Allison Transmission®

Allison 4th Generation Controls

In-Chassis Maintenance

1000 And 2000 Product Families

GN4008EN

In-Chassis Maintenance

2007 JANUARY

GN4008EN

Allison Transmission

Allison 4th Generation Controls

1000 Product Family
2000 Product Family

Allison Transmission, Inc.
P.O. Box 894 Indianapolis, Indiana 46206-0894
www.allisontransmission.com

Printed in USA

NOTES

TABLE OF CONTENTS

SECTION VII CUSTOMER SERVICE

TRADEMARK USAGE

The following trademarks are the property of the companies indicated:

- Allison DOC™ is a trademark of General Motors Corporation.
- Windows® is a registered trademark of Microsoft Corporation.
- Torx® is a registered trademark of Camcar/Texron.

WARNINGS, CAUTIONS, NOTES

IT IS YOUR RESPONSIBILITY to be completely familiar with the warnings and cautions described in this handbook. It is, however, important to understand that these warnings and cautions are not exhaustive. Allison Transmission could not possibly know, evaluate, and advise the service trade of all conceivable ways in which service might be done or of the possible hazardous consequences of each way. The vehicle manufacturer is responsible for providing information related to the operation of vehicle systems (including appropriate warnings, cautions, and notes). Consequently, Allison Transmission has not undertaken any such broad evaluation. Accordingly, **ANYONE WHO USES A SERVICE PROCEDURE OR TOOL WHICH IS NOT RECOMMENDED BY ALLISON TRANSMISSION OR THE VEHICLE MANUFACTURER MUST** first be thoroughly satisfied that neither personal safety nor equipment safety will be jeopardized by the service methods selected.

Proper service and repair is important to the safe, reliable operation of the equipment. The service procedures recommended by Allison Transmission (or the vehicle manufacturer) and described in this handbook are effective methods for performing service operations. Some of these service operations require the use of tools specially designed for the purpose. The special tools should be used when and as recommended.

Three types of headings are used in this handbook to attract your attention. These warnings and cautions advise of specific methods or actions that can result in personal injury, damage to the equipment, or cause the equipment to become unsafe.

WARNING: A warning is used when an operating procedure, practice, etc., if not correctly followed, could result in personal injury or loss of life.

CAUTION: A caution is used when an operating procedure, practice, etc., if not strictly observed, could result in damage to or destruction of equipment.

NOTE: A note is used when an operating procedure, practice, etc., is essential to highlight.

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–Service Tool.

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 INHIBIT(ED)** 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–Service Tool). 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–Service Tool. Figure 1–1 shows a typical beginning screen for the Allison DOC™ For PC–Service 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, P2, U0, U1, or U2 followed immediately by three additional numbers. For a complete list of codes and more detailed information, refer to TS3977EN, 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).

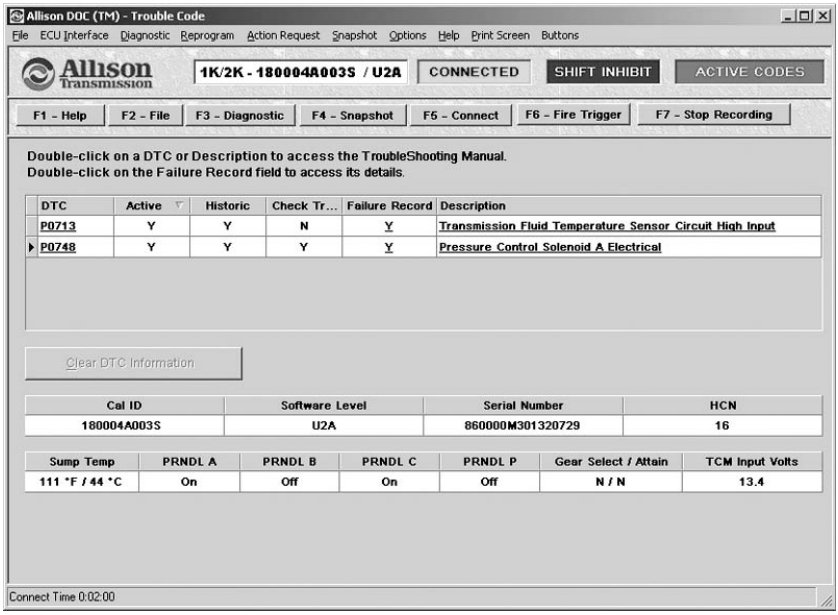

Figure 1–1. Trouble Code Screen—Allison DOC™ For PC–Service Tool

d. Troubleshooting When No Diagnostic Codes Are Present.

1. Always start with the basics:
   - Make sure the shifter is in the appropriate range.
   - Measure the fluid level.
   - Make sure batteries are properly connected and charged.
   - Make sure throttle is closed and engine speed is below 900 rpm.
   - Make sure electrical connections are properly made.
   - Inspect and test support equipment for proper installation and operation.
2. If adaptive information has been reset, initial upshifts and downshift may be harsh. Allow shifts to “converge” before assuming there is a shift problem.
3. Refer to Section 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 tests include mechanical and hydraulic items.

4. If the troubleshooting charts refer to an Electronic Control test, 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, determine if any of the following items are at fault:

- 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) allowing moisture to enter
- 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 determinations before beginning specific troubleshooting, removing the transmission, or removing attached components.

- Are wheels chocked?
- 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 determinations, use the various sections of this manual to isolate the listed problems. Table 1–1 addresses specific vehicle complaints. Some complaints involve diagnostic codes, so all troubleshooting should involve determining if diagnostic codes have set.

Table 1–1. Troubleshooting Performance Complaints

Problem	Possible Cause	Suggested Remedy
VEHICLE WILL NOT START—ENGINE WILL NOT CRANK	Lever shift selector not in **N** (Neutral), **P** (Park), or **PB** (Auto-Apply Parking Brake)	Select **N** (Neutral) and restart
	Dead battery	Recharge battery
	Disconnected battery	Reconnect battery
	Faulty starter circuit	Repair vehicle starter circuit
	Faulty Internal Mode Switch (IMS)	Replace IMS (refer to Section 3–2, INTERNAL MODE SWITCH (IMS))
	Faulty wiring in vehicle neutral start circuit or relay	Repair wiring
	Electrical connector not properly seated on IMS	Properly install electrical connector
CHECK TRANS LIGHT WILL NOT GO OUT AT START-UP	TCM has logged a DTC	Install Allison DOC™ For PC–Service Tool to determine if DTC is present
	Faulty **CHECK TRANS** light, relay, or circuit	Replace relay or repair circuit
CHECK TRANS LIGHT FLASHES INTERMITTENTLY	Intermittent power to TCM	Measure input power to the TCM and correct if necessary
	Faulty vehicle wiring	Repair vehicle wiring
	Loose wiring to **CHECK TRANS** light	Repair wiring
	Faulty or incorrect ground wire attachment	Repair ground circuit
	Intermittent opening in Circuit 129	Repair Circuit 129

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

Problem	Possible Cause	Suggested Remedy
NO **CHECK TRANS** LIGHT AT IGNITION	Faulty light bulb or socket	Replace light bulb or socket
	Incorrect wiring to and from **CHECK TRANS** light bulb	Repair wiring (refer to Troubleshooting Manual, TS3977EN, Appendix E)
	Faulty vehicle wiring	Repair vehicle wiring
	Circuit 129 open	Repair Circuit 129
TRANSMISSION WILL NOT SHIFT TO FORWARD OR REVERSE (STAYS IN NEUTRAL)	Engine rpm too high	Reduce engine rpm (it may be necessary to reselect **N** (Neutral) also, and then **D** (Drive) or **R** (Reverse))
	Low fluid level	Add fluid to correct level (refer to Mechanic's Tips, MT4007EN)
	Throttle position sensor or linkage is not functioning properly	Refer to Mechanic's Tips, MT4007EN
	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) circuitry (refer to Section 6–3, SPEED SENSOR REPLACEMENT)
	Mechanical failure to C5 clutch	Repair transmission
	Mechanical failure in transmission torque converter, shafts, or planetaries	Repair transmission
	Low main 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 level	Add fluid to correct level
	Leaking at solenoid assembly	Rebuild solenoid assembly (refer to Service Manual, SM4006EN)
	Low main pressure	Refer to Low Pressure Section
	Faulty solenoid—leaking	Replace solenoid (refer to Section 6–9, CONTROL VALVE COMPONENT REPLACEMENT)
TRANSMISSION WILL NOT MAKE A SPECIFIC SHIFT	Low engine power	Correct engine problem (refer to engine Service Manual, SM4006EN)
	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	Determine if a temperature reading is inhibiting shifts
	Incorrect calibration	Install proper calibration via PCCS
	Faulty or misadjusted shift selector	Repair shift selector

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

Problem	Possible Cause	Suggested Remedy
TRANSMISSION DOES NOT SHIFT PROPERLY (ROUGH SHIFTS, SHIFTS OCCURRING AT TOO LOW OR TOO HIGH SPEED)	Engine idle speed too high (neutral to range shift)	Adjust engine idle speed
	Faulty throttle sensor/circuit	Refer to Mechanic's Tips, MT4007EN, and/or Troubleshooting Manual, TS3977EN
	Excessive clutch running clearance	Rebuild transmission and adjust clearances
	Incorrect shift calibration for vehicle	Install correct calibration via PCCS
	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(s) (refer to Troubleshooting Manual, TS3977EN)
	Degraded fluid	Change transmission fluid and control main filter (refer to Mechanic's Tips, MT4007EN)
	Loose speed sensor	Tighten speed sensor retaining bracket bolt
	Incorrect fluid level	Correct fluid level (refer to Mechanic's Tips, MT4007EN)
	Shift adaptives not converged	Drive vehicle until shift adaptives are converged

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

Problem	Possible Cause	Suggested Remedy
TRANSMISSION DOES NOT SHIFT PROPERLY (ROUGH SHIFTS, SHIFTS OCCURRING AT TOO LOW OR TOO HIGH SPEED) (cont'd)	Engine parameters not correct	Have OEM verify engine parameters that may affect transmission performance
	Low main pressure	Refer to Low Pressure Section
	Intermittent wiring problems	Inspect wiring harnesses and connectors (refer to Troubleshooting Manual, TS3977EN)
	Loose or damaged speed gear	Tighten output flange bolt or replace speed gear
	Sticking valves in control valve assembly	Overhaul control valve body assembly
	Leaking pressure control solenoids	Repair or replace pressure control solenoids (refer to Section 6–9, CONTROL VALVE COMPONENT REPLACEMENT)
	Incorrect TCM calibration	Install correct calibration via PCCS
ABNORMAL TRANSMISSION ACTIVITIES OR RESPONSES		
A. Excessive Creep in First and Reverse Gears	Engine idle speed too high	Adjust engine idle speed
B. Vehicle Moves Forward in Neutral	C1 clutch failed or not released	Rebuild C1 clutch assembly (refer to Service Manual, SM4006EN)
C. Vehicle Moves Backward in Neutral	C3 clutch failed or not released	Rebuild C3 clutch assembly (refer to Service Manual, SM4006EN)

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

Problem	Possible Cause	Suggested Remedy
EXCESSIVE FLARE—ENGINE OVERSPEED ON FULL THROTTLE UPSHIFTS	TPS Adjustment:	
	— Overstroke	Adjust TPS linkage for proper stroke (refer to Mechanic's Tips, MT4007EN)
	— Loose	Tighten loose bolts or connections
	Incorrect calibration	Install correct calibration via PCCS
	Incorrect fluid level	Add fluid to proper level (refer to Mechanic's Tips, MT4007EN)
	Sticking valves in control valve assembly	Rebuild control valve body assembly
	Low main pressure	Refer to Low Pressure Section
	Leaking pressure control solenoids	Repair or replace pressure control solenoids (refer to Service Manual, SM4006EN)
	Erratic speed sensor signal	Refer to speed sensor DTCs
	Piston seals leaking or clutch plates slipping in range involved	Overhaul transmission (refer to Service Manual, SM4006EN)
RANGE CLUTCH TROUBLESHOOTING SECTION		
EXCESSIVE SLIPPAGE AND CLUTCH CHATTER	Incorrect TCM calibration	Install correct calibration
	Throttle Position Sensor (TPS) out of adjustment or failed	Adjust or replace TPS (refer to Mechanic's Tips, MT4007EN)
	Incorrect speed sensor readings	Refer to speed sensor DTCs

