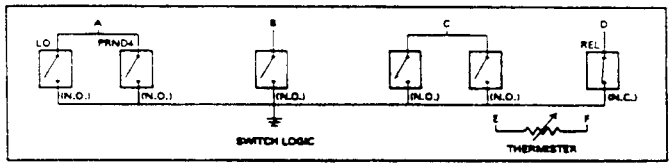
Each fluid pressure switch produces either an open or ground to the PCM depending on the presence of fluid pressure at the switches. The sequence of open and closed switches produces a combination of voltage readings that are monitored by the PCM (see chart and switch logic diagram). The PCM measures PSA signal voltage from each pin to ground and compares the voltage to a PSA combination chart stored in the PCM memory. If the PCM does not recognize the switch sequence a diagnostic code will be set as a result. A diagnostic code may also be set if the PSA switch sequence indicates a gear range selection that conflicts with other sensory inputs to the PCM.

RANGE INDICATOR	FLUID*					CIRCUIT+		
	REV	PRND4	DR	D21	LO	A	B	C
Park/Neutral	0		0	0	0	1	0	0
Reverse			0	0	0	1	0	1
Overdrive	0			0	0	1	1	0
Manual Third	0	0		0	0	0	1	0
Manual Second	0	0			0	0	1	1
Manual First	0	0				1	1	1

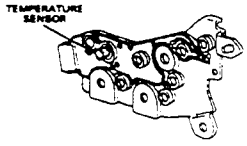
*: 1 = Pressurized
0 = Exhausted

+: 1 = Grounded (Resistance <50 ohms, 0 volts)
0 = Open (Resistance >50k ohms, 12 volts)

Note: Resistance should be measured with the engine running. When the transaxle pass thru connector is disconnected from the vehicle harness and the engine is running, multiple diagnostic codes will be set. Be sure to clear these codes when finished with this procedure.



Transaxle Temperature Sensor



The temperature sensor is a negative temperature coefficient thermistor (temperature sensitive resistor) that provides information to the PCM regarding transmission fluid temperature. The temperature sensor is integrated in the pressure switch assembly (PSA) which is bolted to the valve body. The sensor monitors pressurized main line pressure from the inside of the valve body to determine the operating temperature of the transaxle fluid. The sensor, similar to each of the PSA fluid pressure switches, uses an o-ring seal to maintian fluid pressure in the valve body.

The internal electrical resistance of the sensor varies in relation to the operating temperature of the transmission fluid (see chart). The PCM sends a 5 volt reference signal to the temperature sensor and measures the voltage drop in the electrical circuit. A lower fluid temperature creates a higher resistance in the temperature sensor, thereby measuring a higher voltage signal.

The PCM measures this voltage as another input to help control line pressure, shift schedules and TCC apply. When transaxle fluid temperature reaches 140°C (284°F) the PCM enters "hot mode". Above this temperature the PCM modifies transmission shift schedules and TCC apply in an attempt to reduce fluid temperature by reducing transmission heat generation. During hot mode the PCM applies the TCC at all times in Third and Fourth gears. Also, the PCM performs the 2-3 and 3-4 shifts earlier to help reduce fluid heat generation.

TRANSAXLE SENSOR – TEMPERATURE TO RESISTANCE TO VOLTAGE (approximate)

°C	R low (ohms)	R high (ohms)
0	7987	10859
10	4934	6407
20	3106	3923
30	1991	2483
40	1307	1611
50	878	1067
60	605	728
70	425	507
80	304	359
90	221	259
100	163	190

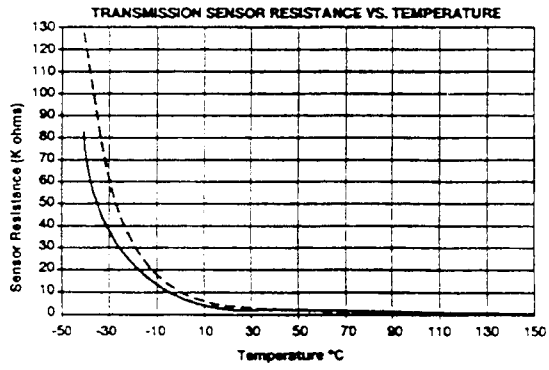
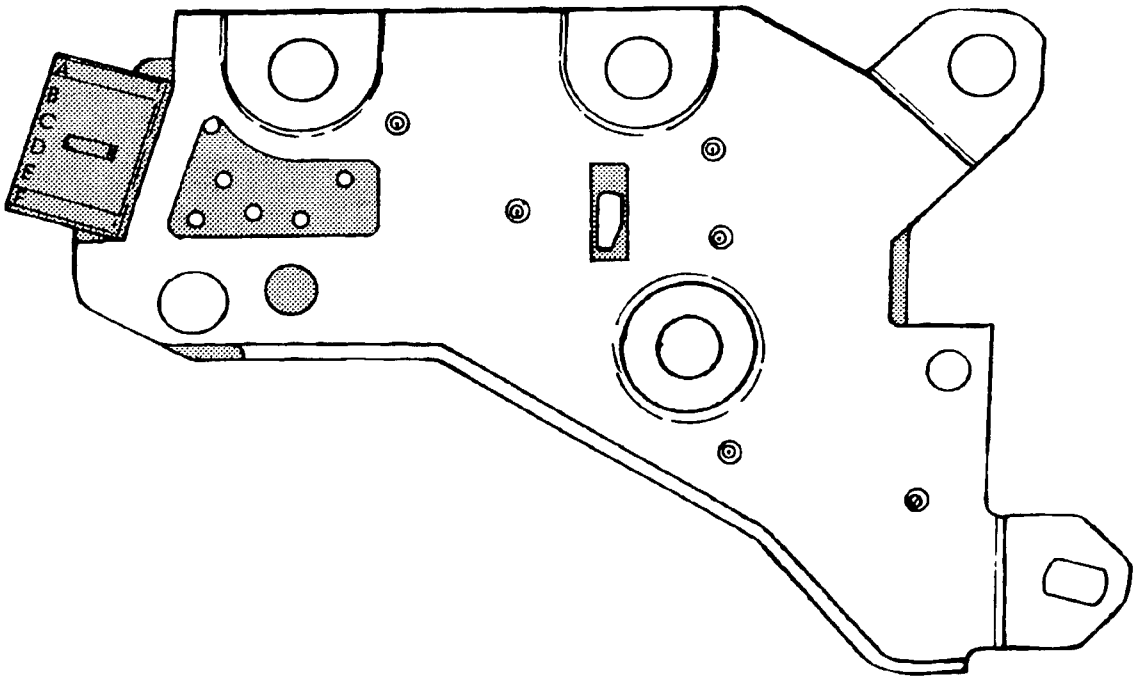


Figure 13

PRESSURE SWITCH ASSEMBLY



PRESSURE SWITCH ASSEMBLY (PSA) CONNECTOR

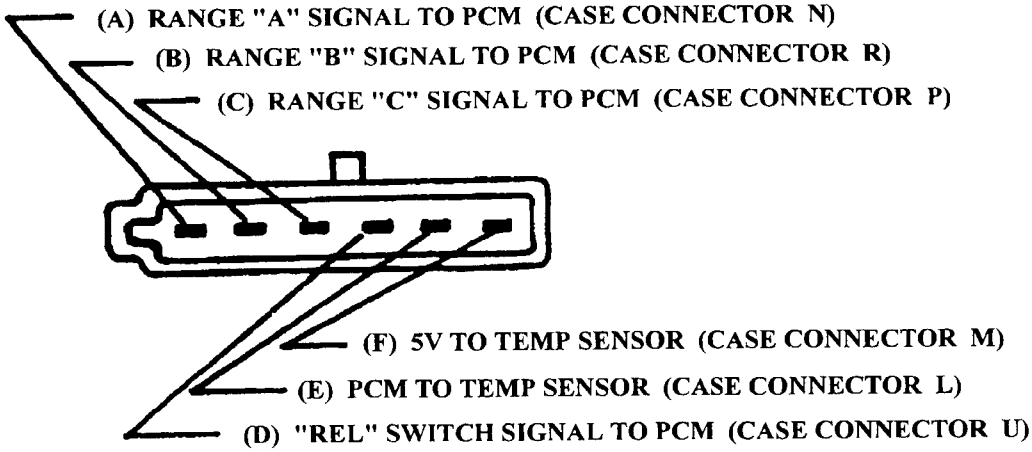
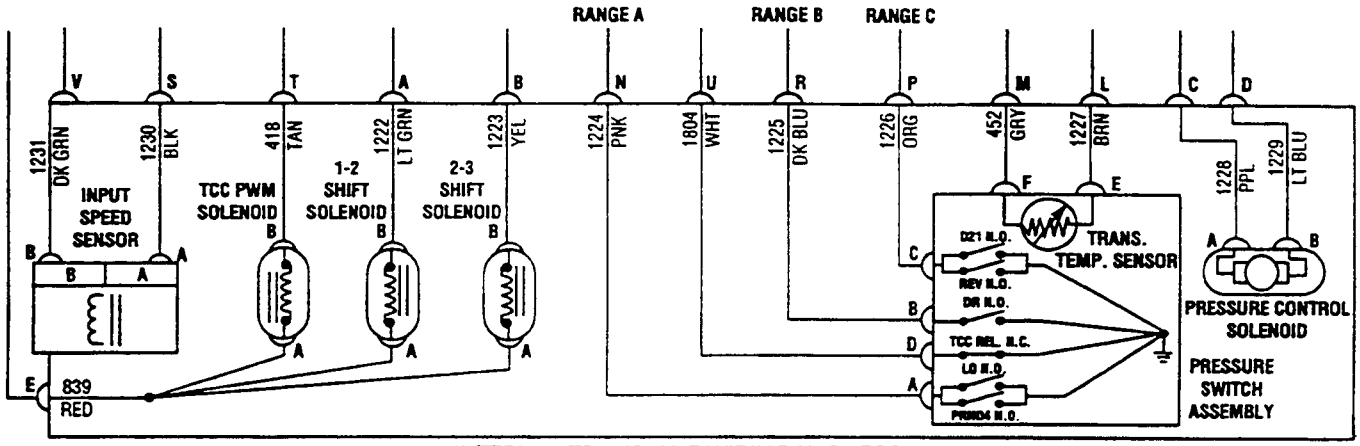


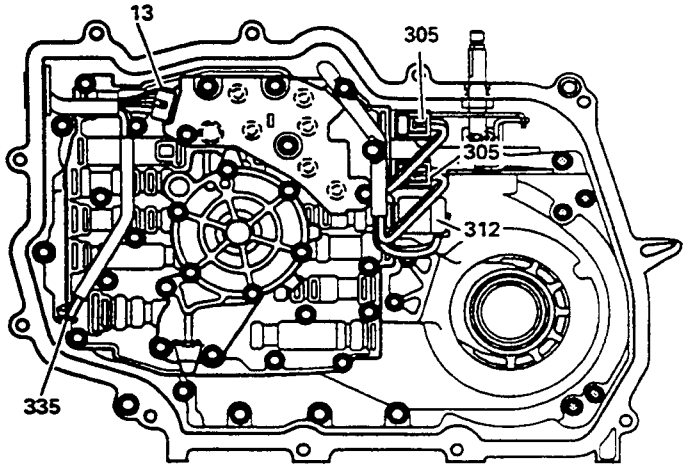
Figure 14

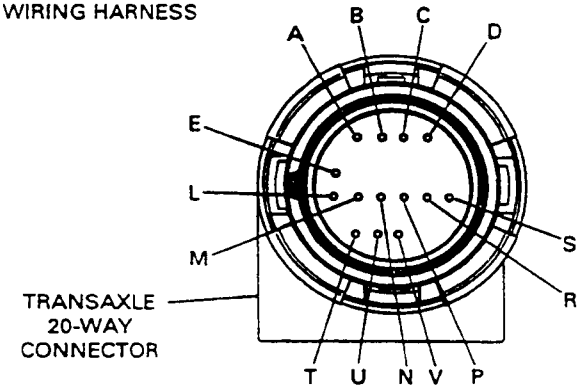
CASE CONNECTOR AND INTERNAL WIRING HARNESS



INTERNAL TRANSAXLE WIRING HARNESS

N.C. = NORMALLY CLOSED SWITCH
N.O. = NORMALLY OPEN SWITCH



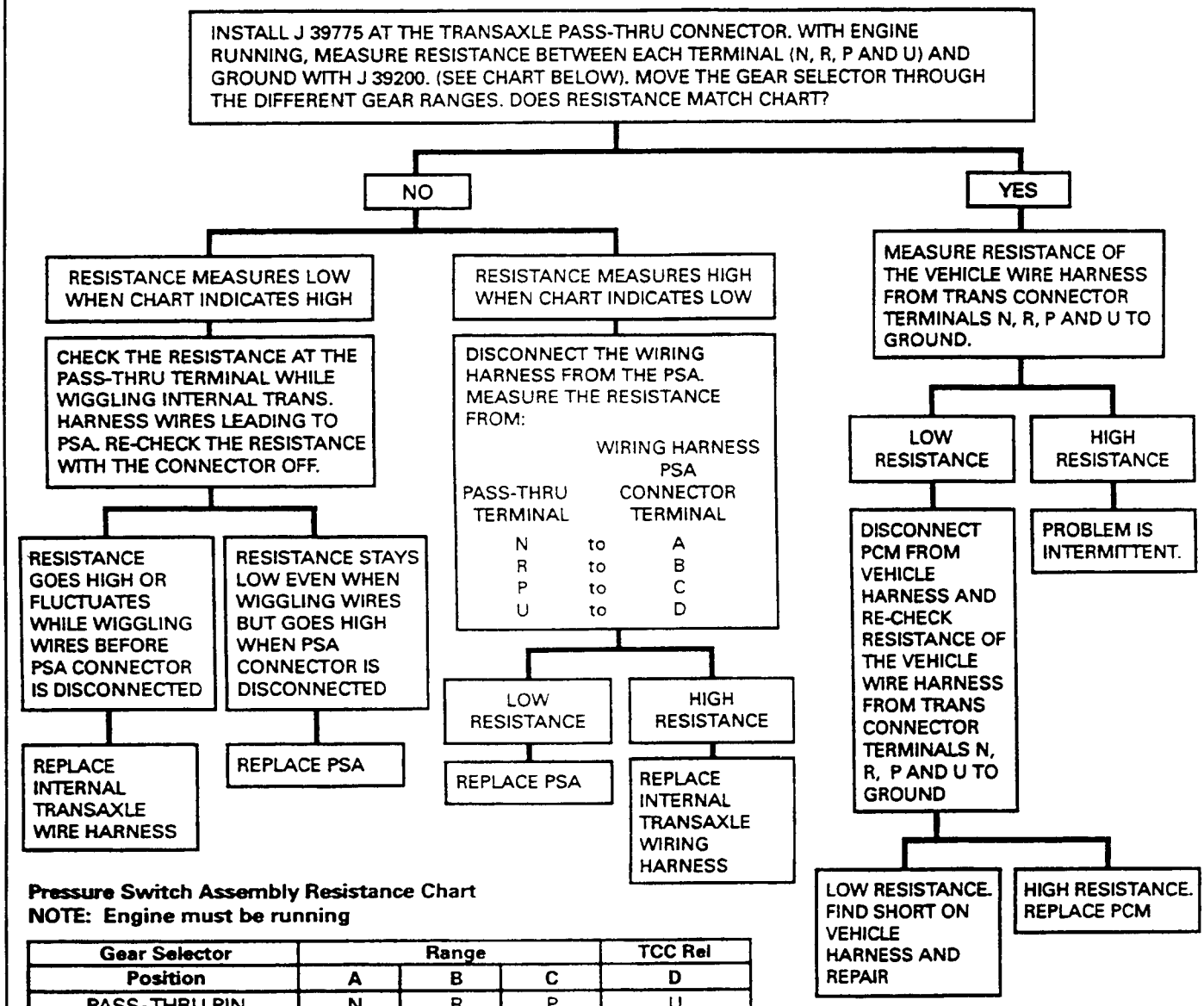


13 PRESSURE SWITCH ASSEMBLY (PSA)
305 SOLENOID, SHIFT (1-2 & 2-3)
312 SOLENOID, PRESSURE CONTROL
335 SOLENOID, TCC PWM CONTROL

CAVITY	FUNCTION
A	1-2 SHIFT SOLENOID
B	2-3 SHIFT SOLENOID
C	PRESSURE CONTROL SOLENOID (HIGH)
D	PRESSURE CONTROL SOLENOID (LOW)
E	BOTH SHIFT SOLENOIDS AND TCC PWM SOLENOID
L	TRANSAXLE FLUID TEMPERATURE SENSOR (HIGH)
M	TRANSAXLE FLUID TEMPERATURE SENSOR (LOW)
N	RANGE SIGNAL "A"
P	RANGE SIGNAL "C"
R	RANGE SIGNAL "B"
S	INPUT SPEED SENSOR (HIGH)
T	TCC PWM SOLENOID
U	TCC RELEASE SWITCH
V	INPUT SPEED SENSOR (LOW)

Figure 15

4T40-E TRANSAXLE
PRESSURE SWITCH ASSEMBLY (PSA) RESISTANCE CHECK



Pressure Switch Assembly Resistance Chart
NOTE: Engine must be running

Gear Selector	Range			TCC Rel
Position	A	B	C	D
PASS-THRU PIN	N	R	P	U
PARK	L	H	H	
REVERSE	L	H	L	
NEUTRAL	L	H	H	
D	L	L	H	
3	H	L	H	
2	H	L	L	
1	L	L	L	
TCC APPLIED				L
TCC OFF				H
ENGINE OFF, ANY GEAR	H	H	H	L

When range "X" is measured for resistance to ground,
H = High resistance (greater than 50K Ohms) - open circuit
L = Low resistance (less than 200 Ohms) - grounded circuit

IMPORTANT:

Whenever the transaxle pass-thru connector is disconnected from the vehicle harness and the engine is running, multiple transaxle Diagnostic Trouble Codes will set. Be sure to clear these codes when finished with this procedure.

Figure 16

4T40-E COMPONENT RESISTANCE CHART

COMPONENT	PASS THRU PINS	RES 20° C OHMS	RES 100° C OHMS	RES TO GND (CASE) OHMS
1-2 SHIFT SOLENOID	A, E	19-24 Ω	24-31 Ω	Greater than 250 K Ω
2-3 SHIFT SOLENOID	B, E	19-24 Ω	24-31 Ω	Greater than 250 K Ω
TCC CONTROL PWM	T, E	10-11 Ω	13-15 Ω	Greater than 250 K Ω
PRESSURE CONTROL SOLENOID	C, D	3-5 Ω	4-7 Ω	Greater than 250 K Ω
PRESSURE SWITCH ASSEMBLY	SEE PSA RESISTANCE CHECK			
* TRANSAXLE FLUID TEMPERATURE SENSOR	M, L	3106-3923 Ω	164-190 Ω	Greater than 20 M Ω
INPUT SPEED SENSOR	S, V	615-700 Ω	750-835 Ω	Greater than 10 M Ω
VEHICLE SPEED SENSOR	A, B (OSS) CONN	1550-1650 Ω	1700-1870 Ω	Greater than 10 M Ω

* NOTE: The resistance of this device is necessarily temperature dependant and will therefore vary far more than any other device.

CENTIGRADE TO FARENHEIT CHART

°C	°F	°C	°F
0	32	91	194
7	40	103	213
19	68	115	239
31	86	127	260
43	110	139	284
55	131	151	302
67	145		
79	176		

Figure 17

CONDITION	INSPECT COMPONENT	FOR CAUSE
HIGH OR LOW LINE PRESSURE (Verify With Gage) (All Shifts Harsh or Soft) Possible Codes: - 121 TP Sensor Circuit – Range/ Performance Problem - 122 TP Sensor Circuit – Low Input - 123 TP Sensor Switch "A" Circuit – Intermittent - 502 VSS Circuit – Low Input - 503 VSS Circuit – Intermittent/Erratic - 712 Trans Fluid Temp Sensor Circuit – Low Input - 713 Trans Fluid Temp Sensor Circuit – High Input - 716 Input Speed Sensor Circuit – Range/Performance - 717 Input Speed Sensor Circuit – No Signal - 742 TCC Stuck On - 748 PCS – Electrical - 751 1-2 Shift Solenoid Performance - 753 1-2 Shift Solenoid Electrical - 756 2-3 Shift Solenoid Performance - 758 2-3 Shift Solenoid Electrical - 1560 System Voltage Malfunction - 1810 PSA Malfunction - 1811 Max Adapt/Longshift - 1871 Undefined Gear Ratio - 1887 TCC Release Switch Malfunction	• Oil Level • Pressure Regulator Valve (328), Springs (326, 327) and Boost Valve (325) • Pressure Control Solenoid (312) • Torque Signal Regulator Valve (309) • Transmission Wiring Harness (11) • Pressure Switch Assembly (13) • Throttle Position Sensor • Oil Filter (85) • Oil Filter Seal (84) • Cooler Lines • Cooler Line Seals (49) • Oil Pump (10) • Oil Pump Drive Shaft (19) • Pressure Relief Valve (214) • Transaxle Case (1), Valve Body (18), Channel Plate (27)	– High or Low: correct as required. – Stuck. – Leak, o-rings damaged. – Loose connector, pins damaged. – Contaminated. – Stuck. – Loose connector at vehicle harness, short. – Loose connector. – Damaged or missing o-ring. – Damaged, sticking, disconnected. – Intermittent open or shorted circuit. – Clogged, broken, loose. – Leaking. – Clogged or restricted. – Leaking. – Damaged, sticking, porosity, leaking. – Damaged. – Damaged spring, ball missing. – Porosity, leaking circuits. – Flatness of machined surfaces.
INACCURATE / INCONSISTENT SHIFT POINTS Possible Codes: - 121 TP Sensor Circuit – Range/Performance Problem - 122 TP Sensor Circuit – Low Input - 123 TP Sensor Switch "A" Circuit – Intermittent - 502 VSS Circuit – Low Input - 503 VSS Circuit – Intermittent/Erratic	• Shift Solenoids (305) • Throttle Position Sensor • Vehicle (62) and Input Speed Sensors (46)	– Contamination. – Intermittent open or shorted circuit. – Damaged, disconnect. – Intermittent open or shorted circuit. – Damaged, disconnected, loose. – Intermittent open or shorted circuit.

ALL ILLUSTRATION NUMBERS REFERENCE HYDRA-MATIC 4T40-E UNIT REPAIR SECTION

Figure 18

CONDITION	INSPECT COMPONENT	FOR CAUSE
INACCURATE / INCONSISTENT SHIFT POINTS (Continued) - 716 Input Speed Sensor Circuit – Range/Performance - 717 Input Speed Sensor Circuit – No Signal - 751 1-2 Shift Solenoid – Performance - 753 1-2 Shift Solenoid – Electrical - 756 2-3 Shift Solenoid – Performance - 758 2-3 Shift Solenoid – Electrical - 1560 System Voltage Malfunction		
HARSH SHIFTS (General)	• Line Pressure • Checkballs (26) • Accumulators • Clutch Housing Retainer and Ball Assemblies	– High (See High Line Pressure). – Missing; no orificed apply. – Springs or piston binding; no accumulation. – Accumulator valve stuck. – Plugged.
NO REVERSE, SLIPS IN REVERSE Possible Codes: - 1810 PSA Malfunction with Input Speed Sensor	• Reverse Clutch – Piston and Seal Assembly (457) – Inner Seal (456) – Clutch Plates (460 - 463) – Snap Ring (459, 464) – Housing (454) – Housing Retainer and Ball Assembly – Springs (458) • Reverse Clutch Fluid Routing – Driven Sprocket Support (95) – Channel Plate & Gasket, and Valve Body, Gaskets and Channel Plate • Lo & Reverse Band and Servo – Servo Piston (69) – Servo Piston Seals (71, 72) – Servo Pin (67) and Springs (66, 68) – Servo Cover (73)	– No apply / slipping. – Binding, cracked, leaking. – Orifice plugged. – Friction worn, splines broken. – Out of position. – Cracked, feed holes plugged, tangs broken. – Missing / out of position. – Binding. – Fluid leak / restriction. – Seal rings leaking. – Porosity, damaged, misaligned. – Porosity, fluid leak across channels, misaligned, damaged, fluid restriction. – No apply / slipping. – Broken, binding. – Leaking. – Binding. – Broken, loose, leaking.

ALL ILLUSTRATION NUMBERS REFERENCE HYDRA-MATIC 4T40-E UNIT REPAIR SECTION

Figure 19

CONDITION	INSPECT COMPONENT	FOR CAUSE
NO REVERSE, SLIPS IN REVERSE (Continued)	– Lo & Reverse Band (111) – Anchor Pin (64) – Fluid Feed Tubes (83) – Transaxle Case (1) • Shift Linkage • Manual Valve (800) and Link (802) • #1 Checkball (LO/PRN) • Fluid Level • Fluid Pressure	– Broken, worn, out of position. – Broken. – Broken, bent, plugged, seal rings missing / leaking. – Porosity, fluid leak or restriction. – Disconnected, misaligned. – Disconnected, misaligned. – Missing (No Lo Band Fluid). – Low. – Low (See Low Fluid Pressure).
NO FIRST GEAR, SLIPS IN FIRST GEAR Possible Codes: - 502 VSS Circuit – Low Input - 503 VSS Circuit – Intermittent/Erratic - 716 Input Speed Sensor Circuit – Range/Performance - 717 Input Speed Sensor Circuit – No Signal - 751 1-2 Shift Solenoid Performance - 753 1-2 Shift Solenoid Electrical - 756 2-3 Shift Solenoid Performance - 758 2-3 Shift Solenoid Electrical - 1810 PSA Malfunction with Input Speed Sensor - 1871 Undefined Gear Ratio	• Forward Clutch – Piston and Seal Assembly (607) – Inner Seal (608) – Clutch Plates (601 - 604) – Snap Ring (600, 605) – Housing (609) – Housing Retainer and Ball Assembly – Springs (606) • Input Sprag (515) • Lo Roller Clutch (652) • Forward Clutch Fluid Routing – Oil Feed Tubes (83) – Forward Clutch Support (114) – Channel Plate (27) and Gasket (28) – PSA (13) • 1-2 Shift Solenoid (305) • 1-2 Shift Valve (302) • 2-3 Shift Solenoid (305) • Manual Valve (800) / Shift Linkage • Torque Converter (55) • Line Pressure	– No apply / slipping. – Binding, cracked, leaking. – Orifice Plugged. – Splines broken, friction worn. – Out of position. – Cracked, feed holes plugged. – Missing, out of position. – Binding. – Damaged, not holding. – Damaged, not holding. – Fluid leak or restriction. – Bent, broken, seal rings leaking, plugged. – Porosity, seal rings leaking, damaged, feed holes plugged. – Porosity, misaligned, fluid leak across channels or restriction. – Drive switch o-ring leaking. – Failed "OFF", leaking. – Stuck in upshifted position. – Failed "ON", exhaust plugged. – Misaligned. – Stator roller clutch not holding. – Low (See Low Line Pressure).

ALL ILLUSTRATION NUMBERS REFERENCE HYDRA-MATIC 4T40-E UNIT REPAIR SECTION

Figure 20

CONDITION	INSPECT COMPONENT	FOR CAUSE
NO SECOND GEAR, SLIPS IN SECOND GEAR Possible Codes: - 751 1-2 Shift Solenoid Performance - 753 1-2 Shift Solenoid Electrical - 1871 Undefined Gear Ratio	• 2nd Clutch – Piston and Seal Assembly (404) – Clutch Plates (96 - 99) – Snap Ring (406) – Springs (405) – Driven Sprocket Support (95)	– No apply / slipping. – Binding, cracked, leaking. – Friction worn, splines broken. – Out of position. – Binding. – Damaged, leaking, porosity.
	• 2nd Clutch Fluid Routing – Valve Body, Gaskets & Spacer Plate; Channel Plate & Gasket; and Driven Sprocket Support	– Fluid leak or restriction. – Porosity, misaligned, loose, restriction, fluid leak across channels.
	• 2nd Roller Clutch (452)	– Damaged, not holding.
	• 1-2 Shift Solenoid (305)	– Stuck "ON", plugged.
	• Forward Clutch • Line Pressure	– Low Capacity shows up in Second Gear. – Low (See Low Line Pressure).
	• 1-2 Accumulator (29-31)	– Leak at piston seal. – Channel plate / case porosity.
	• 1-2 Accumulator Valve (323)	– Stuck.
	• 2-3 Shift Valve (306)	– Stuck in upshifted position.
	• PSA	– Malfunction (Electrical or Hydraulic)
NO THIRD GEAR, SLIPS IN THIRD GEAR Possible Codes: - 756 2-3 Shift Solenoid Performance - 758 2-3 Shift Solenoid Electrical - 1871 Undefined Gear Ratio	• Direct Clutch – Piston and Seal Assembly (518) – Clutch Plates (521 - 523) – Snap Ring (520) – Springs (519) – Direct & Coast Housing and Input Shaft (520) – Housing Retainer and Ball Assembly	– No apply / slipping. – Binding, cracked, leaking. – Friction worn, splines broken. – Out of position. – Binding. – Damaged, cracked, feed holes restricted. – Missing, loose.
	• Direct Clutch Fluid Routing – Valve Body, Gaskets & Spacer Plate; Channel Plate & Gasket; Driven Sprocket Support – Driven Sprocket Support Seals – Input Shaft	– Porosity, misaligned, loose, fluid restriction, fluid leak across channels. – Leaking. – Seals leaking. – Sleeve damaged; misaligned.
	• 2-3 Shift Solenoid (305)	– Stuck "OFF", leaking.
	• 2-3 Accumulator	– Leak at piston seal. – Channel plate / case porosity.

ALL ILLUSTRATION NUMBERS REFERENCE HYDRA-MATIC 4T40-E UNIT REPAIR SECTION

Figure 21

CONDITION	INSPECT COMPONENT	FOR CAUSE
NO THIRD GEAR, SLIPS IN THIRD GEAR (Continued)	• 2-3 Accumulator Valve (330)	– Stuck.
	• Line Pressure	– Low (See Low Line Pressure).
	• 3-4 Shift Valve (319)	– Stuck in upshifted position.
	• PSA (13)	– Malfunction (Electrical or Hydraulic).
SECOND GEAR ONLY	• 1-2 Shift Valve (302)	– Stuck in down shifted position.
NO FOURTH GEAR, SLIPS IN FOURTH GEAR Possible Codes: - 751 1-2 Shift Solenoid Performance - 753 1-2 Shift Solenoid Electrical - 1871 Undefined Gear Ratio	• Intermediate / 4th Band & Servo – Servo Piston (77) – Servo Piston Seals (78, 79) – Servo Pin (76) and – Servo Cover (80) – Band (100) – Case (1)	– No apply / slipping. – Broken, binding. – Leaking. – Binding. Springs (75, 68) – Broken, loose, leaking. – Broken, worn, out of position. – Cracked at band seat.
	• Band Apply Fluid Routing – Valve Body, Gaskets & Spacer Plate; Channel Plate; Case	– Porosity, misaligned, loose, fluid restricting, fluid leak across channels.
	• 1-2 Shift Solenoid (305)	– Stuck "OFF", leaking.
	• 3-4 Shift Valve (319)	– Stuck in downshifted position.
	• Manual Valve (800)	– Misaligned (in Manual Third).
	• 3-4 Accumulator	– Leak at piston seal. – Channel plate / case porosity.
	• 3-4 Accumulator Valve (323)	– Stuck.
	• Line Pressure	– Low (See Low Line Pressure).
	• Direct Clutch	– Low capacity will cause failure in Fourth gear.
	• PSA	– Malfunction (Hydraulic or Electrical)
LOSS OF DRIVE	• Torque Converter (55)	– Broken lugs, failed lug weld. – Sheared lug bolts. – Worn turbine shaft splines. – Internal failure. – Cracked cover at weld.
	• Axles	– Damaged, splines worn, loose.
	• Turbine Shaft (39)	– Stripped splines.
	• Oil Pump (10)	– Seized, broken pump gears.
	• Oil Pump Shaft (19)	– Broken, stripped splines.

ALL ILLUSTRATION NUMBERS REFERENCE HYDRA-MATIC 4T40-E UNIT REPAIR SECTION

Figure 22

CONDITION	INSPECT COMPONENT	FOR CAUSE
LOSS OF DRIVE (Continued)	• Filter and Filter Seal (85, 84)	– Plugged, missing.
	• Fluid Level	– Low.
	• Shift Linkage	– Disconnected.
	• Drive / Driven Sprockets and Drive Chain (36, 37, 91)	– Broken.
	• Planetary Gears	– Failure, lack of lube.
	• Final Drive	– Gear failure, lack of lube.
	• Channel Plate and Gasket (28)	– Damaged, leaking, misaligned.
	• Valve Body, Gaskets and Spacer Plate	– Damaged, leaking, misaligned.
	• Forward Sprag Clutch; Forward Clutch; Lo Roller Clutch	– Damaged, not holding. (See No First Gear)
	• Hydraulic System	– Tie up, fluid circuit leaks
LOSS OF POWER Possible Codes: - 751 1-2 Shift Solenoid Performance - 753 1-2 Shift Solenoid Electrical - 756 2-3 Shift Solenoid Performance - 758 2-3 Shift Solenoid Electrical	• Fluid Level	– Low.
	• Shift Solenoids (305)	– Failed "OFF", 2nd gear start. – 2-3 Shift solenoid, failed "ON"
	• TCC System	– TCC stuck on or dragging.
	• Torque Converter (55)	– Contaminated, damaged.
ENGINE STALL Possible Codes: - 742 TCC Circuit stuck on	• TCC System – TCC Solenoid (335) – TCC Regulated Apply Valve (339)	– TCC stuck on or dragging. – Stuck "ON", solenoid exhaust plugged. – Stuck in apply position.
1ST AND 2ND GEARS ONLY Possible Codes: - 756 2-3 Shift Solenoid Performance - 758 2-3 Shift Solenoid Electrical	• 2-3 Shift Solenoid (305)	– Stuck "OFF"; solenoid leaking, electrical.
	• 2-3 Shift Valve (307)	– Stuck in downshifted position.
	• Direct Clutch	– Failed clutch (released)

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Figure 23

CONDITION	INSPECT COMPONENT	FOR CAUSE
3RD AND 4TH GEARS ONLY Possible Codes: - 756 2-3 Shift Solenoid Performance - 758 2-3 Shift Solenoid Electrical	• 2-3 Shift Solenoid (305) • 1-2 and 2-3 Shift Valves	– Stuck "ON"; solenoid plugged, electrical. – Both stuck in upshifted position.
1ST AND 4TH GEARS ONLY Possible Codes: - 751 1-2 Shift Solenoid Performance - 753 1-2 Shift Solenoid Electrical	• 1-2 Shift Solenoid (305)	– Stuck "ON", electrical, solenoid plugged.
2ND AND 3RD GEARS ONLY Possible Codes: - 751 1-2 Shift Solenoid Performance - 753 1-2 Shift Solenoid Electrical	• 1-2 Shift Solenoid (305)	– Stuck "OFF", electrical, solenoid leaking.
NO PARK	• Parking Lock Actuator Assembly (807) • Detent Roller and Spring (804) • Detent Lever (806) • Manual Valve (800) • Park Lock Gear (659) • Parking Lock Pawl (663) • Park Pawl Spring (662) • Shift Linkage	– Rod bent or damaged. – Spring binding or broken. – Rod not attached to detent lever. – Bolt not torqued, loose. – Bent, damaged. – Damaged, loose (manual shaft pin missing). – Misaligned, manual valve to detent lever link bent. – Damaged teeth, splines damaged. – Damaged, tooth broken. – Broken, missing. – Misadjusted.
RATCHETING NOISE	• Parking Pawl (663)	– Return spring damaged, weak or misassembled.

ALL ILLUSTRATION NUMBERS REFERENCE HYDRA-MATIC 4T40-E UNIT REPAIR SECTION

Figure 24

CONDITION	INSPECT COMPONENT	FOR CAUSE
NO ENGINE COMPRESSION BRAKING: ALL MANUAL RANGES	• Coast Clutch – Piston and Seal Assembly (504) – Clutch Plates (508, 509) – Springs (505) – Direct & Coast Clutch Housing and Input Shaft (502) – Housing Retainer and Ball Assembly	– No apply/ slipping. – Binding, cracked, leaking. – Friction worn, splines broken. – Binding. – Damaged cracked, fluid feed holes restricted. – Missing, loose.
	• Coast Clutch Fluid Routing –Valve Body Gaskets and Spacer Plate; Channel Plate and Gasket; Driven Sprocket Support – Driven Sprocket Support Seals – Input Shaft (502)	– Porosity, misaligned, loose, fluid restriction, fluid leak across channels. – Leaking. – Seals leaking. – Sleeve damaged, misaligned.
	• Oil Level / Line Pressure	– Low (See Low Line Pressure).
	• 3-4 Shift Valve (319)	– Stuck in 4th gear position. (No coast clutch apply).
	• Manual Valve / Shift Linkage (800)	– Misaligned.
NO ENGINE COMPRESSION BRAKING: MANUAL SECOND – SECOND GEAR Possible Codes: - 1810 PSA Malfunction	• Coast Clutch	– No apply / slipping (See No Engine Compression Braking: All Ranges).
	• Intermediate / 4th Band (100)	– No apply / slipping (See No 4th Gear: Intermediate / 4th Band – No apply).
	• Pressure Switch Assembly (13)	– Leaking, inoperative.
	• Vehicle Speed Sensor (62)	– Reads 0 mph.
NO ENGINE COMPRESSION BRAKING: MANUAL FIRST – FIRST GEAR Possible Codes: - 1810 PSA Malfunction	• Coast Clutch	– No apply / slipping (See No Engine Compression Braking: All Ranges).
	• Lo & Reverse Servo	– No apply / slipping (See No Reverse: Lo & Reverse Band – No apply / slipping).
	• Pressure Switch Assembly (13)	– Leaking, inoperative.
	• #1 Checkball (LO/PRN)	– Missing.
DRIVES IN NEUTRAL	• Forward Clutch (Drives Forward)	– Not releasing.

ALL ILLUSTRATION NUMBERS REFERENCE HYDRA-MATIC 4T40-E UNIT REPAIR SECTION

Figure 25

CONDITION	INSPECT COMPONENT	FOR CAUSE
DRIVES IN NEUTRAL (Continued)	• Reverse Clutch and Lo & Reverse Servo (Drives in Reverse)	– Both not releasing.
	• Manual Valve and Linkage (800)	– Misaligned.
NO GEAR SELECTIONS	• Manual Valve to Detent Lever Link (802)	– Broken, missing. – Disconnected from manual valve.
	• Manual Valve to Link Clip (801)	– Disconnected.
	• Manual Valve (800)	– Stuck.
	• Shift Linkage	– Disconnected.
	• Valve Body, Channel Plate and Case	– Blocked fluid channels.
SHIFT INDICATOR INDICATES WRONG GEAR SELECTION	• Indicator Linkage	– Misadjusted.
	• Detent Spring and Roller Assembly (804)	– Broken, missing. – Bolt loose,
	• Manual Valve (800)	– Not connected to detent lever.
FLUID LEAKS	• Refer to Fluid Leak Diagnosis in this section.	
FLUID FOAMING	• Fluid	– Degraded fluid. – Contaminate (Antifreeze). – Transaxle overfilled.
	• Cooler Lines	– Plugged
	• Transaxle Oil Filter (85)	– Clogged. – Cracked.
	• Filter Seal (84)	– Leaking.
	• Side Cover Seal (6)	– Damaged.
	• Engine	– Overheated.
	• Vehicle	– Overloaded.
	• Oil Level Control Valve (86)	– Damaged, loose.

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Figure 26

CONDITION	INSPECT COMPONENT	FOR CAUSE
VIBRATION	• Torque Converter (55)	– Out of balance. – Internal failure.
	• Transaxle / Engine	– Misaligned.
	• Output (94) / Stub Shafts (58)	– Out of balance. – Bushings worn or damaged.
	• Turbine Shaft (39)	– Worn bushings. – Out of balance.
NOISE –		
IN ALL RANGES or (A whine which may RPM load sensitive or ceases when TCC engages.)	• Torque Converter (55)	– Verify noise internal to torque converter by placing left foot on brake with gear or selector in Drive and momentarily stall engine. Torque converter noise increases under load.
A High Pitch WHINE which will intensify with engine RPM or is Oil Pressure sensitive.	• Oil Pump System	– Verify noise internal to oil pump during preliminary oil pressure check. An increase in line pressure will vary an oil pump noise.
A Popping noise similar to Popcorn popping.		– Pump cavitation - indicated by bubbles in fluid. – Transaxle fluid filter for seam leak. – Transaxle fluid filter seal for proper positioning or cut seal.
A BUZZ or High Frequency Rattle sound.	• Trace cooler pipes and check for binding or contact at the Radiator other than the Cooler pipe connectors.	– Verify pressure buzz by watching for a needle vibration on the pressure gage. (Road test may be necessary.)
A WHINE or GROWL that increases and fades with Vehicle speed and is most Noticeable under Light Acceleration.	• Drive Link Assembly System • Verify noise from sprockets and/or drive link assembly (chain) by placing left foot on brake and moving gear selector from Park or Reverse. If noise stops check items below:	
	• Drive Chain (36)	– Stretched.
	• Drive Sprocket (37) and Driven Sprocket (91)	– Teeth broken or sheared. – Bearing surfaces nicked or scored. – Bearing race or roller bearing surfaces on gear Support Inner Bearing rough or pitted. – Bearing damaged.

ALL ILLUSTRATION NUMBERS REFERENCE HYDRA-MATIC 4T40-E UNIT REPAIR SECTION

Figure 27

CONDITION	INSPECT COMPONENT	FOR CAUSE
NOISE – (Continued)	• Drive Sprocket Support (43) and Driven Sprocket Support (95)	– Bearing outer race support rough or nicked.
A Final Drive Noise or Hum, is most noticeable under light throttle acceleration and/or turns.	• Final Drive Gear Set (116) Final Drive Internal Gear (118)	– Worn, planet pinions or washers. – Worn, tooth damage.
	• Differential Carrier (116) Differential Side Gears (709)	– Gears worn or pitted. – Thrust washer damage.
Noise in 1st, 2nd, 3rd or 4th.	• Final Drive Sun Gear (115) Final Drive Pinions (707)	– Gear worn or damage. – Gears worn or damaged.
Noise only in certain gear ranges.	• Check Range Reference Chart. Determine power flow and applicable components that may be causing noise.	
NO TCC / SLIPPING / SOFT APPLY Possible Codes: - 502 VSS Circuit – Low Input - 503 VSS Circuit – Intermittent/Erratic - 703 Torque Converter/ Brake Switch Malfunction - 712 Trans Fluid Temp Sensor Circuit – Low Input - 713 Trans Fluid Temp Sensor Circuit – High Input - 716 Input Speed Sensor Circuit – Range/Performance - 717 Input Speed Sensor Circuit – No Signal - 741 TCC Circuit – Stuck "OFF" - 742 TCC Circuit – Stuck "ON" - 751 1-2 Shift Solenoid Performance - 753 1-2 Shift Solenoid Electrical - 756 2-3 Shift Solenoid Performance - 758 2-3 Shift Solenoid Electrical - 1560 System Voltage Malfunction - 1810 PSA Malfunction - 1812 Trans Fluid Overtemp - 1887 TCC Release Switch Malfunction	• TCC Solenoid (335) • Wiring Harness (11) • PCM • Brake Switch • Pressure Regulator Valve • Torque Converter (55) • TCC Fluid Circuits • TCC Regulated Apply Valve (339) and TCC Control Valve (334) • TCC Feed Limit Valve • Fluid Level or Pressure • Cooler Lines	– Stuck "OFF". – O-ring leaking. – No voltage to solenoid. – Poor electrical connection. – Pinched wire (electrical short). – Damaged electrical connector. – No signal to solenoid. – Not functioning (open). – Stuck. – Internal failure. – Leaks (Refer to Oil Flow Diagrams). – Plugged Release Exhaust Orifice. – Stuck in TCC release position. – Stuck. – Low. – Plugged.

ALL ILLUSTRATION NUMBERS REFERENCE HYDRA-MATIC 4T40-E UNIT REPAIR SECTION

Figure 28

CONDITION	INSPECT COMPONENT	FOR CAUSE
NO TCC RELEASE	• TCC Solenoid (335)	– Internal failure. – Fluid exhaust plugged. – External Ground.
	• Torque Converter (55)	– Internal Failure.
	• TCC Regulated Apply Valve (339) and TCC Control Valve (334)	– Stuck in TCC apply position.
TCC APPLY WITH COLD ENGINE	• Engine Coolant Temp Sensor	– Malfunction.
TCC SHUDDER	• Refer to TCC Shudder Diagnosis in this section. (SEE PAGE 36)	

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Figure 29

TCC SHUDDER DIAGNOSIS

The key to diagnosing Torque Converter Clutch (TCC) shudder is to note when it happens and under what conditions.
TCC shudder should occur only during the ***Apply*** and/or ***Release*** of the converter clutch, but ***Seldom*** after the TCC plate is fully applied.

While TCC is Applying Or Releasing:

If the shudder occurs while TCC is applying, the problem can be within the transaxle and/or torque converter. Something is not allowing the clutch to become fully engaged, not allowing the clutch to release, or is trying to release and apply the clutch at the same time. This could be caused by leaking turbine shaft seals, a restricted release orifice, a distorted clutch or housing surface due to converter bolts too long, or defective friction material on the TCC plate.

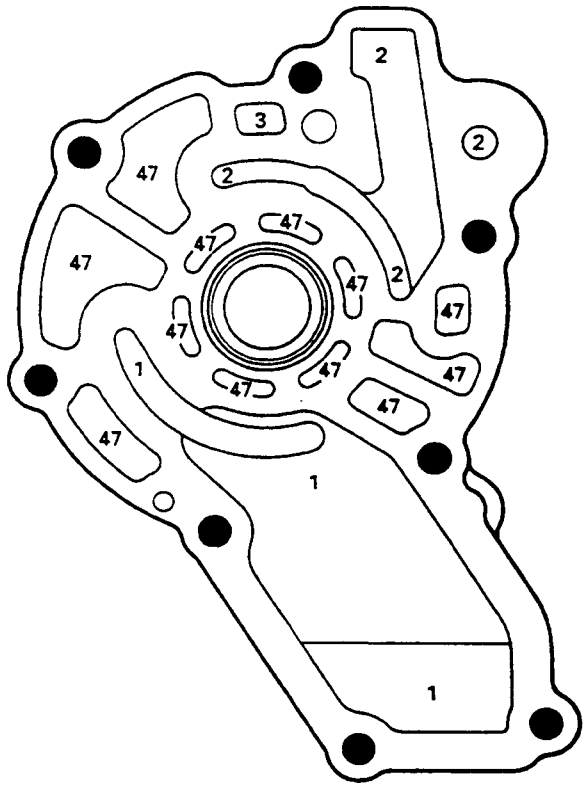
Shudder Occurs After TCC Has Applied:

In this case, most of the time there is nothing wrong with the transaxle! Once the TCC has been applied, it is very unlikely that it will slip.
Engine problems may go unnoticed under light throttle and load, but become very noticeable after TCC apply when going up a hill or accelerating, due to the mechanical coupling between the engine and transaxle.
Remember, once TCC is applied there is no torque converter (fluid coupling) assistance, and engine or driveline vibrations may not be detected before TCC engagement.

Inspect the following components to avoid possible misdiagnosis of TCC shudder and possible rebuild of the transaxle and/or replacing a torque converter unnecessarily.

1. ***Spark Plugs*** - Inspect for cracks, high resistance or broken insulators.
2. ***Plug Wires*** - Look into each end. If there is Red dust (ozone) or Black substance (carbon) present then the wires are bad. Also look for evidence of arcing during hard acceleration.
3. ***Distributor Cap and Rotor*** - Look for broken or uncrimped parts.
4. ***Ignition Coils*** - Look for idication of arcing while engine is under acceleration, and check each coil for proper ground.
5. ***Fuel Injector*** - Nozzles and/or filter plugged or partially restricted.
6. ***Vacuum Leaks*** - Engine will not get the correct amount of fuel. Engine may run rich or lean depending on where the leak is located.
7. ***EGR Valve*** - May let in too much unburnable exhaust gas and cause engine to run lean.
8. ***MAP/MAF Sensor*** - Like the vacuum leak, the engine will not recieve correct amount of fuel for proper engine operation.
9. ***Carbon on Intake Valves*** - Restricts the proper flow of air/fuel mixture into the cylinders.
10. ***Flat Camshaft*** - Valves don't open far enough to let proper fuel/air mixture into cylinders.
11. ***Oxygen Sensor*** - May command engine too rich or too lean for too long.
12. ***Fuel Pressure*** - May be too low.
13. ***Engine Mounts*** - Vibration of mounts can be multiplied by TCC engagement.
14. ***TPS*** - If TPS is out of specification, TCC may remain applied during initial engine crowd.
15. ***Cylinder Balance*** - Bad piston rings or poorly seating valves can cause low horsepower.
16. ***Fuel Contaminated*** - Engine performance can be severly impaired.

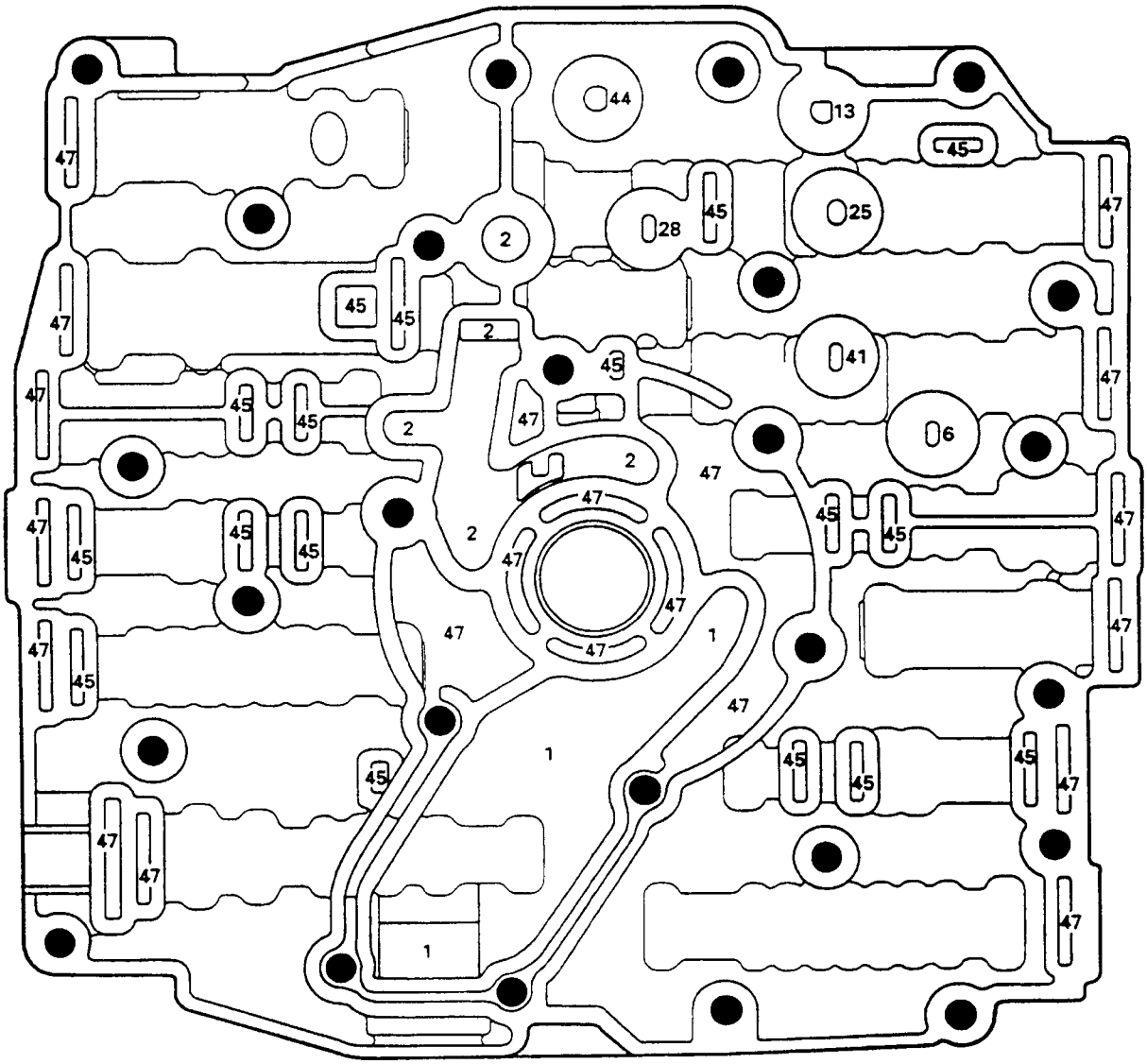
PUMP BODY OIL PASSAGES



1 SUCTION
2 LINE
3 DECREASE
47 VOID

Figure 30

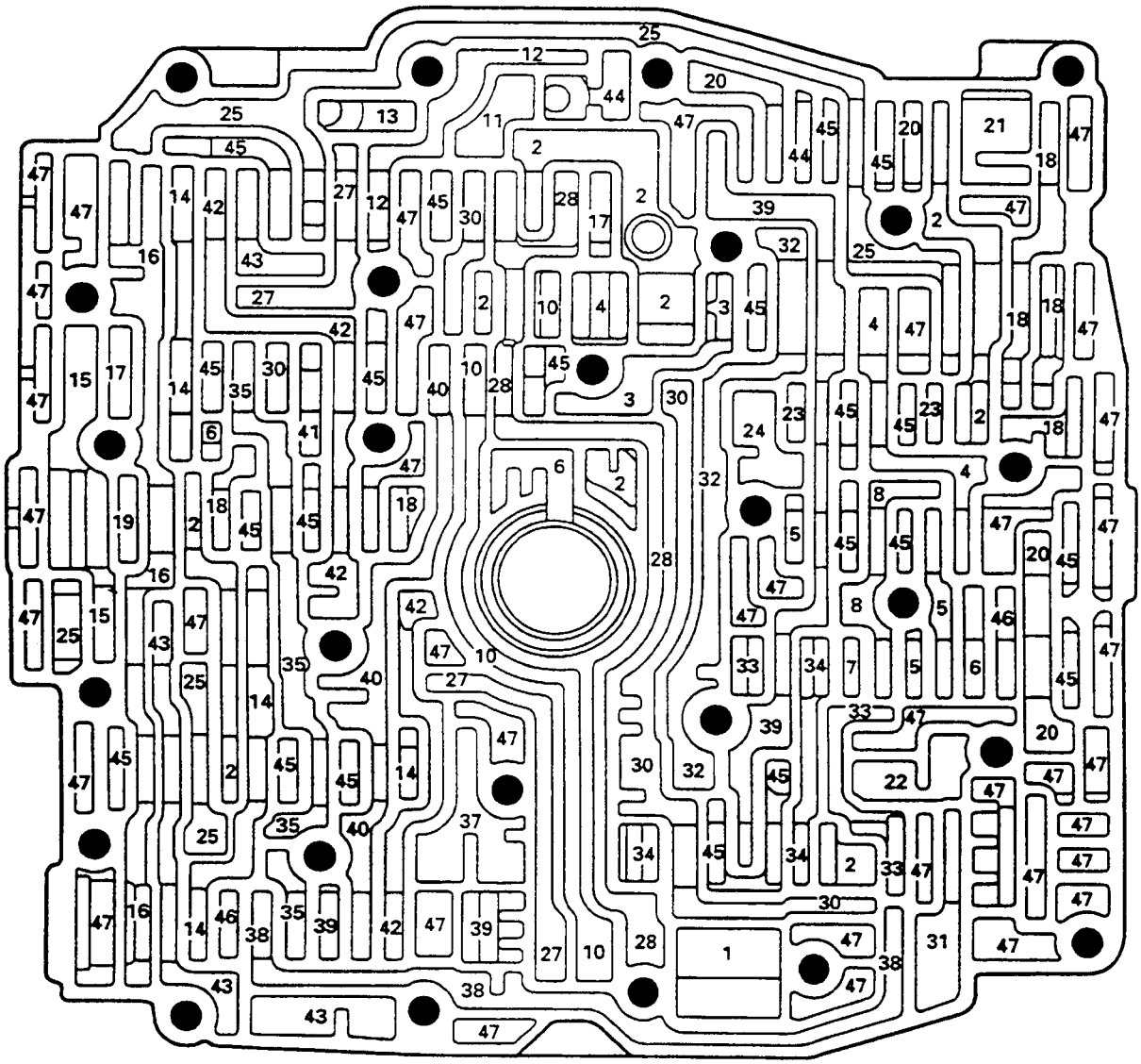
VALVE BODY PASSAGES - OIL PUMP SIDE



1	SUCTION	17	2-3 SIGNAL	33	TCC SIGNAL (PWM)
2	LINE	18	TORQUE SIGNAL	34	TCC REGULATED APPLY
3	DECREASE	19	PCS SIGNAL	35	3-4 DRIVE
4	CONVERTER FEED	20	1-2/3-4 ACCUMULATOR	36	DIRECT CLUTCH FEED
5	TCC FEED LIMIT	21	1-2 ACCUMULATOR FEED	37	DIRECT CLUTCH
6	RELEASE	22	3-4 ACCUMULATOR FEED	38	4TH BAND
7	APPLY	23	2-3 ACCUMULATOR	39	D321
8	COOLER	24	2-3 ACCUMULATOR FEED	40	COAST CLUTCH
9	LUBE 1	25	REVERSE	41	D21
10	LUBE 2	26	REVERSE CLUTCH	42	INTERMEDIATE BAND FEED
11	PRN	27	LO BAND	43	INTERMEDIATE BAND
12	LO/PRN	28	DRIVE	44	LO
13	PRND4	29	FORWARD CLUTCH	45	EXHAUST
14	ACTUATOR FEED	30	2-3 DRIVE	46	ORIFICED EXHAUST
15	FILTERED ACTUATOR FEED	31	FILTERED 2-3 DRIVE	47	VOID
16	1-2 SIGNAL	32	2ND CLUTCH		

