

A decorative horizontal band featuring a repeating pattern of interlocking gears in a light blue color, set against a darker blue background. This band is positioned above the main title area.

# **In-Chassis Maintenance**

## **1000 And 2000 Product Families**

**JA3664EN**

# In-Chassis Maintenance

2004 APRIL 01

JA3664EN

## Allison Transmission

### VOCATIONAL MODELS

1000 EVS	2100 EVS	2200 EVS	2500 EVS
1000 HS	2100 HS	2200 HS	2500 HS
1000 MH	2100 MH	2200 MH	2500 MH
1000 PTS	2100 PTS	2200 PTS	2500 PTS
1000 RDS	2100 RDS	2200 RDS	2500 RDS
1000 SP	2100 SP	2200 SP	2500 SP
B 210	B 220		

1000 Series™ 2000 Series™ 2000 MH Series 2400 Series™



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## **TRADEMARKS**

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# NOTES



## TROUBLESHOOTING

## SECTION I

### 1-1. GENERAL TROUBLESHOOTING INFORMATION

**a. CHECK TRANS Light.** The **CHECK TRANS** light is original equipment manufacturer (OEM)-supplied and usually located on the vehicle's instrument panel.

The **CHECK TRANS** light is illuminated briefly during vehicle start-up as a bulb check.



**NOTE:** The **CHECK ENGINE** light may serve the **CHECK TRANS** function for vehicles which are compliant to Industry On Board Diagnostics II (OBD-II) requirements.

When the light is "ON" shifts may be restricted by the Transmission Control Module (TCM) when the TCM senses abnormal conditions as follows:



**WARNING:** If ignition is turned "OFF" and then "ON" while the **CHECK TRANS** light is displayed, the transmission may remain in neutral until the code is cleared. Leave ignition "ON" until you are in a safe place to stop.

- The transmission may be locked in the range it was in when the problem was detected.
- The transmission may continue to operate with inhibited shifting.
- The TCM may not respond to shift selector requests.
- Direction changes and shifts from neutral-to-range may not occur.

Whenever the **CHECK TRANS** light is displayed, the TCM logs a diagnostic code in memory. These diagnostic codes can be accessed through the Allison DOC™ For PC diagnostic system.



**NOTE:** Diagnostic codes can be logged without illuminating the **CHECK TRANS** light. This occurs when the TCM senses a problem, but determines the problem won't cause immediate transmission damage or dangerous performance.

**b. Range Inhibit Indicator.** If the TCM detects conditions such that a shift from Neutral to a forward range or to Reverse should not be allowed, shifts out of Neutral may be inhibited.

At the same time these events occur, a required OEM-supplied **RANGE INHIBITED** light, mounted on the dash or near the shift selector, is illuminated. This notifies the driver that shifting is inhibited and the shift selector may not respond to shifts requested.

**c. Allison Diagnostic Optimized Connection™ (Allison DOC™ For PC).**

Control system diagnostics are performed using a “Windows” PC operating system and interface/software which is available through Allison Transmission tool sources. The PC acts as a receiver/transmitter/display medium that allows the service technician to communicate with the TCM. Typical troubleshooting activities performed are installation checkout and diagnostic code retrieval.

Consult the User Guide which accompanies the Allison DOC™ For PC diagnostic tool. Figure 1–1 shows a typical beginning screen for the Allison DOC™ for PC diagnostic tool. The user's manual contains the information for performing the following:

- Displaying (retrieving) diagnostic trouble codes (DTCs) Transmission diagnostic codes begin with P0, P1, U1, or U2 followed immediately by three additional numbers. For a complete list of codes and more detailed information, refer to TS3192EN, Electronic Troubleshooting Manual.
- Clearing diagnostic codes
- Obtaining transmission data such as input speed or sump fluid temperature
- Conducting solenoid testing
- Conducting clutch diagnostics (including torque converter clutch)





- Make sure throttle is closed and engine speed is below 900 rpm.
- Make sure electrical connections are properly made.
- Check support equipment for proper installation and operation.
- If adaptive information had been reset, initial upshifts and downshift may be harsh. Allow shifts to “converge” before assuming there is a shift problem.
- Refer to Paragraph 1–2 “General Troubleshooting of Performance Complaints.”
  - These troubleshooting charts list a variety of conditions that may or may not relate to the Electronic Control.
  - Some conditions and suggested checks include mechanical and hydraulic items.
- If the troubleshooting charts refer you to an Electronic Control check, use the diagnostic code troubleshooting information that best applies to the situation.

**e. Troubleshooting Intermittent Diagnostic Codes.** Intermittent codes are a result of conditions which are not always present.

When conditions causing the code exist, the code is logged in memory. The code stays in memory until it is manually cleared or cycled out.

When intermittently occurring codes exist, check for the following items:

- Dirty, damaged or corroded harness connectors and terminals
- Terminals not fully seated in connectors
- Damaged harnesses (due to poor routing, chafing, excessive heat, tight bends, etc.)
- Improperly mounted electronic control components
- Poor connector seals (where applicable)
- Exposed harness wires
- Electromagnetic Interference (EMI) generating components and accessories
- Loose ground connections

To help locate intermittents, it sometimes helps to place the appropriate tester on the suspect component or circuit and simulate operating conditions — wiggle, pull, bump, and bend while watching the tester.

## **1-2. GENERAL TROUBLESHOOTING OF PERFORMANCE COMPLAINTS**

Make the following general checks before beginning specific troubleshooting, removing the transmission, or removing attached components.

- Are wheel chocks in place?
- Are there active diagnostic codes?
- Is the shift selector in **N** (Neutral) to allow starting the engine?
- Is the battery properly connected and charged?
- Is the transmission fluid level correct?
- Is voltage to the TCM correct?
- Are engine parameters correct for the transmission?
- Is the engine properly tuned?
- Is fuel flow to the engine correct?
- Is air flow to the cooler and radiator unrestricted?
- Is the driveline properly connected?
- Are there signs of fluid leakage under the vehicle? What is the origination point?
- Are hydraulic connections correctly made and not leaking?
- Has vehicle acceleration from a stop changed?
- Are electrical connections correctly made?
- Are there any other obvious vehicle or transmission problems?

After making these general checks use the various sections of this manual to isolate the listed problems. The following charts address specific vehicle complaints. Some complaints involve diagnostic codes, so all troubleshooting checks should involve checking the system for diagnostic codes.

Table 1–1. Troubleshooting Performance Complaints

Problem	Possible Cause	Suggested Remedy
VEHICLE WILL NOT START (ENGINE WILL NOT CRANK)	Lever shift selector not in neutral or Park	Select <b>N</b> (Neutral) and restart
	Dead battery	Recharge battery
	Disconnected battery	Reconnect battery
	Faulty starter circuit	Repair vehicle starter circuit
	Faulty NSBU switch	Replace NSBU switch (see Paragraph 3–2 <b>b</b> )
	Misadjusted NSBU switch	Adjust NSBU switch (see Paragraph 3–2 <b>a</b> )
	Faulty wiring in vehicle neutral start circuit	Repair wiring
<b>CHECK TRANS LIGHT WILL NOT GO OUT AT START-UP</b>	Electrical connector not properly seated on NSBU switch	Properly install electrical connector
	TCM HAS LOGGED A DTC	INSTALL DIAGNOSTIC TOOL TO DETERMINE IF DTC IS PRESENT
	Faulty <b>CHECK TRANS</b> light, relay, or circuit.	Replace relay or repair circuit

Table 1–1. Troubleshooting Performance Complaints (cont'd)

Problem	Possible Cause	Suggested Remedy
<b>CHECK TRANS LIGHT FLASHES INTERMITTENTLY</b>	Intermittent power to TCM	Check input power to the TCM and correct if necessary
	Faulty vehicle wiring	Repair vehicle wiring
	Loose wiring to <b>CHECK TRANS</b> light	Repair wiring
	Faulty or incorrect ground wire attachment	Repair ground circuit
	Intermittent opening in Circuit 125	Repair Circuit 125
<b>NO CHECK TRANS LIGHT AT IGNITION</b>	Faulty light bulb or socket	Replace light bulb or socket
	Incorrect wiring to and from <b>CHECK TRANS</b> light bulb	Repair wiring (see Troubleshooting Manual TS3192EN)
	Faulty vehicle wiring	Repair vehicle wiring
	Circuit 125 open	Repair Circuit 125

Table 1-1. Troubleshooting Performance Complaints (cont'd)

Problem	Possible Cause	Suggested Remedy
TRANSMISSION WILL NOT SHIFT TO FORWARD OR REVERSE (STAYS IN NEUTRAL)	Engine rpm too high	Reduce engine rpm (it may be necessary to reselect Neutral also, and then <b>D</b> or <b>R</b> )
	Low fluid level	Add fluid to proper level (refer to Mechanic's Tips MT3190EN)
	Throttle position sensor or linkage is not functioning properly	Refer to Mechanic's Tips MT3190EN
	Faulty throttle signal from engine	Correct engine throttle signal
	Shift selector is not functioning properly	Repair shift selector or adjust linkage
	Speed sensor(s) not functioning properly	Repair or replace speed sensor(s) or circuitry (see Paragraph 6-3)
	Mechanical failure to C5 clutch	Repair transmission
	Mechanical failure in transmission torque converter, shafts, or planetaries	Repair transmission
	Low pressure	Repair transmission
	Faulty wiring in TCM Input/Output function circuits	Correct circuit wiring

Table 1–1. Troubleshooting Performance Complaints (*cont'd*)

Problem	Possible Cause	Suggested Remedy
TRANSMISSION WILL NOT STAY IN FORWARD OR REVERSE	Auto-neutral for PTO circuit (input function) faulty	Repair quick-to-neutral circuit
	Low fluid	Adjust fluid level
	Leaking at solenoid assembly	Rebuild solenoid assembly (refer to transmission Service Manual SM3191EN)
	Low pressure	Repair transmission
	Faulty solenoid — leaking	Replace solenoid (see Paragraph 6–9c, d, e)
TRANSMISSION WILL NOT MAKE A SPECIFIC SHIFT	Low engine power	Correct engine problem, see Engine Service Manual
	Extreme fluid temperature	Inspect cooling system and fluid level
	Faulty speed sensor/circuit	Repair circuit or replace speed sensor(s)
	Incorrect engine parameters	Have OEM reset to correct setting
	Faulty temperature sensor/circuit	Check for temperature reading which inhibits shifts
	Incorrect calibration	Install correct calibration
	Faulty or misadjusted shift selector	Repair shift selector

**Table 1–1. Troubleshooting Performance Complaints (*cont'd*)**

<b>Problem</b>	<b>Possible Cause</b>	<b>Suggested Remedy</b>
TRANSMISSION DOES NOT SHIFT PROPERLY (ROUGH SHIFTS, SHIFTS OCCURRING AT TOO LOW OR TOO HIGH SPEED)	Engine idle speed too fast (neutral to range shift)	Adjust engine idle speed (refer to Vehicle Service Manual)
	Faulty throttle sensor/circuit	Refer to Mechanic's Tips MT3190EN and/or Troubleshooting Manual TS3192EN
	Faulty or sticking bleed ball in C1 position housing	Replace C1 piston housing
	Excessive clutch running clearance	Rebuild transmission and adjust clearances
	Incorrect shift calibration for vehicle	Install correct calibration
	Instrument panel tachometer incorrect	Repair or replace tachometer
	Incorrectly calibrated electronic speedometer	Calibrate electronic speedometer
	Faulty speed sensor/circuit	Repair circuit or replace speed sensor (refer to Troubleshooting Manual TS3192EN)
	Degraded fluid	Change transmission fluid and filter
	Loose speed sensor	Tighten speed sensor retaining bracket bolt

**Table 1-1. Troubleshooting Performance Complaints (*cont'd*)**

<b>Problem</b>	<b>Possible Cause</b>	<b>Suggested Remedy</b>
TRANSMISSION DOES NOT SHIFT PROPERLY (ROUGH SHIFTS, SHIFTS OCCURRING AT TOO LOW OR TOO HIGH SPEED) ( <i>cont'd</i> )	Incorrect fluid level	Correct fluid level
	Shift adaptives not converged	Drive vehicle until shift adaptives are converged
	Engine parameters not correct	Have OEM verify engine parameters that may affect transmission performance
	Low main pressure	Repair transmission
	Intermittent problems	Check wiring harnesses and connectors (see Troubleshooting Manual TS3192EN)
	Loose or damaged speed gear	Tighten output flange bolt or replace speed gear
	Sticking valves in control valve body	Overhaul control valve body assembly
	Leaking trim solenoids	Repair or replace trim solenoids (see Paragraph 6-9)
	Incorrect calibration	Install correct calibration



Table 1–1. Troubleshooting Performance Complaints (*cont’d*)

Problem	Possible Cause	Suggested Remedy
<b>ABNORMAL ACTIVITIES OR RESPONSES</b>		
A. Excessive Creep in First and Reverse Gears	Engine idle speed too high	Adjust to correct idle speed
B. Vehicle Moves Forward in Neutral	C1 clutch failed or not released	Rebuild C1 clutch (refer to transmission Service Manual)
C. Vehicle Moves Backward in Neutral	C3 clutch failed or not released	Rebuild C3 clutch assembly (refer to transmission Service Manual SM3191EN)
<b>EXCESSIVE FLARE — ENGINE OVERSPEED ON FULL-THROTTLE UPSHIFTS</b>		
TPS Adjustment:		
— Overstroke		— Adjust TPS linkage for proper stroke (refer to Mechanic’s Tips MT3190EN)
— Loose		— Tighten loose bolts or connections
Incorrect calibration		Install correct calibration
Incorrect fluid level		Add fluid to proper level (refer to Mechanic’s Tips MT3190EN)
Sticking valves in control valve body assembly		Rebuild control valve body assembly
Low main pressure		See Low Pressure section

**Table 1-1. Troubleshooting Performance Complaints (*cont'd*)**

<b>Problem</b>	<b>Possible Cause</b>	<b>Suggested Remedy</b>
<b>EXCESSIVE FLARE — ENGINE OVERSPEED ON FULL- THROTTLE UPSHIFTS (<i>cont'd</i>)</b>	Leaking trim solenoids	Repair or replace trim solenoids (see Paragraph 6-9)
	Erratic speed sensor signal	See speed sensor DTCs
	Piston seals leaking or clutch plates slipping in range involved	Overhaul transmission (refer to transmission Service Manual SM3191EN)
<b>RANGE CLUTCH TROUBLESHOOTING SECTION</b>		
<b>EXCESSIVE SLIPPAGE AND CLUTCH CHATTER</b>	Incorrect calibration	Install correct calibration
	Throttle position sensor out of adjustment or failed	Adjust or replace throttle position sensor (refer to Mechanic's Tips MT3190EN)
	Incorrect speed sensor readings	See speed sensor DTCs
	Incorrect fluid level	Correct fluid level (refer to Mechanic's Tips MT3190EN)
	Main pressure low	Refer to transmission Service Manual SM3191EN
	TCC clutch not applied	Inspect torque converter clutch system wiring, pressure, and controls; repair as necessary (refer to transmission Service Manual SM3191EN)

**Table 1–1. Troubleshooting Performance Complaints (*cont'd*)**

<b>Problem</b>	<b>Possible Cause</b>	<b>Suggested Remedy</b>
<b>A. Ranges 1, 2, 3, 4 Only</b>	C1 clutch slipping, leaks at splintline gasket, leaks at rotating clutch seals, leaks at piston seals, C1 clutch plates worn	Inspect control module gasket, C1 clutch plates, and piston and rotating seals; replace/rebuild as necessary (refer to transmission Service Manual SM3191EN)
<b>B. Ranges 4, 5 Only</b>	C2 clutch slipping, leaks at splintline gasket, leaks at rotating clutch seals, leaks at piston seals, C2 clutch plates worn	Inspect control module gasket, C2 clutch plates, and piston and rotating seals; replace/rebuild as necessary (refer to transmission Service Manual SM3191EN)
<b>C. Ranges 3, 5, R Only</b>	C3 clutch slipping, leaks at piston seals, C3 clutch plates worn	Inspect C3 clutch plates and piston seals; replace/rebuild as necessary (refer to transmission Service Manual SM3191EN)
<b>D. Range 2 Only</b>	C4 clutch slipping, leaks at piston seals, C4 clutch plates worn	Inspect C4 clutch plates and piston seals; replace/rebuild as necessary (refer to transmission Service Manual SM3191EN)
<b>E. Ranges 1, R Only</b>	C5 clutch slipping, leaks at piston seals, C5 clutch plates worn	Inspect C5 clutch plates and piston seals; replace/rebuild as necessary (refer to transmission Service Manual SM3191EN)

