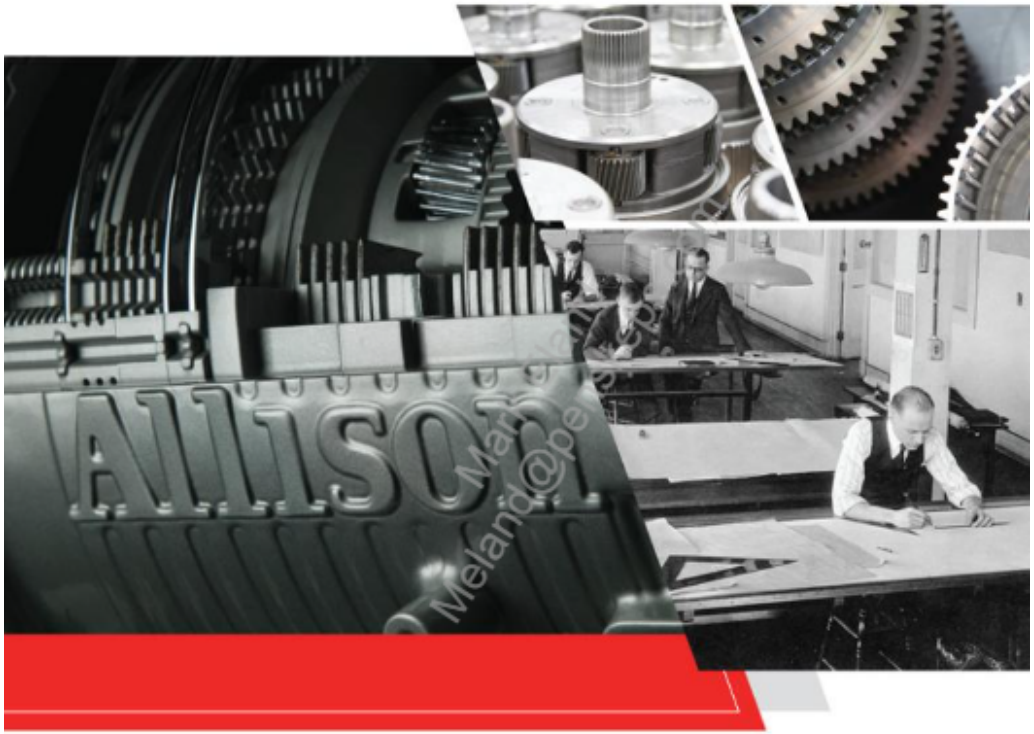
3000/4000 Product Families™

Allison 5th Generation Controls



MECHANIC'S TIPS

MT7151EN

Allison Transmission

Mechanic's Tips

2016 JULY

MT7151EN

Allison Transmission

3000 and 4000 Product Families

3000 EVS	3200 SP	4000 RDS	4500 RDS	B 500
3000 HS	3200 TRV	4000 SP	4500 SP	T 310
3000 MH	3500 ORS	4000 TRV	4600 ORS	T 325
3000 PTS	3500 RDS	4200 ORS	4700 RDS	T 350
3000 RDS	3500 SP	4430 ORS	4700 SP	T 375
3000 SP	4000 EVS	4440	4800 EVS	T 425
3000 TRV	4000 HS	ORS*	4800 SP	T 450
3200 MH	4000 MH	4500 HS	B 300	T 525
3200 ORS	4000 ORS	4500 ORS	B 400	

* Not a current model

Allison Transmission

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

IMPORTANT SAFETY INFORMATION

IT IS YOUR RESPONSIBILITY to be completely familiar with the warnings and cautions in this manual. These warnings and cautions advise of specific methods or actions that can result in personal injury, equipment damage, or cause the equipment to become unsafe. These warnings and cautions are not exhaustive. Allison Transmission could not possibly know, evaluate, or advise the service trade of all conceivable procedures by which service might be performed or of the possible hazardous consequences of each procedure. Accordingly, ANYONE WHO USES A SERVICE PROCEDURE OR TOOL WHICH IS NOT RECOMMENDED BY ALLISON TRANSMISSION MUST first be thoroughly satisfied that neither personal safety nor equipment safety will be jeopardized by the service methods used.

Vehicle or equipment manufacturers (collectively hereinafter "manufacturer(s)") integrate Allison transmissions into vehicles or equipment used for a variety of vocations and services. The manufacturer is responsible for identifying the specific operating conditions to which the vehicle or equipment will be subjected and to communicate the appropriate means for preventing unintended vehicle or equipment movement within those conditions, in order to ensure vehicle or equipment safety and operator safety. The vehicle or equipment owner and operator should be aware of and follow the manufacturer's operating instructions and warnings related to parking and preventing unintended vehicle or equipment movement.