Figure 31

VALVE BODY PASSAGES - CHANNEL PLATE SIDE



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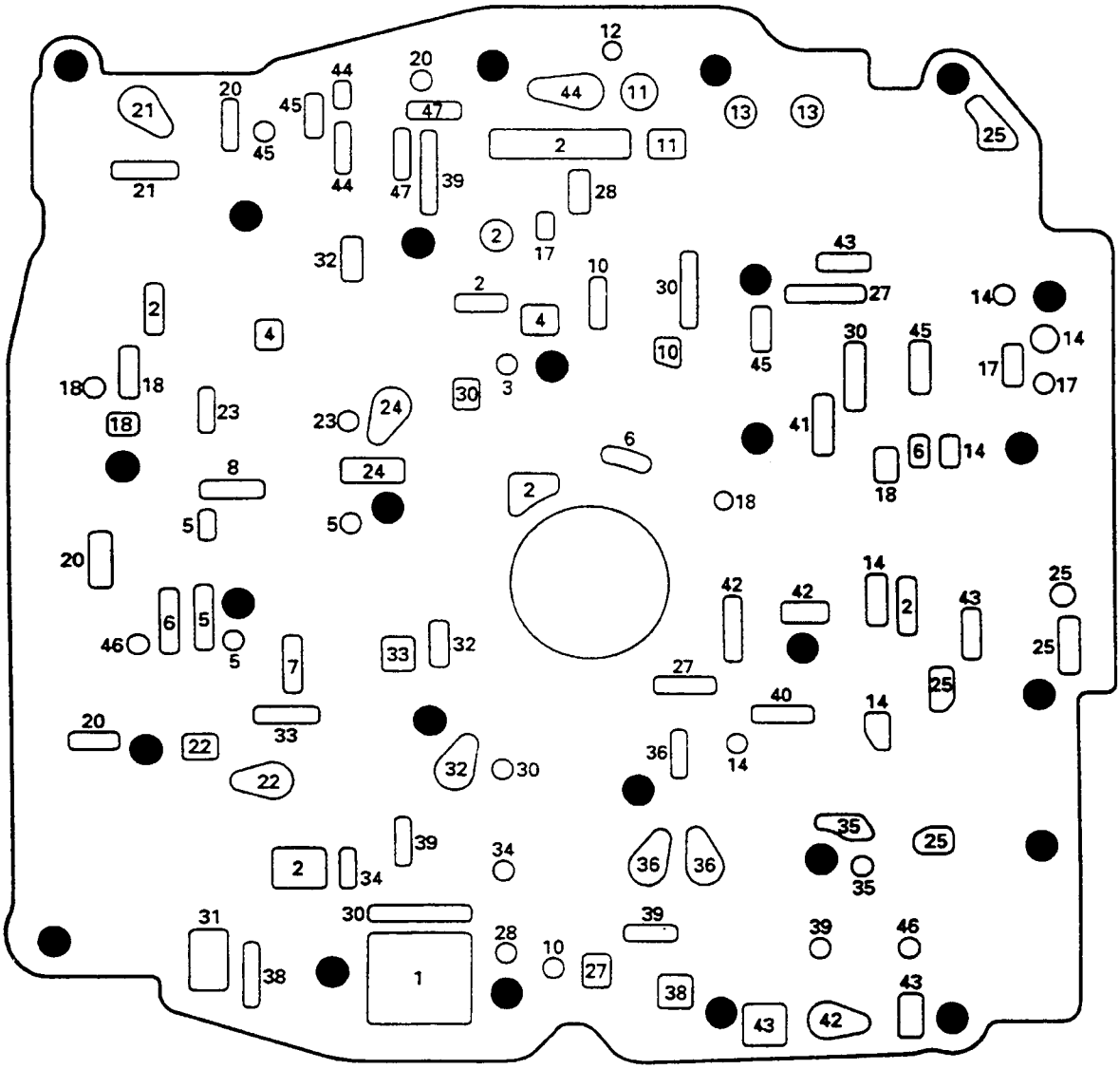
13	PRND4	29	FORWARD CLUTCH	45	EXHAUST
14	ACTUATOR FEED	30	2-3 DRIVE	46	ORIFICED EXHAUST
15	FILTERED ACTUATOR FEED	31	FILTERED 2-3 DRIVE	47	VOID
16	1-2 SIGNAL	32	2ND CLUTCH		

Figure 32

VALVE BODY TO SPACER PLATE GASKET



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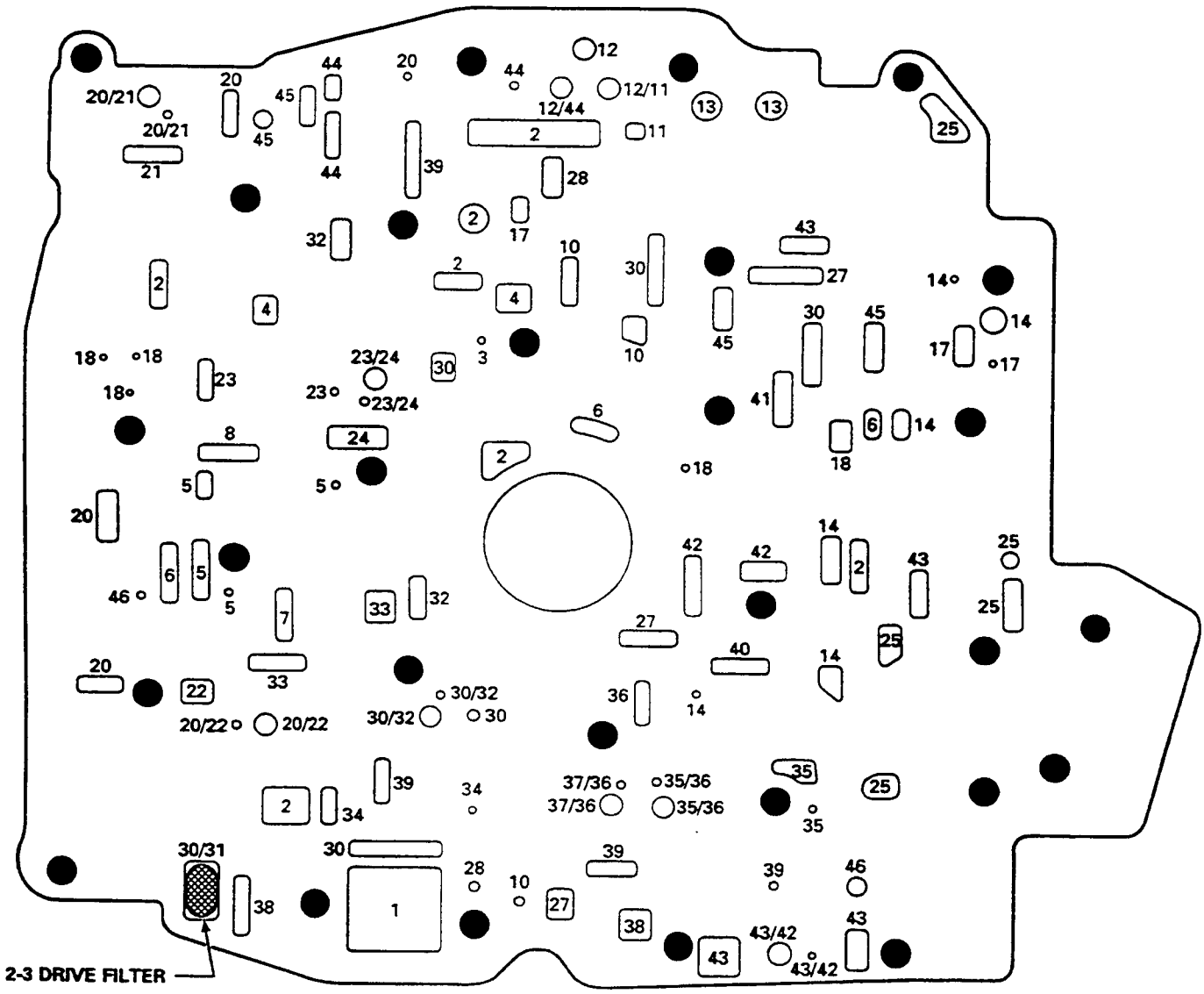
13	PRND4	29	FORWARD CLUTCH	45	EXHAUST
14	ACTUATOR FEED	30	2-3 DRIVE	46	ORIFICED EXHAUST
15	FILTERED ACTUATOR FEED	31	FILTERED 2-3 DRIVE	47	VOID
16	1-2 SIGNAL	32	2ND CLUTCH		

Figure 33

TYPICAL SPACER PLATE



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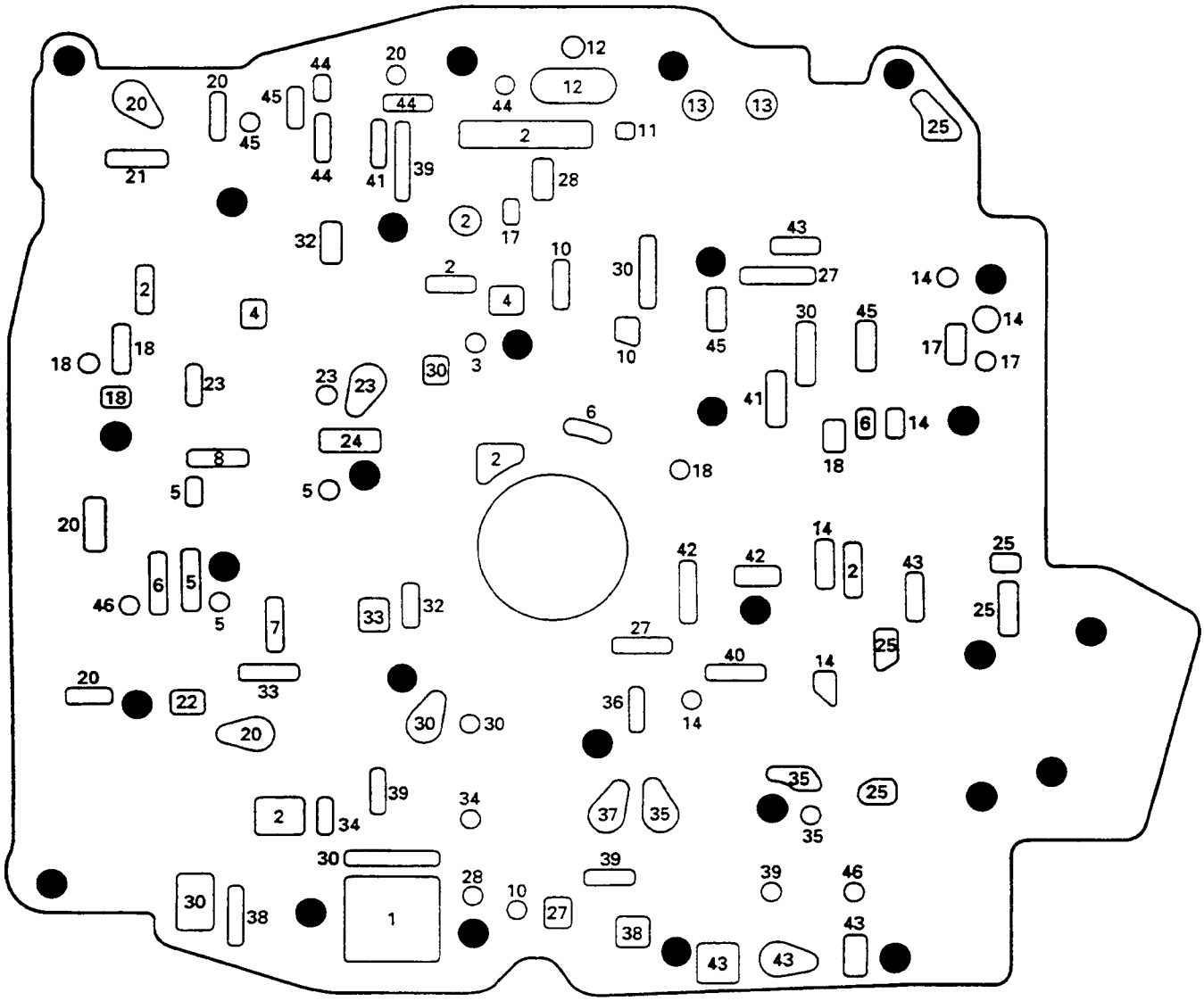
15	FILTERED ACTUATOR FEED	31	FILTERED 2-3 DRIVE	47	VOID
16	1-2 SIGNAL	32	2ND CLUTCH		

Figure 34

SPACER PLATE TO CHANNEL PLATE GASKET



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15	FILTERED ACTUATOR FEED	31	FILTERED 2-3 DRIVE	47	VOID
16	1-2 SIGNAL	32	2ND CLUTCH		

Figure 35

CHANNEL PLATE PASSAGES - VALVE BODY SIDE

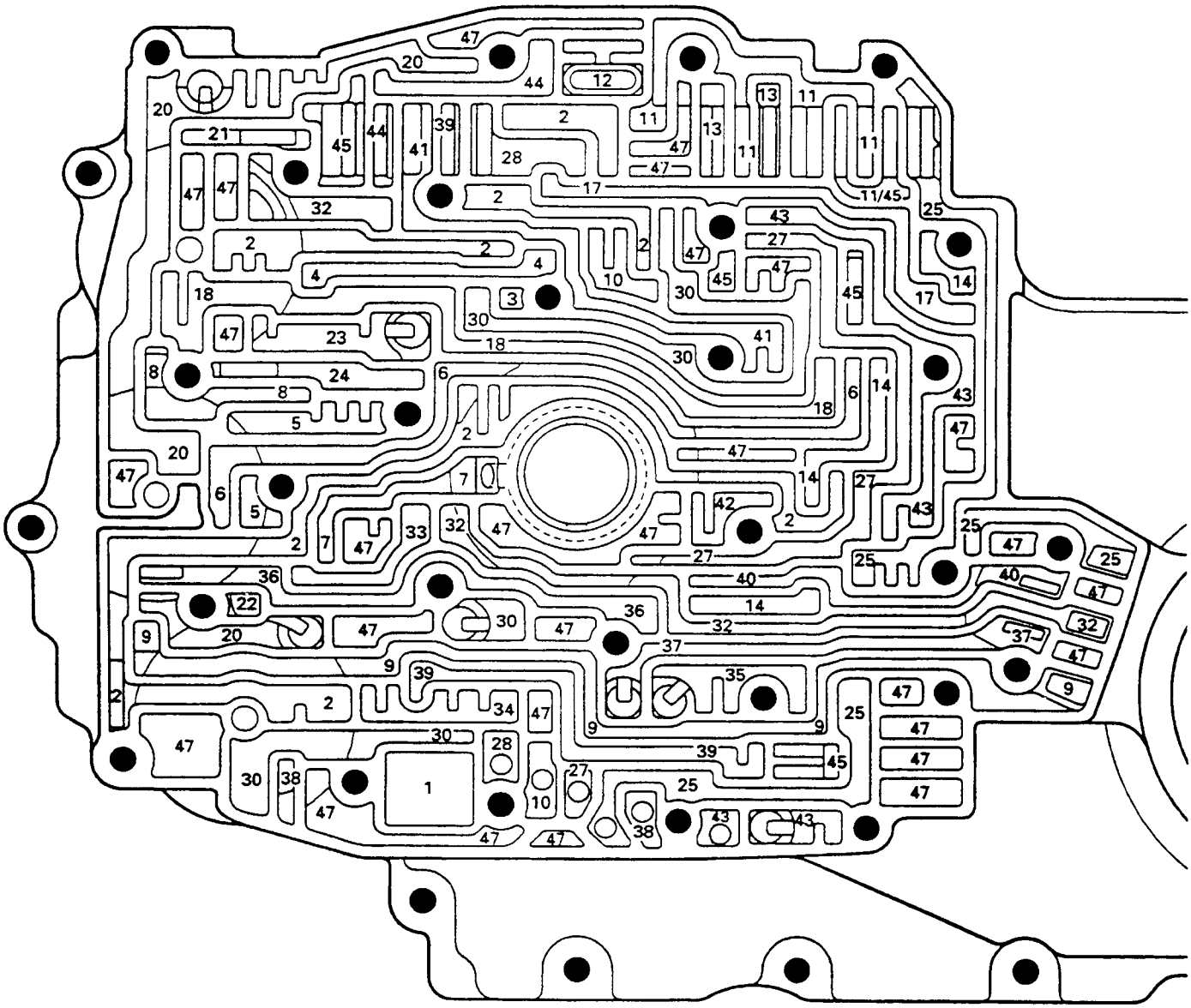

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Figure 36

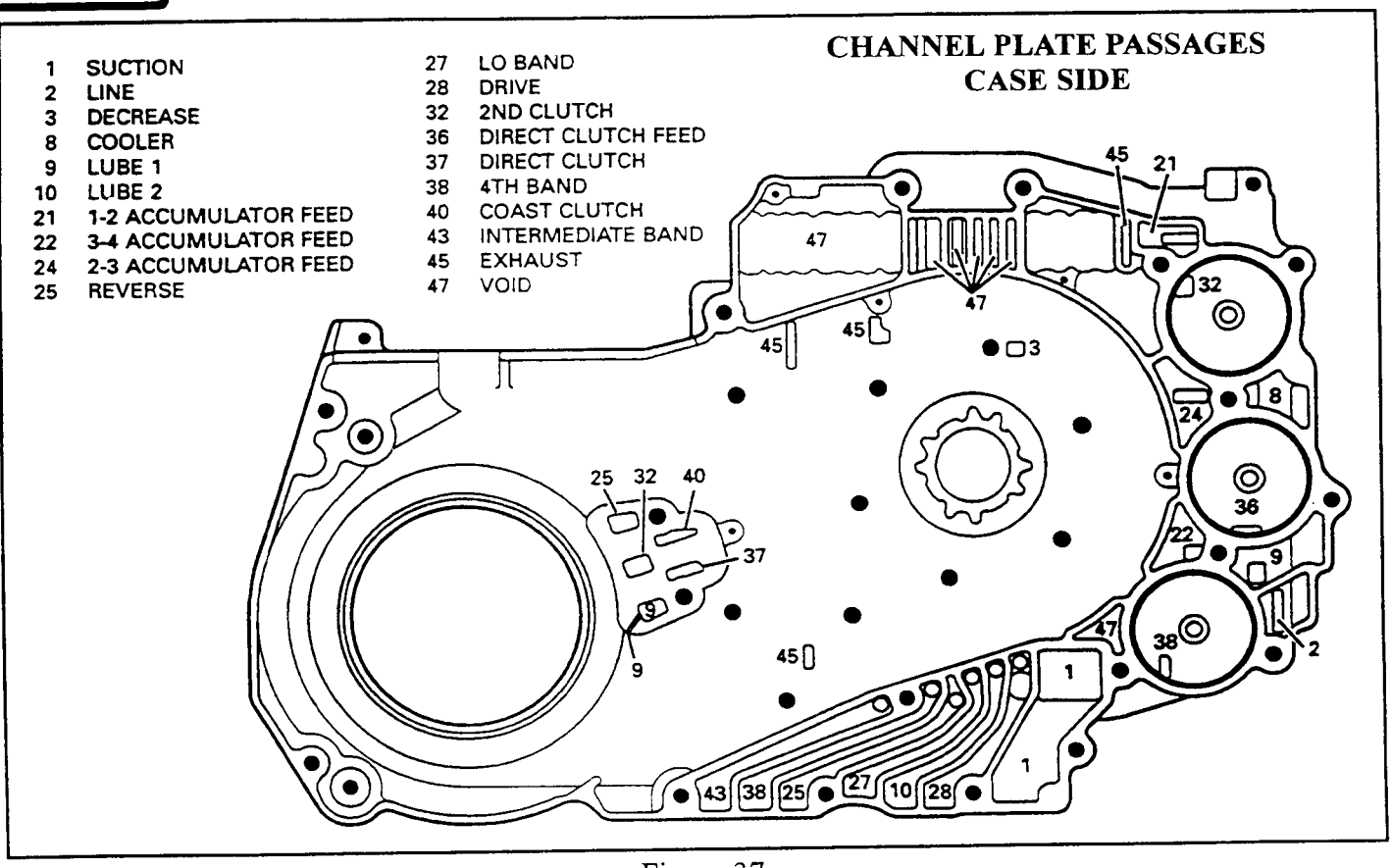


Figure 37

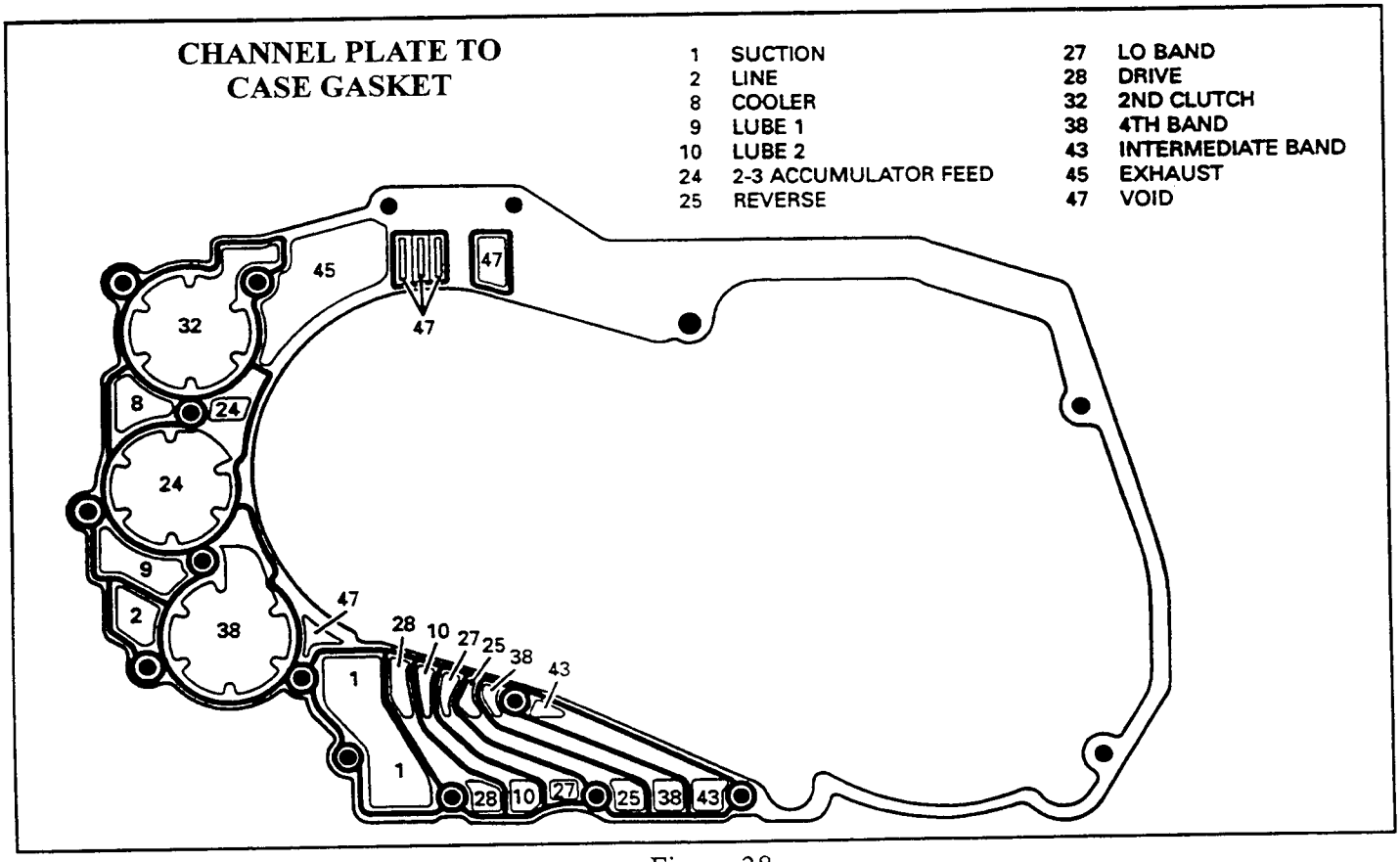


Figure 38

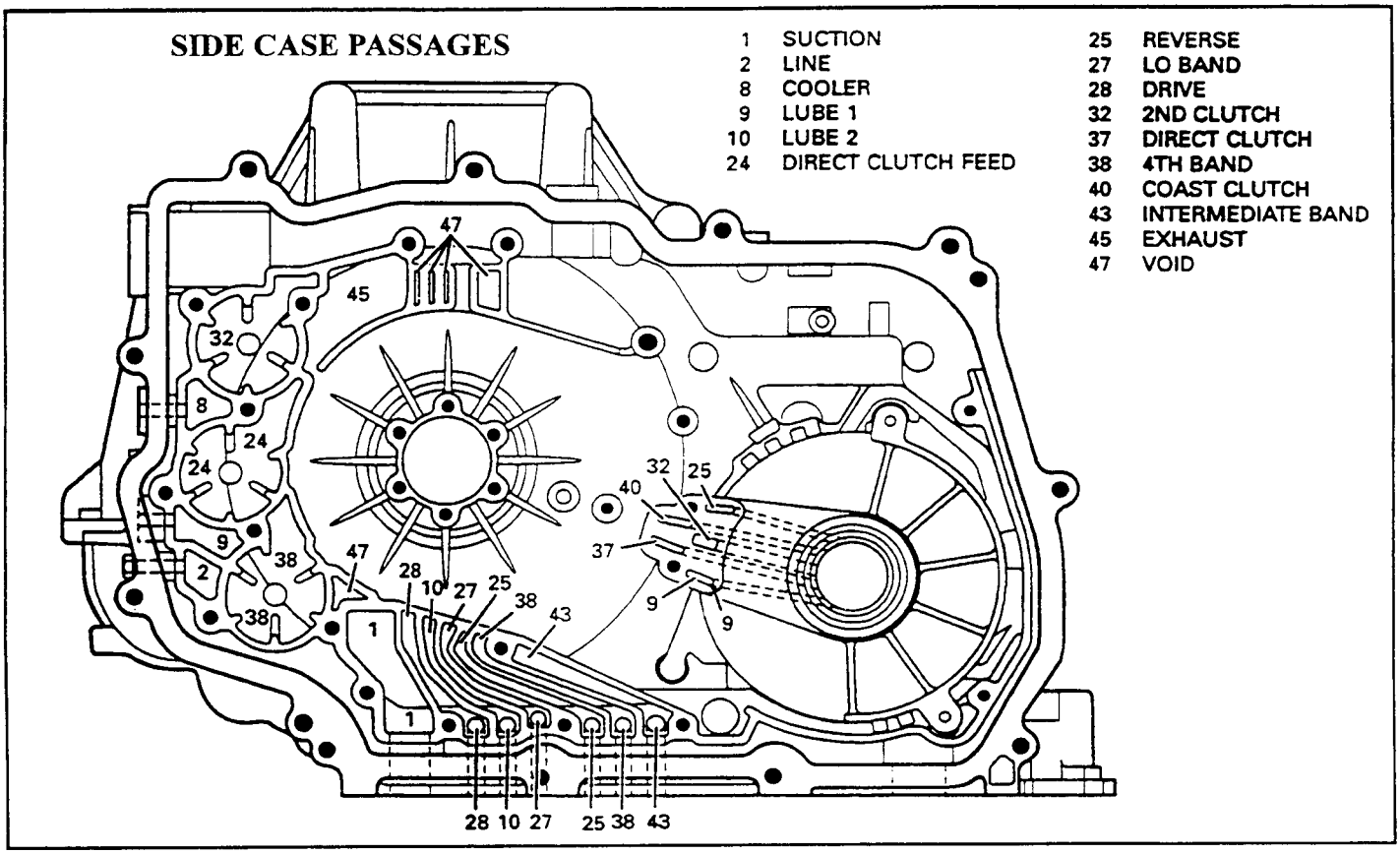


Figure 39

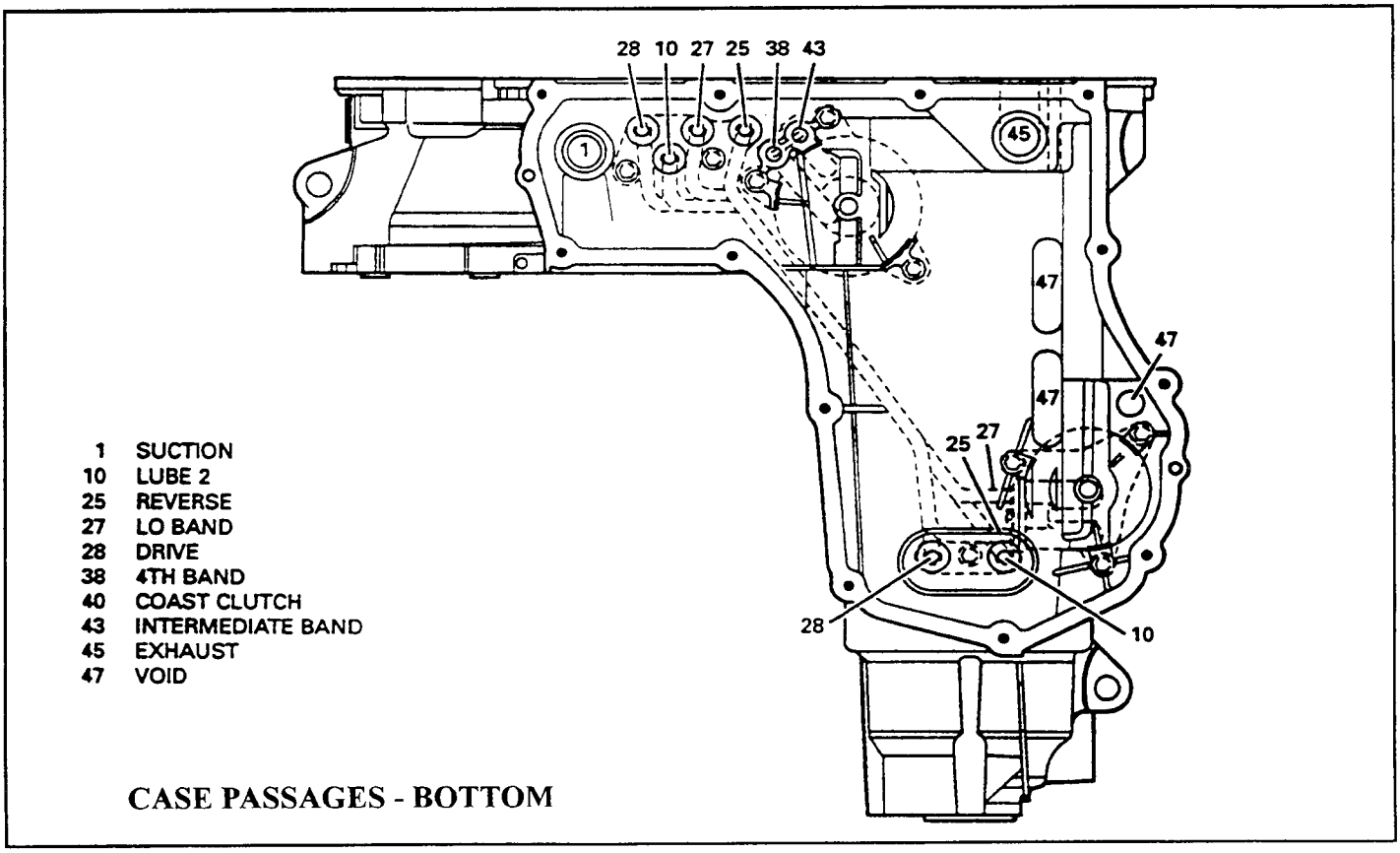
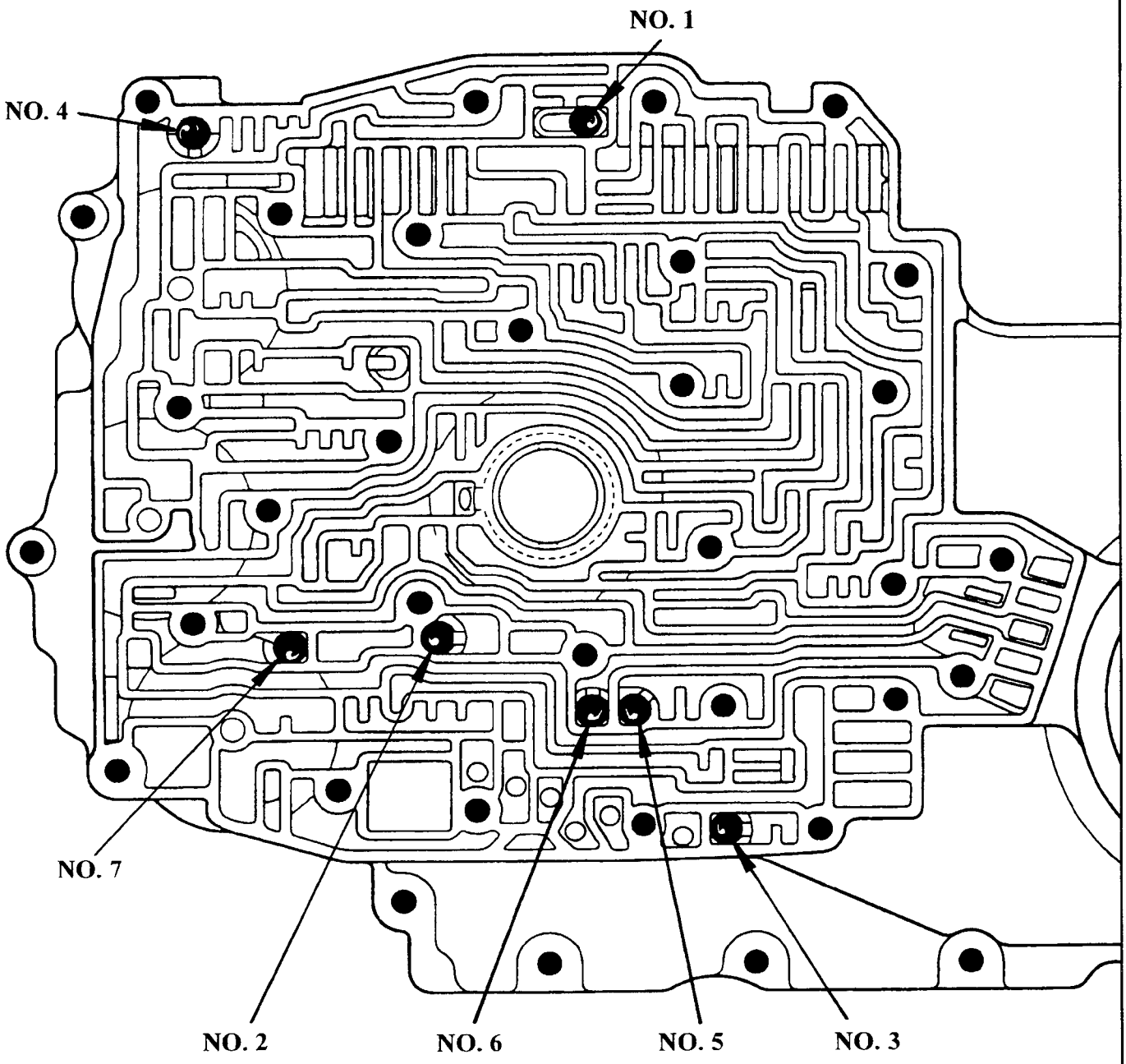


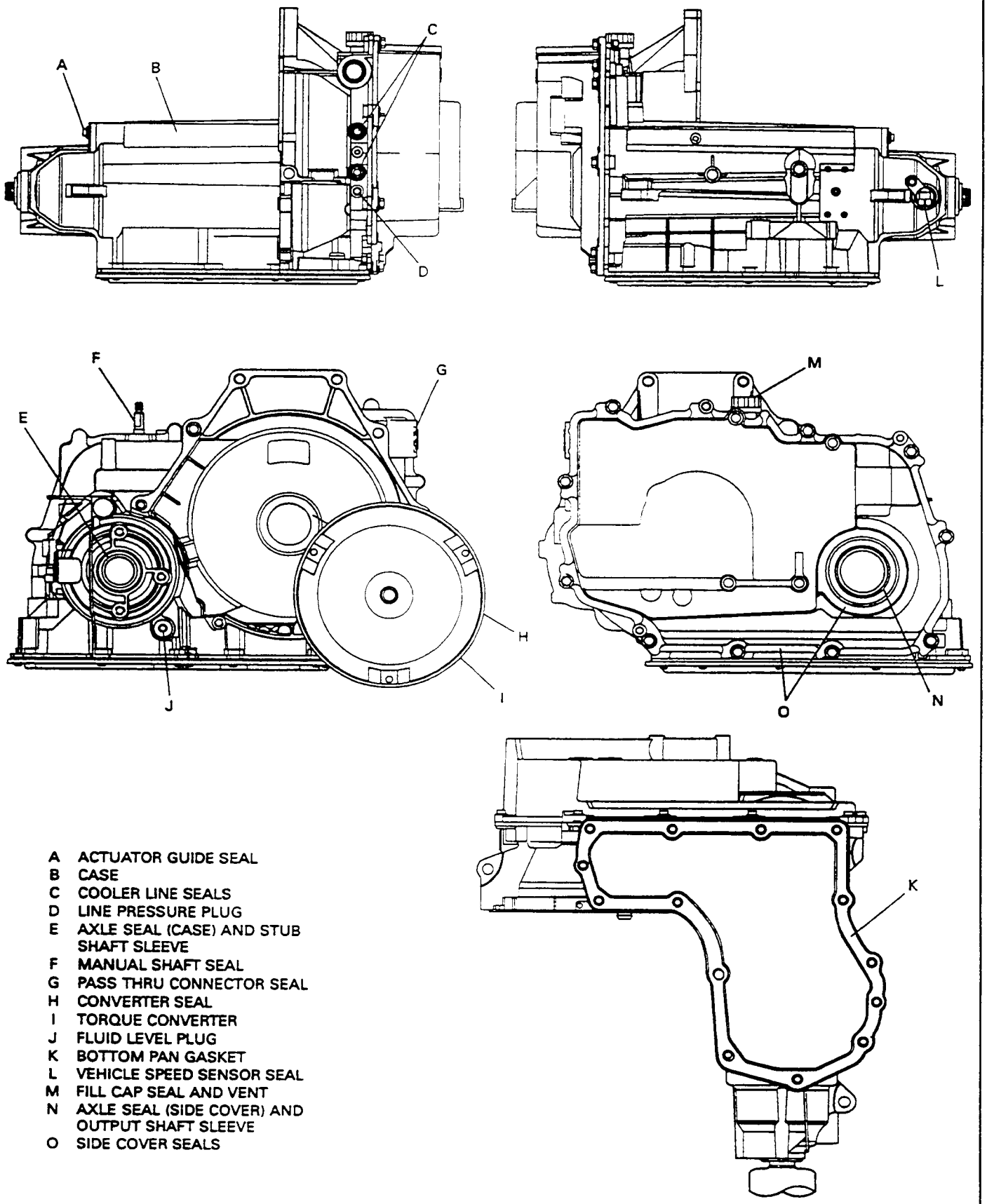
Figure 40

CHECKBALL LOCATIONS



NO. 1 SEPERATES LO/PRN FLUID CIRCUITS.
NO. 2 FORCES 2-3 DRIVE FLUID THRU ORIFICE #3 TO CONTROL 1-2 SHIFT FEEL.
NO. 3 FORCES INTERMEDIATE BAND APPLY OIL THRU ORIFICE #8 FOR APPLY FEEL.
NO. 4 FORCES ACCUMULATOR OIL THRU ORIFICE #24 TO THE 1-2 ACCUMULATOR.
NO. 5 FORCES 3-4 DRIVE OIL THRU ORIFICE #26 TO CONTROL 2-3 SHIFT FEEL.
NO. 6 FORCES EXHAUSTING DIRECT CLUTCH OIL THRU ORIFICE #25 TO CONTROL RELEASE. OF DIRECT CLUTCH.
NO. 7 FORCES ACCUMULATOR OIL THRU ORIFICE #28 TO THE 3-4 ACCUMULATOR.

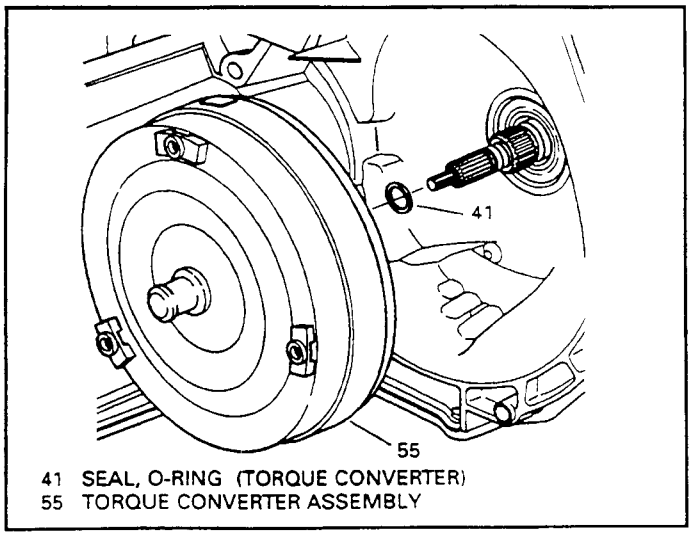
Figure 41



A ACTUATOR GUIDE SEAL
B CASE
C COOLER LINE SEALS
D LINE PRESSURE PLUG
E AXLE SEAL (CASE) AND STUB SHAFT SLEEVE
F MANUAL SHAFT SEAL
G PASS THRU CONNECTOR SEAL
H CONVERTER SEAL
I TORQUE CONVERTER
J FLUID LEVEL PLUG
K BOTTOM PAN GASKET
L VEHICLE SPEED SENSOR SEAL
M FILL CAP SEAL AND VENT
N AXLE SEAL (SIDE COVER) AND OUTPUT SHAFT SLEEVE
O SIDE COVER SEALS

LEAK INSPECTION POINTS

Figure 42



41 SEAL, O-RING (TORQUE CONVERTER)
55 TORQUE CONVERTER ASSEMBLY

Figure 43

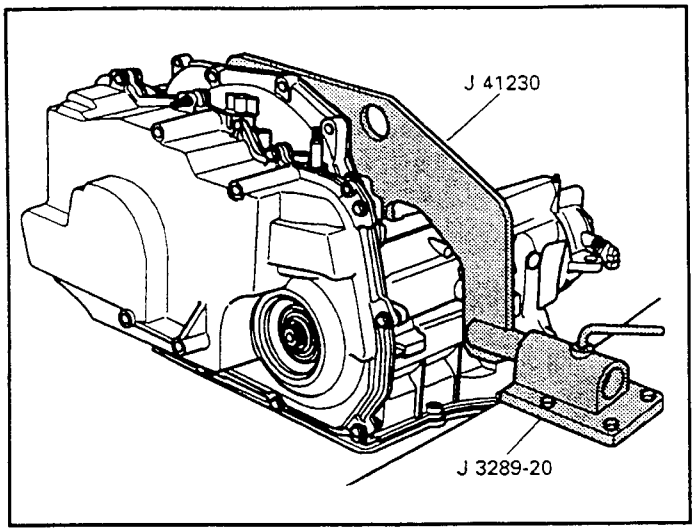


Figure 44

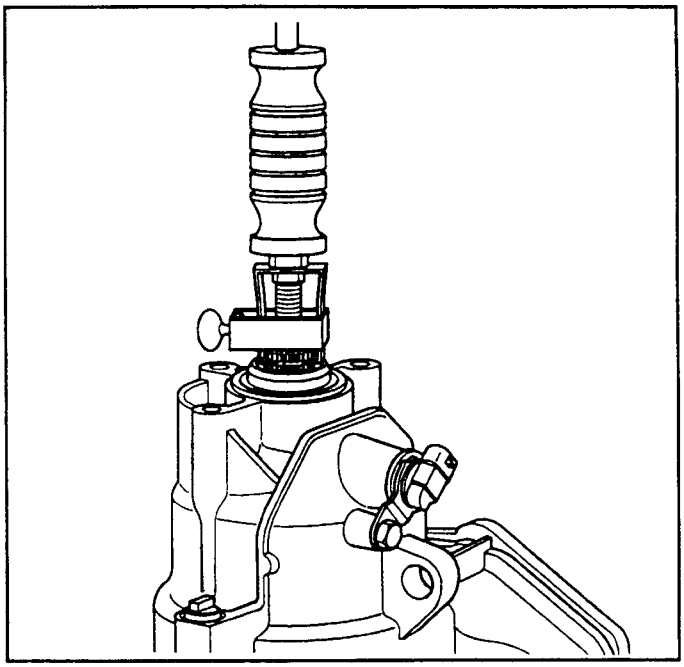
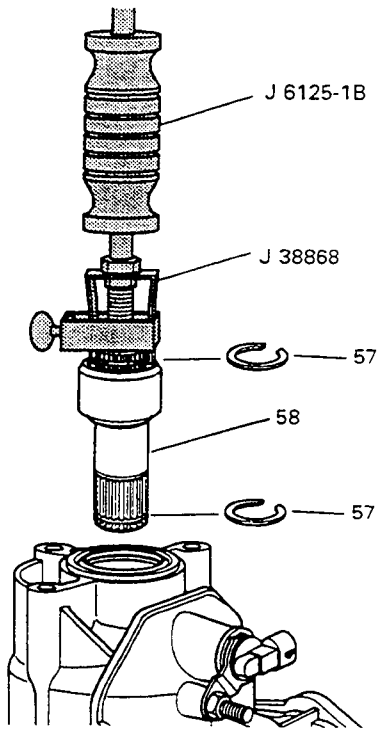


Figure 45

TRANSAXLE DISASSEMBLY

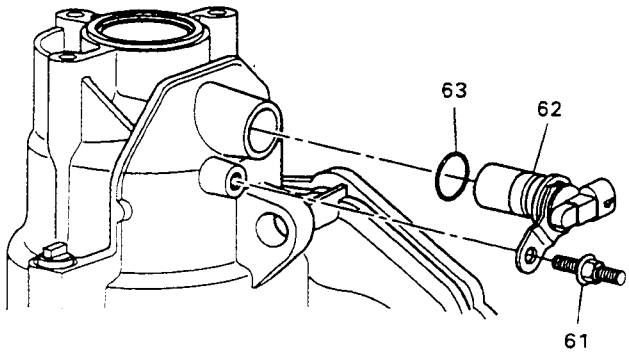
1. Thoroughly clean the exterior of the transaxle prior to disassembly.
2. Remove the torque converter assembly from the transaxle as shown in Figure 43.
3. Remove the turbine shaft "O" ring (41) from the end of the turbine shaft (See Figure 43).
4. Install transaxle support fixture J-41230 onto the transaxle as shown in Figure 44, and torque the bolts to 10 ft.lb.
5. Install the transaxle and support fixture into the fixture base J-3289-20 that is bolted to bench, as shown in Figure 44.
6. Rotate transaxle and position transaxle with the side cover facing down.
7. Insert the locking pin in the fixture base to lock the unit in place.
8. Remove and discard the snap ring (57) from the end of the stub shaft (See Figure 46). Snap ring ***is not*** reusable.
9. Attach slide hammer to the shaft removal tool J-38868 (See Figure 45).
10. Install the stub shaft removal tool into the snap ring groove on stub shaft, and tighten the shaft removal tool securely to the stub shaft, shown in Figure 45.



57 RING, OUTPUT/STUB SHAFT SNAP
58 SHAFT, OUTPUT STUB

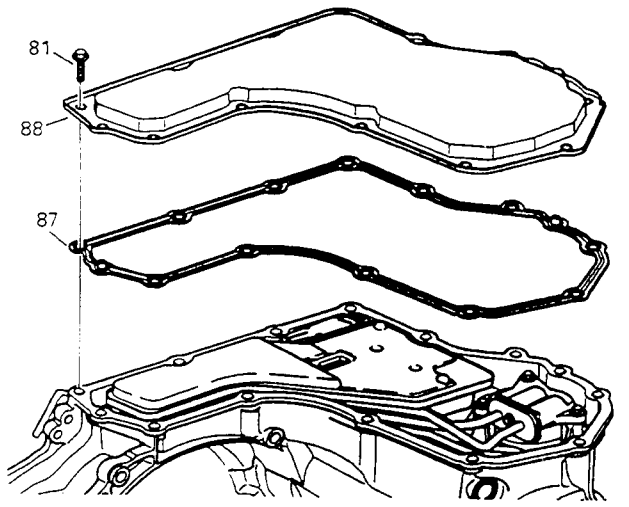
Figure 46

11. Pull lightly on the stub shaft and rotate it until the stub shaft snap ring inside at the differential seats into the taper on differential side gear.
12. Damage may occur when attempting to remove the stub shaft if the stub shaft snap ring at the differential is not properly seated.
13. Pull the stub shaft out using the slide hammer impact as shown in Figure 46.
14. With the stub axle removed you can now drain most of the fluid by rotating the transaxle with the side cover facing up.
15. After the fluid has drained, rotate the transaxle with the bottom oil pan facing up.
16. Remove the speed sensor stud (61), the speed sensor assembly (62) and "O" ring, as shown in Figure 47.
17. Pull the speed sensor assembly straight out of the transaxle case to prevent damage to the case bore (See Figure 47).
18. Remove the twelve bottom oil pan bolts, the oil pan, and oil pan gasket as shown in Figure 48.



61 STUD, VEHICLE SPEED SENSOR
62 SENSOR, VEHICLE SPEED
63 SEAL, O-RING (VEHICLE SPEED SENSOR)

Figure 47

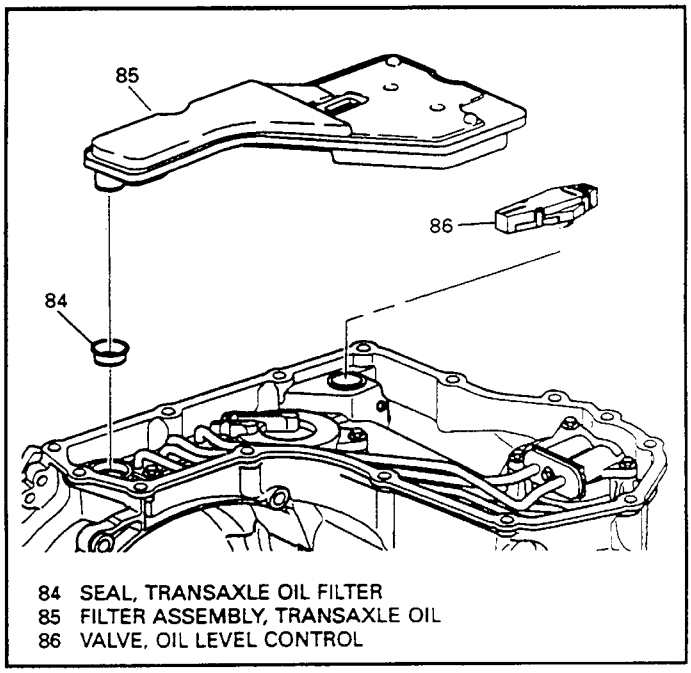


81 BOLT, OIL PAN
87 GASKET, TRANSAXLE OIL PAN
88 PAN, TRANSAXLE OIL

Figure 48

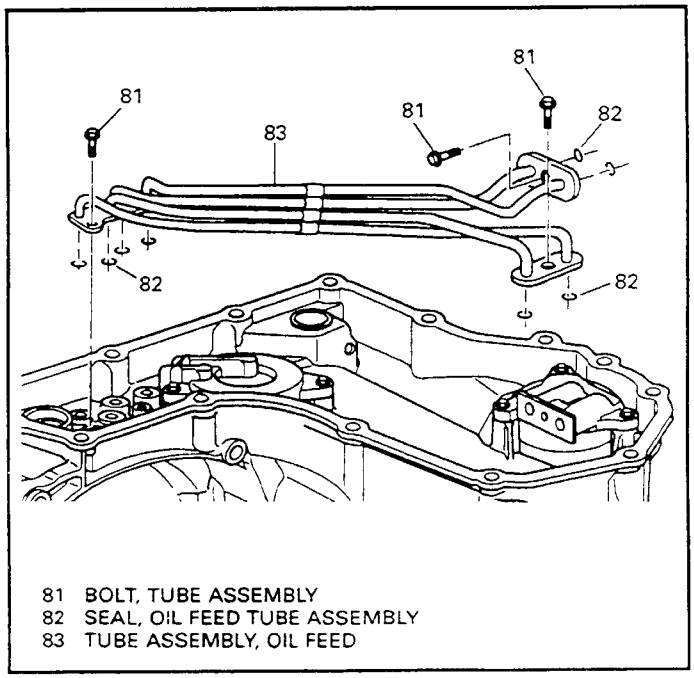
19. ***The bottom oil pan gasket is reusable as long as the beads are not broken. Do not discard.***

Continued on next Page



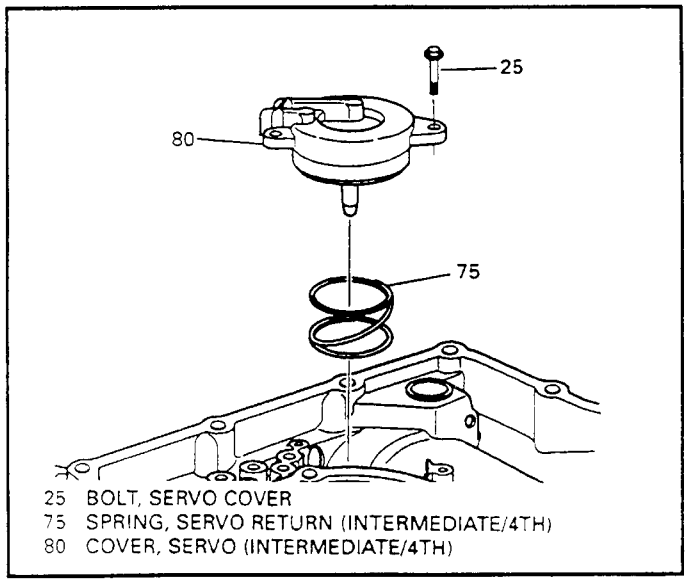
84 SEAL, TRANSAXLE OIL FILTER
85 FILTER ASSEMBLY, TRANSAXLE OIL
86 VALVE, OIL LEVEL CONTROL

Figure 49



81 BOLT, TUBE ASSEMBLY
82 SEAL, OIL FEED TUBE ASSEMBLY
83 TUBE ASSEMBLY, OIL FEED

Figure 50



25 BOLT, SERVO COVER
75 SPRING, SERVO RETURN (INTERMEDIATE/4TH)
80 COVER, SERVO (INTERMEDIATE/4TH)

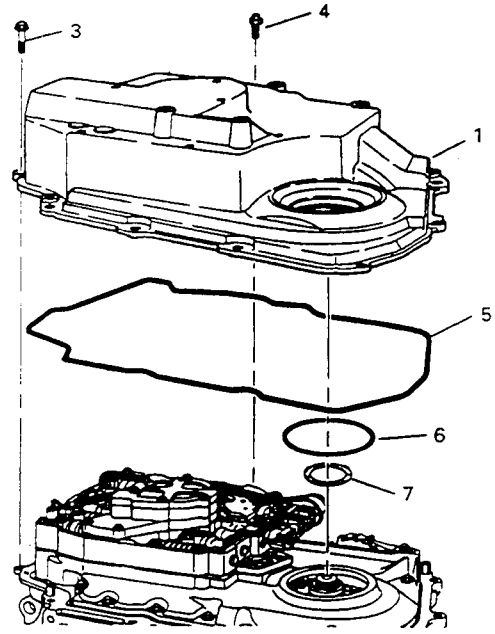
Figure 51

Continued from Page 49

20. Remove the transaxle filter assembly as shown in Figure 49.
21. Remove and discard the filter neck seal from the transaxle case as shown in Figure 49.
22. This seal is tough to remove without damaging the case bore and will require special tooling, like the proper size tap with a slide hammer.
23. Remove the oil level control valve (86) from the case as shown in Figure 49.
    NOTE: G.M. recommends replacing the oil level control valve (86) if it is removed.
24. Remove the four oil feed pipe bolts (81), and remove the oil feed pipe assembly as shown in Figure 50.
    NOTE: The feed pipe assembly "O" rings are glued into place and should remain with the feed pipe as they are reusable unless damaged. If new "O" rings are required they must also be glued back in place.
25. Remove three Int/4th servo cover retaining bolt as shown in Figure 51.
26. Remove the Int/4th servo cover (80), the servo piston and servo return spring (See Figure 51).
27. Remove three Lo/Rev servo cover bolts shown in Figure 52.
28. Remove the Lo/Rev servo cover (73), the servo piston and servo return spring (See Figure 52).

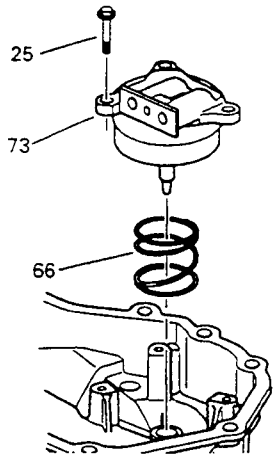
29. Rotate the transaxle so that the side cover (1) is facing upward as shown in Figure 53.
30. Remove the ten side cover bolts and one stud, as shown in Figure 53.
31. Remove the transaxle side cover.
32. Remove and discard the two side cover gaskets (5 and 6) as shown in Figure 53.
33. Remove the side cover to driven sprkt support thrust washer (See Figure 53).
34. Side cover gaskets and thrust washer might stay on side cover as it was removed.
35. Remove the eight retaining bolts from the oil pump as shown in Figure 54.
36. Remove the oil pump assembly (10) as shown in Figure 54.
37. Remove the oil pump drive shaft (19) as shown in Figure 54.