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

Problem	Possible Cause	Suggested Remedy
EXCESSIVE SLIPPAGE AND CLUTCH CHATTER (cont'd)	Incorrect fluid level	Correct fluid level (refer to Mechanic's Tips, MT4007EN)
	Main pressure low	Refer to Low Main Pressure Section
	TCC clutch not applied	Inspect lockup clutch system wiring, pressure, and controls; repair as necessary (refer to Service Manual, SM4006EN)
A. Ranges 1, 2, 3, 4 Only	C1 clutch slipping, leaks at splitline gasket, leaks at rotating clutch seals, leaks at piston seals, C1 clutch plates worn	Inspect control module gasket, C1 clutch plates, piston, and rotating seals; replace/rebuild as necessary (refer to Service Manual, SM4006EN)
B. Ranges 4, 5 Only	C2 clutch slipping, leaks at splitline gasket, leaks at rotating clutch seals, leaks at piston seals, C2 clutch plates worn	Inspect C2 clutch plates, piston, and rotating seals; replace/rebuild as necessary (refer to Service Manual, SM4006EN)
C. Ranges 3, 5, R Only	C3 clutch slipping, leaks at piston seals, C3 clutch plates worn	Inspect C3 clutch plates and piston seals; replace/rebuild as necessary (refer to Service Manual, SM4006EN)
D. Range 2 Only	C4 clutch slipping, leaks at piston seals, C4 clutch plates worn	Inspect C4 clutch plates and piston seals; replace/rebuild as necessary (refer to Service Manual, SM4006EN)

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

Problem	Possible Cause	Suggested Remedy
E. Ranges 1, R Only	C5 clutch slipping, leaks at piston seals, C5 clutch plates worn	Inspect C5 clutch plates and piston seals; replace/rebuild as necessary (refer to Service Manual, SM4006EN)
	LOW PRESSURE SECTION	
A. Low or No Main Pressure in All Ranges	Incorrect fluid level	Correct fluid level (refer to Mechanic's Tips, MT4007EN)
	Clogged or faulty oil filter element	Replace oil filter (refer to Section 6–8, SUCTION FILTER AND SEAL REPLACEMENT)
	Main pressure regulator valve sticking	Overhaul front support assembly (refer to Service Manual, SM4006EN)
	Leaking solenoids in control valve assembly	Repair or replace solenoids (refer to Section 6–9, CONTROL VALVE COMPONENT REPLACEMENT)
	Main Mod solenoid failure	Replace Main Mod solenoid (refer to Service Manual, SM4006EN)
	Weak, broken, or missing main pressure regulator valve spring	Test spring and replace if necessary (refer to Service Manual, SM4006EN)
	Control valve body leakage (separator plate not flat, loose control valve body bolts)	Replace or rebuild control valve assembly. Care should be taken when removing and labeling shift springs (refer to Service Manual, SM4006EN)
	Faulty or incorrect fluid pressure gauge	Repair or replace gauge

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

Problem	Possible Cause	Suggested Remedy
A. Low or No Main Pressure in All Ranges (cont'd)	Worn or damaged oil pump	Replace or rebuild oil pump (refer to Service Manual, SM4006EN)
	Leak in suction circuit	Inspect suction circuit for leaking seal, gasket, or mating surface
B. Low Main Pressure in Specific Ranges, Normal Pressure in Other Ranges	Seal leak	Refer to Service Manual, SM4006EN
ABNORMAL STALL SPEEDS (Stall In First Range–Fifth Range)		
A. High Stall Speeds	Not in gear	Select **D** (Drive)
	Low fluid level, aerated fluid	Add fluid to proper level (refer to Mechanic's Tips, MT4007EN)
	Faulty torque converter	Replace torque converter
	Incorrect torque converter	Replace torque converter (refer to Service Manual, SM4006EN)
	Clutch pressure low	Refer to Low Pressure Section
	Clutch slipping; use the Allison DOC™ to determine turbine speed	Rebuild transmission (refer to Service Manual, SM4006EN)
	Higher power engine	Confirm proper engine match
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)

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

Problem	Possible Cause	Suggested Remedy
B. Low Stall Speeds (cont'd)	Stall speeds 33 percent of normal implies freewheeling stator	Replace converter assembly (refer to Service Manual, SM4006EN)
	Engine smoke controls	Compare lugback vs. static stall speed
	Incorrect torque converter	Install correct torque converter (refer to Service Manual, SM4006EN)
OVERHEATING IN ALL RANGES	Aerated fluid—incorrect fluid level	Adjust fluid to proper level, determine if there is a leak in the suction circuit or the pump is defective (refer to Mechanic's Tips, MT4007EN)
	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
	Inaccurate sump temperature sensor	Replace Pressure Switch Manifold (PSM) or internal harness (refer to Section 6–9, CONTROL VALVE COMPONENT REPLACEMENT)
	Inadequate cooler sizing	Refer to vehicle OEM for specifications
	Excessive cooler circuit pressure drop	Determine if cooler is plugged, lines too small, collapsed hoses, too many elbows in circuit
	Transmission cooler lines reversed	Connect cooler lines properly (oil and water should flow in opposite directions)

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

Problem	Possible Cause	Suggested Remedy
OVERHEATING IN ALL RANGES (cont'd)	Transmission cooler lines restricted	Remove restrictions, clean or replace lines (refer to vehicle service manual)
	Torque converter (wrong converter, no lockup, stuck stator, or slipping stator)	Replace converter assembly (refer to Service Manual, SM4006EN). **NOTE:** Stuck stator will not allow cool down in neutral.
	Cooler flow loss due to internal transmission leakage	Overhaul transmission (refer to Service Manual, SM4006EN)
FLUID COMES OUT OF THE FLUID FILL TUBE AND/OR BREATHER	Dipstick loose	Tighten cap, replace if necessary
	Fluid level too high	Drain to proper level (refer to Mechanic's Tips, MT4007EN)
	Fluid level too low	Add fluid to proper level
	Breather stopped up—clogged	Clean or replace breather (refer to Service Manual, SM4006EN)
	Fluid contaminated with foreign liquid	Drain and replace fluid. Locate and fix source of additional fluid (refer to Mechanic's Tips, MT4007EN)
	Dipstick or fill tube seal worn	Replace seals or dipstick
	Cut C5 piston seal	Replace C5 piston seal (refer to Service Manual, SM4006EN)
	Improperly vented dipstick	Vent dipstick
	Incorrect dipstick marking	Calibrate dipstick (refer to Mechanic's Tips, MT4007EN)

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

Problem	Possible Cause	Suggested Remedy
NOISE OCCURRING INTERMITTENTLY (BUZZING)	Low fluid level	Add fluid to proper level (refer to Mechanic's Tips, MT4007EN)
	Air leak in oil suction screen canister	Replace suction filter (refer to Service Manual, SM4006EN)
	Clogged filter	Replace filter (refer to Section 6–9, CONTROL VALVE COMPONENT REPLACEMENT)
	Aerated fluid causes noisy pump	Correct fluid level (refer to Mechanic's Tips, MT4007EN)
	Low pressure causes main regulator valve to oscillate	Refer to Low Pressure Section
LEAKING FLUID (TRANSMISSION OUTPUT)	Faulty or missing seal at output flange	Install new lip-type seal in rear of tranmission housing (refer to Section 6–6, REAR SEAL REPLACEMENT, or Service Manual, SM4006EN)
	Machine lead on output flange seal surface	Replace flange

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

Problem	Possible Cause	Suggested Remedy
LEAKING FLUID (TRANSMISSION OUTPUT) (cont'd)	Rear cover porosity	Repair or replace cover
	Flange worn at seal surface	Replace flange
	Insufficient sealant around seal OD	When replacing seal, refer to Section 6–6, REAR SEAL REPLACEMENT
	Damaged or missing output bolt washer seal	Replace output bolt sealing washer
	Damaged, missing, or loose flange bolt	Replace and/or torque output flange bolts (refer to Section 6–1, OUTPUT FLANGE/YOKE REPLACEMENT)
LEAKING FLUID (TRANSMISSION INPUT)	Front seal leaks	Replace front seal (refer to Section 6–10, FRONT SEAL REPLACEMENT)
	Manifold gasket leaks	Verify bolt torque. Replace manifold gasket seal (refer to Section 6–5, COOLER MANIFOLD GASKET REPLACEMENT)
	Front support bolt seals leak	Verify bolt torque. Replace bolt seals
	Converter leaks	Inspect for cracked converter lugs, converter cover, or converter housing porosity; replace converter (refer to Service Manual, SM4006EN)

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

Problem	Possible Cause	Suggested Remedy
LEAKING FLUID (TRANSMISSION INPUT) (cont'd)	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. Check adaption
DIRTY FLUID	Failure to change fluid and filters	Change fluid and install new filters (refer to Mechanic's Tips, MT4007EN)
	Excessive heat	Inspect and test cooling system for restrictions and proper capacity
	Substandard fluid	Use recommended fluid (refer to Mechanic's Tips, MT4007EN)
	Clutch/transmission failure	Overhaul transmission (refer to Service Manual, SM4006EN)

1–3. TRANSMISSION STALL TEST AND NEUTRAL COOL-DOWN TEST

a. Purpose. Stall testing is performed to determine if a vehicle performance complaint is due to an engine or transmission malfunction. Stall testing is a troubleshooting procedure only—never perform a stall test as a general test or during routine maintenance.

Transmission stall speed is the maximum engine rpm attainable when the engine is at full throttle and the torque converter turbine is not moving, or "stalled." After a transmission stall test, compare the actual full throttle engine speed at torque converter turbine stall with specifications established by the vehicle manufacturer.

NOTE: Engine speed data can be obtained from the engine manufacturer or from the equipment dealer or distributor. Some engine manufacturers provide a programmable parameter to limit engine speed when the transmission output speed is 0 rpm, such as at a stop. This parameter should be set to a higher value than the expected transmission stall speed before performing the stall test.

---

b. Stall Testing Preparation. If a transmission stall test is to be performed, make sure the following preparations have been made before conducting the transmission stall test:

1. The manufacturer concurs with performing a full throttle transmission stall test.
2. The engine programmable parameter for 0 rpm transmission output speed is set higher than the value expected at transmission stall speed.
3. The vehicle is in an area in which a transmission stall test can be safely performed.
4. Make sure the fuel control linkage goes to full throttle and does not stick when released.
5. Make sure the engine air induction system and exhaust system have no restrictions.
6. Perform a cold check of the transmission fluid level and adjust as necessary.
7. Connect the Allison DOC™ For PC–Service Tool to the vehicle diagnostic data connector or install an accurate tachometer (do not rely on the vehicle tachometer).
8. Install a temperature gauge with the probe in the transmission converter-out (to cooler) line. Allison DOC™ For PC–Service Tool displays sump temperature only.
9. Install wheel chocks.

10. Find a competent operator to assist at the vehicle controls.
11. Be sure the vehicle brakes are fully locked.

WARNING: To help avoid personal injury, such as burns, from hot transmission fluid and/or to help avoid equipment damage, do not stall the torque converter for more than ten seconds maximum and monitor transmission fluid temperature. Immediately return the engine to idle if converter out (to cooler) temperature exceeds 150°C (300°F). Operating the transmission at high engine power at transmission stall or near stall conditions causes a rapid rise in the transmission fluid temperature. The fluid in the transmission torque converter is absorbing all of the engine power and the vehicle cooling system cannot dissipate the excessive heat load. Extended operation under high heat load conditions causes transmission and cooling system damage, and may cause hydraulic lines to fail causing high temperature fluid leaks.

WARNING: To help avoid personal injury and equipment damage while conducting a transmission stall test, the vehicle must be positively prevented from moving. Apply the parking brake, the service brake, and chock the wheels securely. Warn personnel to keep clear of the vehicle and its travel path.

c. Performing a Transmission Stall Test.

1. Start the engine. While in neutral let the transmission warm to normal operating temperature:
   — Sump temperature 71–93°C (160–200°F)
   — Converter out temperature 82–104°C (180–220°F)
2. Perform a hot check of the transmission fluid level and adjust as necessary.
3. Turn **OFF** all engine accessories.
4. Use the Allison DOC™ For PC–Service Tool to select fourth range. Using fourth range reduces the torque imposed on the transmission driveline. Do not perform a transmission stall test in reverse.

CAUTION: To help avoid transmission or driveline damage, full throttle stall tests must never be performed in **R** (Reverse) range.

5. Notify personnel in the area to keep clear of the vehicle.
6. Slowly increase engine rpm until engine speed stabilizes.
7. Record engine speed.

CAUTION: The transmission stall test procedure causes a rapid rise in transmission fluid temperature that can damage the transmission. Never maintain a stall condition once engine speed stabilizes or converter out (to cooler) temperature exceeds 150°C (300°F). During a stall condition, converter out temperature rises much faster than the internal (sump) temperature. Never use sump fluid temperature to determine the length of the stall condition. If the stall test is repeated, do not let the engine overheat.

8. Record converter out (to cooler) temperature.
9. Reduce the engine speed to idle and shift the transmission to neutral.
10. Raise engine speed to 1200–1500 rpm for 2 minutes to cool transmission fluid.
11. At the end of two minutes, record converter out (to cooler) temperature.

d. Driving Transmission Stall Test.

NOTE: If the vehicle is equipped with a smoke controlled or an emission controlled engine or engine control programming inhibiting engine acceleration, the following stall test procedure can be used.

WARNING: To help avoid personal injury and/or equipment damage, a driving transmission stall test must be performed by a trained driver and a qualified technician.

e. Driving Transmission Stall Test Preparation. If a driving transmission stall test is to be performed, make sure the following preparations have been made before conducting the transmission stall test.