**Table 1-1. Troubleshooting Performance Complaints (*cont'd*)**

<b>Problem</b>	<b>Possible Cause</b>	<b>Suggested Remedy</b>
<b>LOW PRESSURE SECTION</b>		
<b>A. Low Main Pressure in All Ranges</b>	Incorrect fluid level	Correct fluid level (refer to Mechanic's Tips MT3190EN)
	Plugged or faulty suction filter	Clean or replace oil suction filter element (refer to Paragraph 6-8)
	Main pressure regulator valve sticking	Overhaul front support assembly (refer to transmission Service Manual SM3191EN)
	Leaking solenoids in control valve body assembly	Repair or replace solenoids (see Paragraph 6-9)
	Stuck or sticking lube regulator valve	Overhaul front support assembly (refer to transmission Service Manual SM3191EN)
	Main pressure regulator valve spring weak, broken, or missing	Check spring and replace if necessary (refer to transmission Service Manual SM3191EN)
	Control module body leakage (separator plate not flat, separator plate gasket leakage, loose control valve body bolts)	Replace or rebuild control module assembly. Care should be taken when removing and labeling shift springs (refer to transmission Service Manual SM3191EN)
	Faulty or incorrect fluid pressure gauge	Repair or replace gauge

**Table 1–1. Troubleshooting Performance Complaints (*cont'd*)**

<b>Problem</b>	<b>Possible Cause</b>	<b>Suggested Remedy</b>
<b>A. Low Main Pressure in All Ranges (<i>cont'd</i>)</b>	Oil pump worn or damaged	Replace or rebuild oil pump (refer to transmission Service Manual SM3191EN)
	Leak in suction circuit	Check suction circuit for leaking seal, gasket, or mating surface
<b>B. Main Pressure Low in Specific Ranges, Normal Pressure in Other Ranges</b>	Seal leak	See SM3191EN for procedure to replace seals that are causing low pressure in a particular range
<b>C. Low Lubrication Pressure</b>	Incorrect fluid level	Correct fluid level (refer to Mechanic's Tips MT3190EN)
	Plugged suction filter	Change filter (refer to Mechanic's Tips MT3190EN)
	Plugged cooler circuit filter	Change filter
	Excessive internal fluid leakage	Check other pressures (above items); also check control module mounting bolts; lubrication valve and spring (refer to transmission Service Manual SM3191EN); converter housing to separator plate gasket
	Cooler lines restricted or leaking	Check for kinks, leakage; reroute or replace lines as necessary
	Lubrication regulator valve sticking	Clean or replace regulator valve

**Table 1-1. Troubleshooting Performance Complaints (*cont'd*)**

<b>Problem</b>	<b>Possible Cause</b>	<b>Suggested Remedy</b>
<b>C. Low Lubrication Pressure (<i>cont'd</i>)</b>	Converter relief valve sticking	Clean or replace converter relief valve
	Cooler plugged	Clean or replace cooler
	Faulty gauge	Repair or replace gauge
<b>ABNORMAL STALL SPEEDS (Stall In First Range — Fifth Range)</b>		
<b>A. High Stall Speeds</b>		
	Not in gear	Select <b>D</b> (Drive)
	Low fluid level, aerated fluid	Add fluid to proper level (refer to Mechanic's Tips MT3190EN)
	Faulty torque converter	Replace torque converter
	Incorrect torque converter	Replace torque converter (refer to transmission Service Manual SM3191EN)
	Clutch pressure low	Refer to TS3192EN Electronic Troubleshooting
	C1 or C5 clutch slipping. <i>Note:</i> Use the diagnostic tool to check turbine speed	Rebuild C1 or C5 clutch (refer to transmission Service Manual SM3191EN)
	Higher power engine	Confirm proper engine match

Table 1-1. Troubleshooting Performance Complaints (cont'd)

Problem	Possible Cause	Suggested Remedy
B. Low Stall Speeds	Engine not performing efficiently (may be due to plugged or restricted injectors, high altitude conditions, dirty air filters, out of time, throttle linkage, electronic engine controls problem)	Refer to Vehicle Engine Manufacturer's Manual or Vehicle Service Manual
	Stall speeds of 33 percent of normal implies freewheeling stator	Replace converter assembly (refer to transmission Service Manual SM3191EN)
	Engine smoke controls	Compare lugback vs. static stall speed
	Incorrect torque converter	Install correct torque converter (refer to transmission Service Manual SM3191EN)
OVERHEATING IN ALL RANGES		
	Aerated fluid — incorrect fluid level	Adjust fluid to proper level, check for defective pump (refer to MT3190EN)
	Air flow to cooler obstructed	Remove air flow obstruction
	Engine overheat	Correct overheat situation (refer to Vehicle Service Manual)
	Inaccurate temperature gauge or sending unit	Replace gauge and/or sending unit

**Table 1-1. Troubleshooting Performance Complaints (*cont'd*)**

<b>Problem</b>	<b>Possible Cause</b>	<b>Suggested Remedy</b>
<b>OVERHEATING IN ALL RANGES</b> ( <i>cont'd</i> )	Inaccurate sump temperature sensor	Replace Pressure Switch Manifold (PSM) or internal harness (refer to Paragraphs 6-9)
	Inadequate cooler sizing	See vehicle OEM for specifications
	Excessive cooler circuit pressure drop	Check for plugged cooler, lines too small, collapsed hose, too many elbows in circuit
	Transmission cooler lines reversed	Connect cooler lines properly (oil and water should flow in opposite directions)
	Fluid cooler lines restricted	Remove restrictions, clean or replace lines (refer to Vehicle Service Manual)
	Torque converter (wrong converter, no torque converter clutch, stuck stator, or slipping stator)	Replace or repair converter assembly (refer to transmission Service Manual SM3191EN) <i>Note:</i> Stuck stator will not allow cool down in neutral
	Cooler flow loss due to internal transmission leakage	Overhaul transmission (refer to transmission Service Manual SM3191EN)



**Table 1–1. Troubleshooting Performance Complaints (*cont'd*)**

<b>Problem</b>	<b>Possible Cause</b>	<b>Suggested Remedy</b>
<b>FLUID COMES OUT OF THE FLUID FILL TUBE AND/OR BREATHER</b>	Dipstick loose	Tighten cap, replace if necessary
	Fluid level too high	Drain to proper level (refer to Mechanic's Tips MT3190EN)
	Fluid level too low	Add fluid to proper level
	Breather stopped up — clogged	Clean or replace breather (refer to transmission Service Manual SM3191EN)
	Fluid contaminated with foreign liquid	Drain and replace fluid. Locate and fix source of additional fluid (refer to Mechanic's Tips MT3190EN).
	Dipstick or fill tube seal worn	Replace seals or dipstick
<b>NOISE OCCURRING INTERMITTENTLY (BUZZING)</b>	Incorrect dipstick marking	Calibrate dipstick (refer to Mechanic's Tips MT3190EN)
	Low fluid level	Add fluid to proper level (refer to Mechanic's Tips MT3190EN)
	Air leak in oil suction screen canister	Replace oil suction screen canister (refer to transmission Service Manual SM3191EN)
	Clogged suction filter	Replace filter (refer to Paragraph 6–8)

**Table 1-1. Troubleshooting Performance Complaints (*cont'd*)**

<b>Problem</b>	<b>Possible Cause</b>	<b>Suggested Remedy</b>
NOISE OCCURRING INTERMITTENTLY (BUZZING) ( <i>cont'd</i> )	Aerated fluid causes noisy pump	Correct fluid level (refer to Mechanic's Tips MT3190EN)
	Low main pressure causes main regulator valve to oscillate	See Service Manual SM3191EN
LEAKING FLUID (TRANSMISSION OUTPUT)	Faulty or missing seal at output flange	Install new lip-type seal in rear of transmission housing (refer to transmission Service Manual SM3191EN) (see Paragraph 6-6)
	Machine lead on output flange seal surface	Replace flange
	Rear cover porosity	Repair or replace cover
	Flange worn at seal surface	Replace flange
	Insufficient sealant around seal OD	When replacing seal, refer to Paragraph 6-6
	Damaged or missing output bolt washer seal	Replace output bolt sealing washer
	Damaged, missing, or loose output flange bolt	Replace and/or torque output flange bolts (see Paragraph 6-1)

Table 1-1. Troubleshooting Performance Complaints (*cont'd*)

Problem	Possible Cause	Suggested Remedy
TRANSMISSION INPUT	Front seal leaks	Replace front seal (refer to Paragraph 6-10)
	Manifold gasket leaks	Replace manifold gasket (refer to Paragraph 6-5)
	Front support bolt seals leaking	Replace bolt seals
	Converter leaks	Check converter seals, cracked converter pump tangs, converter cover, or converter housing porosity; replace parts as required (refer to transmission Service Manual SM3191EN)
	Spin-on filter leaking	Replace filter
	Main pressure plug leak	Replace or torque main pressure plug
	Pump bushing shows excessive wear	Rebuild and repair pump

Table 1–1. Troubleshooting Performance Complaints (*cont’d*)

Problem	Possible Cause	Suggested Remedy
DIRTY FLUID	Failure to change fluid and filters	Change fluid and install new filters (refer to Mechanic’s Tips MT3190EN)
	Excessive heat	Check cooling system for restrictions and proper capacity
	Substandard fluid	Use recommended fluid (refer to Mechanic’s Tips MT3190EN)
	Clutch/transmission failure	Overhaul transmission (refer to transmission Service Manual SM3191EN)

## 1-3. TRANSMISSION STALL TEST AND NEUTRAL COOL-DOWN CHECK



**a. Purpose.** When a vehicle is performing unsatisfactorily, use the stall test to determine if the malfunction is in the engine or in the transmission. The neutral cool-down check uses a two minute cooling period after the stall to gather fluid temperature data for troubleshooting.



**NOTE:** The stall test should only be performed by a qualified service technician.



**NOTE:** The engine manufacturer's test data must be available for the stall test. This data can be obtained from the engine manufacturer or from the equipment dealer or distributor or from SCAAN.

- The engine stall rpm under load is compared to the engine manufacturer's specified rpm for the stall test.



**NOTE:** The Diagnostic Tool can read sump temperature to show when normal operating temperatures have been reached and the temperature has stabilized.

- Connect a tachometer (the Diagnostic Tool can read engine rpm) of known accuracy to the engine and install a temperature probe into the converter-out (to cooler) hose. Bring the transmission to the normal operating temperature range of 71°C–93°C (160°F–200°F).



**WARNING:** To help avoid injury or property damage caused by sudden and unexpected vehicle movement, do not start a stationary stall test until you:

- Put the transmission in **P** (Park) or **N** (Neutral)...and
- Apply the parking brake and service brake...and
- Chock the vehicle wheels and take any other steps necessary to keep the vehicle from moving...and
- Warn personnel to keep clear of the vehicle and its path.



**CAUTION:** DO NOT conduct a stall test in **R** (Reverse) range. The torque produced in reverse range can damage the vehicle driveline or axle.



**CAUTION:** The stall condition causes a rapid rise in fluid temperature; never maintain the stall for more than 30 seconds at any one time. Do not let the converter-out fluid temperature exceed 149°C (300°F). During stall conditions, converter-out temperatures rise much faster than internal temperatures. Do not use internal fluid temperature to determine the length of the stall condition. If the stall test is repeated, do not let the engine overheat.

- Shift transmission into a forward range.
- With the vehicle blocked and wheels chocked, parking and service brakes applied, hold the engine at wide-open throttle and record the maximum engine speed reached. This is the stall speed.
- Reduce engine rpm to idle and shift to N (Neutral).
- Raise engine speed between 1200–1500 rpm for 2–3 minutes to allow transmission to cool down.
- Monitor converter-out temperature.

#### **b. Stall Test Results.**



**NOTE:** Environmental conditions, such as ambient temperature, altitude, engine accessory loss variations, etc., affect the power input to the converter. Under such conditions, stall speed can vary from specification by  $\pm 150$  rpm and still be accepted as within normal range.

- If engine stall speed is more than 150 rpm below the stall speed specified by the engine manufacturer, an engine problem is indicated. If engine stall speed is more than 150 rpm above specification, a transmission problem is indicated, such as slipping clutches, cavitation, aeration, or torque converter failure.
- An extremely low stall speed (such as 33 percent of the specified engine stall rpm), during which the engine does not smoke, could indicate a freewheeling stator in the converter.
- Perform a neutral cool-down check if engine stall-speed tests meet specifications, but cause the transmission fluid to overheat.
- If the engine stall speed meets the specification and the cool-down check shows that transmission fluid cools properly, an electronic control problem may exist. Refer to the 1000 and 2000 Product Families Electronic Control Troubleshooting Manual TS3192EN.

#### **c. Neutral Cool-Down Check Procedure.**

- The neutral cool-down check determines if the transmission fluid cools following an engine load condition. Perform this check immediately after the maximum engine rpm has been recorded in the stall test.

- Record the converter-out fluid temperature.
- Reduce the engine rpm to idle and shift to **N** (Neutral). Run the engine at 1200–1500 rpm for two minutes to cool the fluid.
- At the end of two minutes, record the converter-out fluid temperature. Converter-out fluid temperature should return to within the normal operating temperature range.
- If the fluid does not cool during the two minute cool-down check, a stuck stator may be the source of the problem.



**NOTE:** You may use the Allison DOC™ For PC diagnostic tool to perform stall test and clutch test procedures. Refer to the Allison DOC™ For PC User Guide for specific instructions.

## 1-4. PRESSURE SCHEDULE CHECK

Use the following table to check for proper main pressure. Be sure the transmission is at operating temperature when checking main pressure.

Range	Main Pressure @ 600 rpm	Main Pressure @ 2100 rpm
Forward (Converter)	800–1380 kPa (115–200 psi)	1515–1795 kPa (220–260 psi)
Forward (Torque Converter Clutch Applied)	—	1000–1170 kPa (145–170 psi)
Reverse	800–1380 kPa (115–200 psi)	1515–1795 kPa (220–260 psi)
Neutral/Park	900–1653 kPa (130–240 psi)	1515–1795 kPa (220–260 psi)
(Transmissions with Modulated Main “G” solenoid)		
Forward/Rev Converter w/ G solenoid active	590–720 kPa (85–105 psi)	634–758 kPa (92–110 psi)
Forward Converter with G inactive	700–1380 kPa (101–200 psi)	1515–1795 kPa (220–260 psi)
Forward Lockup with G active*	N/A	510–627 kPa (74–91psi)
Forward Lockup with G inactive*	N/A	1000–1170kPa (145–170 psi)
Neutral/Park with G solenoid active	590–720 kPa (85–105 psi)	N/A
Neutral/Park	800–1655 kPa (130–240 psi)	1515–1795kPa (220–260 psi)
* Medium duty gasoline engines only.		



## FLUID LEAK DIAGNOSIS

## SECTION II

### 2-1. FINDING THE LEAK

#### a. Identify the fluid.

1. Determine if the fluid is engine oil, automatic transmission fluid, or hydraulic fluid from a specific vehicle system.
2. Operate the vehicle to reach normal operating temperature and park the vehicle. Inspect the vehicle to identify the source of the leak.

**b. Typical Leak Points and Causes.** Refer to the following list for possible points of fluid leaks and their causes.

- Transmission mating surfaces:
  - Attaching bolts not correctly tightened
  - Improperly installed or damaged gasket
  - Mounting face damaged
- Housing leak:
  - Filler pipe or plug seal damaged or missing
  - Filler pipe bracket dislocated
  - Oil cooler connector fittings loose or damaged
  - Output shaft seals worn-out or damaged
  - Pressure port plugs loose
  - Porous casting
- Leak at converter end:
  - Converter seal damaged
  - Seal lip cut (check converter hub for damage)
  - Garter spring missing from seal
  - Converter leak in weld area
  - Porous casting
- Fluid comes out of fill tube:
  - Overfilled — incorrect dipstick
  - Plugged vent (breather)
  - Water or coolant in fluid — fluid will appear milky
  - Drain-back holes plugged



1. Visually inspect the suspected area. Inspect all the gasket mating surfaces for leaks.



**CAUTION:** When cleaning the transmission, do not spray steam, water, or cleaning solution directly at the breather (oil vent). Spraying steam, water, or cleaning solution at the breather can force the water or cleaning solution into the transmission and contaminate the transmission fluid.

2. If the leak still cannot be identified, then clean the suspected area with a degreaser, steam, or spray solvent. Clean and dry the area. Operate the vehicle for several miles at varying speeds. Inspect the vehicle for leaks. If the source of the leak is still not identified, use the powder method, and/or black light and dye method as explained below.

#### c. Powder Method.

- Clean the suspected area.
- Apply an aerosol-type white powder.
- Operate the vehicle under normal operating conditions.
- Visually inspect the suspected area and trace the leak path over the white powder surface to the source.