Continued on next Page



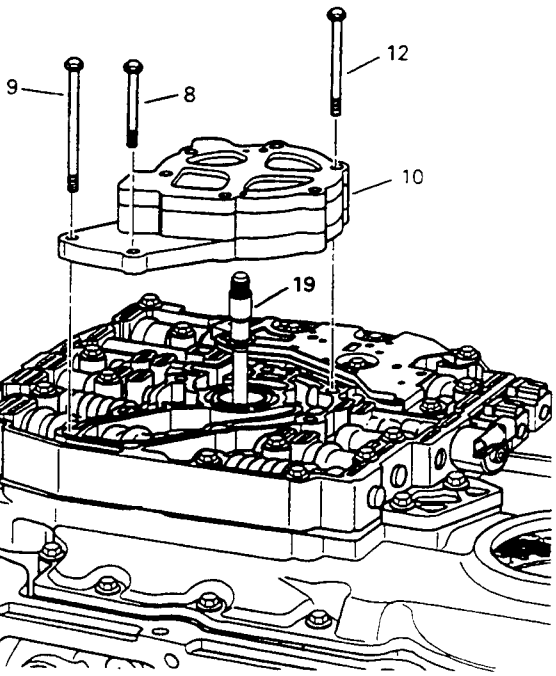
1 COVER, SIDE (STRUCTURAL)
3 BOLT, SIDE COVER
4 STUD, SIDE COVER
5 GASKET, SIDE COVER
6 GASKET, SIDE COVER OIL LEVEL CONTROL
7 WASHER, THRUST (SIDE COVER TO DRIVEN SPROCKET)

Figure 53



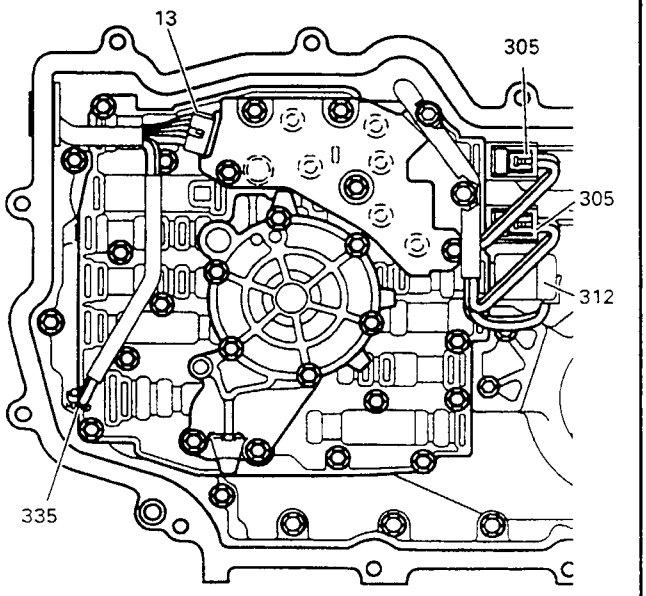
25 BOLT, SERVO COVER
66 SPRING, SERVO RETURN (LO/REVERSE)
73 COVER, SERVO (LO/REVERSE)

Figure 52



8 BOLT, OIL PUMP
9 BOLT, OIL PUMP
10 PUMP ASSEMBLY, TRANSAXLE OIL
12 BOLT, OIL PUMP
19 SHAFT, OIL PUMP DRIVE

Figure 54



13 PRESSURE SWITCH ASSEMBLY (PSA)
305 SOLENOID, SHIFT (A AND B)
312 SOLENOID, PRESSURE CONTROL
335 SOLENOID, TCC CONTROL

Figure 55

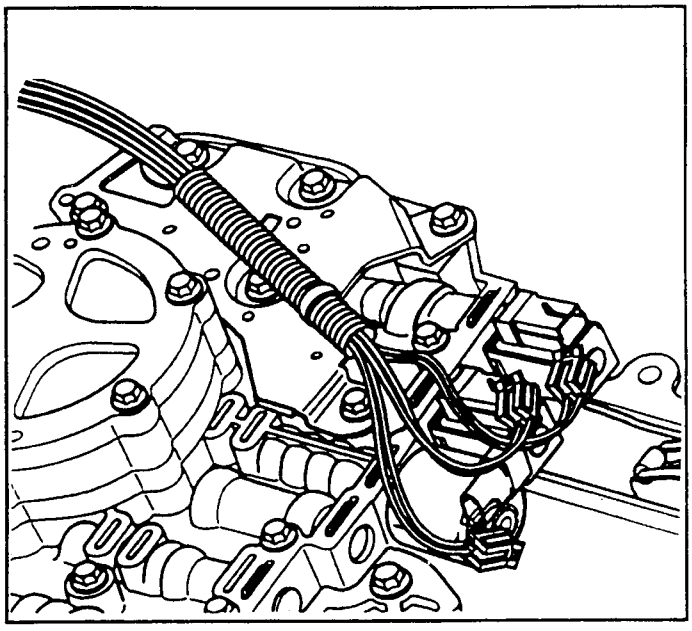
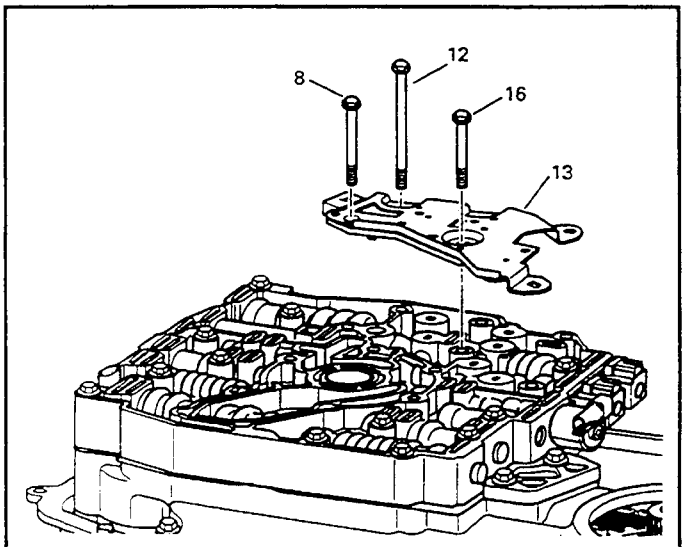


Figure 56



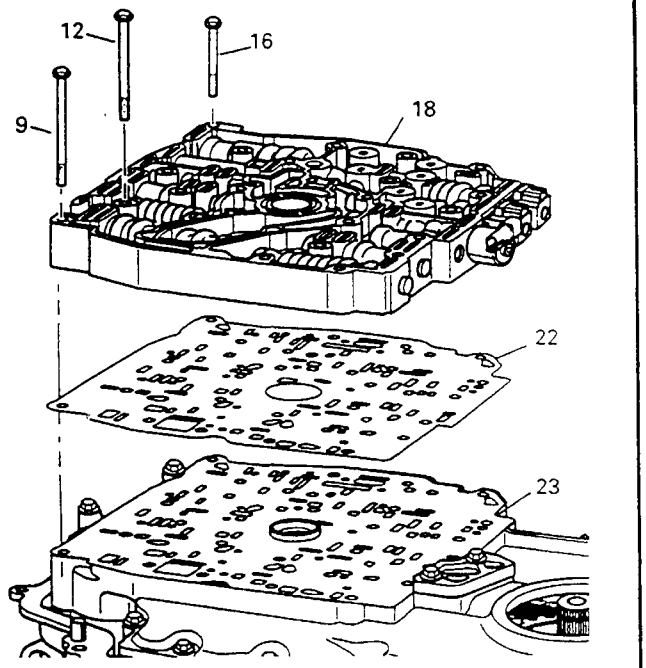
8 BOLT, (TR) PRESSURE SWITCH ASSEMBLY/VALVE BODY
12 BOLT, (TR) PRESSURE SWITCH ASSEMBLY/VALVE BODY
13 (TR) PRESSURE SWITCH ASSEMBLY
16 BOLT, (TR) PRESSURE SWITCH ASSEMBLY/VALVE BODY

Figure 57

Continued from Page 51

38. Disconnect the wiring harness connectors from the pressure control solenoid, 1-2 and 2-3 shift solenoids, pressure switch assembly, and TCC solenoid as shown in Figures 55 and 56.
39. Remove the six bolts from the pressure switch assembly as shown in Figure 57.
40. Remove the pressure switch assembly from the valve body assembly (See Figure 57).
41. The 7 pressure switch "O" rings are reusable, and should remain with the pressure switch.
42. Remove the remaining 12 bolts and remove the valve body assembly as shown in Figure 58.
43. ***There are not any checkballs in valve body.***
44. Remove and discard the valve body to spacer plate gasket (See Figure 58).
45. Remove the two spacer plate support bolts, as shown in Figure 59.
46. Remove the spacer plate with the spacer plate filter attached as shown in Figure 59.
47. Remove and discard the spacer plate to channel plate gasket (See Figure 59).
48. Remove the seven checkballs from the pockets in the channel plate as shown in Figure 60.
49. Notice that one of the pockets does not contain a checkball (See Figure 60).
50. Disconnect the manual valve clip and manual valve link from manual valve (See Figure 61).

Continued on Page 54



9 BOLT, VALVE BODY
12 BOLT, VALVE BODY
16 BOLT, VALVE BODY
18 BODY ASSEMBLY, CONTROL VALVE
22 GASKET, VALVE BODY TO SPACER PLATE
23 PLATE, VALVE BODY SPACER

Figure 58

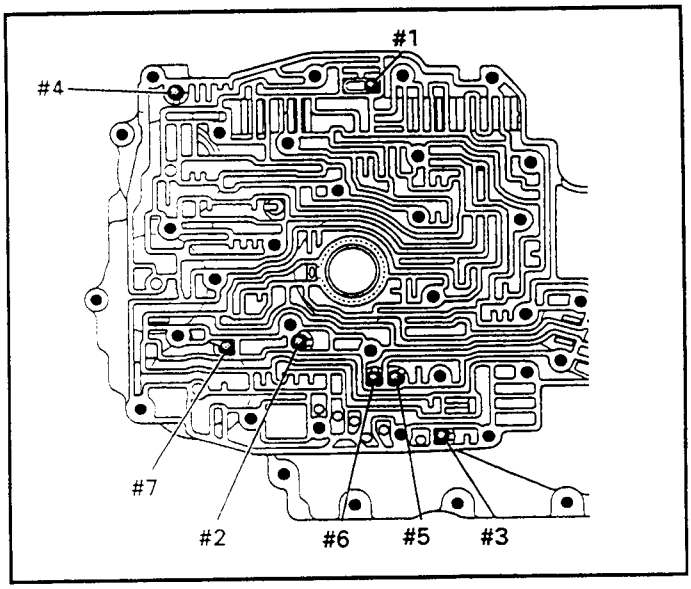
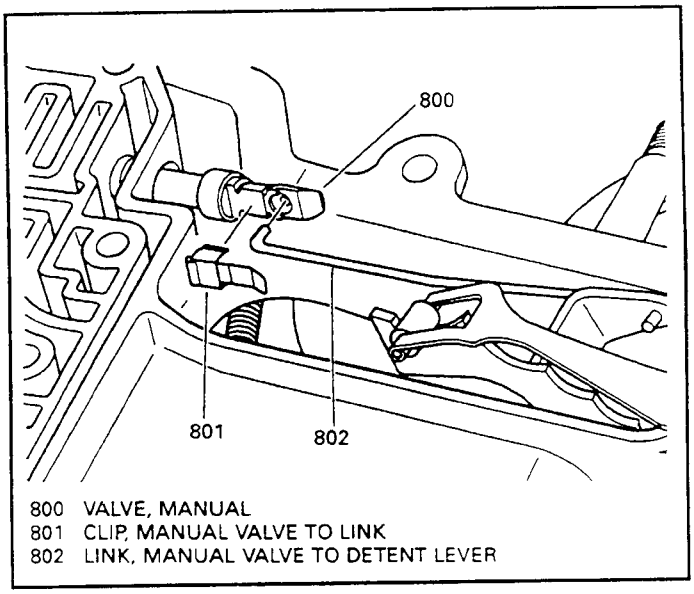
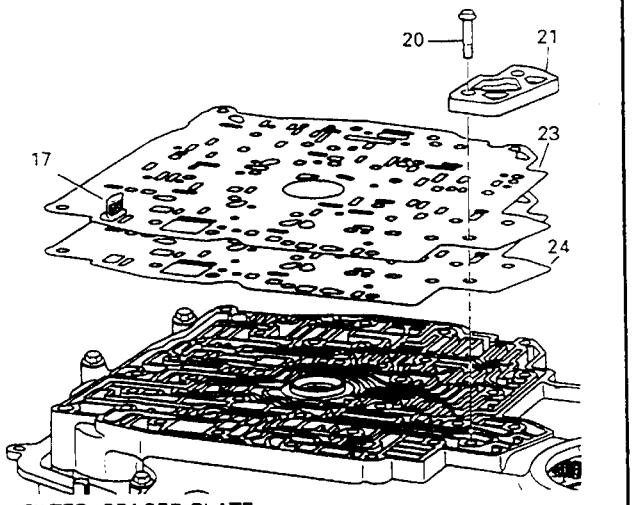


Figure 60



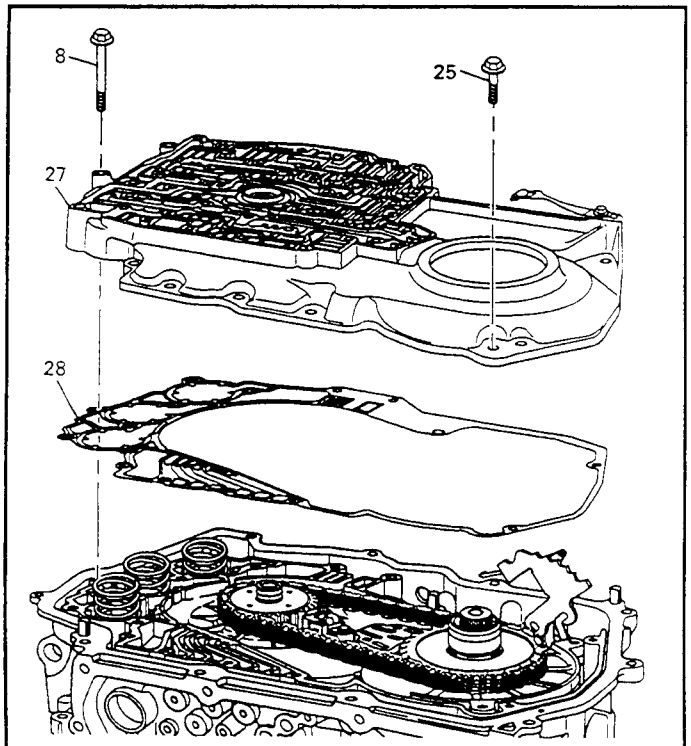
800 VALVE, MANUAL
801 CLIP, MANUAL VALVE TO LINK
802 LINK, MANUAL VALVE TO DETENT LEVER

Figure 61



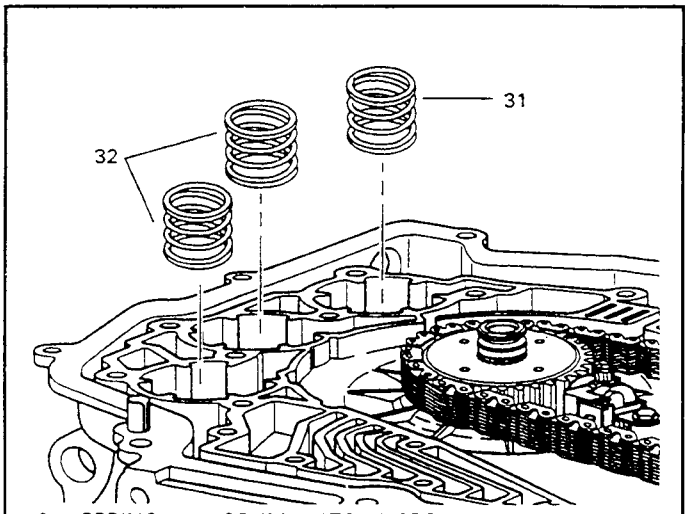
17 FILTER, SPACER PLATE
20 BOLT, SPACER PLATE SUPPORT
21 SUPPORT, SPACER PLATE
23 PLATE, VALVE BODY SPACER
24 GASKET, SPACER PLATE TO CHANNEL PLATE

Figure 59



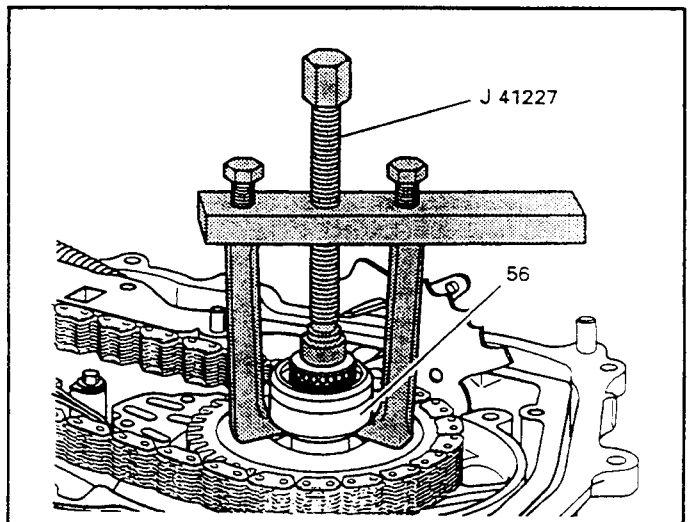
8 BOLT, CHANNEL PLATE
25 BOLT, CHANNEL PLATE
27 PLATE, CHANNEL
28 GASKET, CASE TO CHANNEL PLATE

Figure 62



31 SPRING, 1-2 ACCUMULATOR PISTON
32 SPRING, 2-3 AND 3-4 ACCUMULATOR PISTON

Figure 63

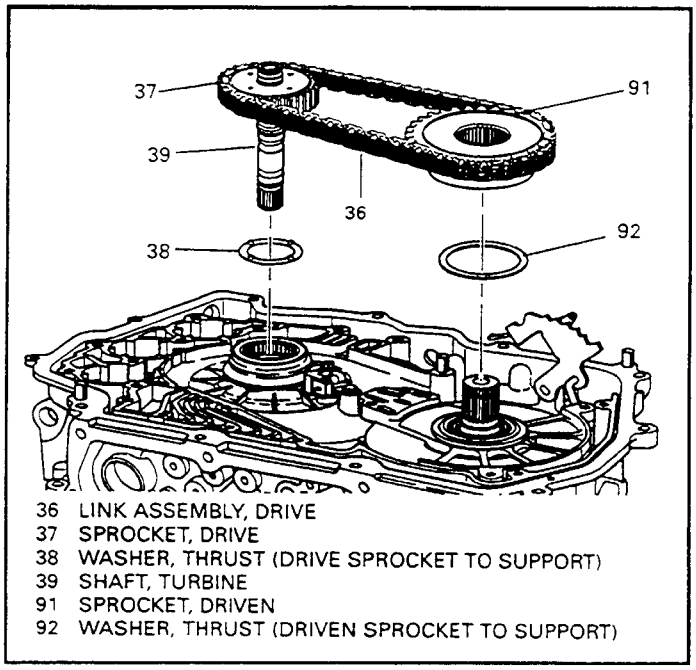


56 SLEEVE, OUTPUT/STUB SHAFT

Figure 64

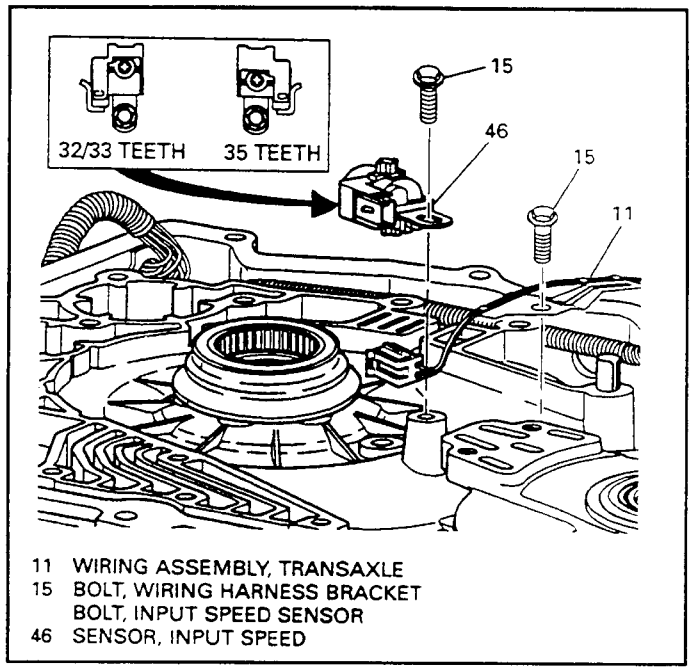
Continued from Page 52

51. Remove the ten channel plate bolts, as shown in Figure 62.
52. Remove the channel plate assembly (27) from transaxle, as shown in Figure 62.
    Note: The accumulator pistons and pins, the manual valve, the detent lever spring and bolt, and drive sprocket/channel plate thrust washer, should remain with the channel plate.
53. Remove and discard the channel plate to case gasket, as shown in Figure 62.
54. Remove the three accumulator springs from the case, as shown in Figure 63.
    Note: The 1-2 accumulator spring is different than the 2-3 and 3-4 accumulator springs, and is shown in Figure 63.
55. ***NOTICE: The transaxle output shaft cannot be removed without complete disassembly of transaxle. Attempting to remove output shaft at this time, in the same manner as stub shaft, will result in damage to other transaxle parts.***
56. Remove and discard the output shaft sleeve as shown in Figure 64, using the sleeve puller tool J-41227.
    NOTICE: The output shaft sleeve cannot be reused after being removed from the shaft.
57. Locate the pullers legs under the sleeve as it is shown in Figure 64, and tighten the pullers center bolt, to pull the sleeve off the shaft.



36 LINK ASSEMBLY, DRIVE
37 SPROCKET, DRIVE
38 WASHER, THRUST (DRIVE SPROCKET TO SUPPORT)
39 SHAFT, TURBINE
91 SPROCKET, DRIVEN
92 WASHER, THRUST (DRIVEN SPROCKET TO SUPPORT)

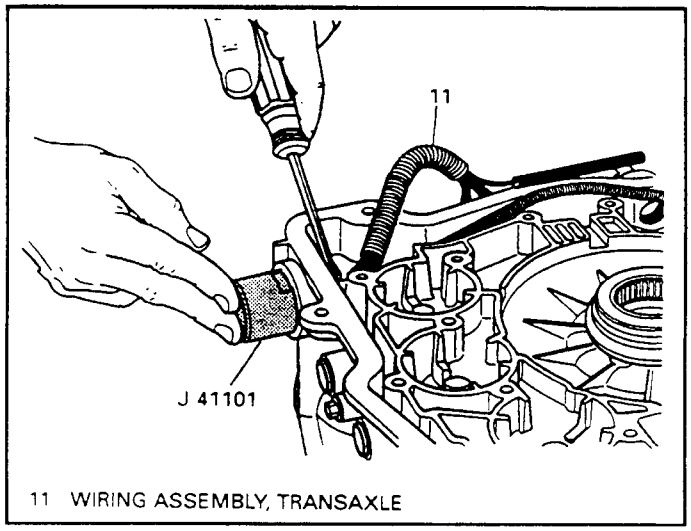
Figure 65



11 WIRING ASSEMBLY, TRANSAXLE
15 BOLT, WIRING HARNESS BRACKET
BOLT, INPUT SPEED SENSOR
46 SENSOR, INPUT SPEED

Figure 66

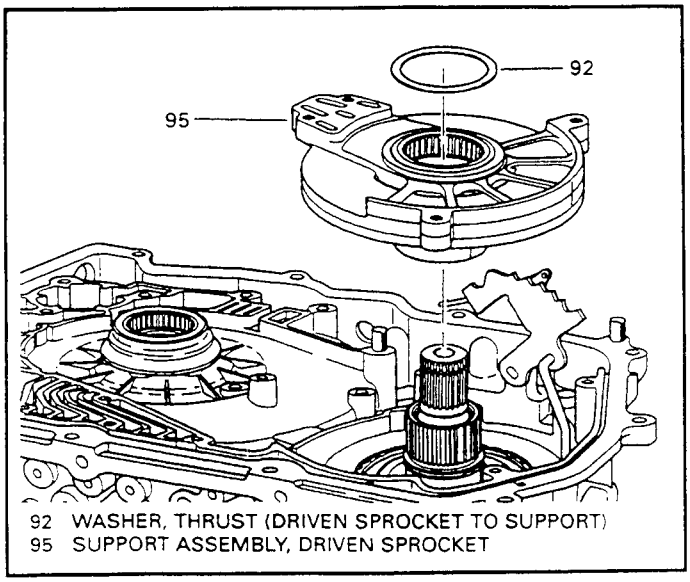
58. Remove the drive sprocket, driven sprocket and drive chain assembly, as an entire unit as shown in Figure 65.
Note which direction the chain is facing when removed. The chain should be installed in the same direction during assembly to help prevent excessive noise.
59. Remove the drive sprocket to support thrust washer (38) if it did not remain with the drive sprocket assembly (See Figure 65).
60. Remove the driven sprocket to driven sprocket support thrust washer (92) shown in Figure 65.
61. Disconnect the wire harness connector from the input speed sensor (See Figure 66).
62. Remove the input speed sensor retaining bolt, and the input speed sensor (See Figure 66).
63. Remove the harness retainer clip bolt and the retainer clip (See Figure 66).
64. Remove the pass thru case connector using the tool J-41101 as shown in Figure 67. Push the removal tool onto the case connector from the outside of the transaxle case to compress case connectors retaining tabs. With the retaining tabs compressed, use a screwdriver to remove the case connector through the inside of the transaxle case.



11 WIRING ASSEMBLY, TRANSAXLE

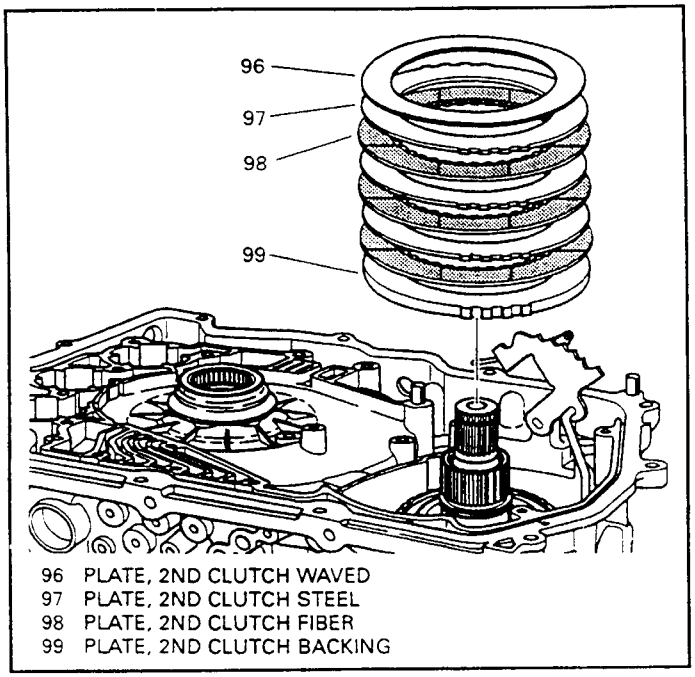
Figure 67

Continued on next Page



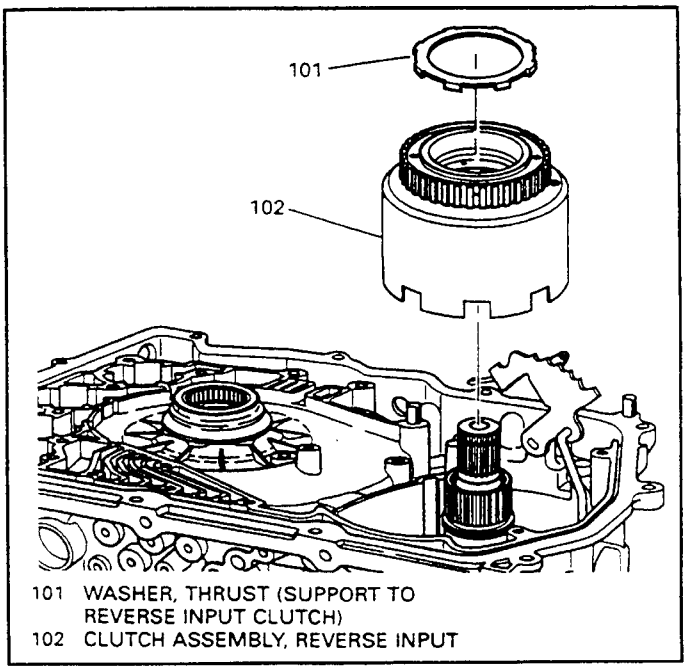
92 WASHER, THRUST (DRIVEN SPROCKET TO SUPPORT)
95 SUPPORT ASSEMBLY, DRIVEN SPROCKET

Figure 68



96 PLATE, 2ND CLUTCH WAVED
97 PLATE, 2ND CLUTCH STEEL
98 PLATE, 2ND CLUTCH FIBER
99 PLATE, 2ND CLUTCH BACKING

Figure 69



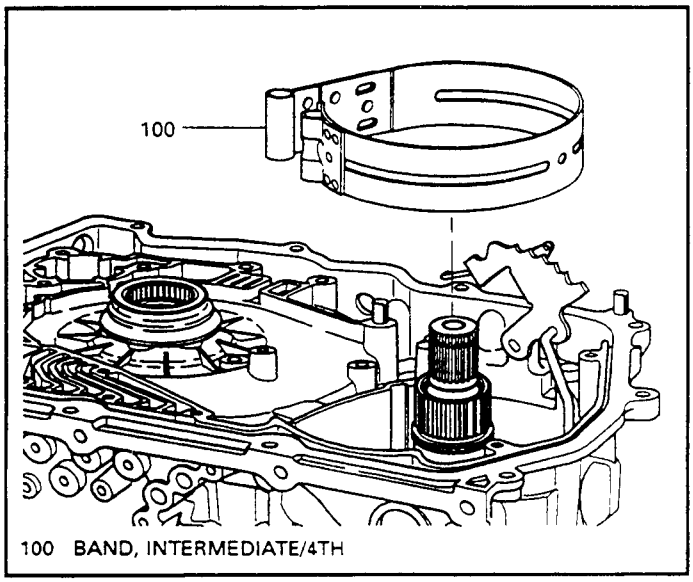
101 WASHER, THRUST (SUPPORT TO REVERSE INPUT CLUTCH)
102 CLUTCH ASSEMBLY, REVERSE INPUT

Figure 70

Continued from Page 55

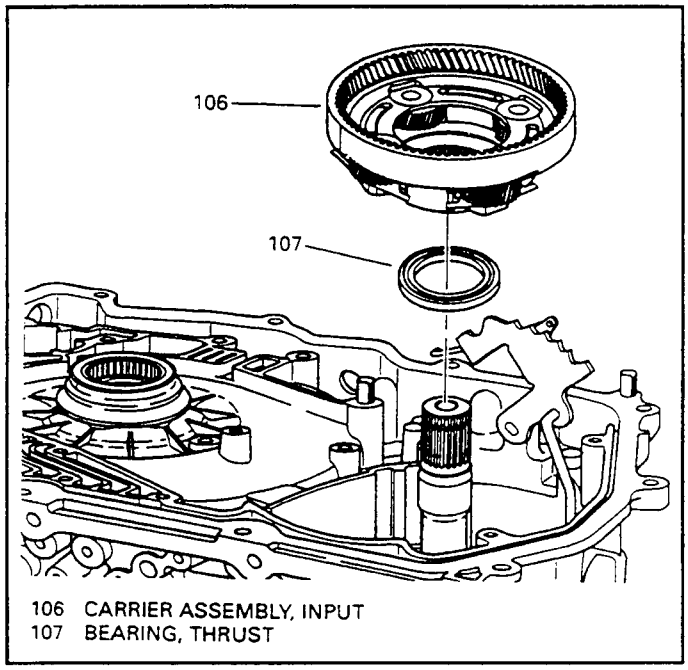
65. Remove the driven sprocket support assembly, as shown in Figure 68.
66. Remove the 2nd clutch plates, one wave plate, three steel plates, three lined plates, and one backing plate, as shown in Figure 69.
67. Remove the driven sprocket support to reverse input clutch housing thrust washer (101), as shown in Figure 70.
68. Remove the reverse input clutch housing and 2nd roller clutch assembly (See Figure 70).
69. Remove the intermediate/4th band assembly as shown in Figure 71.
70. Remove the direct/coast clutch and the reaction carrier assembly by lifting straight up as shown in Figure 72. Keep the bearing assembly (103) and the selective thrust washer (104), located on top, with the assembly for now.
71. Remove the input carrier and reaction ring gear assembly, as shown in Figure 73.
72. Remove the input carrier to forward clutch hub thrust bearing (107) as shown in Figure 73.
73. Remove the ring gear and forward clutch hub assembly, as shown in Figure 74.
74. Remove the forward clutch hub to race thrust washer (109) if it did not remain with forward clutch hub (See Figure 74).

Continued on Page 58



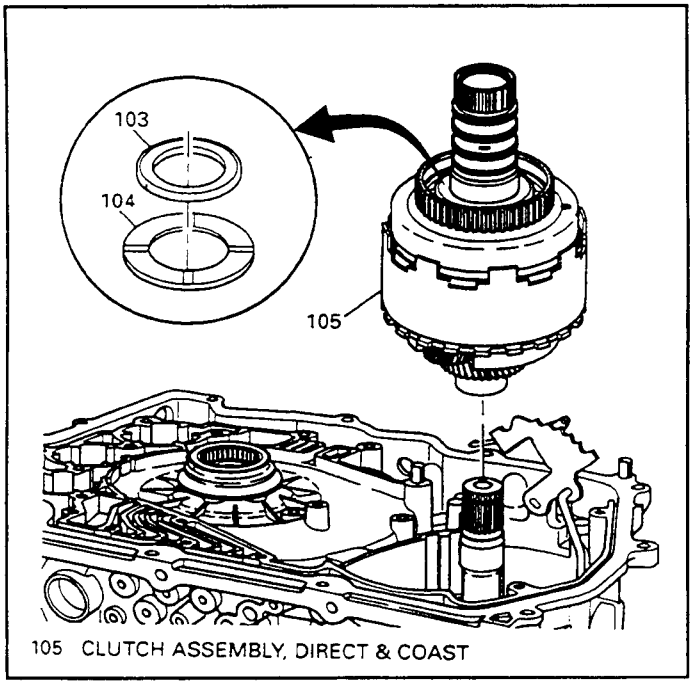
100 BAND, INTERMEDIATE/4TH

Figure 71



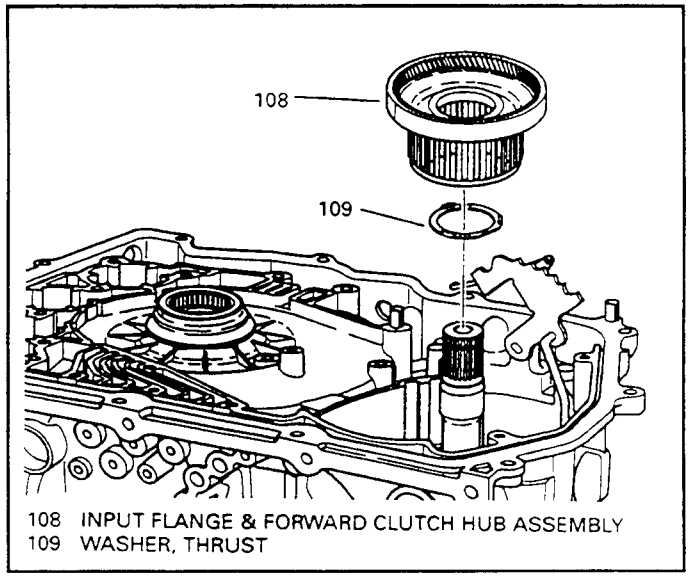
106 CARRIER ASSEMBLY, INPUT
107 BEARING, THRUST

Figure 73



105 CLUTCH ASSEMBLY, DIRECT & COAST

Figure 72



108 INPUT FLANGE & FORWARD CLUTCH HUB ASSEMBLY
109 WASHER, THRUST

Figure 74

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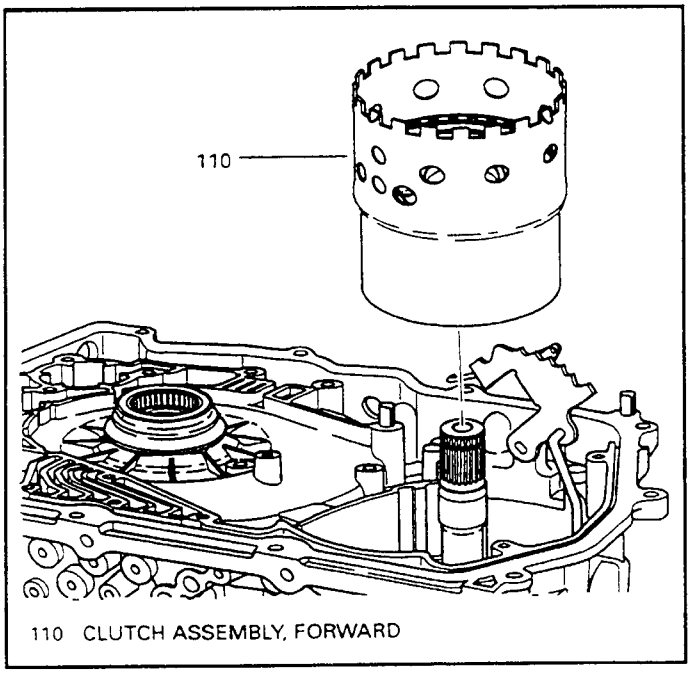
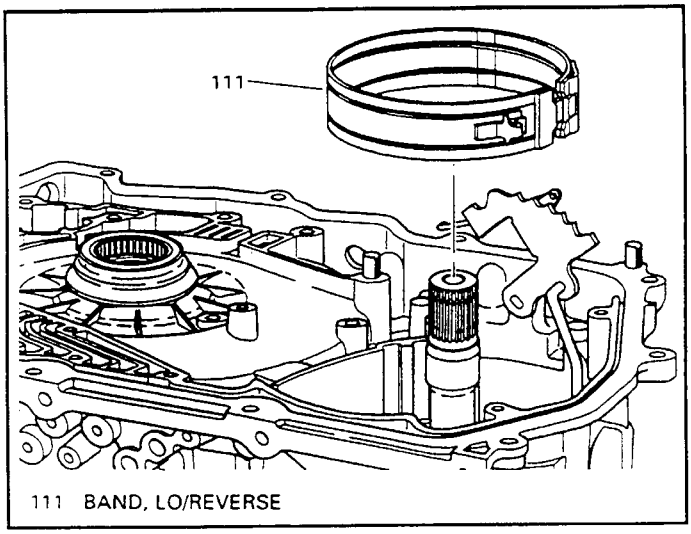


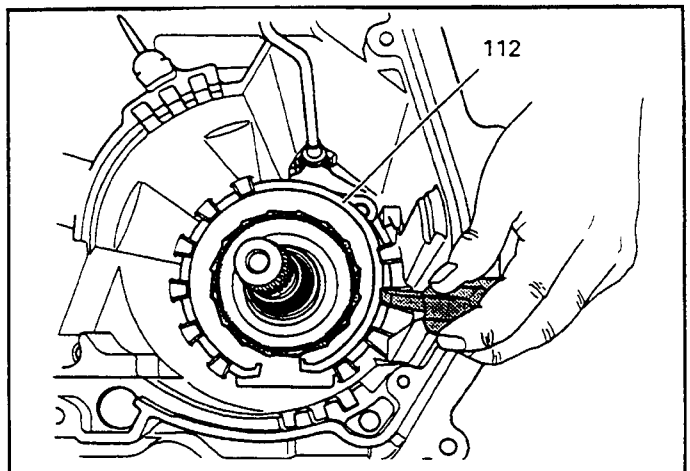
110 CLUTCH ASSEMBLY, FORWARD

Figure 75



111 BAND, LO/REVERSE

Figure 76

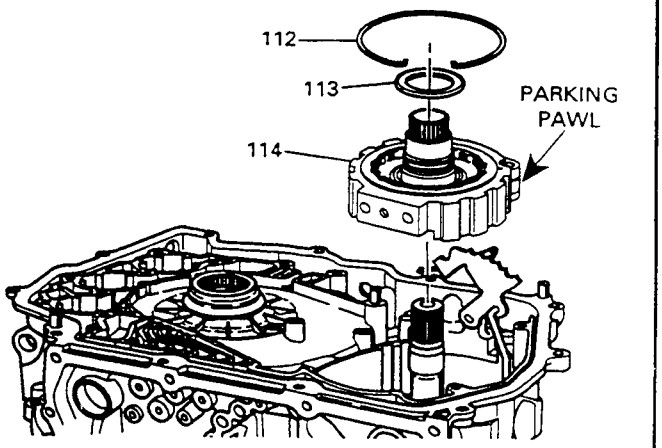


112 RING, SNAP (FORWARD CLUTCH SUPPORT TO CASE)

Figure 77

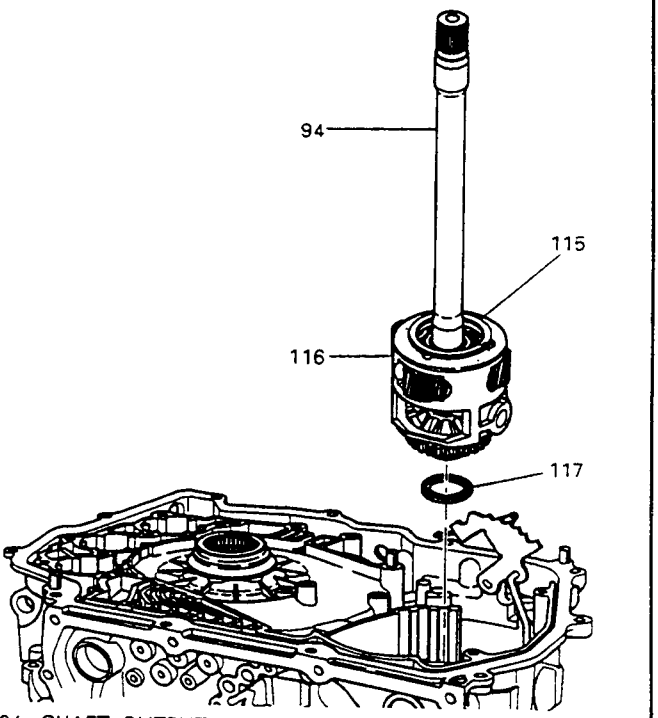
Continued from Page 56

75. Remove the complete forward clutch housing, as shown in Figure 75.
76. Remove the Lo/Reverse band assembly from the case, as shown in Figure 76.
77. Remove the forward clutch support snap ring using a modified screwdriver (See Figure 77). This is a very strong snap ring.
    NOTICE: The snap ring opening should at the bottom pan side of the case. If the snap ring opening is out of position, inspect the case for damage.
78. Remove the forward clutch support and the Lo roller clutch assembly as shown in Figure 78. Keep the thrust bearing (113) with support. The parking pawl may need to be depressed to allow forward clutch support to be removed. (See Figure 78).
79. Lift straight up on the output shaft and remove final drive assembly and final drive sun gear as one assembly (See Figure 79).
80. Remove the final drive internal ring gear, by lifting straight up with equal force on both side of the ring gear (See Figure 80).
    NOTE: The fretting ring (119) is located in the case groove. The fretting ring does not need to be removed unless it appears to be damaged. (See Figure 80).
81. Remove the manual shaft to transaxle case retaining pin (Nail), as shown in Figure 81.
82. Remove manual shaft/detent lever assembly (806), by pushing the manual shaft into case, as shown in Figure 81.



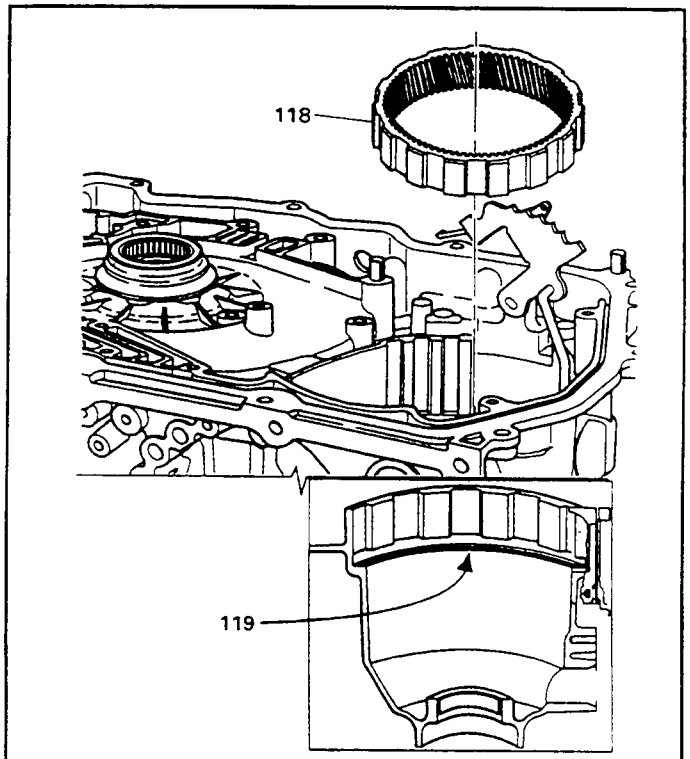
112 RING, SNAP (FORWARD CLUTCH SUPPORT TO CASE)
113 BEARING, THRUST
114 SUPPORT ASSEMBLY, FORWARD CLUTCH

Figure 78



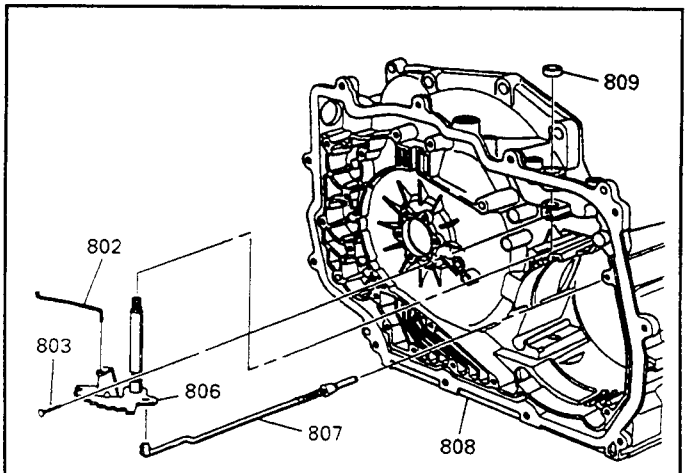
94 SHAFT, OUTPUT
115 GEAR, SUN (FINAL DRIVE)
116 DIFFERENTIAL AND FINAL DRIVE ASSEMBLY
117 BEARING, THRUST

Figure 79



118 GEAR, FINAL DRIVE INTERNAL
119 RING, FRETTING (INTERNAL GEAR TO CASE)

Figure 80

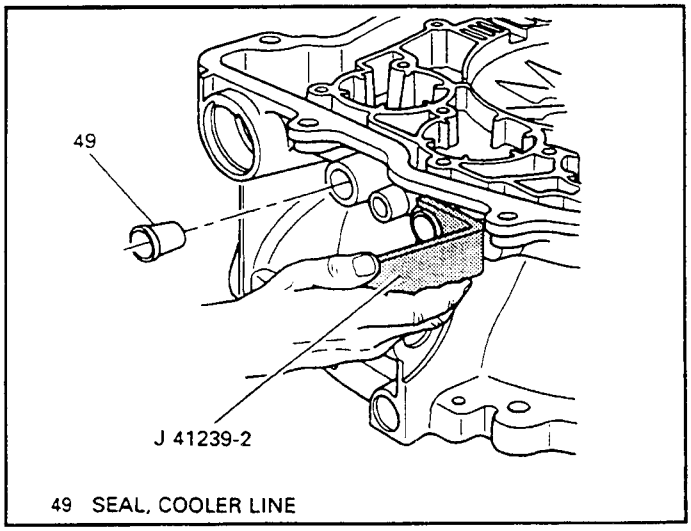


802 LINK, MANUAL VALVE TO DETENT LEVER
803 PIN, MANUAL SHAFT TO CASE
806 MANUAL SHAFT AND DETENT LEVER ASSEMBLY
807 PARKING LOCK ACTUATOR ASSEMBLY
808 CASE, TRANSAXLE
809 SEAL, MANUAL SHAFT TO CASE

Figure 81

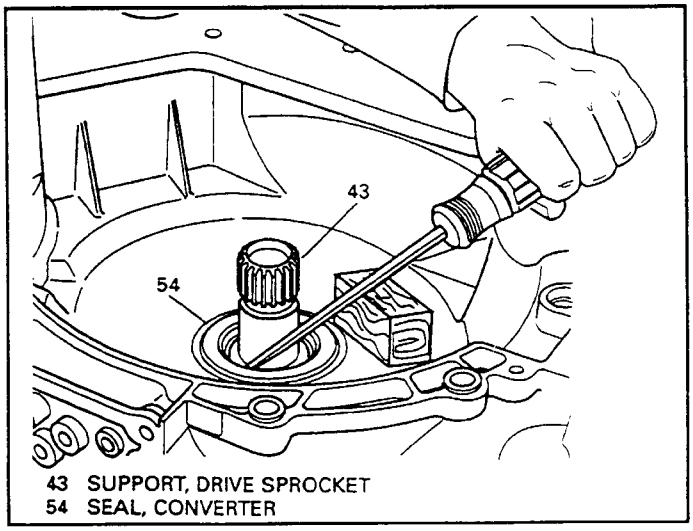
83. The parking rod will remain attached to the detent lever until the assembly is removed.
84. Remove the manual shaft seal (809) from the case using a small screwdriver. Be careful not to damage the case bore during removal.

Continued on next Page



49 SEAL, COOLER LINE

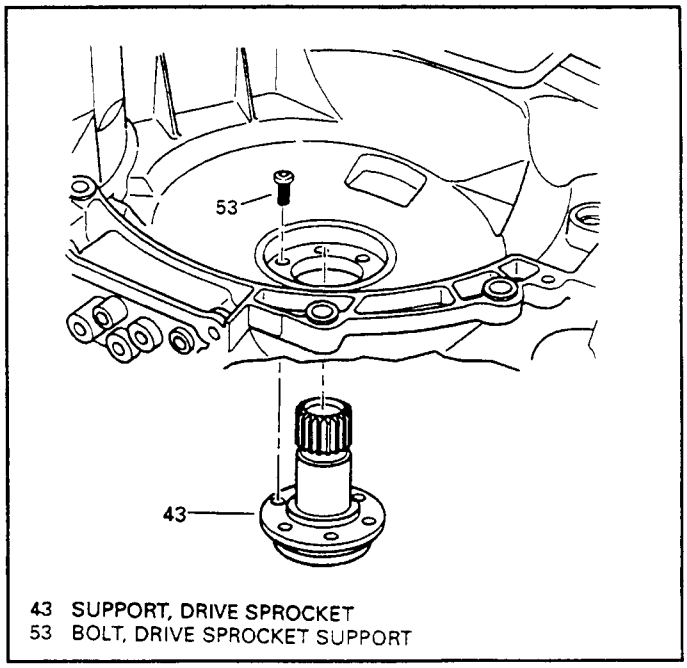
Figure 82



43 SUPPORT, DRIVE SPROCKET
54 SEAL, CONVERTER

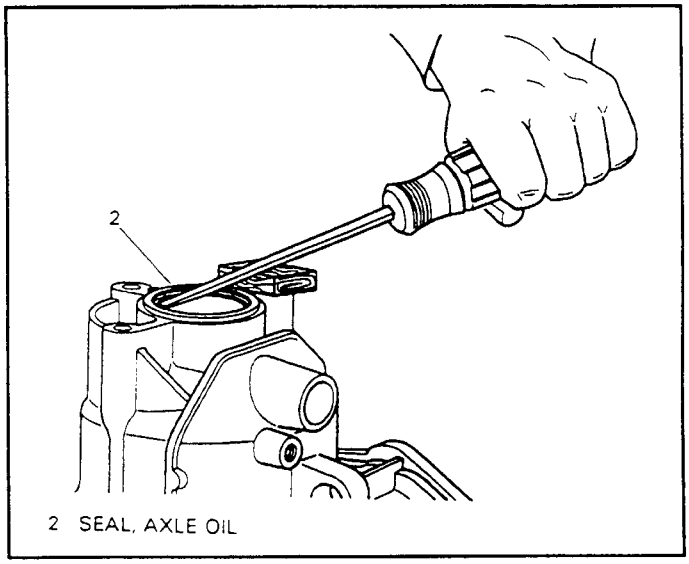
Figure 83

85. Remove the cooler line seals (49) using cooler line seal removal tool J-41239-2, as shown in Figure 82.
86. Wedge the tool into the seal on the outside of the case bore using a hammer (See Figure 82).
87. Pry the seal out of the case, strike the tool with a hammer if necessary (See Figure 82).
88. Remove the converter seal using a screwdriver or appropriate seal removal tool (Figure 83).
89. Remove the bolts from the drive sprocket support and remove drive sprocket support from the case (See Figure 84).
90. Remove the right hand axle seal from the case using a screwdriver or appropriate seal removal tool (See Figure 85).



43 SUPPORT, DRIVE SPROCKET
53 BOLT, DRIVE SPROCKET SUPPORT

Figure 84



2 SEAL, AXLE OIL

Figure 85

COMPONENT REPAIR AND TRANSAXLE ASSEMBLY

TRANSAXLE CASE ASSEMBLY

1. Thoroughly clean the transaxle case and all of the case threads with clean solvent, and blow dry with compressed air.
2. Inspect the transaxle case for the following:
   - 0 Case exterior for cracks or porosity.
   - 0 Channel plate to valve body surface and the case to channel plate surface for flatness.
   - 0 Bottom pan, side cover and channel plate gasket surfaces for damage.
   - 0 External bores for damage, sharp edges, and any porosity. Output speed sensor, the case connector bore, cooler line bores, axle seal bore, fill cap and manual shaft bores.
   - 0 Bolt holes for thread damage, repair with a Heli-Coil as necessary.
   - 0 Case interior for damaged snap ring groove, and/or damaged case lugs.
   - 0 Case bushing for excessive wear or damage.
3. Remove the actuator guide roll pin (810) from the case (See Figure 86).
4. Remove the actuator guide (812) and "O" ring seal assembly from the case (See Figure 86). ***NOTE: The acutator guide should not be removed unless it appears damaged.***
5. Install a new "O" ring on the actuator guide as shown in Figure 86.
6. Lubricate the actuator guide case bore with a small amount of "Trans-Jel".
7. Install the actuator guide and "O" ring seal into the transaxle case (See Figure 86).
8. Install the actuator guide roll pin into the case to secure the actuator guide, making certain the roll pin enters the slot in the actuator guide as shown in Figure 86.
9. Install the drive sprocket support into the bell housing in the case (See Figure 87).
10. Install the six drive sprocket support retaining bolts (53) into the drive sprocket support as shown in Figure 87.
11. Hand start all of the bolts, and then torque to 9 ft.lb. (See Figure 87).

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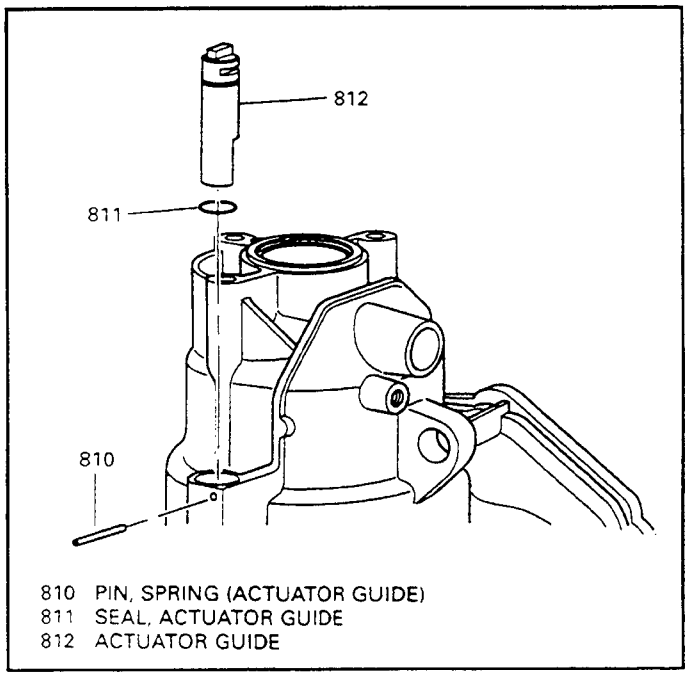
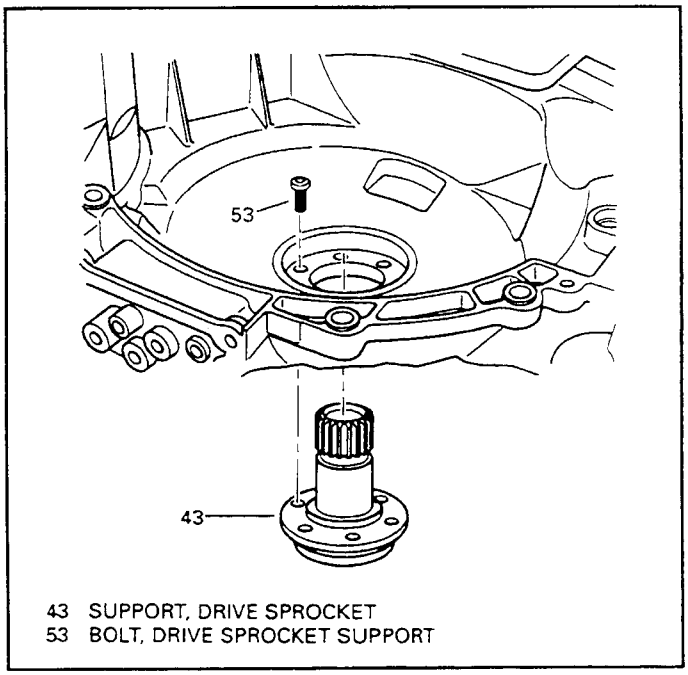


810 PIN, SPRING (ACTUATOR GUIDE)
811 SEAL, ACTUATOR GUIDE
812 ACTUATOR GUIDE

Figure 86



43 SUPPORT, DRIVE SPROCKET
53 BOLT, DRIVE SPROCKET SUPPORT

Figure 87

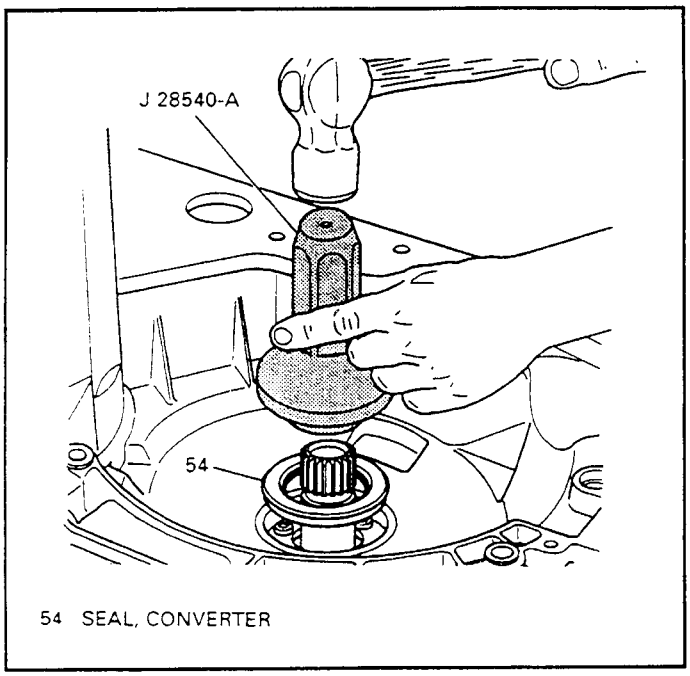


Figure 88

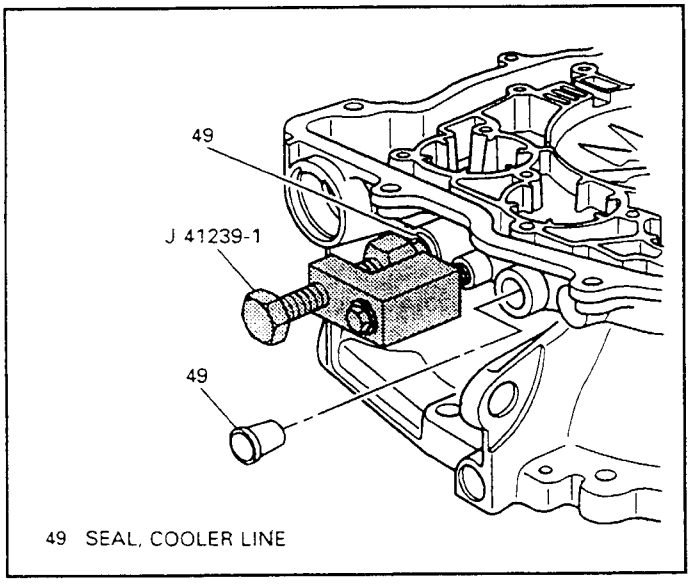
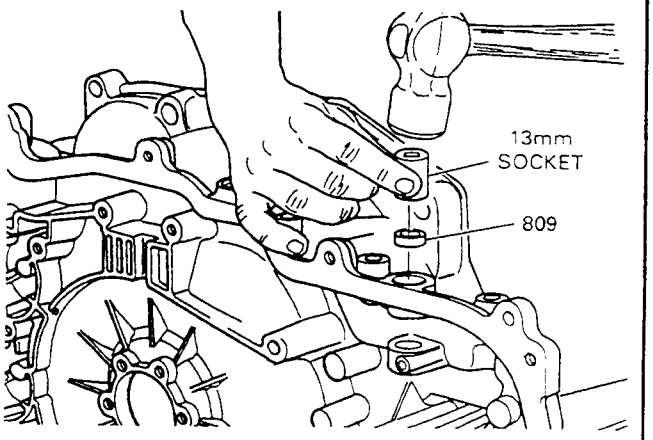


Figure 89

Continued from Page 61

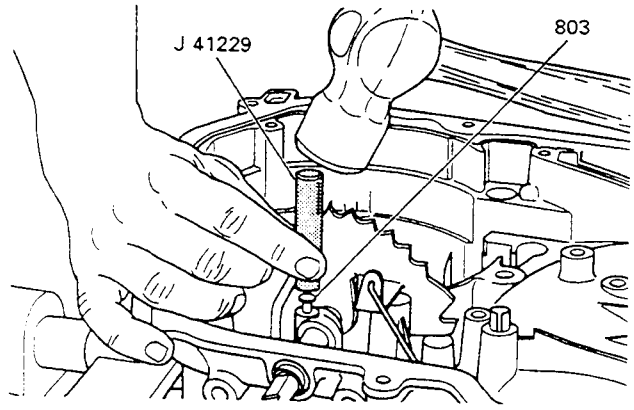
12. Install a new torque converter seal (54) using the installation tool J-28540-A, as shown in Figure 88.
13. After installation, insure that the garter spring is still in the correct position on the seal and lubricate seal with small amount of "Trans-Jel"
14. Place a new cooler line seal (49) into the case bore as shown in Figure 89.
15. Install tool J-41239-1 on the transaxle case at the cooler line bracket bolt hole, as shown in Figure 89.
16. Press the new cooler line seal in by tightening the seal pressing bolt on the tool until the seal bottoms out in the case bore (See Figure 89).
17. Repeat steps 14 thru 16 for the second cooler line seal.
18. Install a new manual shaft seal into the case bore using a 13mm deep socket, as shown in Figure 90.
19. Ensure that the manual shaft seal is fully seated into the case bore.
20. Install the manual shaft and detent lever Asm. (806) into the case with the parking actuator rod, and the manual valve link, attached to the detent lever (See Figure 91).
21. Verify that the parking actuator rod is in proper position in the actuator guide in the bottom of case.
22. Install the manual shaft to case retaining pin (803) using installation tool J-41229 as shown in Figure 92.
    NOTE: The manual shaft pin (Nail) must be installed to the correct height to properly lock the manual shaft, and tool J-41229 provides this correct installation. If the pin is installed too deep, it will crack the case boss.