1. The manufacturer concurs with performing a full throttle transmission stall test.
2. The engine programmable parameter for 0 rpm transmission output speed is set higher than the value expected at transmission stall speed.
3. The vehicle is in an area in which the transmission stall test can be safely performed.
4. Make sure the fuel control linkage goes to full throttle and does not stick when released.
5. Inspect the engine air induction system and exhaust system to make sure there are no restrictions.

6. Perform a cold check of the transmission fluid level and adjust as necessary.
7. Connect the Allison DOC™ For PC–Service Tool to the vehicle diagnostic data connector.
8. Install an accurate tachometer (do not rely on the vehicle tachometer).
9. Install a temperature gauge with the probe in the transmission converter-out (to cooler) line. The Allison DOC™ For PC–Service Tool displays sump temperature only.

f. Performing A Driving Transmission Stall Test.

1. Start the engine. While in neutral let the transmission warm to normal operating temperature:
   - — Sump temperature 71–93°C (160–200°F)
   - — Converter out temperature 82–104°C (180–220°F)
2. Perform a hot check of the transmission fluid level and adjust as necessary.
3. Turn **OFF** all engine accessories.
4. While located in an isolated area, begin the driving transmission stall test.
5. Select a hold range that will limit road speed (usually second or third range). Never perform a driving stall test in reverse.
6. Operate the engine at 100 percent full throttle, maximum governed speed.
7. With the engine at maximum governed speed, begin gradually applying the vehicle service brakes while maintaining 100 percent full throttle.

CAUTION: The transmission stall test procedure causes a rapid rise in transmission fluid temperature that can damage the transmission. Never maintain a stall condition once engine speed stabilizes or converter out (to cooler) temperature exceeds 150°C (300°F). During a stall condition, converter out temperature rises much faster than the internal (sump) temperature. Never use sump fluid temperature to determine the length of the stall condition. If the stall test is repeated, do not let the engine overheat.

8. When the vehicle comes to a complete stop, record engine speed.
9. Record converter out (to cooler) temperature.
10. Reduce the engine speed to idle and shift the transmission to neutral.
11. Raise engine speed to 1200–1500 rpm for two minutes to cool transmission fluid. At the end of two minutes, record converter out (to cooler) temperature.

g. Neutral Cool-Down Check Procedure.

1. At the end of two minutes the converter out (to cooler) fluid temperature should return to within normal operating temperature range.
2. If the transmission fluid does not cool within two minutes, the cause could be a stuck torque converter stator or an issue with the transmission cooler, lines, or fittings.

h. Transmission Stall Test Results.

NOTE: Environmental conditions, such as ambient temperature, altitude, engine accessory loss variations, etc., affect the power input to the converter. Due to such conditions, stall speed can vary from specification by ±150 rpm and still be accepted as within published stall speed.

- If engine speed with the transmission stalled is more than 150 rpm below the stall speed specification, an engine issue is indicated.
- If engine stall speed is more than 150 rpm above specification, a transmission issue is indicated.
- Conditions that can exist to cause a stall speed of 150 rpm above specification could be:
  - — Transmission fluid cavitation or aeration. Verify proper fluid level using the oil level sensor, if equipped, or dipstick.
  - — Slipping clutch.
  - — Torque converter malfunction.
  - — Sticking or damaged torque converter valve.
- A low stall speed (at least 33 percent lower than published stall speed) could indicate an engine issue or a freewheeling stator in the torque converter.

1–4. PRESSURE SCHEDULE VERIFICATION

Use Table 1–2 to verify proper main pressure. Make sure the transmission is at operating temperature when verifying main pressure.

Table 1–2. Pressure Schedule

Range	Main Pressure	
	600 rpm	2100 rpm
Forward/reverse converter with Main Mod active	590–720 kPa (85–105 psi)	634–758 kPa (92–110 psi)
Forward converter with Main Mod inactive	700–1380 kPa (101–200 psi)	1515–1795 kPa (220–260 psi)
Forward lockup with Main Mod active	N/A	510–627 kPa (74–91 psi)
Forward lockup with Main Mod inactive	N/A	1000–1170 kPa (145–170 psi)
Neutral/park with Main Mod active	590–720 kPa (85–105 psi)	N/A
Neutral/park with Main Mod inactive	800–1655 kPa (130–240 psi)	1515–1795 kPa (220–260 psi)

Section II	FLUID LEAK DIAGNOSIS	

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 seal worn-out or damaged
  - — Pressure port plug 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 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 electrical connectors. Spraying steam, water, or cleaning solution at the electrical connectors can cause codes and cross talk.

CAUTION: When cleaning the transmission, do not spray steam, water, or cleaning solution directly at the breather. 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.

1. Clean the suspected area.
2. Apply an aerosol-type white powder.
3. Operate the vehicle under normal operating conditions.
4. 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. Refer to kit directions for the color of the fluid dye mix.

d. Black Light and Dye Method.

1. Pour the specified amount of dye into the transmission fill tube.
2. Operate the vehicle in normal operating conditions.
3. 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 souce, inspect the leaking part for the follwing conditions, and repair the part.

- Gaskets:
  - — Fluid level/pressure is too high
  - — Plugged breather 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
- Seals:
  - — Fluid level/pressure is too high
  - — Plugged breather or drain-back holes
  - — Damaged seal bore
  - — Damaged or worn-out seal
  - — Improper installation
  - — Cracks in component
  - — Output yoke 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.

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 (refer to Figure 3–1). Follow the procedure below to adjust the shift selector cable at the shift lever on the transmission.

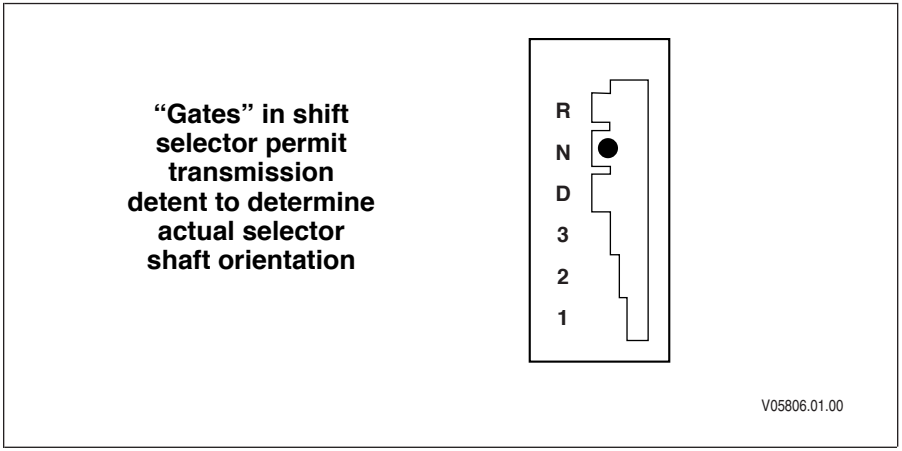

Figure 3–1. Proper Shift Selector Cable Adjustment

1. With the engine off, set the parking brake and block the wheels to prevent vehicle movement.
2. Dettach the cable pivot from the transmission selector lever (refer to Figure 3–2).
3. Place both the shift selector and the transmission selector shaft in the **N** (Neutral) position.

4. At the transmission end of the cable, push the cable to move the shift handle against the end of the shift selector neutral gate. Note the position of the pivot at the end of the cable with respect to the hole in the selector lever (refer to Figure 3–2).

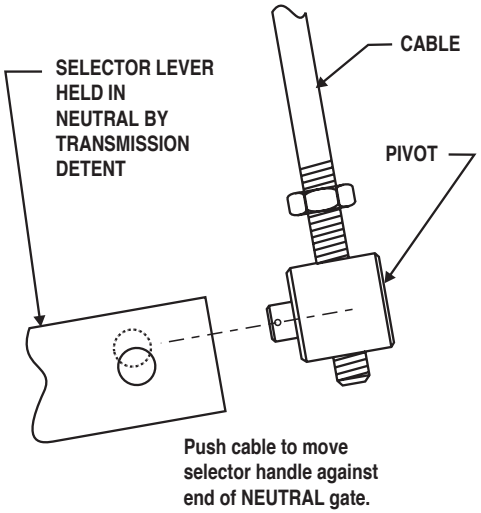

Figure 3–2. Proper Shift Selector Cable Adjustment

5. Pull the cable to move the shift handle against the opposite end of the shift selector neutral gate. Note the position of the pivot at the end of the cable with respect to the hole in the selector lever (refer to Figure 3–3).
6. Center the position of the cable at the midpoint of travel determined by Steps 4 and 5 (refer to Figure 3–4).
7. Holding the cable at the position determined in Step 6, rotate the pivot on the threaded section of the cable end until it is aligned with the hole in the selector lever (refer to Figure 3–5).
8. Verify that the attachment pin of the pivot does not bind in the selector lever hole and that the detent in the transmission is positively engaged. This condition is sometimes called “free-pin fit,” referring to lack of friction at the cable/shift lever interface once the transmission detent is engaged. Repeat Steps 4 through 6 as necessary to create this condition.

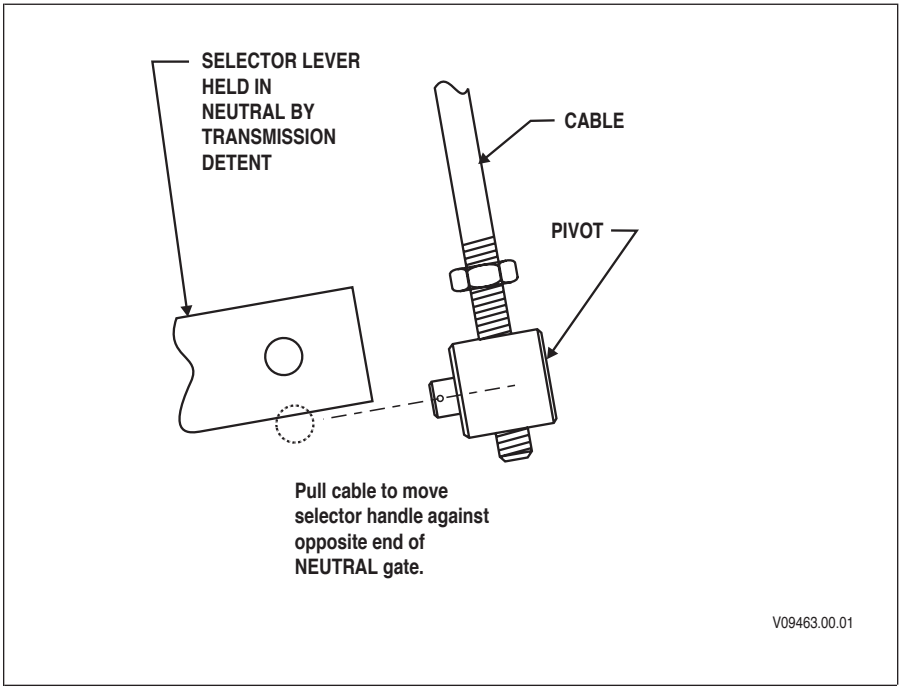

Figure 3–3. Proper Shift Selector Cable Adjustment

9. Attach the pivot to the selector lever and secure with the lock pin. If a jam nut is provided with the cable hardware, tighten the jam nut to lock the pivot to the cable end as noted in Figure 3–5. If the cable manufacturer does not provide a jam nut with the cable assembly, do not add one during the installation process.

NOTE: Once the jam nut is tightened, the pivot pin should slide freely into the hole in the lever. Do not twist the cable to insert it into the lever. Loosen the jam nut, re-orient the pivot to insert freely into the lever, then tighten the jam nut again.

---

10. Once this attachment is made, move the selector through all the range positions at the operator's station. Verify that free-pin fit exists in each range position, and that the position of the shift lever is determined by the internal transmission detent—not by tension or compression on the shift cable. Special attention should be devoted to the free-pin fit in the **N** (Neutral) position, in the lowest forward range, **1** (First), and if available, in the **P** (Park) or **PB** (Auto-Apply Parking Brake) position (refer to Figure 3–6).

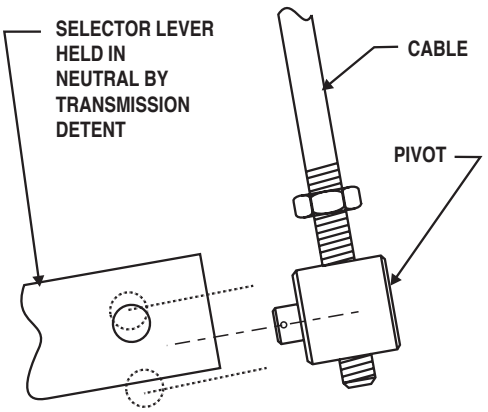

Figure 3–4. Proper Shift Selector Cable Adjustment

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.

