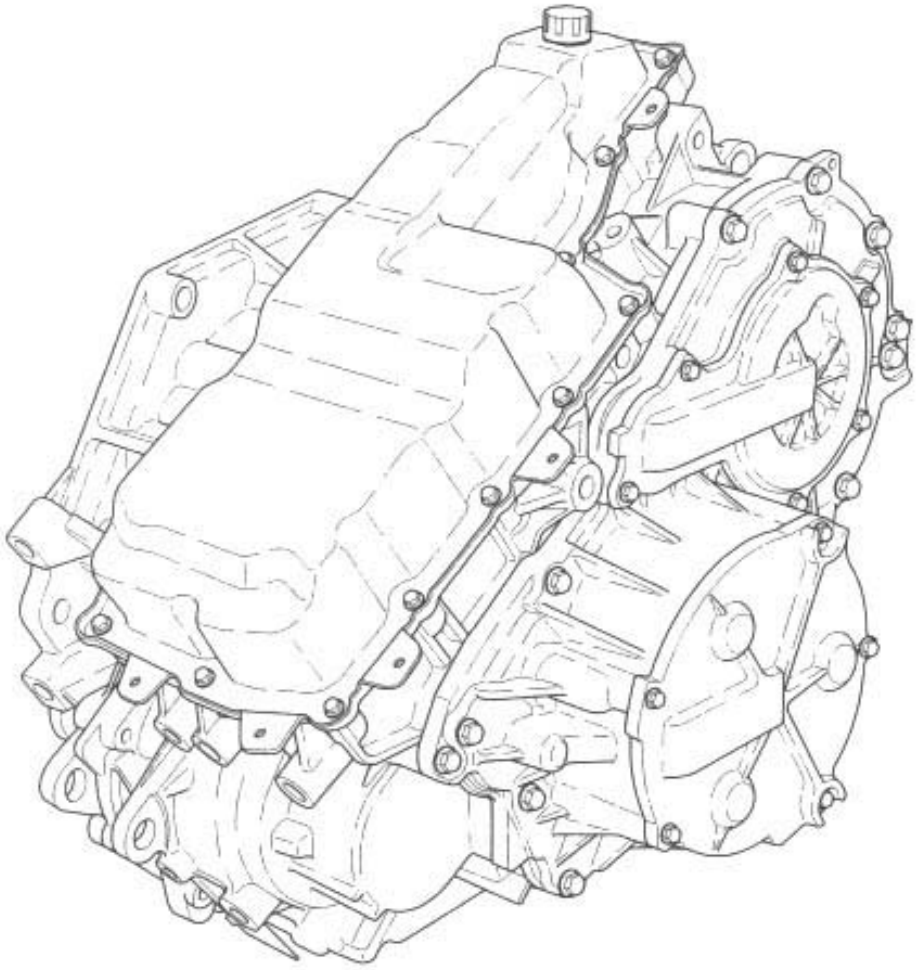
SATURN CVT

KWIKNOTES



Produced by AAMCO Transmissions Inc. Technical Services Department

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Transmission Identification Information

VT 2OE/25E

The VT-20E and VT-25E automatic transaxles were introduced into the GM fleet for 2002 on the Saturn CVT and Saturn Ion applications. The transaxles are produced by GM Powertrain division in their European plant located in Hungary. Both the VT-20E and the VT-25E applications are many times referred to as ”Variable Transmissions” or "CVT's". The primary difference between the VT-20E and the VT-25E is the units input torque capacity. Operationally the units are identical.

The VT-25E is available in two versions, 2WD (RPO M75) and AWD (RPO M16).

Construction and Operation

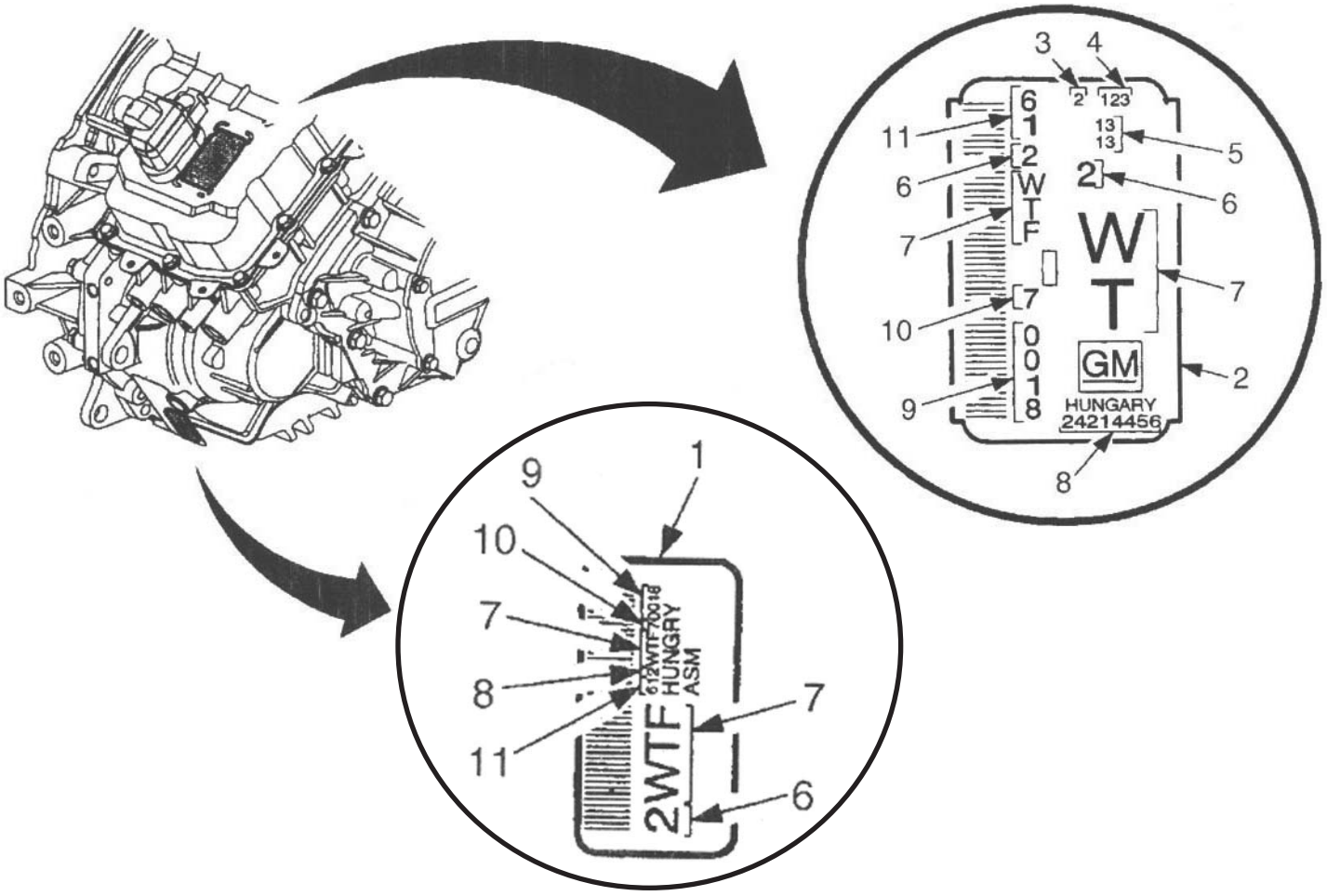
The VT-20E/25E applications utilize the following components:

- 2 Multiple disc clutches (1 forward, 1 reverse)
- 2 Variable diameter pulleys
- 1 Drivebelt
- 1 Planetary gear set
- 1 Control valve body (11 valves, 3 check balls)
- 1 Ratio control "stepper" motor
- 3 Control solenoids (Line pressure, Neutral/Idle/TCC PWM, Neutral/Idle/TCC ON/OFF)
- 1 Pressure sensor
- 1 Transmission fluid temperature sensor
- 2 Speed sensors (1 input, 1 output)

Vehicle Application

Application	Transaxle Model (RPO Code)
Saturn Vue 2.2L	
AWD	VT25-E (M75)
FWD	VT25-E (M16)

Transmission Identification Information



1	Transaxle ID Sticker Location
2	Transaxle ID Metal Tag Location
3	Calendar Year
4	Julian Date
5	Shift & Line Number
6	Model Year
7	Model
8	Transaxle Part Number
9	Serial Number
10	Hungary Plant
11	Transaxle

Fluid Information

Fluid Type and Capacity

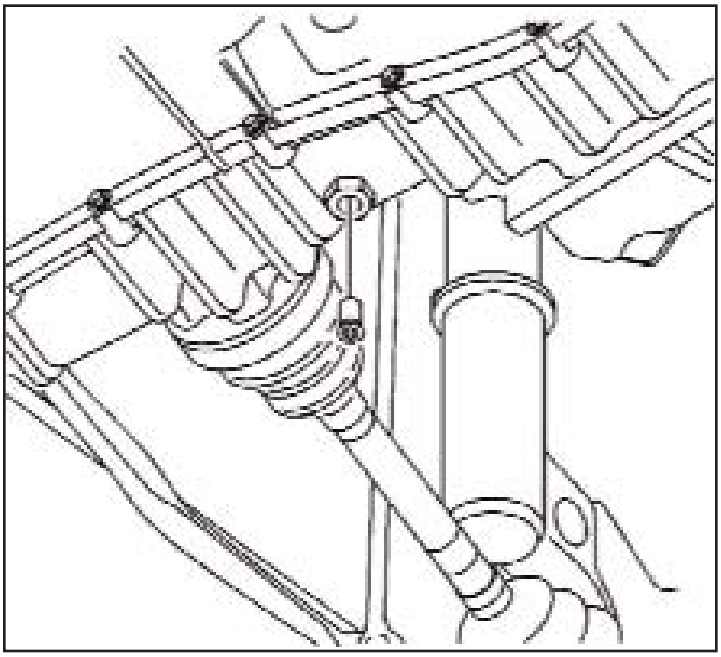
Fluid Type		
Saturn Transaxle Fluid (Part Number 22688912) only.		
Application	*Drain & Refill - Qts. (L)	Overhaul - Qts. (L)
VT25E**	7.0 (6.5)	8.1 (7.7)

* Drain and refill capacity does not include torque converter.
** Transaxle is not equipped with a dipstick. To check transaxle fluid level use lower tube plug.

NOTE **SATURN ATF (PART NUMBER 21005966 AND 21019223) AND DEXRON-III ATF ARE NOT COMPATIBLE WITH THIS TRANSAXLE.**

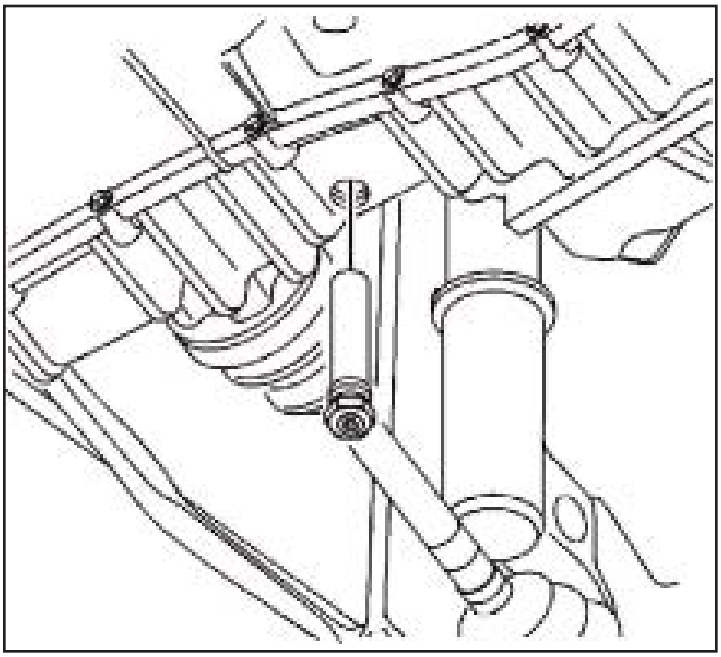
THIS TRANSAXLE USES SATURN TRANSAXLE FLUID (PART NUMBER 22688912) ONLY!

Transmission Fluid Replacement



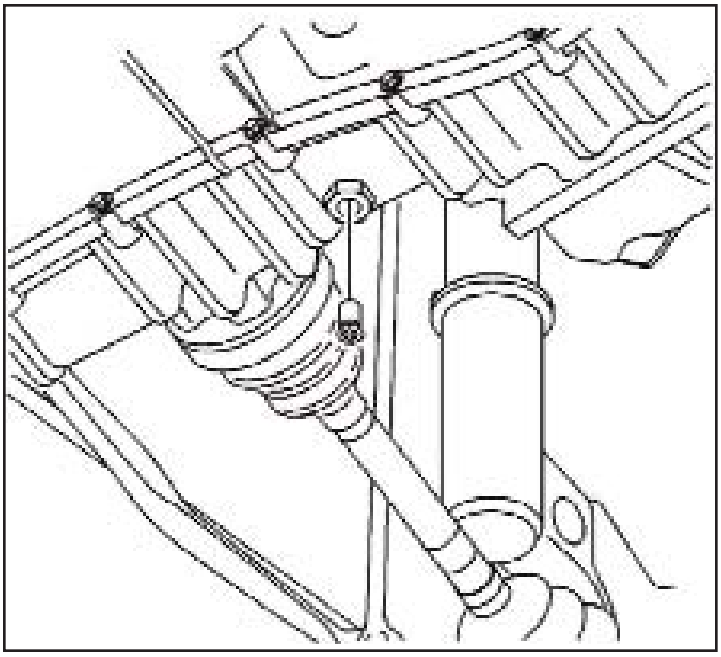
1. Raise and support the vehicle.
2. Place a drain pan under the transmission.
3. Remove the lower tube assembly drain plug.

Transmission Fluid Replacement



4. Remove the lower tube assembly from the transmission. Allow the fluid to completely drain.

5. Install the lower tube assembly into the transmission. Tighten the assembly to 20 N•m (15 lb ft).



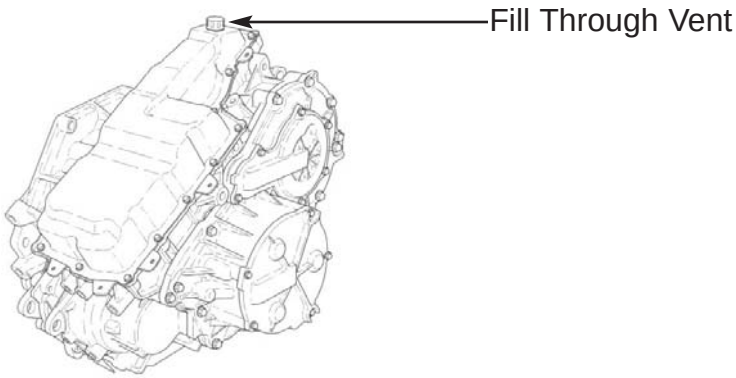
6. Temporarily install the original lower tube plug. Tighten only until snug.

7. Lower the vehicle.

Transmission Fluid Replacement

IMPORTANT **USE SATURN DEX-CVT® FLUID PART NUMBER 22688912 ONLY! NO OTHER FLUIDS ARE COMPATIBLE WITH THIS TRANSMISSION.**

8. Start by filling the transmission through vent cap to the proper drain and refill capacity, (7.0 qts) page 3, with Saturn DEX-CVT® Fluid Part Number 22688912.



9. Install a scan tool.
10. With the vehicle on a flat and level surface, start the vehicle.
11. Circulate the fluid through the transmission using the following procedure:
    A) With the brake applied, shift the transmission from the PARK (P) to REVERSE (R) for 10 seconds.
    B) Shift the transmission to DRIVE (D) for 10 seconds.
    C) Shift the transmission to PARK (P), allowing the engine to remain running.
12. Raise and support the vehicle.
13. Remove the lower tube assembly drain plug and discard.
14. Perform the following procedure to assure proper fluid level:
    - If the fluid drains down at a steady stream from the opening, allow the fluid to drain until it stops. This will drain the fluid to the proper level.
    - If no fluid or a very small amount of fluid drains, add fluid to the transmission until a steady stream starts to drain. Stop adding fluid immediately. Allow the fluid to drain until it stops.
15. Install a **new** lower tube assembly drain plug and clean any excess fluid from the transmission. Tighten the plug to 11 N·m (97 lb in).
16. Lower the vehicle.
17. To now properly complete, filling the transmission, use a scan tool to record the TRANS FLUID TEMP.
    - If the TRANS FLUID TEMP is 20°C (68°F) or less, add 0.47 liter (0.5 qt) of fluid to the transmission.
    - If the TRANS FLUID TEMP is 40°C (104°F), add 0.71 liter (0.75 qt) of fluid to the transmission.
    - If the TRANS FLUID TEMP is 60°C (140°F), add 0.95 liter (1.0 qt) of fluid to the transmission.
    - If the TRANS FLUID TEMP is 80°C (176°F), add 1.2 liter (1.25 qt) of fluid to the transmission.
18. Turn OFF the ignition.
19. Add Saturn DEX-CVT® additive Part Number 22697447 to the transmission using the provided applicator. Inject the entire contents into the transmission.

Theory of Operation

The VT20-E/VT25-E is a fully-automatic, continuously-variable, front-wheel drive transmission. It consists primarily of a four-element torque converter, one planetary gear set, an electronic hydraulic pressurization and control system, two variable drive pulleys, two friction clutches and 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 transmission. 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 transmission.

The planetary gear set provides REVERSE. Changing drive ratios is fully automatic and is accomplished through the use of a transmission control module (TCM). The TCM receives and monitors various electronic sensor inputs and uses this information to control the transmission ratios at the most optimum time.

The ratio control motor is used to change drive ratios, and feedback from the speed sensors supplies information to the TCM. The TCM then uses this information to determine when to apply and release the torque converter clutch. This allows the engine to deliver the maximum fuel efficiency without sacrificing vehicle performance.

The hydraulic system primarily consists of a vane type pump, a control valve body, a control solenoid valve assembly, a case and a case cover. The pump maintains the working pressures needed to stroke the clutch pistons that apply or release the friction components. These friction components, when applied or released, support the forward or reverse ranges of the transmission.

The hydraulic system supplies pressurized fluid to the variable drive and driven pulley assemblies to provide accurate variable ratio-controlled output torque to the differential.

The transmission can be operated in any one of the six different positions shown on the shift quadrant.

Shift Quadrant Positions

Gear	Description
P	This position enables the engine to be started while preventing the vehicle from rolling either forward or backward. For safety reasons, the vehicle parking brake should be used in addition to the transmission “PARK” position. Since, the front differential carrier assembly is mechanically locked to the case through the park pawl, variable driven pulley assembly and front differential drive pinion gear assembly, PARK position should not be selected until the vehicle has come to a complete stop.
R	This position enables the vehicle to be operated in a rearward direction.
N	This position enables the engine to start and operate without driving the vehicle.
D	Drive range should be used for all normal driving conditions for maximum efficiency and fuel economy. Drive range allows the transmission to operate in the full range of variable ratios. Drive allows low to high ratios without any limitations, and torque converter clutch apply.
I	Intermediate can be used for conditions where it may be desirable to use only low and intermediate ratios. These conditions include towing a trailer and driving on hilly terrain as described above. The variable ratios are the same as in Drive range except that the variable drive pulleys will not be allowed to achieve the higher ratios.
Low	Low can be selected at any vehicle speed. If the transmission is in Drive or Intermediate range, it will immediately change the ratio to low when vehicle speed is below approximately 56 km/h (35 mph). This is particularly beneficial for maintaining maximum engine braking when descending steep grades. With low range selected, the variable drive pulleys will not be allowed to achieve the high or intermediate ratios.

Ratio Control

To control the VT-20/25E ratio, a bi-directional stepper motor is used. The motor controls the position of the variable ratio control valve. The position of the variable ratio control valve is used to determine the amount of hydraulic pressure that is allowed to travel to the variable drive and driven pulleys. Valve position is determined by the ratio control motor position and the position to the variable drive pulley. A compound lever assembly is attached to the variable ratio control valve, the ratio control motor and the variable drive pulley. As the ratio control motor commanded, position changes the variable ratio control, valve position changes also, allowing more or less fluid into the variable pulley hydraulic system. As the position of the variable ratio pulley changes, so does the position of the variable ratio control valve. This action is used to balance or offset the position of the variable ratio motor to allow precise control of the variable ratio control valve and pulley position.

As the vehicle accelerates the ratio will start to change. To accomplish this task the TCM will command the ratio control motor to change positions. When changing from a low ratio to a high ratio the ratio control motor will move the variable ratio control valve. In the low ratio position, line pressure from the pump is blocked from traveling through the variable ratio control valve. Line pressure is then fed to the variable driven pulley to force the pulley into the low ratio position.