Continued on Page 64



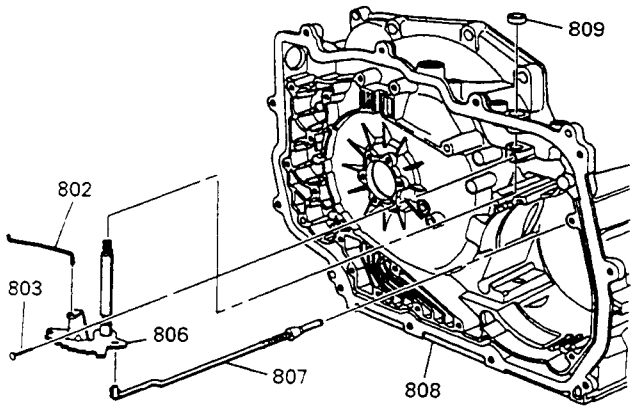
809 SEAL, MANUAL SHAFT TO CASE

Figure 90



803 PIN, MANUAL SHAFT TO CASE

Figure 92

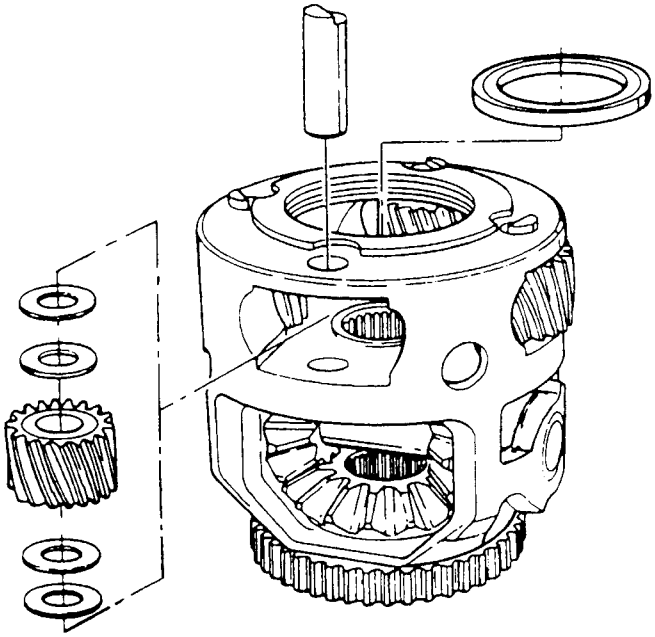


802 LINK, MANUAL VALVE TO DETENT LEVER
803 PIN, MANUAL SHAFT TO CASE
806 MANUAL SHAFT AND DETENT LEVER ASSEMBLY
807 PARKING LOCK ACTUATOR ASSEMBLY
808 CASE, TRANSAXLE
809 SEAL, MANUAL SHAFT TO CASE

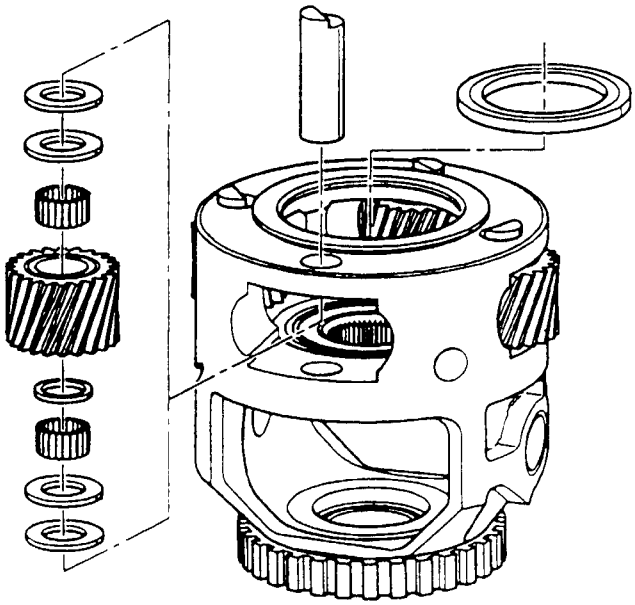
Figure 91

INFORMATION FOR FINAL DRIVE IDENTIFICATION

THM 4T60-E

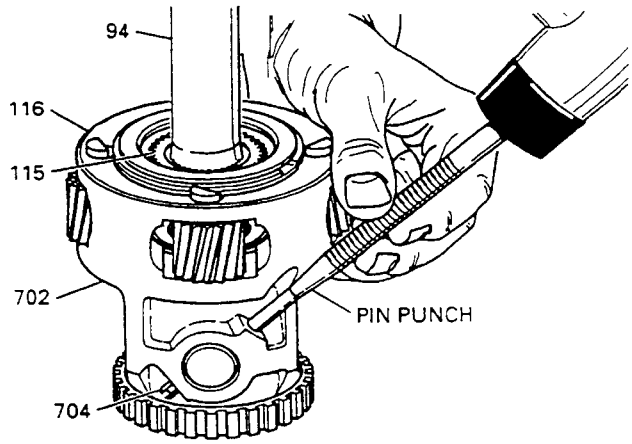


THM 4T40-E



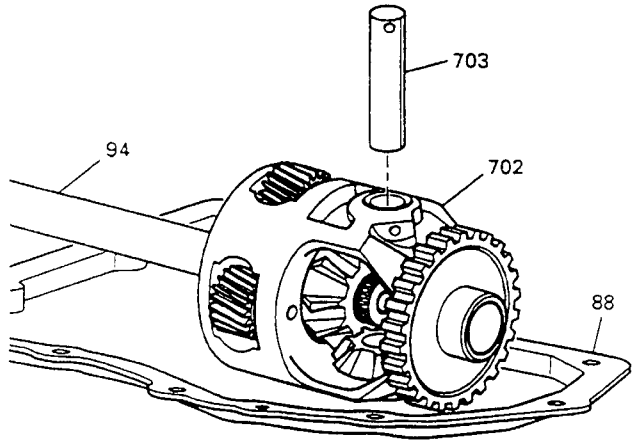
NOTICE THAT THE PINION GEAR TEETH ARE CUT IN THE OPPOSITE DIRECTION ON THESE TWO UNITS EVEN THOUGH THE FINAL DRIVES ARE VERY SIMILAR

Figure 93



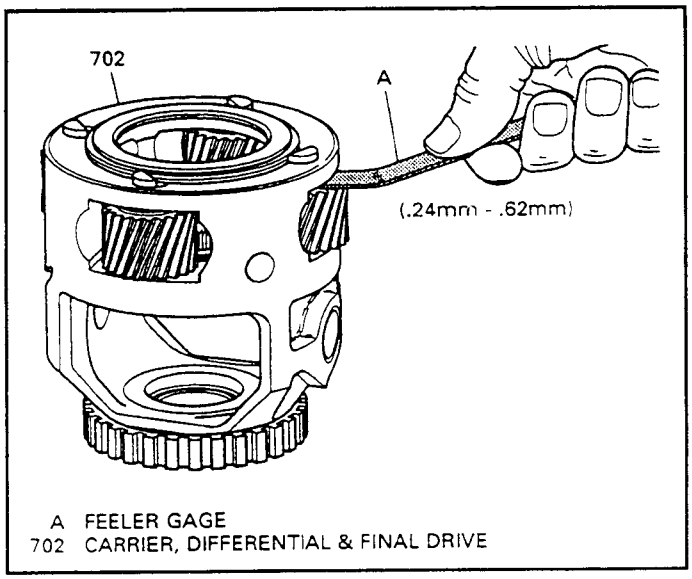
94 SHAFT, OUTPUT
115 GEAR, SUN (FINAL DRIVE)
116 DIFFERENTIAL AND FINAL DRIVE ASSEMBLY
702 CARRIER, DIFFERENTIAL & FINAL DRIVE
704 PIN, DIFFERENTIAL PINION SHAFT RETAINING

Figure 94



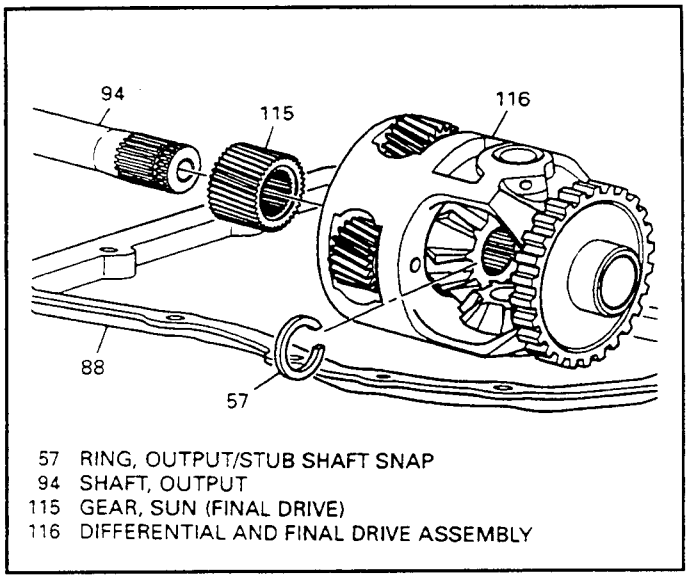
88 PAN, TRANSAXLE OIL
94 SHAFT, OUTPUT
702 CARRIER, DIFFERENTIAL & FINAL DRIVE
703 SHAFT, DIFFERENTIAL PINION

Figure 95



A FEELER GAGE
702 CARRIER, DIFFERENTIAL & FINAL DRIVE

Figure 96



57 RING, OUTPUT/STUB SHAFT SNAP
94 SHAFT, OUTPUT
115 GEAR, SUN (FINAL DRIVE)
116 DIFFERENTIAL AND FINAL DRIVE ASSEMBLY

Figure 97

FINAL DRIVE ASSEMBLY

1. Inspect the complete final drive assembly for any wear and/or damage.
2. Check for proper pinion end play, with a feeler gage, as shown in Figure 96. Proper end play should be .009"-.025" (.24mm-.62mm).
3. ***NOTE: Do not disassemble the final drive assembly unless necessary for damaged parts.***
4. Remove the differential pinion shaft retaining pin (704) using a drift punch (See Figure 94).
5. Remove the differential pinion cross shaft from final drive housing as shown in Figure 95.
6. Remove and discard the snap ring (57) from the end of the output shaft (See Figure 97). ***Snap ring is not reusable.***
7. Remove the output shaft and final drive sun gear, as shown in Figure 97.
8. Rotate and remove the differential pinion gears (707) and thrust washers (706) using Figure 98 as a guide.
9. Remove the differential side gears (709) and thrust washers (708) as shown in Figure 98.
10. Inspect the gears for wear and/or damage.

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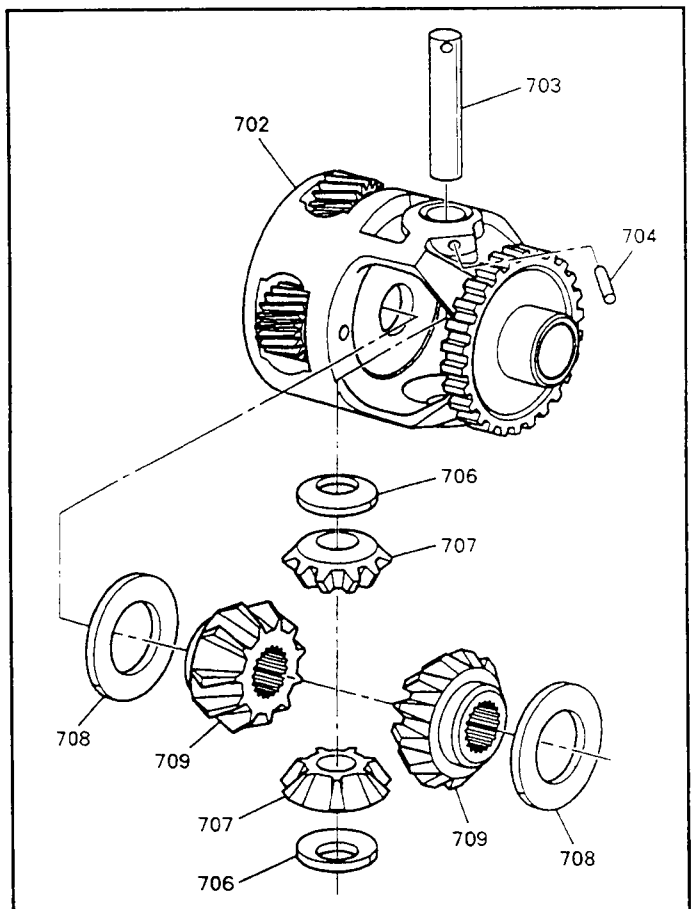
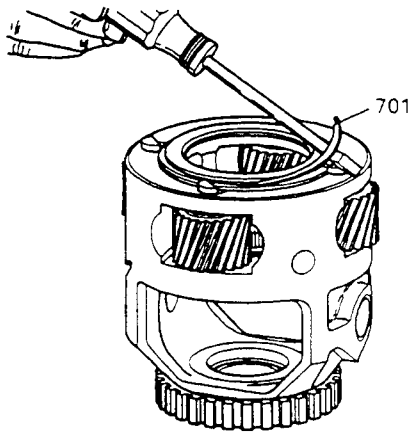


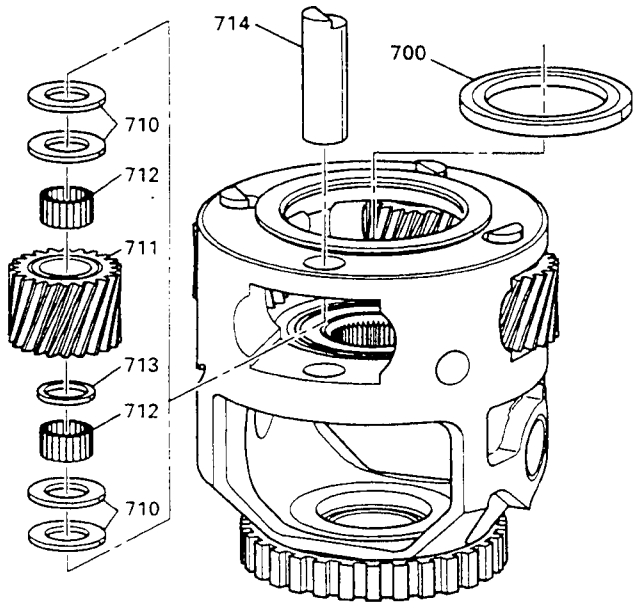
702 CARRIER, DIFFERENTIAL & FINAL DRIVE
703 SHAFT, DIFFERENTIAL PINION
704 PIN, DIFFERENTIAL PINION SHAFT RETAINING
706 WASHER, THRUST (DIFFERENTIAL PINION)
707 GEAR, DIFFERENTIAL PINION
708 WASHER, THRUST (DIFFERENTIAL SIDE GEAR)
709 GEAR, DIFFERENTIAL SIDE

Figure 98



701 RING, SPIRAL PIN RETAINING

Figure 99

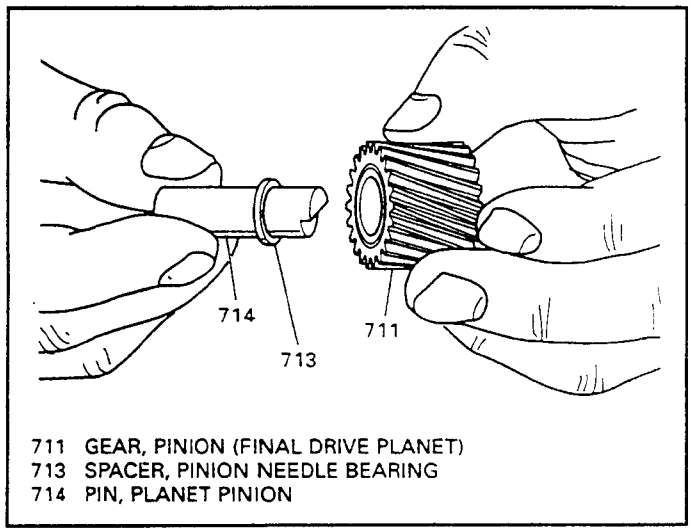


700 BEARING, THRUST
710 WASHER, PINION THRUST
711 GEAR, PINION (FINAL DRIVE PLANET)
712 ROLLER NEEDLE BEARING
713 SPACER, PINION NEEDLE BEARING
714 PIN, PLANET PINION

Figure 100

Continued from Page 65

11. Remove the spiral snap ring that retains the planetary pinion pins as shown in Figure 99. ***NOTE: Note the orientation of the planetary pinion gears before removal. The pinion gear should be re-installed in the same direction as removed, to prevent any noise because of the change in set wear patterns.***
12. Place the final drive carrier into a transaxle pan to prevent the needle bearings from being lost as the planet pinions are removed.
13. Remove the four planet pinion pins (714), four planet pinion gears (711), pinion thrust washers (710), needle roller bearings (712) and needle bearing spacers (See Figure 100).
14. Remove the final drive sun gear thrust bearing (700) as shown in Figure 100.
15. Inspect all parts removed for any wear and/or damage. Polishing is a normal condition for the pinion pins and needle bearings.
16. Install the pinion gear needle spacer (713) onto pinion pin and install inside of the planetary pinion gear as shown in Figure 101. The spacer must be assembled between the two rows of needle bearings.
17. Install the needle roller bearings (712) one at a time into the planet pinion. Place thrust washer (710) on the bottom of pinion to retain bottom row of needle bearings. Use "Trans-Jel" to aid in the assembly and keep the needle bearings in place (See Figure 102).
18. Install the sun gear to final drive carrier thrust bearing (700) into final drive carrier, as shown in Figure 100 and retain with "Trans-Jel".
19. Assemble the four planet pinion gears and the thrust washers into the final drive carrier, as shown in Figure 100.
20. Install the four planet pinion gear pins (714) in the final drive carrier to retain pinion gears as shown in Figure 100.
21. Install the final drive carrier spiral snap ring (701) into the groove to retain the planetary pinion gear pins, as shown in Figure 99.
22. Check planetary pinion end play with a feeler gage for proper end play as shown Figure 96. End play should be .009"-.025".



711 GEAR, PINION (FINAL DRIVE PLANET)
713 SPACER, PINION NEEDLE BEARING
714 PIN, PLANET PINION

Figure 101

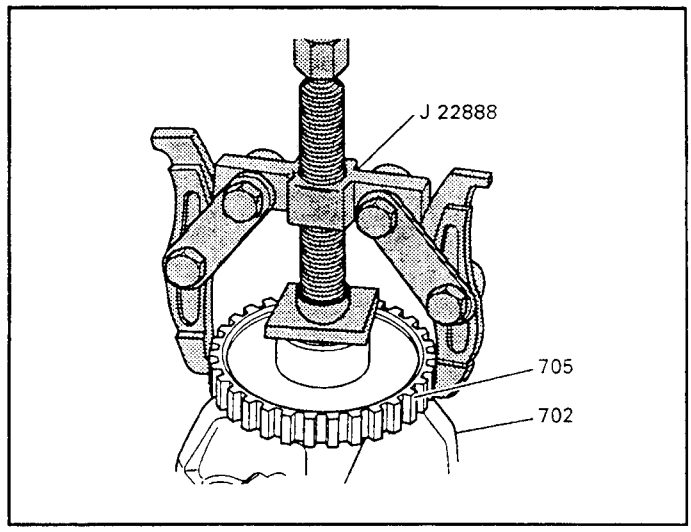
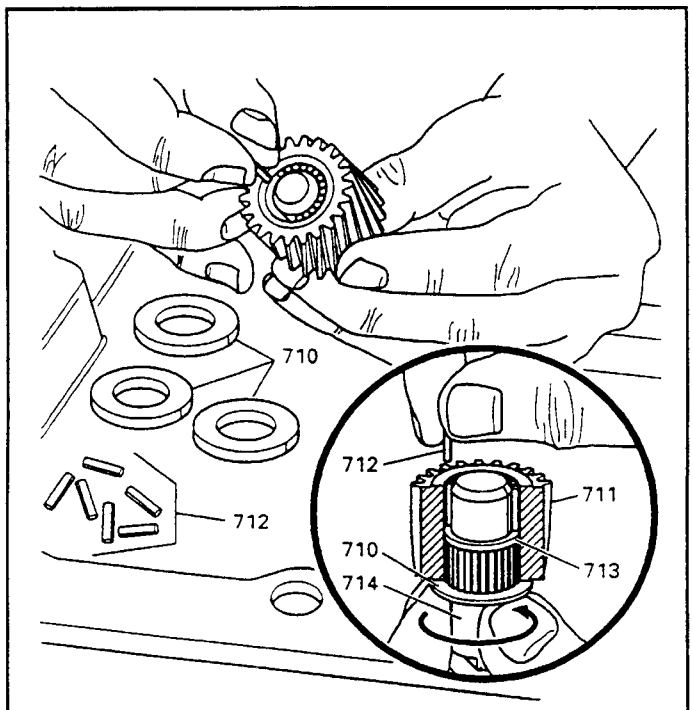


Figure 103



710 WASHER, PINION THRUST
711 GEAR, PINION (FINAL DRIVE PLANET)
712 ROLLER NEEDLE BEARING
713 SPACER, PINION NEEDLE BEARING
714 PIN, PLANET PINION

Figure 102

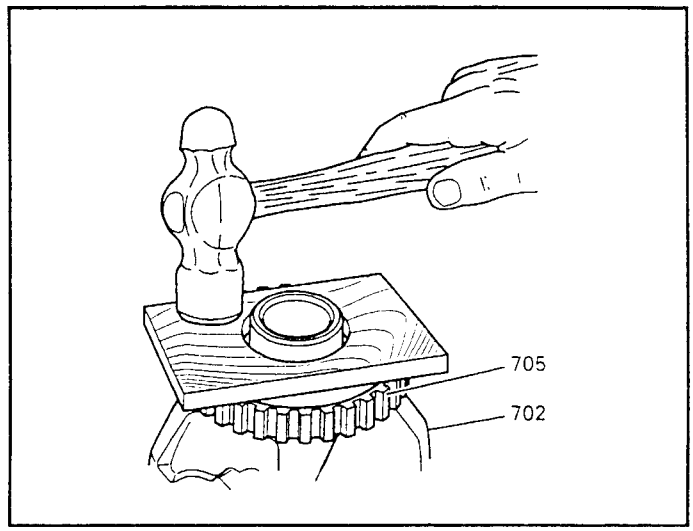


Figure 104

Continued from Page 66

23. NOTE: Do not remove the speed sensor rotor unless damage is apparent.
24. If necessary, use a universal puller and a thick flat washer to remove the speed sensor rotor as shown in Figure 103.
25. Install new speed sensor rotor using a modified wooden block and a plastic mallet, as shown in Figure 104.
26. Warming the new speed sensor rotor before installing will help the installation process.

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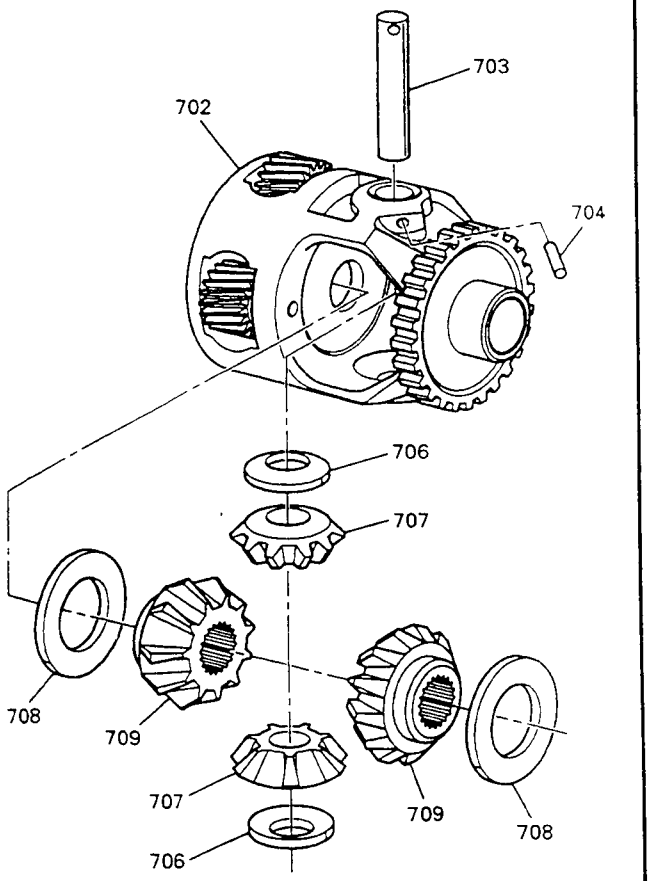
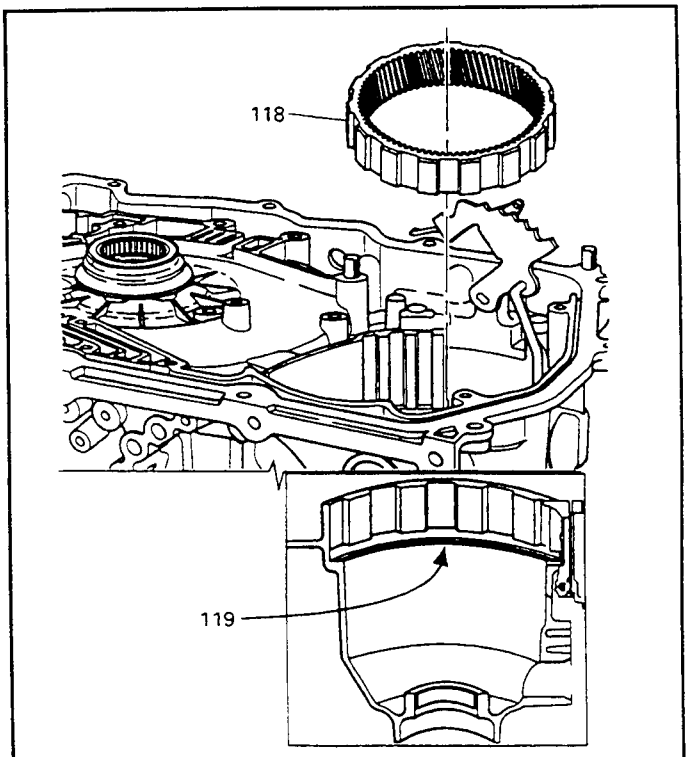


702 CARRIER, DIFFERENTIAL & FINAL DRIVE
703 SHAFT, DIFFERENTIAL PINION
704 PIN, DIFFERENTIAL PINION SHAFT RETAINING
706 WASHER, THRUST (DIFFERENTIAL PINION)
707 GEAR, DIFFERENTIAL PINION
708 WASHER, THRUST (DIFFERENTIAL SIDE GEAR)
709 GEAR, DIFFERENTIAL SIDE

Figure 105

Continued from Page 67

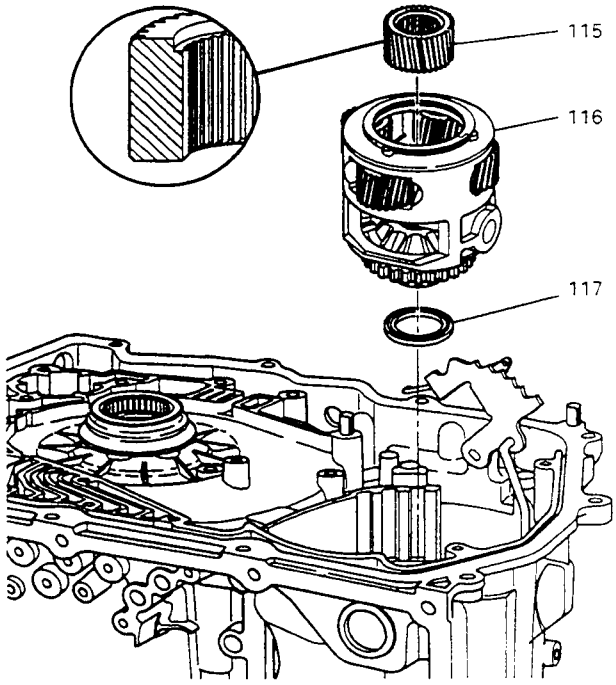
27. Assemble the side gear thrust washers (708) on the differential side gears (709) and install the differential side gears into the final drive carrier as shown in Figure 105.
28. Assemble the pinion gear thrust washers (706) onto the differential pinion gears (707), retain with "Trans-Jel", as shown in Figure 105.
29. Install the differential pinion gears with thrust washers attached into the final drive carrier, as shown in Figure 105.
30. Rotate the pinion gears into position and install the pinion shaft (703) through the final drive carrier and pinion gears (See Figure 105).
31. The position of the pinion shaft must allow the retaining pin to be installed.



118 GEAR, FINAL DRIVE INTERNAL
119 RING, FRETTING (INTERNAL GEAR TO CASE)

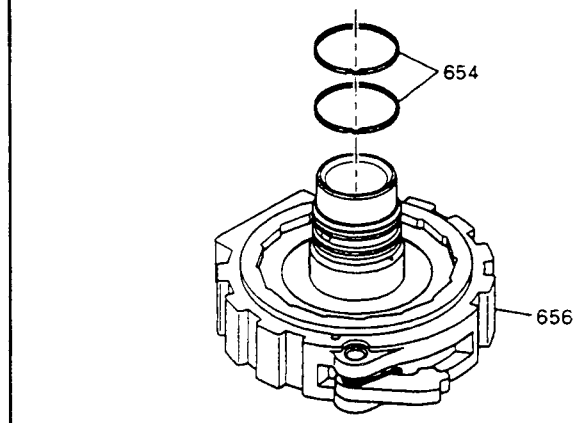
Figure 106

32. Install the pinion shaft retaining pin (704) thru the final drive carrier and pinion shaft to retain the pinion shaft, as shown in Figure 105.
33. Drive the pinion pin in with drift punch.
34. Install fretting ring (119) into the small groove in the transaxle case if it was removed, shown in Figure 106.
35. Install the final drive internal ring gear (118) into the transaxle case as shown in Figure 106.
36. Install the final drive carrier to case thrust bearing (117) onto the final drive and retain with "Trans-Jel" (See Figure 107).
37. Install the complete final drive carrier (116), into the transaxle by rotating into position in the ring gear (See Figure 107).
38. Install the final drive sun gear into the final drive carrier with the grooved side facing up, as shown in Figure 107.



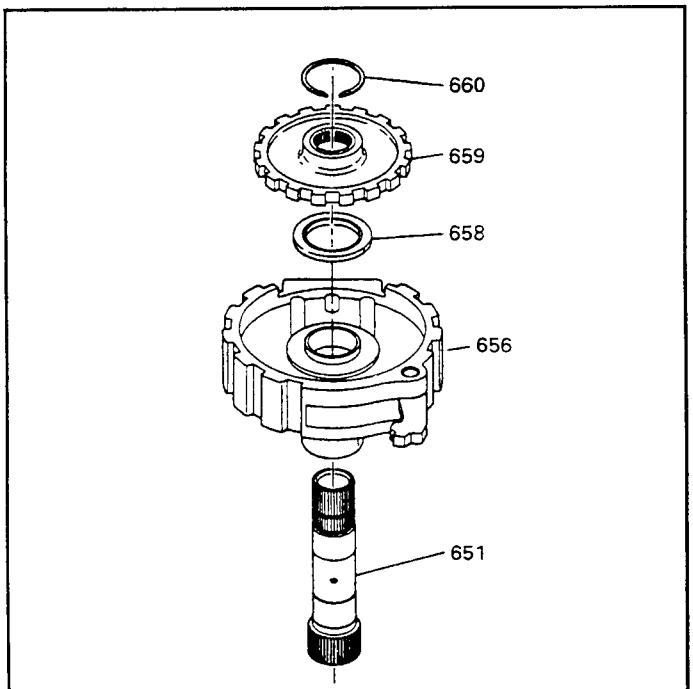
115 GEAR, SUN (FINAL DRIVE)
116 DIFFERENTIAL AND FINAL DRIVE ASSEMBLY
117 BEARING, THRUST

Figure 107



654 RING, OIL SEAL (FORWARD CLUTCH SUPPORT)
656 SUPPORT, FORWARD CLUTCH

Figure 109



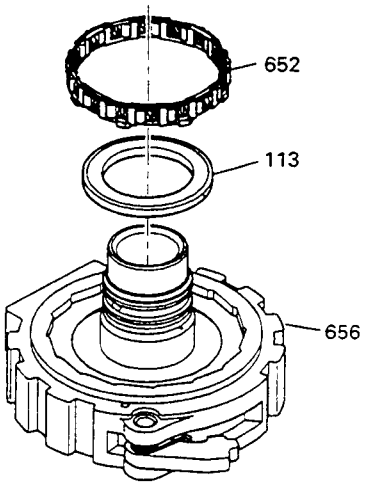
651 SHAFT, FINAL DRIVE SUN
656 SUPPORT, FORWARD CLUTCH
658 BEARING, THRUST (FORWARD SUPPORT TO PARK GEAR)
659 GEAR, PARK LOCK
660 RING, SNAP (FINAL DRIVE SUN SHAFT)

Figure 108

FORWARD CLUTCH SUPPORT AND LO ROLLER CLUTCH

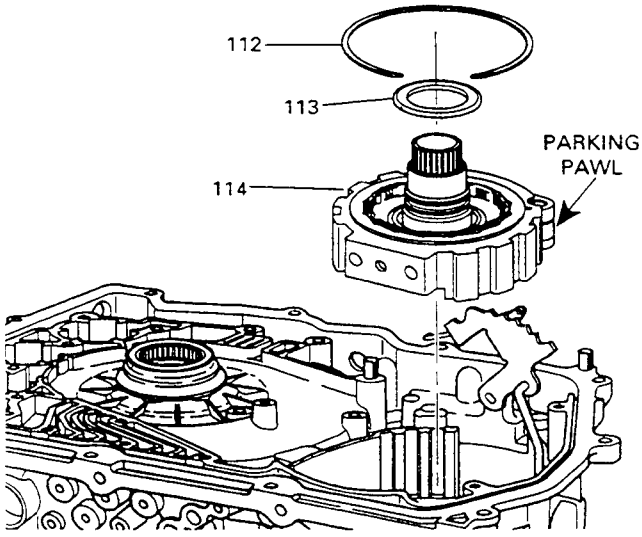
1. Install two new seals (654) onto the forward clutch support as shown in Figure 109.
2. Assemble the forward clutch support onto the final drive sun gear shaft (See Figure 108).
3. Install the thrust bearing (658) onto forward clutch support as shown in Figure 108.
4. Install the parking pawl gear (659) onto final drive sun gear shaft with the raised inner boss facing up, so that the parking pawl properly engages the teeth on gear (See Figure 108).
5. Install the snap ring onto final drive sun gear shaft to retain parking gear (See Figure 108). NOTE: There is approximately 1/8" space between the parking gear and snap ring. This space is normal.

Continued on next Page



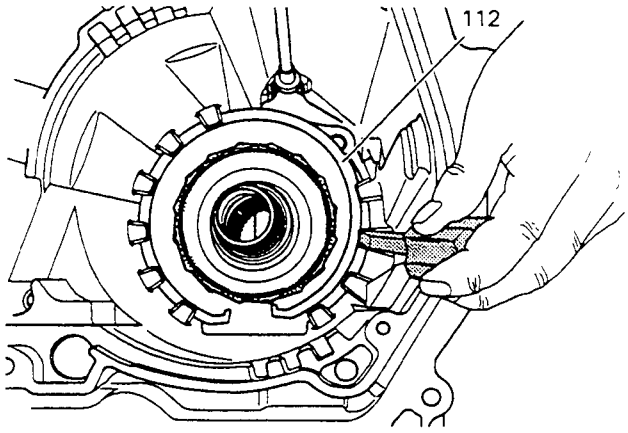
113 BEARING, THRUST
652 CLUTCH ASSEMBLY, LO ROLLER
656 SUPPORT, FORWARD CLUTCH

Figure 110



112 RING, SNAP (FORWARD CLUTCH SUPPORT TO CASE)
113 BEARING, THRUST
114 SUPPORT ASSEMBLY, FORWARD CLUTCH

Figure 111

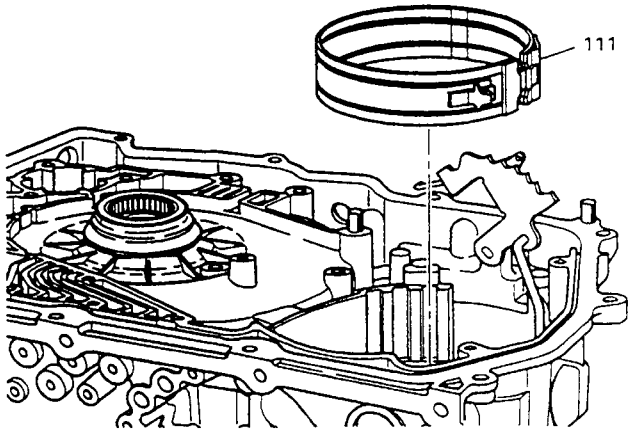


112 RING, SNAP (FORWARD CLUTCH SUPPORT TO CASE)

Figure 112

Continued from Page 69

6. Install the Lo roller clutch assembly (652) into the forward clutch support. The larger tabs on the plastic cage must face down into forward clutch support, rotate slightly counterclockwise to lock the tabs into the grooves in the forward clutch support (See Figure 110).
7. Install the thrust bearing (113) onto the forward clutch support as shown in Figure 110.
8. Compress the parking pawl spring and line up the parking pawl with the parking gear. While holding in this position, install the forward clutch support assembly into the transaxle case, as shown in Figure 111.
9. Install the forward clutch snap ring (112) into the transaxle case with the chamfer side facing up as shown in Figure 112.
10. The snap ring opening must be toward bottom of the case facing the bottom pan as shown in Figure 112.
11. Use a screwdriver to set the snap ring in place, as shown in Figure 112.
12. Install the Lo/Reverse band (111) into transaxle case as shown in Figure 113.
13. Align the band servo pin apply surface toward the bottom pan and hook the band onto band anchor pin in the transaxle case as shown in Figure 113

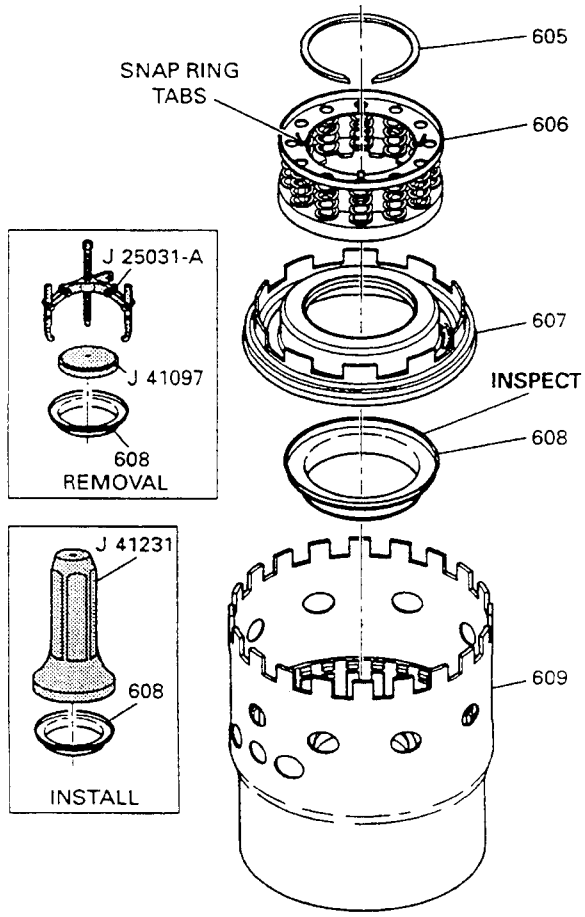


111 BAND, LO/REVERSE

Figure 113

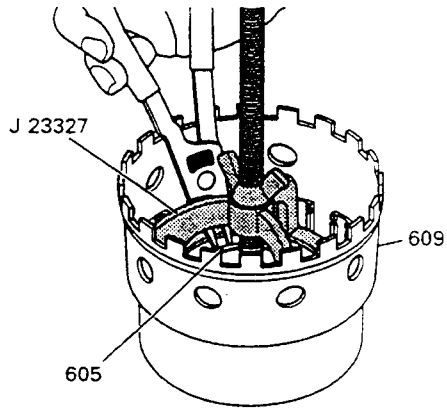
FORWARD CLUTCH HOUSING ASSEMBLY

1. ***NOTE: All pistons for the clutch packs in this transaxle are stamped steel with the rubber seals molded to the pistons, and reusable if they are not damaged.***
2. Inspect the forward clutch inner seal assembly (608) for any damage (See Figure 114).
3. If the seal is damaged, remove the seal using removal tools J-41907 and J-25031-A, shown in Figure 114.
4. Press a new inner seal assembly onto forward clutch housing inner hub using an arbor press and tool J-41231 (See Figure 114).
5. Lubricate the inner seal with "Trans-Jel".
6. Lubricate all seal surfaces with "Trans-Jel" and install the forward clutch piston (607) into the forward clutch housing with a twisting motion (See Figure 114).
7. Install the forward clutch return spring Asm. on top of the forward clutch piston with the snap ring tabs facing up as shown in Figure 114.
8. Lay the snap ring on top of the return spring assembly, install spring compressor as shown in Figure 115.
9. Compress the return spring assembly using care as it is compressed so as not to damage return spring cage as it goes by the snap ring groove.
10. Install the snap ring into the groove, to retain the return spring assembly (See Figure 115).
11. Remove the spring compressor after the snap ring is installed.



605 RING, SNAP (FORWARD CLUTCH SPRING ASSEMBLY)
606 SPRING ASSEMBLY, FORWARD CLUTCH RETURN
607 PISTON ASSEMBLY, FORWARD CLUTCH
608 SEAL AND SLEEVE ASSEMBLY, FORWARD CLUTCH INNER
609 HOUSING, FORWARD CLUTCH

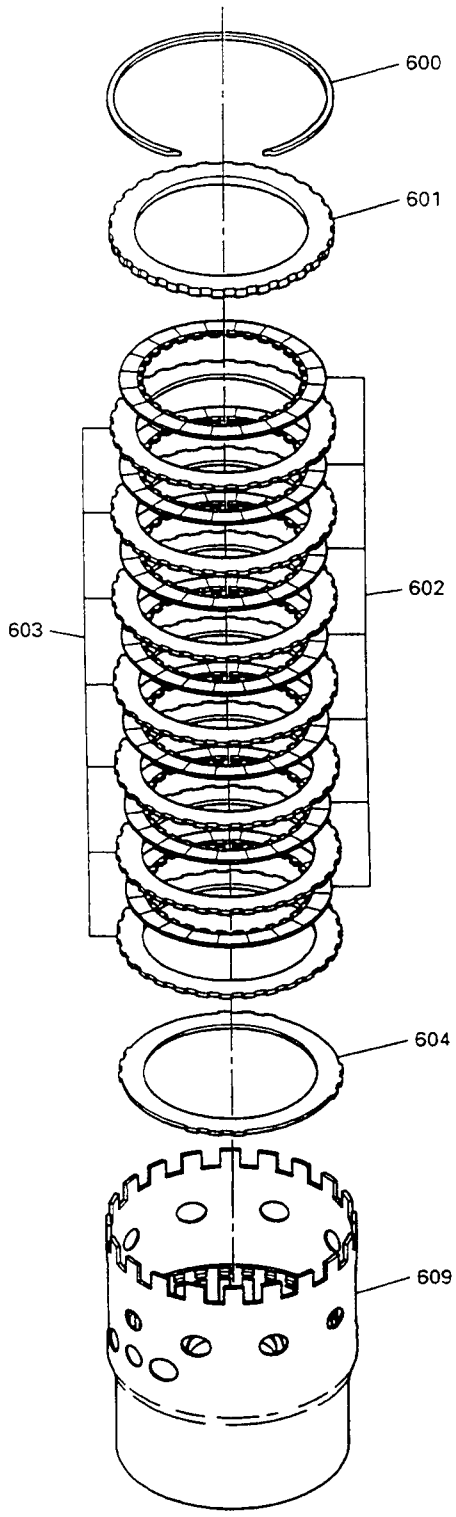
Figure 114



605 RING, SNAP (FORWARD CLUTCH SPRING ASSEMBLY)
609 HOUSING, FORWARD CLUTCH

Figure 115

Continued on next Page



600 RING, SNAP (FORWARD CLUTCH)
601 PLATE, FORWARD CLUTCH (BACKING)
602 PLATE, FORWARD CLUTCH (FIBER)
603 PLATE, FORWARD CLUTCH (STEEL)
604 PLATE, FORWARD CLUTCH (WAVED)
609 HOUSING, FORWARD CLUTCH

Figure 116

Continued from Page 71

12. Install the forward clutch wave plate (604) into the forward clutch housing (See Figure 116).
13. Install the forward clutch plates beginning with a steel plate on top of the wave plate and then alternating with lined plates, until you have installed seven steel plates and seven friction plates, as shown in Figure 116.
14. Install the forward clutch backing plate, with the flat side facing up as shown in Figure 116.
15. Install the forward clutch backing plate snap ring as shown in Figure 116.
16. Air check the forward clutch to verify proper operation of the seals and clutch pack as shown in Figure 117.
17. Install the forward clutch housing assembly in the transaxle case by rotating counterclockwise during assembly to seat the assembly into the lo roller clutch as shown in Figure 118.
18. When assembled properly the forward clutch housing will freewheel counterclockwise and lock in clockwise direction.
19. Verify the proper installation of the Lo/Reverse band by inserting a screwdriver through the reverse servo pin hole as shown in Figure 119.
20. The screwdriver should compress the band around the forward clutch housing and prevent it from turning in either direction.

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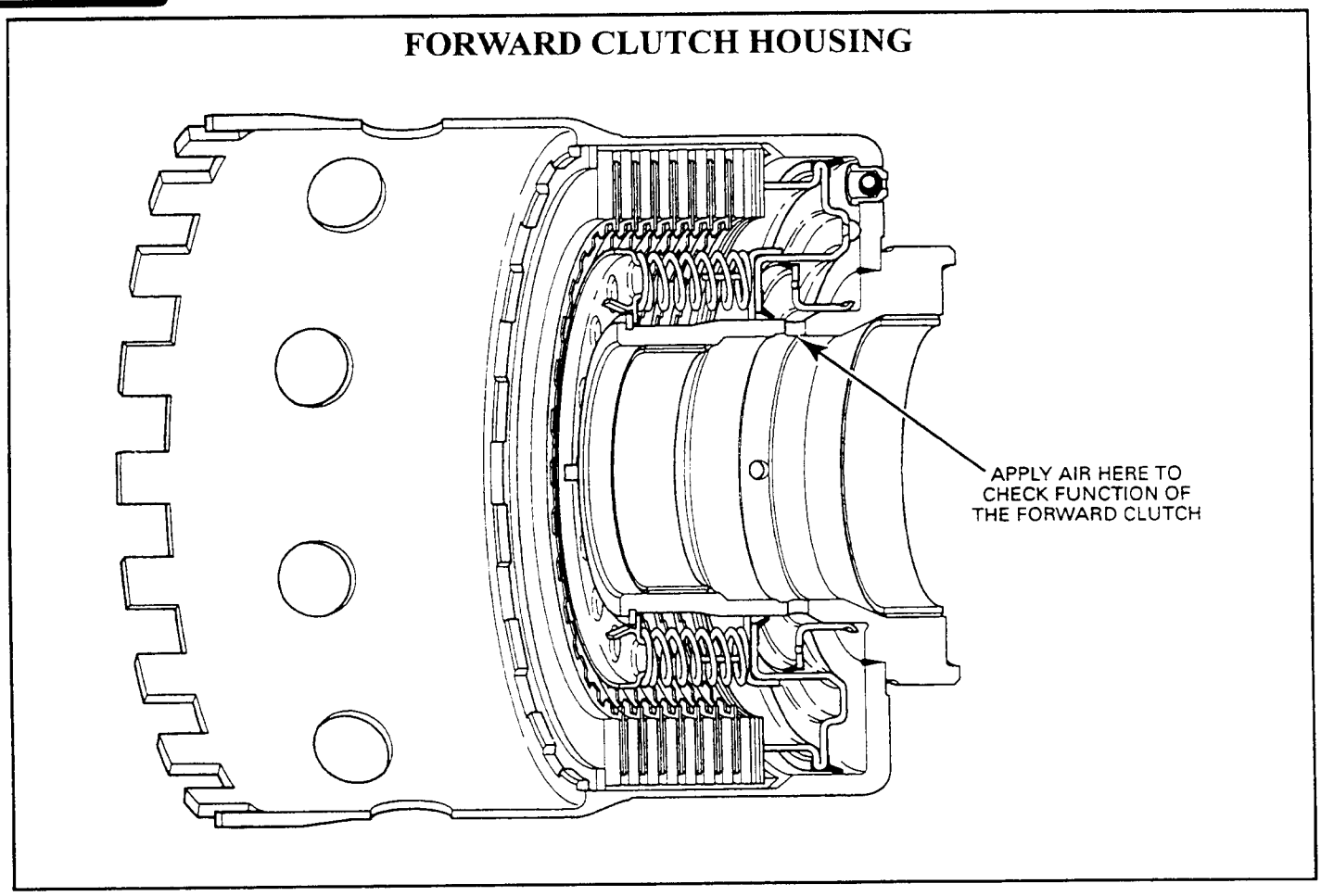


Figure 117

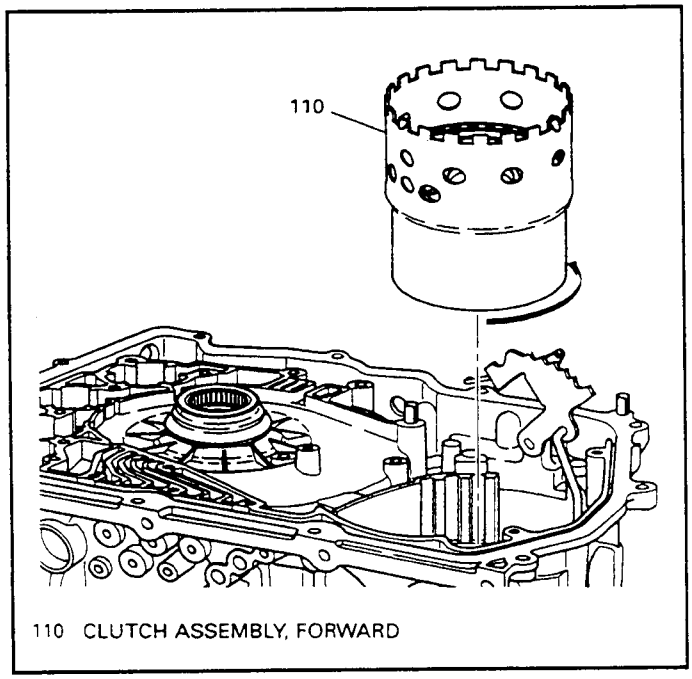


Figure 118

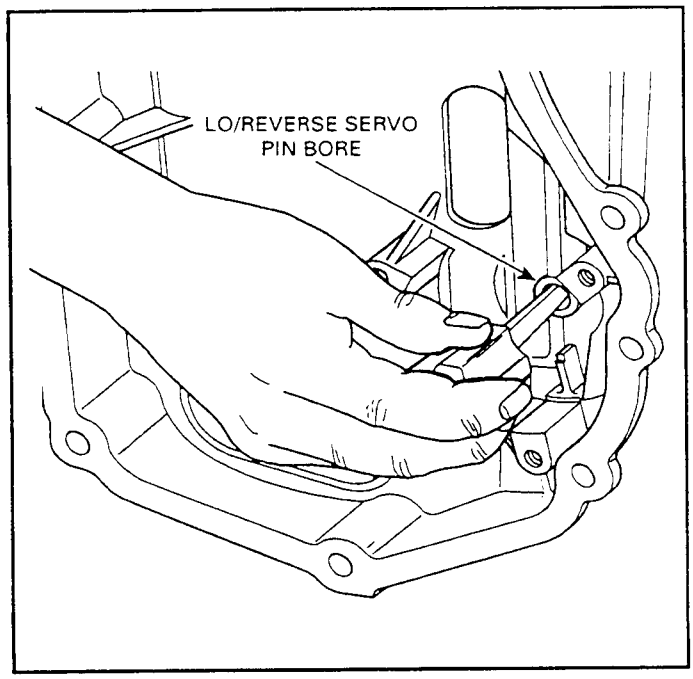
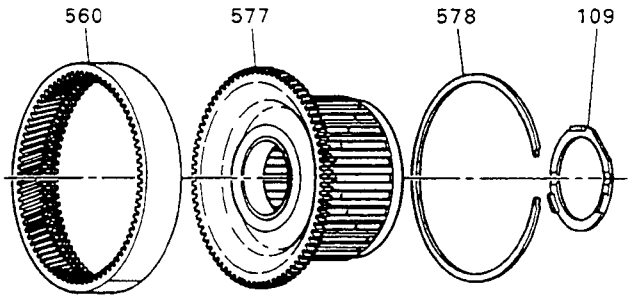
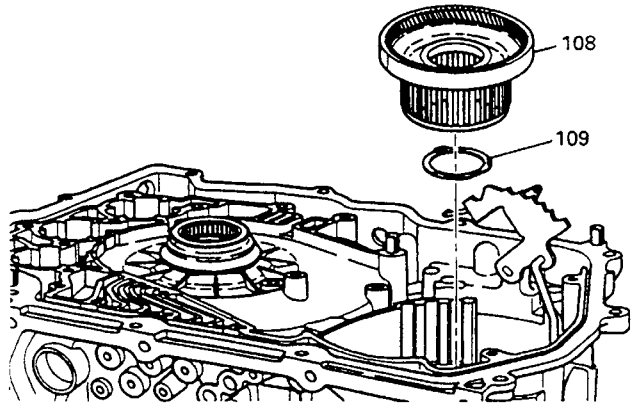


Figure 119



109 WASHER, THRUST
560 GEAR INTERNAL, INPUT
577 INPUT FLANGE AND FORWARD CLUTCH HUB
578 RING, SNAP (INPUT INTERNAL TO INPUT FLANGE)

Figure 120



108 INPUT FLANGE & FORWARD CLUTCH HUB ASSEMBLY
109 WASHER, THRUST

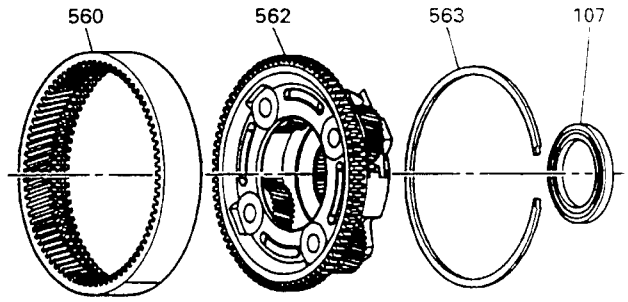
Figure 121

Continued from Page 72

21. Inspect the input internal ring gear and forward clutch hub splines, bushing and thrust washer for wear and/or damage (See Figure 120).
22. Assemble the input ring gear onto the forward clutch hub and install the snap ring as shown in Figure 120.
23. Install the thrust washer (109) onto the forward clutch hub and retain with a generous amount of "Trans-Jel" (See Figure 120).
24. Install the forward clutch hub and input ring gear assembly into the transaxle, by rotating back and forth to engage the hub splines into the forward clutch plates (See Figure 121).

REACTION INTERNAL RING GEAR AND INPUT CARRIER ASSEMBLY

1. Inspect the reaction internal ring gear and input carrier for wear or damage (See Figure 122).
2. Measure the pinion gear end play with a feeler gage for proper clearance (See Figure 123).
3. Should be .009"-.027" (.24mm-.69mm), as shown in Figure 123.
   NOTE: Replace the carrier if the pinion gear clearance is out of specification. The pinion gears are permanently assembled to carrier and are not serviced individually.
4. Assemble the reaction ring gear and the input carrier and install snap ring (See Figure 122).
5. Install thrust bearing (107) onto input carrier and retain with "Trans-Jel" (See Figure 122).
6. Install reaction ring gear and the input carrier assembly into the transaxle by rotating into the input internal ring gear (See Figure 124).