Proper service and repair is important to the safe and reliable operation of the equipment. The service procedures recommended by Allison Transmission (or the manufacturer) and described in this manual are effective methods for performing service and diagnostic operations. Some procedures require using specially designed tools. Use special tools when and in the manner recommended.

The WARNINGS, CAUTIONS, and NOTES in this manual apply only to the Allison transmission and not to other vehicle or equipment systems which may interact with the transmission. Be sure to review and observe any vehicle or equipment system information provided by the manufacturer and/or body builder at all times the Allison transmission is being serviced.

WARNINGS, CAUTIONS, NOTES

Three types of headings are used in this manual to attract your attention:

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

CAUTION: A caution is used when an operating procedure, practice, etc., which, 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.

ABBREVIATIONS AND ACRONYMS

• C1	Clutch 1
• C2	Clutch 2
• C3	Clutch 3
• C4	Clutch 4
• C5	Clutch 5
• C6	Clutch 6
• CAN	Controller Area Network
• CMC	Customer Modifiable Constant
• DMD	Display Mode/Diagnostic
• DNA	Do Not Adapt
• DNS	Do Not Shift
• DTC	Diagnostic Trouble Code
• DTCs	Diagnostic Trouble Codes
• ECM	Engine Control Module
• EMI	Electromagnetic Interference
• FCC	Federal Communications Commission
• FLI	Filter Life Indicator
• FM	Filter Life Monitor
• HSD1	High Side Driver 1
• HSD2	High Side Driver 2
• HSD3	High Side Driver 3
• ISO	International Organization for Standardization
• LRTP	Low Range Torque Protection
• N/C	Normally Closed
• OEM	Original Equipment Manufacturer
• OLS	Oil Level Sensor
• OM	Oil Life Monitor
• PC	Personal Computer
• PCS	Pressure Control Solenoid
• PS2	Pressure Switch 2
• psi	Pounds per Square Inch
• PTO	Power Takeoff
• PWM	Pulse-Width Modulation

• RAM	Random Access Memory
• RELS	Reduced Engine Load at Stop
• RFI	Radio Frequency Interference
• rpm	Revolutions Per Minute
• RPM	Revolutions Per Minute
• SAE	Society of Automotive Engineers
• SEM	Shift Energy Management
• SIL	Service Information Letter
• SPS	Specialty Series
• TAN	Total Acid Number
• TCC	Torque Converter Clutch
• TCM	Transmission Control Module
• TIR	Total Indicated Runout
• TM	Transmission Health Monitor
• TPS	Throttle Position Sensor
• VF	Vacuum Fluorescent
• VFD	Vacuum Fluorescent Display

TRADEMARK USAGE

The following trademarks are the property of the companies indicated:

- Allison DOC® is a registered trademark of Allison Transmission, Inc.

ISO 14000

As a responsible corporate citizen, Allison Transmission, Inc. is dedicated to protecting human health, natural resources and the global environment. End-users and service personnel are responsible for understanding and complying with all applicable environmental laws, safety regulations, and Allison Transmission's policies and standards. The following recommendations concern the treatment and disposal of hazardous materials resulting from servicing an Allison Transmission product.

1. All lubricants/fluids used in the operation or storage of a transmission are to be treated as hazardous waste. These fluids are to be separated and discarded per current local statutes/regulations for the purpose of recycling, treatment, storage, and/or disposal.
2. Oil soaked components (e.g., filters, seals, clutch packs, etc.) are to be treated as hazardous waste and are to be handled and discarded per current local statutes/regulations.
3. Exhausted electronic components (e.g., transmission control modules (TCM), pressure switches, speed sensors, etc.) are to be treated as electronic waste and are to be handled and discarded per current local statutes/regulations.

LIST OF WARNINGS

This manual contains the following warnings—

IT IS YOUR RESPONSIBILITY TO BE FAMILIAR WITH ALL OF THEM.