As the commanded position of the ratio control motor changes so does the position of the variable ratio control valve. This allows some oil pressure into the primary feed circuit which is used to control the position of the variable drive pulley. Primary feed pressure moves the piston within the variable drive pulley toward the belt effectively increasing the size of the drive pulley and the pulley ratio. As the belt begins to push on the pulleys, the force exerted on the variable driven pulley increases dramatically, causing the pulley to overcome the hydraulic force within the variable driven pulley piston chamber. This action forces the variable driven pulley diameter to decrease leading to even higher over all gear ratios.

As the variable drive pulley changes position so does the position of the variable ratio control valve. As primary fluid pressure continues to rise the variable drive pulley will be pushed to its full travel position. With the variable drive pulley at its maximum diameter and the variable driven pulley at its minimum diameter maximum ratio is attained.

If the throttle is held steady the variable ratio control valve will reach a position that allows the valve to block line I fluid from entering or exiting the primary feed circuit. This action stabilizes the position of the variable drive pulley. Line one fluid is still being fed to the variable driven pulley so tension is maintained on the drive belt by the variable driven pulley.

Ratio Control

Forward Ranges

To make the vehicle move forward, the forward clutch must be applied. The forward clutch connects the input shaft to the variable drive pulley. With the forward clutch applied, the planetary gear set will be driven at the same speed and direction as the input shaft. The motion will then be carried through to the variable drive pulley and driven pulleys which will determine the gear ratio. Ratio changes are accomplished by changing the diameter of the drive and driven pulleys.

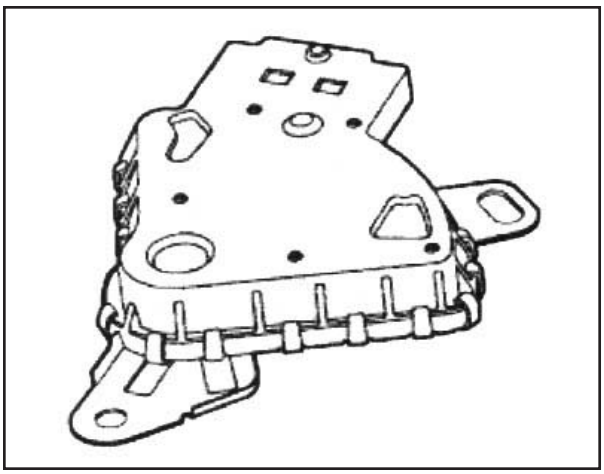
Forward ratios can vary from as high as 2.61-1 to as low as .44-1 depending on load, speed and torque inputs to the TCM. The motion of the variable drive pulley is transferred to the variable driven pulley via the drive belt. The direction the belt rotates causes it to push rather than pull on the pulleys as in other transmission applications.

Similar to other transmission applications, the VT-20/25E provides the customer with manual ranges I, LI. Power flow in L1 or I range is the same as if the selector was placed in drive range with one exception, the VT-20/25E will limit the ratio so that higher ratios (Lower numeric number) are not available. This means that the unit will vary its ratio when the selector is placed in I up to a ratio that is some what less than that attained in D range. Likewise, in L1 range the VT-20/25E will further limit the variable ratios available in manual low range. Engine braking will be available in all forward gear ranges, but again the maximum gear ratios that are able to be attained in I and L1 will provide even greater engine braking.

Reverse

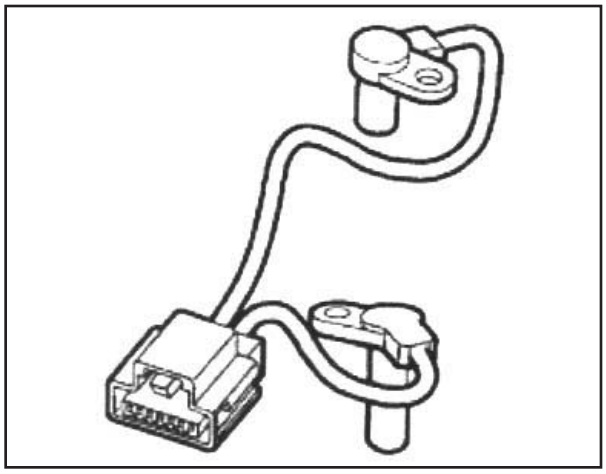
For the unit to operate in reverse the reverse clutch must be applied. The reverse clutch is splined to the transmission case and to the outside diameter of the planetary ring gear. As the reverse clutch holds the planetary ring gear stationary, the carrier which is attached to the input shaft, planetary pinions walk around the stationary ring gear. The unique design of the 6 pinion carrier outputs torque and motion in reverse at a ratio of 2.15-1 to the sun gear. The sun gear is attached to the variable drive pulley. The variable drive pulley is rotated in reverse at a 2.15 ratio with its motion being carried to drive belt. The variable driven pulley is rotated by the drive belt in the same speed and direction as the variable drive pulley.

Transaxle Inputs



Transaxle Range Switch Assembly

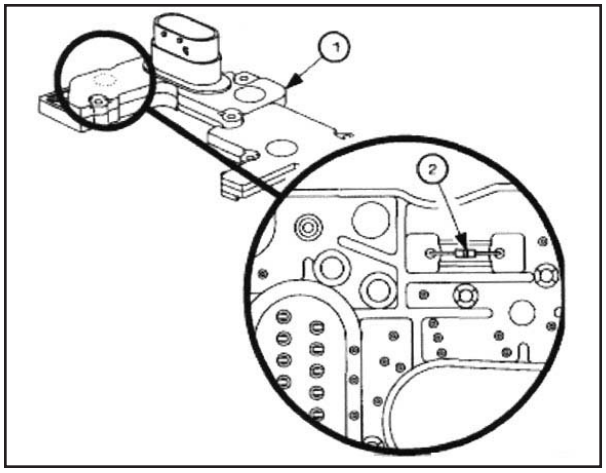
The transaxle range switch assembly is a sliding contact switch attached to the manual shift shaft inside the transaxle case. The five inputs to the TCM from the transaxle range switch assembly indicate which position is selected by the transaxle selector lever. This information is used for engine controls as well as determining the transaxle ratio control patterns. The state of each input is available for display on the Scan tool.



Automatic Transaxle Input and Output (Shaft) Speed Sensor Assembly

The input and output speed sensor assembly is mounted inside the transaxle, under the control valve body cover. Both sensors are variable reluctance magnetic pickups and are wired into the same connector, which plugs into the control solenoid valve assembly. The sensors consist of a permanent magnet surrounded by a coil of wire.

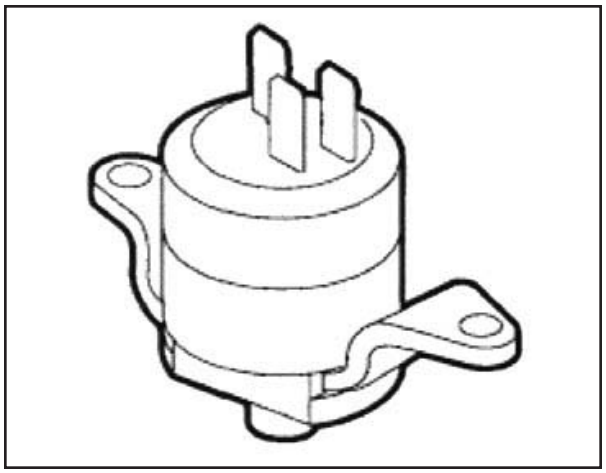
Transaxle Inputs



Transaxle Fluid Temperature (TFT) Sensor

The TFT sensor is part of the lead frame (1) assembly, which is attached to the control solenoid valve assembly. The TFT sensor is a resistor, or thermistor (2) which changes value based on temperature. The sensor has a negative-temperature coefficient. This means that as the temperature increases, the resistance decreases, and as the temperature decreases, the resistance increases. The TCM supplies a 5-volt reference signal to the sensor and measures the voltage drop in the circuit. When the transaxle fluid is cold, the sensor resistance is high and the TCM detects high signal voltage. As the fluid temperature warms to a normal operating temperature, the resistance becomes less and the signal voltage decreases. The TCM uses this information to maintain shift quality and torque converter clutch apply quality over the operating temperature range.

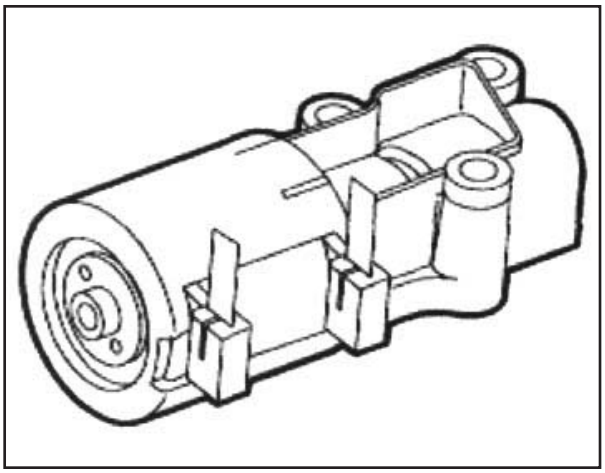
Transaxle Outputs



Pressure Sensor

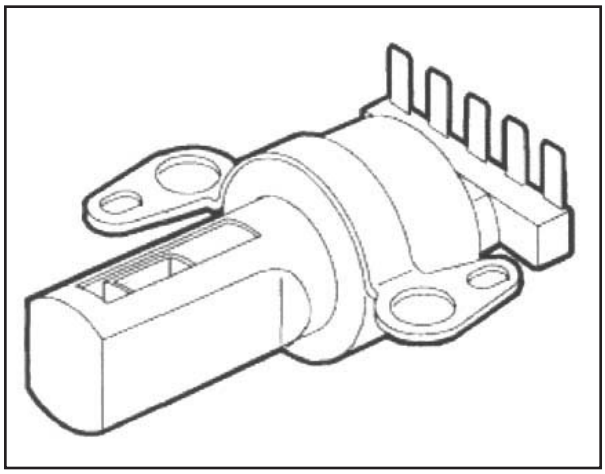
The pressure sensor is used to monitor line pressure and feedback to the TCM with an analog signal of 0-5 volts. The pressure sensor is fed with tier 2 feed fluid pressure, which nominally ranges from **70 psi to 850 psi (483 to 5861 kPa)**.

Transaxle Outputs



Line Pressure Control Solenoid Valve

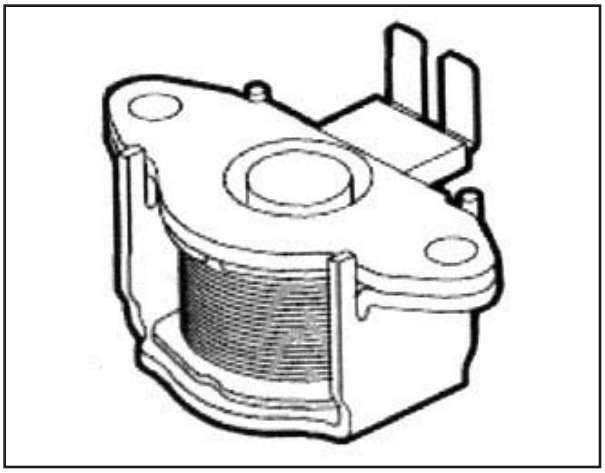
The line pressure control solenoid valve (normally high, 3-port linear pressure control solenoid) is a precision electronic pressure regulator that controls transaxle line pressure based on current flow through its coil windings. As current flow is increased, the magnetic field produced by the coil moves the solenoid's plunger further away from the exhaust port. Opening the exhaust port decreases the output fluid pressure regulated by the line pressure control solenoid valve, which ultimately decreases line pressure. The TCM controls the line pressure control solenoid valve based on various inputs including throttle position, transaxle fluid temperature and gear state.



Ratio Control Motor

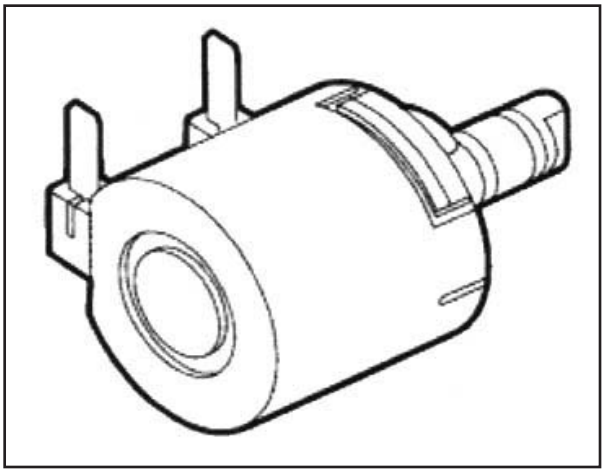
The ratio control motor is a linear position device, which changes transaxle ratio by accurately controlling the position of the variable ratio control valve in order to regulate primary feed fluid flow. This component has a total nominal travel of **22.0 mm (0.87 inch)**.

Transaxle Outputs



Neutral Idle/TCC On-Off Solenoid Valve

The neutral idle/TCC ON-OFF solenoid valve is a normally closed, 3-port, ON/OFF solenoid that the TCM controls to apply and release the converter clutch. When de-energized, actuator feed limit fluid pressure is blocked from pressurizing the TCC/NI enable signal fluid circuit. Without TCC/NI enable signal fluid pressure at the end of the TCC control valve, spring force holds the valve in the released position.



Neutral Idle/TCC Clutch Control Solenoid Valve

The neutral idle/TCC clutch control solenoid valve is a normally low, 3-port linear pressure control solenoid used to control the apply and release of the forward and reverse clutches, and the torque converter clutch. The TCM operates the solenoid with a negative duty cycle at a fixed frequency of 32 Hz to control the rate of clutch apply/release. The solenoid's ability to "ramp" the clutch apply and release pressures results in a smoother clutch operation.

Valving/Hydraulic Controls

The VT-20/25E applications utilize 11 valves contained within the valve body assembly to control the operation of the transmission. The valves and their functions are listed below:

• Forward and Reverse Clutch Valve: (1)
The forward and reverse clutch valve regulates line 2 limit fluid pressure into the clutch control circuit. Regulation is controlled by VBS signal (TCC/NI control) fluid pressure and orificed clutch control fluid pressure, in opposition to clutch boost fluid pressure and spring force. VBS signal (TCC/NI control) fluid pressure is controlled by the neutral idle/TCC clutch control solenoid valve duty cycle. When the range selector lever is shifted to the drive or reverse position, clutch boost fluid pressure assists forward and reverse clutch valve spring force and moves the valve to allow additional line 2 limit fluid to enter the clutch control circuit. This provides extra force for initial clutch apply. If the brake pedal is applied while the transmission is operating in forward or reverse, clutch boost fluid pressure is exhausted and VBS signal (TCC/NI control) fluid pressure is increased to shift the forward and reverse clutch valve against spring force. This allows clutch control fluid to exhaust and causes the forward or reverse clutch to release, thereby placing the transmission in a neutral idle condition.

• TCC Control Valve: (2)
The TCC control valve is a spool valve that is controlled by the neutral idle/TCC On-Off solenoid valve. When drive conditions require TCC apply, the TCM energizes (ON) the normally-closed solenoid and TCC/NI enable fluid pressure moves the TCC control valve against spring pressure. This allows regulated apply fluid to feed the TCC apply circuit and routes line 2 limit fluid to the clutch feed circuit instead of clutch control fluid.

• Line Limit Valve: (3)
The line limit valve is a regulating type spool valve that is modified by line 2 limit fluid pressure acting against an opposing spring force. The line limit valve limits line 2 pressure passing through the valve to a maximum of 965 kPa (140 psi). Line 2 limit fluid pressure is then routed to the line 2 pressure regulator valve, the TCC regulator valve, the clutch boost valve, the TCC control valve, and the forward and reverse clutch valve.

• Actuator Feed Limit Valve: (4)
The actuator feed limit valve is a spool valve that limits (regulates) line 1 pressure passing through the valve to a maximum of 1379 kPa (200 psi). Actuator feed limit fluid is then routed to the neutral idle/TCC clutch control solenoid valve, the neutral idle/TCC On-Off solenoid valve, and the line pressure control solenoid valve.

• Primary Limit Valve: (5)
The primary limit valve is a regulating type spool valve that limits (regulates) primary feed limit fluid pressure to a maximum of 2137-2413 kPa (310-350 psi). Primary feed fluid pressure from the variable ratio control valve is modified by ball check valve # 3 and the primary limit valve to help control the variable drive pulley apply. The primary limit valve will exhaust fluid when excess pressure overcomes the valve spring force.

Valving/Hydraulic Controls Continued...

• Line 1 Pressure Regulator Valve: (6)

The line 1 pressure regulator valve regulates line 1 fluid pressure in relation to vehicle operating conditions. The line 1 pressure regulator valve is biased by VBS signal (line control) fluid pressure, line 1 pressure regulator valve spring force, and orificed line 1 fluid pressure. Line 1 pressure is routed through the valve and into both the tier 2 feed and bypass fluid circuits. The line 1 pressure regulator valves regulates the fluid from the pump, to avoid high or low pressure situations and to deliver fluid to the various clutch control valves or back to the pump when less pressure is required.

• Variable Ratio Control Valve and Lever Assembly: (7)

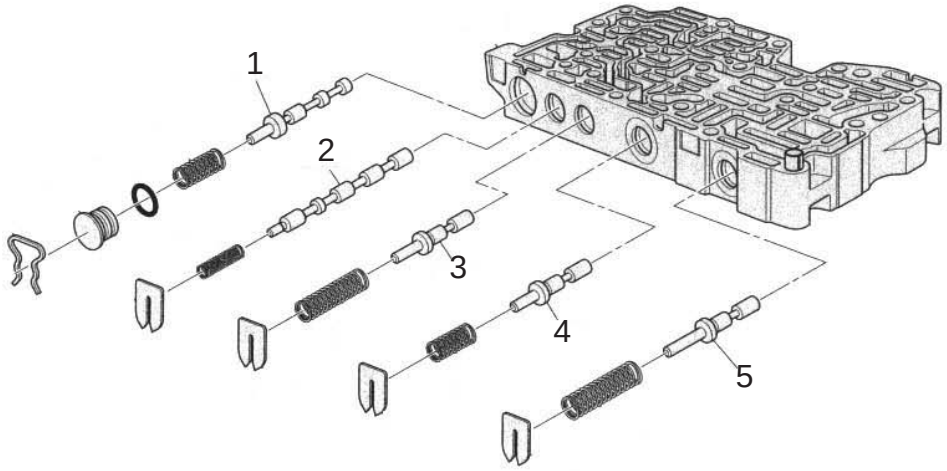
The variable ratio control valve is a regulating type spool valve that is mechanically controlled by the ratio control motor, through a lever assembly, to accurately feed fluid to the primary piston inside the variable drive pulley, which controls the various drive ratios. Line 1 fluid is routed into the primary feed circuit as demanded by TCM signals to the ratio control motor. The opposite end of the variable ratio control valve lever senses pulley travel by riding against the variable drive pulley follower.

• TCC REGULATOR VALVE: (8)

A regulating type spool valve, the TCC regulator valve controls the rate of regulated apply fluid fed to the TCC control valve when the TCC is applied. When the TCC is applied, line 2 limit fluid is regulated through the valve in response to VBS signal (TCC/NI control) fluid pressure acting against spring force. Regulated apply fluid, fed by line 2 limit fluid, is routed to the TCC apply fluid circuit through the TCC control valve.