107 BEARING, THRUST
560 GEAR, INTERNAL REACTION
562 CARRIER, INPUT
563 RING, SNAP (INPUT CARRIER TO REACTION RING GEAR

Figure 122

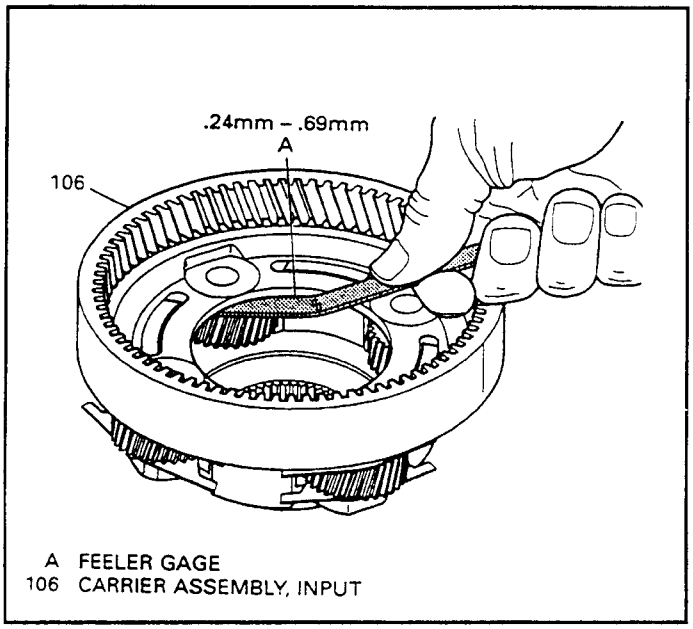


Figure 123

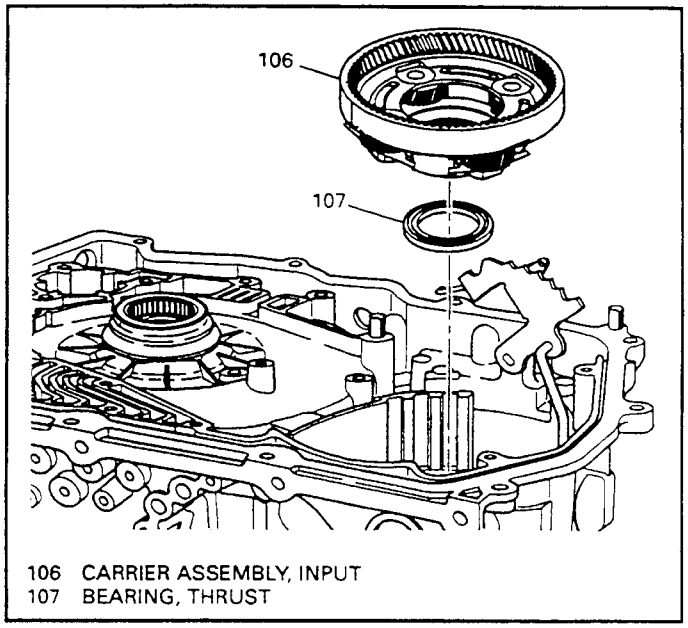


Figure 124

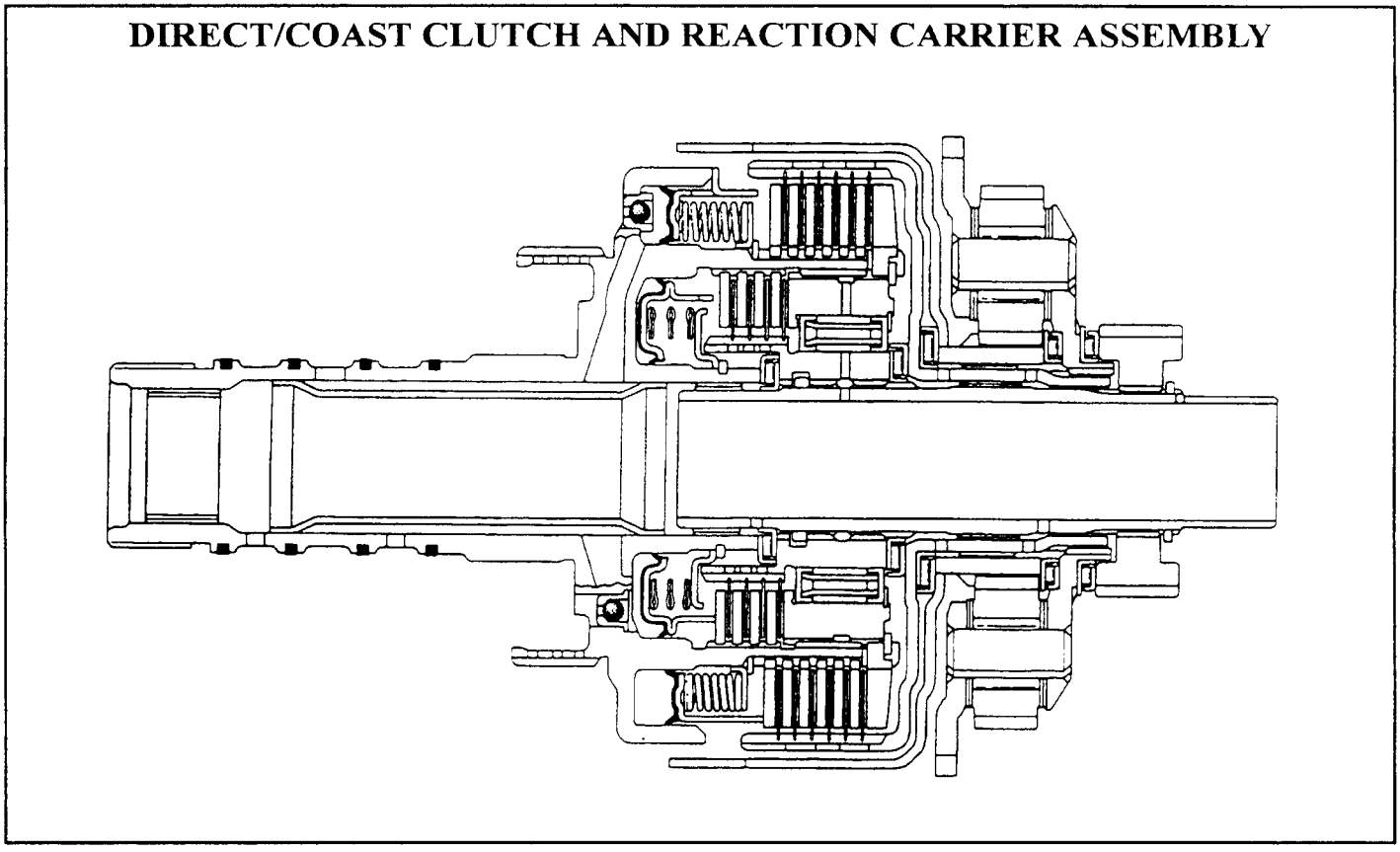
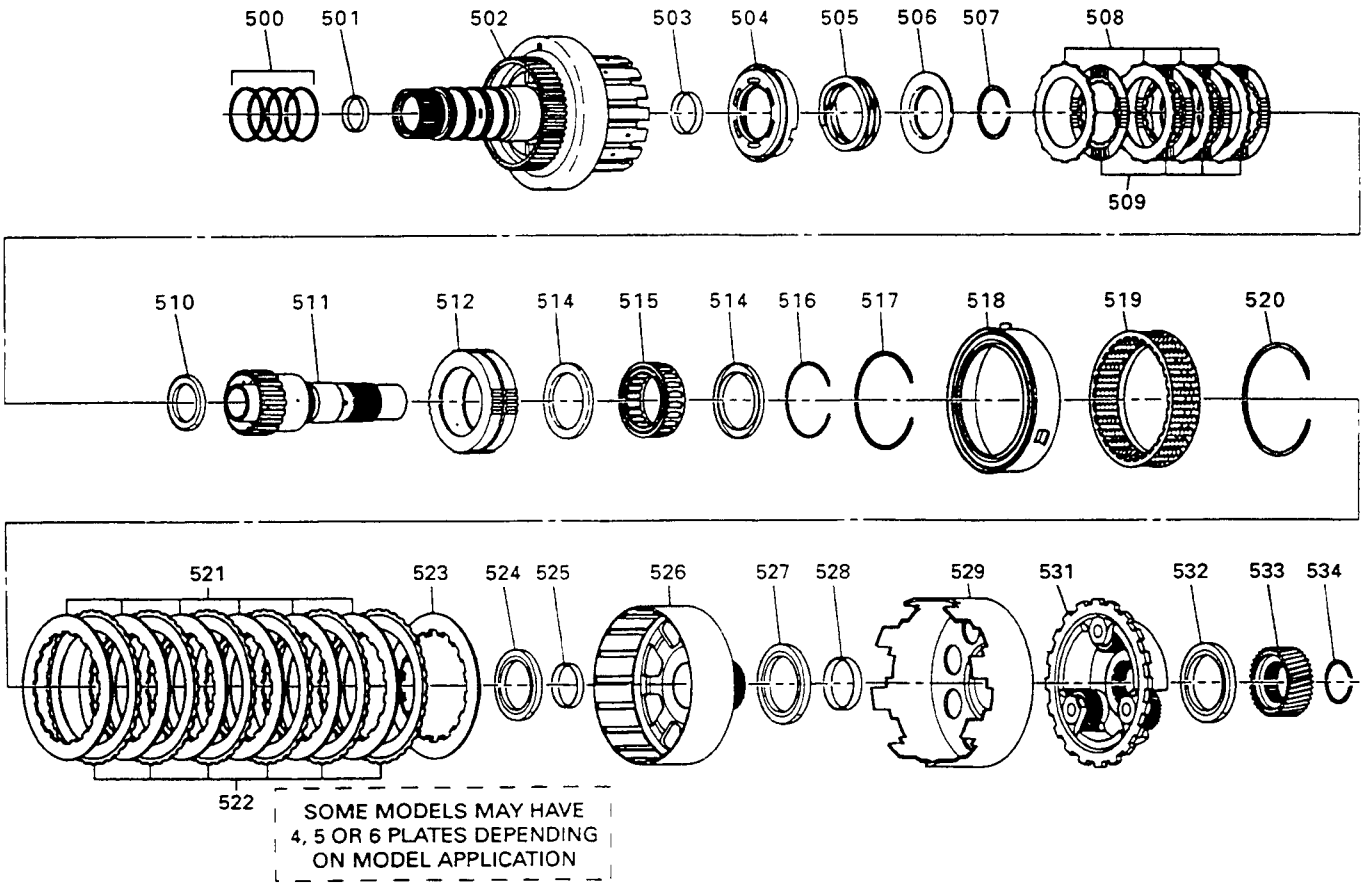


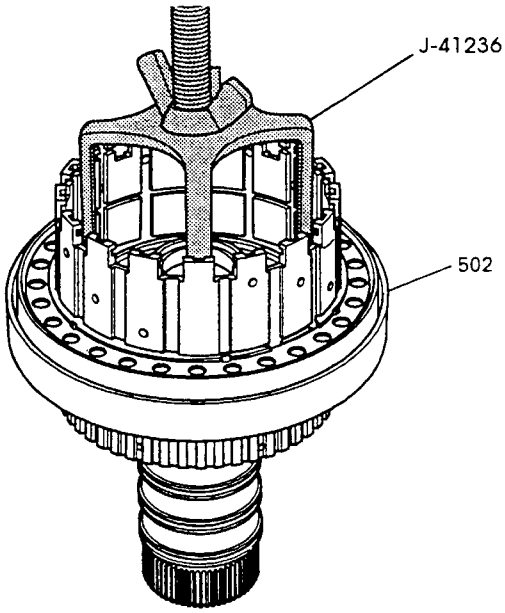
Figure 125

DIRECT/COAST CLUTCH AND REACTION CARRIER ASSEMBLY



500 RING, OIL SEAL - INPUT SHAFT
501 BUSHING, INPUT SHAFT
502 HOUSING, DIRECT & COAST CLUTCH AND INPUT SHAFT
503 BUSHING, DIRECT CLUTCH HOUSING TO OUTPUT SHAFT
504 PISTON ASSEMBLY, COAST CLUTCH
505 SPRING, COAST CLUTCH RELEASE
506 RETAINER, COAST CLUTCH SPRING
507 RING, SNAP (COAST CLUTCH SPRING RETAINER)
508 PLATE, COAST CLUTCH (STEEL)
509 PLATE, COAST CLUTCH (FIBER)
510 BEARING, THRUST
511 SHAFT AND INNER RACE ASSEMBLY, INPUT SUN GEAR
512 RACE, OUTER (INPUT SPRAG)
514 END BEARINGS, SPRAG CLUTCH (2)
515 SPRAG ASSEMBLY, INPUT
516 RING, SNAP (OUTER RACE TO SPRAG ASSEMBLY)
517 RING, SNAP (DIRECT/COAST CLUTCH RETAINING)
518 PISTON ASSEMBLY, DIRECT CLUTCH
519 SPRING AND RETAINER ASSEMBLY, DIRECT CLUTCH
520 RING, DIRECT CLUTCH SPRING RETAINER
521 PLATE, DIRECT CLUTCH (STEEL)
522 PLATE, DIRECT CLUTCH (FIBER)
523 PLATE, DIRECT CLUTCH (BACKING)
524 BEARING, THRUST
525 BUSHING, REACTION CARRIER SHAFT
526 SHELL, REACTION CARRIER SHAFT
527 BEARING, THRUST (CARRIER SHAFT TO SHELL)
528 BUSHING, REACTION SUN GEAR
529 SHELL, REACTION SUN
531 CARRIER ASSEMBLY, REACTION
532 BEARING, THRUST (REACTION CARRIER TO SUN GEAR)
533 GEAR, INPUT SUN
534 RING, SNAP

Figure 126



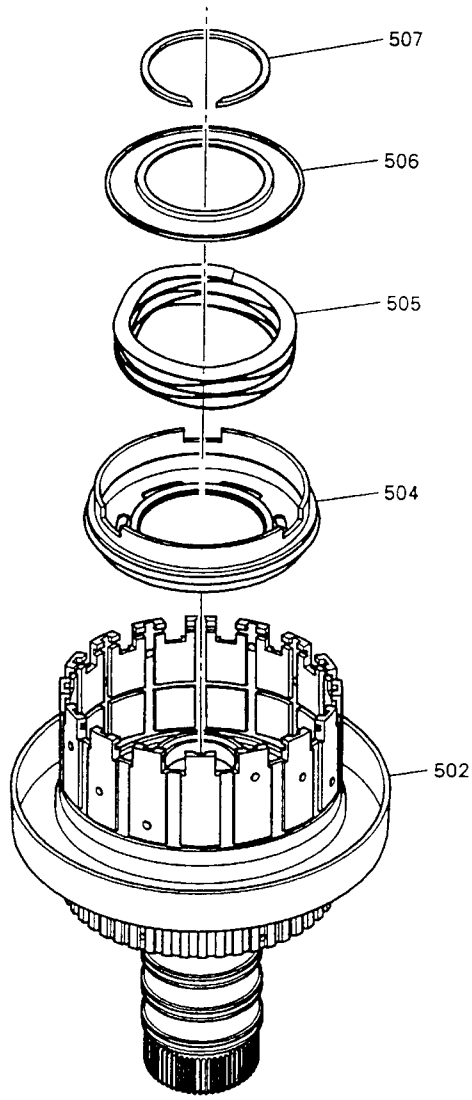
502 HOUSING, DIRECT & COAST CLUTCH AND INPUT SHAFT

Figure 127

DIRECT/COAST CLUTCH HOUSING AND REACTION CARRIER ASSEMBLY

1. Use Figure 126 as a guide to disassemble, and inspect all parts in this housing.
2. Lubricate the inner and outer molded seals on the coast clutch piston with "Trans-Jel".
3. Install the coast clutch piston and seal assembly into the input housing with a rotating motion, as shown in Figure 128.
4. Install the coast clutch return spring on top of the coast clutch piston (See Figure 128).
5. Install the coast clutch return spring retainer on top of the return spring with the inner lip facing up, as shown in Figure 128.
6. Lay the snap ring on top of the retainer, shown in Figure 128.
7. Install compressor tool J-41236, as shown in Figure 127, and compress coast clutch return spring.
8. Install the coast clutch spring retainer snap ring onto the input housing (See Figure 128).
9. Remove the compressor tool after installation of the snap ring.

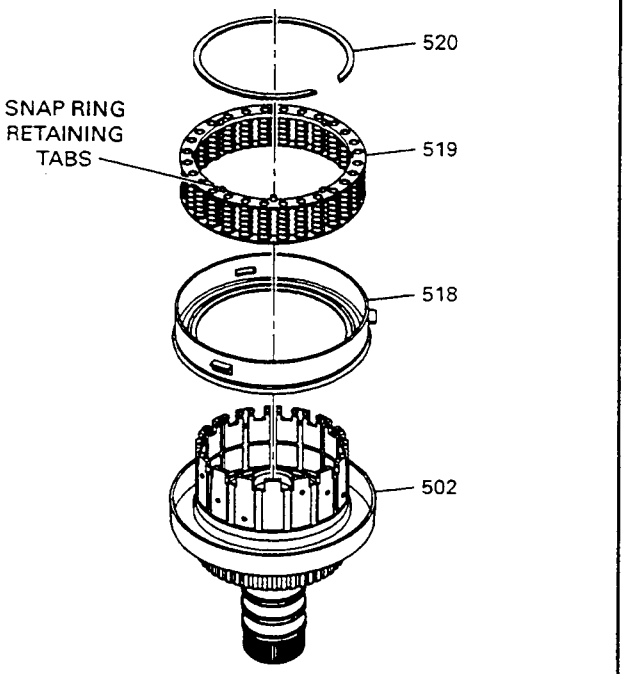
Continued on next Page



502 HOUSING, DIRECT & COAST CLUTCH AND INPUT SHAFT
504 PISTON ASSEMBLY, COAST CLUTCH
505 SPRING, COAST CLUTCH RETURN
506 RETAINER, COAST CLUTCH RETURN SPRING
507 RING, SNAP (COAST CLUTCH SPRING RETAINER)

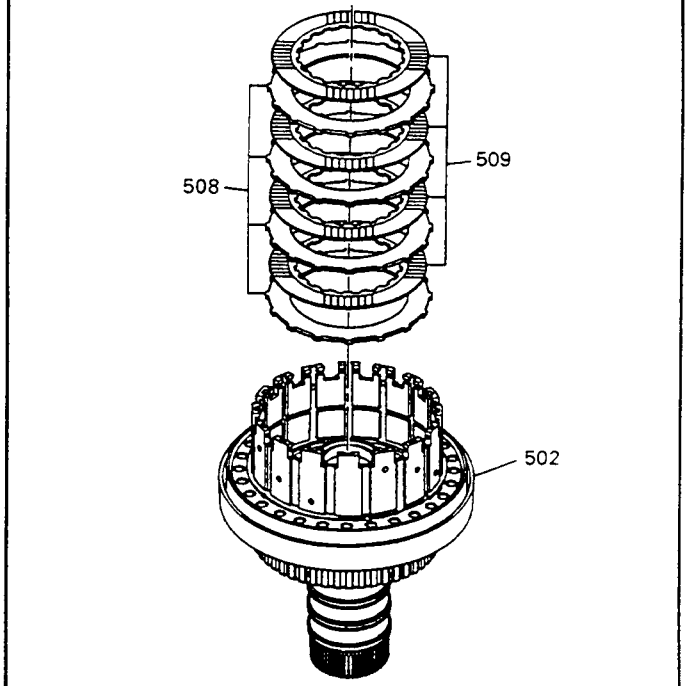
Figure 128

NOTE: All pistons for the clutch packs in this transaxle are stamped steel with the rubber seals molded to the pistons, and reusable if they are not damaged.



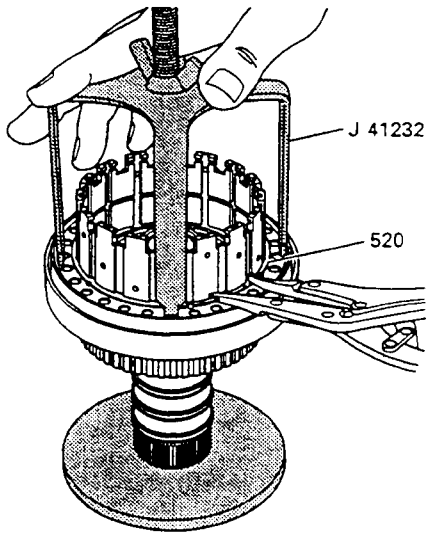
502 HOUSING, DIRECT & COAST CLUTCH AND INPUT SHAFT
518 PISTON ASSEMBLY, DIRECT CLUTCH
519 SPRING AND RETAINER ASSEMBLY, DIRECT CLUTCH
520 RING, DIRECT CLUTCH SPRING RETAINER

Figure 129



502 HOUSING, DIRECT & COAST CLUTCH AND INPUT SHAFT
508 PLATE, COAST CLUTCH (STEEL)
509 PLATE, COAST CLUTCH (FIBER)

Figure 131

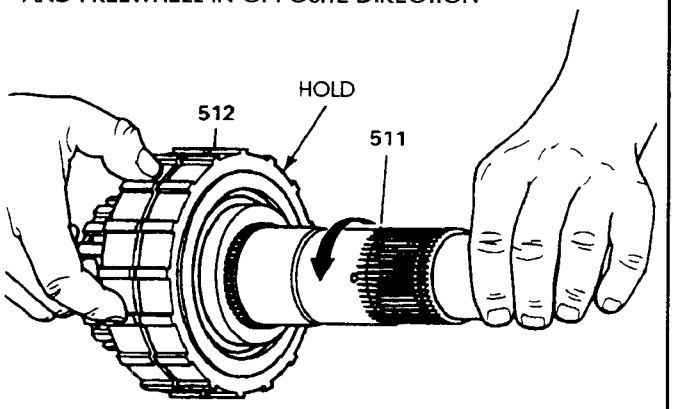


520 RING, DIRECT CLUTCH SPRING RETAINER

Figure 130

Continued from Page 77

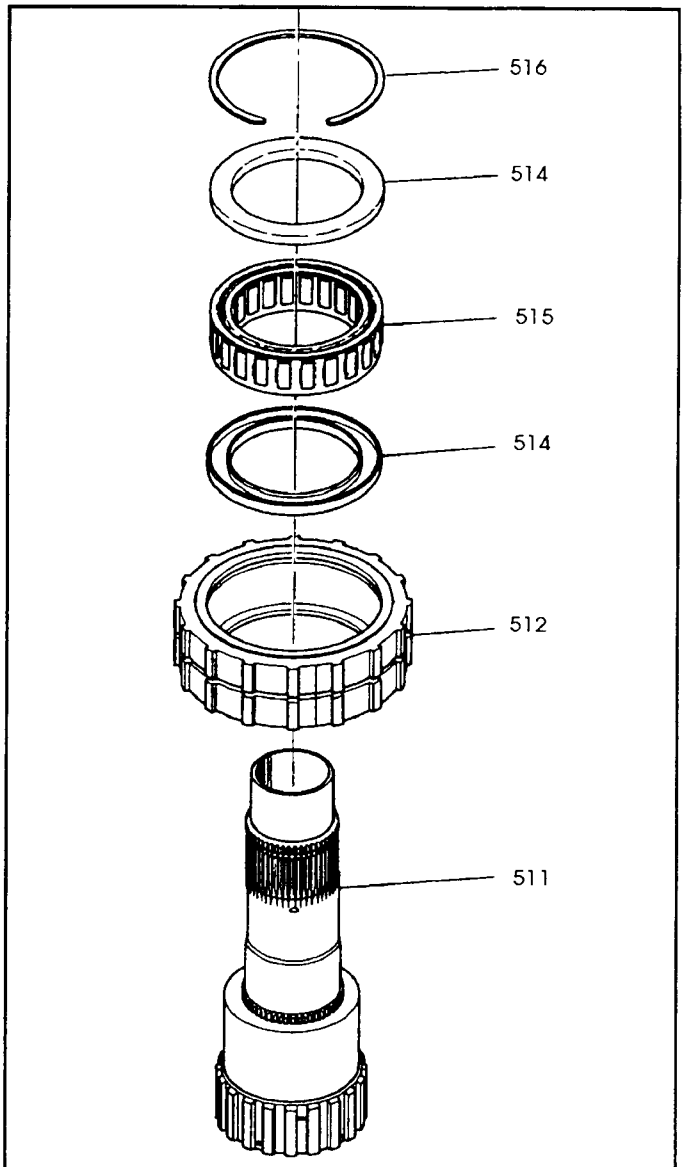
10. Lubricate the inner and outer molded seals on the direct clutch piston with "Trans-Jel".
11. Install direct clutch piston and seal assembly into the input housing in a rotating motion, as shown in Figure 129.
12. Install the direct clutch return spring assembly (519) into the input housing with the snap ring retaining tabs facing up as shown Figure 129.
13. Install spring compressor tool J-41232, shown in Figure 130, and compress the direct clutch return spring assembly.
14. Install the direct clutch snap ring (520), shown in Figure 130, and remove compressor tool.
15. Install the coast clutch plates into the input housing beginning with a steel plate and alternating with lined plates until you have installed four steel and four lined plates, as shown in Figure 131.
    NOTE: The steel plates must be assembled with the splines in the input housing grooves that are machined down to the piston.



511 SHAFT AND INNER RACE ASSEMBLY, INPUT SUN GEAR
512 RACE, OUTER (INPUT SPRAG)

Figure 132

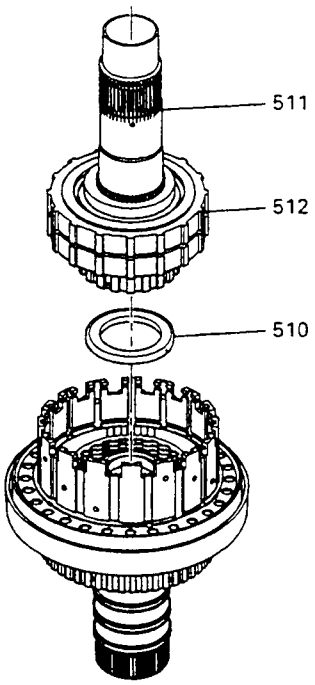
16. Place the input sprag outer race (512) on bench with the flat side down and the end with snap ring groove facing up (See Figure 133).
17. Place one end bearing (514) into the outer race as shown in Figure 133.
18. Install the input sprag assembly (515) into the sprag outer race with the grooved edge up and the flat side down, as shown in Figure 133.
19. Install the other end bearing (514) on top of the input sprag assembly as shown in Figure 133.
20. Install the snap ring (516) into the sprag outer race to retain the input sprag and end bearings as shown in Figure 133.
21. Install the input sprag and outer race assembly onto the input sun shaft (511), with the snap ring side of the assembly facing up, as shown in Figure 133.
22. Rotate the input sun shaft (511) clockwise during assembly to help the installation.
23. NOTE: The flat side of the sprag outer race also functions as the backing plate for the coast clutch.
24. Verify the correct operation of the input sprag by holding the sprag outer race and rotating the input sun shaft, as shown in Figure 132. ***The input sun shaft should rotate only in the clockwise direction (See Figure 132).***



511 SHAFT AND INNER RACE ASSEMBLY, INPUT SUN GEAR
512 RACE, OUTER (INPUT SPRAG)
514 END BEARINGS, INPUT SPRAG (2)
515 SPRAG ASSEMBLY, INPUT
516 RING, SNAP (OUTER RACE TO SPRAG ASSEMBLY)

Figure 133

Continued on next Page



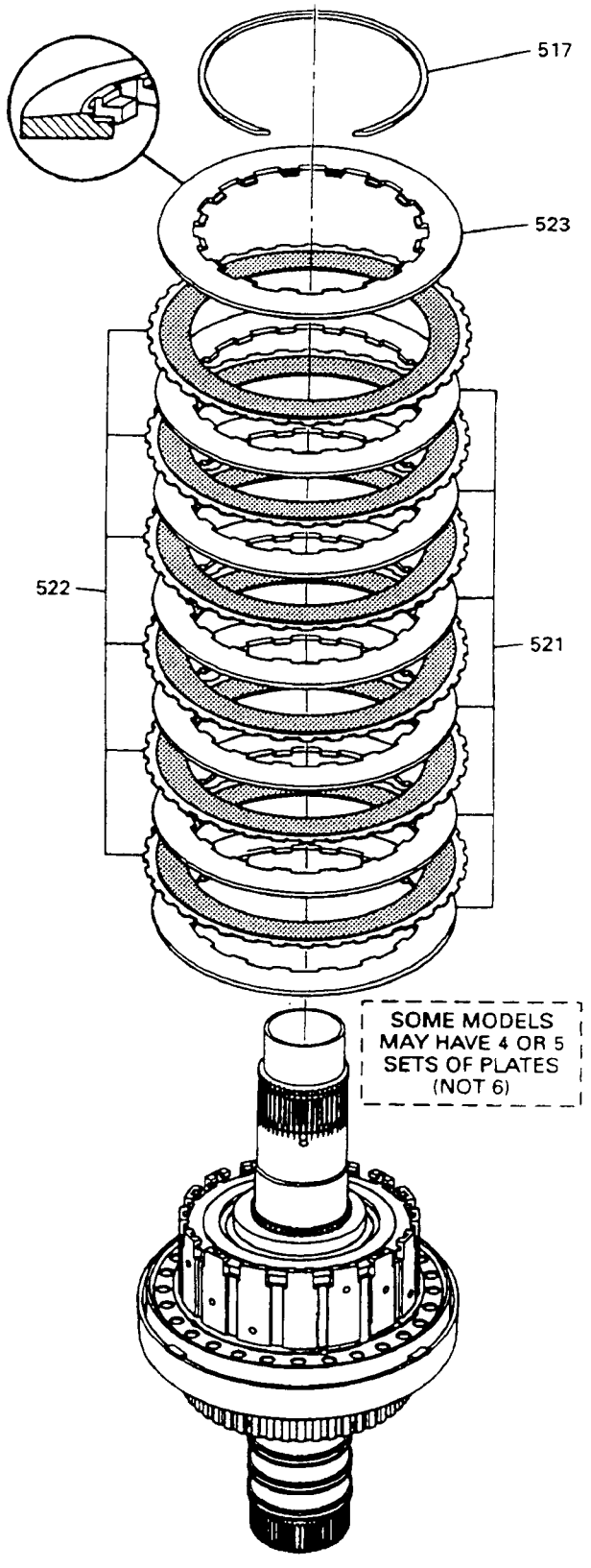
510 BEARING, THRUST
511 SHAFT AND INNER RACE ASSEMBLY, INPUT SUN GEAR
512 RACE, OUTER (INPUT SPRAG)

Figure 134

Continued from Page 79

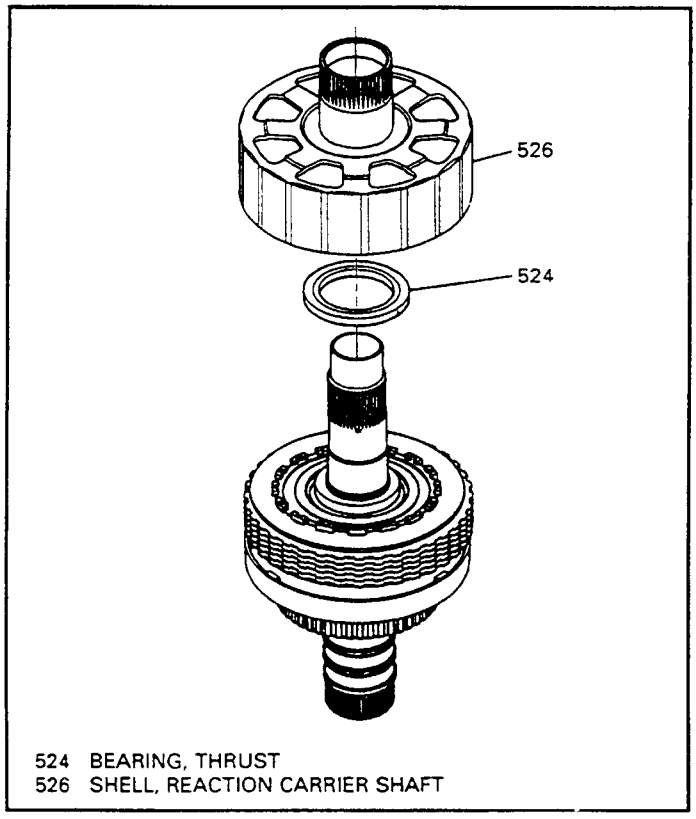
25. Install the thrust bearing (510) on the underside of the input shaft, as shown in Figure 134, and retain with generous amount "Trans-Jel".
26. Install the input shaft and input sprag assembly into the input as shown in Figure 134.
27. The splines on the input sun shaft must engage into the coast clutch lined plates, as shown in Figure 134.
28. Install the direct clutch plates beginning with a steel plate and alternating with lined plates, as shown in Figure 135.
    NOTE: Some models may have 4, 5 or 6 plates depending on model application.
29. Notice that the direct clutch lined plates have external splines, and the steel plates are internal splines (See Figure 135).
30. Install the direct clutch backing plate with the flat side facing down as shown in Figure 135.
31. Install the internal snap ring (517) to retain the input sprag and direct clutch plates as shown in Figure 135.

Continued on Page 81



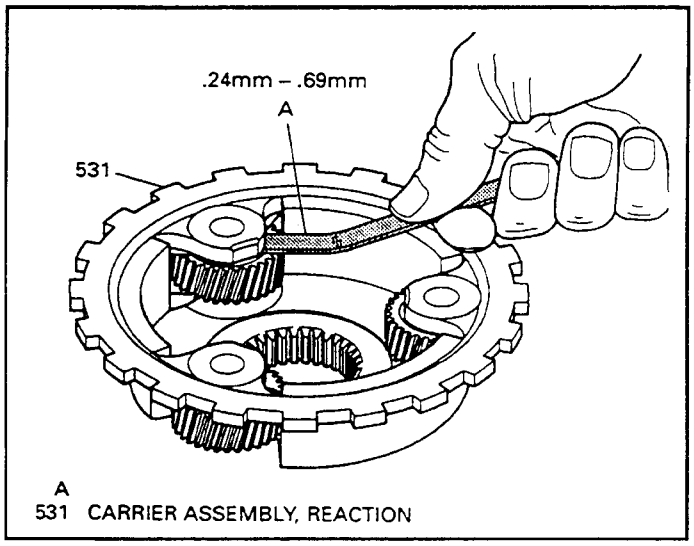
517 RING, SNAP (DIRECT/COAST CLUTCH RETAINING)
521 PLATE, DIRECT CLUTCH STEEL
522 PLATE, DIRECT CLUTCH LINED
523 PLATE, DIRECT CLUTCH BACKING

Figure 135



524 BEARING, THRUST
526 SHELL, REACTION CARRIER SHAFT

Figure 136

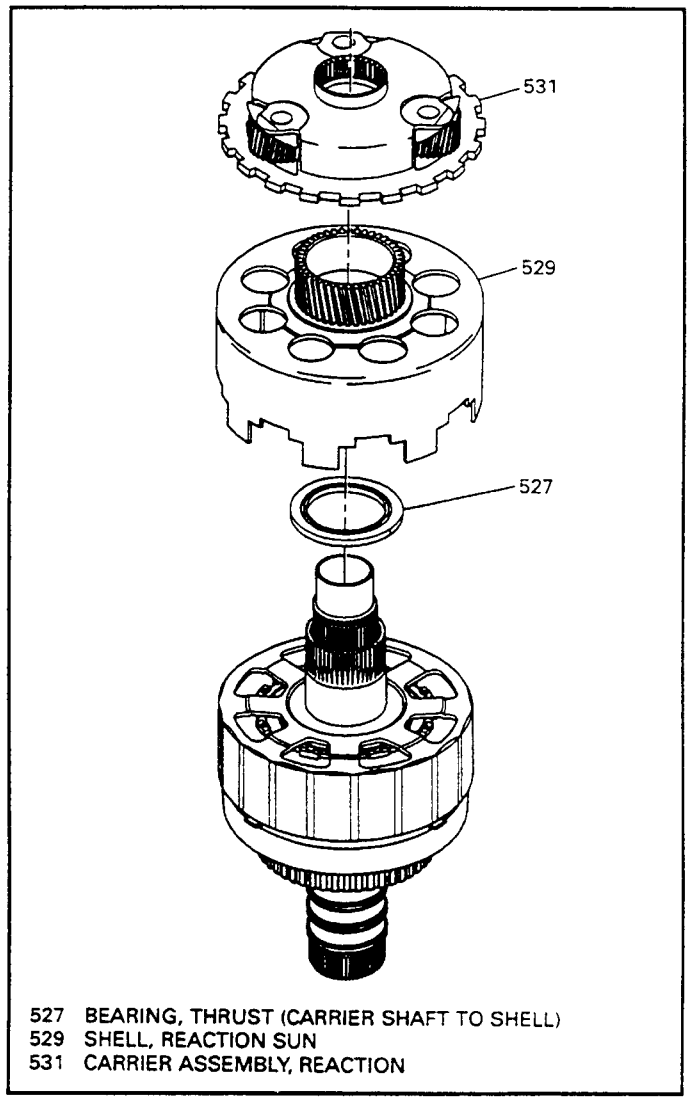


A
531 CARRIER ASSEMBLY, REACTION

Figure 137

Continued from Page 80

32. Install thrust bearing (524) on top of the sprag assembly and retain with "Trans-Jel" as shown in Figure 136.
33. Install the reaction sun shell (526) onto input housing. The splines on inside of the shell must engage on the direct clutch lined plates, shown in Figure 136.

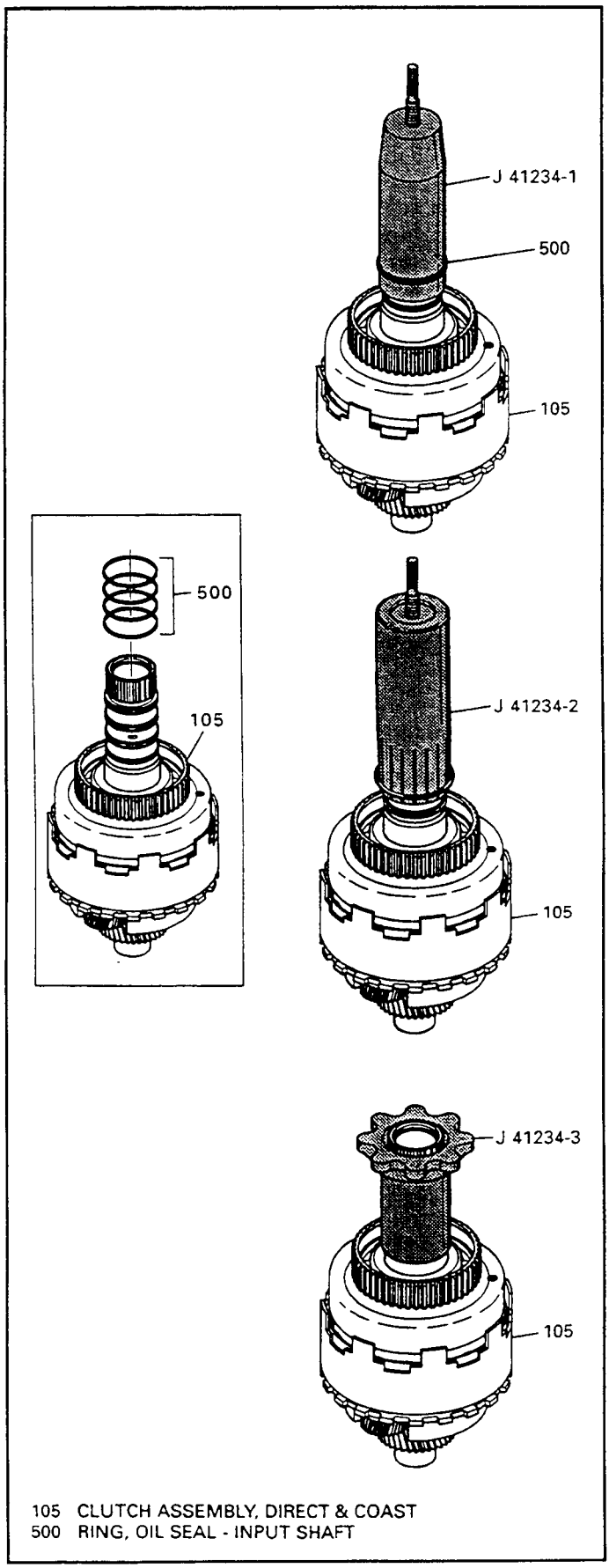


527 BEARING, THRUST (CARRIER SHAFT TO SHELL)
529 SHELL, REACTION SUN
531 CARRIER ASSEMBLY, REACTION

Figure 138

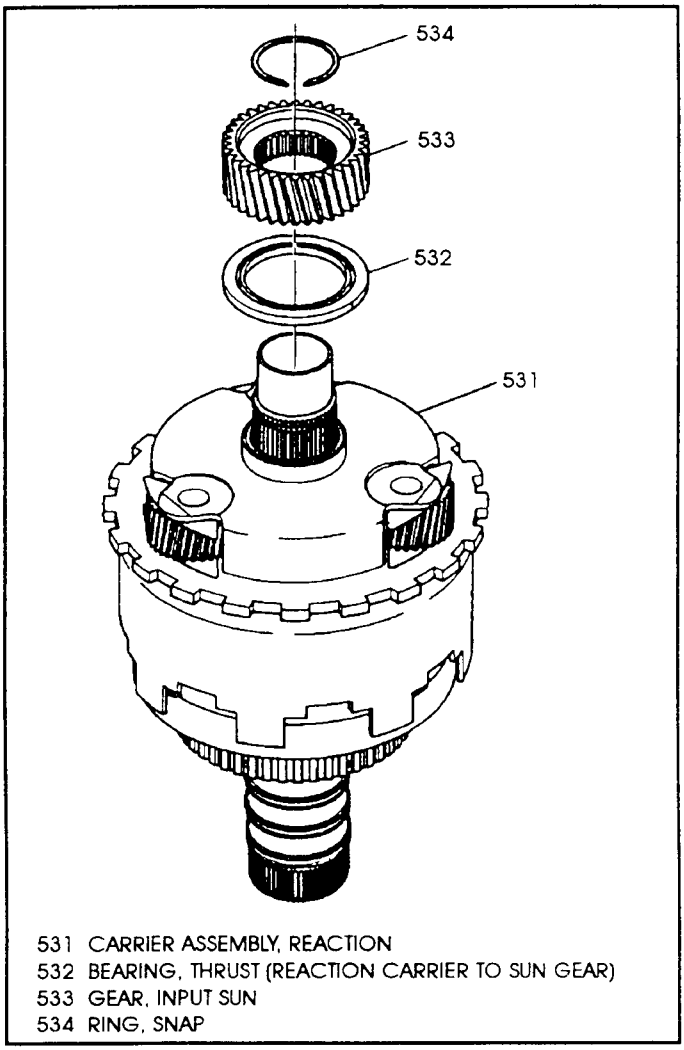
34. Install the thrust bearing (527) onto the top of of the reaction sun shell assembly as shown in Figure 138.
35. Install the reaction sun gear and shell assembly (529) onto the reaction shaft shell, as shown in Figure 138.
36. Measure the reaction carrier pinion gear end play with a feeler gage for proper specification, as shown in Figure 137.
37. End play should be .009"-.027" or .24mm to .69mm, as shown in Figure 137.
    NOTE: Replace the carrier assembly if pinion gear clearance is out of specification. Pinion gears are permanently assembled to the carrier and are not serviced individually.

Continued on next Page



105 CLUTCH ASSEMBLY, DIRECT & COAST
500 RING, OIL SEAL - INPUT SHAFT

Figure 139



531 CARRIER ASSEMBLY, REACTION
532 BEARING, THRUST (REACTION CARRIER TO SUN GEAR)
533 GEAR, INPUT SUN
534 RING, SNAP

Figure 140

Continued from Page 81

38. Install the reaction carrier (531) onto reaction sun gear by rotating the reaction carrier to mesh the sun gear teeth with the pinion gears, until fully seated as shown in Figure 140.
39. Install the reaction carrier to input sun gear bearing (532) on the reaction carrier assembly as shown in Figure 140.
40. Install the input sun gear (533) onto the input sun shaft, as shown in Figure 140.
41. Install the input sun gear snap ring (534) onto the input sun shaft as shown in Figure 140.
42. Install four new solid "Teflon" seals (500) onto the input shaft using tool J-41234, as shown in Figure 139. Begin with the seal closest to the input housing.

DIRECT CLUTCH AND COAST CLUTCH AIR CHECKS

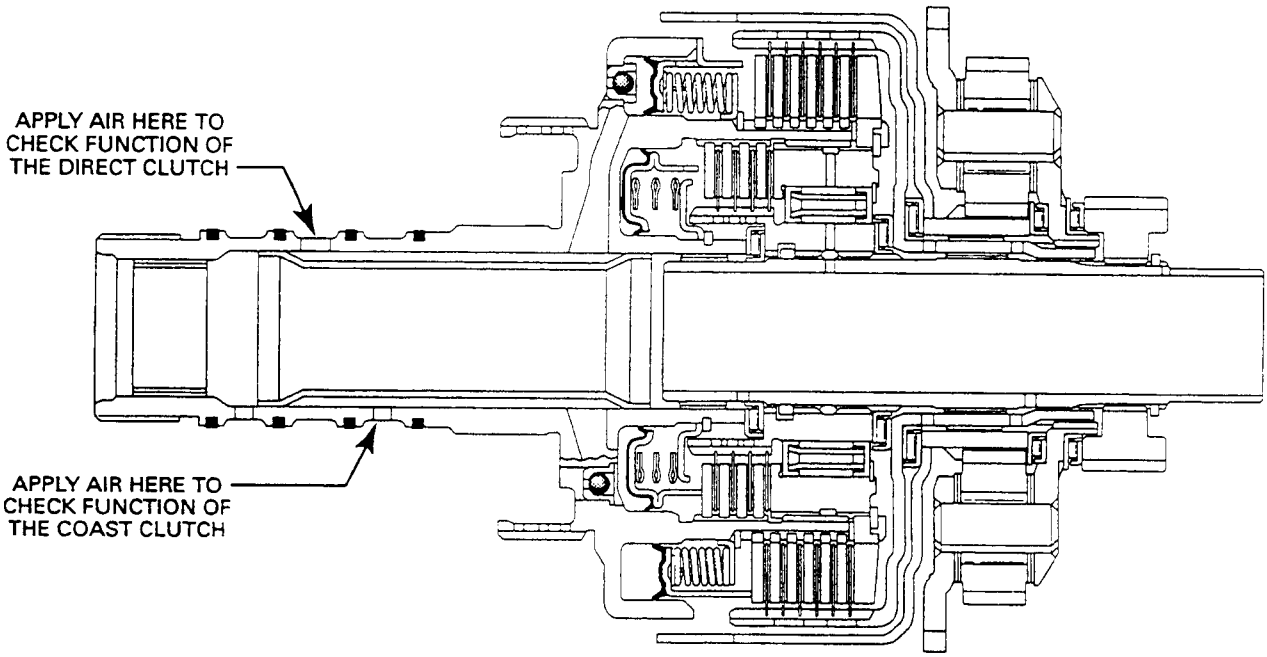


Figure 141

43. Slide tool J-41234-1 over the input shaft and position it at the seal groove closest to the input housing (See Figure 139). Lubricate the tool with small amount of transmission fluid.
44. Guide a new seal onto J-41234-1 and slide it down and into the seal groove with J-41234-2 (See Figure 139).
45. Repeat the procedure for each seal adjusting the J-41234- as necessary for each seal groove.
46. Use tool J-41234-3 to size the seals, as shown in Figure 139.
    Leave the sizer in place for at least 5 minutes before installing into the transaxle.
47. Air check the direct clutch and coast clutch to verify proper operation of the seals and clutch assemblies as shown in Figure 141.
48. Install the direct/coast clutch & reaction carrier assembly (105) into the transaxle, as shown in Figure 142, by rotating into position.

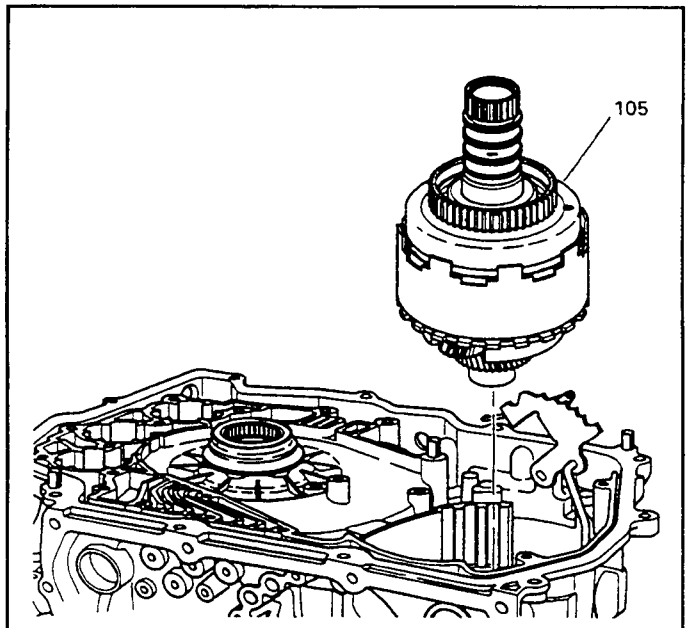
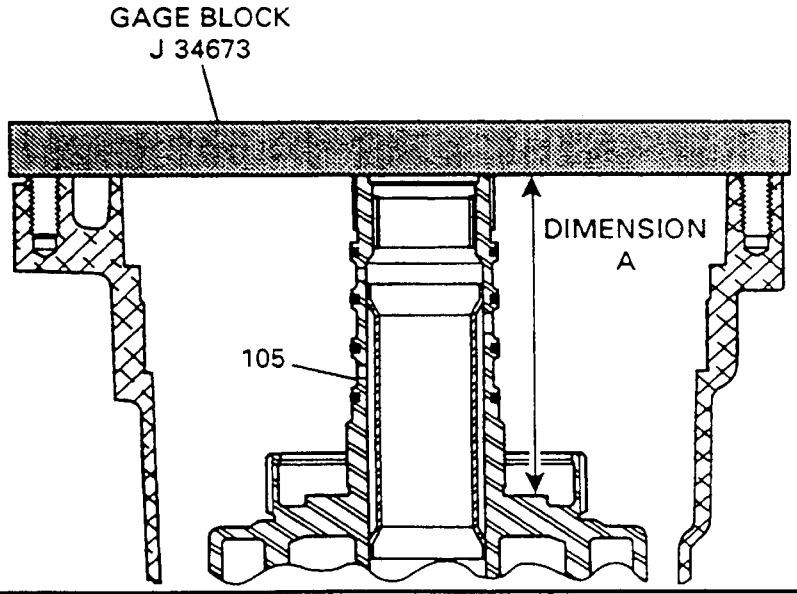


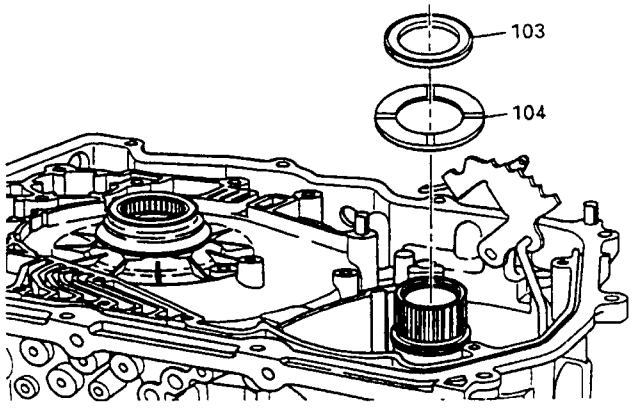
Figure 142

SELECTIVE WASHER MEASUREMENT AND CHART



DIMENSION "A" INCH	DIMENSION "A" MILLIMETER	WASHER COLOR I.D.	WASHER DIMENSION INCH	WASHER DIMENSION MILLIMETER
3.952" - 3.964"	100.40 - 100.70	BROWN	.059" - .062"	1.50 - 1.60
3.965" - 3.976"	100.70 - 100.99	GREY	.070" - .074"	1.80 - 1.90
3.977" - 3.987"	100.99 - 101.29	NATURAL	.082" - .086"	2.09 - 2.19
3.988" - 3.998"	101.29 - 101.59	BLACK	.094" - .098"	2.39 - 2.49
3.999" - 4.010"	101.59 - 101.88	ORANGE	.105" - .109"	2.68 - 2.78
4.011" - 4.021"	101.88 - 102.18	VIOLET	.117" - .121"	2.98 - 3.08
4.022" - 4.033"	102.18 - 102.48	YELLOW	.129" - .133"	3.28 - 3.38
4.034" - 4.045"	102.48 - 102.77	RED	.140" - .144"	3.57 - 3.67
4.046" - 4.057"	102.77 - 103.07	GREEN	.152" - .156"	3.87 - 3.97

Figure 143



103 BEARING, THRUST
104 WASHER, THRUST (SELECTIVE)

Figure 144

SELECTIVE WASHER MEASUREMENT

1. Place gage block J-34673 across the machined surface of the case as shown in Figure 143.
2. Measure the distance between the top of the direct/coast clutch housing and the machined surface of the case (Dimension "A").
   NOTE: If measured with a depth micrometer from the top of the gage block, the thickness of the gage block must be subtracted for the correct Dimension "A".
3. Note the measurement of Dimension "A" and choose the correct selective washer from the chart in Figure 143.
4. Install the correct selective washer (104) onto the top of the input housing with the tab on the thrust washer in recessed area of housing. (See Figure 144).

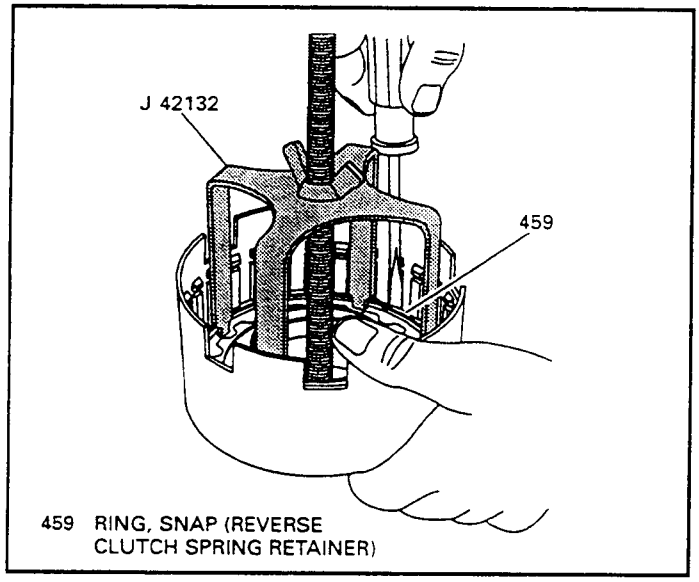


Figure 145

Continued from Page 84

5. Install the thrust bearing (103) over the input shaft and on top of the selective thrust washer as shown in Figure 144.

REVERSE INPUT CLUTCH AND 2ND ROLLER CLUTCH ASSEMBLY

1. ***NOTE: All pistons for the clutch packs in this transaxle are stamped steel with the rubber seals molded to the pistons, and reusable if they are not damaged.***
2. Inspect reverse input clutch inner seal assembly (456) for any damage (See Figure 146).
3. If the seal is damaged, remove the seal using removal tools J-25031-A and J-41907, shown in Figure 146.
4. Press a new inner seal assembly onto reverse input housing inner hub using an arbor press and tool J-41233 (See Figure 146).
5. Lubricate the new inner seal with "Trans-Jel".
6. Lubricate both seal surfaces with "Trans-Jel", and install the reverse input clutch piston into reverse input housing with a twisting motion (See Figure 146).
7. Install the reverse input clutch return spring assembly (458) on top of piston with smaller outside diameter down (See Figure 146).

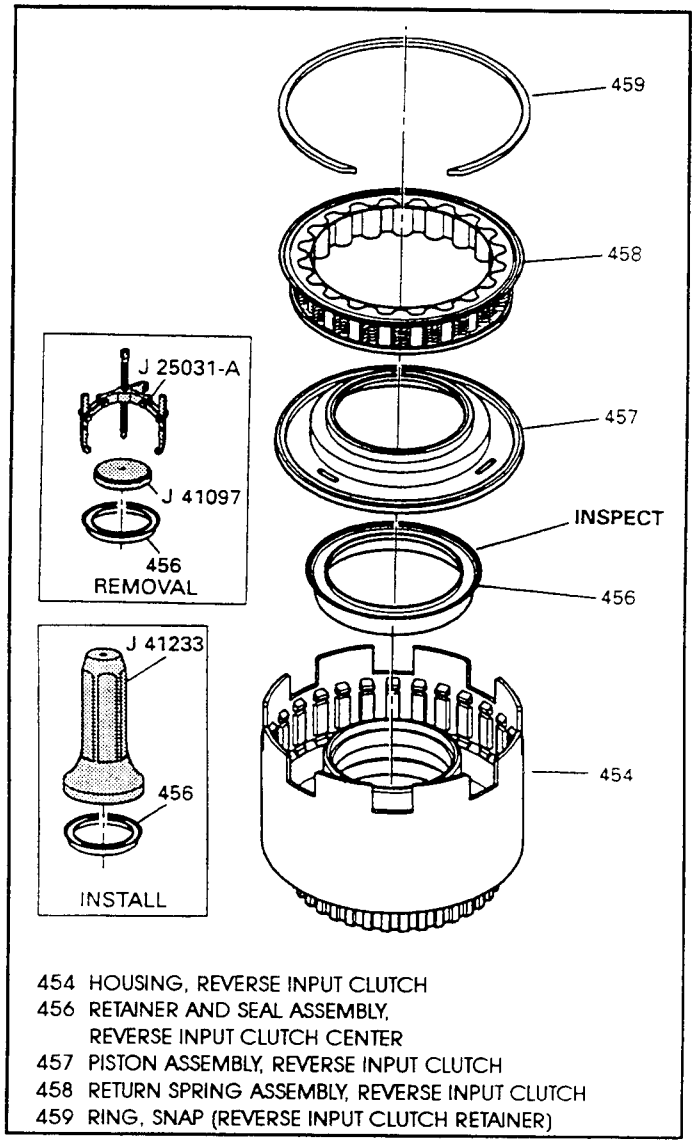


Figure 146

8. Install spring compressor tool and compress the return spring as shown in Figure 145.
9. Install the reverse input clutch return spring snap ring into groove using a screwdriver as shown in Figure 145.
10. Remove the spring compressor tool.