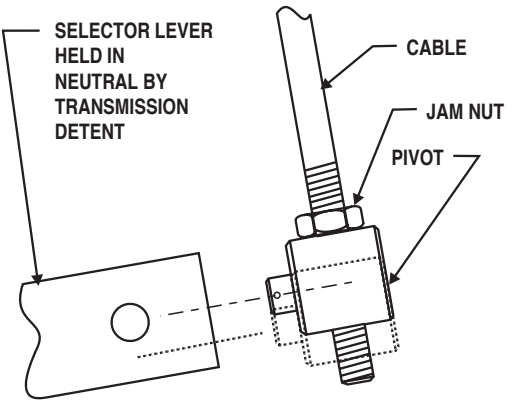

Figure 3–5. Proper Shift Selector Cable Adjustment

3–2. INTERNAL MODE SWITCH (IMS)

a. Adjustment. The Internal Mode Switch (IMS) does not require adjustment. The IMS engagement pin located on the detent spring provides proper alignment between the IMS and the detent lever. Use the following procedure when diagnostic trouble codes have been logged and the corrective action is to replace the IMS switch.

b. Replacement.

NOTE: It would be helpful to know how much transmission fluid is lost during the replacement of the IMS. Fluid in good condition drained into 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 (refer to Figure 6–6). Examine the fluid as described in Mechanic's Tips, MT4007EN.
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.

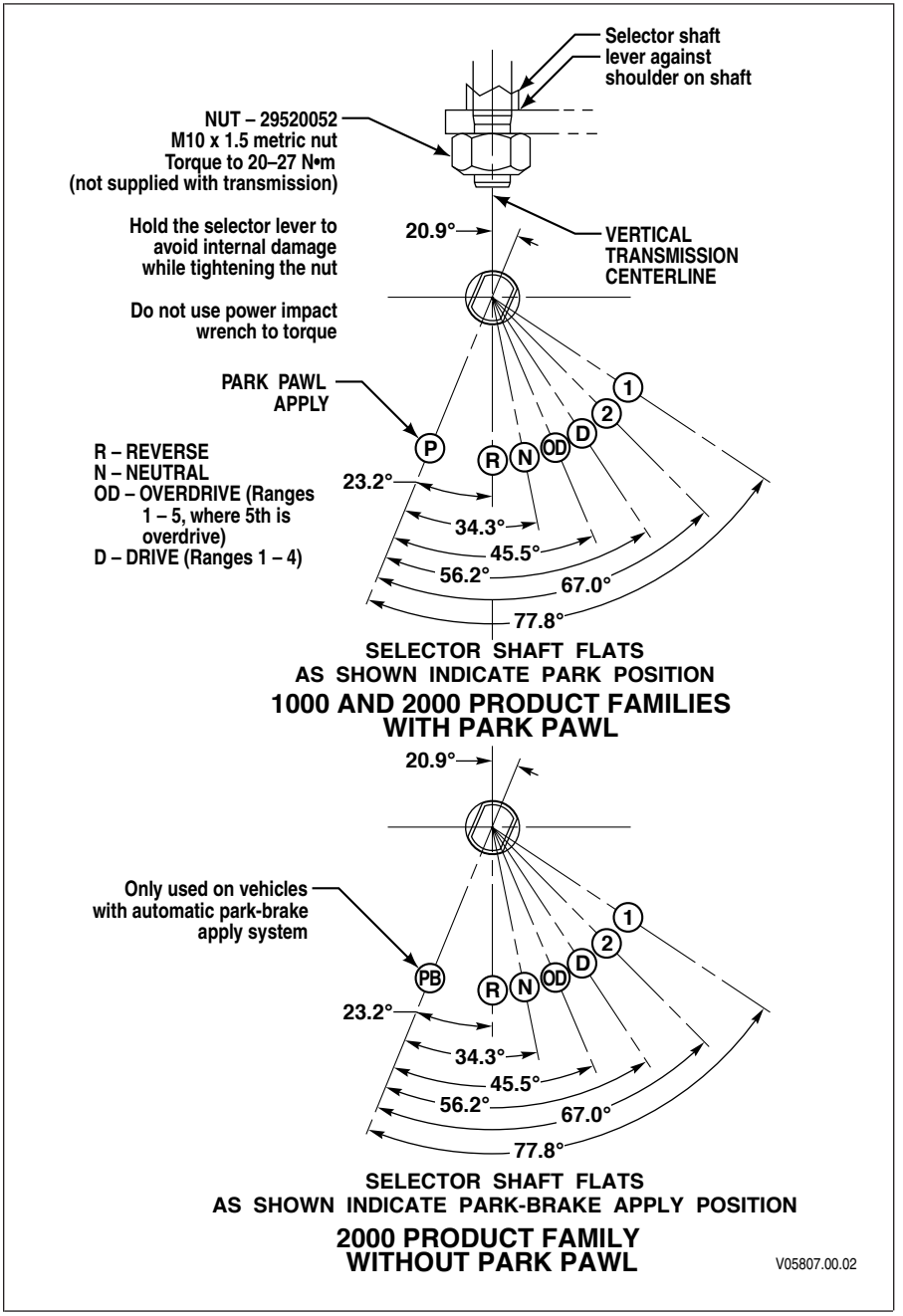

Figure 3–6. Transmission Shift Lever Positions

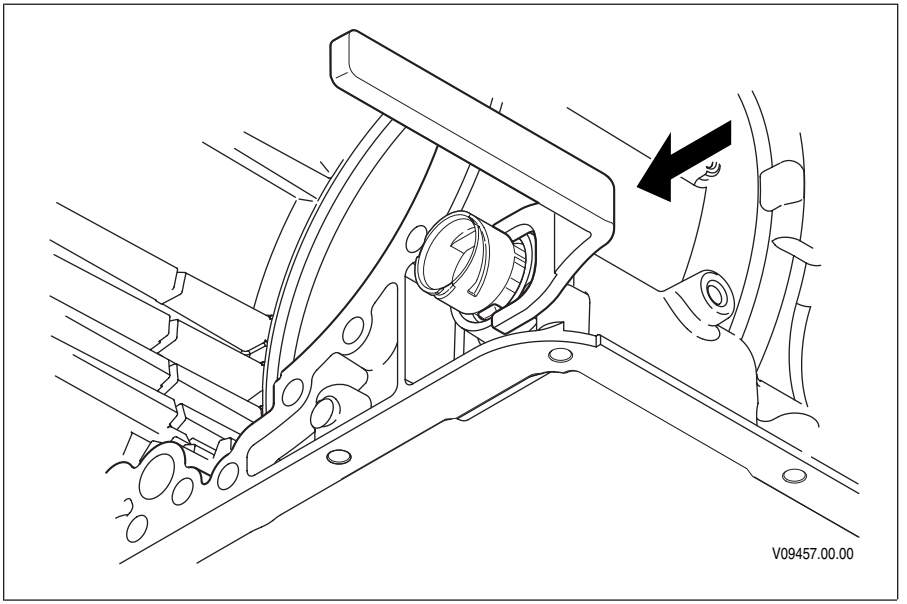

Figure 3–7. Transmission Main Electrical Connector

3. Remove the oil pan and oil pan gasket. Inspect the magnet in the oil pan (refer to 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, at the end of the internal harness, protrudes through the main housing (refer to Figure 3–7).

---

7. Remove the main electrical connector (outer end of internal harness) by placing special tool J 47944 over the connector to release the “feet” that attach the connector to the main housing (refer to Figure 3–7) and push inward on the connector.
8. Disconnect the internal wiring harness from the detent lever/IMS.

NOTE: On some transmission models the manual selector valve and pin can slide out of the valve bore and index slot in the control valve body assembly. Be sure that the manual selector valve and pin do not fall out when removing the control valve body assembly.

9. Remove fifteen bolts at locations marked “1” and “2” (refer to Figure 3–8). Be sure 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 making sure that the manual selector valve and pin **do not fall out** during removal.

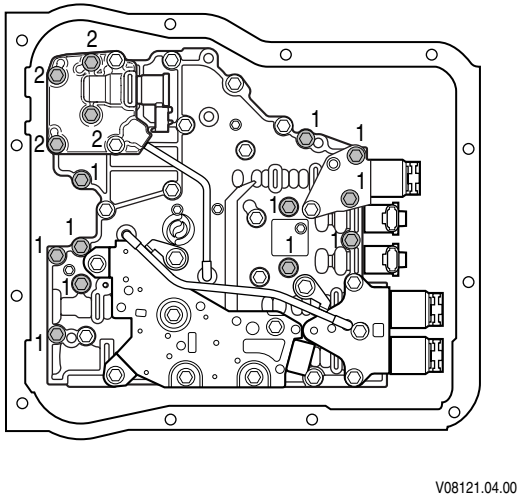

Figure 3–8. Control Valve Body Removal

CAUTION: DO NOT mar the main housing surface around the spherical, grooved pin when removing the pin. An unmarred surface is required to maintain the seal between the control valve body assembly and the main housing.

NOTE: The detent lever/IMS retaining bolt contains patch lock material on the threads. Do not reuse retaining bolt.

10. Remove the detent lever/IMS retaining bolt using a T27 Torx® bit and discard.
11. Place a protective plate on the main housing surface around the spherical, grooved pin. Remove the pin from the main housing.
12. Slide the selector shaft through the detent lever/IMS assembly and through the selector shaft seal and remove the detent lever/IMS assembly.
13. Place the new detent lever/IMS assembly (refer to Figure 3–9) in position in the main housing. Install the selector shaft through the selector shaft seal and through the detent lever/IMS assembly. Push the selector shaft into its final position in the main housing.

CAUTION: DO NOT mar the main housing when installing the spherical, grooved pin. Use only gentle tapping on the pin. Heavy or continued hammering will damage the main housing surface.

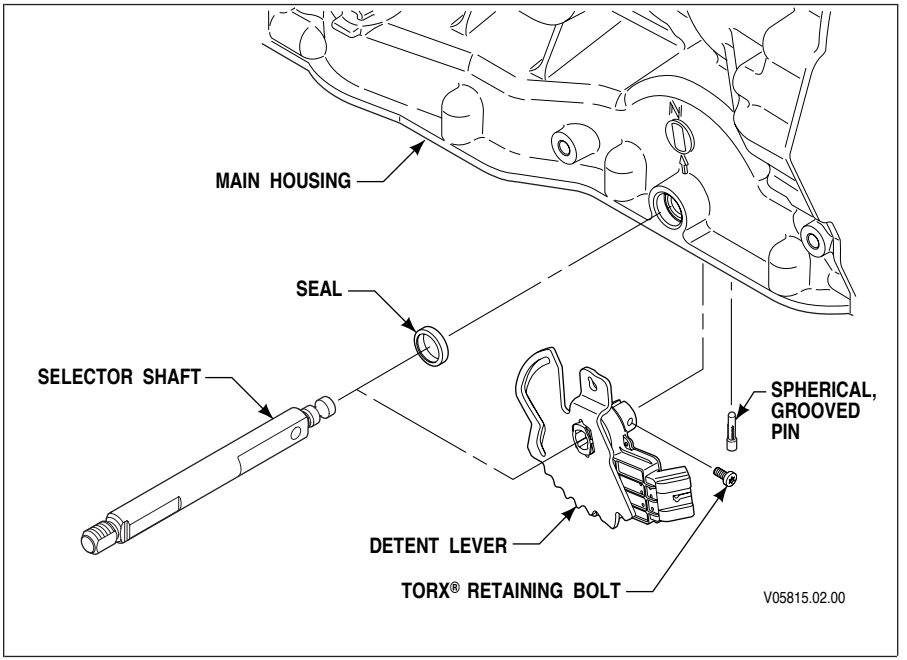

Figure 3–9. Detent Lever/IMS Assembly Replacement

14. Install the spherical, grooved pin into the main housing that retains the selector shaft. Gently tap the spherical, grooved pin into the main housing until properly seated.

NOTE: The detent lever/IMS retaining bolt contains patch lock material on the threads. Do not reuse retaining bolt.

15. Install a new detent lever/IMS retaining bolt into the selector shaft. Tighten bolt using a T27 Torx® bit to 7.0–10.4 N•m (62–92 lb in.).
16. Move the control valve assembly into position under the main housing, while making sure that the manual selector valve and pin remain in the valve bore and index slot. 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. Install the remaining fourteen bolts at locations “1” and “2” (refer to Figure 3–8). Tighten the bolts to 10–13 N•m (7–10 lb ft).
17. Attach the IMS connector on the internal harness onto the IMS.
18. 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 (refer to Figure 3–7). Connect the internal wiring harness.
19. Place a new seal on the suction filter tube. The seal should locate against a shoulder on the suction filter tube or install a new suction filter with seal attached.
20. 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.
21. Be sure that all gasket material is removed from the main housing and there are no scratches that would cause a splitline leak.
22. Install two headless guide bolts (M8 x 1.25) into opposite corners of the oil pan mounting face on the main housing.
23. Place a gasket on the oil pan and align the bolt holes.
24. 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.
25. 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).
26. Install the drain plug and sealing washer. Tighten the drain plug to 30–40 N•m (22–30 lb ft).

27. Replace the quantity of transmission fluid lost during the replacement process. Set the transmission fluid level following the procedure in MT4007EN.