• Clutch Boost Valve: (9)

The clutch boost valve is a spool type on-off valve fed by line 2 limit fluid. When line 2 limit fluid pressure is high enough to overcome opposing spring force, line 2 limit fluid passes through the valve into the clutch boost circuit to assist spring force on the forward and reverse clutch valve.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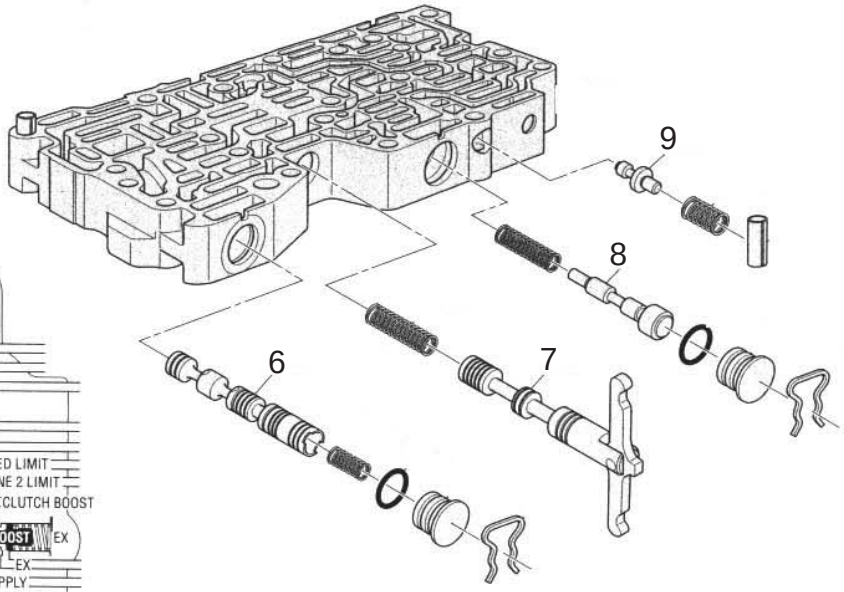
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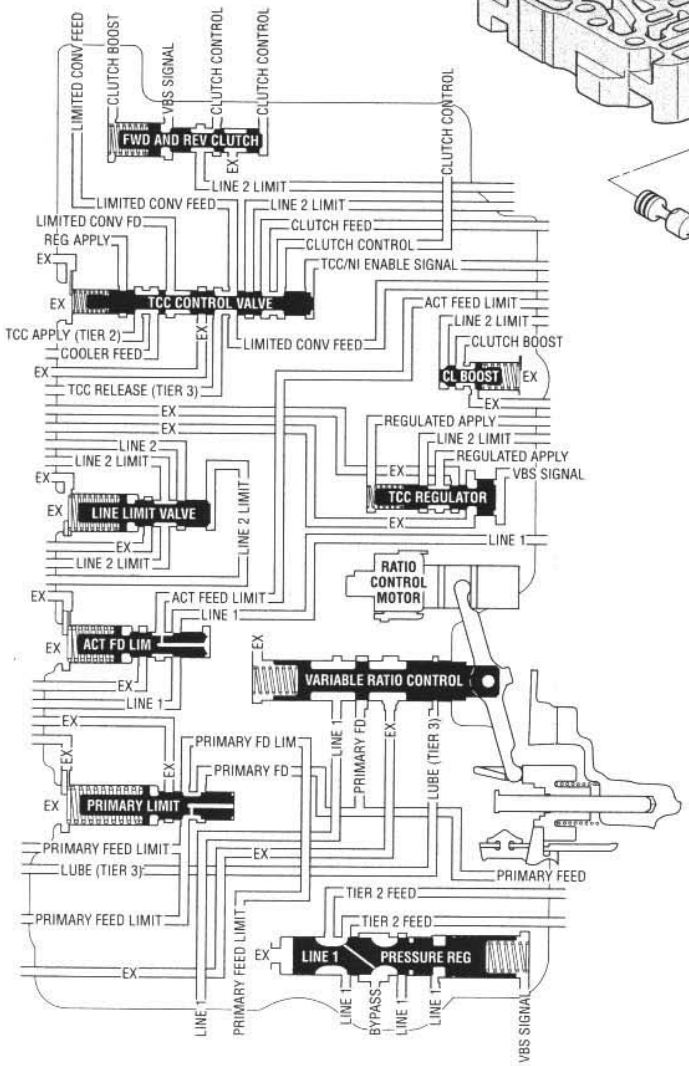

LIMITED CONV FEED
CLUTCH BOOST
VBS SIGNAL
CLUTCH CONTROL
CLUTCH CONTROL
FWD AND REV CLUTCH
CLUTCH CONTROL
LINE 2 LIMIT
LIMITED CONV FEED
LINE 2 LIMIT
LIMITED CONV FD
CLUTCH FEED
REG APPLY
CLUTCH CONTROL
TCC/NI ENABLE SIGNAL
TCC CONTROL VALVE
ACT FEED LIMIT
LINE 2 LIMIT
TCC APPLY (TIER 2)
COOLER FEED
LIMITED CONV FEED
CLUTCH BOOST
CL BOOST
TCC RELEASE (TIER 3)
REGULATED APPLY
LINE 2
LINE 2 LIMIT
REGULATED APPLY
VBS SIGNAL
TCC REGULATOR
LINE LIMIT VALVE
LINE 2 LIMIT
LINE 1
LINE 2 LIMIT
RATIO CONTROL MOTOR
ACT FEED LIMIT
LINE 1
ACT FD LIM
VARIABLE RATIO CONTROL
LINE 1
PRIMARY FD LIM
PRIMARY FD
PRIMARY LIMIT
PRIMARY FEED LIMIT
LUBE (TIER 3)
PRIMARY FEED
TIER 2 FEED
PRIMARY FEED LIMIT
TIER 2 FEED
LINE 1
PRESSURE REG
LINE 1
PRIMARY FEED LIMIT
LINE 1
BYPASS
LINE 1
LINE 1
VBS SIGNAL

Valving/Hydraulic Controls Continued...

• Line 2 Pressure Regulator Valve: (10)
The line 2 pressure regulator valve regulates line 2 and limited converter feed pressure. The valve adjusts line 2 feed pressure in response to changes in VBS signal (line control) fluid pressure which is controlled by the line pressure control solenoid valve.

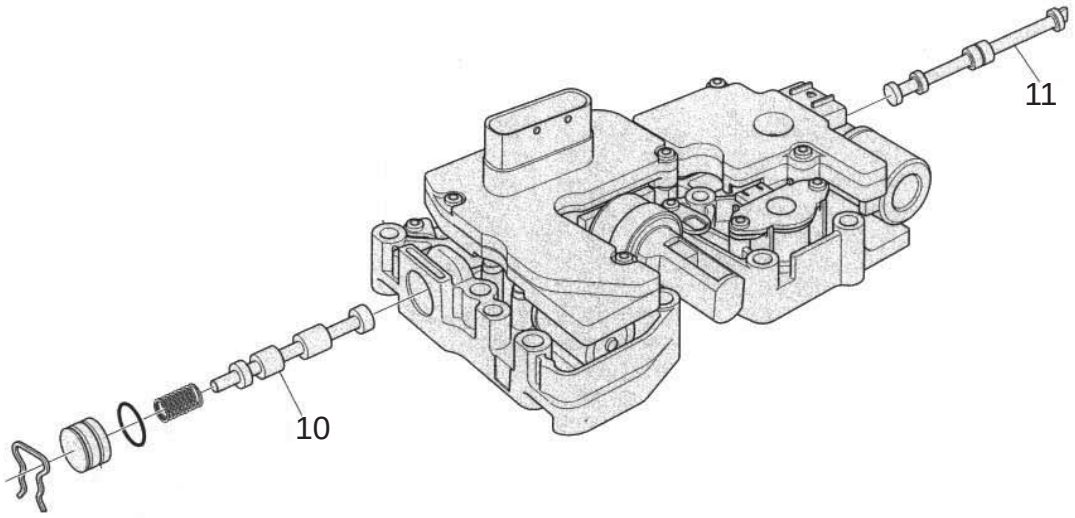
• Manual Valve: (11)
The Manual Valve is a spool valve that is mechanically linked to the range selector lever and is supplied with clutch feed pressure from the TCC control valve. When a range is selected, the manual valve directs clutch feed pressure into the various circuits by opening or closing feed passages. The circuits fed by the manual valve are: Reverse and Drive.

• Neutral Idle/TCC Clutch Control Solenoid Valve:
Controlled by the TCM through a duty cycle operation, the neutral idle/TCC clutch control solenoid valve regulates actuator feed limit fluid pressure into the VBS signal (TCC/NI control) fluid circuit. VBS signal (TCC/NI control) fluid pressure is regulated in response to engine torque and other vehicle operating conditions. VBS signal (TCC/NI control) fluid pressure is routed to the forward and reverse clutch valve to regulate clutch control fluid pressure or to turn off clutch control fluid pressure during a Neutral Idle condition, and to the TCC regulator valve to help control TCC apply.

• Neutral Idle/TCC On-Off Solenoid Valve:
The neutral idle/TCC On-Off solenoid valve is normally-closed, ON/OFF solenoid that, when energized (ON), initiates the converter clutch apply. The Transmission Control Module (TCM) controls the neutral idle/TCC On-Off solenoid valve to apply and release the converter clutch. The neutral idle/TCC On-Off solenoid valve is also used to shift the transmission into a neutral idle condition when the vehicle decelerates, or when the brakes are applied while driving in forward or reverse. When the neutral idle/TCC On-Off solenoid valve is On, TCC is available (Neutral Idle is NOT available). When the neutral idle/TCC On-Off solenoid valve is OFF, Neutral Idle is available (TCC is NOT available).

• Line Pressure Control Solenoid Valve:
Controlled by the TCM through a duty cycle operation, the line pressure control solenoid valve regulates actuator feed limit fluid pressure into the VBS signal (line control) fluid circuit. VBS signal (line control) fluid pressure is regulated in response to engine torque and other vehicle operating conditions. VBS signal (line control) fluid pressure is routed to the line 1 pressure regulator valve and to the line 2 pressure regulator valve to regulate line 1 and line 2 fluid pressures.

• Pressure Sensor:
The pressure sensor monitors tier 2 feed fluid pressure. The TCM uses this information to help determine the duty cycle of the line pressure control solenoid valve and the duty cycle of the neutral idle/TCC clutch control solenoid valve.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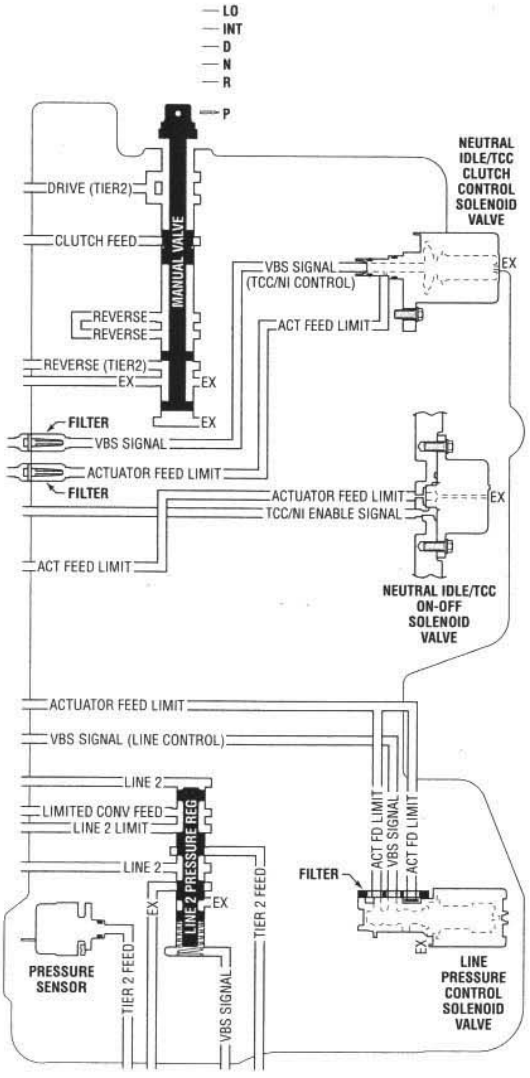
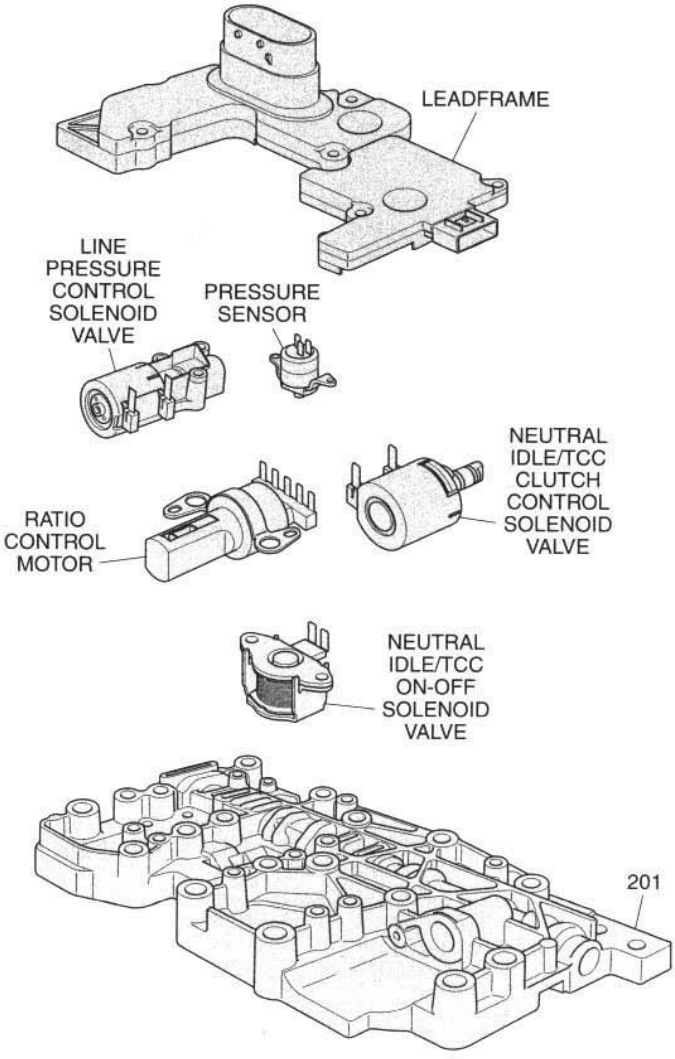
10


LO
INT
D
N
R
P
NEUTRAL IDLE/TCC CLUTCH CONTROL SOLENOID VALVE
DRIVE (TIER2)
CLUTCH FEED
MANUAL VALVE
VBS SIGNAL (TCC/NI CONTROL)
EX
REVERSE
REVERSE
ACT FEED LIMIT
REVERSE (TIER2)
EX
EX
EX
FILTER
VBS SIGNAL
ACTUATOR FEED LIMIT
FILTER
ACTUATOR FEED LIMIT
TCC/NI ENABLE SIGNAL
EX
ACT FEED LIMIT
NEUTRAL IDLE/TCC ON-OFF SOLENOID VALVE
ACTUATOR FEED LIMIT
VBS SIGNAL (LINE CONTROL)
LINE 2
LIMITED CONV FEED
LINE 2 LIMIT
LINE 2
LINE 2 PRESSURE REG
EX
EX
TIER 2 FEED
FILTER
ACT FD LIMIT
VBS SIGNAL
ACT FD LIMIT
EX
PRESSURE SENSOR
TIER 2 FEED
VBS SIGNAL
LINE PRESSURE CONTROL SOLENOID VALVE


LEADFRAME
LINE PRESSURE CONTROL SOLENOID VALVE
PRESSURE SENSOR
NEUTRAL IDLE/TCC CLUTCH CONTROL SOLENOID VALVE
RATIO CONTROL MOTOR
NEUTRAL IDLE/TCC ON-OFF SOLENOID VALVE
201

Line Pressure Test

TOOLS REQUIRED

- J 45195 VT-25E Line Pressure Gauge (or equivalent)

NOTE **MUST BE 0-1000 PSI GAUGE**

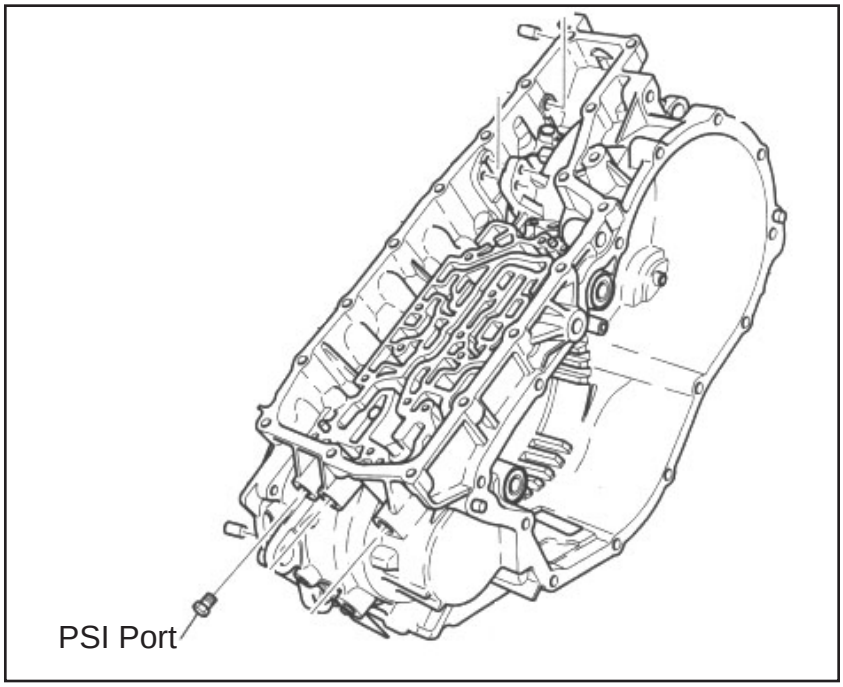
CAUTION **KEEP BRAKES APPLIED AT ALL TIMES IN ORDER TO PREVENT UNEXPECTED VEHICLE MOTION.**

TOTAL TEST RUNNING TIME SHOULD BE LONGER THAN TWO MINUTES. OTHERWISE, TRANSAXLE DAMAGE COULD OCCUR.

1. Hook Up Scan Tool.
2. Start engine and set parking brake.
3. Check for stored diagnostic trouble codes, including diagnostic codes for the line pressure control solenoid.
4. Repair vehicle if necessary. Include the following areas:
   - Inspect fluid level.
   - Inspect manual linkage at transaxle

IMPORTANT **PERMATEX HIGH TEMPERATURE THREAD SEALANT (P/N 2145278) OR EQUIVALENT MUST BE APPLIED TO THE THREADED COMPONENTS OF THE LINE PRESSURE GAUGE TO ENSURE THAT NO LEAKAGE OCCURS DURING TESTING.**

5. Remove the line pressure tap plug and install VT-25E Line Pressure Gauge J45195 (or equivalent) to the transaxle.



Line Pressure Test

6. Make sure that the gear selector is in Park and the parking brake is set.
7. Start the engine and allow the engine to warm up at idle.

IMPORTANT **THE SCAN TOOL IS ONLY ABLE TO CONTROL THE LINE PRESSURE CONTROL SOLENOID IN PARK WITH THE VEHICLE STOPPED. THIS PROTECTS THE TRANSAXLE CLUTCHES FROM EXTREMELY HIGH OR LOW PRESSURE IN DRIVE OR REVERSE.**

8. Access the Line PC Solenoid Control on the Scan tool.
9. With the engine speed at idle, increase/decrease the line PC solenoid amperage to 1.0 amps. Read and record the corresponding line pressure on the pressure gauge.

IMPORTANT **MAXIMUM LINE PRESSURE DEVELOPED BY THE PUMP IS AFFECTED BY ENGINE SPEED, IN ORDER TO DEVELOP THE PRESSURE FOR THE HIGH PRESSURE TEST POINT THE ENGINE SPEED MUST BE BETWEEN 1000 AND 1500 RPM. A LINE PRESSURE READING TAKEN AT LOWER ENGINE SPEED WILL BE LOW AND MAY LEAD TO MISDIAGNOSIS.**

10. Increase the engine speed to be between 1000-1500 rpm before recording performing the next test point.

11. Decrease the Line PC solenoid amperage in to 0.2 amps. Read and record the corresponding line pressure on the pressure gauge. Compare the collected readings to the following chart.