Continued on next Page

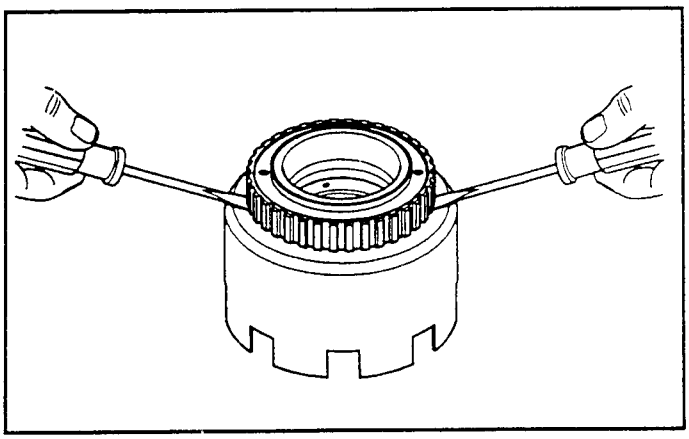
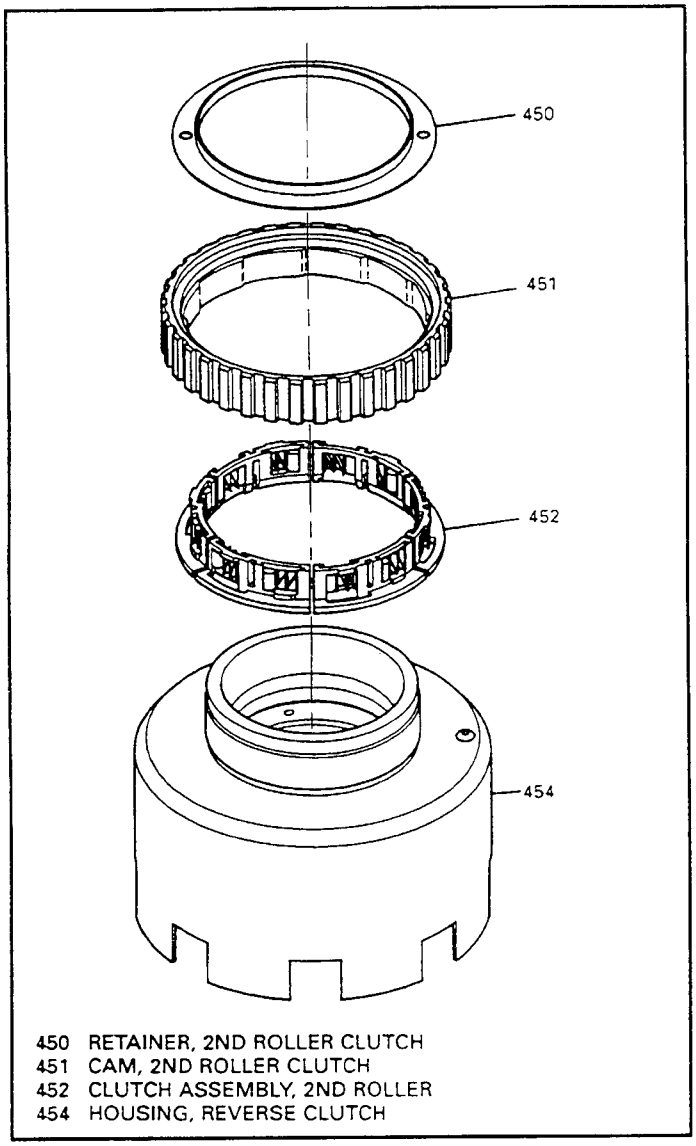
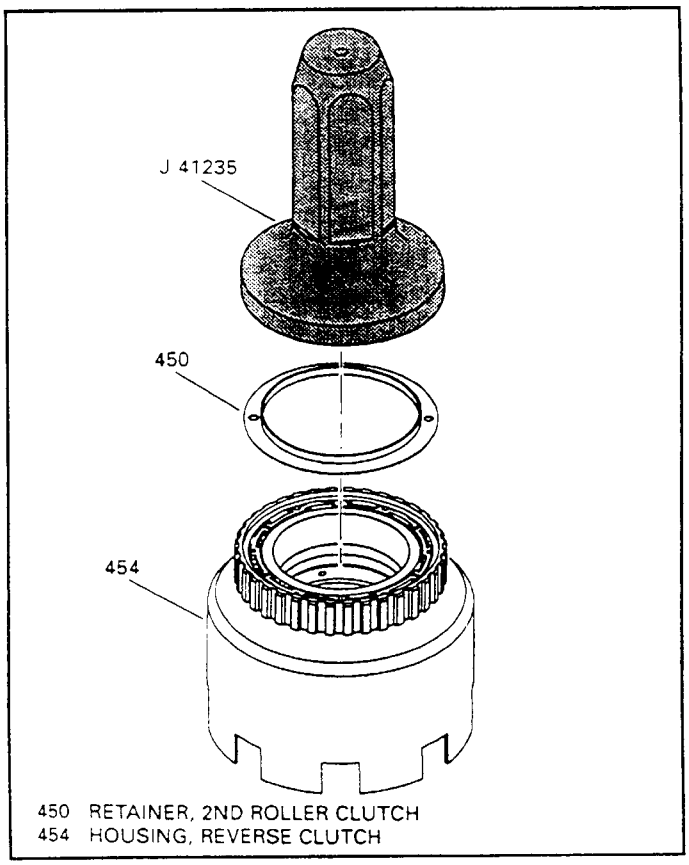


Figure 147



450 RETAINER, 2ND ROLLER CLUTCH
451 CAM, 2ND ROLLER CLUTCH
452 CLUTCH ASSEMBLY, 2ND ROLLER
454 HOUSING, REVERSE CLUTCH

Figure 148



450 RETAINER, 2ND ROLLER CLUTCH
454 HOUSING, REVERSE CLUTCH

Figure 149

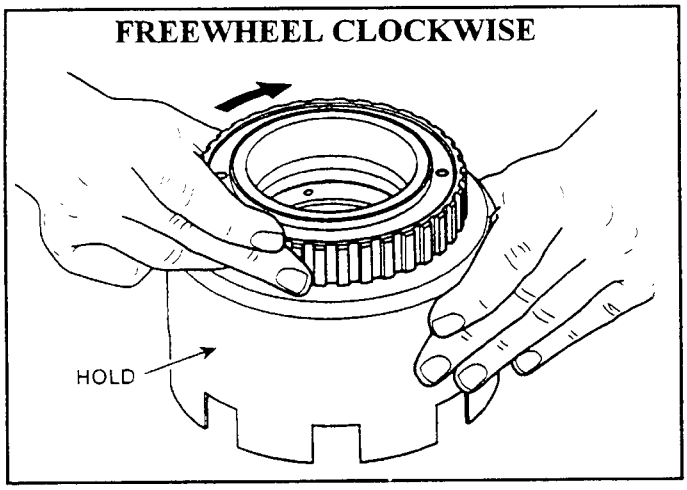
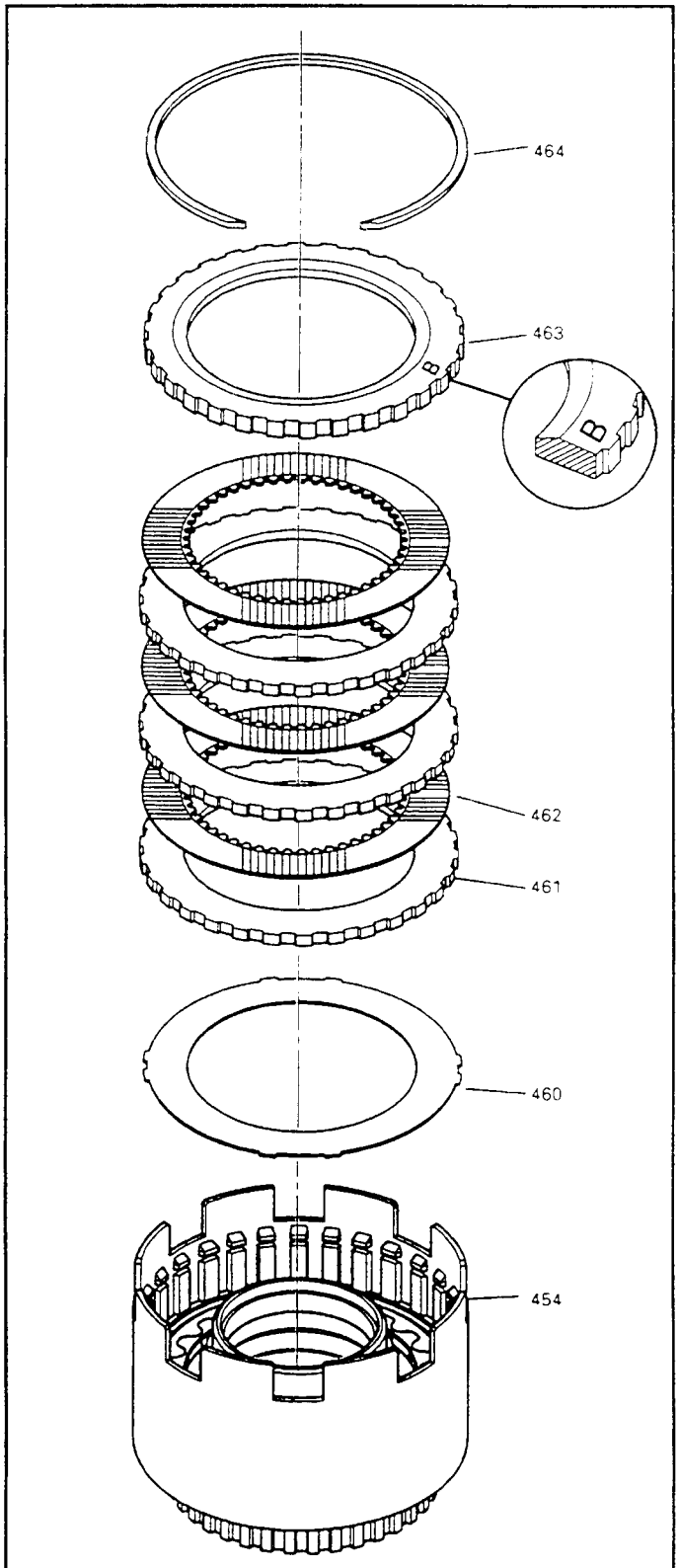


Figure 150

Continued from Page 85

11. Remove the 2nd roller clutch assembly retainer (450) by prying up on the roller clutch outer race with two large screwdrivers, as shown in Figure 147. The 2nd roller clutch retainer is pressed onto the reverse input clutch housing, ***and is not reusable after being removed.***

12. ***NOTE: Be careful when removing the second roller clutch, not to score roller clutch inner race with the screwdrivers.***
13. Inspect and replace parts as necessary as shown in Figure 148.
14. Install the 2nd roller clutch assembly (452) into the roller clutch cam (451) (See Figure 148).
15. Install the 2nd roller clutch assembly onto the reverse input housing with the flat side of the roller clutch cam facing down toward housing. Rotate the roller clutch clockwise to properly engage the rollers (See Figure 148).
16. Verify the proper operation of the roller clutch. While holding the reverse input housing, roller clutch cam should only freewheel clockwise, as shown in Figure 150.
17. Install a new 2nd roller clutch retainer (450) on the housing, using tool J-41235 to press the retainer into place.
    NOTE: Tool J-41235 is designed to press the roller clutch assembly to a specified depth. If the 2nd roller clutch is installed too far down onto the inner race, damage may occur.
18. Install the reverse input clutch wave plate into the housing as shown in Figure 151.
19. Install the reverse input clutch plates beginning with a steel plate on top of the wave plate, and alternating with lined plates, until you have installed 3 steel plates and 3 lined plates, as shown in Figure 151.
20. Measure the distance between the top of the snap ring groove and the top friction plate, as shown in Figure 152 (Dimension "A").
    Use Dimension "A" to select the appropriate backing plate from the chart in Figure 152.
21. The backing plate identification is stamped into the beveled side of the backing plate as shown in Figure 151.
22. Install the proper reverse input backing plate, with the beveled side facing up, as shown in Figure 151.
23. Install the snap ring (464) in the reverse input housing to retain the clutch plates as shown in Figure 151.
24. Air check the reverse input clutch housing, as shown in Figure 152, to verify proper operation of the seals and clutch assembly.

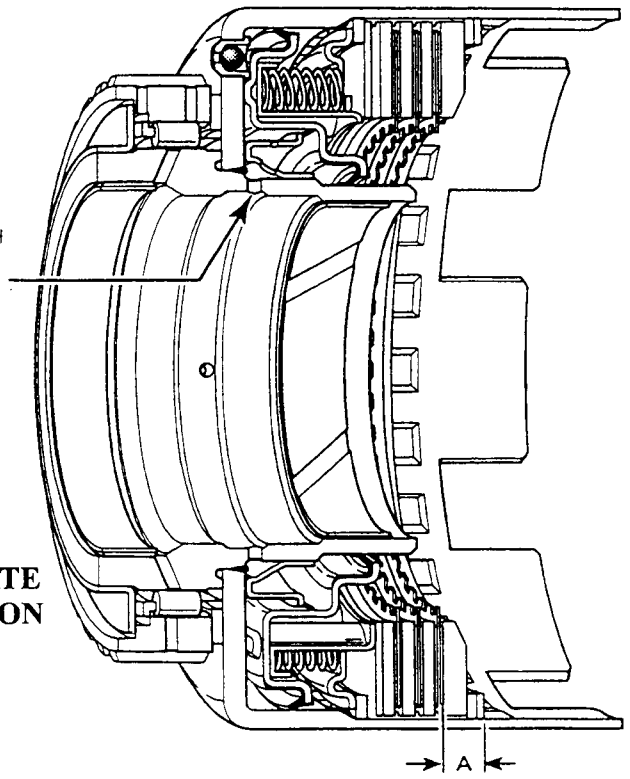


454 HOUSING, REVERSE CLUTCH
460 PLATE, REVERSE CLUTCH (WAVED)
461 PLATE, REVERSE CLUTCH (STEEL)
462 PLATE, REVERSE CLUTCH (FIBER)
463 PLATE, REVERSE CLUTCH (BACKING)
464 RING, SNAP (REVERSE CLUTCH)

Figure 151

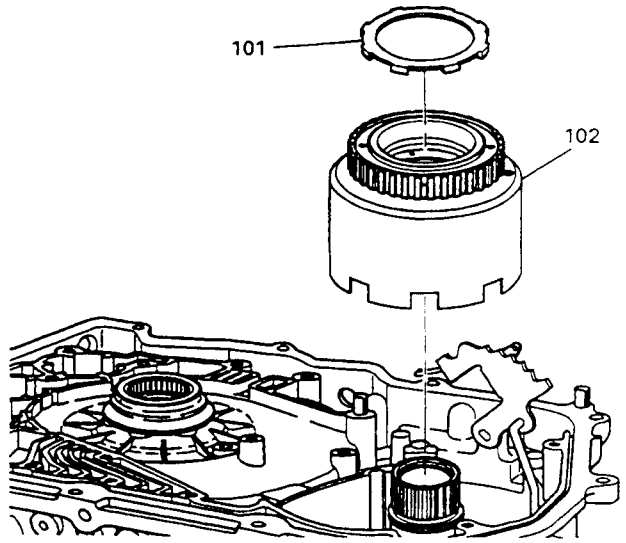
REVERSE INPUT SELECTIVE BACKING PLATE

APPLY 40 PSI AIR HERE TO CHECK FUNCTION OF THE REVERSE INPUT CLUTCH



DIMENSION "A"		BACKING PLATE IDENTIFICATION
INCH	MILLIMETER	
.353" - .371"	8.970 - 9.433	A
.372" - .393"	9.434 - 10.007	B
.394" - .412"	10.008 - 10.470	C

Figure 152



101 WASHER, THRUST (SUPPORT TO REVERSE INPUT CLUTCH)
102 CLUTCH ASSEMBLY, REVERSE INPUT

Figure 153

Continued from Page 87

25. Install the reverse input housing and 2nd roller clutch assembly (102) into the transaxle case as shown in Figure 153.
26. The tangs on the reverse input housing spline to the tangs on the reaction carrier sun gear and shell assembly. Rotate the reverse input clutch housing to align the clutch plates until it's fully seated.
27. Install the reverse input clutch thrust washer (101) onto the top of the 2nd roller clutch with the tabs facing down, as shown in Figure 153, and retain with "Trans-Jel".
28. Install a new intermediate/4th band (100) into the transaxle case as shown in Figure 154.
29. Verify the proper positioning of the band by inserting a screwdriver through the servo bore as shown in Figure 155.
30. The screwdriver should press on the servo pin target area and compress the band around the reverse input clutch housing (See Figure 155).

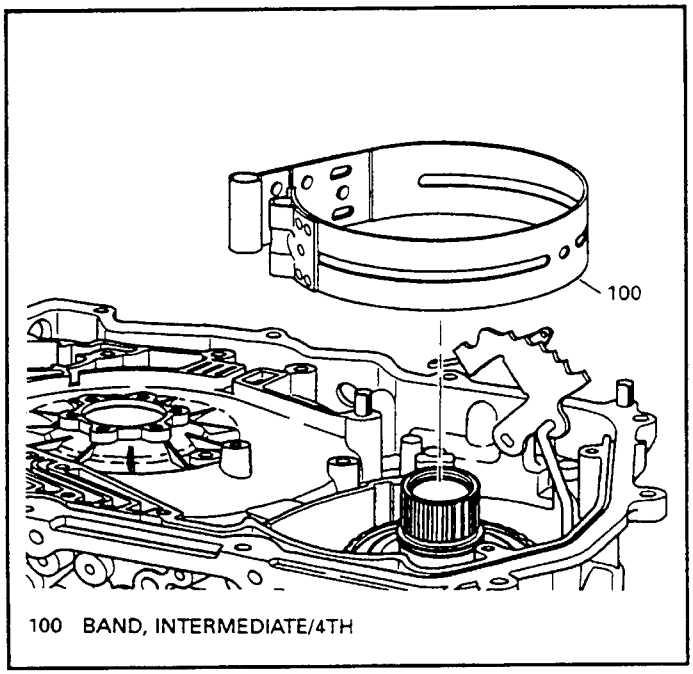


Figure 154

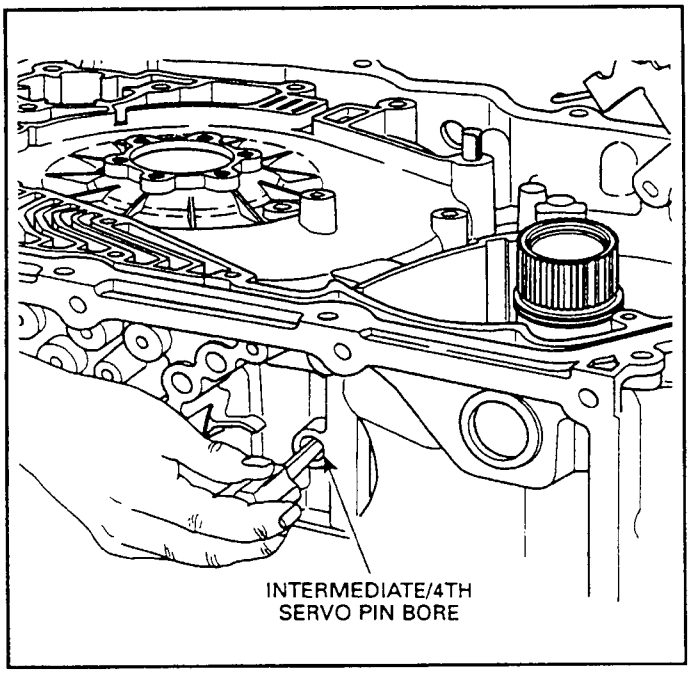


Figure 155

31. Install the 2nd clutch backing plate (99) into the transaxle case with the flat side facing up and the beveled side facing down as shown in Figure 156.
32. Install the three steel plates (97) and three new lined plates (98), beginning with a lined plate against the backing plate and alternating with steel plates, as shown in Figure 156.
33. Install the 2nd clutch wave plate (96) on top of the last steel plate as shown in Figure 156.

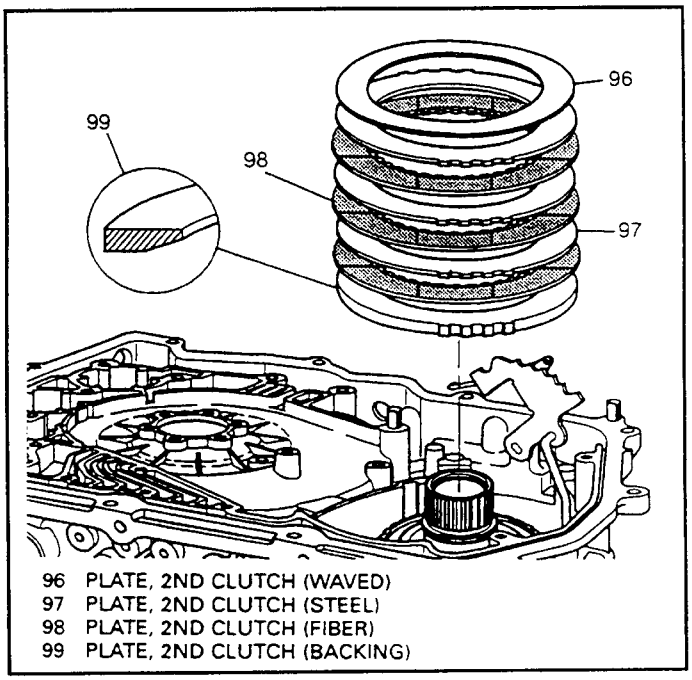
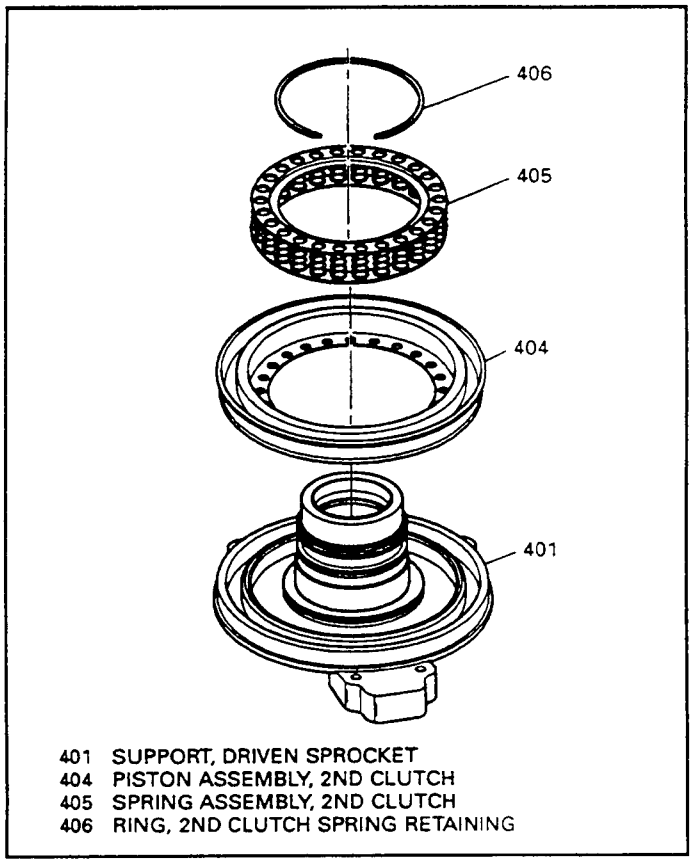
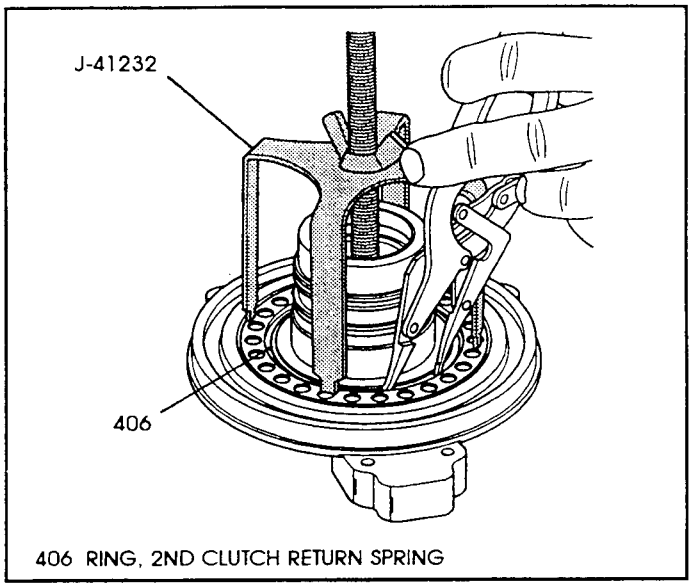


Figure 156



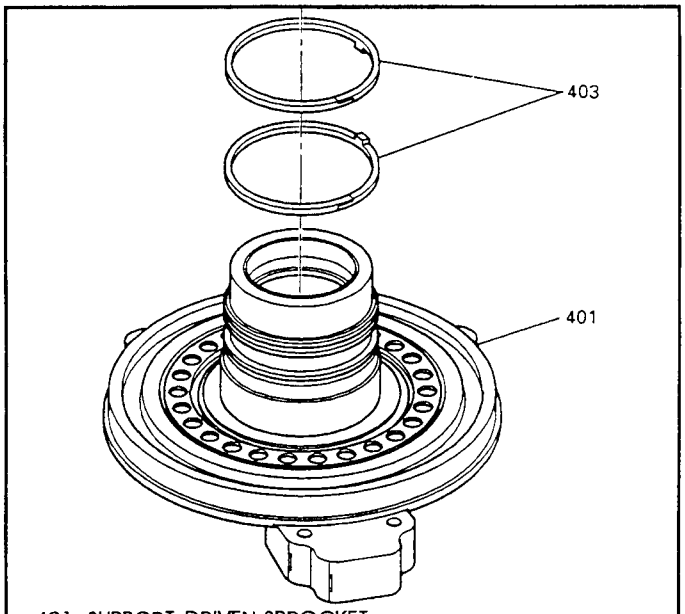
401 SUPPORT, DRIVEN SPROCKET
404 PISTON ASSEMBLY, 2ND CLUTCH
405 SPRING ASSEMBLY, 2ND CLUTCH
406 RING, 2ND CLUTCH SPRING RETAINING

Figure 157



406 RING, 2ND CLUTCH RETURN SPRING

Figure 158



401 SUPPORT, DRIVEN SPROCKET
403 RING, OIL SEAL

Figure 159

DRIVEN SPROCKET SUPPORT ASSEMBLY

1. ***NOTE: All pistons for the clutch packs in this transaxle are stamped steel with the rubber seals molded to the pistons, and reusable if they are not damaged.***
2. Inspect the 2nd clutch piston assembly for any damage and replace as necessary.
3. Lubricate the inner and outer molded seals on the 2nd clutch piston with "Trans-Jel".
4. Install the 2nd clutch piston (404) into driven sprocket support with a twisting motion, as shown in Figure 157.
5. Install the 2nd clutch return spring assembly (405) with inside step facing up, as shown in Figure 157.
6. Install compressor tool J-41232 on the driven sprocket support, as shown in Figure 158, and compress the return spring.
7. Install the 2nd clutch snap ring (406) as shown in Figure 158, and remove compressor tool after snap ring is installed.
8. Install two new sealing rings (403) onto driven sprocket support as shown in Figure 159.
9. Air check the 2nd clutch to verify proper operation of the seals, as shown in Figure 160. ***CAUTION: Use only about 30 PSI of air pressure to prevent damage and/or injury.***

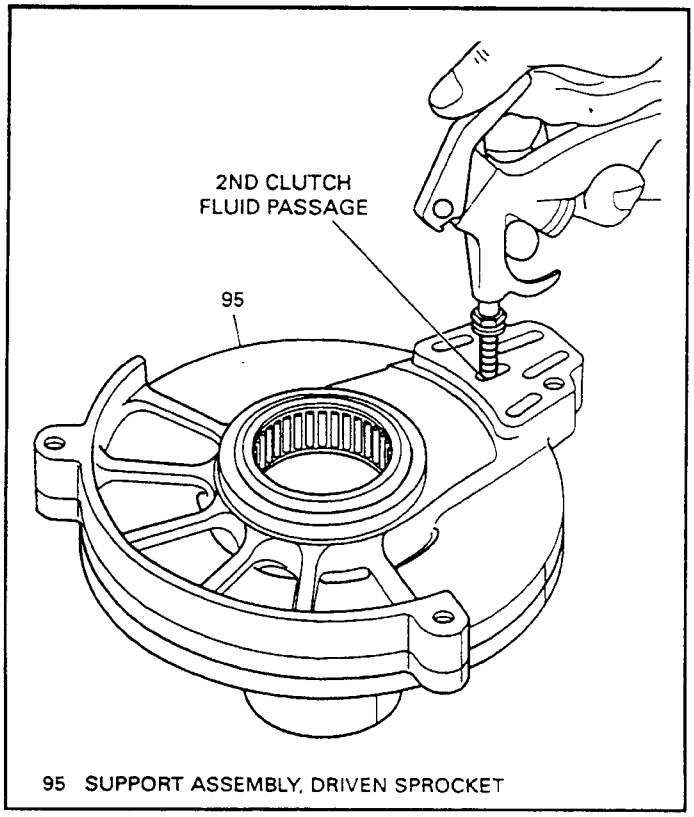


Figure 160

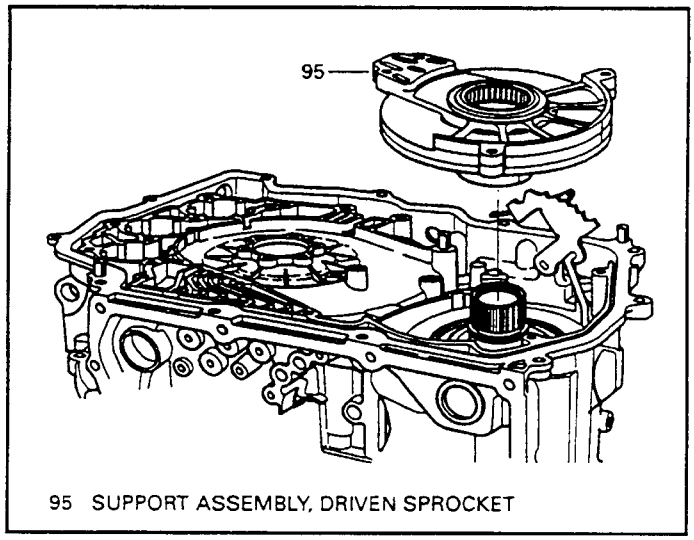


Figure 161

10. Install the completed driven sprocket support into the transaxle case as shown in Figure 161.
11. When installed properly and the right selective thrust washer has been chosen, the driven sprocket support will sit .006" - .012" below the machined surface of the transaxle case.

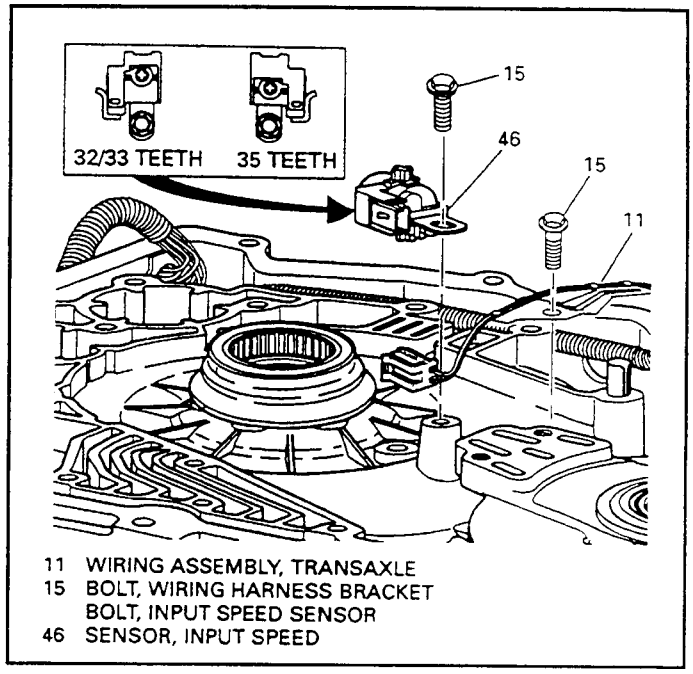
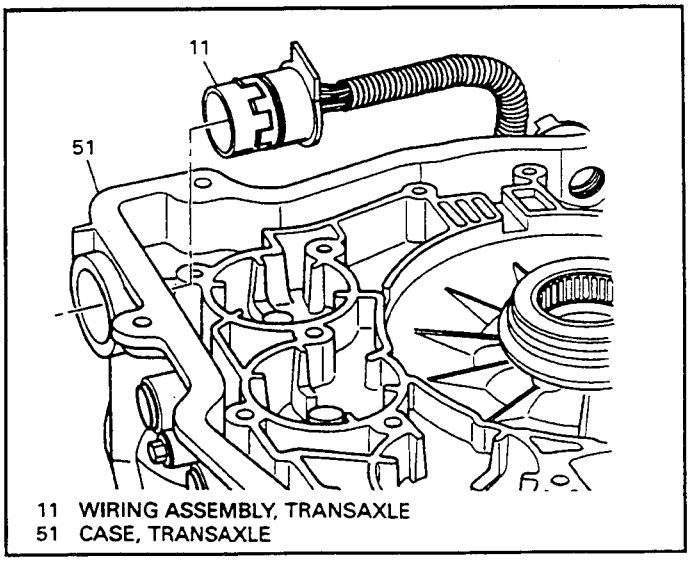


Figure 162

INPUT SPEED SENSOR AND WIRING HARNESS ASSEMBLY

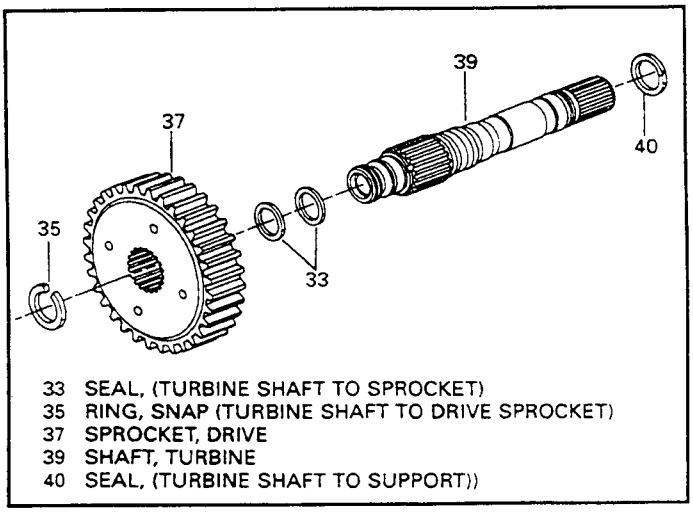
1. Install the input speed sensor (46) in transaxle case. The tab on the input speed sensor housing fits into the recess on the case boss, as shown in Figure 162.
   IMPORTANT: Orientation of the input speed sensor depends on the number of teeth on the drive sprocket, which varies depending on model application. Drive sprockets with 32 or 33 teeth have the speed sensor connector facing the bottom pan as shown in Figure 162. Drive sprockets with 35 teeth have the speed sensor connector facing the fluid fill cap.
2. Install the input speed sensor in the proper direction for your model, install the retaining bolt, and torque to 9 ft.lb (See Figure 162).
3. Inspect the wiring harness (11) for damage. Also inspect the case connector pins for any damage and/or bent pins.

Continued on next Page



11 WIRING ASSEMBLY, TRANSAXLE
51 CASE, TRANSAXLE

Figure 163

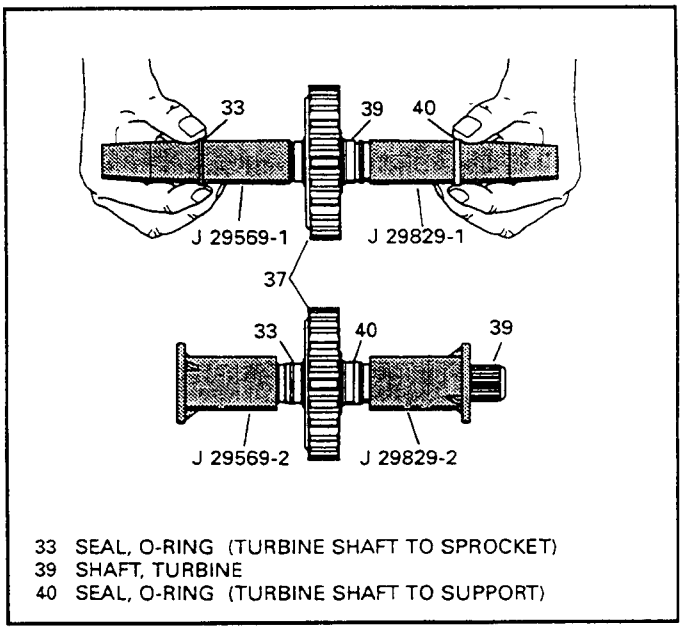


33 SEAL, (TURBINE SHAFT TO SPROCKET)
35 RING, SNAP (TURBINE SHAFT TO DRIVE SPROCKET)
37 SPROCKET, DRIVE
39 SHAFT, TURBINE
40 SEAL, (TURBINE SHAFT TO SUPPORT))

Figure 164

Continued from Page 91

4. Install a new "O" ring on the case connector and lube with small amount of "Trans-Jel".
5. Install the case connector and wiring harness assembly into the transaxle case bore from the inside of transaxle case (See Figure 163).
6. Route the input speed sensor wiring harness in the transaxle case channel.
7. Install the wire harness retainer to the case with wire harness retainer bolt, and torque to 9 ft.lb. (See Figure 162).
8. Connect the input speed sensor connector to the input speed sensor (See Figure 162).

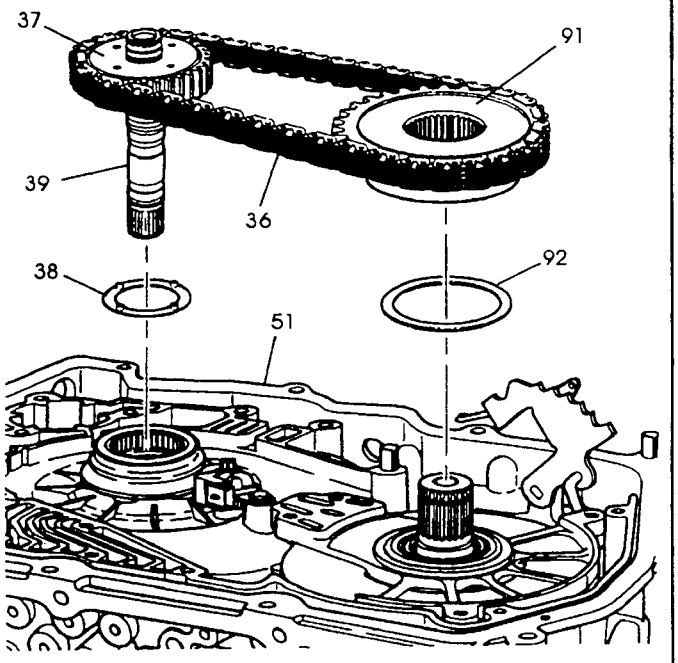


33 SEAL, O-RING (TURBINE SHAFT TO SPROCKET)
39 SHAFT, TURBINE
40 SEAL, O-RING (TURBINE SHAFT TO SUPPORT)

Figure 165

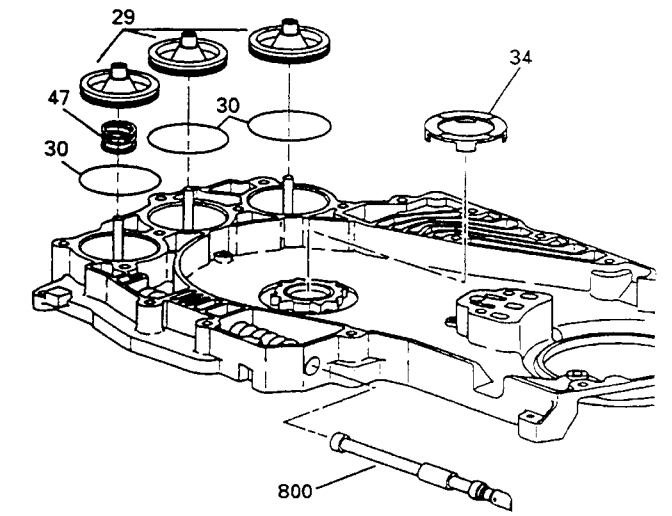
DRIVE AND DRIVEN SPROCKETS AND DRIVE CHAIN ASSEMBLY

1. Remove the drive sprocket from the turbine shaft and inspect the spline area on both, as shown in Figure 164.
2. Remove and discard the three solid sealing rings from the turbine shaft (See Figure 164).
3. Install three new sealing rings onto the turbine shaft using the installation and resizing tools shown in Figure 165.
4. Install the drive sprocket onto the turbine shaft and install the snap ring as shown Figure 164.
5. Install the drive sprocket to drive sprocket support thrust washer (38) into drive sprocket with the tabs on the thrust washer in the holes of the drive sprocket and retain with a small amount of "Trans-Jel" (See Figure 166).
6. Install the driven sprocket to driven sprocket support thrust washer (92) onto the driven sprocket support and retain with "Trans-Jel". (See Figure 166).
7. Assemble the drive chain assembly to the drive and driven sprockets with the chain oriented in the same direction it was removed.
8. Install the drive sprocket, driven sprocket and chain assembly into the transaxle as a complete assembly, as shown in Figure 166.



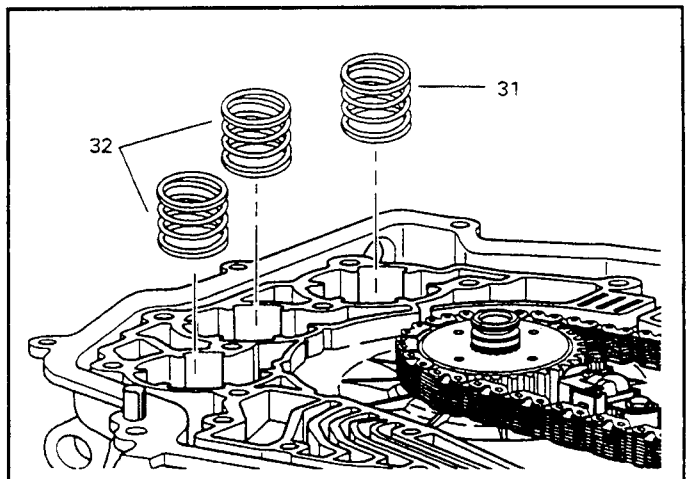
36 CHAIN ASSEMBLY, DRIVE
37 SPROCKET, DRIVE
38 WASHER, THRUST (DRIVE SPROCKET TO SUPPORT)
39 SHAFT, TURBINE
51 CASE, TRANSAXLE
91 SPROCKET, DRIVEN
92 WASHER, THRUST (DRIVEN SPROCKET TO SUPPORT)

Figure 166



29 PISTON, ACCUMULATOR (1-2, 2-3 AND 3-4)
30 SEAL, ACCUMULATOR PISTON (1-2, 2-3 AND 3-4)
34 WASHER, THRUST (CHANNEL PLATE TO DRIVE SPROCKET)
800 VALVE, MANUAL

Figure 167



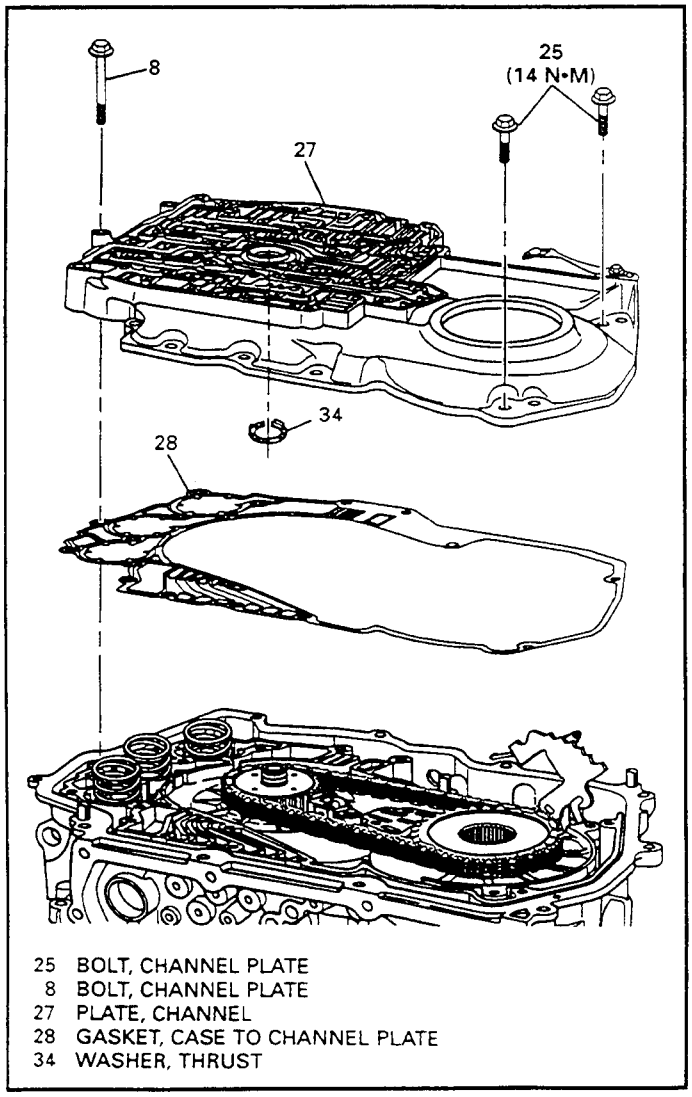
31 SPRING, 1-2 ACCUMULATOR PISTON
32 SPRING, 2-3 AND 3-4 ACCUMULATOR PISTON

Figure 168

CHANNEL PLATE ASSEMBLY

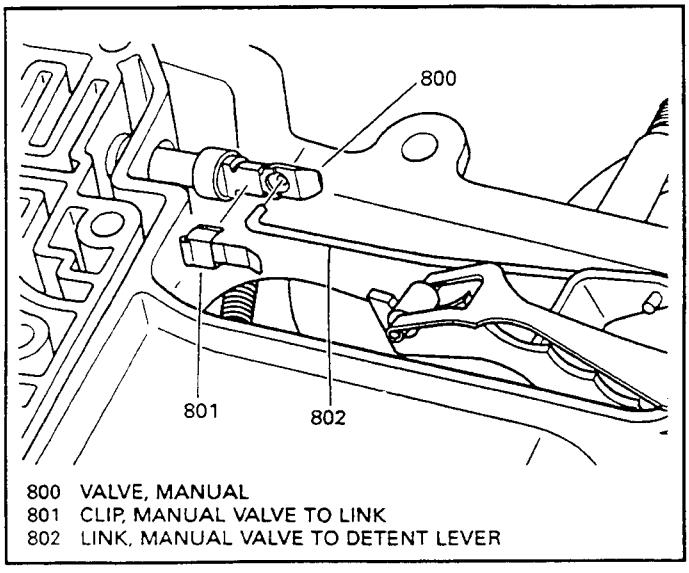
1. Install new seals on the 3 plastic accumulator pistons as shown in Figure 167.
2. The accumulator pins are pressed into channel plate and should not be removed.
3. Install the 1-2 accumulator assist spring in the location shown in Figure 167.
4. Install the accumulator pistons into the channel plate over the accumulator pins, as shown in Figure 167.
   NOTE: The accumulator pistons are identical and can be installed in any one of the three accumulator bores.
5. Install the 1-2 accumulator spring (31) into the location shown in Figure 168.
6. Install the 2-3 & 3-4 accumulator springs (32) into the locations shown in Figure 168.
7. NOTE: The 1-2 accumulator spring is slightly taller than the other two springs and is installed in the bore closest to the case connector, shown in Figure 168.
8. Install the channel plate to drive sprocket thrust washer (34) onto the channel plate and retain with "Trans-Jel", as shown in Figure 167.

Continued on next Page



25 BOLT, CHANNEL PLATE
8 BOLT, CHANNEL PLATE
27 PLATE, CHANNEL
28 GASKET, CASE TO CHANNEL PLATE
34 WASHER, THRUST

Figure 169



800 VALVE, MANUAL
801 CLIP, MANUAL VALVE TO LINK
802 LINK, MANUAL VALVE TO DETENT LEVER

Figure 170

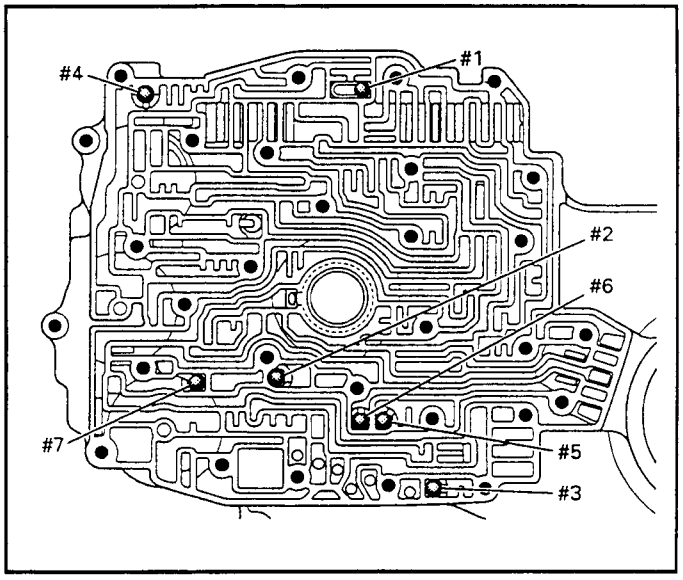


Figure 171

Continued from Page 93

9. Install a new channel plate to case gasket (28) onto the transaxle case as shown in Figure 169.
10. Install the completed channel plate assembly onto the transaxle case as shown in Figure 169. The channel plate should fit tightly over the guide pins located on the transaxle case.
11. There are eight ***short*** channel plate bolts (25), and two ***long*** channel plate bolts (8), that are installed at this time, in the locations shown in Figure 172.
    SPECIAL NOTE: Tighten these ten bolts by hand only at this time. We will torque later.
12. Connect the manual valve link to the manual valve with the manual valve clip (801), shown in Figure 170.
13. Install the seven checkballs into channel plate in the proper locations as shown in Figure 171. Notice that there is one pocket that does not get a checkball.

Continued on Page 96

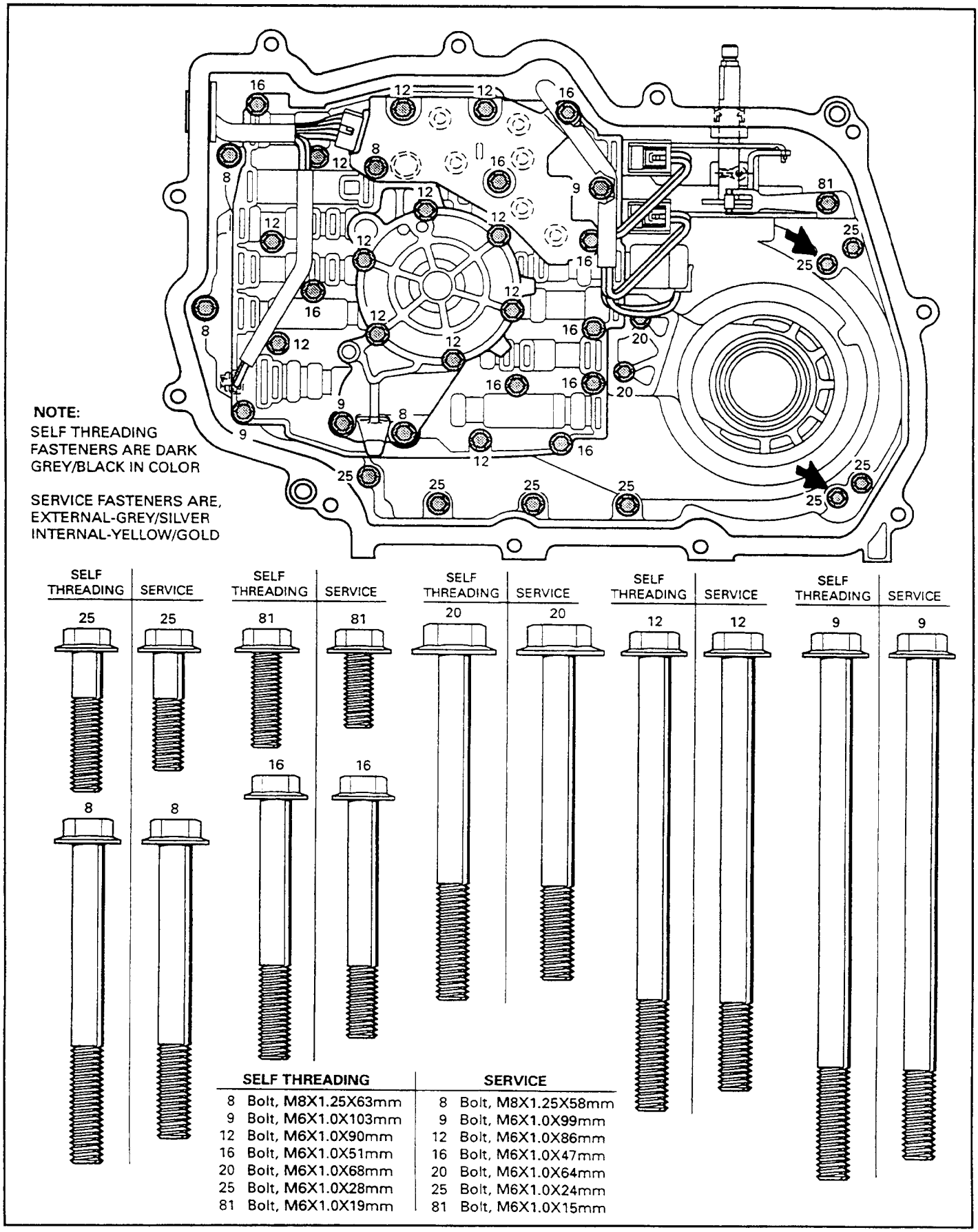
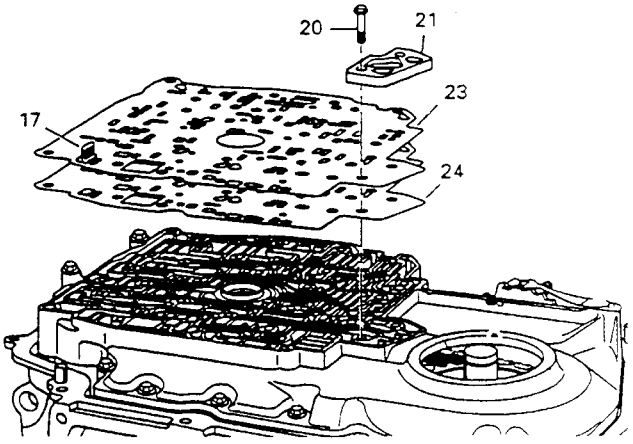


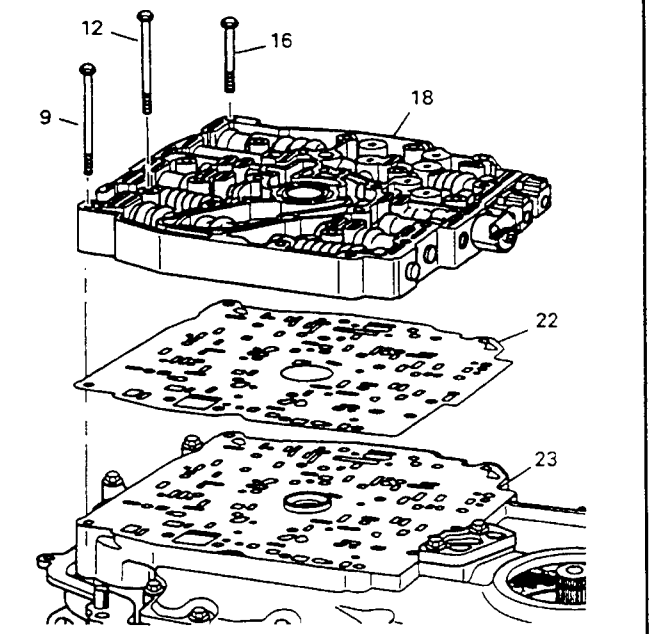
Figure 172

AUTOMATIC TRANSMISSION SERVICE GROUP



17 FILTER, SPACER PLATE
20 BOLT, SPACER PLATE SUPPORT
21 SUPPORT, SPACER PLATE
22 GASKET, VALVE BODY TO SPACER PLATE
23 PLATE, VALVE BODY SPACER
24 GASKET, SPACER PLATE TO CHANNEL PLATE

Figure 173



9 BOLT, VALVE BODY
12 BOLT, VALVE BODY
16 BOLT, VALVE BODY
18 BODY ASSEMBLY, CONTROL VALVE
22 GASKET, VALVE BODY TO SPACER PLATE
23 PLATE, VALVE BODY SPACER

Figure 174

Continued from Page 94

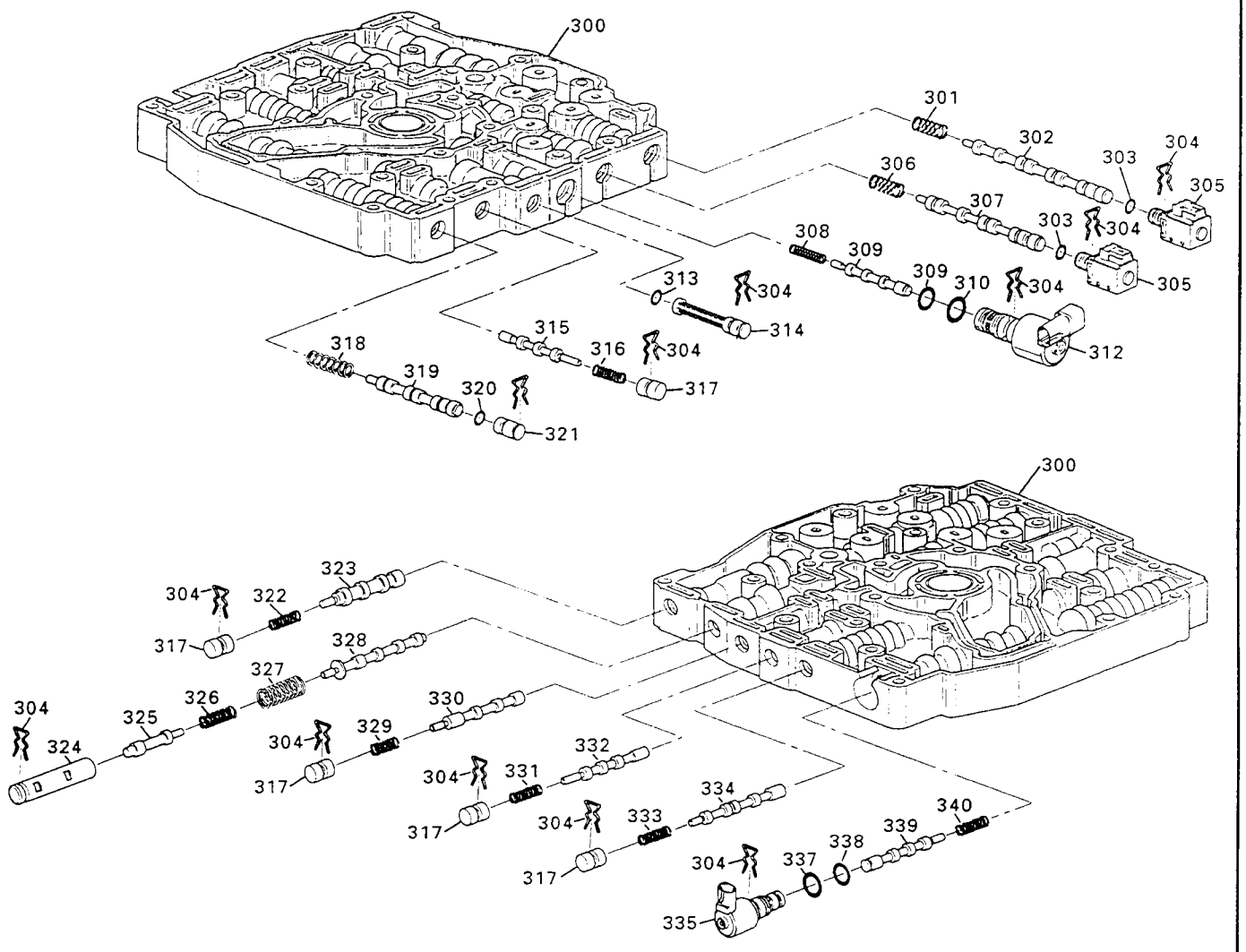
14. Install a new spacer plate to channel plate gasket (24) onto the channel plate as shown in Figure 173.
15. Install the spacer plate (23) on top of the gasket and ensure that the filter screen (17) is in place. (See Figure 173.
16. Install the spacer plate support (21) and the two bolts (20) onto the spacer plate. Hand start the bolts to finger tight.
    NOTE: Torque channel plate bolts in exactly the following sequence.
17. ***Torque the two spacer plate support bolts (20) that just went in to 11 ft.lb. These two bolts pull the driven sprocket support oil passages against the channel plate.***
18. ***Next, torque the remaining channel plate to case bolts to 9 ft.lb. Then torque the two bolts marked with the arrows in Figure 172, to 11 ft.lb.***

VALVE BODY ASSEMBLY

1. Clean the complete valve body assembly with clean solvent thoroughly.
2. Move valves with a pick or small screwdriver to ensure that any debris or dirt is dislodged.
3. Blow dry with compressed air.
4. Position the valve body on a clean and flat work surface for disassembly.
5. Each of the valve line-ups are held in by the retainer clips that can be removed using a small screwdriver. Be careful not to score the valve body when removing the clips and valves.
6. Remove valve trains one at a time beginning in one corner of the valve body.
7. Valves, springs and bushings should be laid out exactly the way they are removed.
8. Clean all valves, springs and bushings and then blow dry with compressed air.
9. Check all solenoids for proper resistance using the chart on Page 23 in this manual.
10. Use the illustrations in Figure 175 to assemble the valves, springs and bushings.
11. Install a new valve body to spacer plate gasket on top of the spacer plate (See Figure 174).
12. Install the valve body assembly and start the three bolts as shown in Figure 174.