Section IV	SELECTOR SHAFT SEAL REPLACEMENT	

4–1. REMOVAL

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

1. Disconnect the shift linkage/cable from the selector lever at the transmission.
2. To avoid damaging the internal stops while removing the selector lever retaining nut, you **must** keep the selector shaft from rotating against the stops. Use a wrench to keep the selector lever from rotating while removing the retaining nut. Carefully remove the selector lever from the selector shaft.
3. Inspect the selector shaft for burrs. Remove burrs with a file.
4. Slide special tool J 43911 over the selector shaft with the threaded end toward the seal. Be sure that the jackscrew is backed off and will not interfere with installation of the removal tool (refer to Figure 4–1). While pushing the removal tool against the seal, rotate the removal tool using a wrench so that the threads on the end of the tool are firmly attached to the steel shell of the seal.
5. Apply a wrench to the jackscrew and rotate it clockwise 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 (refer to Figure 4–2). Position the seal so that it is starting to enter the seal bore.
3. Obtain special tool J 43909 and remove the inner sleeve so that the tool will slide over the selector shaft.

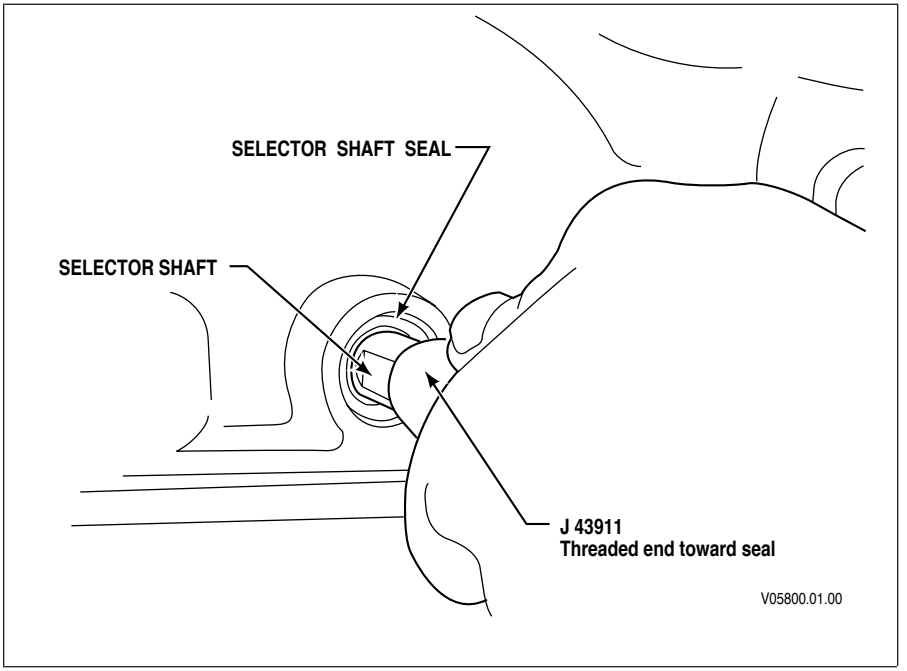

Figure 4–1. Selector Shaft Seal Removal

4. Slide the special tool into position so that the end of the tool contacts the seal being installed (refer to 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. To make sure the selector shaft is in the **N** (Neutral) position (using a wrench on the selector shaft flats), carefully rotate the shaft to its furthest clockwise position and then rotate counter-clockwise two detents (refer to Figure 3–6).

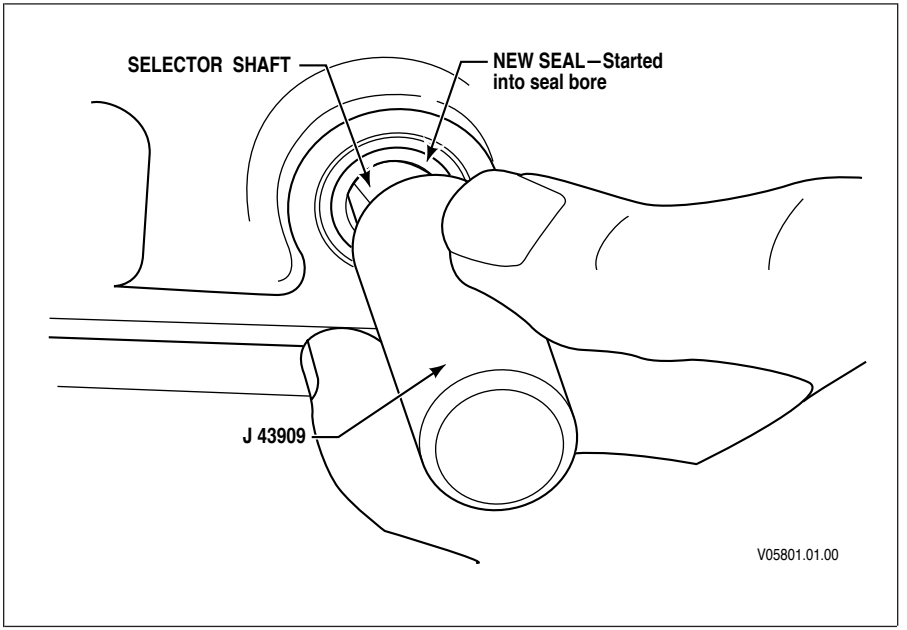

Figure 4–2. Selector Shaft Seal Installation

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 selector lever retaining nut. Hold the lever with a wrench while tightening the nut.

6. Carefully slide the selector lever onto the selector shaft and all the way to the shoulder **without** driving it into place (forcing it onto the selector shaft could cause internal damage). Using a wrench to keep the selector lever from rotating, install the retaining nut and torque it to 20–27 N·m (15–20 lb ft). Connect the shift selector linkage/cable onto the selector lever (refer to Section 3–1, SHIFT SELECTOR AND CABLE/LINKAGE).

PARKING BRAKE

Section V

5–1. ADJUSTMENT

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

WARNING: Chock the 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. Connect the brake apply linkage/cable to the parking brake apply lever.
6. Do a trial parking brake apply to be sure the adjustment was successful and the parking brake can be completely applied.

5–2. REPLACEMENT

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

WARNING: Chock the 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 manufacturer's recommended burnishing procedure. If a manufacturer's 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.

Section VI	COMPONENT REPLACEMENT	

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, 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.
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 (refer to Figure 6–1). Inspect the washer. Replace the washer if the joint was leaking or if a new plug is being installed.

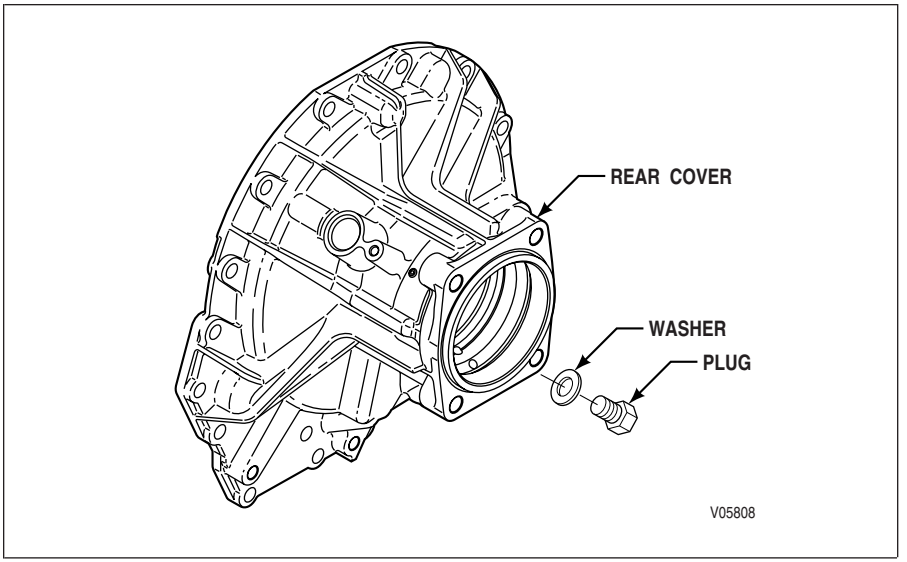

Figure 6–1. Tachograph Plug Replacement

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

1. Be sure the vehicle ignition is turned off.
2. Disconnect the wiring harness from the speed sensor.
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. Connect 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. Refer to 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 re-establish 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/quart).

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 service management.
5. Remove the 12 bolts fastening the cooler manifold to the converter housing (refer to 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. Refer to 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. Install the magnet onto the filter attachment tube.
6. Lubricate the gasket on the control-main filter with transmission fluid.
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. Connect the cooler lines and tighten the fittings securely.
10. Replace the quantity of transmission fluid lost during the gasket replacement process. Refer to MT4007EN for fluid fill and check procedures.

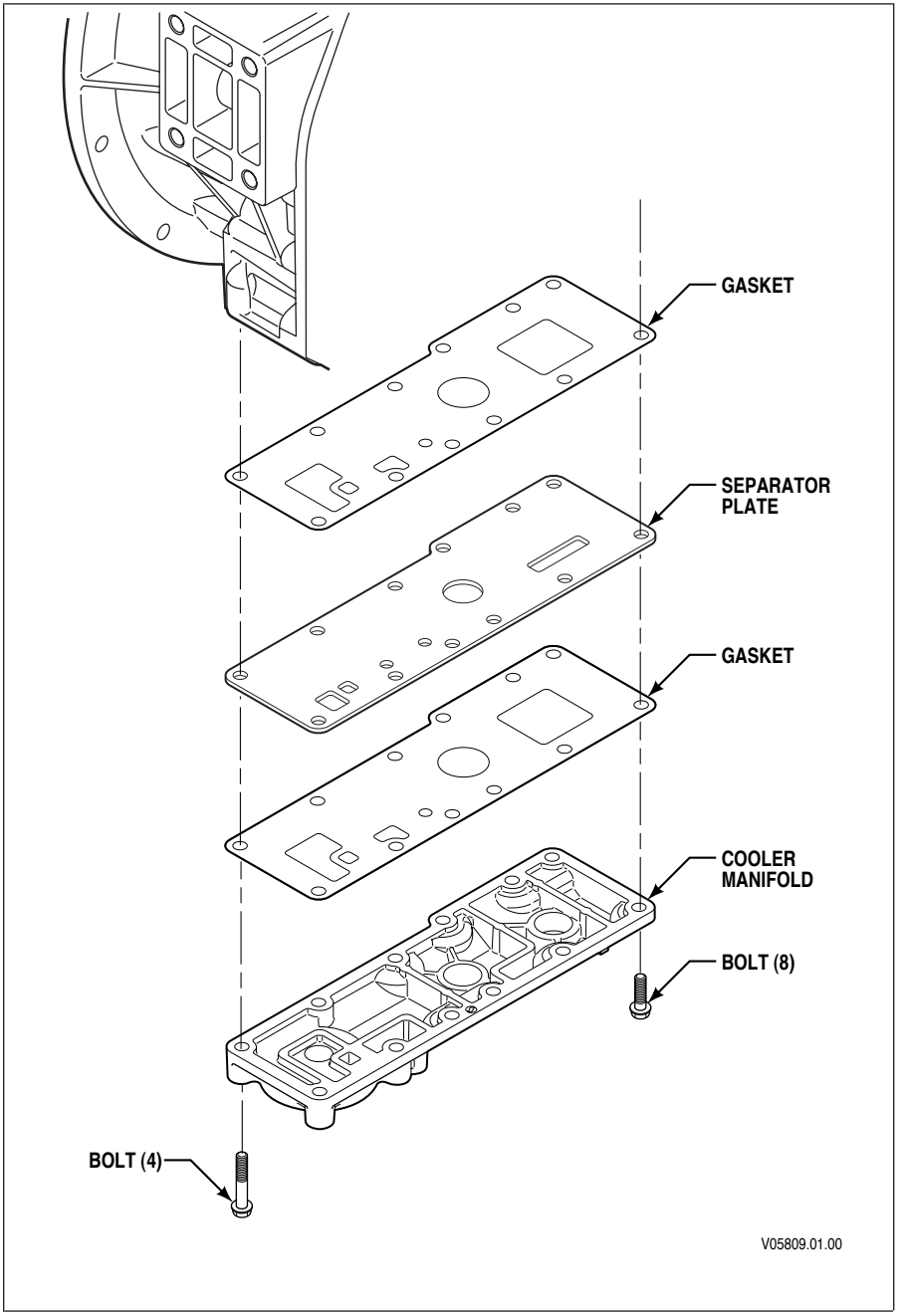

Figure 6–2. Cooler Manifold Gasket Replacement

6–6. REAR SEAL REPLACEMENT

Use the following procedure to remove and install the output seal located in the rear cover of the transmission.

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 (refer to Figure 6–3).
8. Remove the rear seal using the slide-hammer.

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.