**NOTE:** Dye and black light kits are available for finding leaks. Refer to the manufacturer's directions when using the kits. See kit directions for the color of the fluid dye mix.

#### d. Black Light and Dye Method.

- Pour the specified amount of dye into the transmission fill tube.
- Operate the vehicle in normal operating conditions.
- Direct the black light toward the suspected area. The dyed fluid will appear as a brightly colored path leading to the source.

**e. Repairing the Leak.** Once the leak has been traced back to its source, inspect the leaking part for the following conditions, and repair the leaking part.

- Gaskets:
  - Fluid level/pressure is too high
  - Plugged vent or drain-back holes
  - Improperly tightened fasteners or dirty/damaged threads
  - Warped flanges or sealing surfaces
  - Scratches, burrs, or other damage to a sealing surface
  - Damaged or worn-out gasket

- Cracked or porous casting adjacent to the gasket
  - Improper sealant used (where applicable)
- Seals:
  - Fluid level/pressure is too high
  - Plugged vent or drain-back holes
  - Damaged seal bore
  - Damaged or worn-out seal
  - Improper installation
  - Cracks in component
  - Output yoke bearing surface scratched, nicked, or damaged
  - Loose or worn-out bearing causing excess seal wear
- Sealing Flange:
  - Inspect the sealing flange for bends; replace the part with the damaged flange.

## SECTION III

## SHIFT SELECTOR AND CABLE/LINKAGE



### 3-1. SHIFT SELECTOR AND CABLE/LINKAGE

**a. Adjustment.** The transmission internal detent lever and spring must dictate the position of the manual selector valve in the control valve body. Any customer-furnished shift selector system must be designed and adjusted to accomplish this positioning. The shift selector must move the internal detent lever from position to position and not interfere with the ability of the internal detent spring to position the manual selector valve. When the internal detent spring is in the center of a detent lever position, the shift selector handle should be in the center of the shift selector gate (see Figure 3-1). Check the shift selector adjustment as follows:

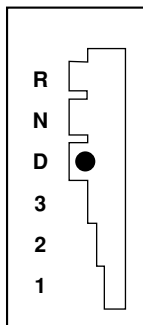
1. Center the shift selector lever at the center of a mid-position gate such as **OD** (Overdrive).
2. Disconnect the selector linkage/cable at the transmission shift lever.



**CAUTION:** Internal transmission damage will occur if the following instructions are not followed:

- DO NOT drive the selector lever onto the selector shaft
- DO NOT use an impact wrench to tighten the shift lever retaining nut. Hold the lever with a wrench while tightening the nut (see Figure 3-4).

**“Gates” in shift  
selector permit  
transmission  
detent to determine  
actual selector  
shaft orientation**



V05806

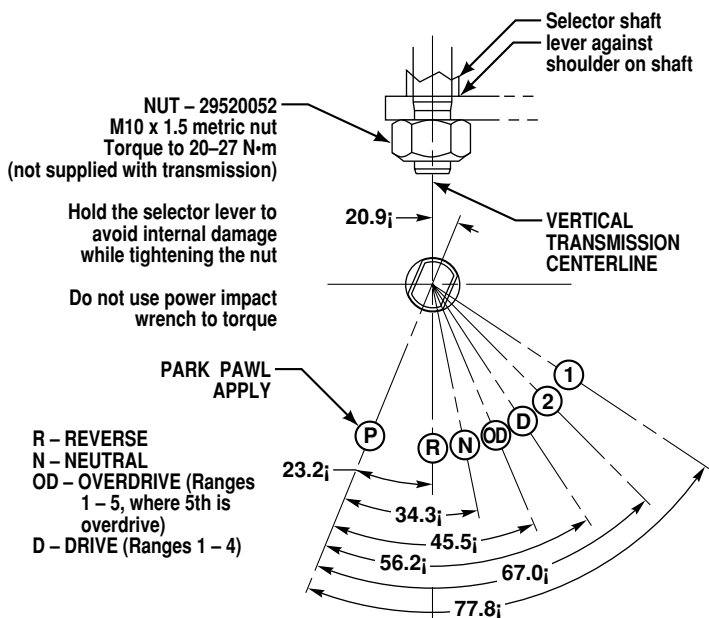
**Figure 3-1. Proper Shift Selector Adjustment**

3. Be sure that the transmission shift lever is seated against the shoulder on the selector shaft and the retaining nut is tightened (proper tightening torque is 20–27 N·m (15–20 lb ft)).
4. Rotate the transmission selector lever to its extreme clockwise position (see Figure 3–2; this is **P** (Park) for the 1000 and 2200 models and the 2400 Series™ and **PB** (Park Brake Apply) for the 2100 and 2500 models and the 2000 Series™).

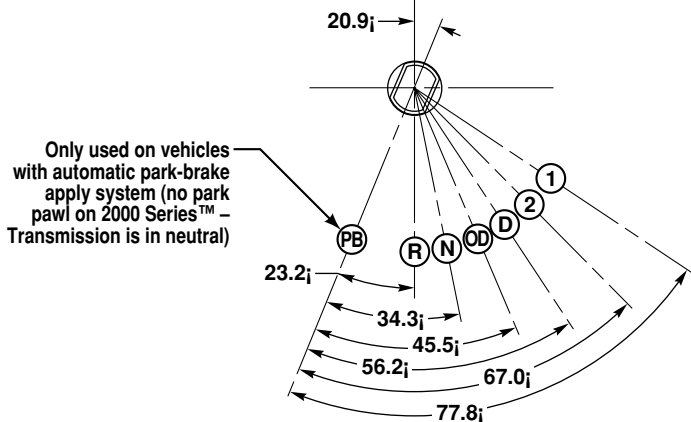


**WARNING:** Although the **PB** (Park Brake Apply) position is available at the transmission for 2100 and 2500 models and the 2000 Series™ transmission, the customer-supplied shift selector at the operator's console will only have a **PB** (Park Brake Apply) position when the vehicle is equipped with a park brake apply system. **For 2100 and 2500 models and the 2000 Series™ equipped vehicles WITHOUT a park brake apply system, there must not be a PB (Park Brake Apply) position on the selector at the operator's console.**

5. Manually rotate the lever in the counter-clockwise direction to the same position as the shift lever at the operators console (three detents to reach OD in our example from Step 1).
6. Reinstall the clevis pin in the shift selector linkage/cable. The clevis pin should freely slide into the transmission shift lever and not bind or move the lever. This is known as “free pin” fit. Adjust the clevis as required to achieve “free pin” fit.
7. Check for “free pin” fit in the selector positions at the extreme ends of the shift selector travel (**1** and **P** for 1000 and 2200 models and the 2400 Series™ units or **1** and either **PB** or **R** for the 2100 and 2500 models and the 2000 Series™ units).



**SELECTOR SHAFT FLATS  
AS SHOWN INDICATE PARK POSITION  
1000 and 2200 TRANSMISSIONS**



**SELECTOR SHAFT FLATS  
AS SHOWN INDICATE PARK-BRAKE APPLY POSITION  
2100 and 2500 TRANSMISSION**

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**Figure 3-2. Transmission Shift Lever Positions**

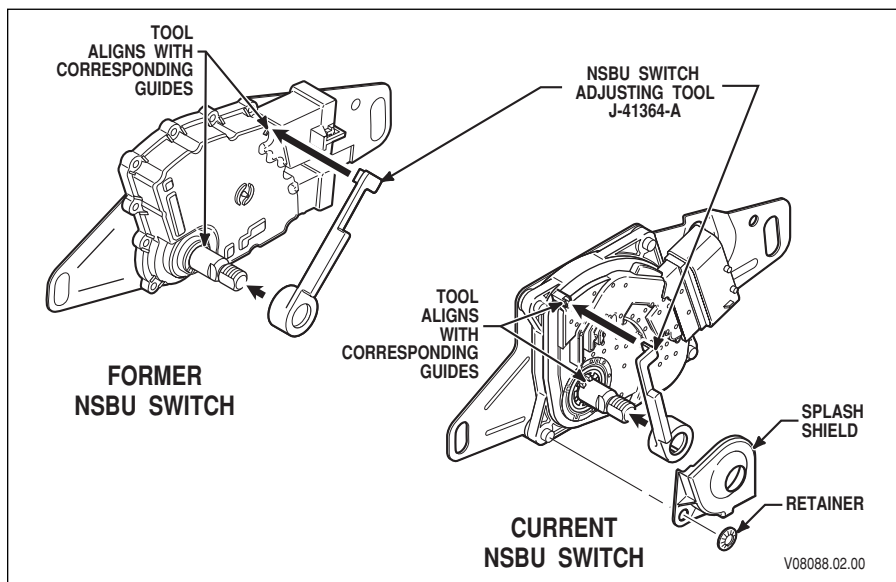
**b. Replacement.** Replace the shift selector, linkage or cable whenever it does not shift the transmission to the range indicated at the shift selector or when it cannot be adjusted to achieve “free pin” fit as described in the procedure above. Use the following procedure for replacing the shift selector, linkage or cable.

1. Use process of elimination to find the problem source.
2. Disconnect the shift linkage/cable at the transmission shift lever end. Move the transmission shift lever through each detent position. If function is normal, the problem must be in the linkage/cable or in the shift selector itself. If detents cannot be felt or if excessive force is needed to move the lever, then the problem may be inside the transmission. Proceed to appropriate repair procedure.
3. Disconnect the linkage/cable from the shift selector at the operator’s console. If shift selector operation is normal, replace the linkage/cable. If operation is not normal, replace the shift selector.
4. Reconnect all components, properly adjust, and be sure that normal function has been restored.

## **3-2. NEUTRAL START/BACKUP (NSBU) SWITCH**

**a. Adjustment.** Use the following procedure when diagnostic trouble codes have been logged and the corrective action is to adjust the NSBU switch or transmission ranges are inhibited.

1. Disconnect the shift linkage/cable from the shift lever at the transmission.
2. With a wrench keeping the shift lever from rotating (see Figure 3-4), remove the nut from the end of the selector shaft. Carefully remove the selector lever from the selector shaft.
3. Remove the dust shield from a single connector NSBU switch.
4. Loosen the two bolts which attach the NSBU switch to the main housing so that the NSBU switch and bracket may be rotated with some effort.
5. Make sure the selector shaft is in the **N** (Neutral) position (using a wrench on the selector shaft flats, rotate the shaft to its furthest clockwise position and then rotate counter-clockwise two detents — see Figure 3-2).
6. For a one-connector NSBU switch, position special tool J 41364-A (see Figure 3-3) over the selector shaft so two tabs on the tool engage two slots in the NSBU switch just outside the selector shaft. Rotate the NSBU switch and bracket until the single tab at the other end of the tool engages the single slot at the top-front of the NSBU switch.
7. For a two-connector NSBU switch, position special tool J 41364-A (see Figure 3-3) over the selector shaft so two tabs on the tool engage two slots in the NSBU switch just outside the selector shaft. Rotate the NSBU switch and bracket until the single tab at the end of the tool engages the slot at the top-rear of the NSBU switch.



**Figure 3-3. Adjusting NSBU Switch Using Special Tool**

8. While holding the special tool in engagement with the NSBU switch, install the bolt closest to the engine and tighten it enough to keep the NSBU switch from rotating, then install the rear bolt. Tighten both bolts to 24–29 N·m (18–21 lb ft).
9. Install the dust shield over the selector shaft and the dust shield alignment pin.
10. Install the dust shield retaining clip onto the dust shield alignment pin.



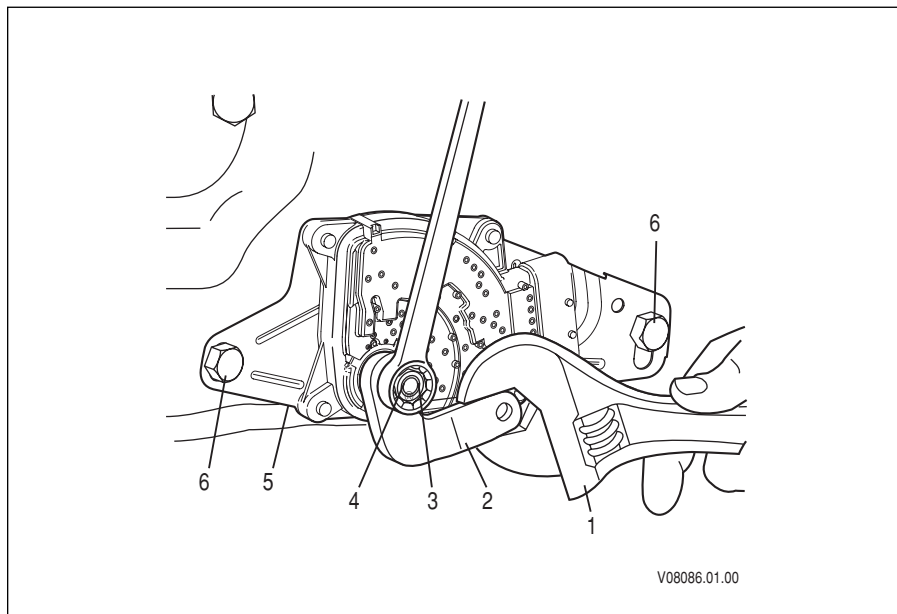
**CAUTION:** Internal transmission damage will occur if the following instructions are not followed:

- DO NOT drive the selector lever onto the selector shaft
- DO NOT use an impact wrench to tighten the shift lever retaining nut. Hold the lever with a wrench while tightening the nut (see Figure 3-4).

11. Reinstall the shift lever. With a wrench keeping the shift lever from rotating, install the nut on the end of the selector shaft and tighten the nut to 20–27 N·m (15–20 lb ft). Reconnect the shift selector linkage/cable to the shift lever. Check for “free pin” fit (refer to Paragraph 3-1).
12. Connect the wiring harness to the NSBU switch.
13. Drive the vehicle and see if diagnostic codes reappear or if the problem has been resolved by adjustment. If the problem has not been resolved, replace the NSBU switch.

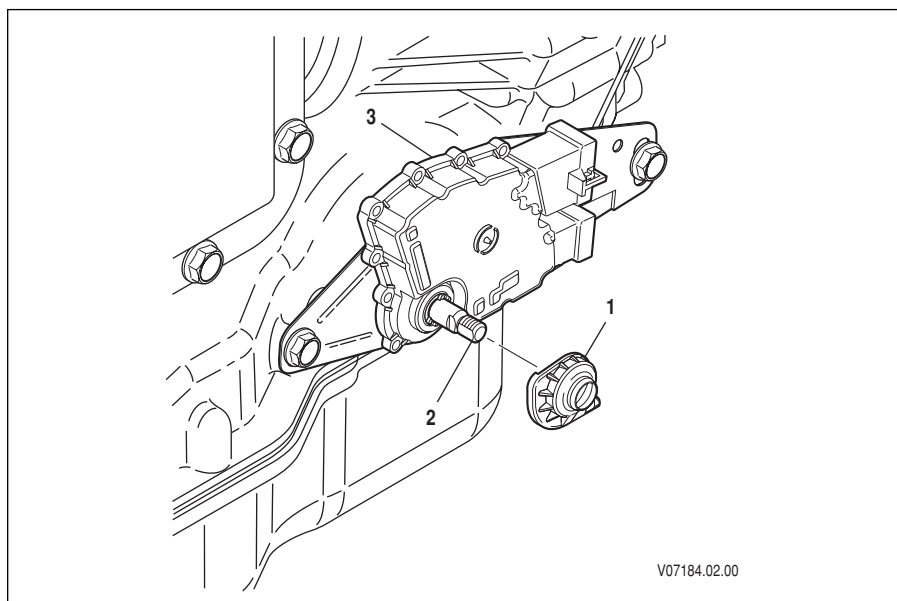
**b. Replacement.** Replace the NSBU switch when diagnostic codes still occur and after the NSBU switch has been readjusted. Use the following procedure to replace the NSBU switch.

1. Disconnect the wiring harness from the NSBU switch. Disconnect the shift linkage/cable from the shift lever at the transmission.
2. With a wrench (1) keeping the shift lever (4) from rotating (see Figure 3–4), remove the nut (3) from the end of the selector shaft. Carefully remove the selector lever (2) from the selector shaft.
3. Inspect the selector shaft for a wear created shoulder or burr. Remove any shoulder or burr with a file.
4. Remove the two bolts (6) which attach the NSBU switch to the main housing. Remove the NSBU switch by sliding it outward over the selector shaft.
5. Make sure the selector shaft is in the **N** (Neutral) position (using a wrench on the selector shaft flats, rotate the shaft to its furthest clockwise position and then rotate counter-clockwise two detents—see Figure 3–2).
6. For a one-connector NSBU switch, slide the new NSBU switch (5) over the selector shaft maintaining the correct NSBU switch to selector shaft alignment (see Figure 3–3). Install the two bolts which attach the NSBU switch to the main housing. Dust shield (1) (refer to Figure 3–5) is retained to the NSBU switch.