Continued on Page 98

4T40-E VALVE BODY EXPLODED VIEW



300	BODY, CONTROL VALVE ASSEMBLY
301	SPRING, 1-2 SHIFT VALVE
302	VALVE, 1-2 SHIFT
303	O-RING, SHIFT SOLENOID A AND B
304	RETAINER CLIP
305	SOLENOID, SHIFT (A AND B)
306	SPRING, 2-3 SHIFT VALVE
307	VALVE, 2-3 SHIFT
308	SPRING, TORQUE SIGNAL REGULATOR VALVE
309	VALVE, TORQUE SIGNAL REGULATOR
310	O-RING, PRESSURE CONTROL SOLENOID
311	O-RING, PRESSURE CONTROL SOLENOID
312	SOLENOID, PRESSURE CONTROL
313	O-RING, ACTUATOR OIL FILTER
314	FILTER, ACTUATOR OIL
315	VALVE, ACTUATOR FEED LIMIT
316	SPRING, ACTUATOR FEED LIMIT VALVE
317	PLUG, BORE
318	SPRING, 3-4 SHIFT VALVE
319	VALVE, 3-4 SHIFT
320	O-RING, 3-4 SHIFT VALVE PLUG
321	PLUG, BORE
322	SPRING, 1-2/3-4 ACCUMULATOR VALVE
323	VALVE, 1-2/3-4 ACCUMULATOR
324	BUSHING, PRESSURE REGULATOR BOOST
325	VALVE, PRESSURE REGULATOR BOOST
326	SPRING, ISOLATOR
327	SPRING, PRESSURE REGULATOR VALVE
328	VALVE, PRESSURE REGULATOR
329	SPRING, 2-3 ACCUMULATOR VALVE
330	VALVE, 2-3 ACCUMULATOR
331	SPRING, TCC FEED LIMIT VALVE
332	VALVE, TCC FEED LIMIT
333	SPRING, TCC CONTROL VALVE
334	VALVE, TCC CONTROL
335	SOLENOID, TCC CONTROL
337	O-RING, TCC CONTROL SOLENOID
338	O-RING, TCC CONTROL SOLENOID
339	VALVE, TCC REGULATED APPLY
340	SPRING, TCC REGULATED APPLY VALVE

Figure 175

PRESSURE SWITCH ASSEMBLY

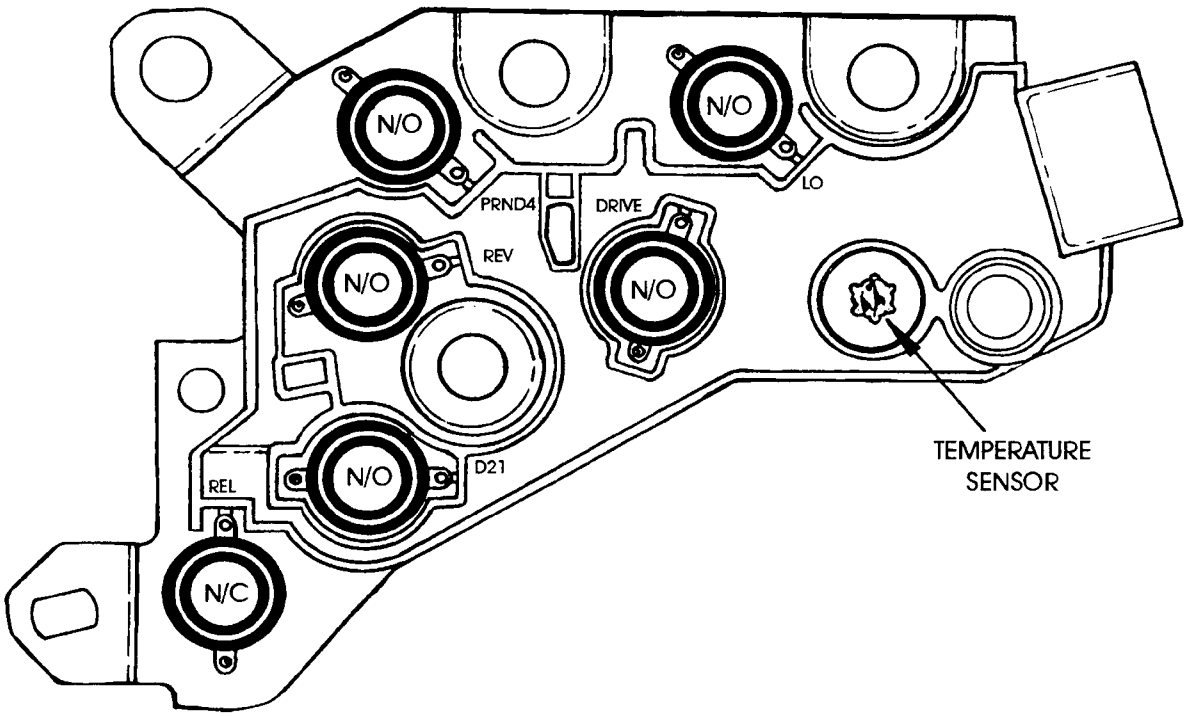
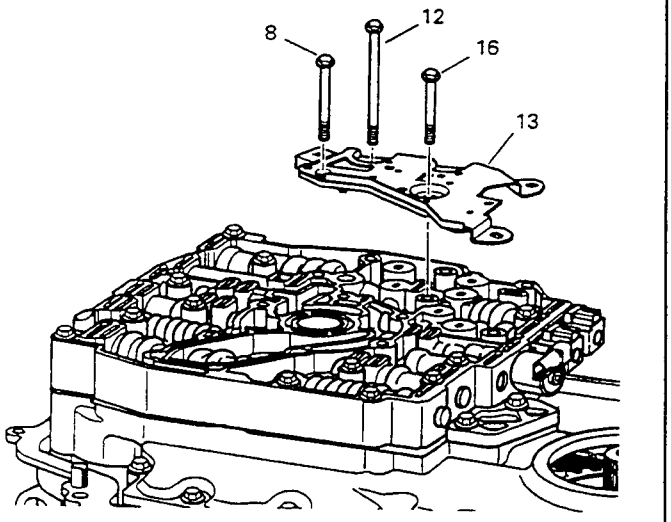


Figure 176

Continued from Page 96

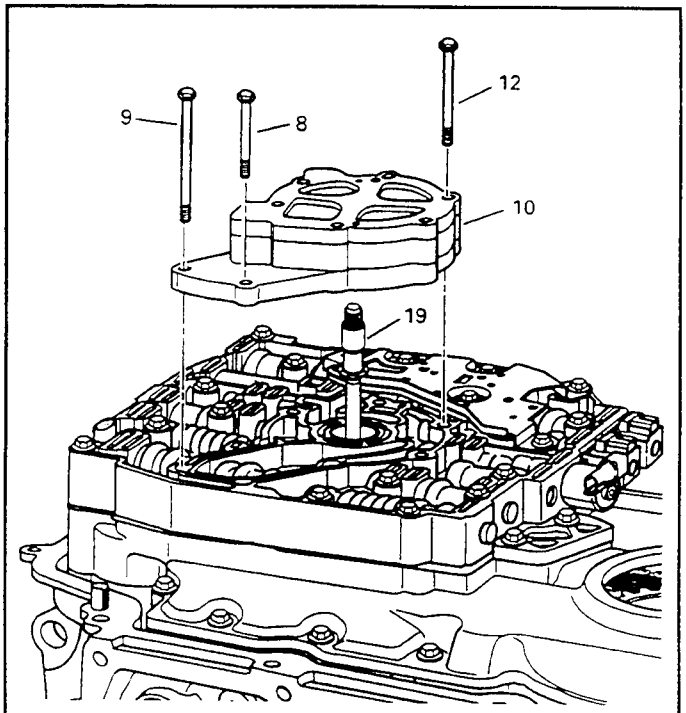
13. Inspect the pressure switch assembly to verify the condition and location of the "O" rings on the back side (See Figure 176).
14. One of the six switches in the pressure switch assembly is normally closed (N.C.), and the other five are normally open (N.O.), as shown in Figure 176.
15. Set your ohmmeter so that it emits a "Tone" when the leads are connected.
16. Place the ohmmeter leads on the pins on each side of the LO switch which is normally open. No tone should be heard.
17. With the leads still in place, using a small flat punch, close the switch by carefully pushing down in the center of switch. If the switch is good, a tone will now be heard from ohmmeter.
18. Check the DRIVE, PRND4, REV, and the D21 switches in the same manner (See Figure 176).
19. Place the ohmmeter leads on the pins on each side of the REL switch, which is normally closed (N.C.) as shown in Figure 176.
20. A tone should be heard from ohmmeter until you push down in the center of the switch with small flat punch, and the tone will then stop.
21. To check the resistance values for the transaxle temperature sensor, see Page 19 of this manual.
22. Install the pressure switch assembly (13) onto transaxle valve body as shown in Figure 177.
23. Install the valve body bolts using the chart in Figure 172 for length and location. Hand start the bolts and finger tighten only.
24. Thoroughly flush the oil pump assembly with clean transmission fluid through the oil pump inlet and outlet passages. While flushing, use the oil pump drive shaft to rotate pump rotor. This action will flush clean fluid through the oil pump assembly.
    NOTE: The oil pump is very difficult to get apart. Oil pump should not be disassembled unless damage is apparent. At time of this printing, it is serviced only as a complete assembly.
25. Install the oil pump drive shaft into transaxle as shown in Figure 178.



8 BOLT, VALVE BODY/(PSA) PRESSURE SW ASM
12 BOLT, VALVE BODY/(PSA) PRESSURE SW ASM
13 (PSA) PRESSURE SWITCH ASSEMBLY
16 BOLT, VALVE BODY/PRESS SW ASM

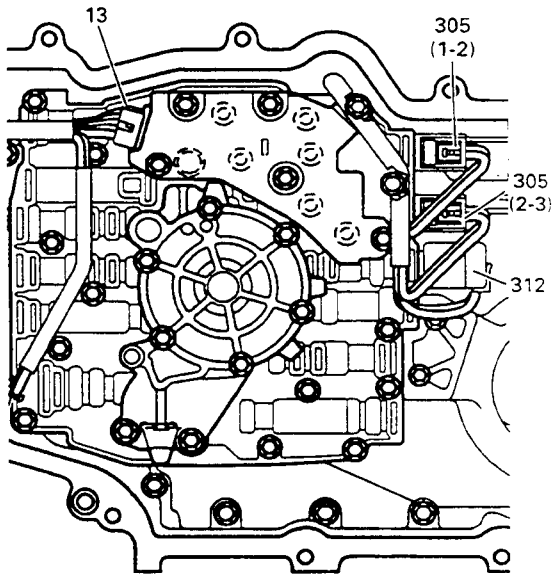
Figure 177

26. Install the oil pump assembly onto the transaxle as shown in Figure 178.
27. Install the oil pump bolts using Figure 172 for length and location.
28. Torque all oil pump and valve body bolts down to 9 ft.lb. Begin in the center and work outward in a circle (See Figure 179).
29. Connect the wiring harness assembly to each of the electrical components (See Figure 179).
    NOTE: The 1-2 shift solenoid wires are Red and Light Green.
    NOTE: The 2-3 shift solenoid wires are Red and Yellow.
    These wires can be connected improperly so be very careful.



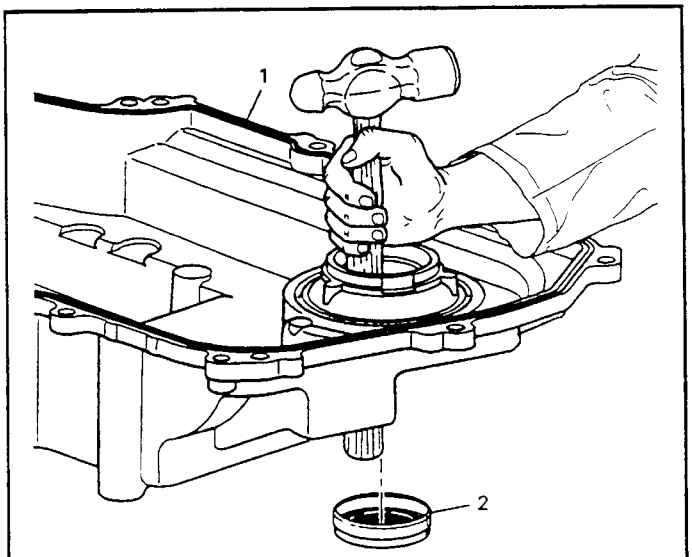
8 BOLT, OIL PUMP
9 BOLT, OIL PUMP
10 PUMP ASSEMBLY, TRANSAXLE OIL
12 BOLT, OIL PUMP
19 SHAFT, OIL PUMP DRIVE

Figure 178



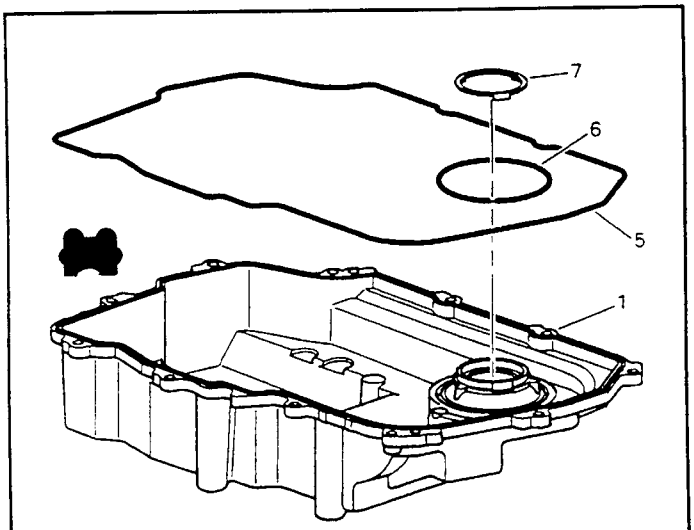
13 PRESSURE SWITCH ASSEMBLY (PSA)
305 SOLENOID, SHIFT (1-2 & 2-3)
312 SOLENOID, PRESSURE CONTROL
335 SOLENOID, TCC CONTROL

Figure 179



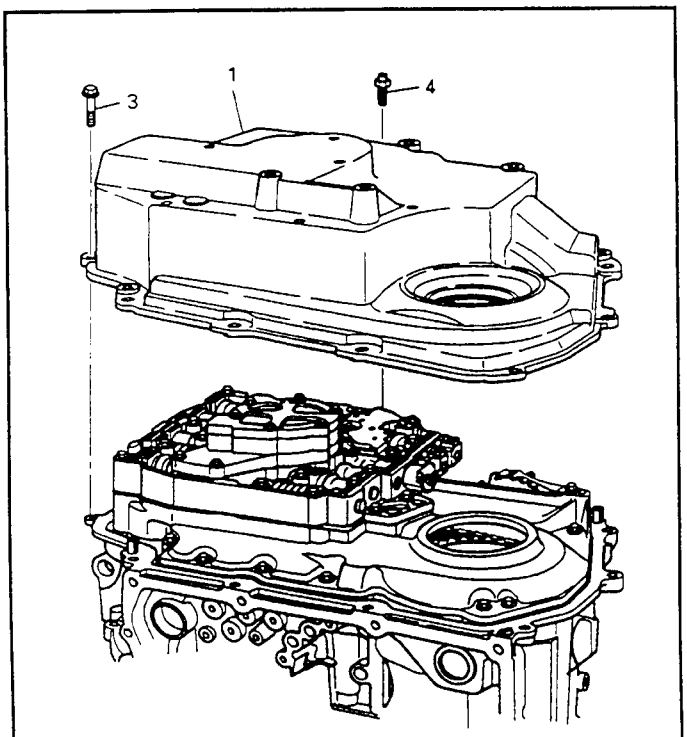
1 COVER, SIDE (STRUCTURAL)
2 SEAL, AXLE OIL

Figure 180



1 COVER, SIDE (STRUCTURAL)
5 GASKET, SIDE COVER
6 GASKET, SIDE COVER OIL LEVEL CONTROL
7 WASHER, THRUST (SIDE COVER TO DRIVEN SPROCKET)

Figure 181



1 COVER, SIDE (STRUCTURAL)
3 BOLT, SIDE COVER
4 STUD, SIDE COVER

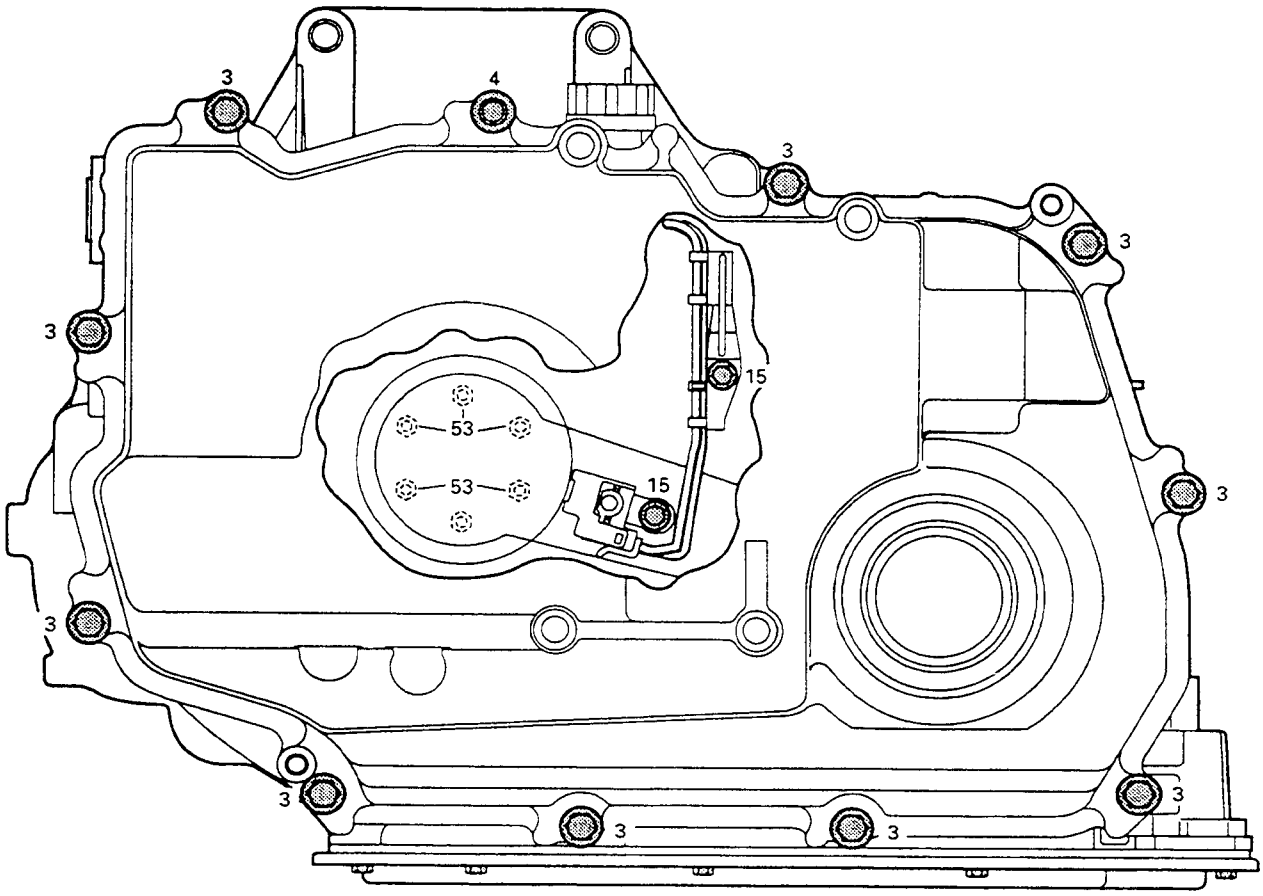
Figure 182

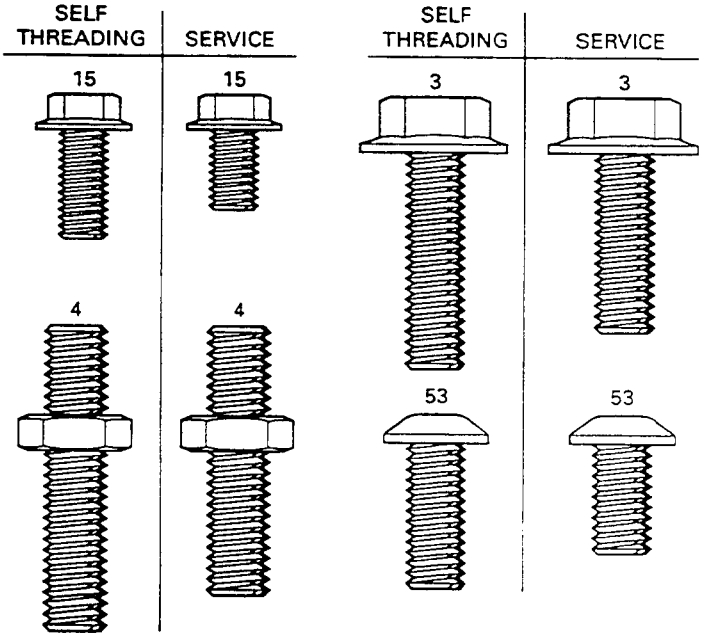
TRANSAXLE SIDE COVER AND AXLE SHAFTS, ASSEMBLY

1. Remove the side cover axle seal using a press or a hammer handle as shown in Figure 180. ***NOTE: Do not install a new axle seal into the side cover at this time.***
2. During initial assembly, the side cover seals are glued into place. Be sure to thoroughly clean the side cover grooves before assembly.
3. Install the side cover gaskets carefully into the grooves with the dual lips facing up as shown in Figure 181.
4. Retain the side cover seals in the groove with "Trans-Jel" or equivalent
5. Install the side cover to driven sprocket thrust washer (7) onto the side cover, as shown in Figure 181, and retain with "Trans-Jel".
6. Install the side cover assembly onto transaxle case as shown in Figure 182.
7. Install the nine side cover bolts and one stud using the chart in Figure 183 for the length and locations, and torque to 15 ft.lbs.

Continued on page 102

SIDE COVER BOLT LOCATIONS



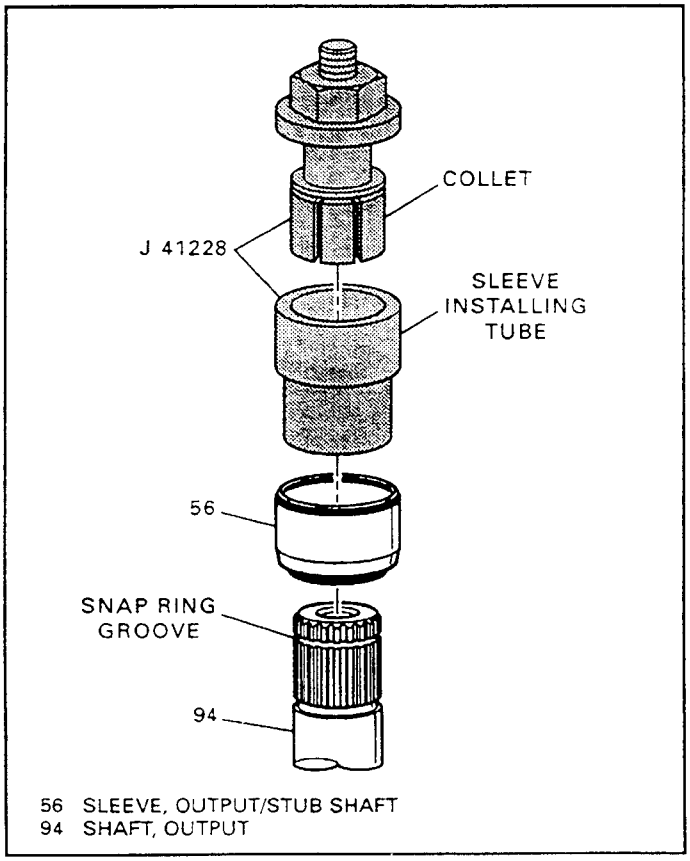


NOTE:
SELF THREADING FASTENERS ARE DARK GREY/BLACK IN COLOR

SERVICE FASTENERS ARE, EXTERNAL-GREY/SILVER INTERNAL-YELLOW/GOLD

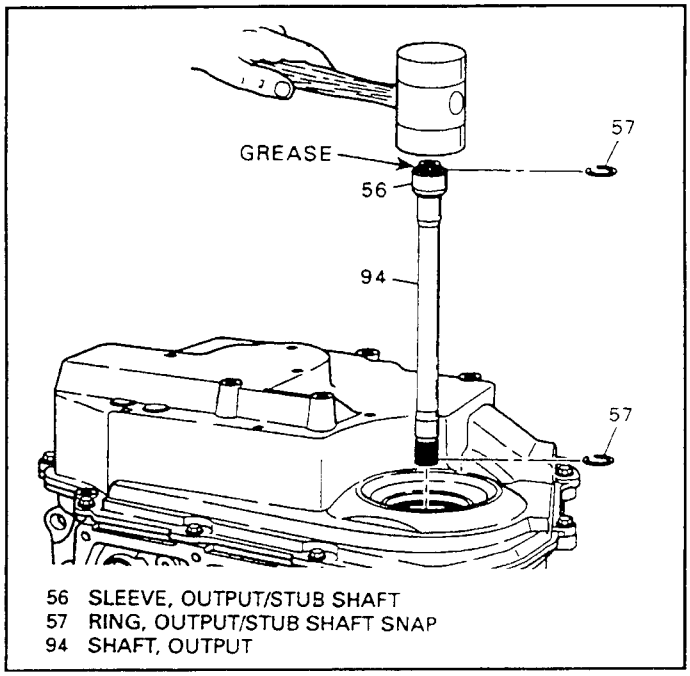
	SELF THREADING	SERVICE
3	Bolt, M8X1.25X28mm	Bolt, M8X1.25X23mm
4	Stud, M8X1.25X25mm	Stud, M8X1.25X20mm
15	Bolt, M6X1.0X15mm	Bolt, M6X1.0X11mm
53	Bolt, M8X1.25X20mm	Bolt, M8X1.25X16mm

Figure 183



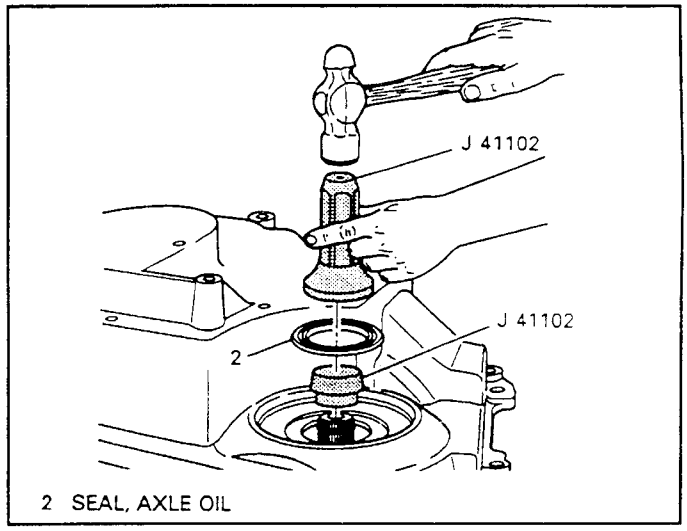
56 SLEEVE, OUTPUT/STUB SHAFT
94 SHAFT, OUTPUT

Figure 184



56 SLEEVE, OUTPUT/STUB SHAFT
57 RING, OUTPUT/STUB SHAFT SNAP
94 SHAFT, OUTPUT

Figure 185

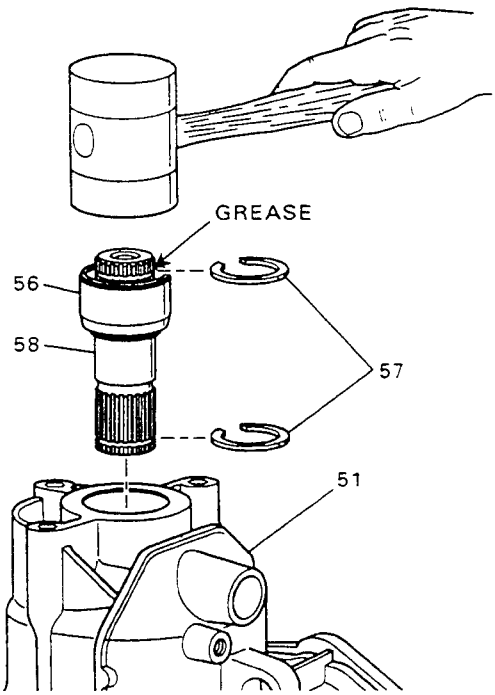


2 SEAL, AXLE OIL

Figure 186

Continued from Page 100

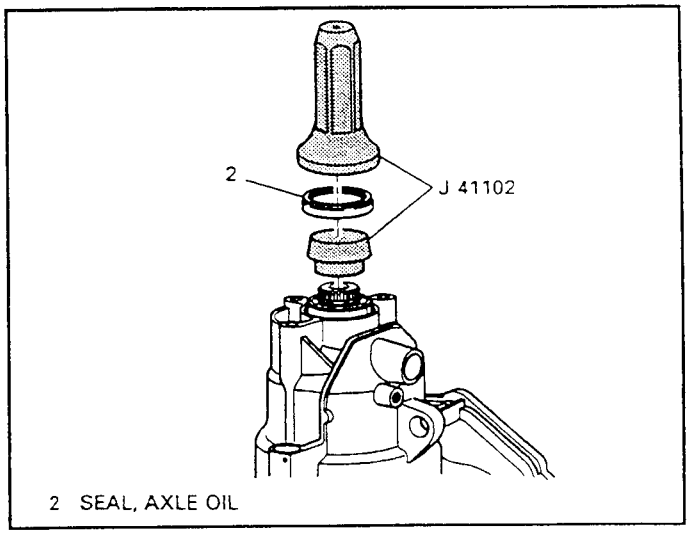
8. Install a ***new*** output shaft sleeve (56) onto the output shaft, using tool J-41228, as shown in Figure 184.
   NOTE: Installation not using tool J-41228 will result in a fluid leak.
9. Place a new sleeve over the end of the output shaft as shown in Figure 184.
10. Install the collet into the output shaft snap ring groove with the collet attached to the threaded collet shaft (See Figure 184).
11. Locate the sleeve installing tube over the collet with the small end of the tube fitting securely into the sleeve (See Figure 184).
12. Install the bearing and nut onto the threaded collet shaft (See Figure 184).
13. Hold the end of the threaded collet shaft while tightening the nut down. This will press the sleeve onto the output shaft.
14. Remove the installation tool.
15. Install two new snap rings (57) into the output shaft snap ring grooves (See Figure 185).
16. Install the output shaft and sleeve assembly into the transaxle using a mallet to install the shaft through the differential gear, as shown in Figure 185.
17. Install a new side cover axle seal into the side cover using tool J-41102 as shown Figure 186. Tool J-41102 installs the axle seal to a given depth and also spreads the seal to get it over the sleeve without damage.
18. Add Polyurea grease, part number 7843867 to the splines on the output shaft.



51 CASE, TRANSAXLE
56 SLEEVE, OUTPUT/STUB SHAFT
57 RING, OUTPUT/STUB SHAFT SNAP
58 SHAFT, OUTPUT STUB

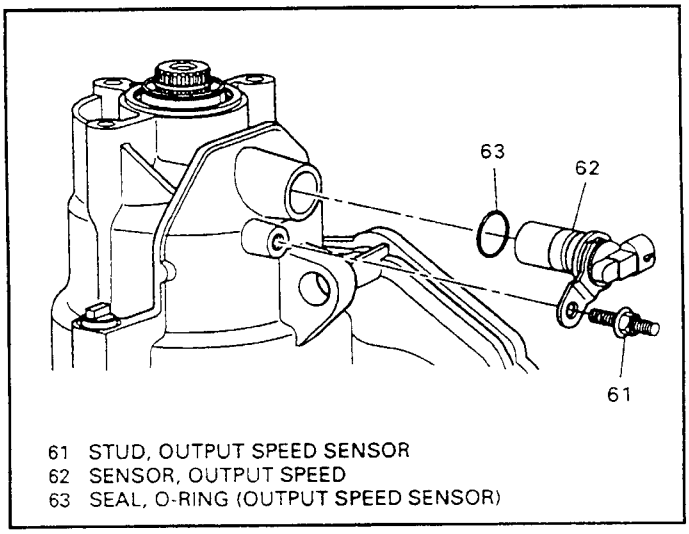
Figure 187

19. Inspect the stub shaft (58) for damage to the splines, snap ring grooves and journals.
20. Inspect the stub shaft sleeve (56) for scratches, nicks or damage that may cause a leak. If the sleeve appears damaged, it must be replaced using the same procedure for the removal and installation as with the output shaft.
21. Install two new snap rings (57) into the snap ring grooves on the stub shaft, as shown in Figure 187.
    These snap rings are not reusable once the stub shaft has been removed.
22. Install the stub shaft and sleeve assembly into the transaxle, using a mallet to install the shaft through the final drive differential gear, shown in Figure 187.
23. Install a new right hand axle seal into transaxle case using tool J-41102 (See Figure 188). Tool J-41102 installs the seal to a given depth and also spreads the seal to get it over the sleeve without any damage.
24. Add Polyurea grease, part number 7843867, to the splines on the stub shaft after the seal has been installed.



2 SEAL, AXLE OIL

Figure 188

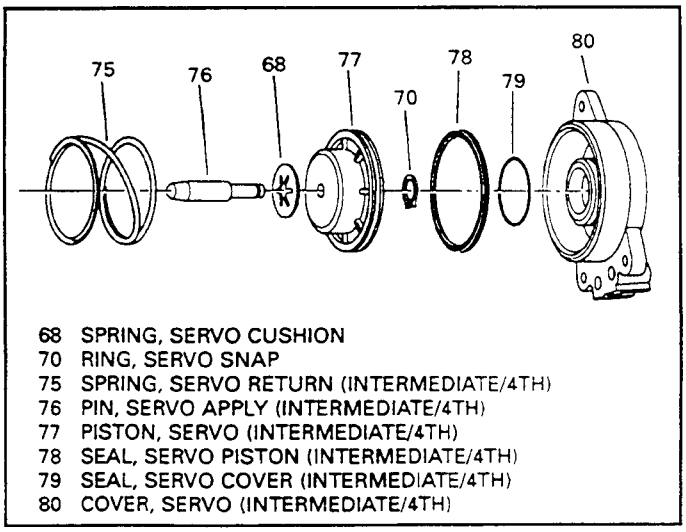


61 STUD, OUTPUT SPEED SENSOR
62 SENSOR, OUTPUT SPEED
63 SEAL, O-RING (OUTPUT SPEED SENSOR)

Figure 189

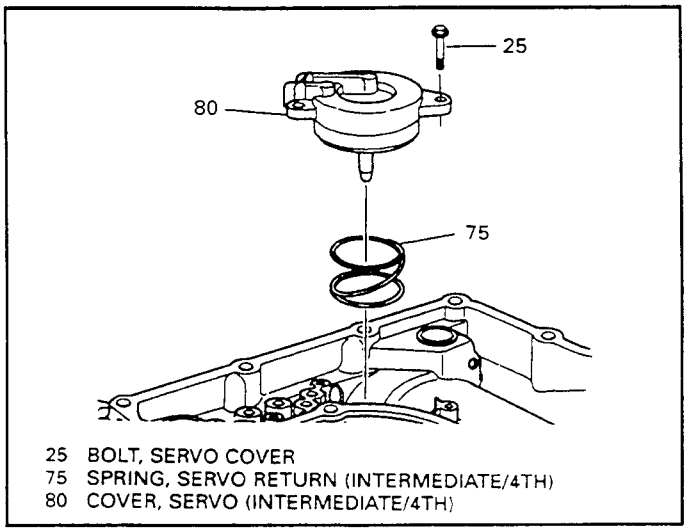
OUTPUT SPEED SENSOR

1. Inspect the output speed sensor for any damage to the sensor or the electrical connector.
2. Check the resistance across the two terminals in the speed sensor, using the chart on Page 23 for the proper specifications.
3. Install a new "O" ring seal on the output speed sensor as shown in Figure 189.
4. Install the speed sensor into the transaxle case using a small amount of "Trans-Jel" in the case bore (See Figure 189).
5. Install the speed sensor stud and torque stud to 9 ft.lb. (See Figure 189).



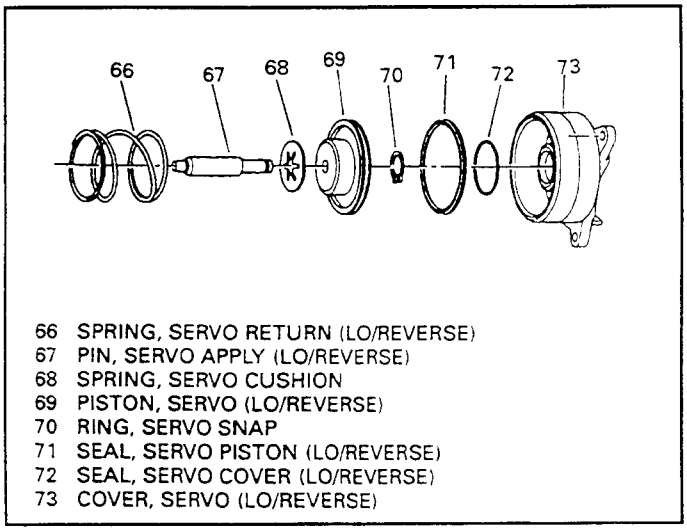
68 SPRING, SERVO CUSHION
70 RING, SERVO SNAP
75 SPRING, SERVO RETURN (INTERMEDIATE/4TH)
76 PIN, SERVO APPLY (INTERMEDIATE/4TH)
77 PISTON, SERVO (INTERMEDIATE/4TH)
78 SEAL, SERVO PISTON (INTERMEDIATE/4TH)
79 SEAL, SERVO COVER (INTERMEDIATE/4TH)
80 COVER, SERVO (INTERMEDIATE/4TH)

Figure 190



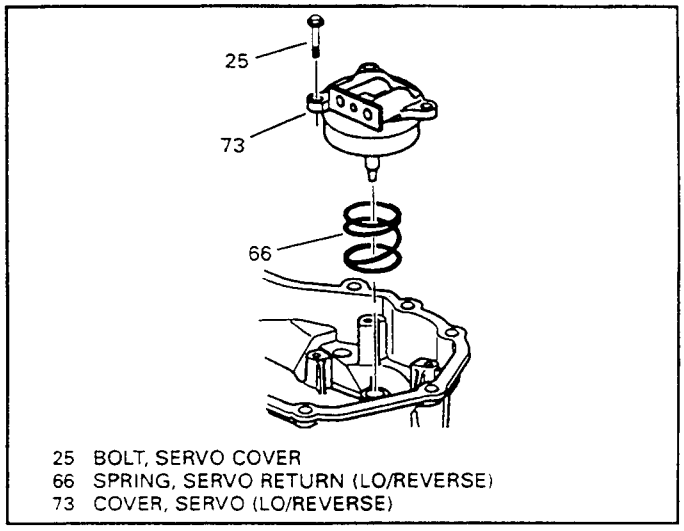
25 BOLT, SERVO COVER
75 SPRING, SERVO RETURN (INTERMEDIATE/4TH)
80 COVER, SERVO (INTERMEDIATE/4TH)

Figure 191



66 SPRING, SERVO RETURN (LO/REVERSE)
67 PIN, SERVO APPLY (LO/REVERSE)
68 SPRING, SERVO CUSHION
69 PISTON, SERVO (LO/REVERSE)
70 RING, SERVO SNAP
71 SEAL, SERVO PISTON (LO/REVERSE)
72 SEAL, SERVO COVER (LO/REVERSE)
73 COVER, SERVO (LO/REVERSE)

Figure 192

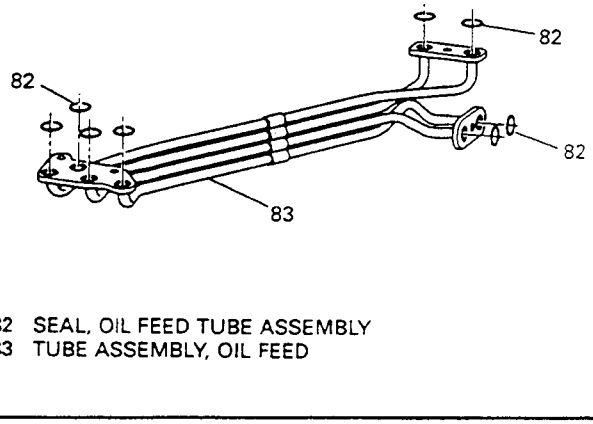


25 BOLT, SERVO COVER
66 SPRING, SERVO RETURN (LO/REVERSE)
73 COVER, SERVO (LO/REVERSE)

Figure 193

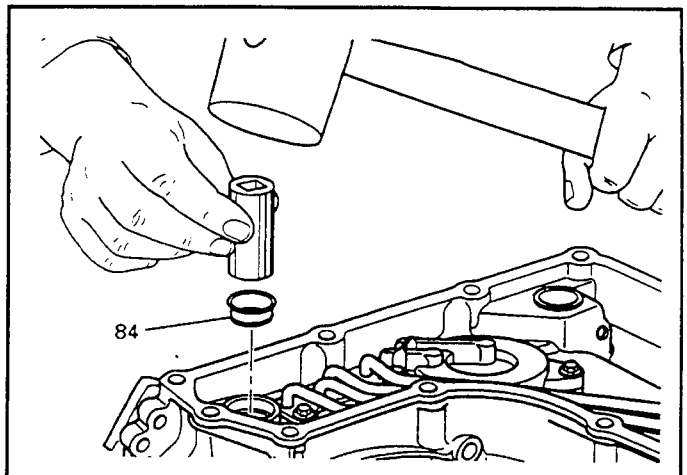
SERVO ASSEMBLIES AND SERVO FEED PIPES ASSEMBLE

1. Assemble the Intermediate/4th servo cushion springs (68) and servo piston onto the servo apply pin, as shown in Figure 190. Retain the spring and piston by installing the snap ring as shown in Figure 190.
2. Install new servo seals (78) and (79) onto the servo piston and servo cover and lubricate with "Trans-Jel", as shown in Figure 190.
3. Assemble the intermediate/4th servo piston in the servo cover, as shown in Figure 190.
4. Install the intermediate/4th servo return spring (75) into the transaxle case (See Figure 191).
5. Install the intermediate/4th servo cover and piston as an assembly over the return spring as shown in Figure 191.
6. Install the three servo cover retaining bolts and torque to 9 ft.lb. (See Figure 191).
7. Assemble the lo/reverse servo cushion spring (68) and servo piston onto the servo apply pin as shown in Figure 192.
8. Install new servo seals (71) and (72) onto the servo piston and servo cover and lubricate with "Trans-Jel", as shown in Figure 192.
9. Assemble the lo/reverse servo piston into the servo cover, as shown in Figure 192.
10. Install the lo/reverse servo return spring (66) into the transaxle case (See Figure 193).
11. Install the lo/reverse servo cover and piston as an assembly over the return spring, as shown in Figure 193.



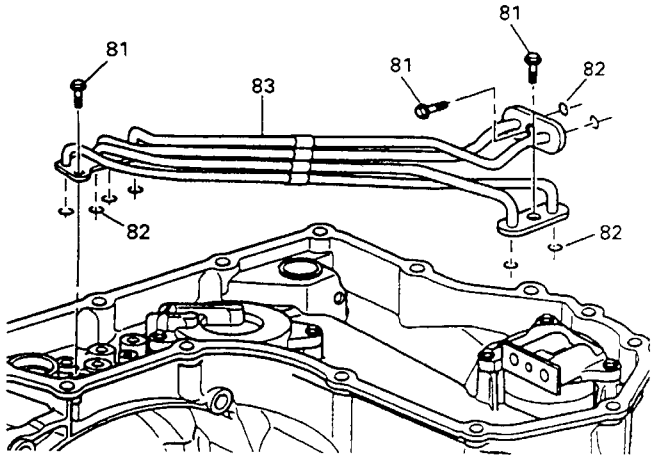
82 SEAL, OIL FEED TUBE ASSEMBLY
83 TUBE ASSEMBLY, OIL FEED

Figure 194



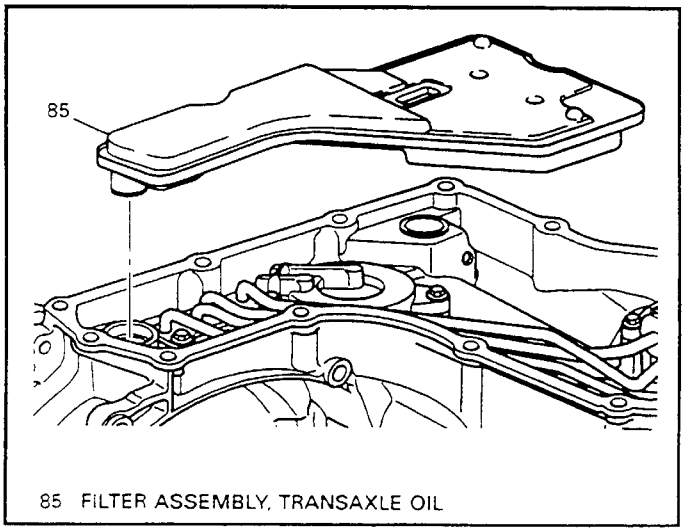
84 SEAL, TRANSAXLE OIL FILTER

Figure 196



81 BOLT, TUBE ASSEMBLY
82 SEAL, OIL FEED TUBE ASSEMBLY
83 TUBE ASSEMBLY, OIL FEED

Figure 195



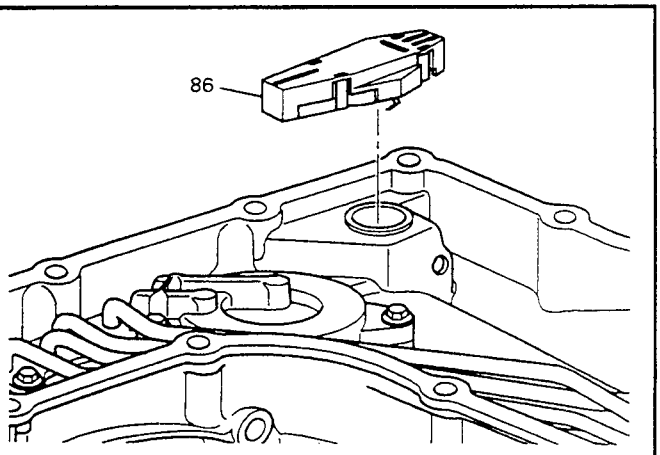
85 FILTER ASSEMBLY, TRANSAXLE OIL

Figure 197

12. Install the three lo/reverse servo cover bolts and torque to 9 ft.lb. as shown Figure 193.
13. The oil feed pipe "O" rings are glued into place during initial assembly. Be sure to thoroughly clean any residual glue from the oil feed pipe pockets (See Figure 194).
14. Install new feed pipe "O" rings into the feed pipe pockets and retain with "Trans-Jel", as shown in Figure 194.
15. Install the oil feed pipe assembly onto transaxle as shown Figure 195, hand start the four bolts, and torque bolts to 9 ft.lb.

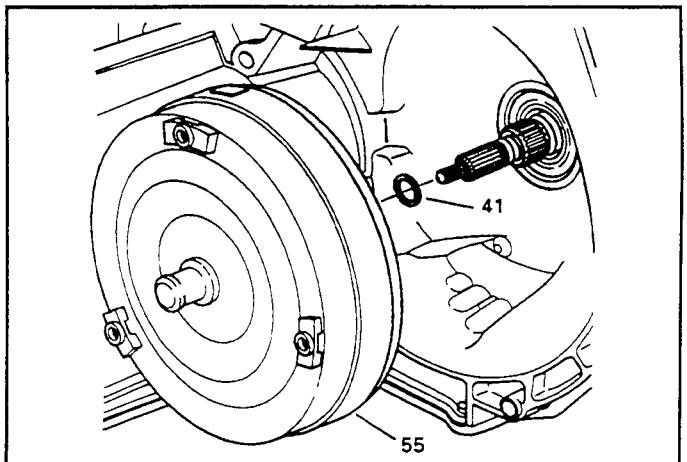
OIL FILTER SEAL AND OIL FILTER ASSEMBLY

1. Install a new oil filter seal (84) in the transaxle case, as shown in Figure 196. Tap gently and evenly on the seal to prevent damage to case bore and seal, using a large socket to tap seal into position (See Figure 196).
2. Install a new oil filter assembly into filter seal as shown in Figure 197, twisting the oil filter slightly during installation.



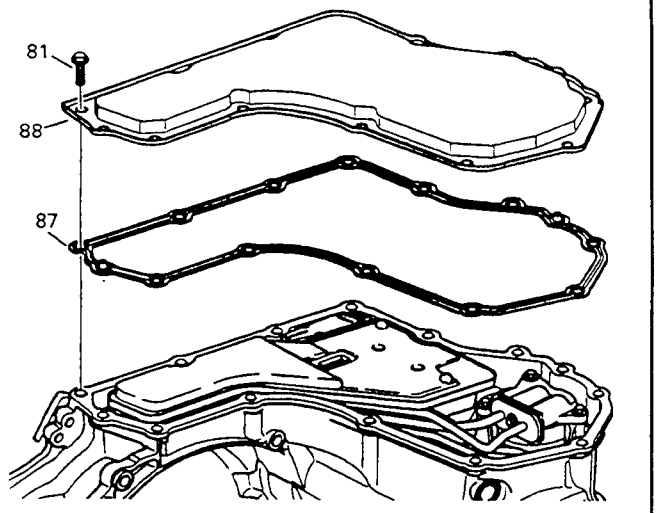
86 VALVE, OIL LEVEL CONTROL

Figure 198



41 SEAL, O-RING (TORQUE CONVERTER)
55 TORQUE CONVERTER ASSEMBLY

Figure 200



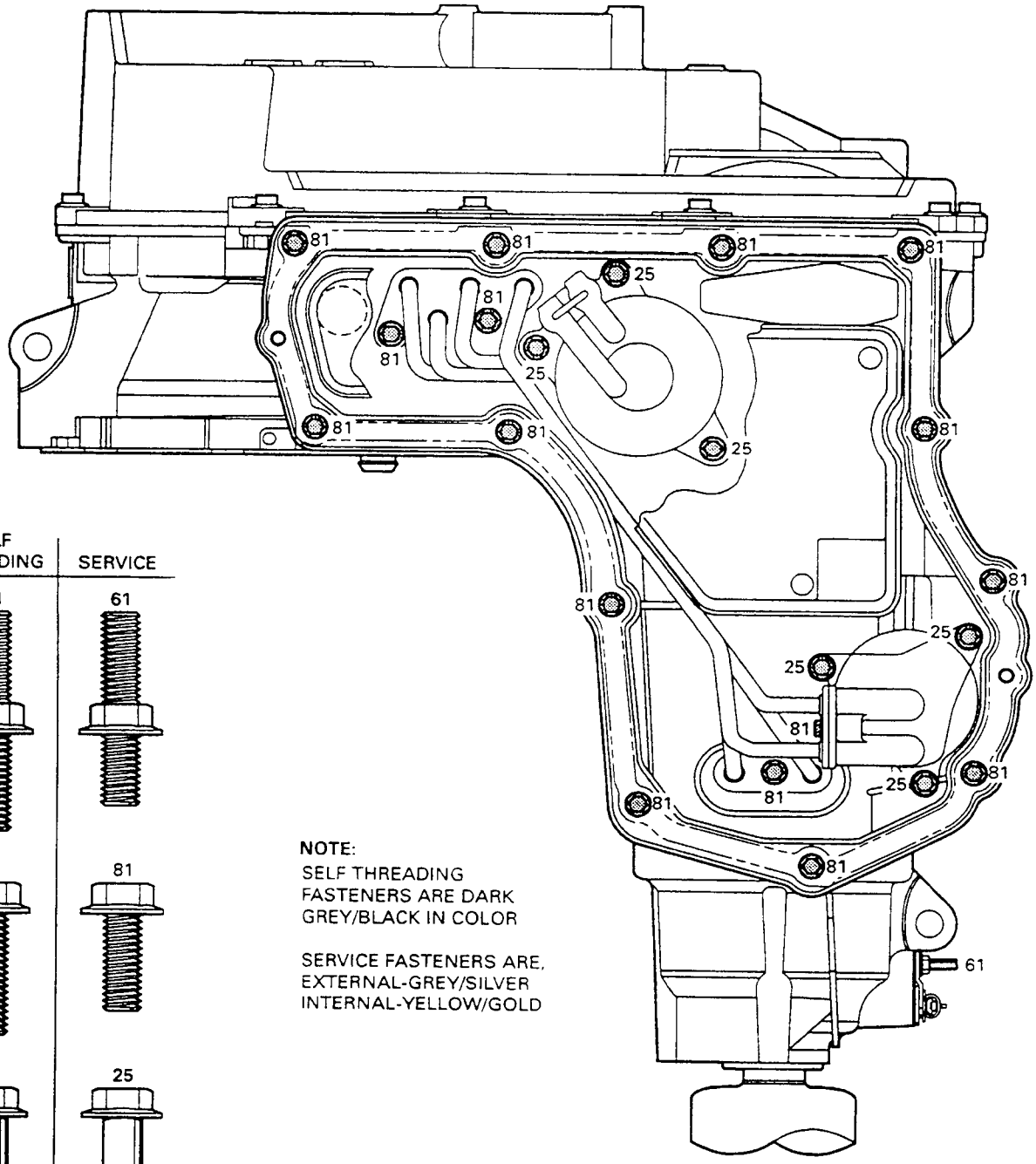
81 BOLT, BOTTOM PAN
87 GASKET, TRANSAXLE BOTTOM PAN
88 PAN, TRANSAXLE OIL

Figure 199

OIL LEVEL CONTROL VALVE BOTTOM PAN AND GASKET

1. General Motors recommends that the oil level control valve (86) be replaced if it is removed. The oil level control valve can be reused if the retaining tabs on the bottom are not bent and still have the ability to retain it in the case bore (See Figure 198).
2. Install the oil level control valve into transaxle case bore as shown in Figure 198, by pushing down on oil level control valve where it says ***"PRESS HERE"***.
3. Install the bottom pan gasket and the bottom pan onto the transaxle as shown in Figure 199.
4. Install the twelve bottom pan bolts, hand start and then torque to 8 ft.lb. (See Figure 199).
5. Install a new turbine shaft "O" ring into the turbine shaft "O" ring groove, as shown in Figure 200.
6. Remove the transaxle from the holding fixture and install the torque converter, as shown in Figure 200.