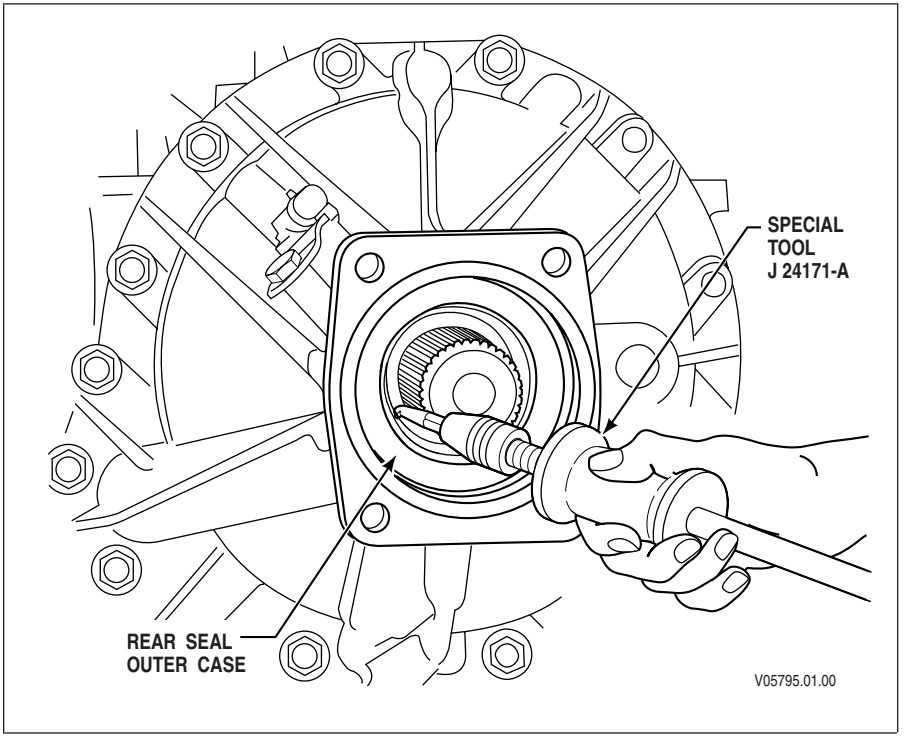

Figure 6–3. Rear Seal Removal

3. Install the new seal onto J 43782 (units without parking brake provision) or J 43783 (units with 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 (refer to 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 (refer to 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.

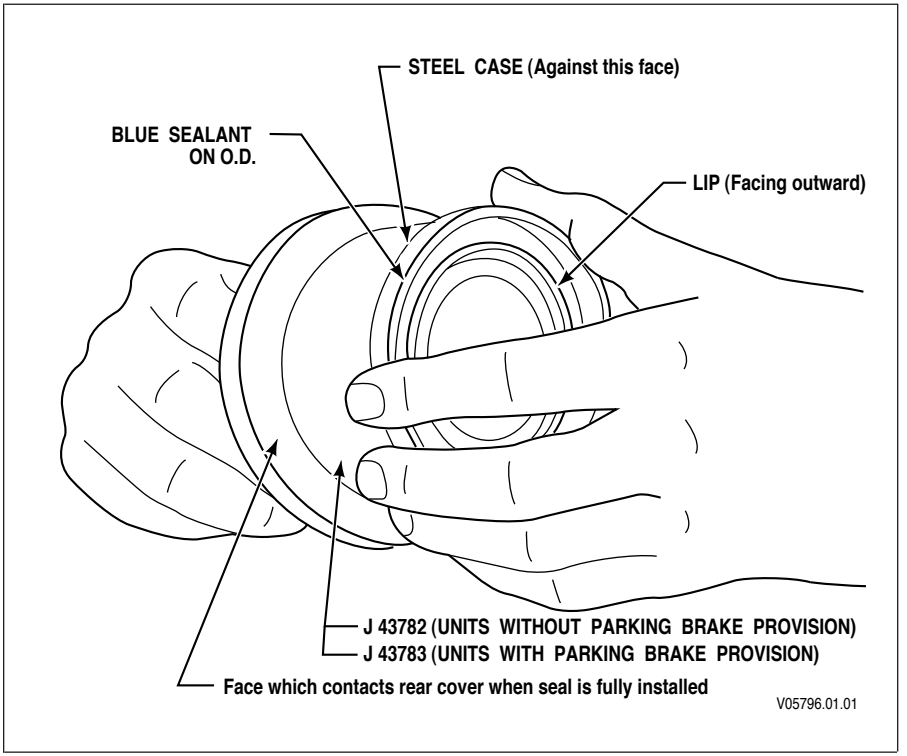

Figure 6–4. Positioning New Seal on Installer Tool

6–7. OIL PAN GASKET REPLACEMENT

Use the following procedure to remove and install 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 (refer to Figure 6–6). Refer to MT4007EN 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.

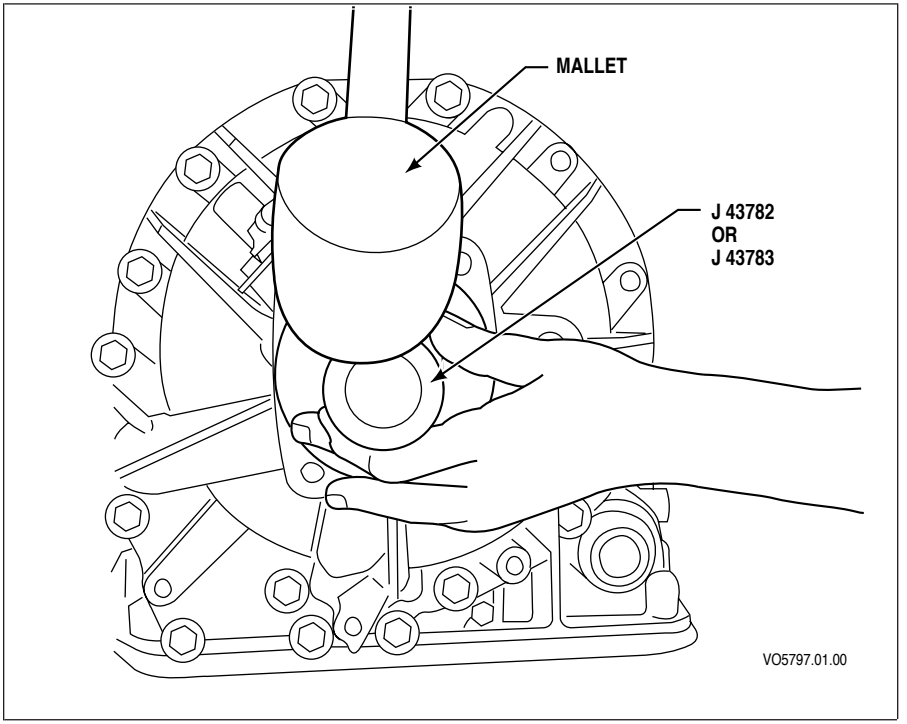

Figure 6–5. Installing Rear Seal

3. Remove the oil pan and oil pan gasket. Inspect 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.

b. Installation.

1. Be sure that all gasket material is removed from the main housing and there are no scratches that would cause a splitline 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. Install the drain plug and sealing washer. Tighten the drain plug to 30–40 N•m (22–30 lb ft).

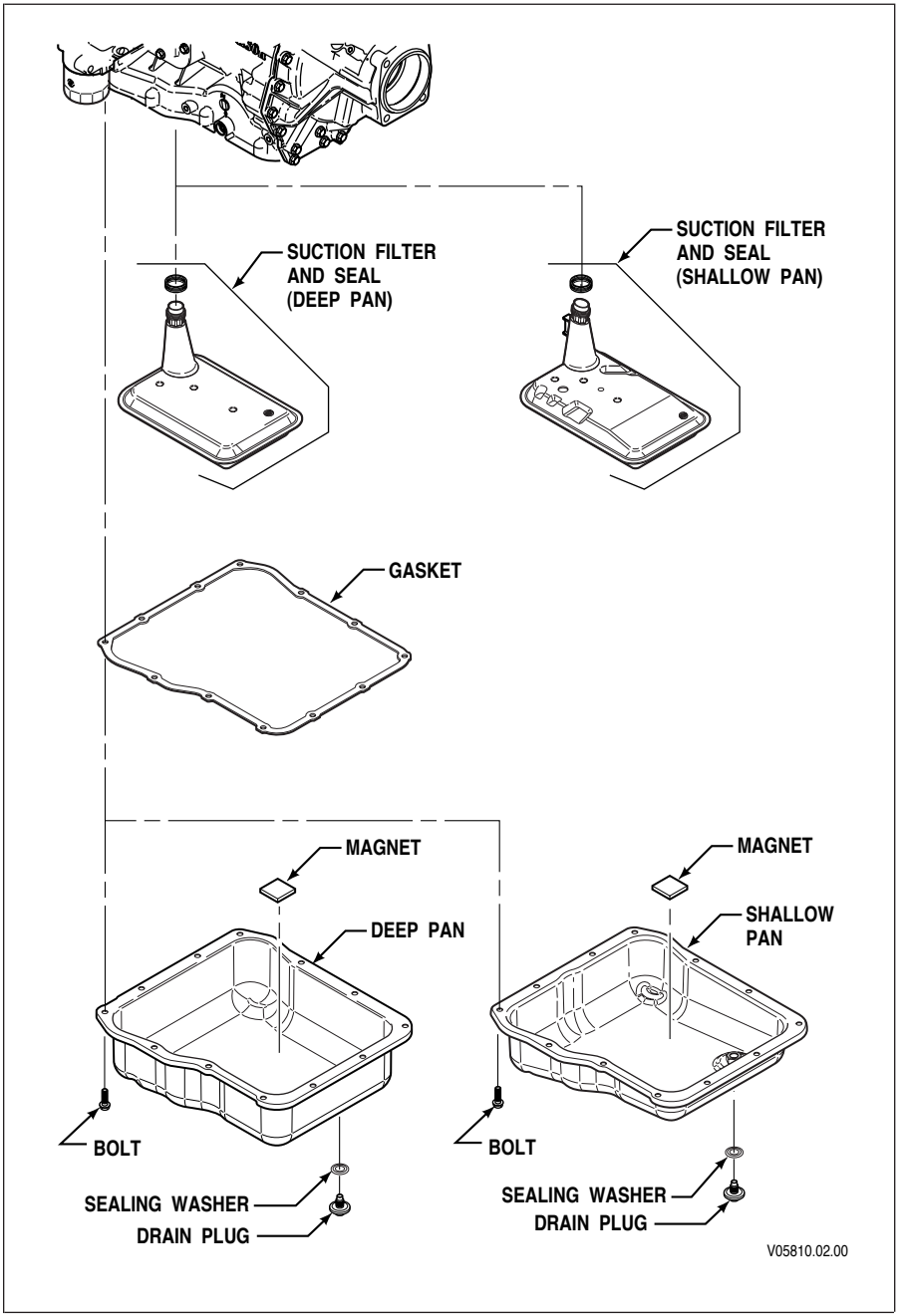

Figure 6–6. Oil Pan and Suction Filter

7. Replace the quantity of transmission fluid lost during the gasket replacement process. Refer to MT4007EN for fluid fill and check procedures.

6–8. SUCTION FILTER AND SEAL REPLACEMENT

Use the following procedure to remove and install the suction filter and seal. Replacement is usually not necessary except at overhaul (refer to 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 MT4007EN.
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. Inspect 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.

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. Install 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 MT4007EN for fluid fill and check procedures.

6–9. CONTROL VALVE COMPONENT REPLACEMENT

The control valve components 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 (refer to Figure 6–6). Examine the fluid as described in MT4007EN.
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. Inspect the magnet in the oil pan (refer to 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 (refer to Figure 6–7).

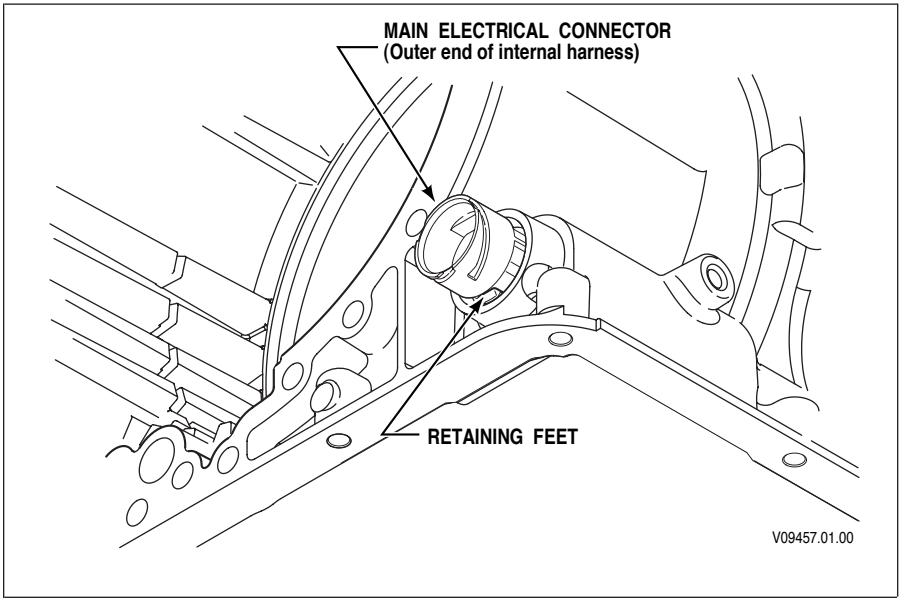

Figure 6–7. Transmission Main Electrical Connector

7. Disconnect the internal wiring harness connectors from the solenoids (refer to Figure 6–8), Internal Mode Switch (IMS), and from the pressure switch manifold assembly.
8. Remove the retaining clips for SS3 and SS2 which also retain tabs on the wiring harness U-channel (refer to 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 using special tool J 47944 over the connector to release the “feet” that attach the connector to the main housing (refer to Figure 6–10) and pushing inward on the connector. Remove the internal wiring harness from the transmission.
10. Place the new internal wiring harness in the approximate position it will occupy after installation.