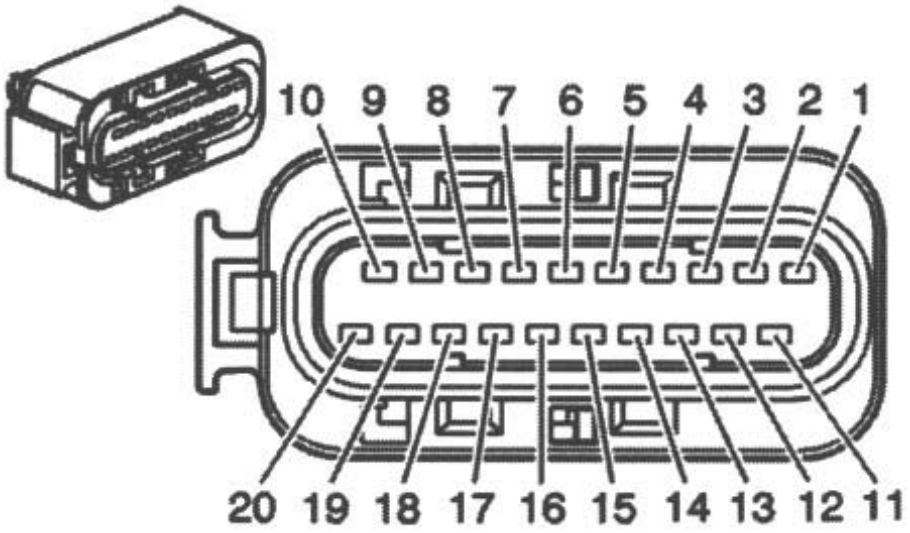
Transmission in Park			
Pressure Control Solenoid Current (Amps)	Engine Speed RPM	Approximate Line Pressure	
		kPa	psi
0.2	1000-1500	4495-5502	652-798
1.0	Idle	1048-1848	152-268

IMPORTANT **BEFORE REINSTALLING THE LINE PRESSURE TAP PLUG, APPLY PERMATEX MEDIUM GRADE THREADLOCKER BLUE OR EQUIVALENT TO THE THREAD OF THE PLUG.**

12. Remove the J45195 VT-25E Line Pressure Gauge and install the line pressure tap plug.

Electronic Components

AT Inline Harness 20-way Connector



Connector Part Information		Blue 20-Way
Cavity	Wire Color	Function
1	BK	Low Reference
2	RD/BK	ISS High Signal
3	D-BU/WT	ISS Low Signal
4	YL	OSS High Signal
5	PU	OSS Low Signal
6	YL/BK	TCC Pressure Control Solenoid Valve Low Control
7	BN	TCC Pressure Control Solenoid Valve High Control
8	PK/BK	TCC Enable Solenoid Valve High Control
9	D-BU/WT	TCC Enable Solenoid Valve Low Control
10	OG/BK	Ratio Control Motor B2 Low Control
11	GY	5-Volt Reference
12	YL	Transmission Fluid Pressure Sensor Signal
13	OG/BK	Transmission Fluid Temperature Sensor Low Reference
14	TN/WT	Transmission Fluid Temperature Sensor Signal
15	D-BU	Line Pressure Control Solenoid Valve High Control
16	WT	Line Pressure Control Solenoid Valve Low Control
17	L-GN/WT	Ratio Control Motor A1 Low Control
18	PU/WH	Ratio Control Motor B1 Low Control
19	PK	Ignition 1 Voltage
20	D-GN	Ratio Control Motor A2 Low Control

Electronic Components

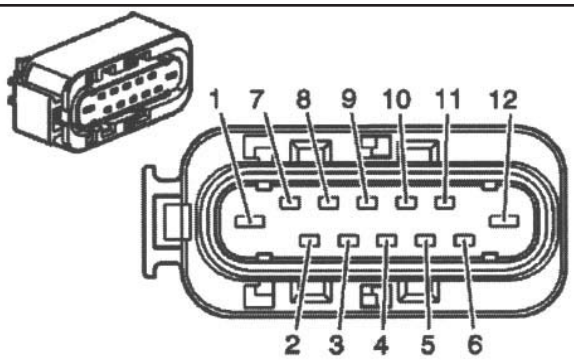
Component Resistance

Component Resistance	Connector Pins	Resistance 20°C (68°F)	Resistance to Ground (Case)
Automatic Transmission Input (Shaft) Speed Sensor	2, 3	1,000-2,000 ohms	Greater than 50 K ohms
Automatic Transmission Output (Shaft) Speed Sensor	4, 5	1, 000-2,000 ohms	Greater than 50 K ohms
Ratio Control Motor Coil-PWR to either Coil	19 to 10, 17, 18, or 20	20-30 ohms	Greater than 50 K ohms
Ratio Control Motor Coil-Coil to Coil	10, 17, 18, 20	40-60 ohms	Greater than 50 K ohms
Transmission Fluid Pressure Sensor PWR to Signal	11,12	Greater than 1 M ohms	Greater than 50 K ohms
Transmission Fluid Pressure Sensor PWR to GRD	1, 11	Greater than 1 M ohms	Greater than 50 K ohms
Transmission Fluid Pressure Sensor Signal to GRD	1, 12	6,000 - 10, 000 ohms	Greater than 50 K ohms
Line Pressure Control Solenoid Valve	15, 16	3.3 - 4.3 ohms	Greater than 500 K ohms
Torque Converter Clutch (TCC) Enable Solenoid Valve	8, 9	18 - 22 ohms	Greater than 500 K ohms
Torque Converter Clutch (TCC) Pressure Control Solenoid Valve	6, 7	3.3 - 4.3 ohms	Greater than 500 K ohms
*Transmission Fluid Temperature (TFT) Sensor	13, 14	3,164 - 3,867 ohms	Greater than 500 K ohms

*The resistance of this device is necessarily dependent on the temperature. Therefore the resistance will vary far more than any other device.

Electronic Components

Park/Neutral Position Switch Harness 12-Way Connector



Connector Part Information		Black 12-Way
Cavity	Wire Color	Function
1	YL	Crank Voltage
2-3	--	Not Used
4	L-GN	Backup Lamp Supply Voltage
5	--	Not Used
6	PK	Ignition 1 Voltage
7	GY	Transmission Range Switch Signal C
8	YL	Transmission Range Switch Signal B
9	TN/WT	Transmission Range Switch Signal A
10	WT	Transmission Range Switch Signal P
11	PK	Ignition 1 Voltage
12	PU	Starter Solenoid Crank Voltage

Electronic Components

Transmission Range Switch Logic

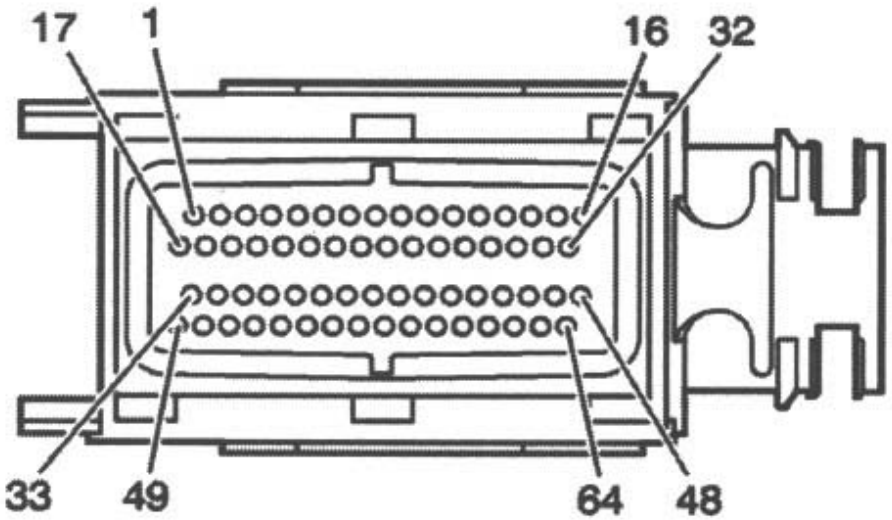
Gear Select	Signal Circuits			
	A	B	C	P
P	HI	LOW	LOW	HI
R	HI	HI	LOW	LOW
N	LOW	HI	LOW	HI
D	LOW	HI	HI	LOW
I	HI	HI	HI	HI
L	HI	LOW	HI	LOW

Range Reference

Range	Controller State	Solenoids				Forward Clutch	Reverse Clutch
		Neutral Idle/TCC ON/OFF	Neutral Idle/TCC Clutch Control	Line Pressure Control	Radio Control Motor		
Park	--	OFF	Low	Variable	Low	--	--
Reverse	R	OFF	Variable	Variable	Variable	--	Applied
Neutral	--	OFF	Low	Variable	Low	--	--
Drive	TCC Released	OFF	Variable	Variable	Variable	Applied	--
	TCC Applied	ON	Variable	Variable	Variable	Applied	--
	Neutral Idle	OFF	High	Variable	Low	Applied	--

Electronic Components

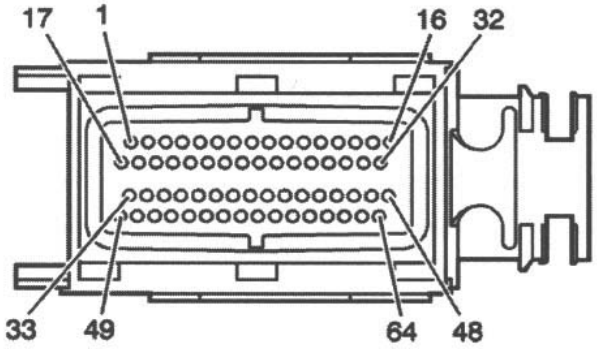
Transmission Control Module Harness 64-Way C1 Connector



Connector Part Information		Black 64-Way
Cavity	Wire Color	Function
1	TN/WT	High Speed GM LAN Serial Data Bus +
2	TN	High Speed GM LAN Serial Data Bus -
3	--	Not Used
4	L-BU	Stop Lamp Switch Signal
5-9	--	Not Used
10	TN	High Speed GM LAN Serial Data Bus -
11	TN/WT	High Speed GM LAN Serial Data Bus +
12-16	--	Not Used
17	BK/WT	Ground
18	--	Not Used
19	PK	Ignition 1 Voltage
20	OG	Battery Positive Voltage
21-28	--	Not Used
29	BK/WT	Ground
30-58	--	Not Used
59	BN/WT	Keyword Serial Data
60-64	--	Not Used

Electronic Components

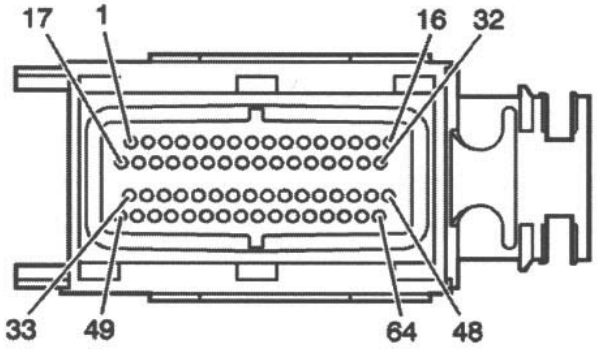
Transmission Control Module Harness 64-Way C2 Connector



Connector Part Information		Black 64-Way
Cavity	Wire Color	Function
1	--	Not Used
2	YL	Transmission Fluid Pressure Sensor Signal
3-5	--	Not Used
6	PU	OSS Low Signal
7-10	--	Not Used
11	PU/WT	Ratio Control Motor B1 Low Control
12	--	Not Used
13	D-GN	Ratio Control Motor A2 Low Control
14	L-GN/WT	Ratio Control Motor A1 Low Control
15	--	Not Used
16	D-BU/WT	TCC Enable Solenoid Valve Low Control
17	--	Not Used
18	TN/WT	Transmission Range Switch Signal A
19	--	Not Used
20	OG/BK	Transmission Fluid Temperature Sensor Low Reference
21-28	--	Not Used
29	TN	Low Reference

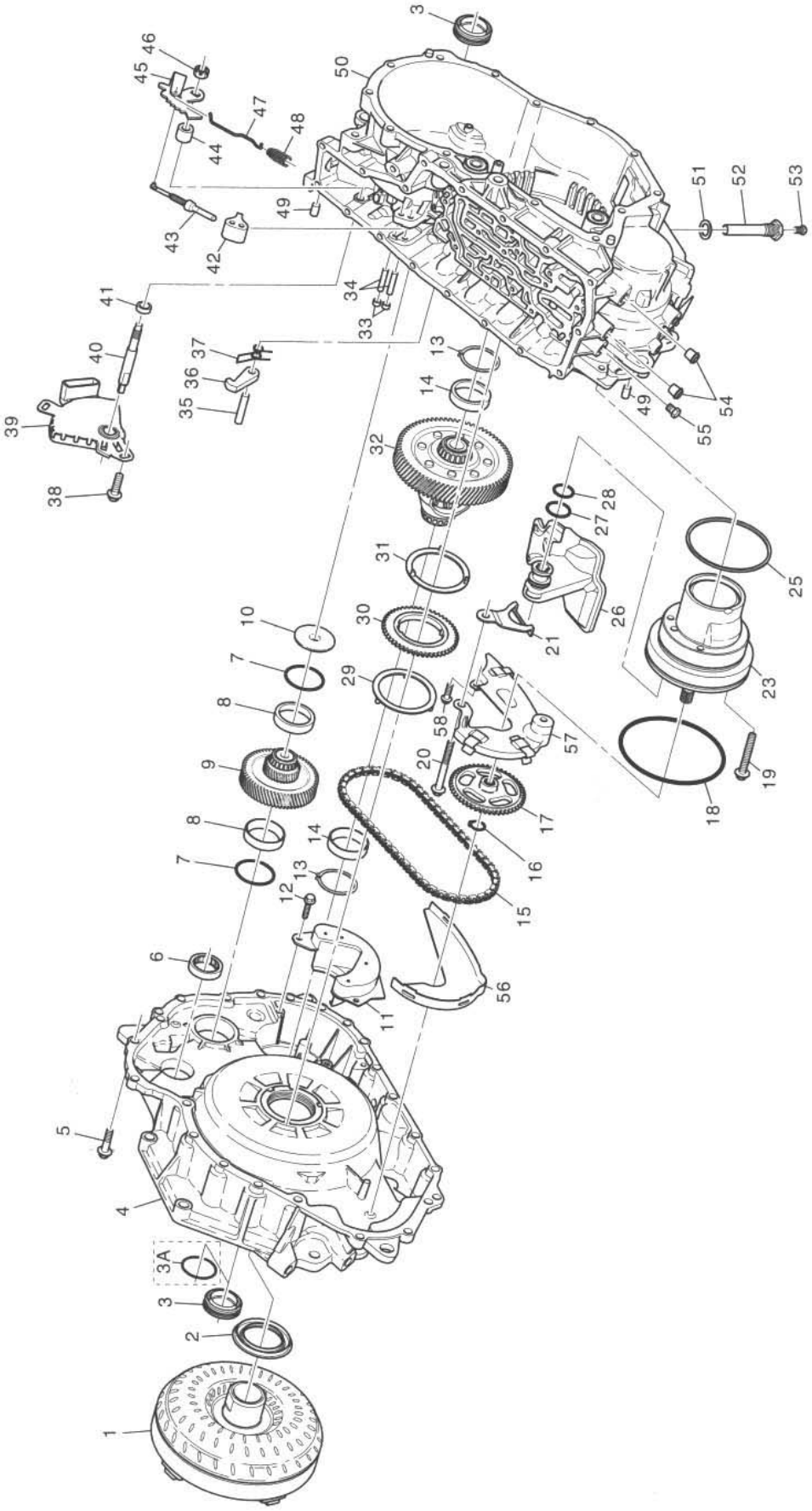
Electronic Components

Transmission Control Module Harness 64-Way C2 Connector Continued...



Connector Part Information		Black 64-Way
Cavity	Wire Color	Function
30	PK/BK	TCC Enable Solenoid Valve High Control
31	OG/BK	Ratio Control Motor B2 Low Control
32-43	--	Not Used
44	YL/BK	TCC Pressure Control Solenoid Valve Low Control
45	BN	TCC Pressure Control Solenoid Valve High Control
46-48	--	Not Used
49	WT	Transmission Range Switch Signal P
50	WT	Line Pressure Control Solenoid Valve Low Control
51	D-BU	Line Pressure Control Solenoid Valve High Control
52	GY	Transmission Range Switch Signal C
53	--	Not Used
54	YL	OSS High Signal
55	D-BU/WT	ISS Low Signal
56	TN/WT	Transmission Fluid Temperature Sensor Signal
57	GY	5-Volt Reference
58	RD/BK	ISS High Signal
59	YL	Transmission Range Switch Signal B
60-64	--	Not Used

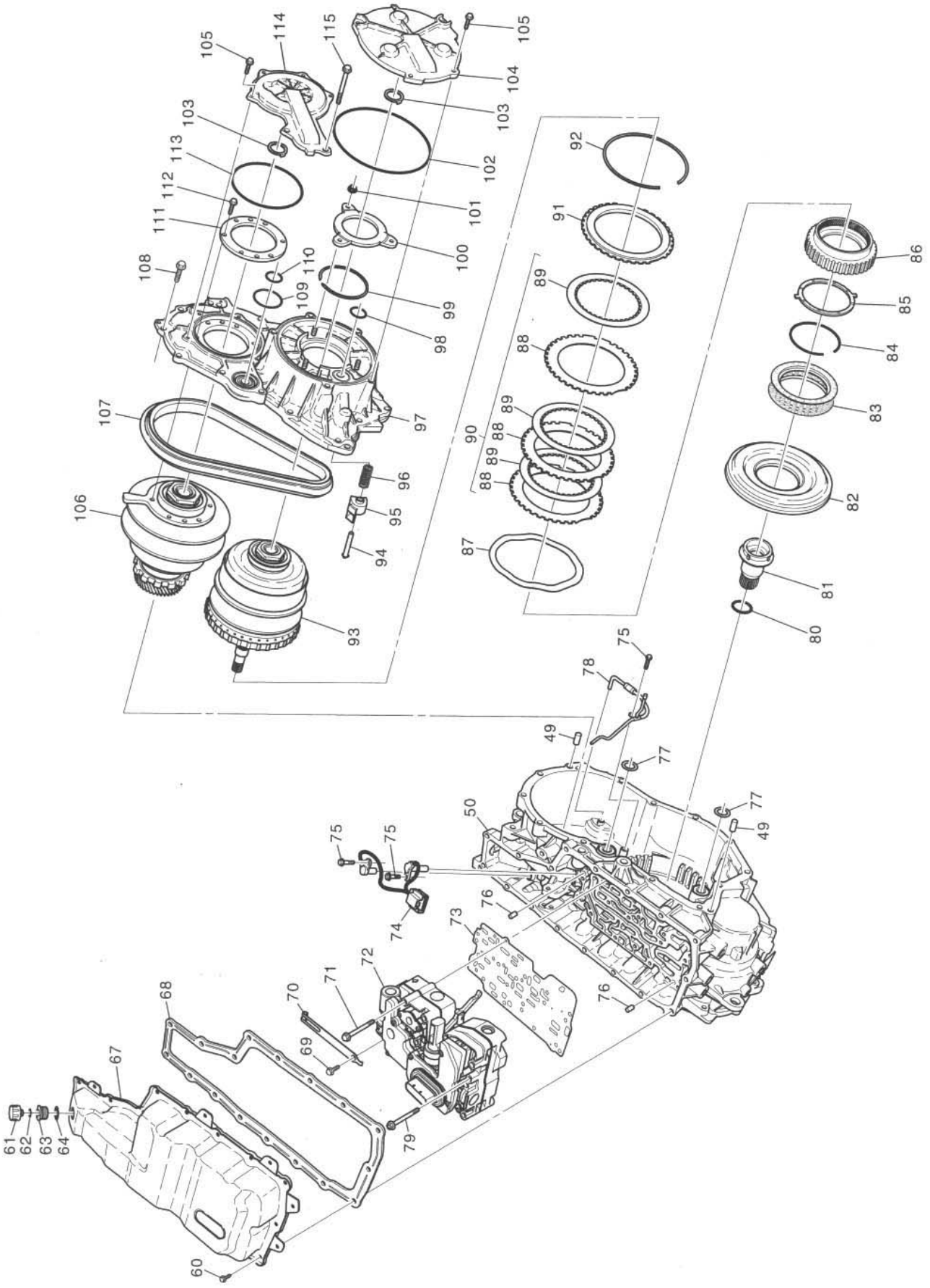
Case and Components



Case and Components Continued...