BOTTOM PAN AREA BOLT LENGTH AND LOCATIONS



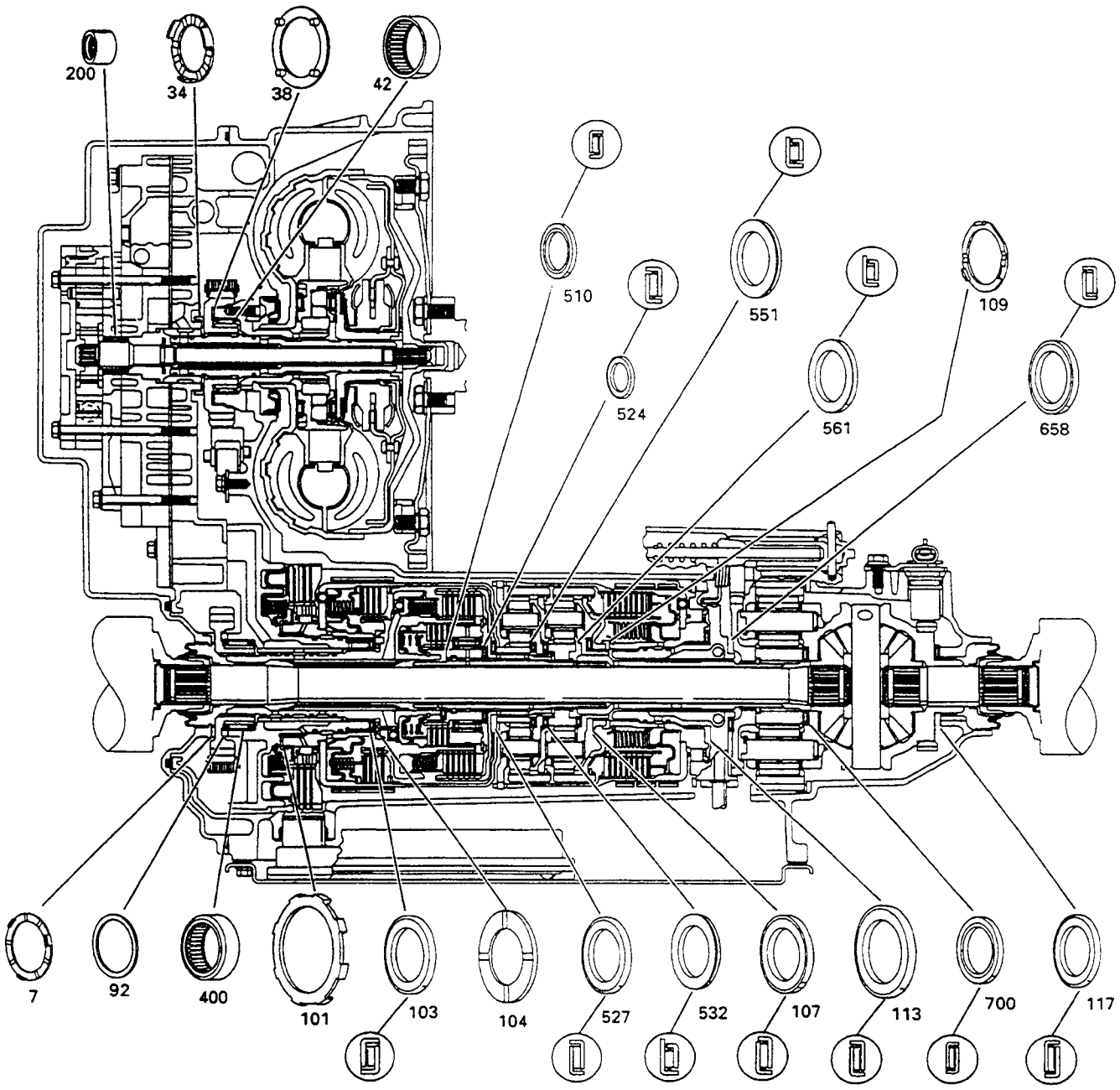
NOTE:
SELF THREADING FASTENERS ARE DARK GREY/BLACK IN COLOR

SERVICE FASTENERS ARE, EXTERNAL-GREY/SILVER INTERNAL-YELLOW/GOLD

SELF THREADING		SERVICE	
25	Bolt, M6X1.0X28mm	25	Bolt, M6X1.0X24mm
81	Bolt, M6X1.0X19mm	81	Bolt, M6X1.0X15mm
61	Bolt, M6X1.0X15mm	61	Bolt, M6X1.0X11mm

Figure 201

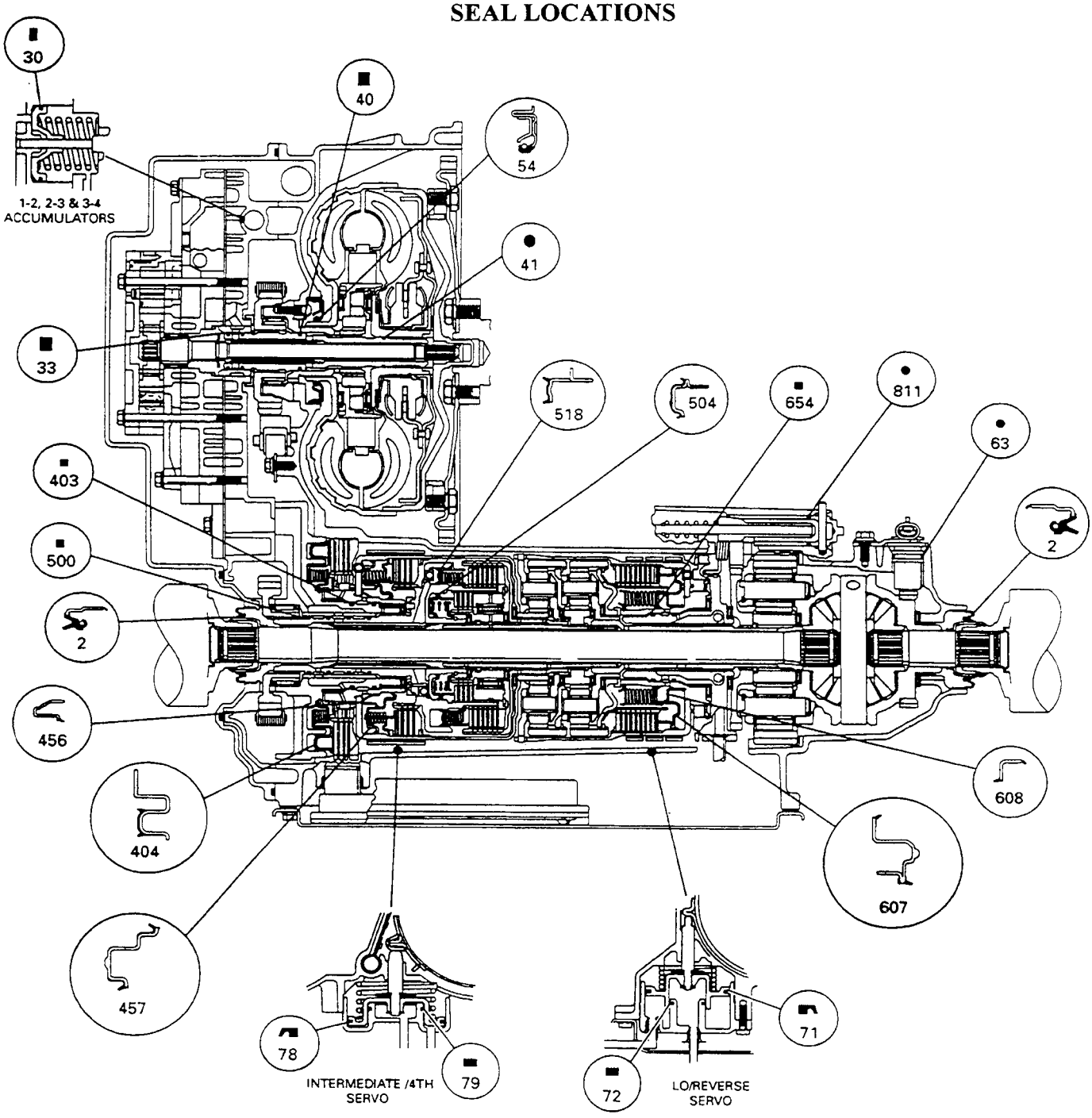
BEARING AND WASHER LOCATIONS



7	WASHER, THRUST (SIDE COVER TO DRIVEN SPROCKET)
34	WASHER, THRUST (CHANNEL PLATE TO DRIVE SPROCKET)
38	WASHER, THRUST (DRIVE SPROCKET TO SUPPORT)
42	BEARING, DRIVE SPROCKET SUPPORT
92	WASHER, THRUST (DRIVEN SPROCKET TO SUPPORT)
101	WASHER, THRUST (SUPPORT TO REVERSE INPUT CLUTCH)
103	BEARING, THRUST
104	WASHER, THRUST (SELECTIVE)
107	BEARING, THRUST
109	WASHER, THRUST
113	BEARING, THRUST
117	BEARING, THRUST
200	BEARING & SEAL ASSEMBLY, OIL PUMP
400	BEARING, DRIVEN SPROCKET SUPPORT
510	BEARING, THRUST
524	BEARING, THRUST
527	BEARING, THRUST (CARRIER SHAFT TO SHELL)
532	BEARING, THRUST (REACTION CARRIER TO SUN GEAR)
551	BEARING, THRUST
561	BEARING, THRUST
658	BEARING, THRUST (FORWARD SUPPORT TO PARK GEAR)
700	BEARING, THRUST

Figure 202

SEAL LOCATIONS



2	SEAL, AXLE OIL	404	PISTON ASSEMBLY, 2ND CLUTCH
30	SEAL, ACCUMULATOR PISTON (1-2, 2-3 AND 3-4)	456	RETAINER & SEAL ASSEMBLY, REVERSE CLUTCH CENTER
33	SEAL, TURBINE SHAFT	457	PISTON ASSEMBLY, REVERSE CLUTCH
40	SEAL, (TURBINE SHAFT TO SUPPORT)	500	RING, OIL SEAL - INPUT SHAFT
41	SEAL, O-RING (TORQUE CONVERTER)	504	PISTON ASSEMBLY, COAST CLUTCH
54	SEAL, CONVERTER	518	PISTON ASSEMBLY, DIRECT CLUTCH
63	SEAL, O-RING (OUTPUT SPEED SENSOR)	607	PISTON ASSEMBLY, FORWARD CLUTCH
71	SEAL, SERVO PISTON (LO/REVERSE)	608	SEAL AND SLEEVE ASSEMBLY, FORWARD CLUTCH INNER
72	SEAL, SERVO COVER (LO/REVERSE)	654	RING, OIL SEAL (FORWARD CLUTCH SUPPORT)
78	SEAL, SERVO PISTON (INTERMEDIATE/4TH)	811	SEAL, ACTUATOR GUIDE
79	SEAL, SERVO COVER (INTERMEDIATE/4TH)		
403	RING, OIL SEAL		

Figure 203

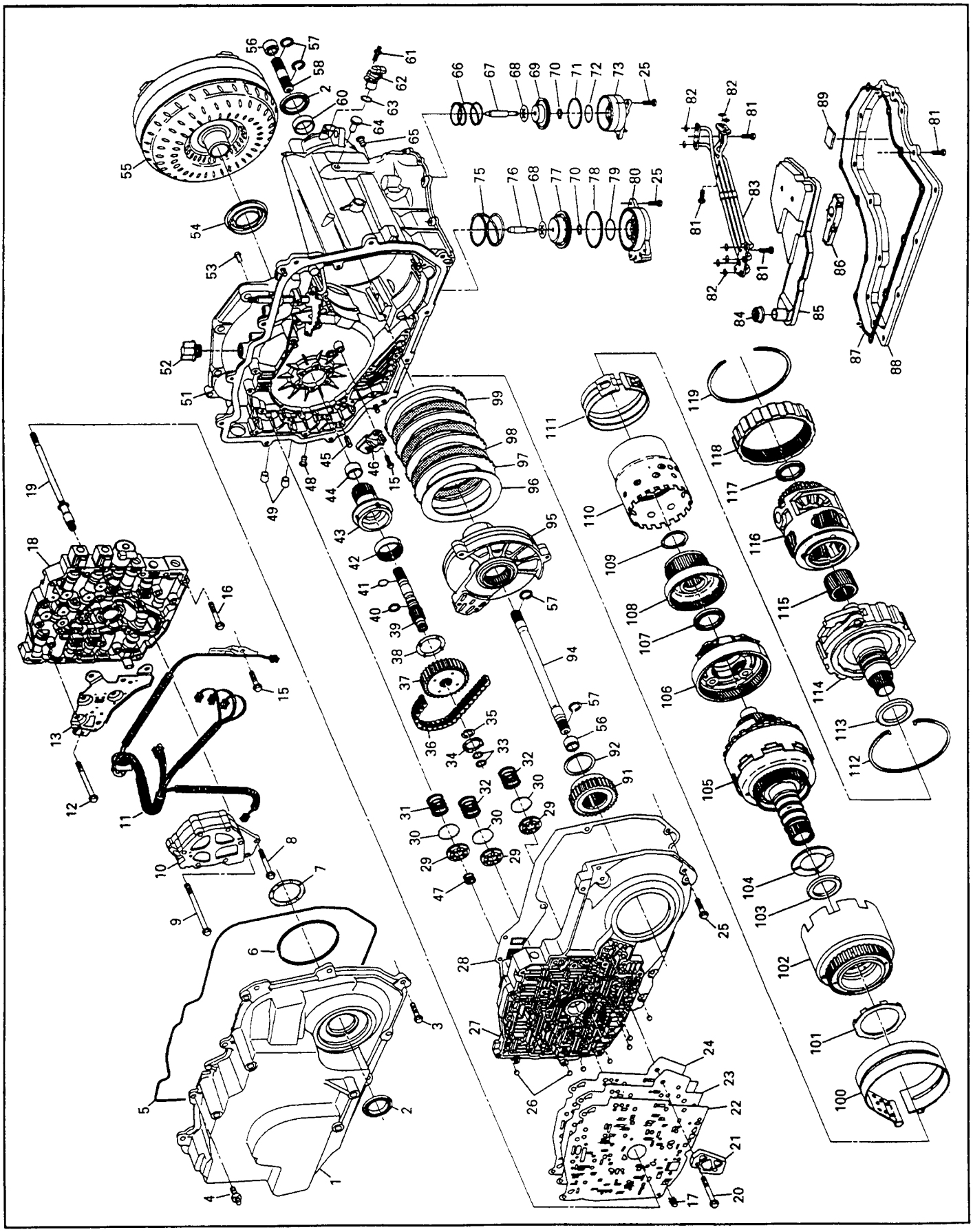
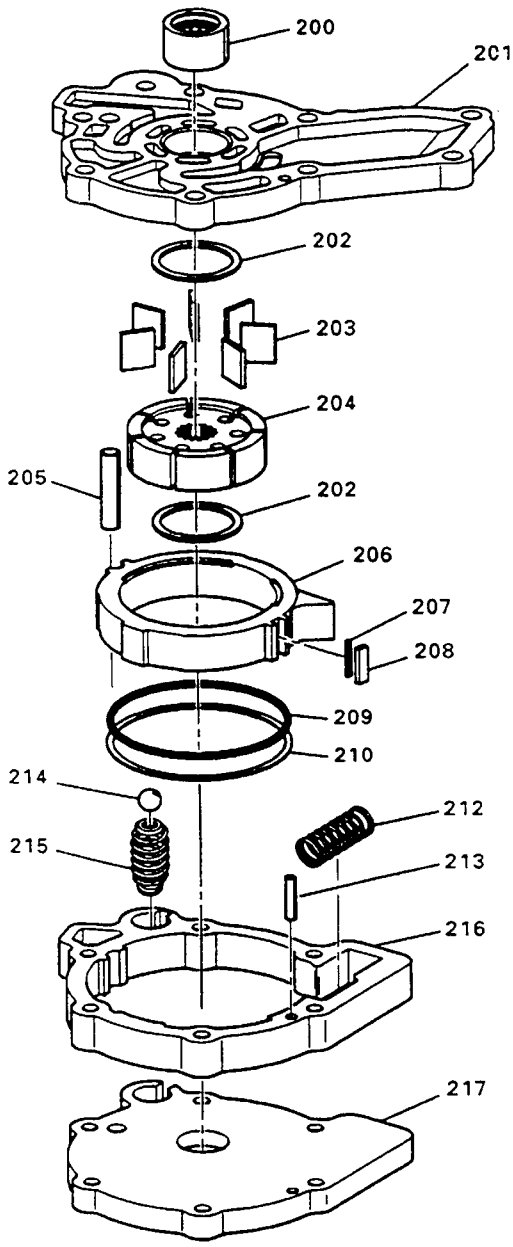


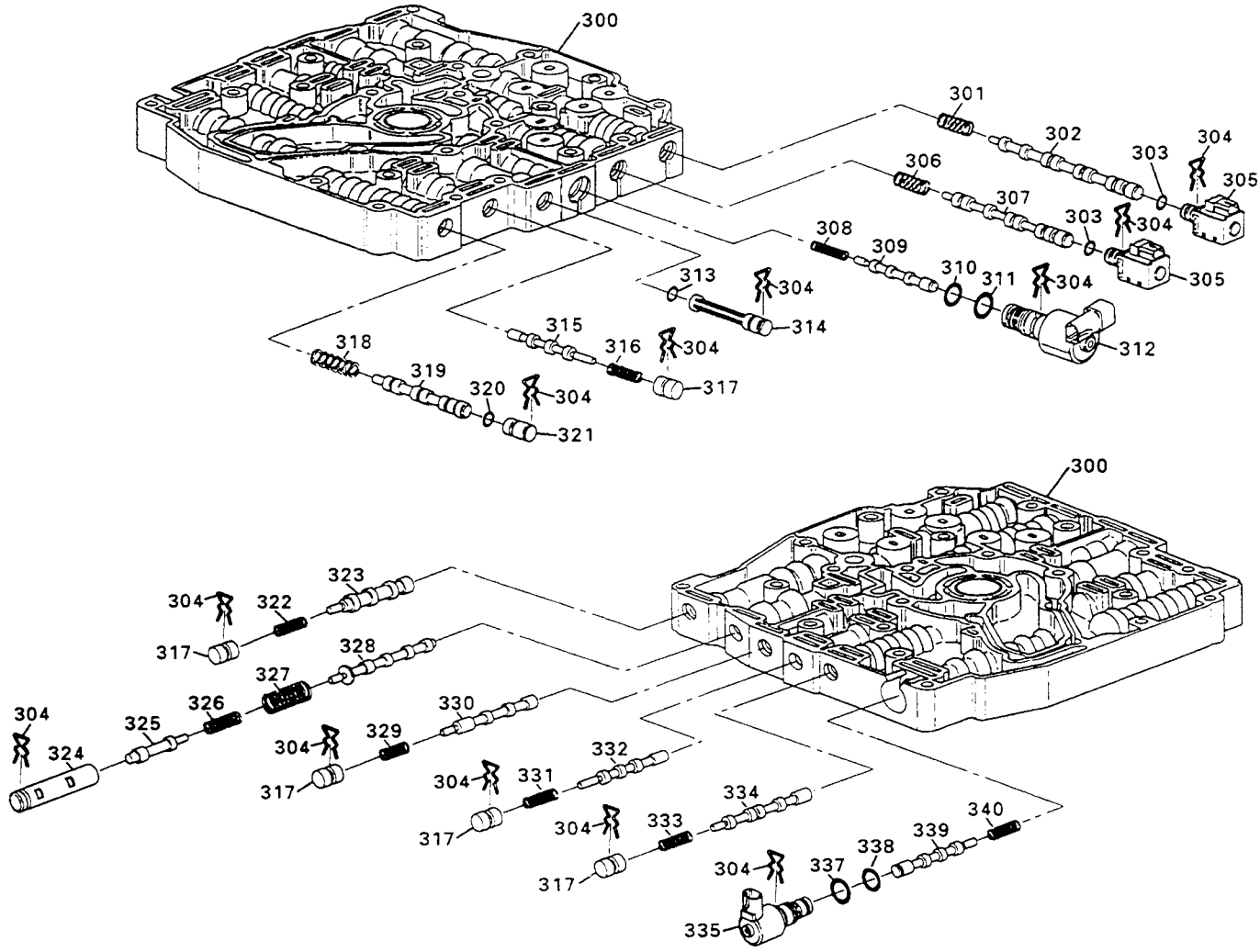
Figure 204

NOTE: At the time of this printing the oil pump assembly was serviced as a complete assembly. only. The oil pump should not be disassembled. Figure 205 is provided only for reference. This policy may change in the future.



200	BEARING & SEAL ASSEMBLY, OIL PUMP
201	BASE, OIL PUMP
202	RING, OIL PUMP VANE
203	VANE, OIL PUMP
204	ROTOR, OIL PUMP
205	PIN, PIVOT (OIL PUMP SLIDE)
206	SLIDE, OIL PUMP
207	SUPPORT, OIL PUMP SLIDE SEAL
208	SEAL, OIL PUMP SLIDE
209	SEAL, O-RING (OIL PUMP SLIDE)
210	RING, FLUID SEAL (SLIDE TO BODY)
212	SPRING, OIL PUMP PRIMING
213	PIN, LOCATING
214	BALL, PRESSURE RELIEF
215	SPRING, PRESSURE RELIEF
216	BODY, OIL PUMP
217	COVER, PUMP

Figure 205

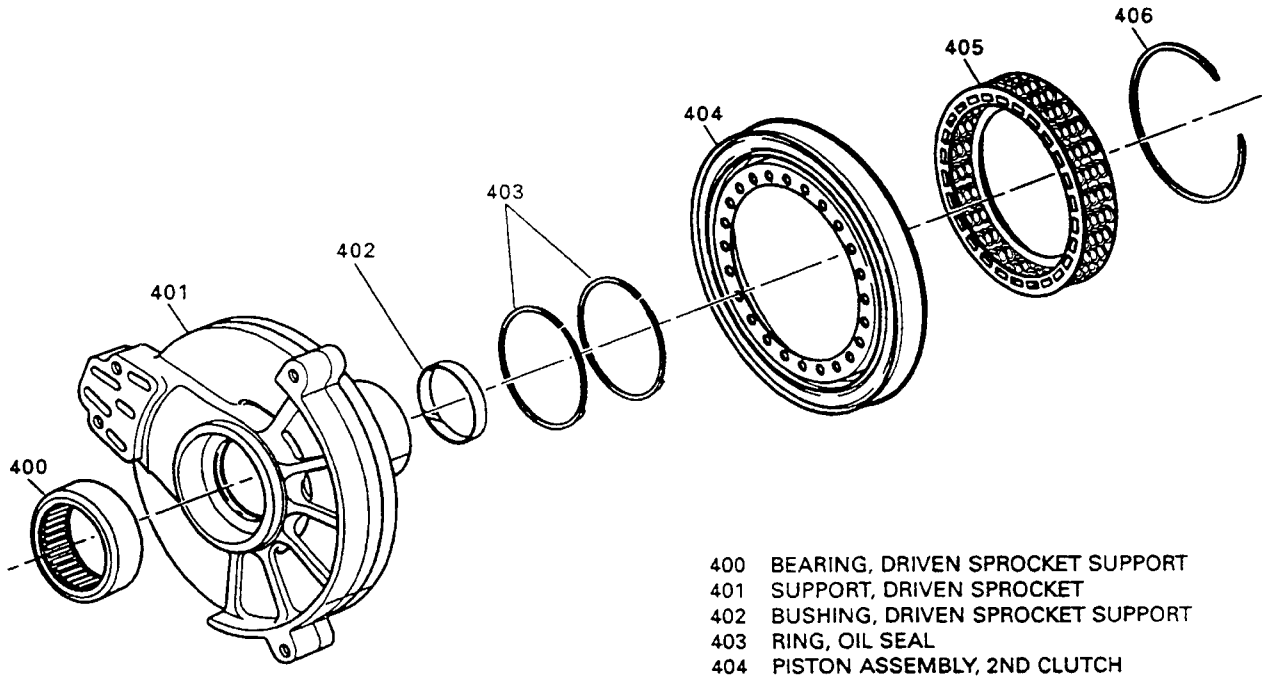


300	BODY, CONTROL VALVE ASSEMBLY
301	SPRING, 1-2 SHIFT VALVE
302	VALVE, 1-2 SHIFT
303	O-RING, SHIFT SOLENOID A AND B
304	RETAINER CLIP
305	SOLENOID, SHIFT (A AND B)
306	SPRING, 2-3 SHIFT VALVE
307	VALVE, 2-3 SHIFT
308	SPRING, TORQUE SIGNAL REGULATOR VALVE
309	VALVE, TORQUE SIGNAL REGULATOR
310	O-RING, PRESSURE CONTROL SOLENOID
311	O-RING, PRESSURE CONTROL SOLENOID
312	SOLENOID, PRESSURE CONTROL
313	O-RING, ACTUATOR OIL FILTER
314	FILTER, ACTUATOR OIL
315	VALVE, ACTUATOR FEED LIMIT
316	SPRING, ACTUATOR FEED LIMIT VALVE
317	PLUG, BORE
318	SPRING, 3-4 SHIFT VALVE
319	VALVE, 3-4 SHIFT
320	O-RING, 3-4 SHIFT VALVE PLUG
321	PLUG, BORE
322	SPRING, 1-2/3-4 ACCUMULATOR VALVE
323	VALVE, 1-2/3-4 ACCUMULATOR
324	BUSHING, PRESSURE REGULATOR BOOST
325	VALVE, PRESSURE REGULATOR BOOST
326	SPRING, ISOLATOR
327	SPRING, PRESSURE REGULATOR VALVE
328	VALVE, PRESSURE REGULATOR
329	SPRING, 2-3 ACCUMULATOR VALVE
330	VALVE, 2-3 ACCUMULATOR
331	SPRING, TCC FEED LIMIT VALVE
332	VALVE, TCC FEED LIMIT
333	SPRING, TCC CONTROL VALVE
334	VALVE, TCC CONTROL
335	SOLENOID, TCC CONTROL
337	O-RING, TCC CONTROL SOLENOID
338	O-RING, TCC CONTROL SOLENOID
339	VALVE, TCC REGULATED APPLY
340	SPRING, TCC REGULATED APPLY VALVE

Figure 206

AUTOMATIC TRANSMISSION SERVICE GROUP

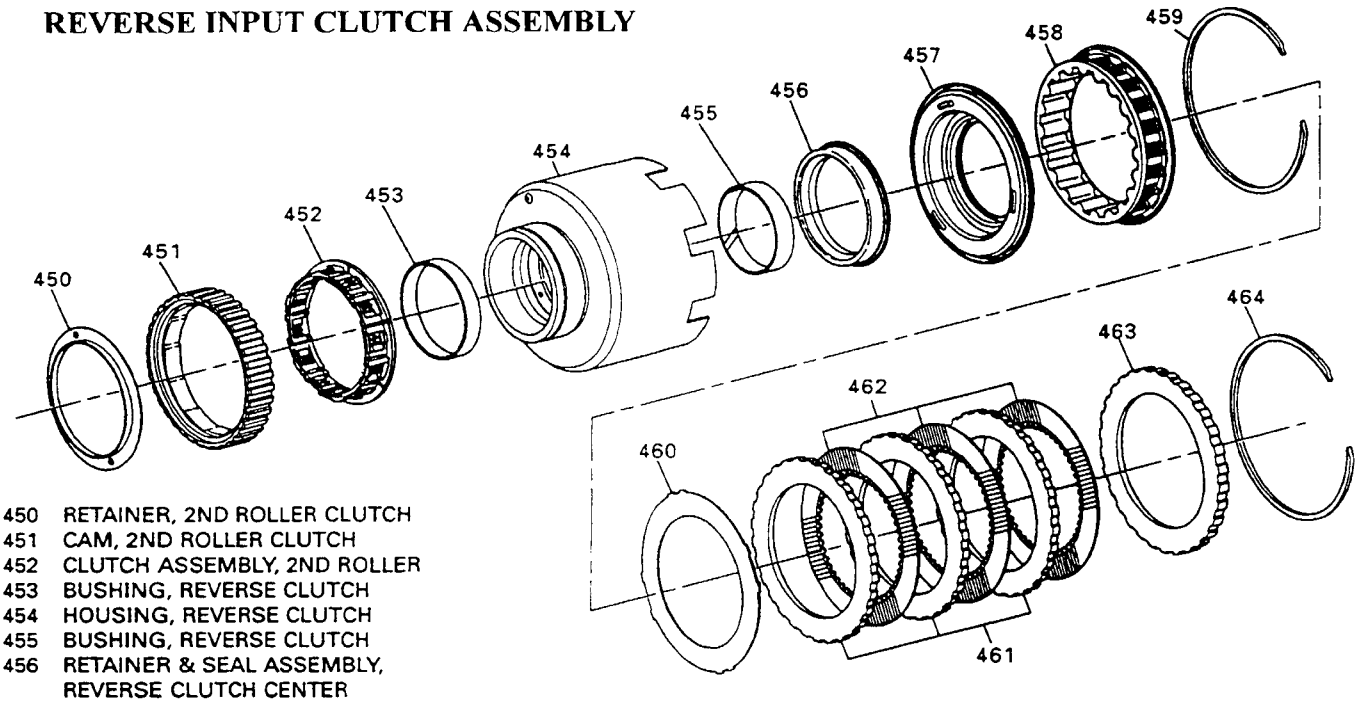
DRIVEN SPROCKET SUPPORT ASSEMBLY



400 BEARING, DRIVEN SPROCKET SUPPORT
401 SUPPORT, DRIVEN SPROCKET
402 BUSHING, DRIVEN SPROCKET SUPPORT
403 RING, OIL SEAL
404 PISTON ASSEMBLY, 2ND CLUTCH
405 SPRING ASSEMBLY, 2ND CLUTCH
406 RING, 2ND CLUTCH SPRING RETAINING

Figure 207

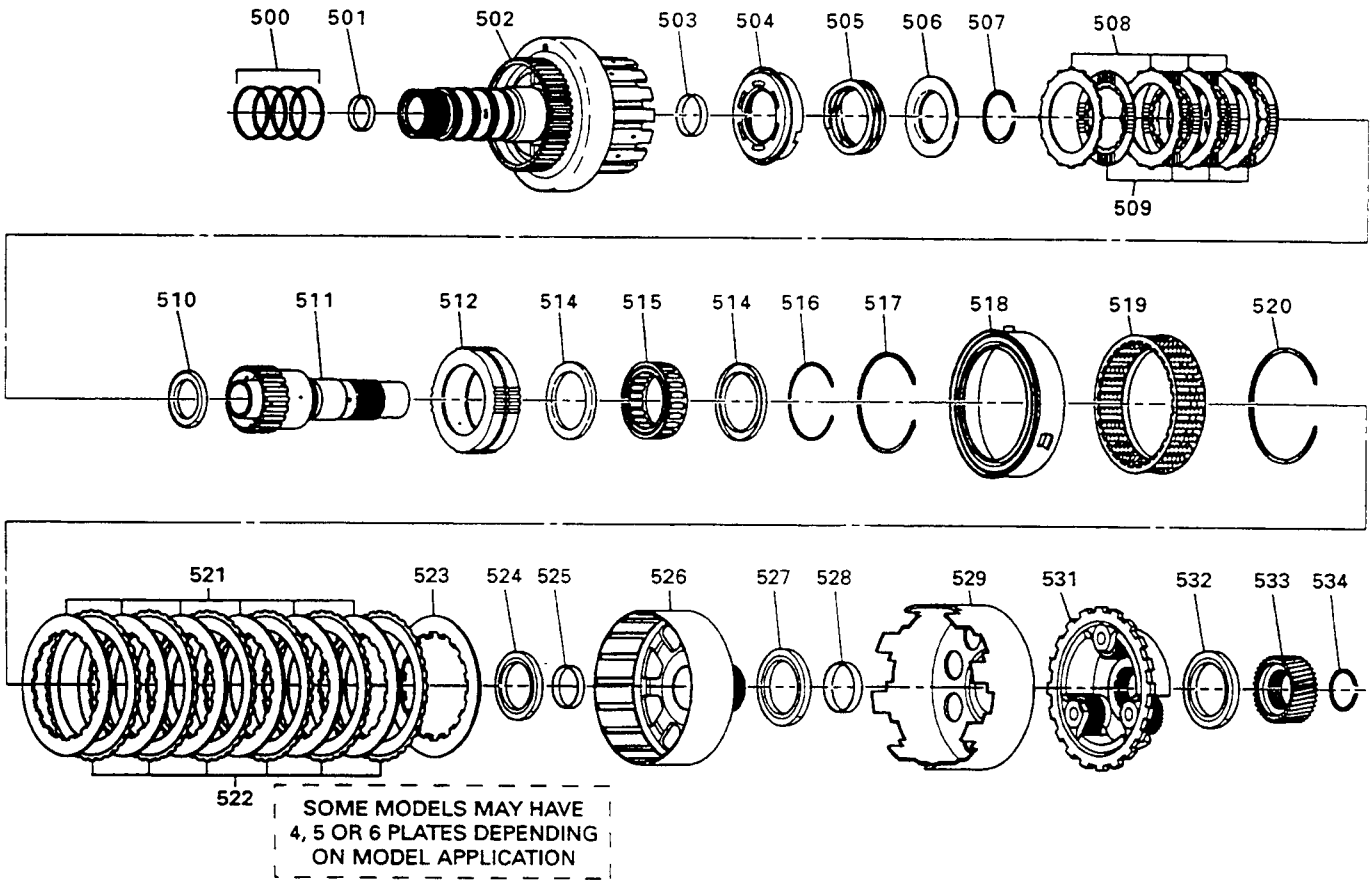
REVERSE INPUT CLUTCH ASSEMBLY



450 RETAINER, 2ND ROLLER CLUTCH
451 CAM, 2ND ROLLER CLUTCH
452 CLUTCH ASSEMBLY, 2ND ROLLER
453 BUSHING, REVERSE CLUTCH
454 HOUSING, REVERSE CLUTCH
455 BUSHING, REVERSE CLUTCH
456 RETAINER & SEAL ASSEMBLY, REVERSE CLUTCH CENTER
457 PISTON ASSEMBLY, REVERSE CLUTCH
458 SPRING & RETAINER ASSEMBLY, REVERSE CLUTCH
459 RING, SNAP (REVERSE CLUTCH SPRING RETAINER)
460 PLATE, REVERSE CLUTCH (WAVED)
461 PLATE, REVERSE CLUTCH (STEEL)
462 PLATE, REVERSE CLUTCH (FIBER)
463 PLATE, REVERSE CLUTCH (BACKING) SELECTIVE
464 RING, SNAP (REVERSE CLUTCH)

Figure 208

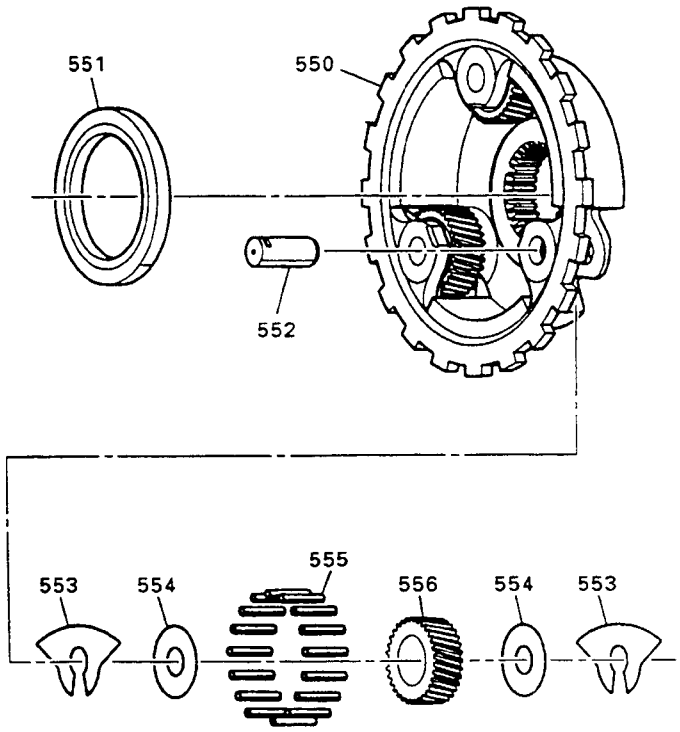
DIRECT AND COAST CLUTCH ASSEMBLIES



500 RING, OIL SEAL - INPUT SHAFT
501 BUSHING, INPUT SHAFT
502 HOUSING, DIRECT & COAST CLUTCH AND INPUT SHAFT
503 BUSHING, DIRECT CLUTCH HOUSING TO OUTPUT SHAFT
504 PISTON ASSEMBLY, COAST CLUTCH
505 SPRING, COAST CLUTCH RELEASE
506 RETAINER, COAST CLUTCH SPRING
507 RING, SNAP (COAST CLUTCH SPRING RETAINER)
508 PLATE, COAST CLUTCH (STEEL)
509 PLATE, COAST CLUTCH (FIBER)
510 BEARING, THRUST
511 SHAFT AND INNER RACE ASSEMBLY, INPUT SUN GEAR
512 RACE, OUTER (INPUT SPRAG)
514 END BEARINGS, SPRAG CLUTCH (2)
515 SPRAG ASSEMBLY, INPUT
516 RING, SNAP (OUTER RACE TO SPRAG ASSEMBLY)
517 RING, SNAP (DIRECT/COAST CLUTCH RETAINING)
518 PISTON ASSEMBLY, DIRECT CLUTCH
519 SPRING AND RETAINER ASSEMBLY, DIRECT CLUTCH
520 RING, DIRECT CLUTCH SPRING RETAINER
521 PLATE, DIRECT CLUTCH (STEEL)
522 PLATE, DIRECT CLUTCH (FIBER)
523 PLATE, DIRECT CLUTCH (BACKING)
524 BEARING, THRUST
525 BUSHING, REACTION CARRIER SHAFT
526 SHELL, REACTION CARRIER SHAFT
527 BEARING, THRUST (CARRIER SHAFT TO SHELL)
528 BUSHING, REACTION SUN GEAR
529 SHELL, REACTION SUN
531 CARRIER ASSEMBLY, REACTION
532 BEARING, THRUST (REACTION CARRIER TO SUN GEAR)
533 GEAR, INPUT SUN
534 RING, SNAP

Figure 209

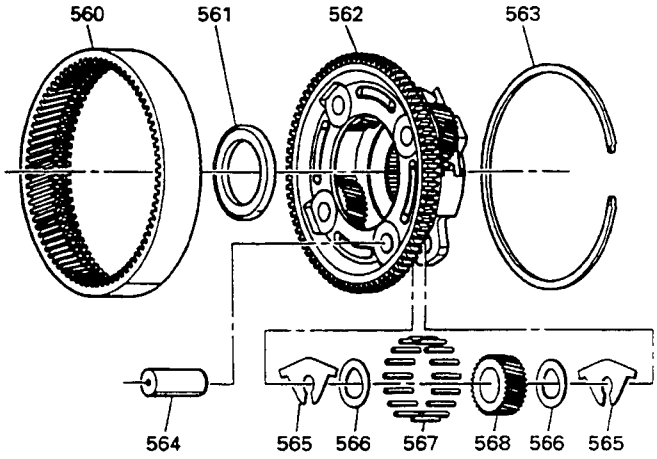
REACTION CARRIER ASSEMBLY



550 CARRIER, REACTION
551 BEARING, THRUST
552 PIN, PLANET PINION
553 WASHER, PINION THRUST REACTION
554 WASHER, PINION THRUST INNER
555 ROLLER NEEDLE BEARING
556 GEAR, REACTION PLANET PINION

Figure 210

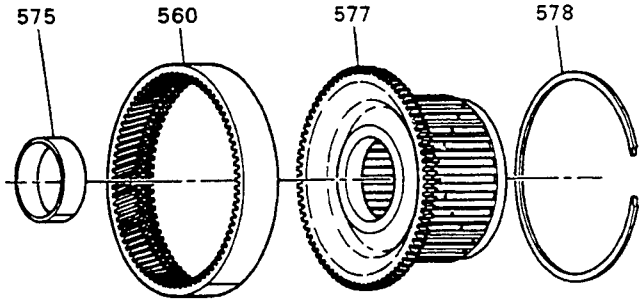
INPUT CARRIER ASSEMBLY



560 GEAR, INTERNAL (INPUT AND REACTION)
561 BEARING, THRUST
562 CARRIER, INPUT
563 RING, SNAP (INPUT CARRIER TO INTERNAL GEAR)
564 PIN, PLANET PINION
565 WASHER, PINION THRUST INPUT
566 WASHER, PINION THRUST INNER
567 ROLLER NEEDLE BEARING
568 GEAR, PINION

Figure 211

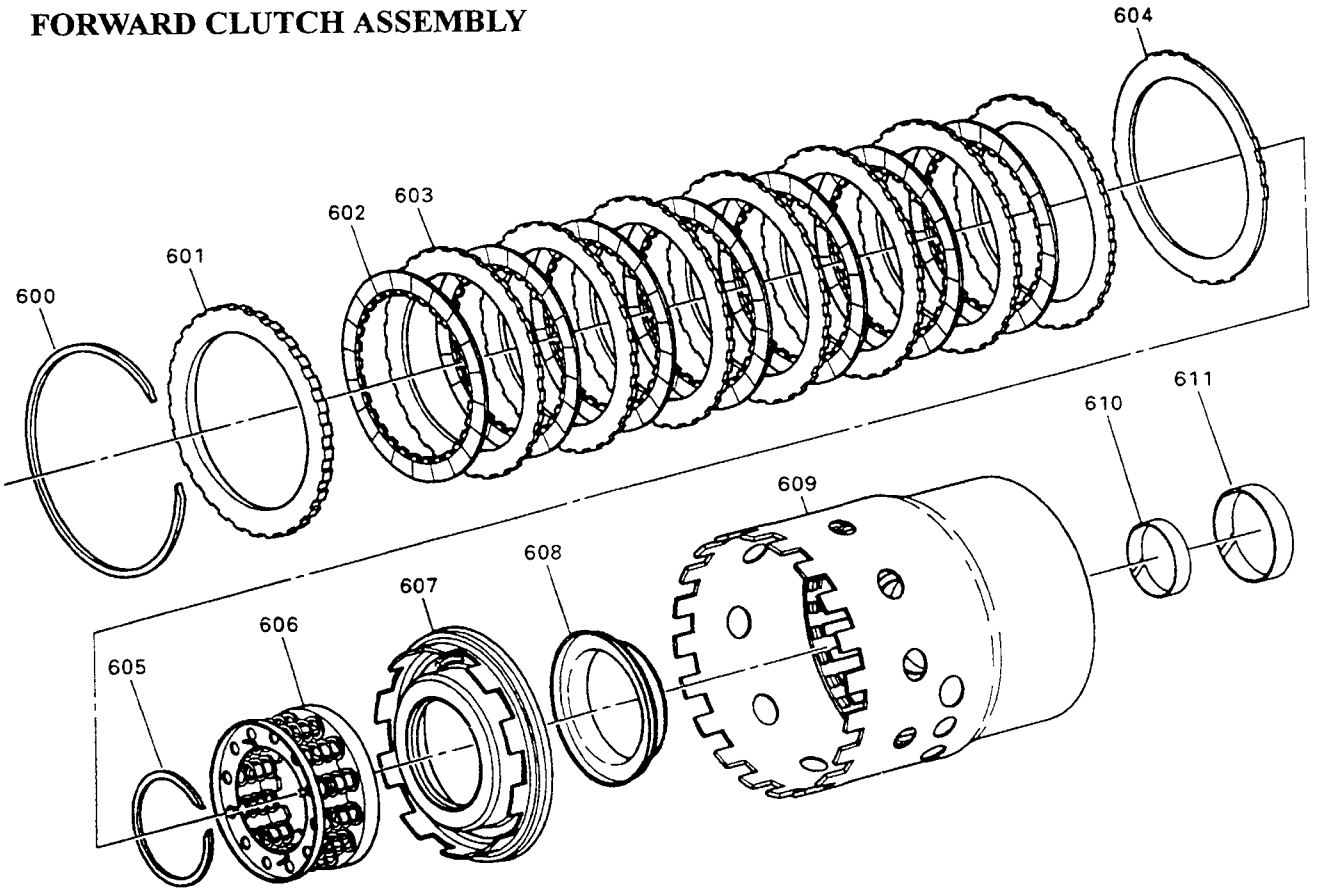
INPUT RING GEAR AND FORWARD CLUTCH HUB



560 GEAR, INTERNAL (INPUT AND REACTION)
575 BUSHING, INPUT FLANGE
577 INPUT FLANGE AND FORWARD CLUTCH HUB
578 RING, SNAP (INPUT INTERNAL GEAR TO INPUT FLANGE)

Figure 212

FORWARD CLUTCH ASSEMBLY



600 RING, SNAP (FORWARD CLUTCH)
601 PLATE, FORWARD CLUTCH (BACKING)
602 PLATE, FORWARD CLUTCH (FIBER)
603 PLATE, FORWARD CLUTCH (STEEL)
604 PLATE, FORWARD CLUTCH (WAVED)
605 RING, SNAP (FORWARD CLUTCH SPRING ASSEMBLY)
606 SPRING ASSEMBLY, FORWARD CLUTCH RETURN
607 PISTON ASSEMBLY, FORWARD CLUTCH
608 SEAL AND SLEEVE ASSEMBLY, FORWARD CLUTCH INNER
609 HOUSING, FORWARD CLUTCH
610 BUSHING, FORWARD CLUTCH SUPPORT
611 BUSHING, FORWARD CLUTCH SUPPORT

Figure 213

FORWARD CLUTCH SUPPORT ASSEMBLY

650 BUSHING, FINAL DRIVE SUN SHAFT
651 SHAFT, FINAL DRIVE SUN
652 CLUTCH ASSEMBLY, LO ROLLER
653 BEARING, THRUST
654 RING, OIL SEAL (FORWARD CLUTCH SUPPORT)
655 BUSHING, FORWARD CLUTCH SUPPORT
656 SUPPORT, FORWARD CLUTCH
657 BUSHING, FORWARD CLUTCH SUPPORT
658 BEARING, THRUST (FORWARD SUPPORT TO PARK GEAR)
659 GEAR, PARK LOCK
660 RING, SNAP (FINAL DRIVE SUN SHAFT)
661 SHAFT, PARKING LOCK PAWL
662 SPRING, PARKING LOCK PAWL RETURN
663 PAWL, PARKING LOCK

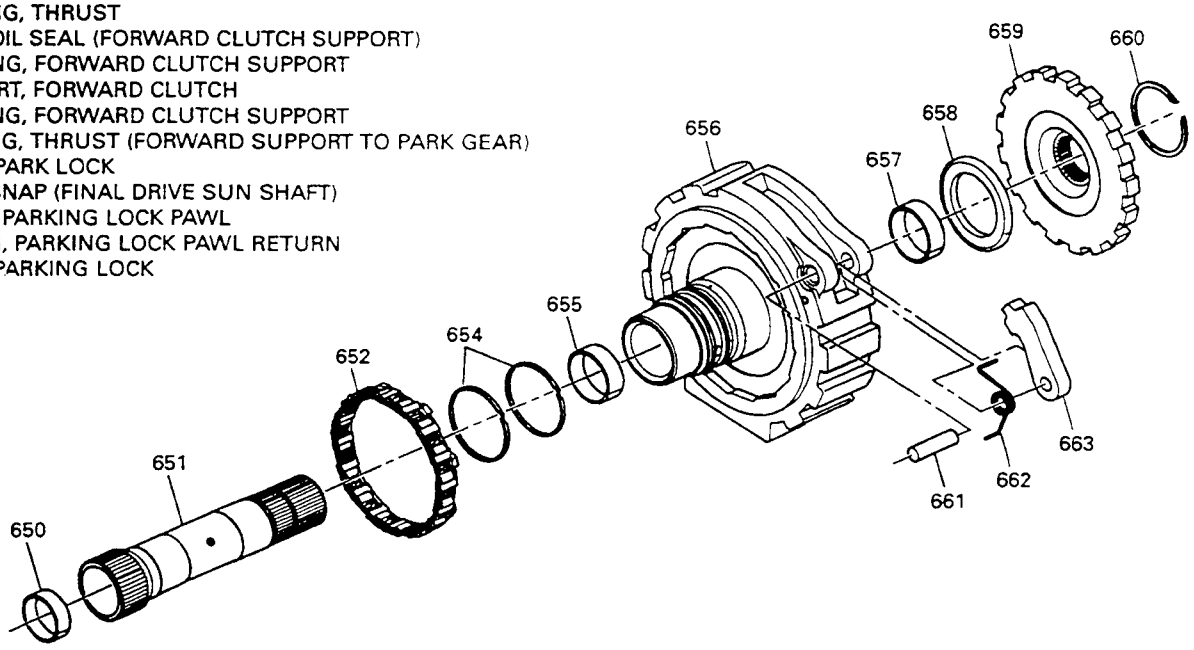


Figure 214

FINAL DRIVE ASSEMBLY

700 BEARING, THRUST
701 RING, SPIRAL PIN RETAINING
702 CARRIER, DIFFERENTIAL & FINAL DRIVE
703 SHAFT, DIFFERENTIAL PINION
704 PIN, DIFFERENTIAL PINION SHAFT RETAINING
705 ROTOR, SPEED SENSOR
706 WASHER, THRUST (DIFFERENTIAL PINION)
707 GEAR, DIFFERENTIAL PINION
708 WASHER, THRUST (DIFFERENTIAL SIDE GEAR)
709 GEAR, DIFFERENTIAL SIDE
710 WASHER, PINION THRUST
711 GEAR, PINION (FINAL DRIVE PLANET)
712 ROLLER NEEDLE BEARING
713 SPACER, PINION NEEDLE BEARING
714 PIN, PLANET PINION

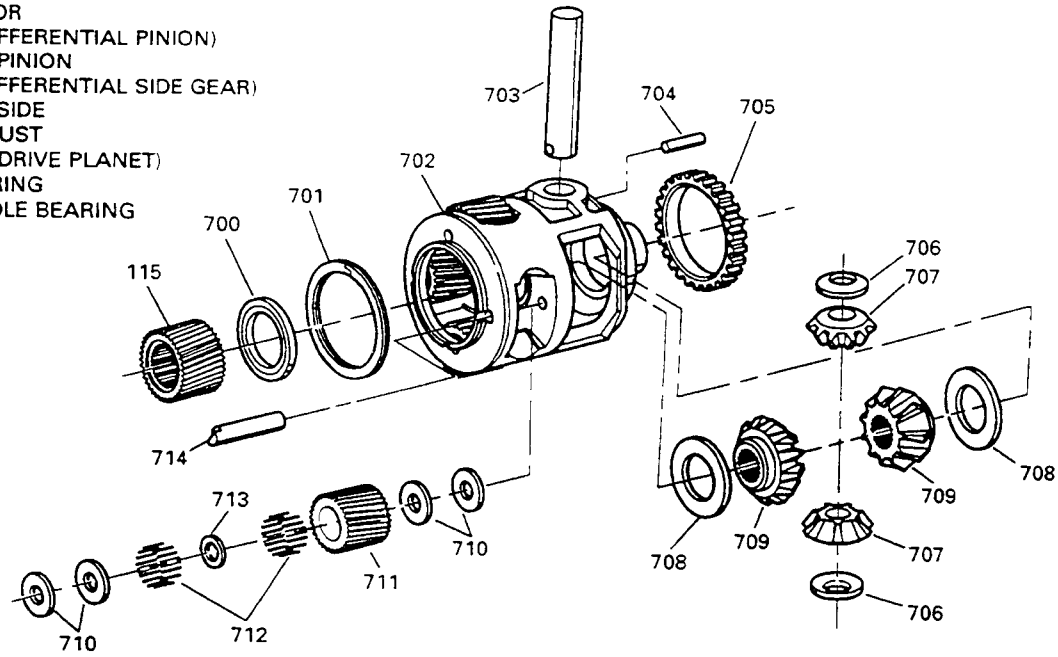
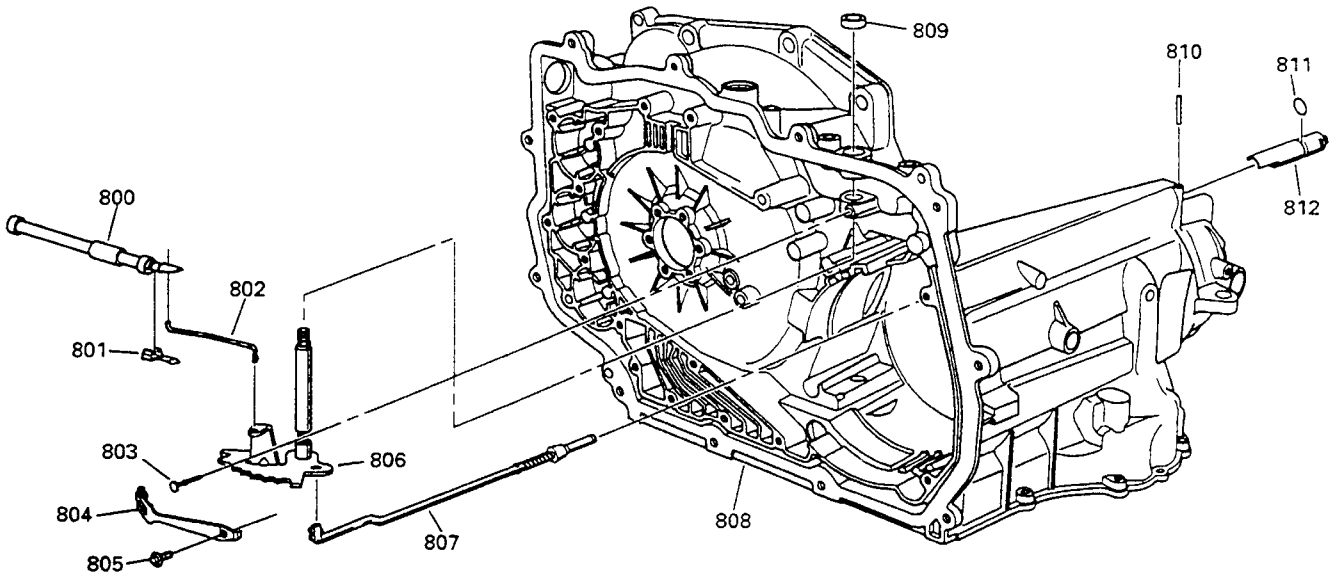


Figure 215



800 VALVE, MANUAL	806 MANUAL SHAFT AND DETENT LEVER ASSEMBLY
801 CLIP, MANUAL VALVE TO LINK	807 PARKING LOCK ACTUATOR ASSEMBLY
802 LINK, MANUAL VALVE TO DETENT LEVER	808 CASE, TRANSAXLE
803 PIN, MANUAL SHAFT TO CASE	809 SEAL, MANUAL SHAFT TO CASE
804 SPRING AND ROLLER ASSEMBLY, MANUAL DETENT	810 PIN, SPRING (ACTUATOR GUIDE)
805 BOLT, SPRING AND ROLLER ASSEMBLY TO CHANNEL PLATE	811 SEAL, ACTUATOR GUIDE
	812 ACTUATOR GUIDE

Figure 216

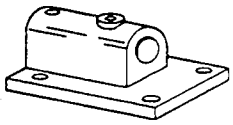
TORQUE SPECIFICATIONS

	FOOT POUNDS	NEWTON METERS
DRIVE SPROCKET SUPPORT TO CASE	9	12
TURBINE SPEED SENSOR TO CASE	9	12
WIRE HARNESS BRACKET TO CASE	9	12
CHANNEL PLATE TO CASE	9	12
CHANNEL PLATE TO DRIVEN SPROCKET SUPPORT	10.5	14
VALVE BODY TO CHANNEL PLATE	9	12
PRESSURE SWITCH ASSEMBLY TO VALVE BODY	9	12
OIL PUMP TO VALVE BODY	9	12
SIDE COVER TO CASE	15	20
OUTPUT SPEED SENSOR TO CASE	9	12
INTERMEDIATE/4TH SERVO TO CASE	9	12
LO/REVERSE SERVO TO CASE	9	12
OIL FEED PIPE ASSEMBLY	9	12
BOTTOM PAN BOLTS	8	10

Figure 217

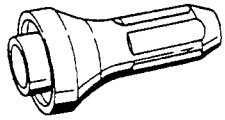
SPECIAL TOOLS

Transmission Support Fixture Base



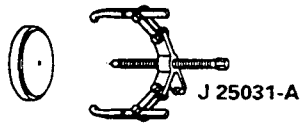
J 3289-20

Torque Converter Seal Installer



J 28540-A

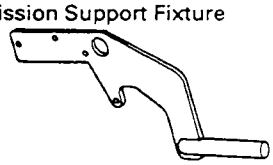
Forward and Reverse Clutch Inner Seal Assembly Remover



J 41097

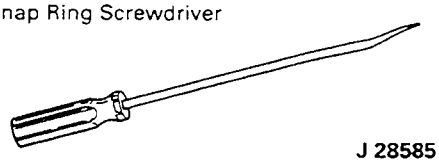
J 25031-A

Transmission Support Fixture



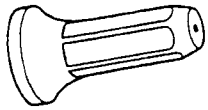
J 41230

Snap Ring Screwdriver



J 28585

Forward Clutch Inner Seal Assembly Installer

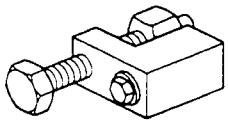


J 41231

Slide Hammer

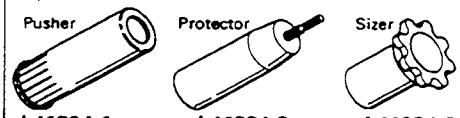
J 6125-1B

Cooler Line Seal Installer



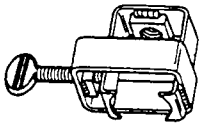
J 41239-1

Input Shaft Seal Installer Set



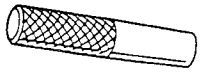
J 41234-1 J 41234-2 J 41234-3

Stub Shaft Sleeve Remover



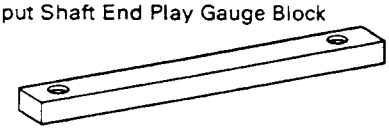
J 38868

Manual Shaft to Case Pin



J 41229

Input Shaft End Play Gauge Block

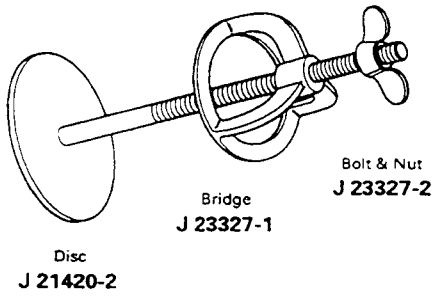


J 34673

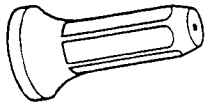
Output Shaft Sleeve Remover

J 41227

Clutch Spring Compressor

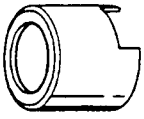


Reverse Clutch Inner Seal Installer



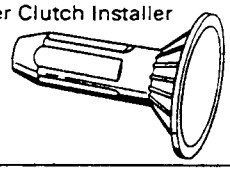
J 41233

Pass Through Connector Remover



J 41101

2nd Roller Clutch Installer

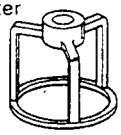


J 41235

Assembly Lubricant

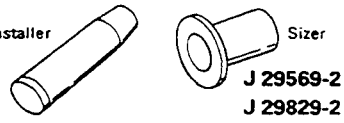
J 36850

Coast Clutch Return Spring Compressor Adapter



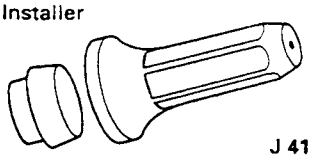
J 41236

Turbine Shaft Seal Installers and Sizers (1 Seal)



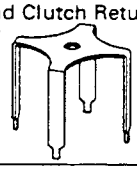
J 29569-1 J 29569-2
J 29829-1 J 29829-2

Axle Seal Installer



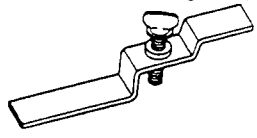
J 41102

Direct, Reverse, & 2nd Clutch Return Spring Compressor Adapter



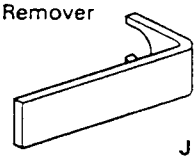
J 41232

Torque Converter Holding Strap



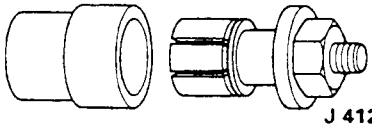
J 21366

Cooler Line Seal Remover



J 41239-2

Stub Shaft Sleeve Installer



J 41228

Figure 218

1 COVER, SIDE (STRUCTURAL)
2 SEAL, AXLE OIL
3 BOLT, SIDE COVER
4 STUD, SIDE COVER
5 GASKET, SIDE COVER
6 GASKET, SIDE COVER OIL LEVEL CONTROL
7 WASHER, THRUST (SIDE COVER TO DRIVEN SPROCKET)
8 BOLT, OIL PUMP
9 BOLT, OIL PUMP
10 PUMP ASSEMBLY, TRANSAXLE OIL
11 WIRING ASSEMBLY, TRANSAXLE
12 BOLT, PRESSURE SWITCH ASSEMBLY
13 PRESSURE SWITCH ASSEMBLY (PSA)
15 BOLT, WIRING HARNESS BRACKET
BOLT, INPUT SPEED SENSOR
16 BOLT, VALVE BODY
17 FILTER
18 BODY ASSEMBLY, CONTROL VALVE
19 SHAFT, OIL PUMP DRIVE
20 BOLT, SPACER PLATE SUPPORT
21 SUPPORT, SPACER PLATE
22 GASKET, VALVE BODY TO SPACER PLATE
23 PLATE, VALVE BODY SPACER
24 GASKET, SPACER PLATE TO CHANNEL PLATE
25 BOLT, CHANNEL PLATE
BOLT, SERVO COVER
26 CHECKBALLS (7)
27 PLATE, CHANNEL
28 GASKET, CASE TO CHANNEL PLATE
29 PISTON, ACCUMULATOR (1-2, 2-3 AND 3-4)
30 SEAL, ACCUMULATOR PISTON (1-2, 2-3 AND 3-4)
31 SPRING, 1-2 ACCUMULATOR PISTON
32 SPRING, 2-3 AND 3-4 ACCUMULATOR PISTON
33 SEAL, (TURBINE SHAFT TO SPROCKET)
34 WASHER, THRUST (CHANNEL PLATE TO DRIVE SPROCKET)
35 RING, SNAP (TURBINE SHAFT TO DRIVE SPROCKET)
36 LINK ASSEMBLY, DRIVE
37 SPROCKET, DRIVE
38 WASHER, THRUST (DRIVE SPROCKET TO SUPPORT)
39 SHAFT, TURBINE
40 SEAL, (TURBINE SHAFT TO SUPPORT)
41 SEAL, O-RING (TORQUE CONVERTER)
42 BEARING, DRIVE SPROCKET SUPPORT
43 SUPPORT, DRIVE SPROCKET
44 BUSHING, DRIVE SPROCKET SUPPORT
45 PIN, DOWEL (CHANNEL PLATE TO CASE)
46 SENSOR, INPUT SPEED
47 SPRING, 1-2 ACCUMULATOR PISTON CUSHION
48 PLUG, LINE PRESSURE TAP
49 SEAL, COOLER PIPE
51 CASE, TRANSAXLE
52 CAP, VENT
53 SCREW, DRIVE SPROCKET SUPPORT
54 SEAL, CONVERTER
55 TORQUE CONVERTER ASSEMBLY
56 SLEEVE, OUTPUT/STUB SHAFT
57 RING, OUTPUT/STUB SHAFT SNAP
58 SHAFT, OUTPUT STUB
60 BUSHING, CASE TO FINAL DRIVE
61 STUD, OUTPUT SPEED SENSOR
62 SENSOR, OUTPUT SPEED
63 SEAL, O-RING (OUTPUT SPEED SENSOR)
64 PIN, BAND ANCHOR - LO/REVERSE
65 PLUG, OIL LEVEL CONTROL
66 SPRING, SERVO RETURN (LO/REVERSE)
67 PIN, SERVO APPLY (LO/REVERSE)
68 SPRING, SERVO CUSHION
69 PISTON, SERVO (LO/REVERSE)
70 RING, SERVO SNAP
71 SEAL, SERVO PISTON (LO/REVERSE)
72 SEAL, SERVO COVER (LO/REVERSE)
73 COVER, SERVO (LO/REVERSE)
75 SPRING, SERVO RETURN (INTERMEDIATE/4TH)
76 PIN, SERVO APPLY (INTERMEDIATE/4TH)
77 PISTON, SERVO (INTERMEDIATE/4TH)
78 SEAL, SERVO PISTON (INTERMEDIATE/4TH)
79 SEAL, SERVO COVER (INTERMEDIATE/4TH)
80 COVER, SERVO (INTERMEDIATE/4TH)
81 BOLT, TUBE ASSEMBLY
BOLT, BOTTOM PAN
82 SEAL, OIL FEED TUBE ASSEMBLY
83 TUBE ASSEMBLY, OIL FEED
84 SEAL, TRANSAXLE OIL FILTER
85 FILTER ASSEMBLY, TRANSAXLE OIL
86 VALVE, OIL LEVEL CONTROL
87 GASKET, TRANSAXLE BOTTOM PAN
88 PAN, TRANSAXLE OIL
89 MAGNET, CHIP COLLECTOR
91 SPROCKET, DRIVEN
92 WASHER, THRUST (DRIVEN SPROCKET TO SUPPORT)
94 SHAFT, OUTPUT
95 SUPPORT ASSEMBLY, DRIVEN SPROCKET
96 PLATE, 2ND CLUTCH WAVED
97 PLATE, 2ND CLUTCH STEEL
98 PLATE, 2ND CLUTCH FIBER
99 PLATE, 2ND CLUTCH BACKING
100 BAND, INTERMEDIATE/4TH
101 WASHER, THRUST (SUPPORT TO REVERSE INPUT CLUTCH)
102 CLUTCH ASSEMBLY, REVERSE INPUT
103 BEARING, THRUST
104 WASHER, THRUST (SELECTIVE)
105 CLUTCH ASSEMBLY, DIRECT & COAST
106 CARRIER ASSEMBLY, INPUT
107 BEARING, THRUST
108 INPUT FLANGE & FORWARD CLUTCH HUB ASSEMBLY
109 WASHER, THRUST
110 CLUTCH ASSEMBLY, FORWARD
111 BAND, LO/REVERSE
112 RING, SNAP (FORWARD CLUTCH SUPPORT TO CASE)
113 BEARING, THRUST
114 SUPPORT ASSEMBLY, FORWARD CLUTCH
115 GEAR, SUN (FINAL DRIVE)
116 DIFFERENTIAL AND FINAL DRIVE ASSEMBLY
117 BEARING, THRUST
118 GEAR, FINAL DRIVE INTERNAL
119 RING, FRETTING (INTERNAL GEAR TO CASE)

Figure 204 Legend

manuales digitales JC

El secreto de los Mecánicos Profesionales es la utilización de los Manuales Técnicos.

Garantice su trabajo siguiendo las instrucciones de los fabricantes...