**Figure 3–4. Restraining the Selector Lever**





**Figure 3-5. Installing New NSBU Switch**

7. For a two-connector NSBU switch, position special tool J 41364-A (see figure 3-3) over the selector shaft so two tabs on the tool engage two slots in the NSBU switch just outside the selector shaft. Rotate the NSBU switch and bracket until the single tab at the end of the tool engages the slot at the top-rear of the NSBU switch.
8. Install the NSBU retaining bolt closest to the engine and tighten it enough to keep the NSBU switch from rotating, then install the rear bolt. Tighten both bolts to 24–29 N·m (18–21 lb ft).



**CAUTION:** Internal transmission damage will occur if the following instructions are not followed:

- DO NOT drive the selector lever onto the selector shaft
- DO NOT use an impact wrench to tighten the shift lever retaining nut. Hold the lever with a wrench while tightening the nut (see Figure 3-4).

9. Reinstall the shift lever. With a wrench keeping the shift lever from rotating, install the nut on the end of the selector shaft and tighten the nut to 20–27 N·m (15–20 lb ft). Reconnect the shift selector linkage/cable to the shift lever.
10. Connect the wiring harness connector to the NSBU switch.



## **SELECTOR SHAFT SEAL REPLACEMENT**

## **SECTION IV**

### **4-1. REMOVAL**

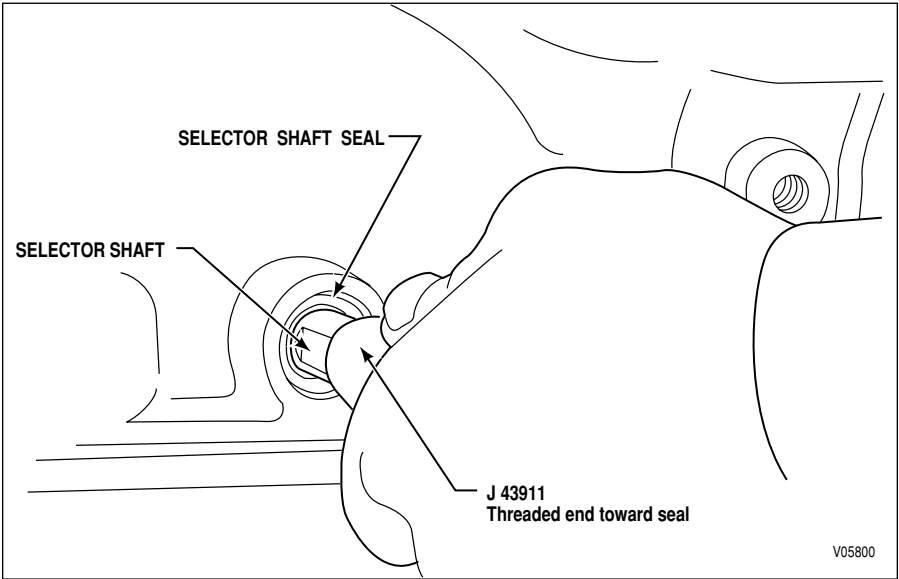
Use the following procedure whenever the selector shaft seal must be removed with the selector shaft in place.

1. Disconnect the wiring harness from the NSBU switch. Disconnect the shift linkage/cable from the shift lever at the transmission.
2. With a wrench keeping the shift lever from rotating, remove the nut from the end of the selector shaft. Carefully remove the selector lever from the selector shaft.
3. Inspect the selector shaft for a shoulder or burr. Remove any shoulder or burr with a file.
4. Remove the two bolts which attach the NSBU switch to the main housing. Remove the NSBU switch by sliding it outward over the selector shaft.
5. Slide special tool J 43911 over the selector shaft with the threaded end towards the seal. Be sure that the jackscrew is backed off and will not interfere with installation of the removal tool (see Figure 4-1). Rotate the removal tool so that the threads on the end of the tool engage the steel shell of the seal. Use a wrench to be sure that the removal tool is firmly attached to the seal.
6. Apply a wrench to the jackscrew and rotate it in the clockwise direction to remove the seal from the bore. Discard the old seal.

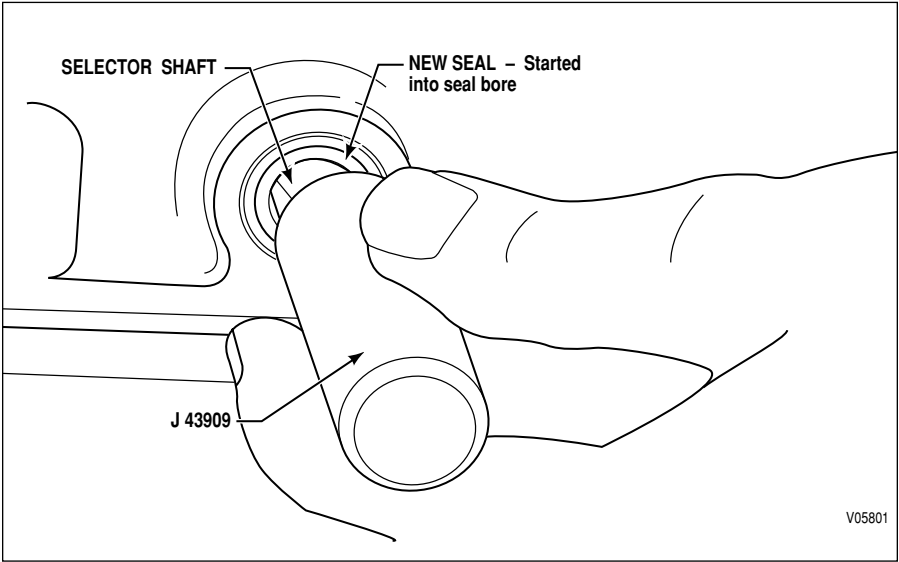
### **4-2. INSTALLATION**

Use the following procedure to install the selector shaft seal with the selector shaft in place.

1. If not done previously, inspect the selector shaft for a shoulder or burr. Remove any shoulder or burr with a file.
2. Carefully slide a new selector shaft seal over the selector shaft with the wide face of the steel case facing outward (see Figure 4-2). Position the seal so that it is starting to enter the seal bore.



**Figure 4-1. Selector Shaft Seal Removal**



**Figure 4-2. Selector Shaft Seal Installation**

3. Obtain special tool J 43909 and remove the inner sleeve so that the tool will slide over the selector shaft.
4. Slide the special tool into position so that the end of the tool contacts the seal being installed (see Figure 4–2). Use a mallet to strike the special tool and drive the new seal into the seal bore until it is seated at the bottom of the bore.
5. Make sure the selector shaft is in the **N** (Neutral) position (using a wrench on the selector shaft flats, rotate the shaft to its furthest clockwise position and then rotate counter-clockwise two detents—see Figure 3–2).
6. Slide the NSBU switch over the selector shaft. Install the two bolts which attach the NSBU switch to the main housing so that the NSBU switch and bracket may be rotated with some effort.
7. Position special tool J 41364-A (see Figure 3–3) over the selector shaft so two tabs on the tool engage two slots in the NSBU switch just outside the selector shaft. Rotate the NSBU switch and bracket until the single tab at the other end of the tool engages the single slot at the top of the NSBU switch.
8. While holding the special tool in engagement with the NSBU switch, tighten the two bolts which attach the NSBU switch to the main housing to 24–29 N·m (18–21 lb ft).



**CAUTION:** Internal transmission damage will occur if the following instructions are not followed:

- DO NOT drive the selector lever onto the selector shaft
- DO NOT use an impact wrench to tighten the shift lever retaining nut. Hold the lever with a wrench while tightening the nut (see Figure 3–4).

9. Reinstall the shift lever. With a wrench keeping the shift lever from rotating, install the nut on the end of the selector shaft and tighten the nut to 20–27 N·m (15–20 lb ft). Reconnect the shift selector linkage/cable to the shift lever.

## SECTION V

## PARKING BRAKE



### 5-1. ADJUSTMENT

Parking brakes are customer-supplied. Follow the vehicle manufacturers or brake manufacturers instructions for adjustment. Use the following general procedure if specific information is not readily available.



**WARNING:** Chock wheels to prevent vehicle from moving when parking brake is being adjusted or replaced.

1. Chock wheels to prevent vehicle movement.
2. Be sure that the parking brake apply handle or pedal is in the OFF position.
3. Disconnect the brake apply linkage/cable from the parking brake apply lever at the transmission.
4. Pull on the parking brake apply lever to remove any slack between the apply lever and the brake shoes. Hold the lever in this position and see if the apply linkage/cable connection aligns with the hole in the apply lever. Adjust the clevis or other adjustment device as required to provide proper alignment.
5. Reconnect the brake apply linkage/cable to the parking brake apply lever.
6. Do a trial parking brake apply to check that the adjustment was successful and the parking brake can be completely applied.

### 5-2. REPLACEMENT

Use vehicle manufacturers or brake manufacturers instructions whenever possible. Use the following general procedure whenever the parking brake must be replaced and no other instructions are available.



**WARNING:** Chock wheels to prevent vehicle from moving when parking brake is being adjusted or replaced.

1. Chock wheels to prevent vehicle movement.
2. Disconnect the parking brake apply linkage/cable from the parking brake apply lever.
3. Disconnect the vehicle driveline from the transmission output flange/yoke. Secure the driveline so that it does not interfere with the removal of parking brake components.
4. Remove the nuts or bolts that attach the parking brake drum to the output flange/yoke. Remove the brake drum.
5. Remove the bolt and sealing washer that attaches the output flange/yoke to the transmission output shaft. Remove the output flange/yoke.
6. Remove the four bolts that attach the parking brake assembly to the rear cover of the transmission. Remove the parking brake assembly.
7. Install the new parking brake assembly in the same position as the one that was removed. Install four bolts which attach the brake assembly to the main housing. Tighten the bolts to 90–110 N·m (66–81 lb ft).
8. Lubricate the internal splines and the rear seal journal of the output flange/yoke with clean transmission fluid. Install the output flange/yoke on the transmission output shaft.
9. Install the bolt and sealing washer that retains the output flange/yoke to the transmission output shaft. Tighten the bolt to 110–135 N·m (80–100 lb ft).
10. Install the parking brake drum over the shoes on the parking brake assembly. Install the nuts/bolts that attach the parking brake drum to the output flange/yoke. Tighten the bolts to specification.
11. Connect the vehicle driveline to the output flange/yoke.
12. Adjust the parking brake linkage/cable (refer to Paragraph 5–1).



**CAUTION:** Apply the parking brake gradually over 10–15 seconds during burnishing. Dynamic braking is not an accepted practice for normal operation. Abrupt dynamic apply may cause transmission damage.

### 5-3. BURNISHING

After installing a new parking brake assembly, be sure to follow the burnishing procedure to attain full holding capacity. Follow the brake manufacturers recommended burnishing procedure. If a manufacturers procedure is not available, use the following procedure which is based on paragraph 7.3.2 of SAE procedure J360. Make ten stops from a maximum speed of 15 kph (9.5 mph) using only the parking brake to retard the vehicle. Space the stops at least 4 km (2.5 miles) apart and operate the vehicle at a minimum speed of 30 kph (18.5 mph) between each stop. Be sure to readjust the parking brake linkage when the burnishing procedure is completed.



**CAUTION:** Avoid sustained use of the parking brake while the engine is running and the transmission is in any selector position other than **N** (Neutral), **P** (Park), or **PB** (Park Brake Apply). Failure to observe this practice may cause transmission overheating and premature failure.



## COMPONENT REPLACEMENT

## SECTION VI

### 6-1. OUTPUT FLANGE/YOKE REPLACEMENT

Use the following procedure whenever an output flange/yoke requires replacement due to damage or wear.



**WARNING:** Chock wheels to prevent vehicle from moving when the driveline is disconnected.

1. Chock wheels to prevent vehicle movement.
2. If present, disconnect the parking brake apply linkage/cable from the parking brake apply lever.
3. Disconnect the vehicle driveline from the transmission output flange/yoke. Secure the driveline so that it does not interfere with the removal of parking brake components or the output flange/yoke.
4. If present, remove the nuts or bolts that attach the parking brake drum to the output flange/yoke. Remove the brake drum.
5. Remove the bolt and sealing washer that attaches the output flange/yoke to the transmission output shaft. Remove the output flange/yoke.
6. Lubricate the internal splines and the rear seal journal of the new output flange/yoke with clean transmission fluid. Install the output flange/yoke on the transmission output shaft.
7. Install the bolt and sealing washer that retains the output flange/yoke to the transmission output shaft. Tighten the bolt to 110–135 N·m (80–100 lb ft).
8. If removed, reinstall the parking brake drum over the shoes on the parking brake assembly. Install the nuts/bolts that attach the parking brake drum to the output flange/yoke. Tighten the bolts to specification.
9. Connect the vehicle driveline to the output flange/yoke.



## 6-2. TACHOGRAPH PLUG REPLACEMENT

Use the following procedure whenever a tachograph plug is present and requires replacement due to damage or to replace the washer under the plug.

1. Remove the plug and washer from the rear cover (see Figure 6-1). Inspect the washer. Replace the washer if the joint was leaking or if a new plug is being installed.
2. Reinstall the plug and washer into the rear cover and hand-tighten. Use a torque wrench and tighten the plug to 60–67 N·m (44–49 lb ft).

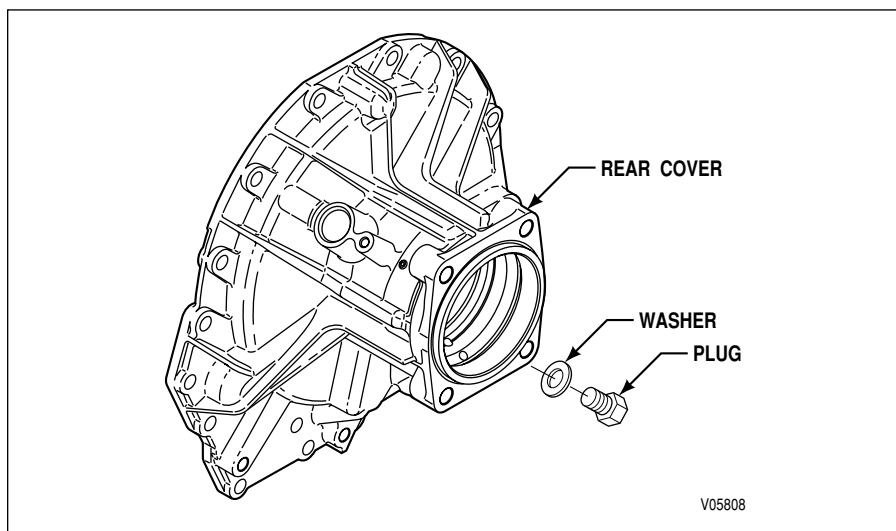
## 6-3. SPEED SENSOR REPLACEMENT

Use the following procedure whenever the input, turbine, or output speed sensors require replacement.



**CAUTION:** DO NOT splice into the speed sensor connector or harness wires to obtain a speed signal. The speed sensor signals are for transmission control purposes ONLY.

1. Be sure the vehicle ignition is turned off.
2. Disconnect the wiring harness from the speed sensor.



**Figure 6-1. Tachograph Plug Replacement**

3. Remove the bolt from the speed sensor retaining bracket and carefully remove the speed sensor.



**NOTE:** Do not rotate the sensor in the retaining bracket. Orientation is fixed and, if changed, may cause improper operation.

4. Be sure a new O-ring is installed on the speed sensor. Lubricate the O-ring with clean transmission fluid. Install the new speed sensor into the speed sensor bore. Be sure that the hole in the retaining bracket is aligned with the bolt hole in the speed sensor boss and the speed sensor seats completely in its bore.
5. Install the speed sensor retaining bolt and tighten to 10–13 N·m (7–10 lb ft).
6. Reconnect the wiring harness connector.

## 6-4. PTO COVER/GASKET REPLACEMENT

Use the following procedure whenever a damaged PTO cover or leaking gasket requires replacement.

1. Remove the six bolts which attach the PTO cover to the transmission main housing. Remove the PTO cover and gasket. Discard the used gasket.
2. Be sure the PTO gasket face on the main housing is free of all foreign material, nicks and scratches.
3. Install the new PTO cover gasket and/or cover. Start the top-center bolt first to hold the cover and gasket in alignment while the other five bolts are installed. Install the other five bolts.
4. Tighten all bolts to 51–61 N·m (38–45 lb ft).