1	Torque Converter Assembly	19	Automatic Transmission Fluid Pump Bolt/Screw - M6 x 1.0 x 55	41	Manual Shift Shaft Seal Assembly
2	Torque Converter and Differential Housing Seal Assembly	20	Bolt/Screw - M6 x 1.0 x 70	42	Park Pawl Actuator Guide
3	Front Wheel Drive Shaft Oil Seal Assembly - 2WD	21	Automatic Transmission Fluid Filter Retainer	43	Park Pawl Actuator Assembly
3A	Front Wheel Drive Shaft Oil O-Ring Seal - F4WD	23	Automatic Transmission Fluid Pump Assembly	44	Manual Shift Shaft Retainer
4	Torque Converter and Differential Housing Assembly - Model Specific	25	Automatic Transmission Fluid Pump Seal	45	Manual Shaft Detent Lever
5	Torque Converter and Differential Housing Bolt/Screw - M8 x 1.25 x 35	26	Automatic Transmission Fluid Filter Assembly	46	Manual Shift Shaft Nut
6	Variable Driven Pulley Bearing Assembly	27	Automatic Transmission Fluid Filter O-Ring Seal	47	Manual Valve Link
7	Front Differential Drive Pinion Gear Shim	28	Automatic Transmission Fluid Filter O-Ring Seal	48	Manual Valve Link Spring
8	Front Differential Drive Pinion Gear Bearing Cup	29	Drive Sprocket Thrust Washer	49	Transmission Case Locator Pin
9	Front Differential Drive Pinion Gear Assembly	30	Drive Sprocket	50	Automatic Transmission Case Assembly
10	Automatic Transmission Case Plug	32	Front Differential Carrier Assembly	51	Transmission Fluid Fill Lower Tube Seal
11	Transmission Fluid Baffle	33	Park Pawl Shaft Hole Plug	52	Transmission Fluid Fill Lower Tube
12	Transmission Fluid Baffle Bolt/Screw - M6 x 1.0 x 17	34	Park Pawl Actuator Guide Pin	53	Transmission Fluid Fill Lower Tube Plug
13	Front Differential Bearing Shim	35	Park Pawl Reaction Pin	54	Transmission Fluid Cooler Pipe Fitting SealAutomatic Transmission Fluid Pressure Test Hole Plug
14	Front Differential Carrier Bearing Cup	36	Park Pawl	55	Automatic Transmission Fluid Pressure Test Hole Plug
15	Drive Link Assembly	37	Park Pawl Spring	56	Transmission Fluid Baffle - Top
16	Driven Sprocket Retaining Ring	38	Park/Neutral Position Switch Assembly Bolt/Screw - M6 x 1.0 x 18.4	57	Transmission Fluid Baffle - Bottom
17	Driven Sprocket	39	Park/Neutral Position Switch Assembly	58	Transmission Fluid Baffle Bolt/Screw - M5 x 0.8 x 13
18	Automatic Transmission Fluid Pump O-Ring Seal	40	Manual Shift Shaft		

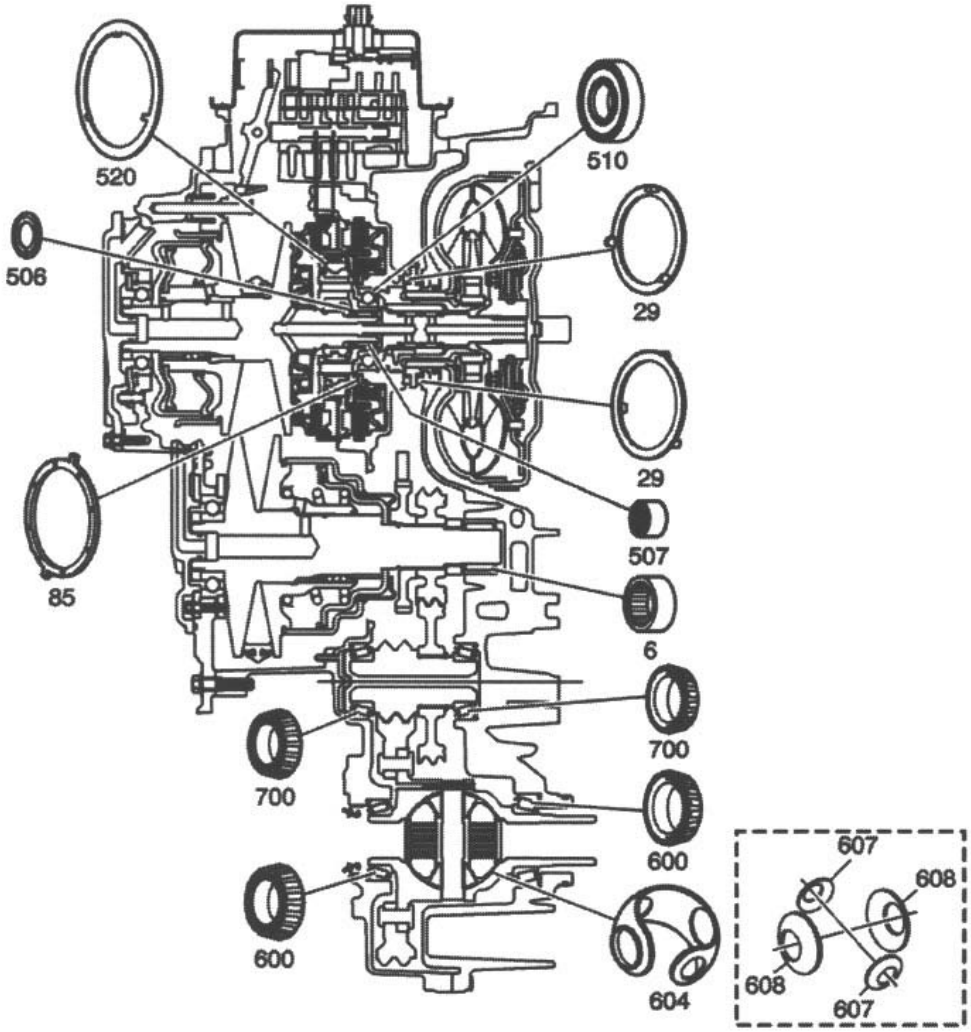
Case and Components



Case and Components Continued...

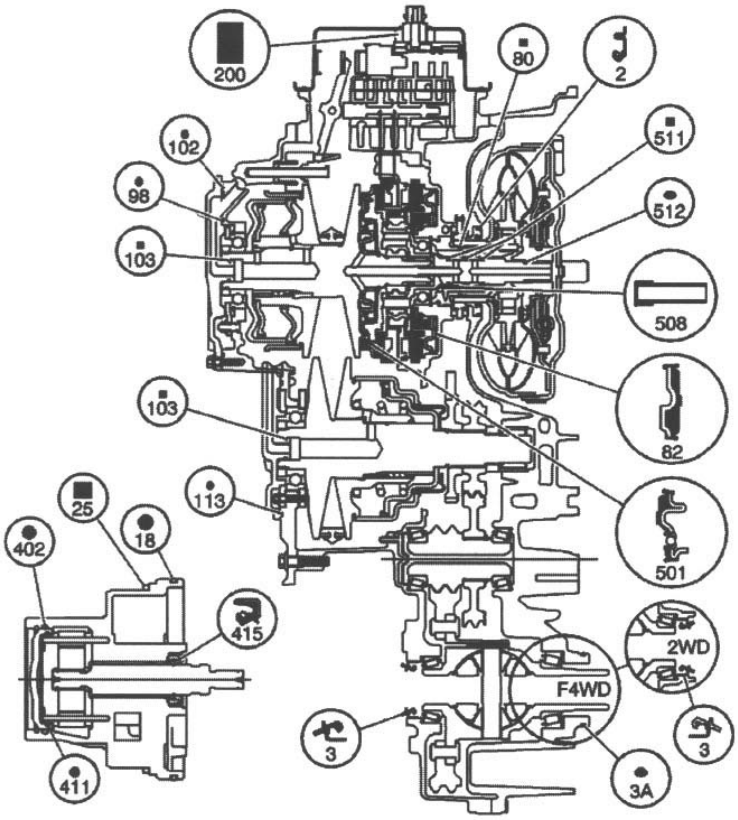
49	Transmission Case Location Pin	79	Control Valve Body Bolt/Screw - M5 x 0.8 x 78	98	Variable Drive Pulley Opening Cover Seal
50	Automatic Transmission Case Assembly	80	Stator Shaft Seal	99	Variable Drive Pulley Bearing Retaining Ring
60	Control Valve Body Cover Bolt/Screw - M6 x 1.0 x25	81	Stator Shaft Assembly	100	Variable Drive Pulley Bearing Retainer
61	Automatic Transmission Vent Cap	82	Reverse Clutch Piston Assembly	101	Variable Drive Pulley Bearing Retainer Nut - M6 x 1.0
62	Automatic Transmission Vent Cap O-Ring	83	Reverse Clutch Spring Assembly	102	Variable Drive Pulley Opening Cover Seal
63	Automatic Transmission Vent Cap Insert	84	Reverse Clutch Spring Retaining Ring	103	Automatic Transmission Case Cover Seal
64	Automatic Transmission Vent Cap Insert O-Ring	85	Reverse Clutch Hub Thrust Washer	104	Variable Drive Pulley Opening Cover
67	Control Valve Body Cover	86	Reverse Clutch - with Input Internal Gear - Hub Assembly	105	Variable Pulley Opening Cover Bolt/Screw - M6 x 1.0 x 25
68	Control Valve Body Cover Gasket	87	Reverse Clutch - Waved - Plate	106	Variable Driven Pulley Assembly
69	Manual Shaft Detent Assembly Bolt/Screw - M6 x 1.0 x30	88	Reverse Clutch Plate Assembly - Spline OD	107	Variable Drive Belt Assembly
70	Manual Shaft Detent Assembly	89	Reverse Clutch Plate Assembly - Spline ID	108	Automatic Transmission Case Cover Bolt/Screw - M8 x 1.25 x 40
71	Control Valve Body Bolt/Screw - M6 x 1.0 x 80	90	Reverse Clutch Plate Set	109	Variable Driven Pulley Opening Cover Seal
72	Control Valve Body Assembly	91	Reverse Clutch Backing Plate	110	Automatic Transmission Case Cover - O-Ring - Seal
73	Control Valve Body Spacer - with Gasket - Plate	92	Reverse Clutch Backing Plate Retaining Ring	111	Variable Driven Pulley Bearing Retainer - Selective
74	Automatic Transmission Input and Output Speed Sensor Assembly	93	Variable Drive Pulley Assembly	112	Variable Driven Pulley Bearing Retainer Bolt/Screw - M6 x 1.0 x 25
75	Bolt/Screw - M6 x 1.0 x 17	94	Variable Drive Pulley Follower Pin	113	Variable Driven Pulley Opening Cover Seal
76	Control Valve Body Locator Pin	95	Variable Drive Pulley Follower	114	Variable Driven Pulley Opening Cover
77	Automatic Transmission Case Cover - O-Ring -Seal	96	Variable Drive Pulley Follower Spring	115	Variable Driven Pulley Opening Cover Bolt/Screw - M8 x 1.25 x 50
78	Lube Oil Pipe	97	Automatic Transmission Case Cover Assembly		

Bearing Locations



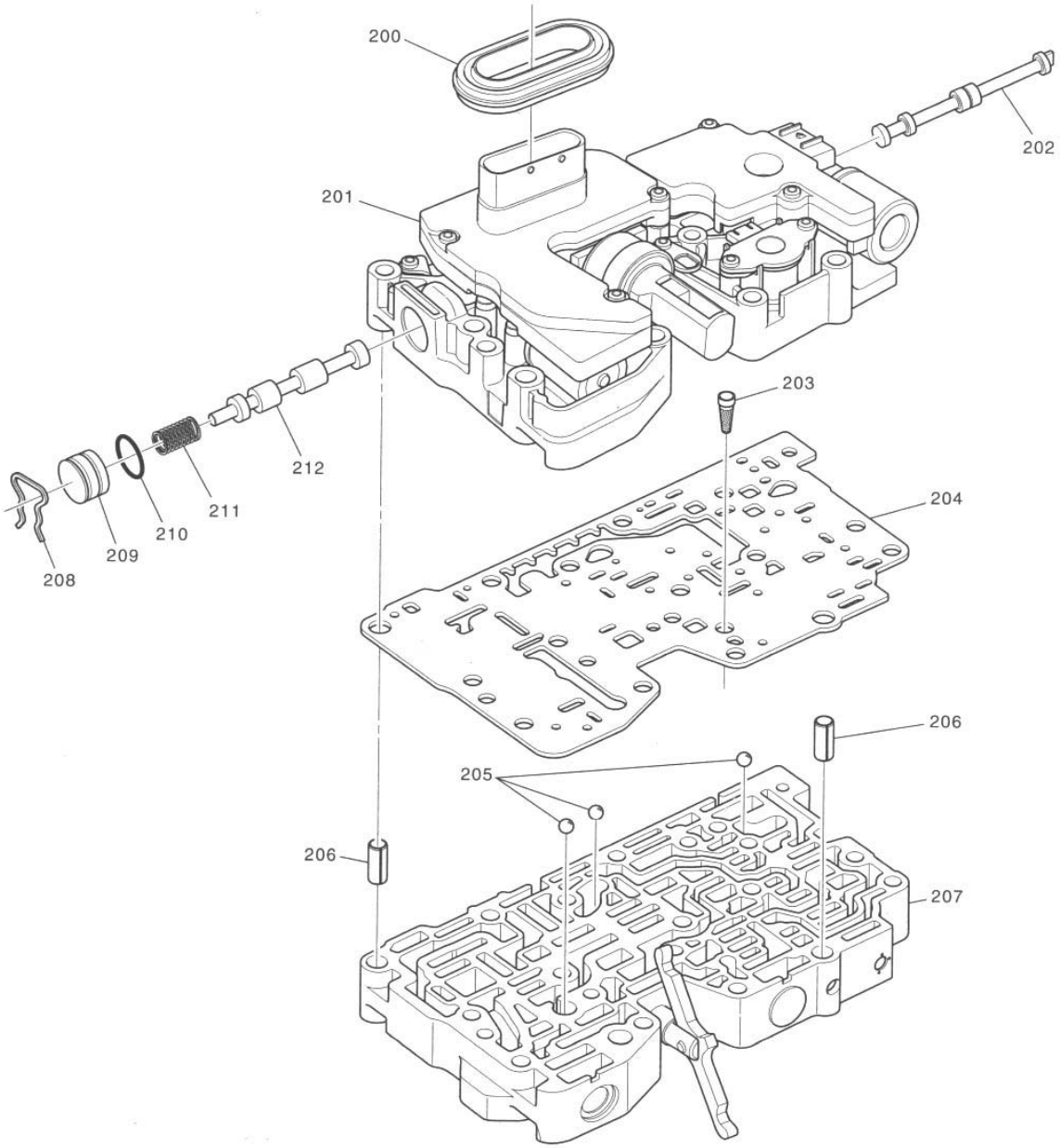
6	Variable Driven Pulley Bearing Assembly
29	Drive Sprocket Thrust Washer
85	Reverse Clutch Hub Thrust Washer
506	Sun Gear Thrust Washer
507	Input Shaft Bearing Assembly - Inner
510	Input Shaft Bearing Assembly - Outer
520	Input Internal Gear Thrust Washer
600	Front Differential Carrier Bearing Assembly
604	Front Differential Carrier Thrust Washer - Some Models
607	Front Differential Pinion Gear Thrust Washer - Some Models
608	Front Differential Side Gear Thrust Washer - Some Models
700	Front Differential Drive Pinion Gear Bearing Assembly

Seal Locations



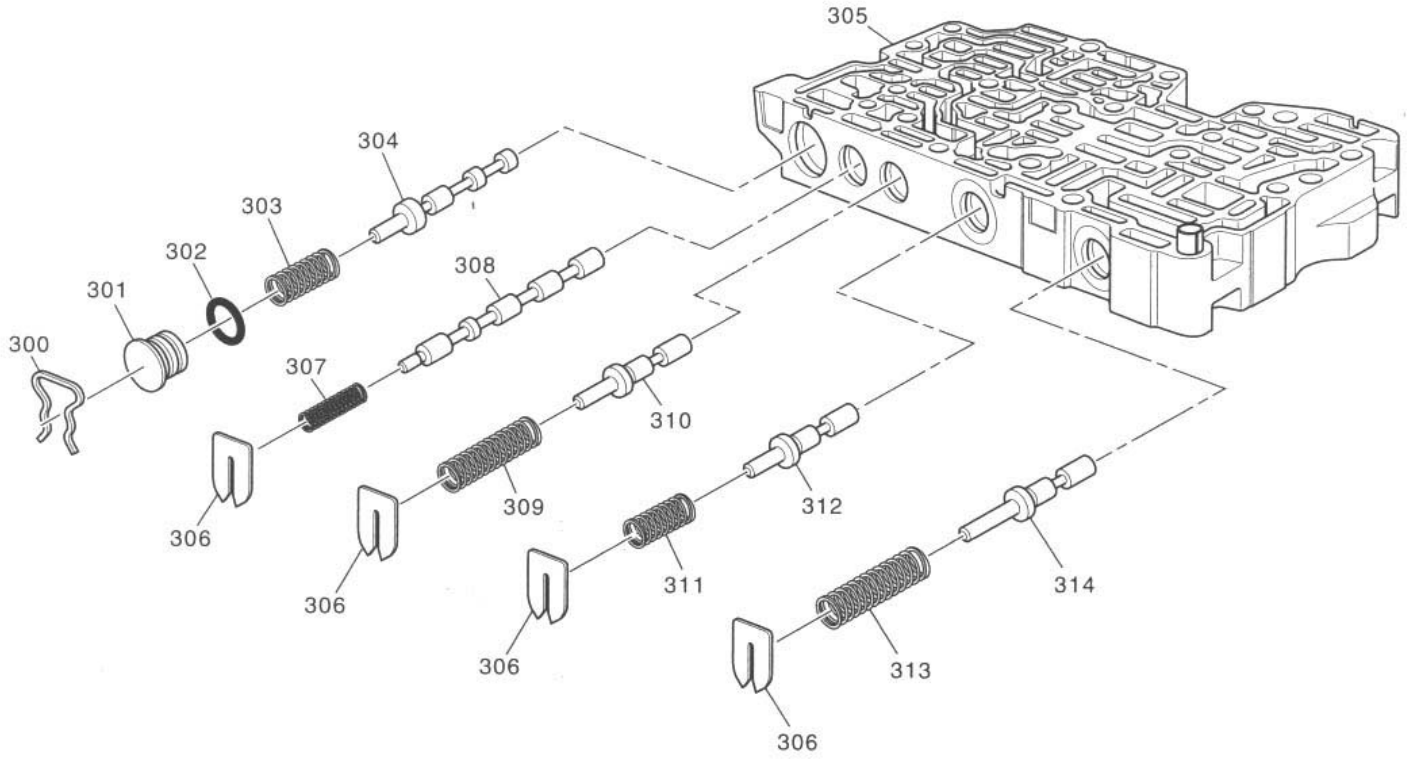
2	Torque Converter and Differential Housing Seal Assembly
3	Front Wheel Drive Shaft Oil Seal Assembly - 2 WD
3a	Front Wheel Drive Shaft Oil O-Ring Seal - F4WD
18	Automatic Transmission Fluid Pump O-Ring Seal
25	Automatic Transmission Fluid Pump Seal
80	Slator Shaft Seal
82	Reverse Clutch Piston Assembly
98	Variable Drive Pulley Opening Cover Seal
102	Variable Drive Pulley Opening Cover Seal
103	Automatic Transmission Case Cover Seal
113	Variable Driven Pulley Opening Cover Seal
200	Control Valve Body Cover Wiring Connector Hole Seal
402	Pump End Cover O-Ring Seal
411	Pump O-Ring Seal - Inner
415	Pump Drive Shaft Seal
501	Forward Clutch Piston Assembly
508	Input Shaft Fluid Passage Sleeve
511	Input Shaft Fluid Seal Ring
512	Input Shaft - O-Ring - Seal Ring

Control Valve Body and Solenoid Assembly



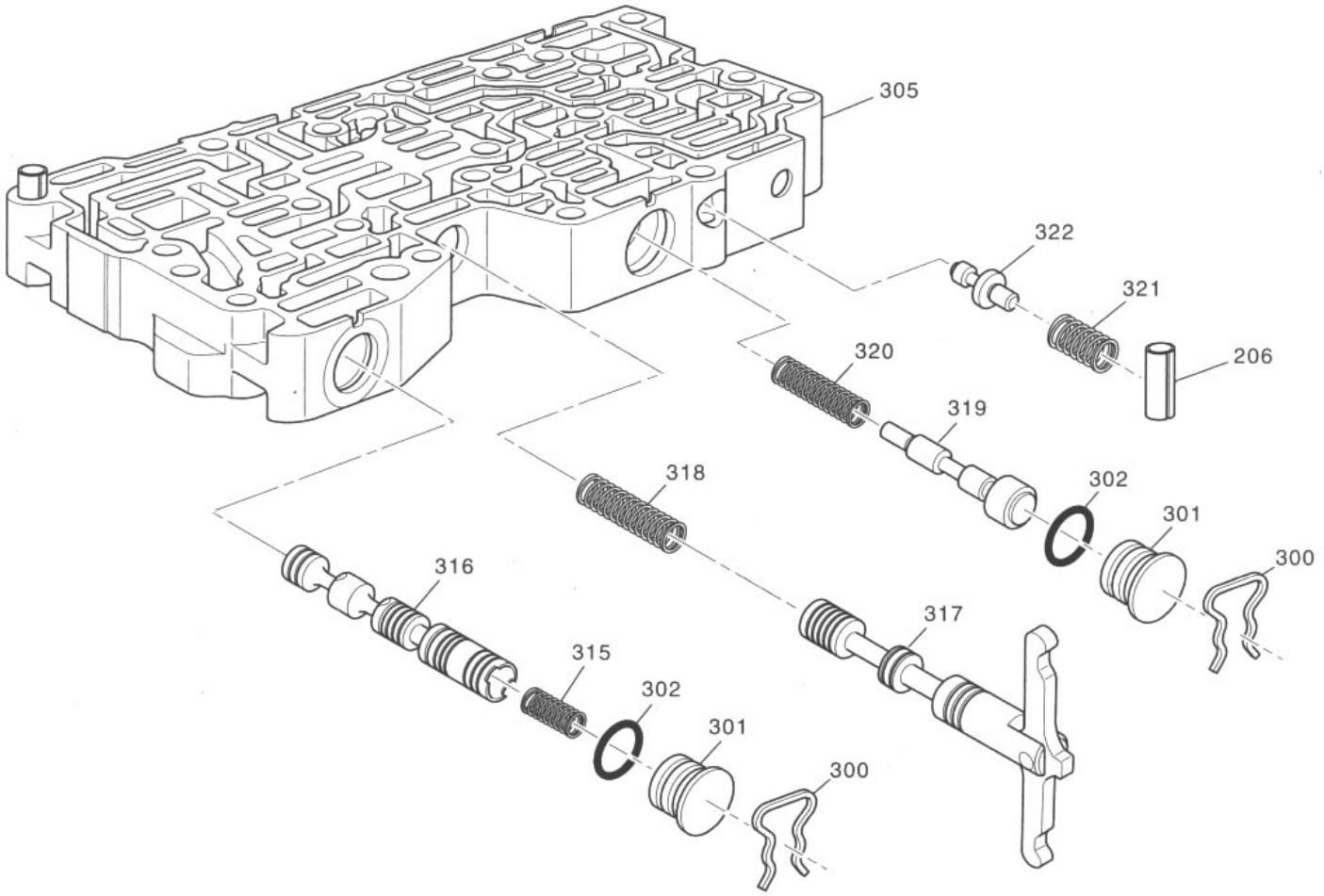
200	Control Valve Body Cover Wiring Connector Hole Seal
201	Control Solenoid Valve Assembly
202	Manual Valve
203	Automatic Transmission Fluid Pump Pressure Screen Assembly
204	Control Valve Body Spacer - with Gasket - Plate Assembly
205	Control Valve Body Ball Check Valve
206	Control Solenoid Valve Locator Pin
207	Control Valve Body Assembly
208	Bore Plug Retainer
209	Bore Plug
210	Bore Plug Seal
211	Line 2 Pressure Regulator Valve Spring
212	Line 2 Pressure Regulator Valve