WARNING: This product can expose you to chemicals including lead, which is known to the State of California to cause cancer and birth defects or other reproductive harm.
For more information go to **www.p65Warnings.ca.gov/product.**

- **To help avoid unexpected vehicle movement that might cause death, serious injury, or property damage, always have your foot on the brake, the throttle released, and the engine at idle before making a N (Neutral) to D (Drive); N (Neutral) to R (Reverse); D (Drive) to R (Reverse); or R (Reverse) to D (Drive) selection.**
- **Do not jump start a vehicle with arc welding equipment. Arc welding equipment's dangerously high currents and voltages cannot be reduced to safe levels.**
- **To help avoid personal injury or property damage caused by sudden and unexpected vehicle movement, do not check fluid level until you:**
  1. **Put the transmission in N (Neutral).**
  2. **Apply the parking brake and emergency brakes and make sure they are properly engaged.**
  3. **Chock the wheels and take and any other steps necessary to keep the vehicle from moving.**
- **Avoid contact with hot fluid or the sump when draining transmission fluid. Direct contact with hot fluid or the hot sump may result in bodily injury.**

LIST OF WARNINGS (cont'd)

This manual contains the following warnings—

IT IS YOUR RESPONSIBILITY TO BE FAMILIAR WITH ALL OF THEM.

- **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 can lead to hydraulic line failure and high temperature fluid leakage.**
- **To help avoid personal injury and equipment damage while conducting a transmission stall test, the vehicle must be 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.**
- **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.**

NOTES

TABLE OF CONTENTS

SECTION 5. PREPARING VEHICLE FOR TRANSMISSION INSTALLATION

SECTION 6. INSTALLING TRANSMISSION INTO VEHICLE

SECTION 7. CHECKS AND ADJUSTMENTS

SECTION 8. CUSTOMER SERVICE

Allison Transmission	INTRODUCTION	Section 1

1.1 ABOUT THIS MANUAL

This manual is a mechanic's reference for maintaining, removing, or installing 3000 and 4000 Product Family transmissions with Allison 5th Generation Controls. All features of the transmission and the vehicle involved in installation procedures are discussed. The information presented will help the mechanic maintain, remove, or install the transmission in a manner that assures satisfactory operation and long service life. For additional detailed information, refer to the appropriate transmission service manual and the troubleshooting manual.

Unless specifically indicated otherwise, this manual refers to all Allison 5th Generation Controls for 3000 and 4000 Product Family transmissions, except for the 3700 SPS model. The differences between the various transmission models are explained as required.