## 6-5. COOLER MANIFOLD GASKET REPLACEMENT

Some converter housings have a removable cooler manifold. Use the following procedure to replace the cooler manifold gaskets.

### a. Removal. (See Figure 6-2)



**NOTE:** A significant amount of transmission fluid may be lost when disconnecting the cooler line fittings. Be prepared to catch the fluid in a clean container if reuse is intended. It is also important to know how much fluid was lost to reestablish fluid level after repair is complete.

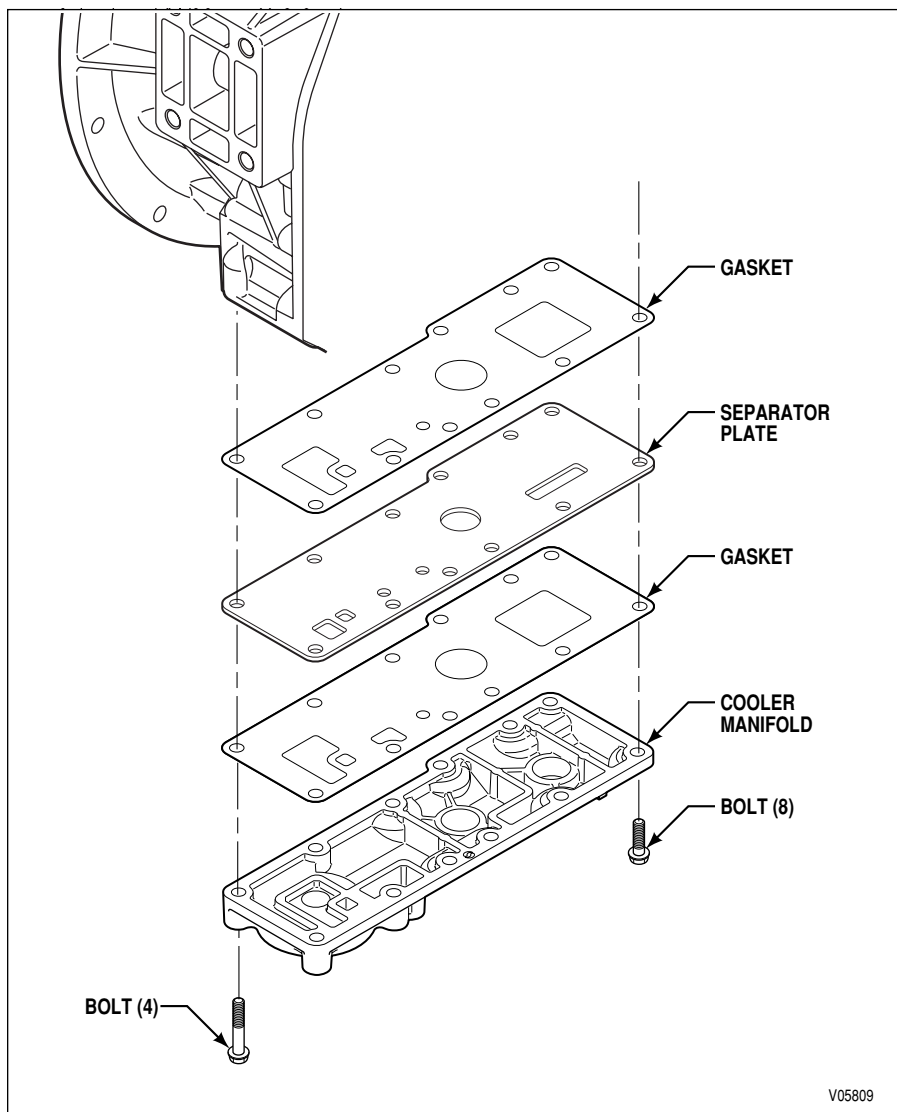


**NOTE:** It is not necessary to drain the transmission fluid for the following procedure. However, be prepared to lose some fluid (all that is above the transmission oil pan splitline — about one liter).

1. Disconnect cooler lines.
2. Remove the control-main filter by rotating it in the counterclockwise direction using special tool J 45023.
3. Remove the magnet from the filter attachment tube or from the top of the filter element.
4. Clean any metal debris from the magnet. Report any metal pieces larger than dust to your maintenance personnel.
5. Remove the 12 bolts fastening the cooler manifold to the converter housing (see Figure 6-2).
6. Remove the cooler manifold, separator plate and the gaskets on both sides of the separator plate. Be sure that all gasket material is removed from the converter housing mounting face, the separator plate and from the cooler manifold.
7. Inspect all faces that are adjacent to gaskets prior to installing new gaskets. The surfaces must be clean and free of transmission fluid. Be sure there are no scratches on the sealing surfaces that could cause a transmission fluid leak.

**b. Installation.** (See Figure 6-2)

1. Install two headless guide bolts (M8 x 1.25) into opposite corners of the cooler manifold mounting face on the converter housing.
2. Align the bolt holes in the parts being reinstalled. Be sure the parts are in the order shown in Figure 6-2.
3. Slide the cooler manifold, separator plate and the gaskets on both sides of the separator plate over the guide bolts and hold them in place while installing two of the bolts to hold the parts in place.
4. Install the remainder of the 12 bolts that fasten the parts to the converter housing (two will replace the guide bolts). Tighten the bolts to 20–34 N·m (15–25 lb ft).
5. Reinstall the magnet onto the filter attachment tube.
6. Lubricate the gasket on the control-main filter with transmission fluid.



**Figure 6-2. Cooler Manifold Gasket Replacement**

7. Install, by hand, the control-main filter until the gasket on the control-main filter touches the converter housing.



**CAUTION:** Turning the control-main filter more than ONE FULL TURN after gasket contact will damage the filter.

8. Turn the filter ONE FULL TURN ONLY after gasket contact.
9. Reconnect the cooler lines and tighten the fittings securely.
10. Replace the quantity of transmission fluid lost during the gasket replacement process. Refer to MT3190EN for fluid fill and check procedures.

## 6-6. REAR SEAL REPLACEMENT

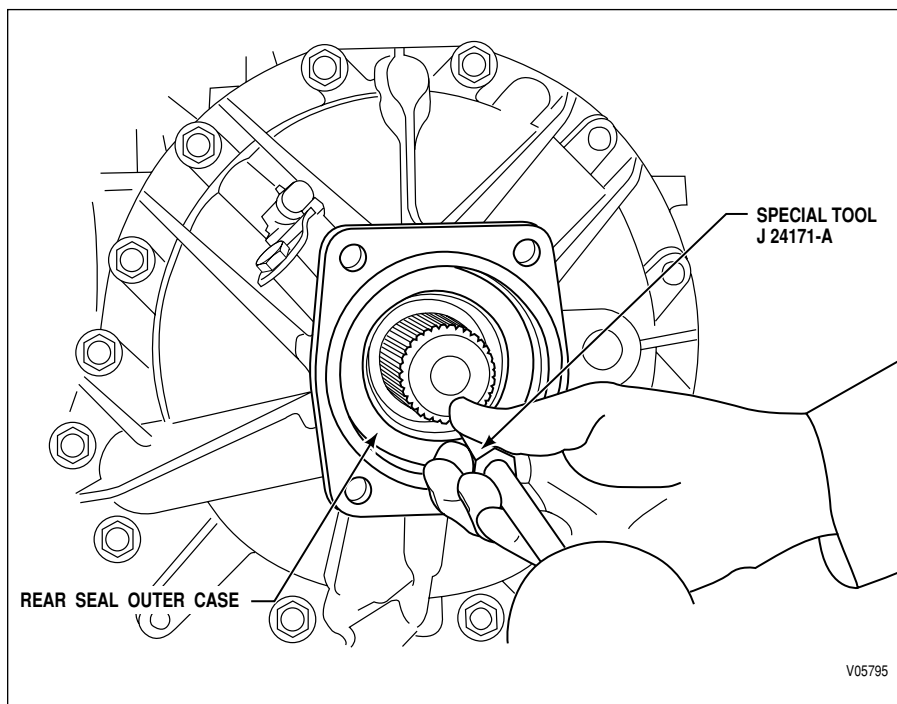
Use the following procedure for removal and installation of the output seal located in the rear cover of the transmission. Removal is usually required to repair a seal leak.

### a. Removal.



**WARNING:** Chock wheels to prevent vehicle from moving when the driveline is disconnected.

1. Chock wheels to prevent vehicle movement.
2. If present, disconnect the parking brake apply linkage/cable from the parking brake apply lever.
3. Disconnect the vehicle driveline from the transmission output flange/yoke. Secure the driveline so that it does not interfere with the removal of parking brake components or the output flange/yoke.
4. Remove the bolt and sealing washer that attaches the output flange/yoke to the transmission output shaft. Remove the output flange/yoke.
5. Inspect the seal journal on the output flange/yoke. Replace the output flange/yoke if scratches or machine type leading is present. Scratches or machine type leading can cause the seal to leak. Replace the output flange/yoke if light scoring cannot be removed using crocus cloth.
6. Obtain special tool J 24171-A and install the tip with a 90 degree hook onto the end of the slide-hammer.
7. Position the 90 degree hook behind the rear face of the seal outer case (see Figure 6-3).
8. Remove the rear seal using the slide-hammer.



**Figure 6–3. Rear Seal Removal**

**b. Installation.**

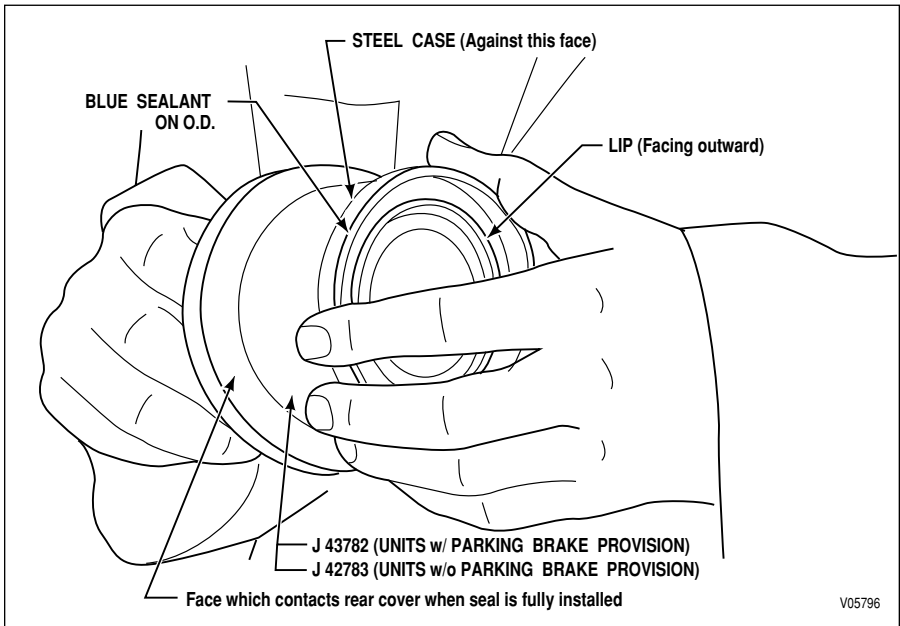
1. Inspect the seal bore for scratches. Inspect the removed seal to determine the cause of a leak. Worn lip? Broken garter spring? Remove any scratches in the seal bore using crocus cloth.
2. Be sure the new seal has blue sealant coating the OD. This identifies the seal for use in the 1000 and 2000 Product Families transmissions.



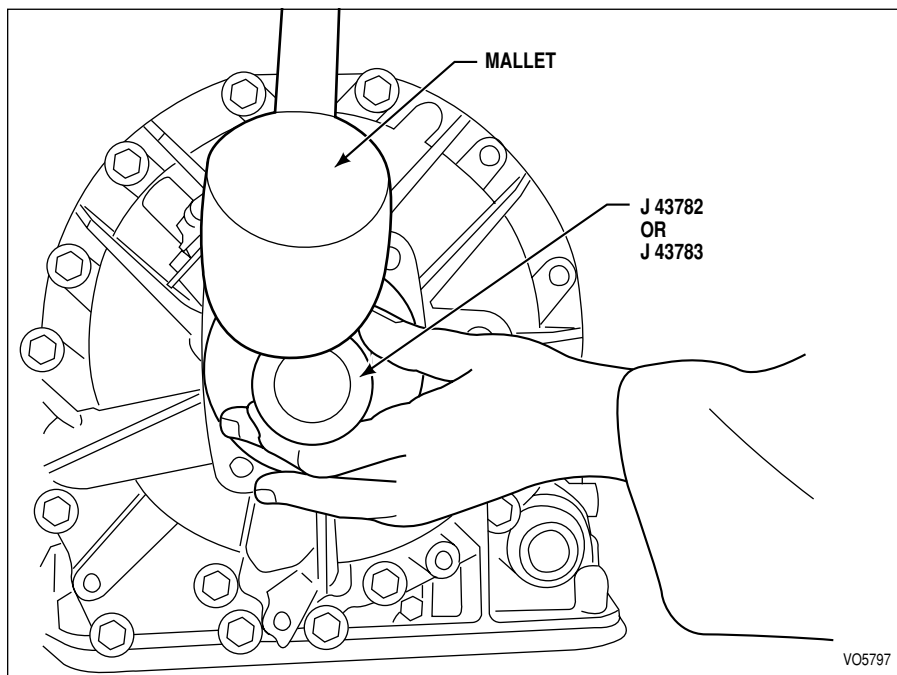
**NOTE:** The blue sealant identification is important because the 1000 and 2000 Product Families transmissions have an overdrive ratio in fifth range and there is a potential for high output shaft speeds and resultant high seal temperature.

3. Install the new seal onto J 43782 (units with parking brake provision) or J 43783 (units without parking brake provision) installer tool. Position the seal so the seal lip is outward and the face of the steel case is against the driving face of the tool (see Figure 6–4).

4. Slide the installer tool over the output shaft until the seal starts into the seal bore. Strike the installer tool with a mallet to drive the seal into the seal bore (see Figure 6–5). The seal is installed correctly when the shoulder of the installer tool squarely contacts the outer surface of the rear cover.
5. Lubricate the internal splines and the rear seal journal of the output flange/yoke with clean transmission fluid. Install the output flange/yoke on the transmission output shaft.
6. Install the bolt and sealing washer that retains the output flange/yoke to the transmission output shaft. Tighten the bolt to 110–135 N·m (80–100 lb ft).
7. Connect the vehicle driveline to the output flange/yoke.



**Figure 6–4. Positioning New Seal On Installer Tool**



**Figure 6–5. Installing Rear Seal**

## 6–7. OIL PAN GASKET REPLACEMENT

Use the following procedure for removal and installation of the oil pan gasket. Replacement is usually necessary to repair a splitline leak.

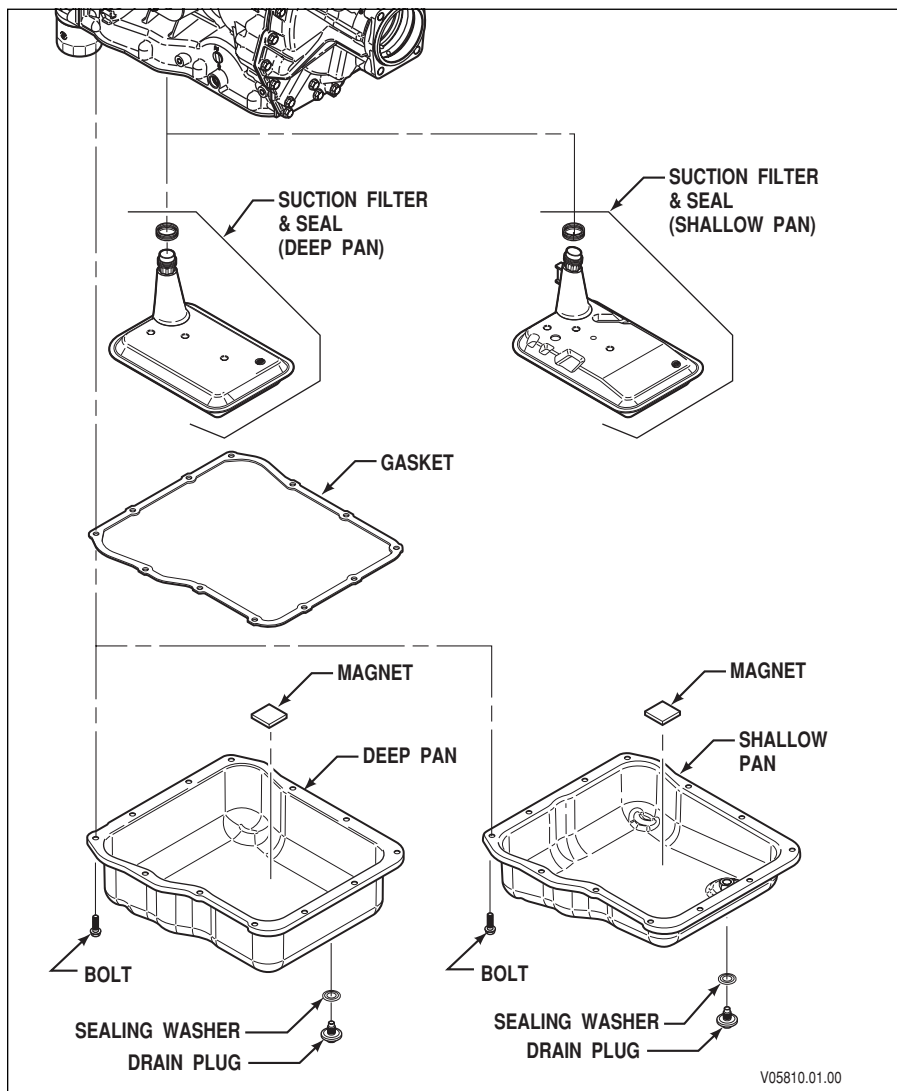
### a. Removal.