Control Valve Body Disassembled View



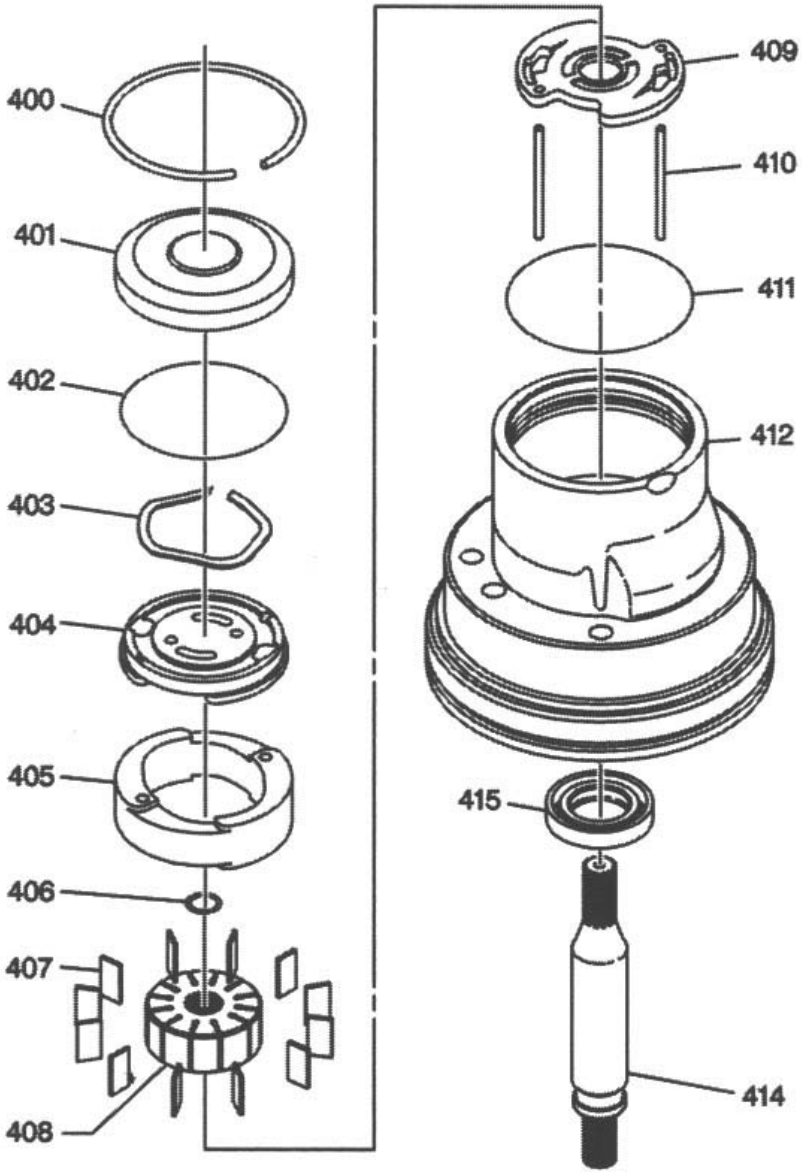
300	Bore Plug Retainer
301	Bore Plug
302	Bore Plug Seal
303	Forward and Reverse Clutch Valve Spring
304	Forward and Reverse Clutch Valve
305	Control Valve Body
306	Valve Spring Seat
307	TCC Control Valve Spring
308	TCC Control Valve
309	Line Limit Valve Spring
310	Line Limit Valve
311	Actuator Feed Limit Valve Spring
312	Actuator Feed Limit Valve
313	Primary Limit Valve Spring
314	Primary Limit Valve

Control Valve Body Disassembled View



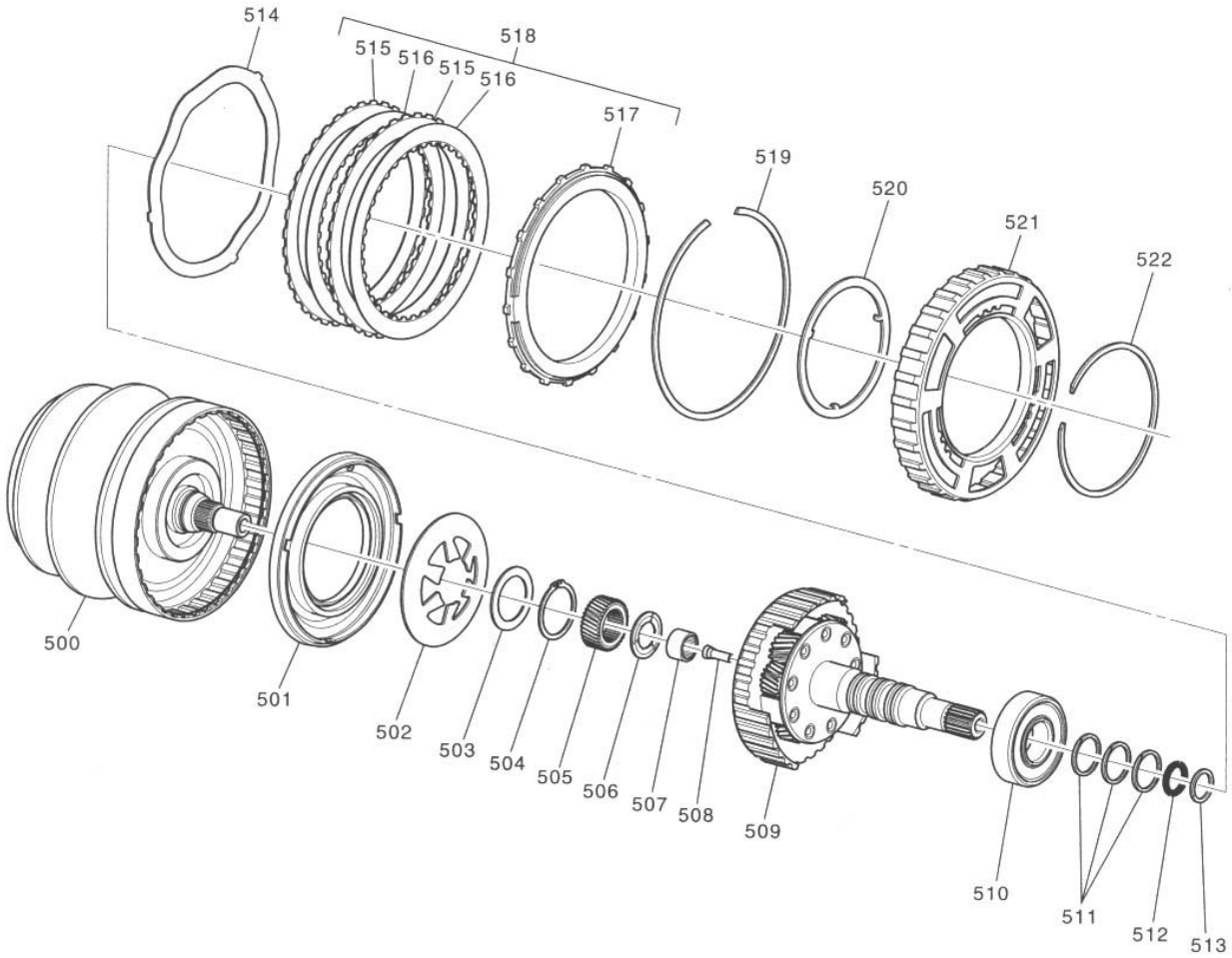
206	Control Solenoid Valve Locator Pin
300	Bore Plug Retainer
301	Bore Plug
302	Bore Plug Seal
305	Control Valve Body
315	Line 1 Pressure Regulator Valve Spring
316	Line 1 Pressure Regulator Valve
317	Variable Ratio Control Valve Lever Assembly
318	Variable Ratio Control Valve Spring
319	TCC Regulator Valve
320	TCC Regulator Apply Valve Spring
321	Clutch Boost Valve Spring
322	Clutch Boost Valve

Fluid Pump Assembly



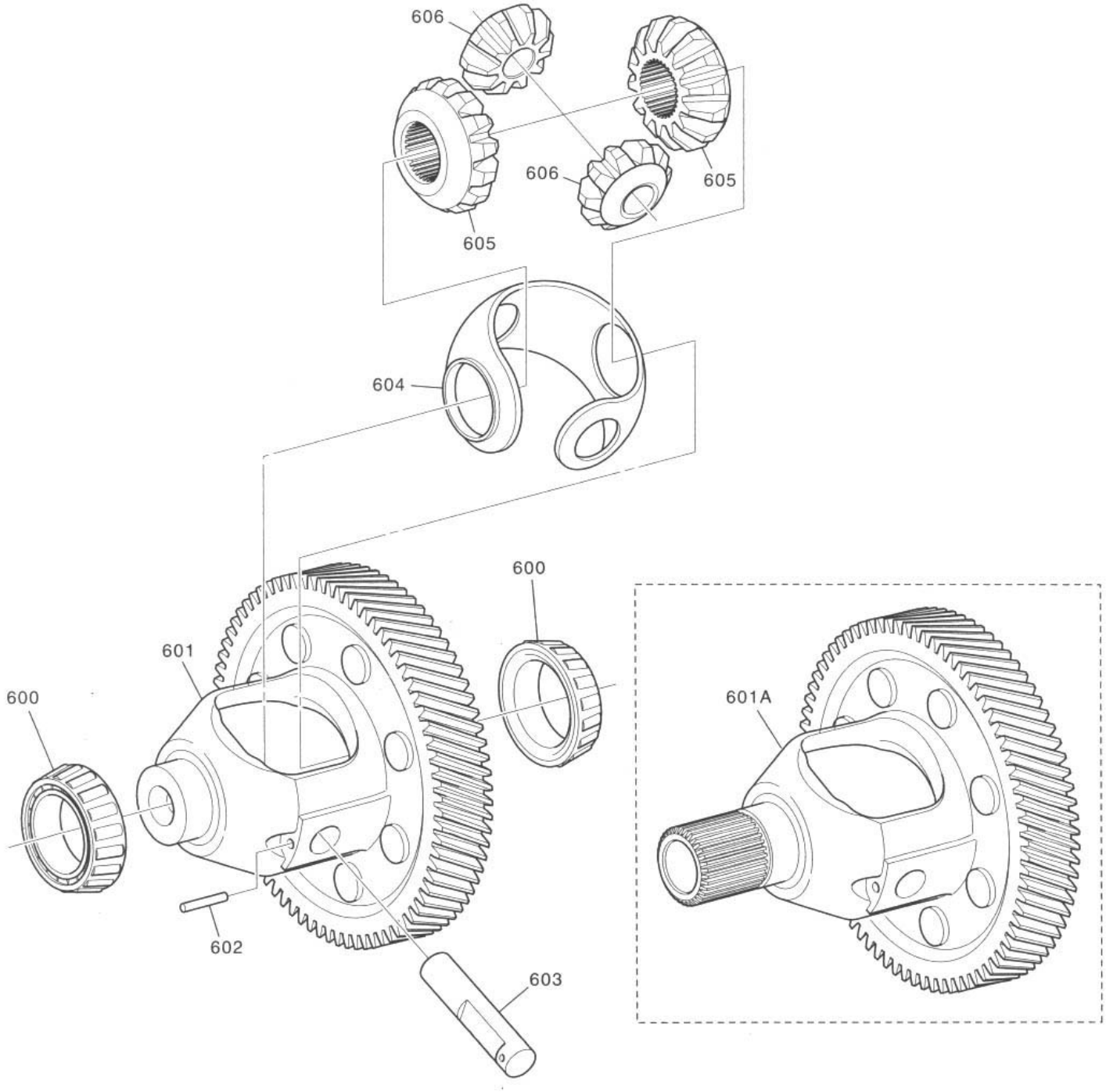
400	End Cover Retaining Ring
401	Pump End Cover
402	Pump End Cover O-Ring Seal
403	Pressure Plate Spring
404	Pressure Plate
405	Cam Ring
406	Pump Drive Shaft Retaining Ring
407	Pump Rotor Vane
408	Pump Rotor
409	Pump Thrust Plate
410	Cam Ring Dowel Pin
411	Pump O-Ring Seal - Inner
412	Pump Housing
414	Pump Drive Shaft
415	Pump Drive Shaft Seal

Input Shaft and Forward Clutch Assembly



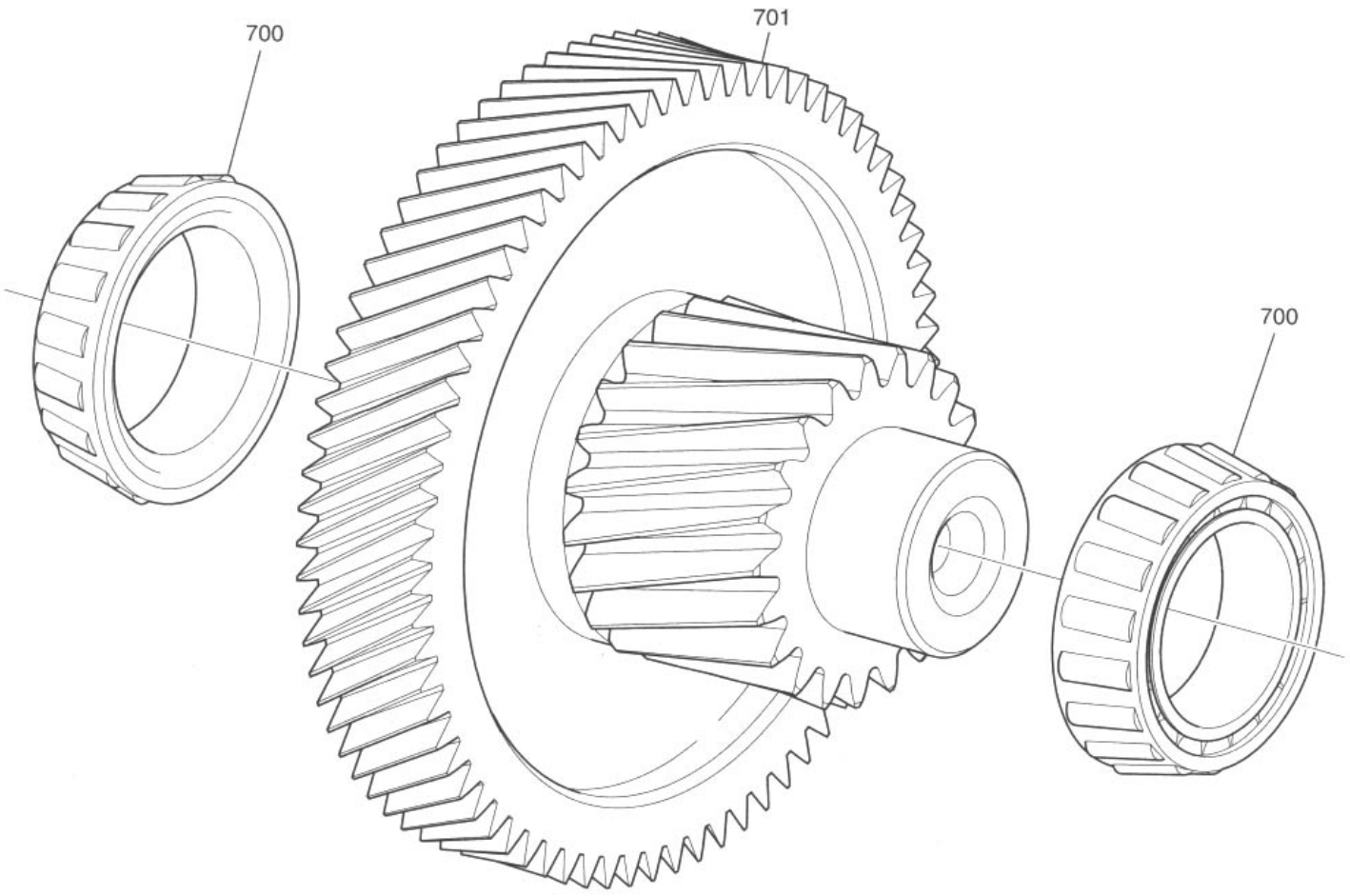
500	Variable Drive Pulley Assembly
501	Forward Clutch Piston Assembly
502	Forward Clutch Piston - Belleville - Spring
503	Forward Clutch Spring Washer - Some Models
504	Forward Clutch Piston Spring Retaining Ring
505	Sun Gear
506	Sun Gear Thrust Washer
507	Input Shaft Bearing Assembly - Inner
508	Input Shaft Fluid Passage Sleeve
509	Input Shaft Assembly
510	Input Shaft Bearing Assembly - Outer
511	Input Shaft Fluid Seal Ring
512	Input Shaft - O-Ring - Seal
513	Input Shaft - Split Spiral - Fluid Seal Ring
514	Forward Clutch - Waved - Plate
515	Forward Clutch Plate Assembly - Spline OD
516	Forward Clutch Plate Assembly - Spline ID
517	Forward Clutch Backing Plate
518	Forward Clutch Plate Set
519	Forward Clutch Backing Plate Retaining Ring
520	Input Internal Gear Thrust Washer
521	Automatic Transmission Input Shaft Speed Sensor Reluctor Ring Assembly
522	Automatic Transmission Input Shaft Speed Sensor Reluctor Ring Retaining Ring

Front Differential Carrier Assembly



600	Front Differential Carrier Bearing Assembly
601	Front Differential Carrier Assembly - 2 WD
601a	Front Differential Carrier Assembly - F4 WD
602	Front Differential Pinion Gear Shaft Pin
603	Front Differential Pinion Shaft
604	Front Differential Carrier Thrust Washer - Some Models
605	Front Differential Side Gear
606	Front Differential Pinion Gear

Front Differential Carrier Assembly



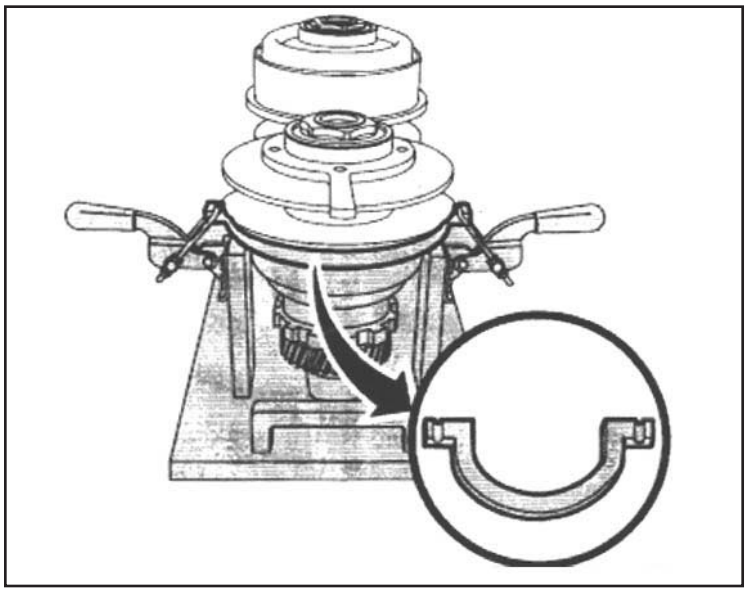
700	Front Differential Drive Pinion Gear Bearing Assembly
701	Front Differential Drive Pinion Gear and Transfer Gear Assembly

Drive Belt Removal and Installation

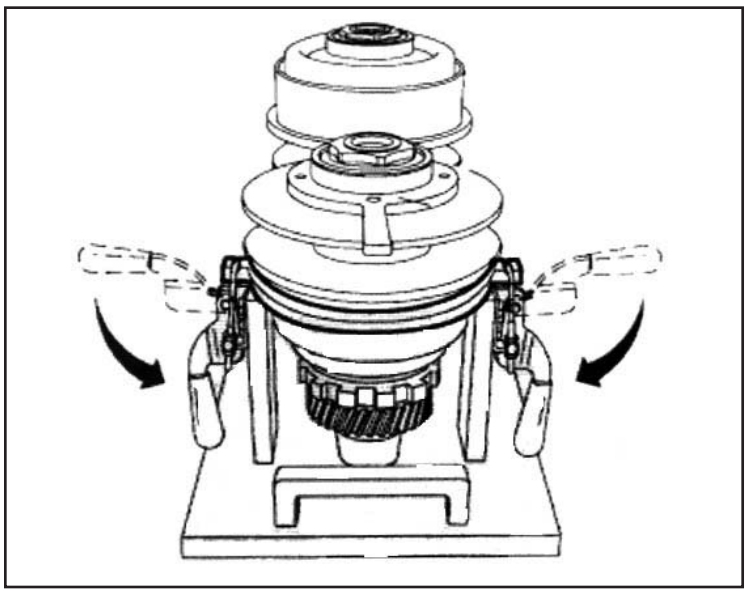
Tools Required

- J 44337 Build Plate Assembly

IMPORTANT **INSTALL TWO PLASTIC TIE STRAPS ON BELT BEFORE REMOVAL**



1. Position drive and driven pulley assemblies on Build Plate Assembly J44337.
2. Inspect belt contact areas on the drive and driven pulley assemblies. The surfaces should be smooth and free from any scoring.
3. Position the U-shaped ring of the build plate assembly J44337 on the driven pulley assembly.
4. Position the clamp U-bolts of the build plate assembly J44337 in the slotted grooves of the U-shaped ring.