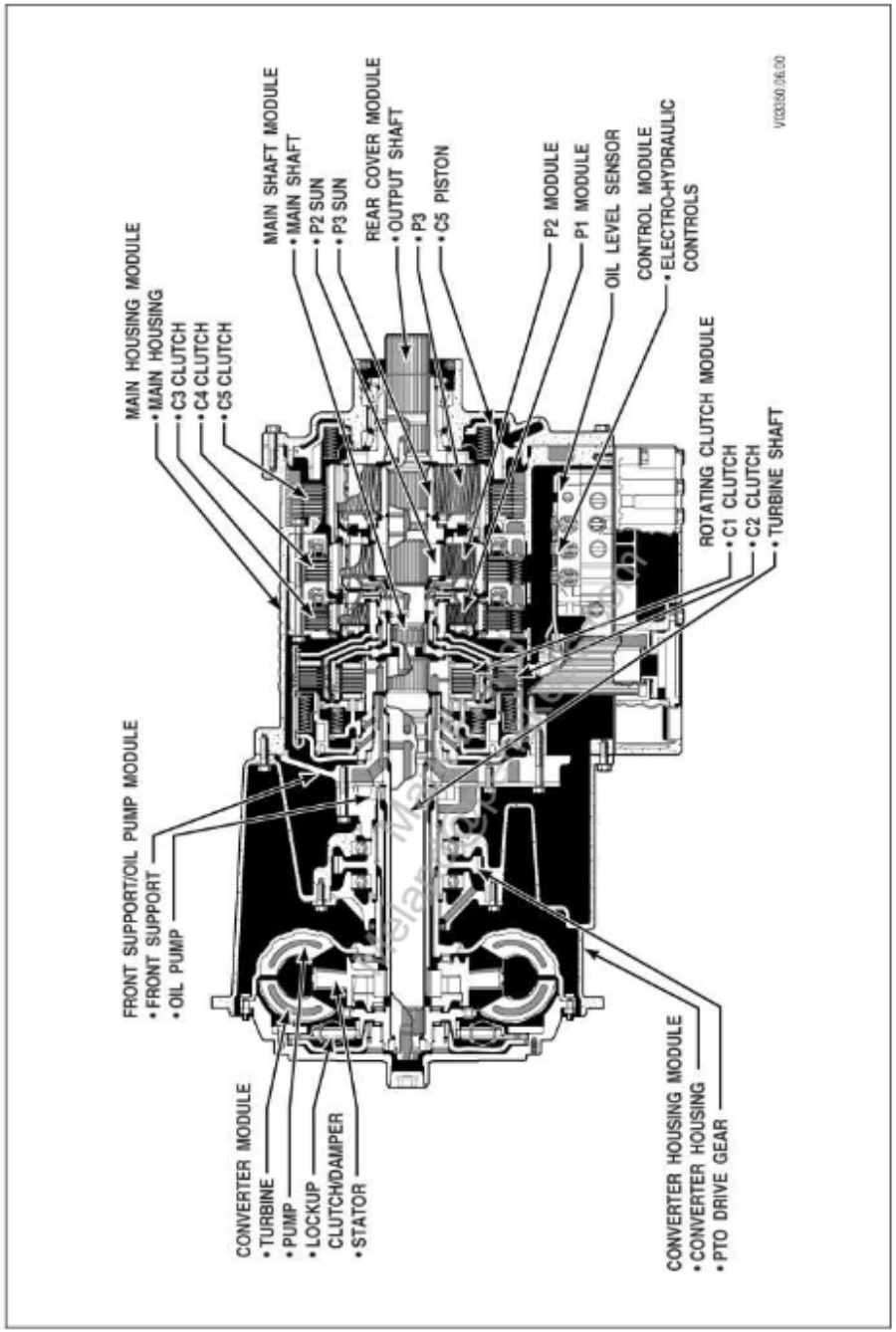


Figure 1–1. 3000 Product Family Transmission—Cross Section (With PTO Provision)

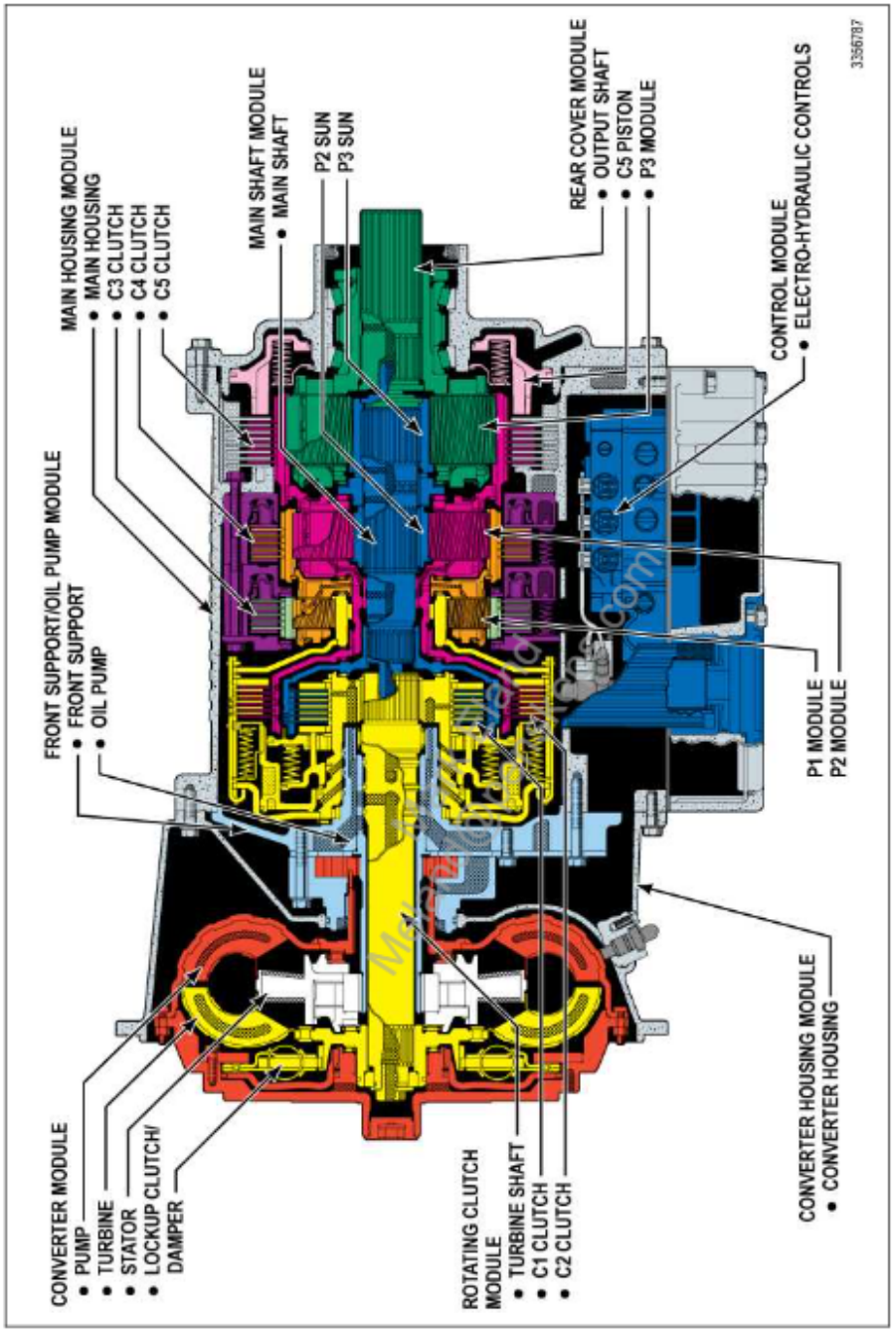


Figure 1–2. 3000 Product Family Transmission—Cross Section (xFE Models)