**NOTE:** It would be helpful to know how much transmission fluid is lost during the replacement of the oil pan gasket. Fluid in good condition caught in a clean container may be reused.

1. Remove the drain plug and sealing washer from the oil pan and allow the fluid to drain into a suitable container (see Figure 6–6). Refer to MT3190EN for fluid fill and check procedures.
2. Remove the 12 bolts that fasten the oil pan to the main housing. Hold the oil pan in position as the last bolt is removed.
3. Remove the oil pan and oil pan gasket. Check the magnet in the oil pan. Be sure that excessive or large metallic particles are not present. These conditions would indicate that an overhaul may be required.





**Figure 6-6. Oil Pan And Suction Filter**

**b. Installation.**

1. Be sure that all gasket material is removed from the main housing and there are no scratches that would cause a splintline leak.
2. Install two headless guide bolts (M8 x 1.25) into opposite corners of the oil pan mounting face on the main housing.
3. Place the new gasket on the oil pan and align the bolt holes.

4. Slide the oil pan gasket and oil pan over the guide bolts and hold them in place while installing two of the bolts to hold the parts in place.
5. Install the remainder of the 12 bolts that fasten the oil pan to the main housing (two will replace the guide bolts). Tighten the bolts to 24–29 N·m (18–21 lb ft).
6. Reinstall the drain plug and sealing washer. Tighten the drain plug to 30–40 N·m (22–30 lb ft).
7. Replace the quantity of transmission fluid lost during the gasket replacement process. Refer to MT3190EN for fluid fill and check procedures.

## 6–8. SUCTION FILTER AND SEAL REPLACEMENT

Use the following procedure for removal and installation of the suction filter and seal. Replacement is usually not necessary except at overhaul (see Figure 6–6).

### a. Removal.



**NOTE:** It would be helpful to know how much transmission fluid is lost during the replacement of the suction filter and seal. Fluid in good condition caught in a clean container may be reused.

1. Remove the drain plug and sealing washer from the oil pan and allow the fluid to drain into a suitable container. Examine the fluid as described in MT3190EN.
2. Remove the 12 bolts that fasten the oil pan to the main housing. Hold the oil pan in position as the last bolt is removed.
3. Remove the oil pan and oil pan gasket. Check the magnet in the oil pan. Be sure that excessive or large metallic particles are not present. These conditions would indicate that an overhaul may be required.
4. Remove the suction filter by pulling straight down where the suction tube is seated in the main housing.
5. Remove the suction seal from the filter or from the seal bore in the main housing. Discard the old seal and the filter, if it is being replaced.

### b. Installation.

1. Place a new seal on the suction filter tube. The seal should locate against a shoulder on the suction filter tube.



**CAUTION:** If a shallow pan and filter were removed, reinstall a shallow pan and filter. If a deep pan and filter were removed, reinstall a deep pan and filter. Transmission damage can occur if the correct oil pan and filter are not installed.

2. Push the filter and seal into the seal bore in the main housing. Be sure the suction filter is properly positioned.

3. Be sure that all gasket material is removed from the main housing and there are no scratches that would cause a splitline leak.
4. Install two headless guide bolts (M8 x 1.25) into opposite corners of the oil pan mounting face on the main housing.
5. Place a gasket on the oil pan and align the bolt holes.
6. Slide the oil pan gasket and oil pan over the guide bolts and hold them in place while installing two of the bolts to hold the parts in place.
7. Install the remainder of the 12 bolts that fasten the oil pan to the main housing (two will replace the guide bolts). Tighten the bolts to 24–29 N·m (18–21 lb ft).
8. Reinstall the drain plug and sealing washer. Tighten the drain plug to 30–40 N·m (22–30 lb ft).
9. Replace the quantity of transmission fluid lost during the suction filter and seal replacement process. Refer to MT3190EN for fluid fill and check procedures.

## 6–9. CONTROL VALVE COMPONENT REPLACEMENT

The control valve components that will be covered as in-chassis repairs are the internal wiring harness, the pressure switch manifold assembly, the solenoids, and the internal detent lever assembly. These components are typically replaced after a diagnostic process has been completed and a faulty component was identified.

**a. Internal Wiring Harness Replacement.** Use the following procedure to replace the internal wiring harness.



**NOTE:** It would be helpful to know how much transmission fluid is lost during the replacement of the internal harness. Fluid in good condition caught in a clean container may be reused.

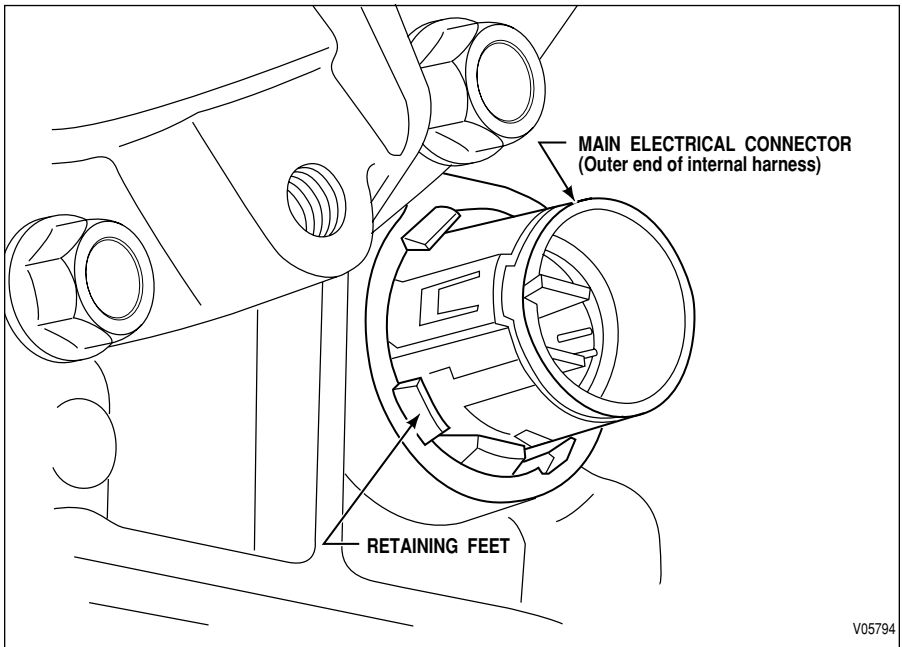
1. Remove the drain plug and sealing washer from the oil pan and allow the fluid to drain into a suitable container (see Figure 6–6). Examine the fluid as described in MT3190EN.
2. Remove the 12 bolts that fasten the oil pan to the main housing. Hold the oil pan in position as the last bolt is removed.
3. Remove the oil pan and oil pan gasket. Check the magnet in the oil pan (see Figure 6–6). Be sure that excessive or large metallic particles are not present. These conditions would indicate that an overhaul may be required.
4. Remove the suction filter by pulling straight down where the suction tube is seated in the main housing.
5. Remove the suction seal from the filter or from the seal bore in the main housing. Discard the old seal and the filter, if it is being replaced.

6. Disconnect the external wiring harness from the main transmission electrical connector.

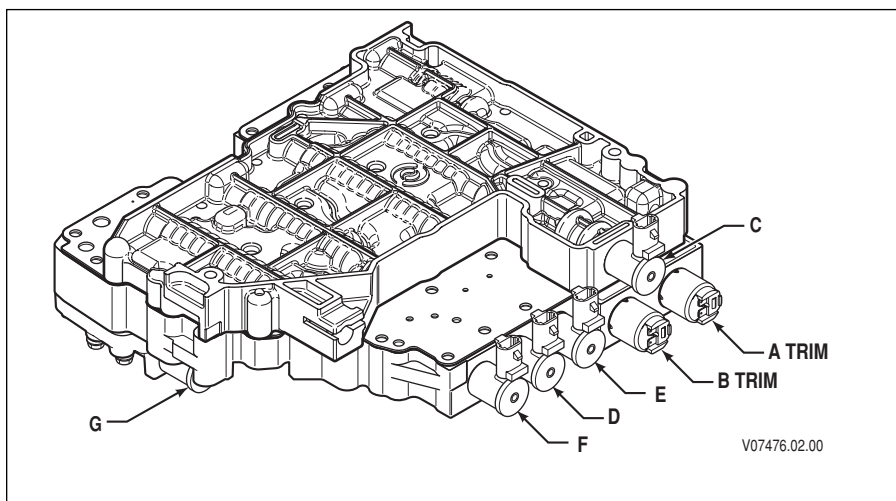


**NOTE:** The transmission main electrical connector is actually one end of the internal harness which protrudes through the main housing (see Figure 6–7).

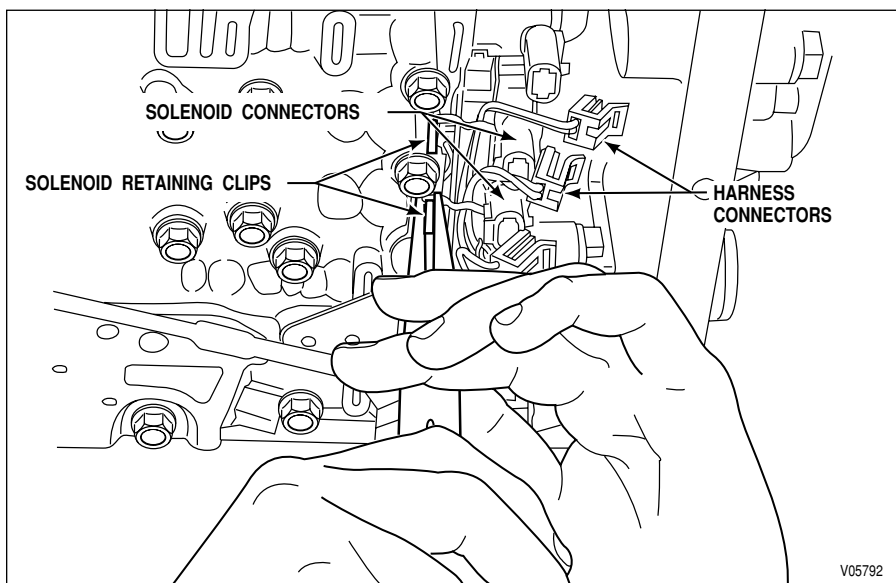
7. Disconnect the internal wiring harness connectors from solenoids A through G (see Figure 6–8) and from the pressure switch manifold assembly.
8. Remove the retaining clips for solenoids E and D which also retain tabs on the wiring harness U-channel (see Figure 6–9). The solenoids will remain in position even after the retaining clips are removed.
9. Remove the main electrical connector (outer end of internal harness) by placing a socket or wrench over the connector to release the “feet” that attach the connector to the main housing (see Figure 6–10) and pushing inward on the connector. Tools which work for this step are 30 mm or 1 ¼ inch 12-point deep sockets or box-end wrenches. Remove the internal wiring harness from the transmission.
10. Place the new internal wiring harness in the approximate position it will occupy after installation.



**Figure 6–7. Transmission Main Electrical Connector**



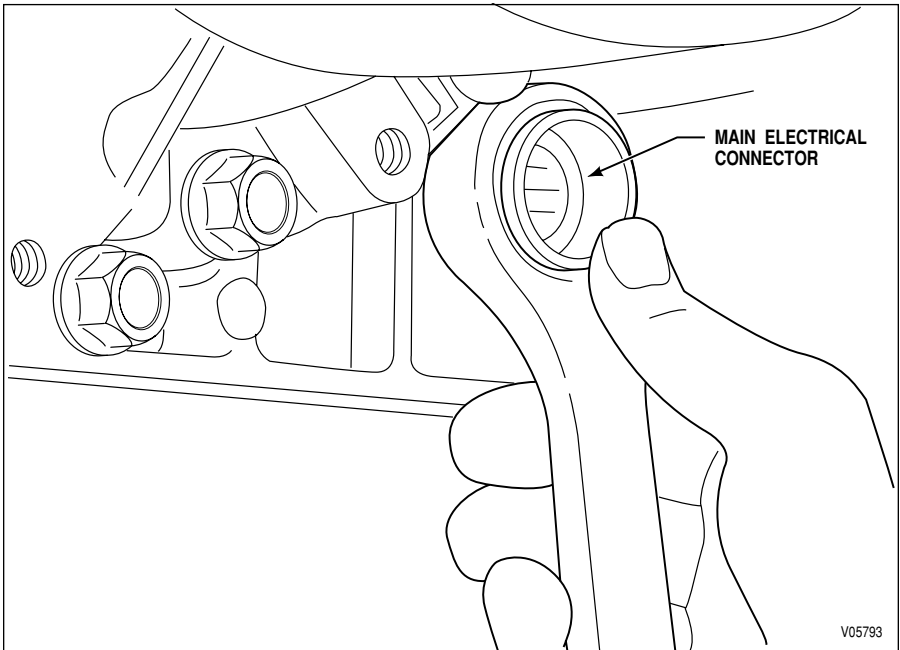
**Figure 6-8. Control Valve Solenoid Location**



**Figure 6-9. Internal Wiring Harness Removal/Installation**

11. Push the main electrical connector outward through the hole in the main housing. Use special tool J 44247 to make sure the retaining feet seat the connector in the main housing (see Figure 6-7).
12. Align the tabs on the wiring harness U-channel with the retaining clip slots for solenoids E and D on the control valve body. Install the retaining clips for the E and D solenoids (see Figures 6-8 and 6-9).

13. Attach the wiring harness connectors to solenoids A through G (see Figure 6–8) and to the pressure switch manifold assembly. The connectors should be in the correct position for installation because of their pre-assembled position in the U-channel.
14. Reconnect the external wiring harness.
15. Place a new seal on the suction filter tube. The seal should locate against a shoulder on the suction filter tube.
16. Push the filter and seal into the seal bore in the main housing. Be sure the suction filter is properly positioned.
17. Be sure that all gasket material is removed from the main housing and there are no scratches that would cause a splitline leak.
18. Install two headless guide bolts (M8 x 1.25) into opposite corners of the oil pan mounting face on the main housing.
19. Place a new gasket on the oil pan and align the bolt holes.
20. Slide the oil pan gasket and oil pan over the guide bolts and hold them in place while installing two of the bolts to hold the parts in place.
21. Install the remainder of the 12 bolts that fasten the oil pan to the main housing (two will replace the guide bolts). Tighten the bolts to 24–29 N·m (18–21 lb ft).



**Figure 6–10. Removal Of Main Electrical Connector**

22. Reinstall the drain plug and sealing washer. Tighten the drain plug to 30–40 N·m (22–30 lb ft).
23. Replace the quantity of transmission fluid lost during the internal harness replacement process. Refer to MT3190EN for fluid check procedures.

**b. Pressure Switch Manifold Assembly Replacement.** Use the following procedure to replace the pressure switch manifold assembly.