5. Using both hands, push down on the clamp handles with equal pressure in order to compress the driven pulley assembly.

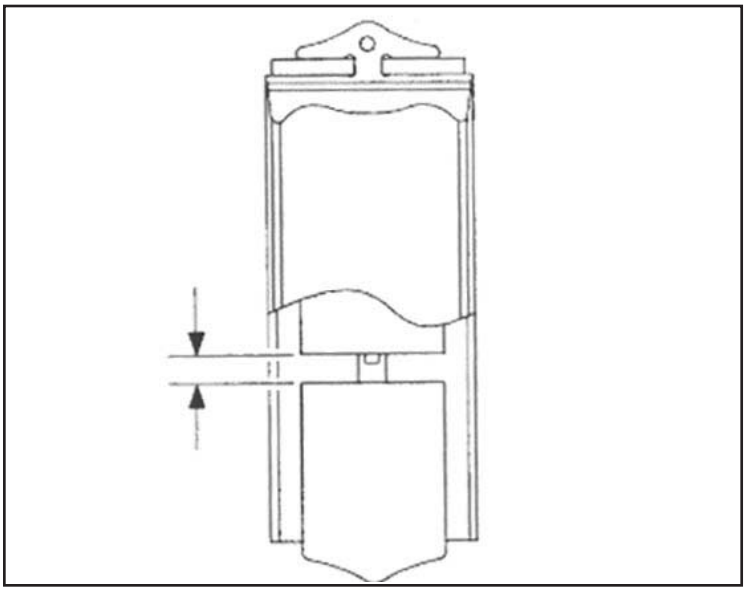
Drive Belt Removal and Installation Continued...

NOTE **USE EXTREME CARE WHEN HANDLING THE BELT ASSEMBLY. AVOID METAL TO METAL CONTACT WITH THE SIDES OF THE BELT RINGSETS. DO NOT DISASSEMBLE BELT ASSEMBLY. DAMAGE TO THE RINGSETS MAY CAUSE THE BELT TO BECOME INOPERATIVE.**

IMPORTANT **DO NOT REMOVE THE TIE STRAPS FROM BELT ASSEMBLY.**

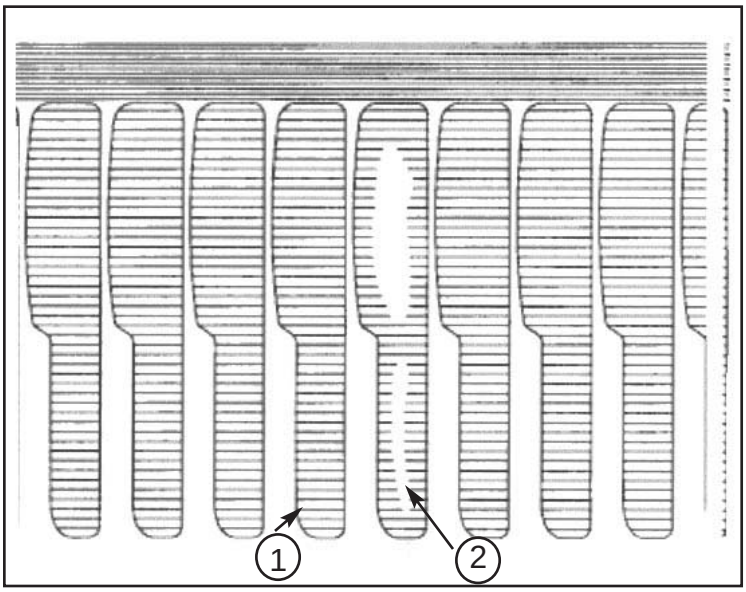
IMPORTANT **WHEN INSPECTING BELT ASSEMBLY, WIPE OIL FROM INSPECTION AREA WITH A SOFT CLOTH. WEAR PATTERNS ARE EASIER TO DISTINGUISH WHEN THE OIL IS REMOVED.**

6. Inspect belt assembly for sharp dents on sides of ringsets.
7. Inspect belt ringsets for burrs.

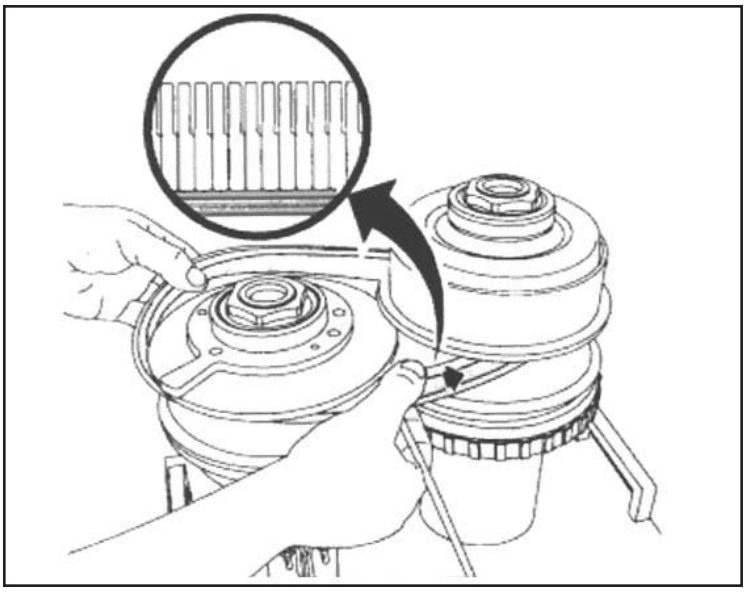


8. Using a feeler gauge, measure belt endplay over the full width of belt assembly element. Proper end play is **2.0 mm (0.079 inch) or less.**

Drive Belt Removal and Installation Continued...



9. Inspect the pulley contact area on the belt assembly elements for wear. The contact area on the elements should display visible horizontal grooves (1). These grooves can also be distinguished by feel. Worn grooves (2) indicate a slipping belt.



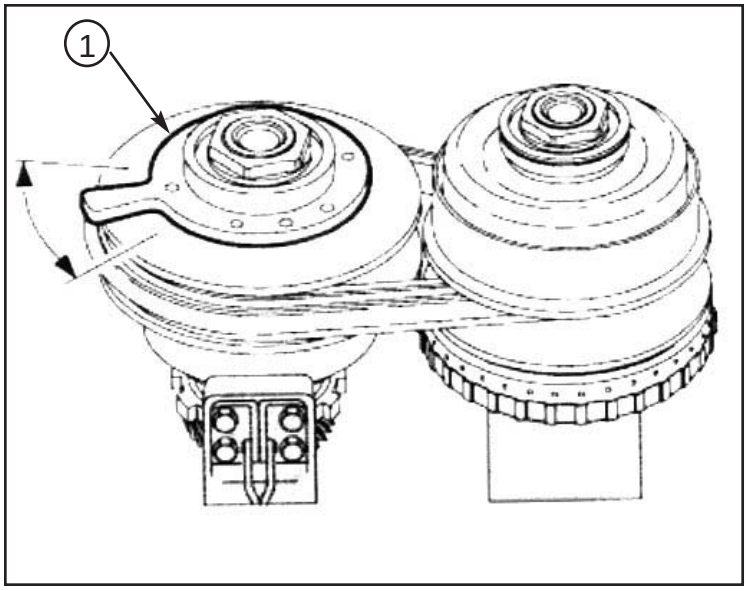
IMPORTANT **WHEN INSTALLING BELT ASSEMBLY, ENSURE THAT THE PRINTED ARROW ON THE BELT ASSEMBLY POINTS TO THE RIGHT. IF THE PRINTED ARROW IS NOT VISIBLE, INSTALL BELT ASSEMBLY SO THAT THE STEP IN RINGSET ELEMENT POINTS TO THE RIGHT.**

10. Carefully install belt assembly.

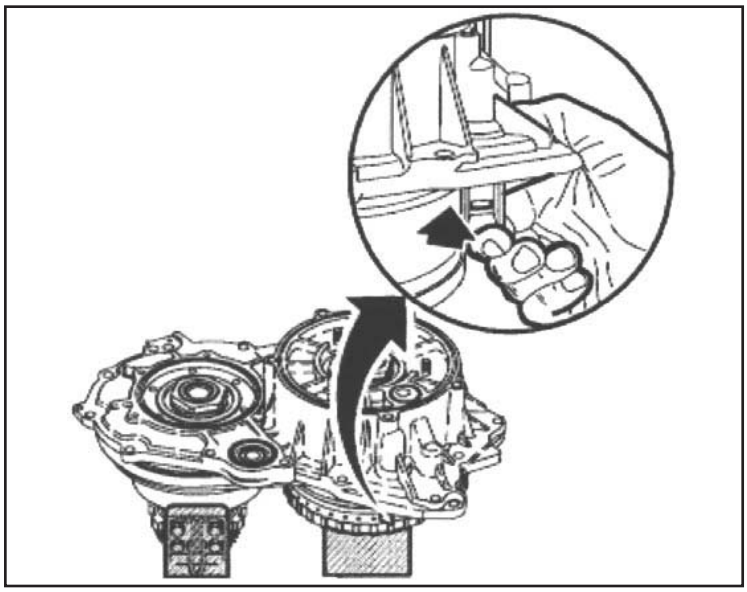
Cover Assembly Assemble

Tools Required

- J 44337 Build Plate Assembly



1. Ensure the driven pulley retainer extension (1) is properly aligned to case cover assembly.

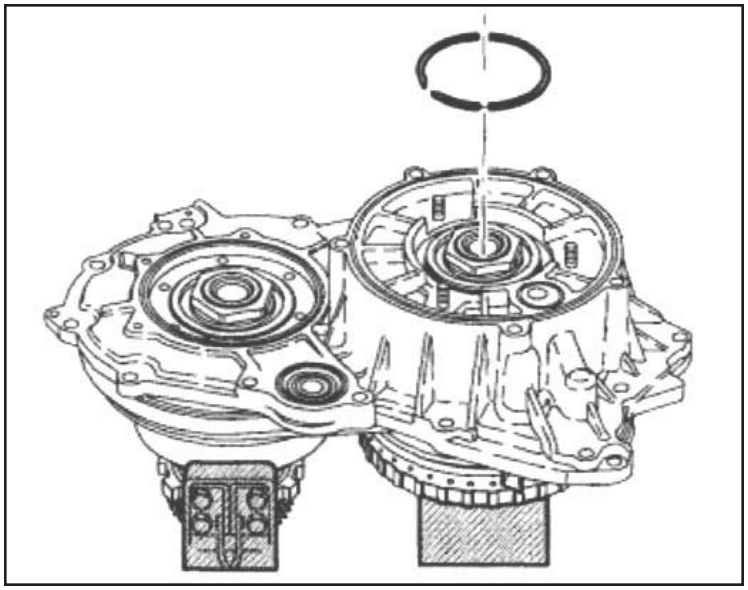


2. Ensure the drive belt assembly is installed and the driven pulley assembly is still in compressed position.

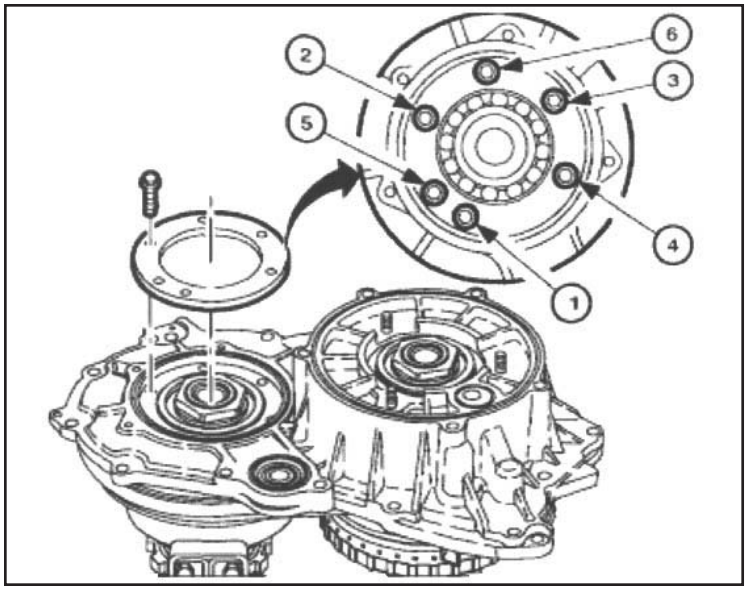
IMPORTANT **WHEN INSTALLING CASE COVER ASSEMBLY ONTO DRIVE AND DRIVEN PULLEY ASSEMBLIES, ENSURE THE FOLLOWER IS POSITIONED PROPERLY ON DRIVE PULLEY.**

Cover Assembly Assemble

3. Position case cover assembly onto drive and driven pulley assemblies.



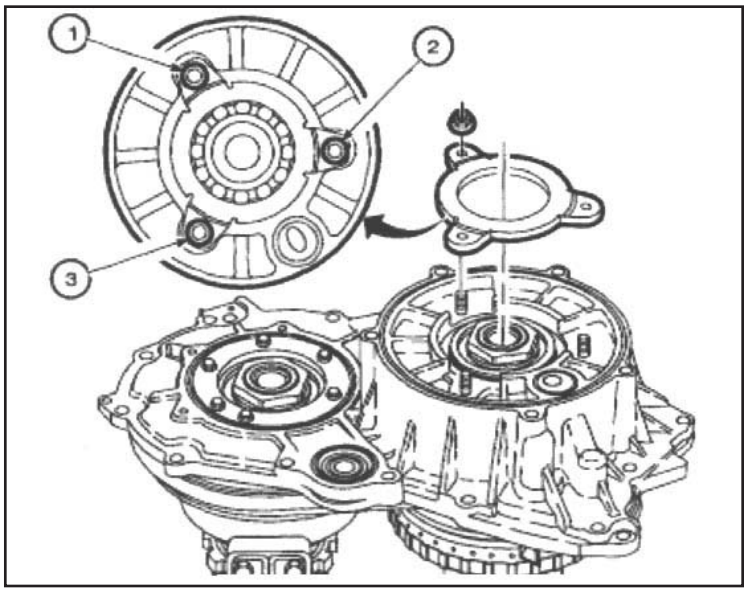
4. Install retaining ring for drive pulley bearing.



IMPORTANT **ENSURE THAT BOLT HOLES IN DRIVEN PULLEY RETAINER EXTENSION ARE PROPERLY ALIGNED WITH BOLT HOLES IN DRIVEN PULLEY BEARING RETAINER.**

5. Install driven pulley bearing retainer and bolts and tighten in sequence shown. Torque: Bearing Retainer Bolts: **5 Nm (44 inch lbs.)**

Cover Assembly Assemble Continued...

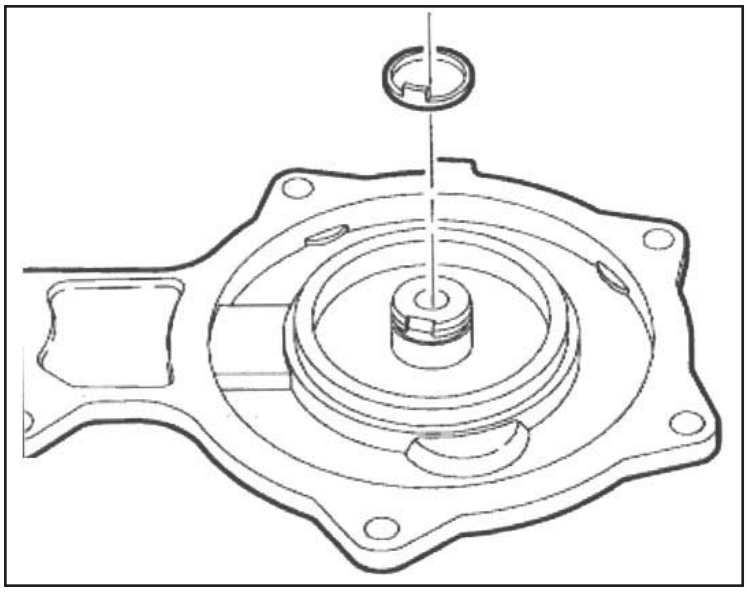


6. Install drive pulley bearing retainer and nuts. Tighten in sequence shown. Torque: Bearing Retainer Nuts: **11 Nm (8 ft. lbs.)**

NOTE **WHEN RELEASING SPRING FORCE ON THE DRIVEN PULLEY ASSEMBLY, SLOWLY PULL UP ON THE CLAMP HANDLES. A RAPID RELEASE OF SPRING FORCE MAY CAUSE DAMAGE TO THE BELT ASSEMBLY.**

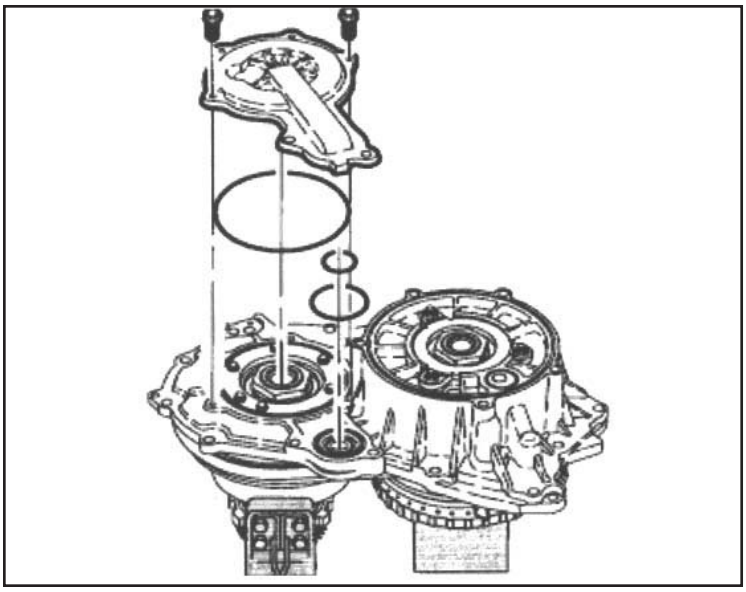
7. Using the build plate assembly J44337, slowly pull up on clamp handles in order to release spring force on driven pulley assembly.

8. Remove U-shaped ring from driven pulley.



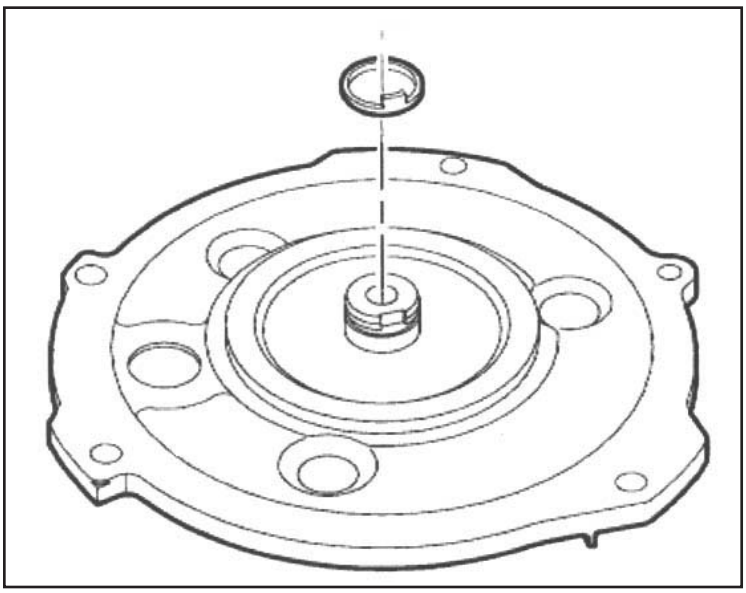
9. Inspect case cover seal on driven pulley cover for damage. Replace if necessary.