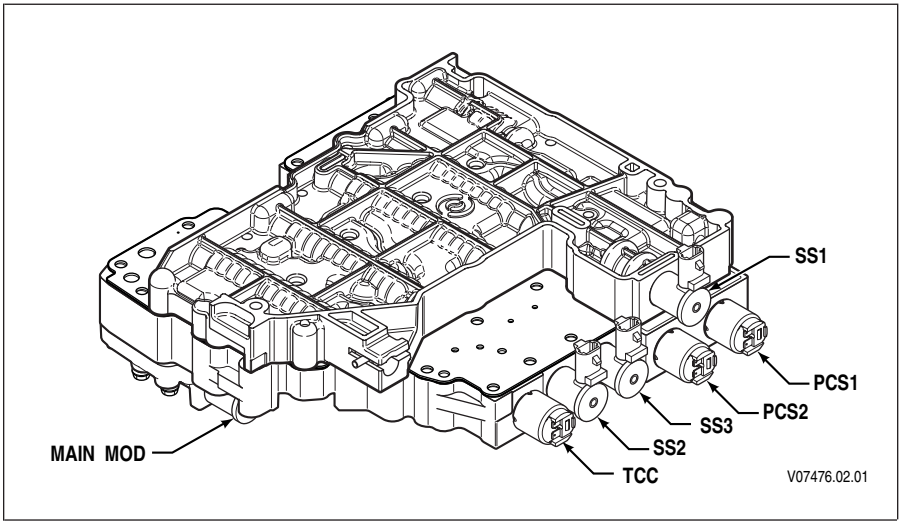

Figure 6–8. Control Valve Solenoid Location

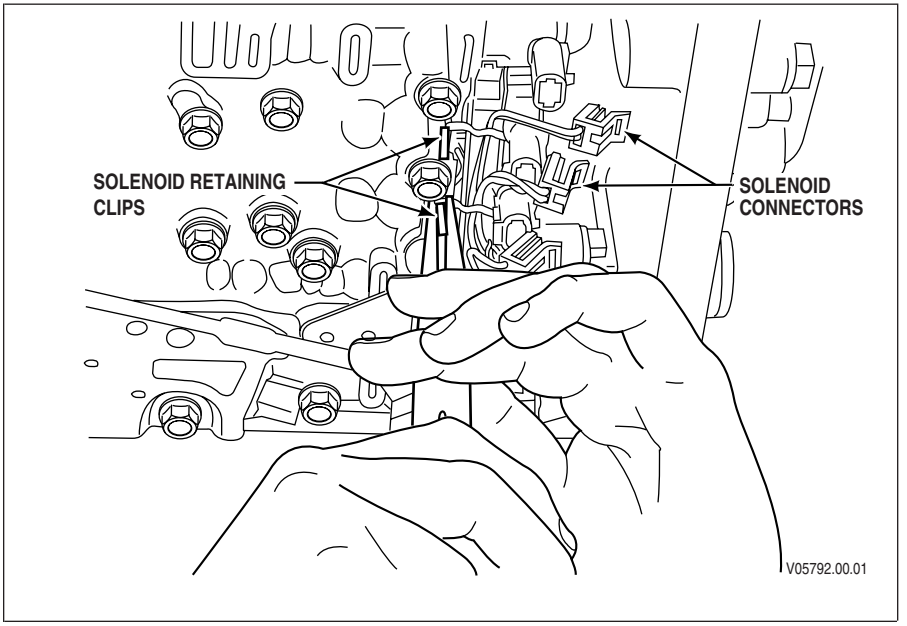

Figure 6–9. Internal Wiring Harness Removal/Installation

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 (refer to Figure 6–7).

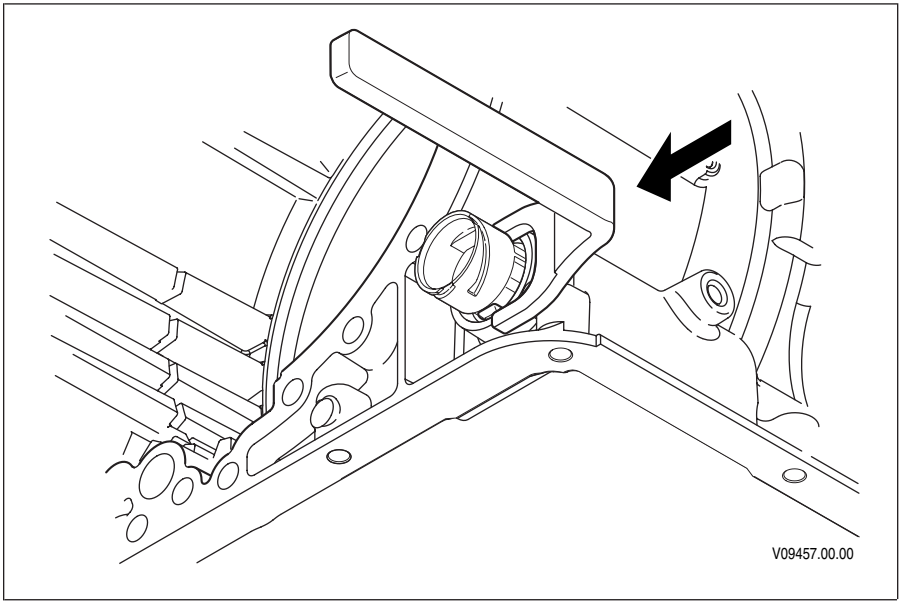

Figure 6–10. Removal Of Main Electrical Connector

12. Align the tabs on the wiring harness U-channel with the retaining clip slots for solenoids SS3 and SS2 on the control valve body. Install the retaining clips for the SS3 and SS2 solenoids (Figure 6–9).
13. Attach the wiring harness connectors to solenoids (refer to Figure 6–9), IMS, 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. Connect 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).
22. Install 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 MT4007EN 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 (refer to Figure 6–6). Examine the fluid as described in MT4007EN.
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. Inspect the magnet in the oil pan (refer to 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 six bolts that attach the pressure switch manifold assembly to the control valve body. Remove the pressure switch manifold assembly from the transmission.
7. 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.

---

8. 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 one longer gold colored bolt and tighten them all by hand. Torque the bolts to 10–13 N•m (7–10 lb ft).

9. Connect the internal wiring harness connector to the pressure switch manifold assembly.
10. Place a new seal on the suction filter tube. The seal should locate against a shoulder on the suction filter tube.
11. Push the filter and seal into the seal bore in the main housing. Be sure the suction filter is properly positioned.
12. Be sure that all gasket material is removed from the main housing and there are no scratches that would cause a splitline leak.
13. Install two headless guide bolts (M8 x 1.25) into opposite corners of the oil pan mounting face on the main housing.
14. Place a gasket on the oil pan and align the bolt holes.
15. 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.
16. 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).
17. Install the drain plug and sealing washer. Tighten the drain plug to 30–40 N·m (22–30 lb ft).
18. Replace the quantity of transmission fluid lost during the pressure switch manifold assembly replacement process. Refer to MT4007EN for fluid check procedures.

c. Solenoid Replacement (PCS1, PCS2, SS2, SS3, or TCC). Use the following procedure to replace any solenoid except Shift Solenoid 1 (SS1) and Main Mod.

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 (refer to Figure 6–6). Examine the fluid as described in MT4007EN.
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. Inspect the magnet in the oil pan (refer to 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.

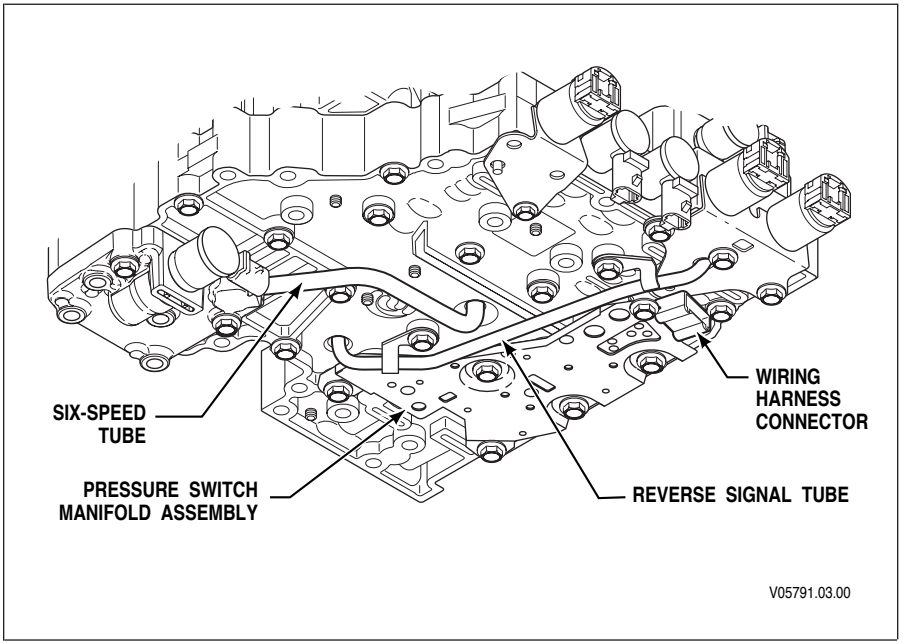

Figure 6–11. Pressure Switch Manifold Assembly Replacement

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 PCS1 and PCS2 solenoid retaining bracket is removed, there are two sets of accumulators and springs which will probably fall from their bores. When installing 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 Pressure Control Solenoid 1 (PCS1) and Pressure Control Solenoid 2 (PCS2), remove two bolts and retaining clips holding the reverse signal tube, and remove three bolts holding the solenoid retaining bracket. To remove Shift Solenoid 3 (SS3) or Shift Solenoid 2 (SS2), remove the solenoid retaining clip (refer to Figure 6–9).

NOTE: The PCS1, PCS2, and TCC solenoid brackets (refer to Figure 6–13) must not be modified. Note that the angle between the two bracket surfaces is less than 90 degrees (refer to Figure 6–12).

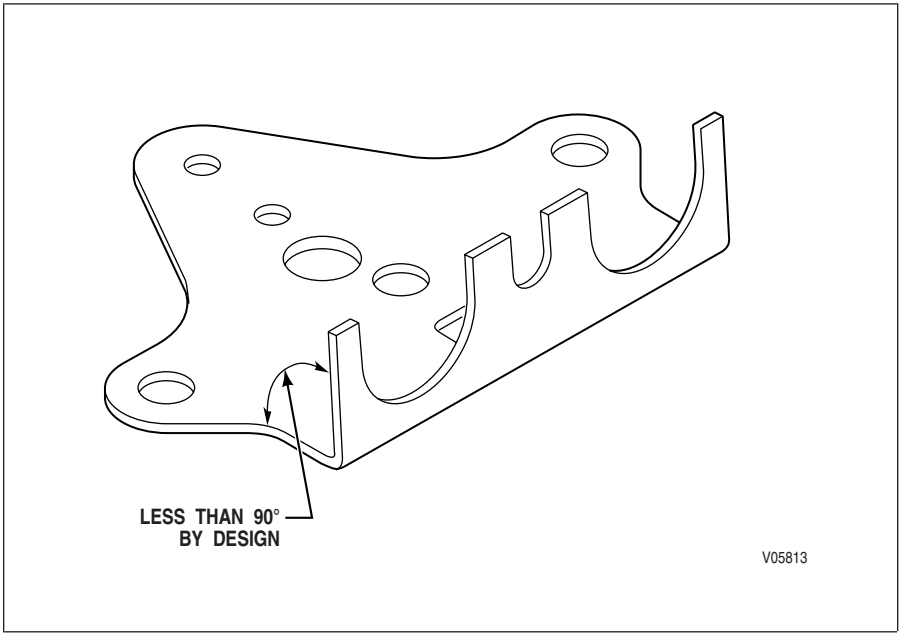

Figure 6–12. PCS1 and PCS2 Retaining Bracket

8. To remove Torque Converter Clutch (TCC) solenoid, remove the retaining bolt and solenoid retaining bracket (refer to Figure 6–13).