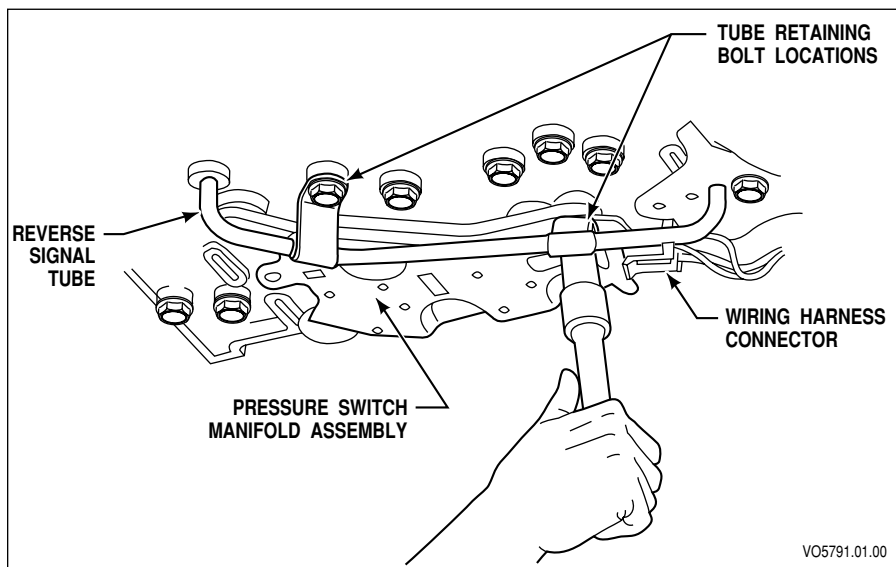
**NOTE:** It would be helpful to know how much transmission fluid is lost during the replacement of the pressure switch manifold assembly. Fluid in good condition caught in a clean container may be reused.

1. Remove the drain plug and sealing washer from the oil pan and allow the fluid to drain into a suitable container (see Figure 6–6). Examine the fluid as described in MT3190EN.
2. Remove the 12 bolts that fasten the oil pan to the main housing. Hold the oil pan in position as the last bolt is removed.
3. Remove the oil pan and oil pan gasket. Check the magnet in the oil pan (see Figure 6–6). Be sure that excessive or large metallic particles are not present. These conditions would indicate that an overhaul may be required.
4. Remove the suction filter by pulling straight down where the suction tube is seated in the main housing.
5. Remove the suction seal from the filter or from the seal bore in the main housing. Discard the old seal and the filter, if it is being replaced.
6. Remove the two bolts that fasten the reverse signal tube to the control valve body (see Figure 6–11). Remove the reverse signal tube.
7. Remove the five bolts that attach the pressure switch manifold assembly to the control valve body. Remove the pressure switch manifold assembly from the transmission.
8. Inspect the valve body for O-ring seals that may have been left from an old pressure switch assembly. Remove any old O-rings found.



**NOTE:** Individual pressure switches cannot be replaced. When any pressure switch needs replacing, the entire assembly must be replaced.

9. Place the new pressure switch manifold assembly in position and install one bolt in a recessed location to hold it into position. Start the remaining four bolts in recessed locations and tighten them all by hand. Torque the bolts to 10–13 N·m (7–10 lb ft). The one remaining bolt will be installed following the reverse signal tube.
10. Connect the internal wiring harness connector to the pressure switch manifold assembly.



**Figure 6–11. Pressure Switch Manifold Assembly Replacement**

11. Install the reverse signal tube. Install the two bolts that fasten the reverse signal tube to the control valve body (see Figure 6–11). Tighten the bolts to 10–13 N·m (7–10 lb ft).
12. Place a new seal on the suction filter tube. The seal should locate against a shoulder on the suction filter tube.
13. Push the filter and seal into the seal bore in the main housing. Be sure the suction filter is properly positioned.
14. Be sure that all gasket material is removed from the main housing and there are no scratches that would cause a splitline leak.
15. Install two headless guide bolts (M8 x 1.25) into opposite corners of the oil pan mounting face on the main housing.
16. Place a gasket on the oil pan and align the bolt holes.
17. Slide the oil pan gasket and oil pan over the guide bolts and hold them in place while installing two of the bolts to hold the parts in place.
18. Install the remainder of the 12 bolts that fasten the oil pan to the main housing (two will replace the guide bolts). Tighten the bolts to 24–29 N·m (18–21 lb ft).
19. Reinstall the drain plug and sealing washer. Tighten the drain plug to 30–40 N·m (22–30 lb ft).
20. Replace the quantity of transmission fluid lost during the pressure switch manifold assembly replacement process. Refer to MT3190EN for fluid check procedures.



**c. Solenoid A, B, D, E, or F Replacement.** Use the following procedure to replace any solenoid except C and G.



**NOTE:** It would be helpful to know how much transmission fluid is lost during the replacement of any solenoid. Fluid in good condition caught in a clean container may be reused.

1. Remove the drain plug and sealing washer from the oil pan and allow the fluid to drain into a suitable container (see Figure 6–6). Examine the fluid as described in MT3190EN.
2. Remove the 12 bolts that fasten the oil pan to the main housing. Hold the oil pan in position as the last bolt is removed.
3. Remove the oil pan and oil pan gasket. Check the magnet in the oil pan (see Figure 6–6). Be sure that excessive or large metallic particles are not present. These conditions would indicate that an overhaul may be required.
4. Remove the suction filter by pulling straight down where the suction tube is seated in the main housing.
5. Remove the suction seal from the filter or from the seal bore in the main housing. Discard the old seal and the filter, if it is being replaced.
6. Disconnect the internal wiring harness from the solenoid being changed.



**NOTE:** When the A and B solenoid retaining bracket is removed, there are two sets of accumulators and springs which will probably fall from their bores. When reinstalling the parts, the valve goes in the bore first with the hollow end facing outward, followed by the spring which goes inside the hollow portion of the valve.

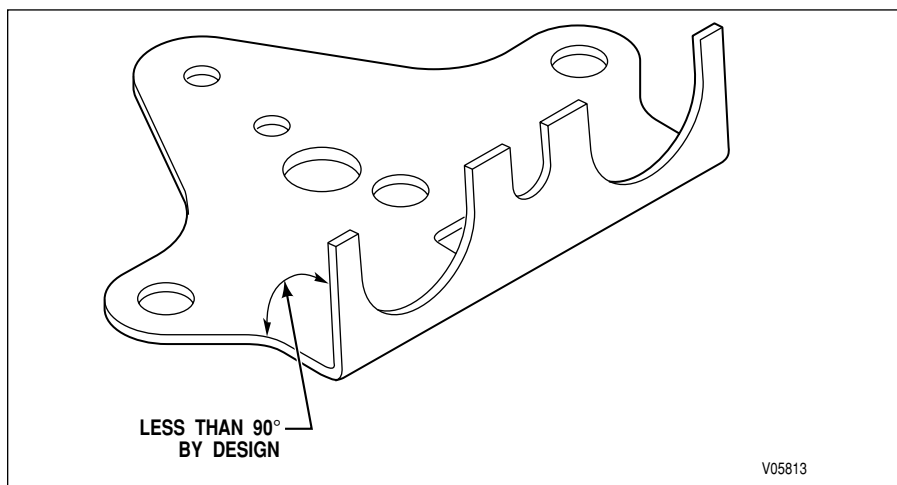
7. To remove A or B solenoid, remove three bolts and the solenoid retaining bracket. To remove solenoids E, D, or F, remove the solenoid retaining clip (see Figure 6–8 or 6–9).



**NOTE:** The A and B solenoid bracket must not be modified. Note that the angle between the two bracket surfaces is less than 90 degrees (see Figure 6–12). Gently bend the bracket to less than 90 degrees.

8. Note the position of the solenoid connector and pull the solenoid out of the bore in the control valve body. The O-rings on the solenoid provide the resistance felt during removal.
9. Obtain the new solenoid. Lubricate the O-rings with clean transmission fluid. Push the new solenoid into the control valve body bore with the wiring harness connector in the same position as when the solenoid was removed.

10. Reinstall the two accumulators and springs before installing the A and B solenoid retaining bracket (see NOTE following Step 6 above). Reinstall the solenoid retaining clip or bracket. Tighten the three bolts which hold the A and B solenoid retaining bracket to 10–13 N·m (7–10 lb ft).
11. Reconnect the internal wiring harness to the solenoid.
12. Place a new seal on the suction filter tube. The seal should locate against a shoulder on the suction filter tube.
13. Push the filter and seal into the seal bore in the main housing. Be sure the suction filter is properly positioned so that the oil pan will clear it and hold it in position.
14. Be sure that all gasket material is removed from the main housing and there are no scratches that would cause a splitline leak.
15. Install two headless guide bolts (M8 x 1.25) into opposite corners of the oil pan mounting face on the main housing.
16. Place a gasket on the oil pan and align the bolt holes.
17. Slide the oil pan gasket and oil pan over the guide bolts and hold them in place while installing two of the bolts to hold the parts in place.
18. Install the remainder of the 12 bolts that fasten the oil pan to the main housing (two will replace the guide bolts). Tighten the bolts to 24–29 N·m (18–21 lb ft).
19. Reinstall the drain plug and sealing washer. Tighten the drain plug to 30–40 N·m (22–30 lb ft).
20. Replace the quantity of transmission fluid lost during the solenoid replacement process. Refer to MT3190EN for fluid fill and check procedures.



**Figure 6–12. Solenoid A And B Retaining Bracket**

**d. Solenoid C Replacement.** Use the following procedure to replace the C solenoid. The control valve body must be completely removed from the transmission.



**NOTE:** It would be helpful to know how much transmission fluid is lost during the replacement of solenoid C. Fluid in good condition caught in a clean container may be reused.

1. Remove the drain plug and sealing washer from the oil pan and allow the fluid to drain into a suitable container (see Figure 6–6). Examine the fluid as described in MT3190EN.
2. Remove the 12 bolts that fasten the oil pan to the main housing. Hold the oil pan in position as the last bolt is removed.
3. Remove the oil pan and oil pan gasket. Check the magnet in the oil pan (see Figure 6–6). Be sure that excessive or large metallic particles are not present. These conditions may indicate that an overhaul is required.
4. Remove the suction filter by pulling straight down where the suction tube is seated in the main housing.
5. Remove the suction seal from the filter or from the seal bore in the main housing. Discard the old seal and the filter, if it is being replaced.
6. Release the main electrical connector from the main housing as described in Sub-paragraph a., Steps 6 and 9 of Section 6–9. This allows the internal wiring harness to remain with the control valve body as it is removed.



**NOTE:** As the control valve body is removed, be careful not to lose the manual selector valve pin or allow the manual selector to slide out.

7. Remove fifteen bolts at locations marked “A” and “B” (see Figure 6–13). Be ready to support the weight of the control valve body (about 10 pounds) as the last bolt is removed. Remove the control valve body assembly from the dowel pins in the main housing. When the valve body assembly has cleared the dowel pins, move it sideways to disengage the pin in the manual selector valve from the slot in the detent lever. Remove the control valve body assembly.
8. Remove the wiring harness connector from C solenoid. Remove the retaining clip for the C solenoid (see Figure 6–8).
9. Note the position of the solenoid connector and pull the solenoid out of the bore in the control valve body. The O-rings on the solenoid provide the resistance felt during removal.
10. Obtain the new solenoid. Lubricate the O-rings with clean transmission fluid. Push the new solenoid into the control valve body bore with the wiring harness connector in the correct position.

11. Reconnect the internal harness to solenoid C. Reinstall the solenoid retaining clip.
12. Move the control valve assembly into position under the main housing. Engage the pin in the manual selector valve into the slot in the detent lever. Align the valve body assembly with the dowel pins in the main housing, seat the body assembly against the main housing and install one bolt to hold the assembly in place. Reinstall the remaining fourteen “A” and “B” bolts (see Figure 6–13) that fasten the control valve body assembly to the main housing. Tighten the bolts to 10–13 N·m (7–10 lb ft).
13. Push the main electrical connector outward through the hole in the main housing. Use tool J 44247 to make sure the retaining feet seat the connector in the main housing (see Figure 6–7). Connect the internal wiring harness.
14. Place a new seal on the suction filter tube. The seal should locate against a shoulder on the suction filter tube.
15. Push the filter and seal into the seal bore in the main housing. Be sure the suction filter is properly positioned so that the oil pan will clear it and hold it in place.
16. Be sure that all gasket material is removed from the main housing and there are no scratches that would cause a splitline leak.
17. Install two headless guide bolts (M8 x 1.25) into opposite corners of the oil pan mounting face on the main housing.
18. Place the gasket on the oil pan and align the bolt holes.
19. Slide the oil pan gasket and oil pan over the guide bolts and hold them in place while installing two of the bolts to hold the parts in place.
20. Install the remainder of the 12 bolts that fasten the oil pan to the main housing (two will replace the guide bolts). Tighten the bolts to 24–29 N·m (18–21 lb ft).
21. Reinstall the drain plug and sealing washer. Tighten the drain plug to 30–40 N·m (22–30 lb ft).
22. Replace the quantity of transmission fluid lost during the solenoid replacement process. Refer to MT3190EN for fluid fill and check procedures.

### e. Solenoid G Replacement.

1. Remove the drain plug and sealing washer from the oil pan and allow the fluid to drain into a suitable container (see Figure 6–6). Examine the fluid as described in MT3190EN.
2. Remove the 12 bolts that fasten the oil pan to the main housing. Hold the oil pan in position as the last bolt is removed.
3. Remove the oil pan and oil pan gasket. Check the magnet in the oil pan (see Figure 6–6). Be sure that excessive or large metallic particles are not present. These conditions may indicate that an overhaul is required.
4. Remove the suction filter by pulling straight down where the suction tube is seated in the main housing.
5. Remove the suction seal from the filter or from the seal bore in the main housing. Discard the old seal and the filter, if it is being replaced.
6. Disconnect the wiring harness from Solenoid G.
7. Remove six bolts retaining the G solenoid valve body to the control valve body.
8. Remove the G solenoid valve body.
9. Turn the G solenoid valve body hydraulic passages up.
10. Remove the solenoid retainer clip.
11. Remove G solenoid **from** the valve body.
12. Lubricate the O-rings on the replacement solenoid.
13. Install Solenoid G into the valve body, electrical connector pointing towards the pressure manifold and parallel to the valve body so that the connector is horizontal when installed in the vehicle.
14. Install the solenoid retainer
15. Install six M6 x 1.5 x 65 mm bolts that retain the modulated main valve body to the main valve body. Tighten bolts to 10–13 N·m (7–10 lb ft).
16. Connect the internal wiring harness.
17. Place a new seal on the suction filter tube. The seal should locate against a shoulder on the suction filter tube.
18. Push the filter and seal into the seal bore in the main housing. Be sure the suction filter is properly positioned so that the oil pan will clear it and hold it in place.
19. Be sure that all gasket material is removed from the main housing and there are no scratches that would cause a splitline leak.
20. Install two headless guide bolts (M8 x 1.25) into opposite corners of the oil pan mounting face on the main housing.

21. Place a gasket on the oil pan and align the bolt holes.
22. Slide the oil pan gasket and oil pan over the guide bolts and hold them in place while installing two of the bolts to hold the parts in place.
23. Install the remainder of the 12 bolts that fasten the oil pan to the main housing (two will replace the guide bolts). Tighten the bolts to 24–29 N·m (18–21 lb ft).
24. Reinstall the drain plug and sealing washer. Tighten the drain plug to 30–40 N·m (22–30 lb ft).
25. Replace the quantity of transmission fluid lost during the solenoid replacement process. Refer to MT3190EN for fluid fill and check procedures.

**f. Internal Detent Lever Replacement.** Use the following procedure to replace the internal detent lever. The control valve body must be removed to accomplish this change.



**NOTE:** It would be helpful to know how much transmission fluid is lost during the replacement of the detent lever. Fluid in good condition caught in a clean container may be reused.

1. Remove the drain plug and sealing washer from the oil pan and allow the fluid to drain into a suitable container (see Figure 6–6). Examine the fluid as described in MT3190EN.
2. Remove the 12 bolts that fasten the oil pan to the main housing. Hold the oil pan in position as the last bolt is removed.
3. Remove the oil pan and oil pan gasket. Check the magnet in the oil pan (see Figure 6–6). Be sure that excessive or large metallic particles are not present. These conditions would indicate that an overhaul may be required.
4. Remove the suction filter by pulling straight down where the suction tube is seated in the main housing.
5. Remove the suction seal from the filter or from the seal bore in the main housing. Discard the old seal and the filter, if it is being replaced.
6. Release the main electrical connector from the main housing as described in Sub-paragraph a., Steps 6 and 9 of Section 6–9. This allows the internal wiring harness to remain with the control valve body as it is removed.



**NOTE:** As the control valve body is removed, be careful not to lose the manual selector valve pin or allow the manual selector to slide out.

7. Remove fifteen bolts at locations marked “A” and “B” (see Figure 6–13). Be ready to support the weight of the control valve body (about 10 pounds) as the last bolt is removed. Remove the control valve body assembly from the dowel pins in the main housing. When the valve body assembly has cleared the

dowel pins, move it sideways to disengage the pin in the manual selector valve from the slot in the detent lever. Remove the control valve body assembly.