Cover Assembly Assemble Continued...



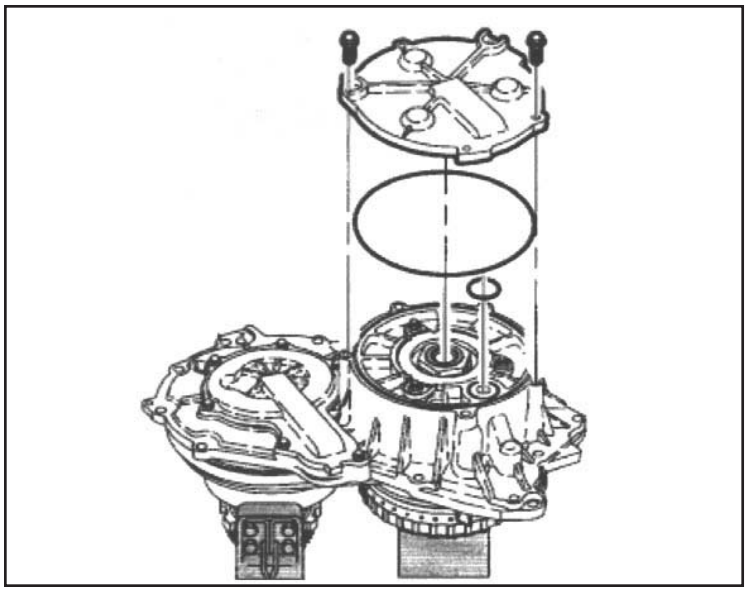
10. Install new driven pulley cover seals and new case cover O-ring seal on case cover assembly.

11. Install driven pulley cover and 2 bolts on case cover assembly. Torque: Drive Pulley Cover Bolts: **11 Nm (8 ft. lbs.)**



12. Inspect case cover seal on drive pulley cover for damage. Replace if necessary.

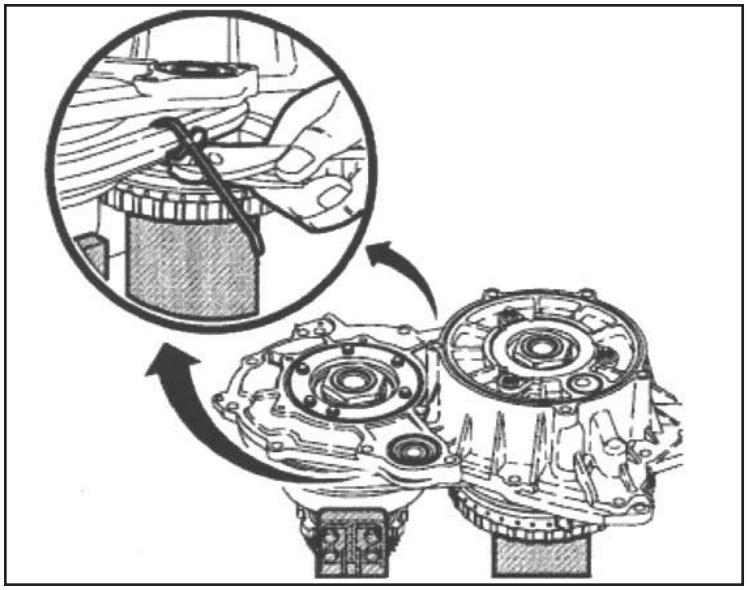
Cover Assembly Assemble Continued...



13. Install new drive pulley cover seals on case cover assembly.

IMPORTANT **DO NOT INSTALL ALL OF THE BOLTS USED TO SECURE DRIVE PULLEY COVER TO CASE COVER ASSEMBLY. TWO OF THE BOLT HOLES ARE USED FOR ATTACHING CASE COVER LIFTING BRACKET.**

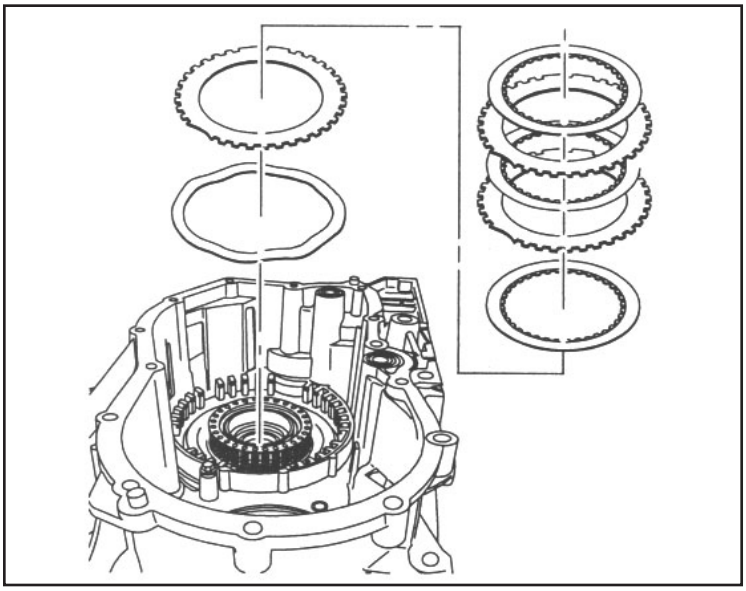
14. Install drive pulley cover and 2 bolts on case cover assembly. Torque: Drive Pulley Cover Bolts: **11 Nm (8 ft. lbs.)**

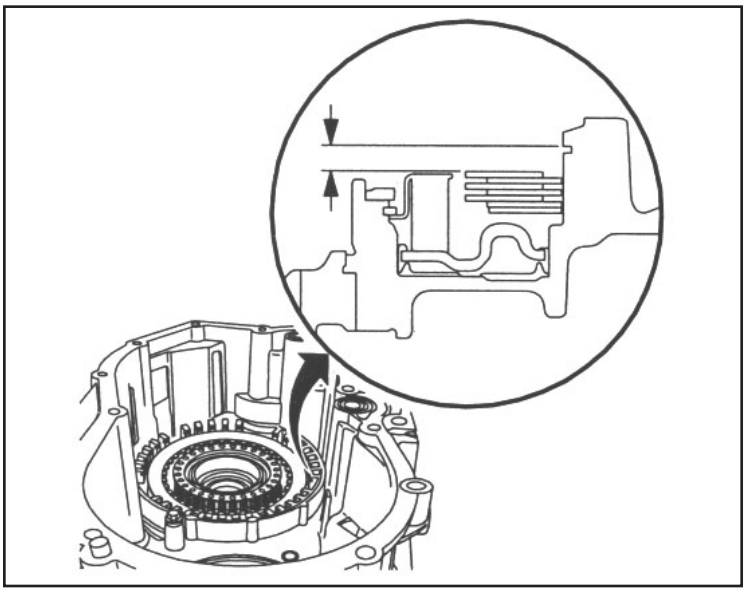


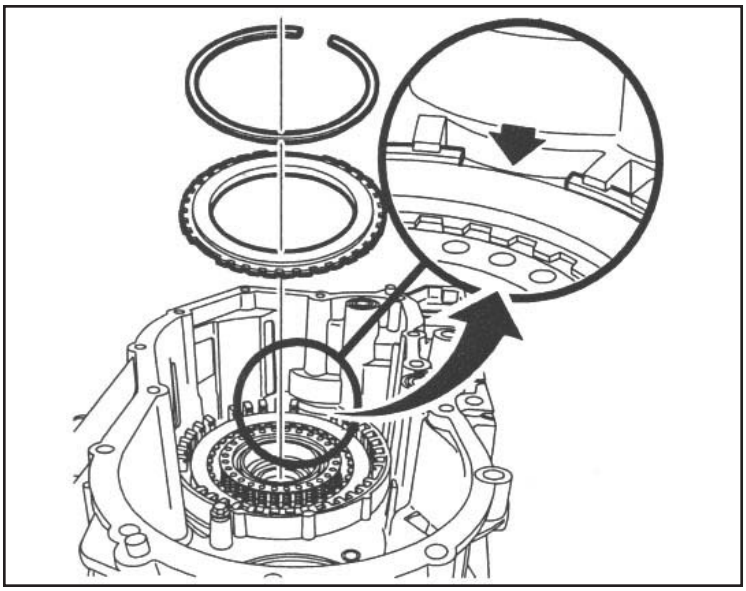
NOTE **AVOID DAMAGE TO BELT RINGSETS. DAMAGE TO THE RINGSETS MAY CAUSE BELT TO BECOME INOPERATIVE.**

15. Remove tie straps from belt assembly.

Checking Reverse Clutch Clearance







1. Install reverse clutch waved plate.

IMPORTANT

THE REVERSE CLUTCH PLATES ARE DESIGNED TO FIT ONLY ONE WAY INTO TRANSAXLE CASE ASSEMBLY

IMPORTANT

INSTALL REVERSE CLUTCH PLATES WITH THE FRICTION MATERIAL FACING UP (TOWARD BACKING PLATE)

2. Install reverse clutch plates (3 each), starting with a plate with splines on outer diameter (external).

3. Measure distance between top (outer) edge of retaining ring groove and top friction plate. Record measurement.

IMPORTANT

THE BACKING PLATE IDENTIFICATION LETTER IS STAMPED ON THE BACKING PLATE

4. Refer to “Reverse Clutch Backing Plate Specifications” chart in order to select the proper backing plate.

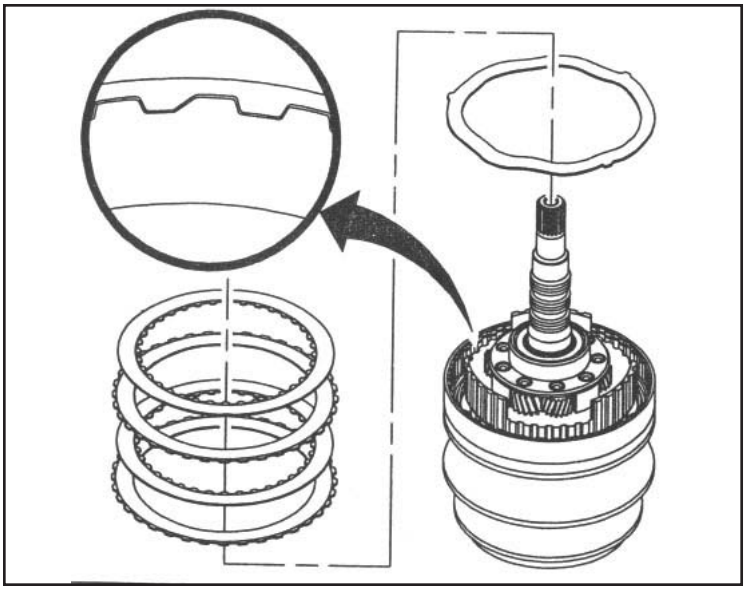
5. Install reverse clutch backing plate.

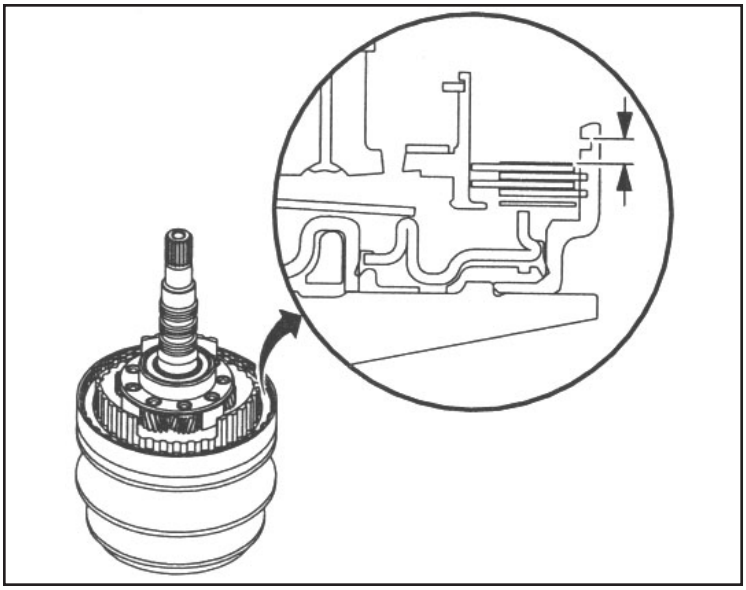
IMPORTANT

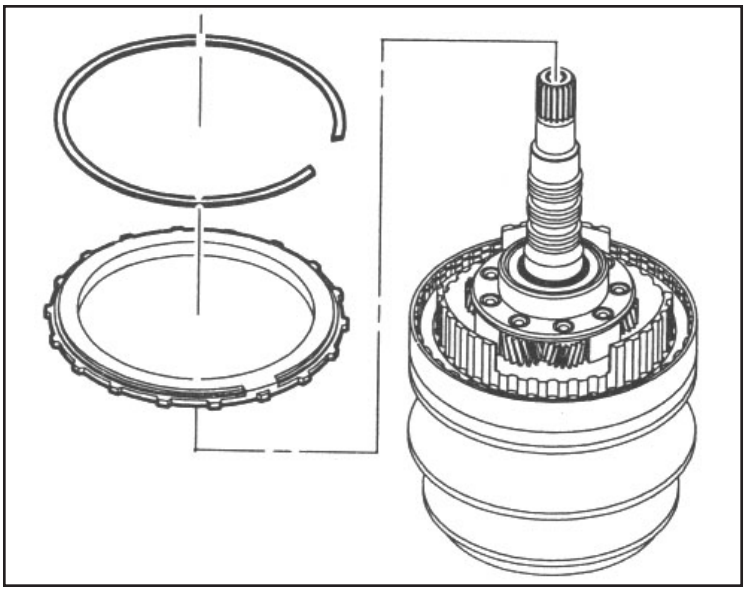
ALIGN RETANING RING GAP WITH FLUID PUMP HOUSING AREA OF TRANSMISSION CASE ASSEMBLY

6. Install retaining ring for reverse clutch backing plate.

Checking Forward Clutch Clearance







1. Install forward clutch waved plate.

IMPORTANT

THE FORWARD CLUTCH PLATES ARE DESIGNED TO FIT ONLY ONE WAY IN THE FORWARD CLUTCH ASSEMBLY. MATCH THE ALIGNMENT NOTCHES ON CLUTCH PLATES WITH THE CORRESPONDING NOTCHES ON FORWARD CLUTCH ASSEMBLY AND INPUT SHAFT ASSEMBLY

IMPORTANT

INSTALL FORWARD CLUTCH PLATES WITH THE FRICTION MATERIAL FACING UP (TOWARD BACKING PLATE)

2. Install forward clutch plates (2 each), starting with a plate with the splines on the outer diameter (external).

3. Measure the distance between the top (outer) edge of retaining ring groove and the top friction plate. Record measurement.

IMPORTANT

THE BACKING PLATE IDENTIFICATION LETTER IS STAMPED ON THE BACKING PLATE

4. Refer to “Forward Clutch Backing Plate Specifications” chart in order to select the proper backing plate.

5. Install forward clutch backing plate.

6. Install retaining ring for the forward clutch backing plate.

Clutch Backing Plate Specifications

Forward Clutch

Recorded Measurement	Backing Plate Identification
5.159-5.399 mm (0.203-0.213 in)	B
5.400-5.641 mm (0.213-0.222 in)	C
5.642-5.882 mm (0.222-0.232 in)	D
5.883-6.124 mm (0.232-0.241 in)	E
6.125-6.365 mm (0.241-0.251 in)	F
6.366-6.607 mm (0.251-0.260 in)	G

Reverse Clutch - Flat Clutch Plate Design I.D. Spline

Recorded Measurement	Backing Plate Identification
5.476-5.947 mm (0.216-0.234 in)	J
5.948-6.420 mm (0.234-0.253 in)	K
6.421-6.892 mm (0.253-0.271 in)	L

Reverse Clutch - Wave Clutch Plate Design I.D. Spline

Recorded Measurement	Backing Plate Identification
5.118-5.325 mm (0.201-0.209 in)	F
5.326-5.533 mm (0.210-0.217 in)	G
5.534-5.574 mm (0.218-0.225 in)	H
5.741-5.948 mm (0.226-0.234 in)	J
5.949-6.156 mm (0.235-0.242 in)	K
6.157-6.363 mm (0.243-0.251 in)	L

Torque Specifications

Application	Specification	
	Metric	English
Axle Shaft Hub Nut	205 N•m	151 lb ft
B+ Cable to Starter Nut	10 N•m	89 lb in
Battery Cooling Box Cover Screws	2 N•m	18 lb in
Battery Hold Down Screw	15 N•m	11 lb ft
Battery Terminal Bolts	17 N•m	13 lb ft
Battery Tray Bracket Screws	16 N•m	12 lb ft
Bearing Retainer Bolts	5 N•m	44 lb in
Bearing Retainer Nuts	11 N•m	97 lb in
Bracket-to-Engine Bolts	35 N•m	26 lb ft
Case Assembly Bolts	28 N•m	21 lb ft
Case Cover Bolts	28 N•m	21 lb ft
Control Valve Body Assembly to Transaxle Case Assembly Bolts	8 N•m	71 lb in
Drive Pulley Cover Bolts	11 N•m	97 lb in
Drive Shaft Bolts	30 N•m	22 lb ft
Drive Shaft Fasteners	25 N•m	18 lb ft
Driven Pulley Cover Bolts	11 N•m	97 lb in
Fluid Baffle Bolts	11 N•m	97 lb in
Fluid Fill Lower Tube Assembly	20 N•m	15 lb ft
Fluid Fill Lower Tube Assembly Plug	11 N•m	97 lb in
Fluid Pressure Test Hole Plug	9 N•m	80 lb in
Fluid Pump Assembly Bolt	11 N•m	97 lb in
Frame-to-Body Bolts	150 N•m	111 lb ft
Front Axle Shaft Hub Nut	205 N•m	151 lb ft
Front Axle to Knuckle Nut	205 N•m	151 lb ft
Front Pitch Restrictor Bolts	50 N•m	37 lb ft
Input and Output Speed Sensor Bolts	11 N•m	97 lb in
Lower Control Arm Ball Stud to Knuckle Nut	10 N•m + 150°	89 lb in + 150°
Lower Control Arm Nut	10 N•m + 150°	89 lb in + 150°
Lower Control Arm to Knuckle Nut	10 N•m + 150°	89 lb in + 150°
Lower Stabilizer Nut	65 N•m	48 lb ft
Lube Oil Bolt	11 N•m	97 lb in
Manual Shaft Detent Assembly Bolts	11 N•m	97 lb in
Manual Shift Shaft Nut	27 N•m	20 lb ft
Oil Cooler Line Assembly Nut	7 N•m	62 lb in
Power Take-Off Bracket Bolts	60 N•m	44 lb ft
Power Take-Off Unit Bolts	60 N•m	44 lb ft
Rack and Pinion Bolts	110 N•m	81 lb ft
Rear Pitch Restrictor Through Bolt	110 N•m	81 lb ft
S Terminal Nut	5 N•m	44 lb in
Stabilizer Bar Link Nut	65 N•m	48 lb ft

Torque Specifications

Application	Specification	
	Metric	English
Starter Bolts	40 N•m	30 lb ft
Through Bolts	110 N•m	81 lb ft
Tie Rod End Nut	50 N•m	37 lb ft
Tie Rod Installation Tool	40 N•m	30 lb ft
Tie Rod to Knuckle Installation Tool	40 N•m	30 lb ft
Torque Converter and Differential Housing Assembly-to-Case Assembly Bolts	28 N•m	21 lb ft
Torque Converter-to-Flexplate Bolts	60 N•m	44 lb ft
Transaxle Cooler Line Fittings	16 N•m	12 lb ft
Transaxle Lower Tube Assembly	20 N•m	15 lb ft
Transaxle Lower Tube Plug	11 N•m	97 lb in
Transaxle Mount Bolts - Upper Left	50 N•m	37 lb ft
Transaxle Oil Cooler Line Assembly Nut	7 N•m	62 lb in
Transaxle Range Switch Bolts	11 N•m	97 lb in
Transaxle Range Switch Lever Nut	16 N•m	12 lb ft
Transaxle-to-Engine Bolts	75 N•m	55 lb ft
Valve Assembly	12 N•m	106 lb in
Valve Body Assembly Bolts	8 N•m	71 lb in
Valve Body Cover Bolts	11 N•m	97 lb in
Wheel Nuts	125 N•m	92 lb ft

End Play Specifications

Application	Specification	
	Metric	English
Torque Converter	0.1-0.5 mm	0.004-0.020 in
Input Shaft Carrier Pinion	0.14-0.65 mm	0.01-0.026 in
Belt Assembly - between elements	2.0 mm or less	0.079 in or less

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