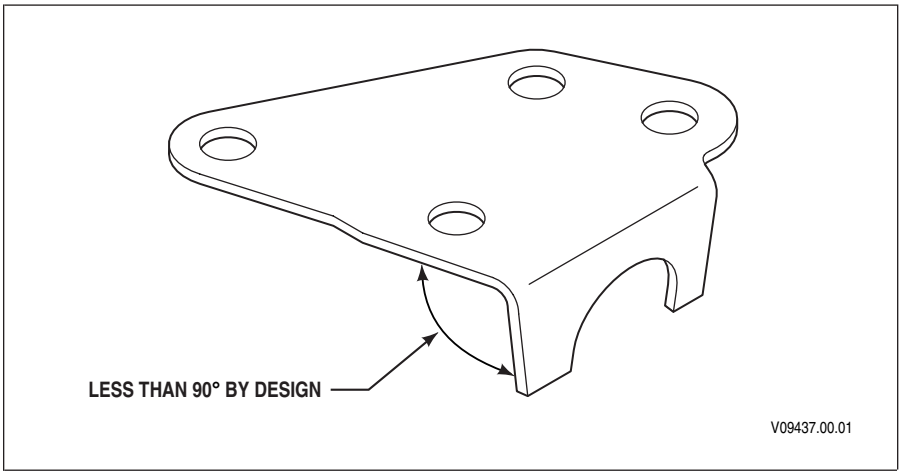

Figure 6–13. TCC Solenoid Retaining Bracket

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 same position as when the solenoid was removed.

NOTE: The PCS2 and TCC solenoids appear to be the same solenoid due to the color of the connector; however, the TCC solenoid has a smaller snout that consists of two o-rings. PCS2 only has one o-ring.

---

11. Install TCC solenoid retaining bracket. Tighten bolt to 10–13 N•m (7–10 lb ft).
12. Install the two accumulators and springs before installing the PCS1 and PCS2 retaining bracket (see NOTE following Step 6 above). Install the solenoid retaining clip or bracket. Tighten the three bolts which hold the PCS1 and PCS2 retaining bracket to 10–13 N•m (7–10 lb ft). Install the reverse signal tube and retaining clips. Tighten the two retaining clip bolts which hold the reverse signal tube to 10–13 N•m (7–10 lb ft).
13. Connect the internal wiring harness to the solenoid.
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 position.
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 a 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. Install 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 MT4007EN for fluid fill and check procedures.

d. Solenoid Replacement (SS1). Use the following procedure to replace SS1. 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 SS1. 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 (refer to Figure 6–6). Examine the fluid as described in MT4007EN.
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. Inspect the magnet in the oil pan (refer to 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. Disconnect internal harness connector from the IMS. 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 “1” and “2” (refer to Figure 3–8). 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 SS1. Remove the retaining clip for SS1 (refer to 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. Connect the internal harness to SS1. Install 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. Install the remaining fourteen "1" and "2" bolts (refer to Figure 3–8) 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 (refer to Figure 6–7). Connect the external 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. Install 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 MT4007EN for fluid fill and check procedures.

e. Solenoid Replacement (Main Mod).

1. Remove the drain plug and sealing washer from the oil pan and allow the fluid to drain into a suitable container (refer to Figure 6–6). Examine the fluid as described in MT4007EN.
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. Inspect the magnet in the oil pan (refer to 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 Main Mod solenoid.
7. Remove six bolts retaining the Main Mod solenoid valve body to the control valve body.
8. Remove the Main Mod solenoid valve body.
9. Turn the Main Mod solenoid valve body hydraulic passages up.
10. Remove the solenoid retainer clip.
11. Remove Main Mod solenoid from the valve body.
12. Lubricate the O-rings on the replacement solenoid.
13. Install Main Mod solenoid 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 on the hydraulic passage side.
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. Install 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 MT4007EN for fluid fill and check procedures.

6–10. FRONT SEAL REPLACEMENT

If front seal leaks are indicated, the seal can not be replaced without removing the transmission from the vehicle and the torque converter from the transmission.

Use the following procedure to replace the front seal that is in the oil pump assembly.

a. Removal.

CAUTION: The torque converter is not bolted to the transmission. If the transmission is not maintained horizontally during removal, the torque converter may separate from the transmission and cause personal injury and/or damage or be damaged.

1. Refer to Section II in MT4007EN for instructions to remove the transmission from the vehicle. During removal, be sure to keep the transmission horizontal so that the torque converter stays connected to the transmission and the fluid does not leak out.

NOTE: When the transmission is turned vertically with the torque converter end up, the fluid will drain out of the rear cover. Make provisions to collect this drainage of fluid.

2. Position the transmission vertically with the torque converter end up.

NOTE: Before the torque converter is separated from the transmission, measure the distance from the torque converter mounting lugs to the transmission mounting face. This is an important measurement that is required during installation to confirm that the torque converter has been installed to correct depth for proper engagement.

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 assembly.

NOTE: Before removing the seal, observe the direction the lip of the seal is pointing (inward toward the bushing) with the enclosed face visible (there may be a part number visible on this face), During installation, the seal **must be** installed in this orientation to seal effectively.

---

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 (refer to Figure 6–14).

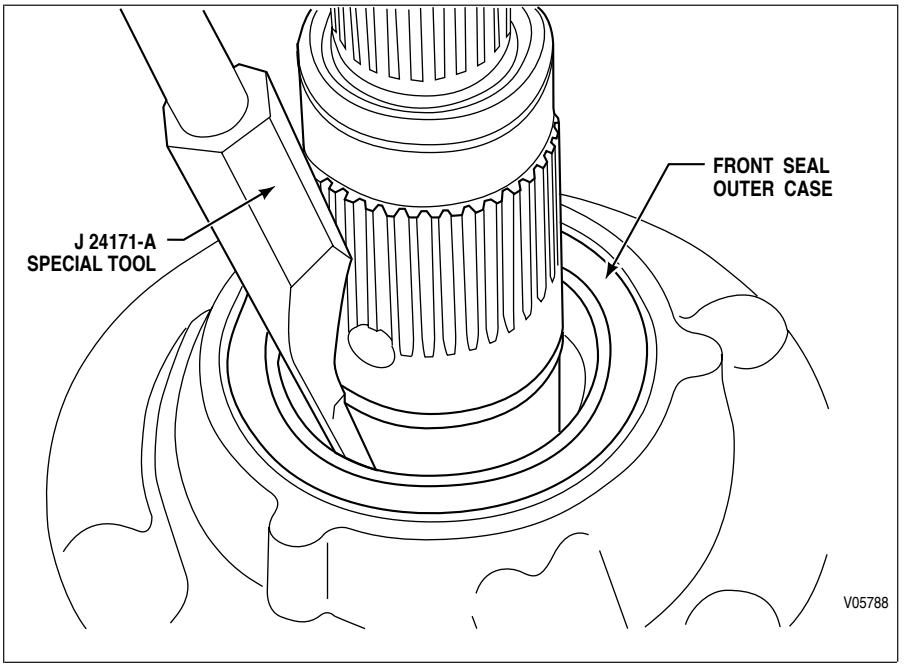

Figure 6–14. Front Seal Removal

7. Remove the front seal using the slide-hammer and discard.

b. Installation.

1. Inspect the inside diameter of the pump bushing for damage. If any portion of the coating (reddish color) is worn and the steel backing material is visible, replace the bushing. Refer to Allison Transmission Publication SM3191EN, 1000 and 2000 Product Families Service Manual, for the correct procedure to remove and install the pump bushing.
2. Install a new seal onto the J 43772 installer tool. Position the seal so that the rubber enclosed face is against the driving force of the tool (refer to Figure 6–15) with the lip of the seal facing toward the pump bushing.

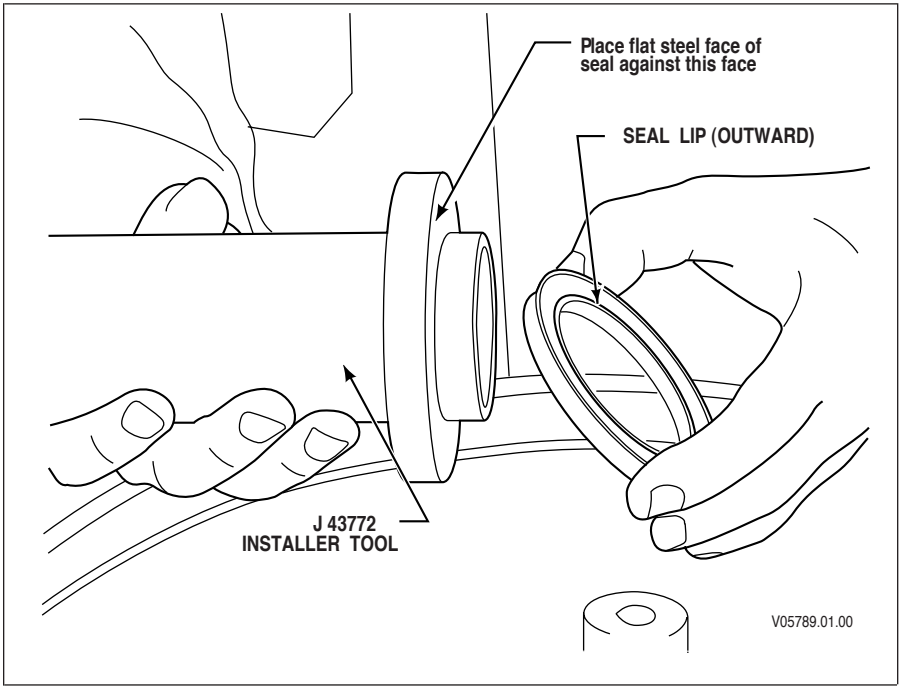

Figure 6–15. Positioning New Seal on Installer Tool

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 (refer to Figure 6–16). 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.

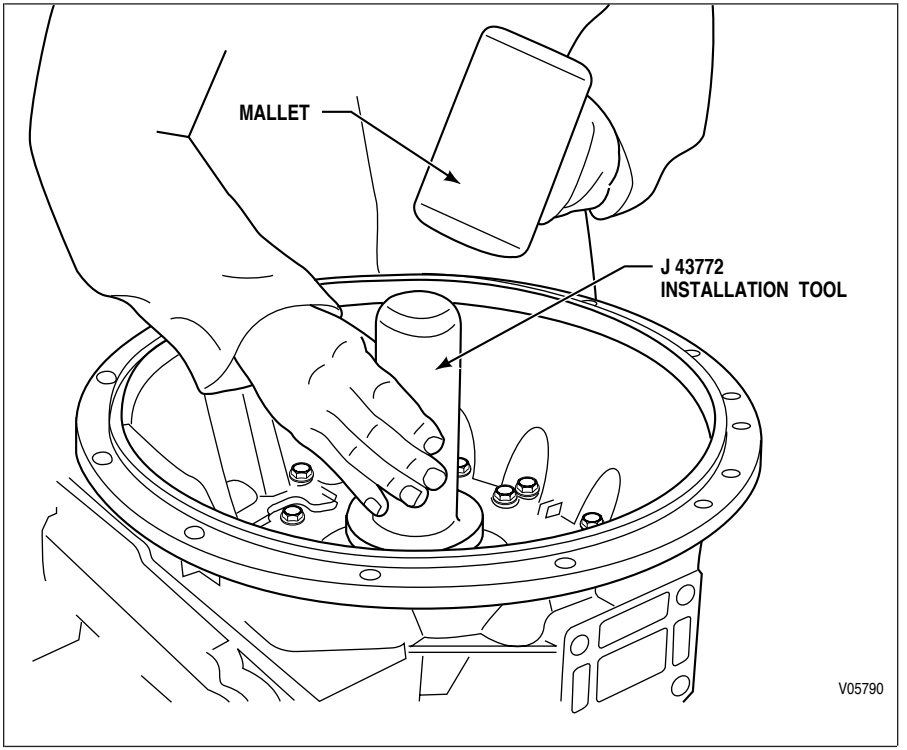

Figure 6–16. Installing Front Seal

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. Install the transmission following instructions in Section V in MT4007EN.

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 test the external cooler circuit for restrictions. 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.

Refer to the Worldwide Sales and Service Directory SA2229EN for a current listing of Allison Transmission authorized distributors and service dealers.

7–2. SERVICE LITERATURE

Refer to Table 7–1 for available service literature. This service literature provides fully illustrated instructions for operation, maintenance, service, overhaul, and parts support for your transmission. To be sure that you get maximum performance and service life from your unit, you may order publications from:

SGI, Inc.
Attn: Allison Literature Fulfillment Desk
8350 Allison Avenue
Indianapolis, IN 46268
TOLL FREE: 888-666-5799
INTERNATIONAL: 317-471-4995

Table 7–1. Available Service Literature

Allison DOC™ For PC–Service Tool User Guide	GN3433EN
Automatic Transmission Fluid Technician's Guide	GN2055EN
*Mechanic's Tips	MT4007EN
*Bus Series Operator's Manual	OM3756EN
*Emergency Vehicle Series Operator's Manual	OM3761EN
*Highway Series Operator's Manual	OM3757EN
*Motorhome Series Owner's Manual	OM3364EN
*Pupil/Transport Series Operator's Manual	OM3758EN
*Rugged Duty Series Operator's Manual	OM3759EN
*Parts Catalog	PC3062EN
Parts Catalog CD-ROM	CD3062EN
Principles of Operation	PO4009EN
Service Manual	SM4006EN
*Transmission In-Chassis Maintenance	GN4008EN
Troubleshooting Manual	TS3977EN
*Worldwide Sales and Service Directory	SA2229EN
*Also available on the internet at ***www.allisontransmission.com***	

GN4008EN 200701 www.allisontransmission.com Printed in USA 200701