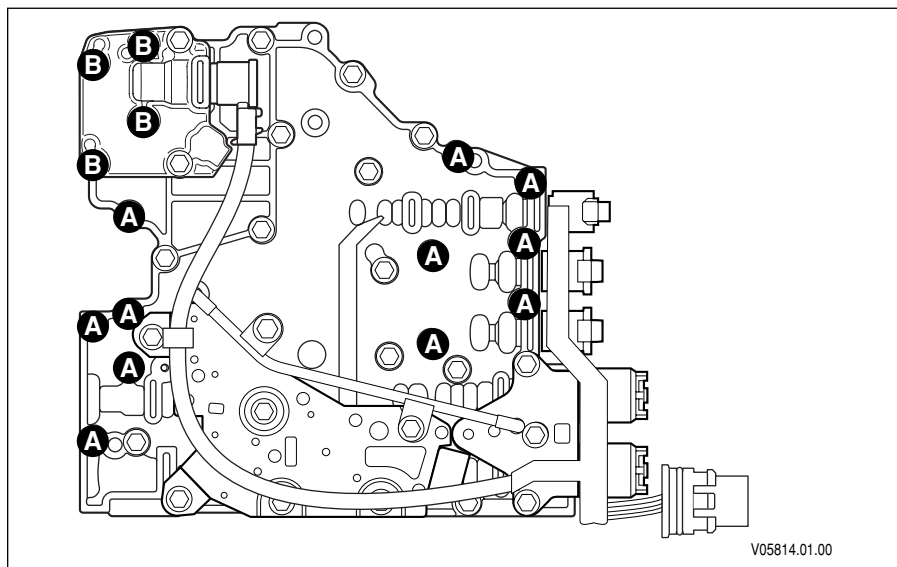
8. Loosen the nut on the selector shaft that is retaining the internal detent lever to the selector shaft (see Figure 6–14).



**NOTE:** DO NOT mar the main housing surface around the spring pin when removing the spring pin. An unmarred surface is required to maintain the seal between the control valve body assembly and the main housing.

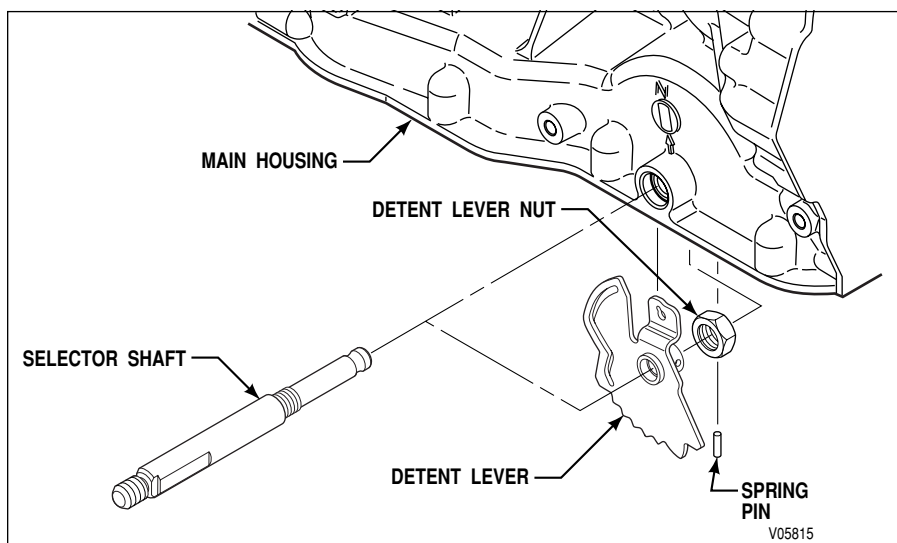
9. Place a protective plate on the main housing surface around the spring pin. Place a drill bit into the spring pin to prevent cutting or collapsing the pin when removing the pin. Remove the spring pin from the main housing.
10. Slide the selector shaft through the detent lever and through the selector shaft seal and remove the detent lever and nut.
11. Place the new detent lever in position in the main housing. Reinstall the selector shaft through the selector shaft seal and through the detent lever. Place the detent lever retaining nut in position over the selector shaft. Push the selector shaft into its final position in the main housing.
12. Reinstall the spring pin into the main housing that retains the selector shaft. If available, use tool J 43766 to install the spring pin. If tool is not available, install pin to 8.5–9.0 mm above main housing surface. Tighten the detent lever retaining nut on the selector shaft.
13. Move the control valve assembly into position under the main housing. Engage the pin in the manual selector valve into the slot in the detent lever. Align the valve body assembly with the dowel pins in the main housing, seat the body assembly against the main housing and install one bolt to hold the assembly in place. Reinstall the remaining fourteen bolts at “A” and “B” (see Figure 6–13) that fasten the control valve body assembly to the main housing. Tighten the bolts to 10–13 N·m (7–10 lb ft).
14. Push the main electrical connector outward through the hole in the main housing. Use tool J 44247 to properly seat the retaining feet to retain the connector in the main housing (see Figure 6–7). Connect the internal wiring harness.
15. Place a new seal on the suction filter tube. The seal should locate against a shoulder on the suction filter tube.
16. Push the filter and seal into the seal bore in the main housing. Be sure the suction filter is properly positioned so that the oil pan will clear it and hold it in place.

17. Be sure that all gasket material is removed from the main housing and there are no scratches that would cause a splitline leak.
18. Install two headless guide bolts (M8 x 1.25) into opposite corners of the oil pan mounting face on the main housing.
19. Place a gasket on the oil pan and align the bolt holes.
20. Slide the oil pan gasket and oil pan over the guide bolts and hold them in place while installing two of the bolts to hold the parts in place.
21. Install the remainder of the 12 bolts that fasten the oil pan to the main housing (two will replace the guide bolts). Tighten the bolts to 24–29 N·m (18–21 lb ft).
22. Reinstall the drain plug and sealing washer. Tighten the drain plug to 30–40 N·m (22–30 lb ft).
23. Replace the quantity of transmission fluid lost during the solenoid replacement process. Set the transmission fluid level following the procedure in MT3190EN.



**Figure 6–13. Control Valve Body Removal**





**Figure 6-14. Detent Lever Replacement**

## 6-10. FRONT SEAL REPLACEMENT

Use the following procedure for removal and installation of the front seal which is in the oil pump inside the converter housing. Replacement of the front seal requires removal of the transmission from the vehicle and removal and reinstallation of the torque converter.

### a. Removal.

1. Refer to Section II in MT3190EN for instructions to remove the transmission from the vehicle.
2. Position the transmission vertically with the torque converter end up.

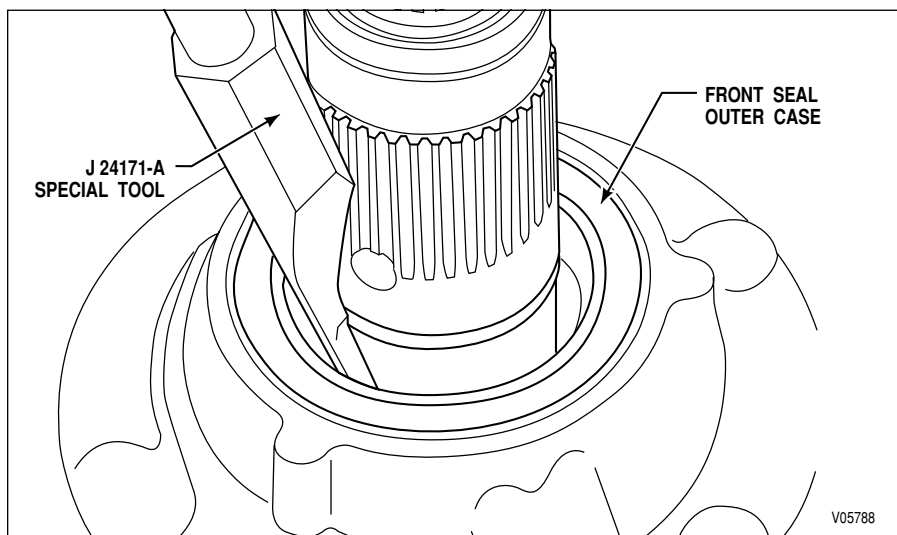


**NOTE:** Measure the distance from the torque converter mounting lugs to the transmission mounting face. This is an important measurement required to check correct reassembly of the torque converter.

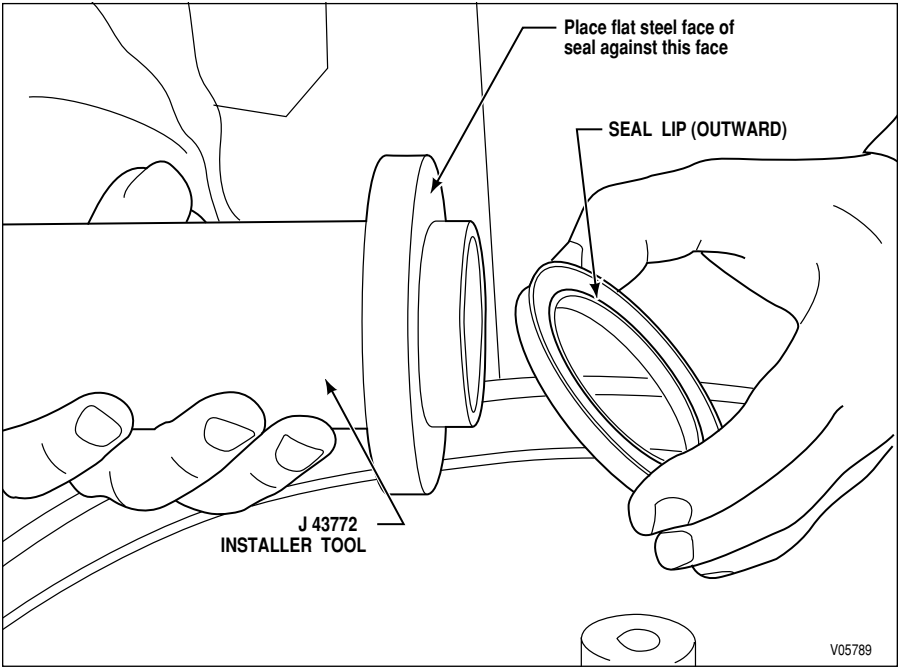
3. Take the measurement described in the NOTE above.
4. Attach a three-strand sling to the torque converter. Lift the torque converter from the transmission and set it safely aside until needed at reassembly.
5. Obtain special tool J 24171-A and install the tip with a 90 degree hook onto the end of the slide-hammer.
6. Position the 90 degree hook behind the rear face of the seal outer case (see Figure 6-15).
7. Remove the front seal using the slide-hammer.

## b. Installation.

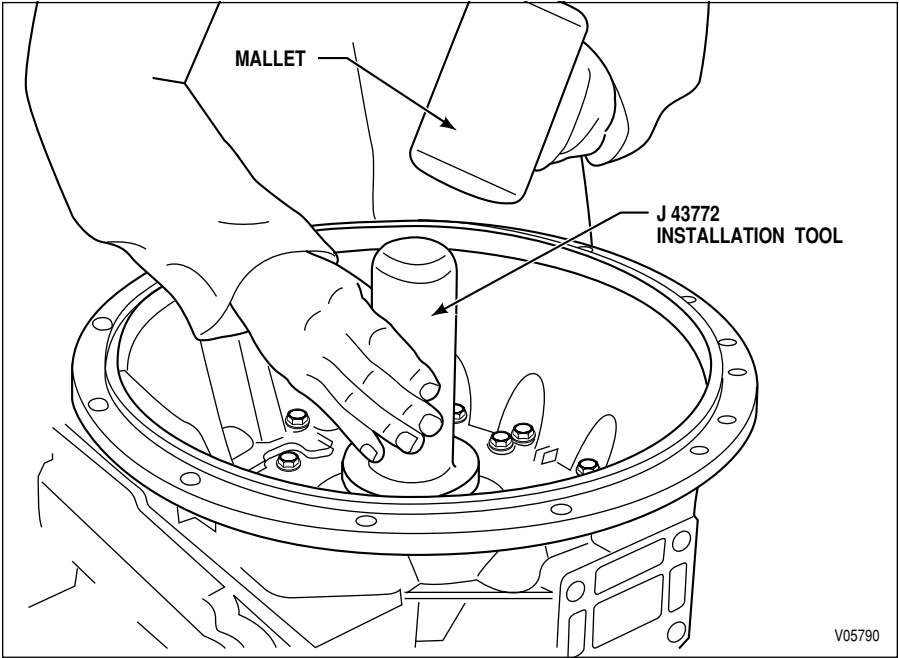
1. Inspect the seal bore for scratches. Inspect the seal removed to see the reason for a leak. Worn lip? Broken garter spring? Remove any scratches in the seal bore using crocus cloth.
2. Install the new seal onto the J 43772 installer tool. Position the seal so the seal lip is outward and the face of the steel case is against the driving face of the tool (see Figure 6–16).
3. Slide the installer tool over the turbine shaft and ground sleeve until the seal starts into the seal bore. Strike the installer tool with a mallet to drive the seal into the seal bore (see Figure 6–17). The seal is installed correctly when the shoulder of the installer tool squarely contacts the outer surface of the oil pump.
4. Inspect the converter hub for damage, scratches or machine type leading. Scratches or machine type leading can cause the seal to leak. Remove minor scoring with crocus cloth.
5. Lubricate the converter pump hub OD and the front seal with clean transmission fluid.
6. Use the three-strand sling to lower the torque converter over the turbine shaft and ground sleeve. Remove the three-strand sling. Spin the torque converter to engage the turbine shaft splines in the torque converter hub, the ground sleeve splines in the stator race and the drive flats on the converter pump hub engage the oil pump drive gear.
7. The torque converter is correctly installed when the same measurement taken in Step a.3 above is obtained.
8. Install the torque converter retaining bracket.
9. Reinstall the transmission following instructions in Section V in MT3190EN.



**Figure 6–15. Front Seal Removal**



**Figure 6-16. Positioning New Seal On Installer Tool**



**Figure 6-17. Installing Front Seal**

## 6-11. COOLER FLUSHING

Metal contamination requires complete transmission disassembly and cleaning. Clean all internal and external hydraulic circuits, transmission cooler, and all areas where metal and other particles could lodge. Special tool J 46550 Transmission Cooler Kwik-Flush Cart is now an essential tool for all overhaul and maintenance service outlets, J 46550 or an approved cooler flushing device that meets Allison cooler flushing requirements and procedures must be used.

1. Flush contaminated fluid from the cooler by flowing transmission fluid through the cooler in the reverse direction of normal flow. Use a flushing pump that pumps fluid in a pulsating flow at a minimum mean rate of 0.5 liters/sec (8.0 gpm) and 275–345 kPa (40–50 psi). The J 46550 Transmission Cooler Kwik-Flush Cart meets these requirements.
2. After flushing the contaminated fluid, use the flushing pump to circulate clean transmission fluid through the cooler in a closed loop back to a 10-micron filter. Circulate fluid in the closed loop for a minimum of five minutes.



**CAUTION:** After flushing the cooler, be sure to check the external cooler circuit restriction. If circuit pressure drop is above specification, the cooler has excessive trapped particles and must be replaced.

## SECTION VII

## CUSTOMER SERVICE



### 7-1. OWNER ASSISTANCE

There are distributors and dealers around the world ready to stand behind every Allison Transmission product. Any situation that arises in connection with the sale, operation, or service of your transmission will be handled by the distributor or dealer in your area. Technical support is available from the Technical Assistance Center (TAC) by telephone at 1-800-252-5283.

Refer to the Allison Transmission website [www.allisontransmission.com](http://www.allisontransmission.com) or to the Worldwide Sales and Service Directory SA2229EN for a current listing of Allison Transmission authorized distributors and service dealers.

### 7-2. SERVICE LITERATURE



This service literature provides fully illustrated instructions for operation, maintenance, service, overhaul, and parts support for your transmission. For maximum performance and service life from your unit, see your dealer or distributor for the following publications. Check the telephone directory for the Allison Transmission service outlet nearest you.

**Table 7-1. Service Literature**

Service Manual	SM3191EN
*Parts Catalog	PC3062EN CD3062EN
Electronic Troubleshooting Manual	TS3192EN
Principles of Operation	PO3065EN
*Mechanic's Tips	MT3190EN
*EVS Operator's Manual	OM3761EN
*HS Operator's Manual	OM3757EN
*RDS Operator's Manual	OM3759EN
*MHS Operator's Manual	OM3364EN
*PTS Operator's Manual	OM3758EN
*BUS Operator's Manual	OM3765EN
*1000, 2000, 2400 Operator's Manual	OM3063EN
* Also Available On The Internet At <a href="http://www.allisontransmission.com">www.allisontransmission.com</a>	