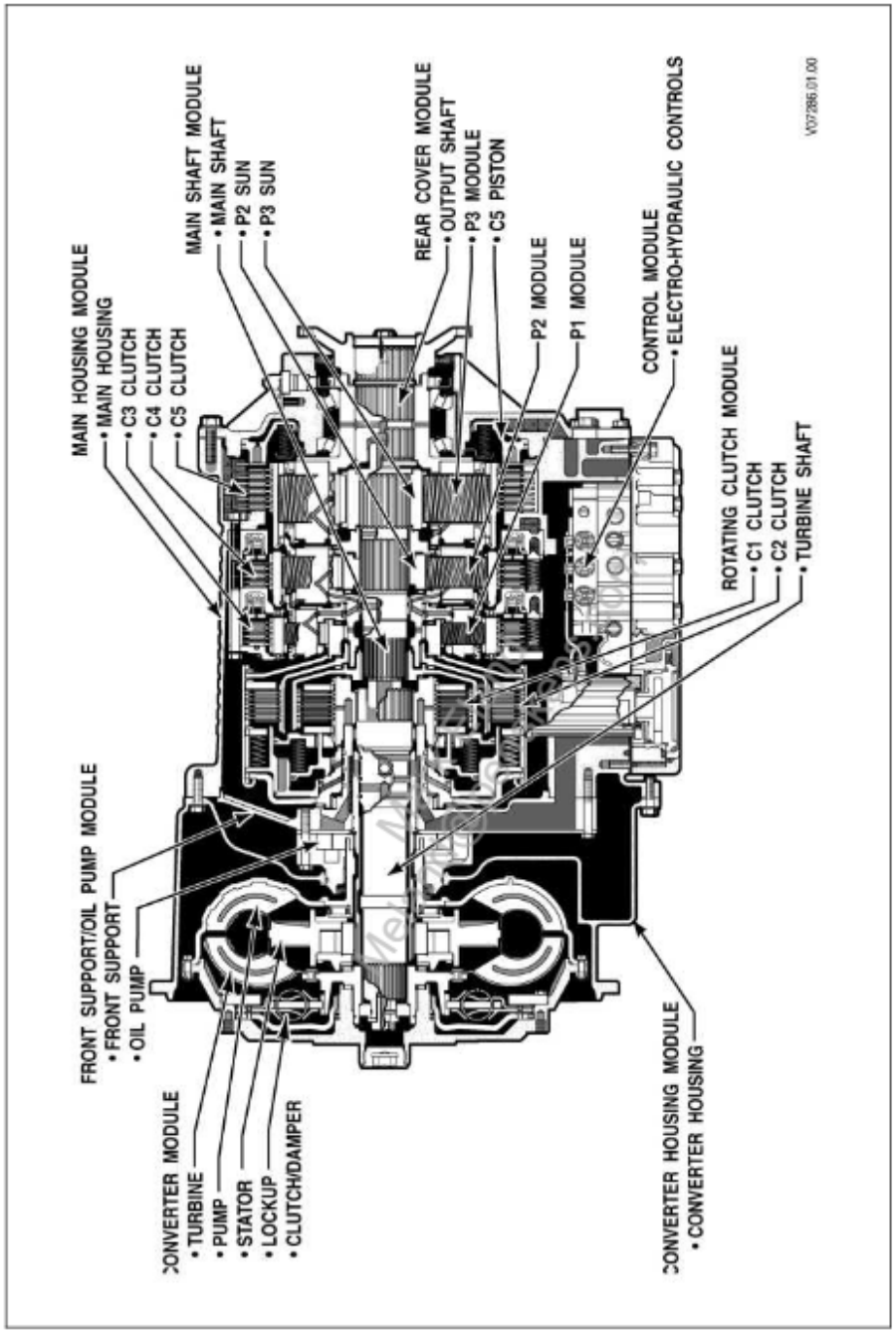


Figure 1–3. 4000 Product Family Transmission—Cross Section

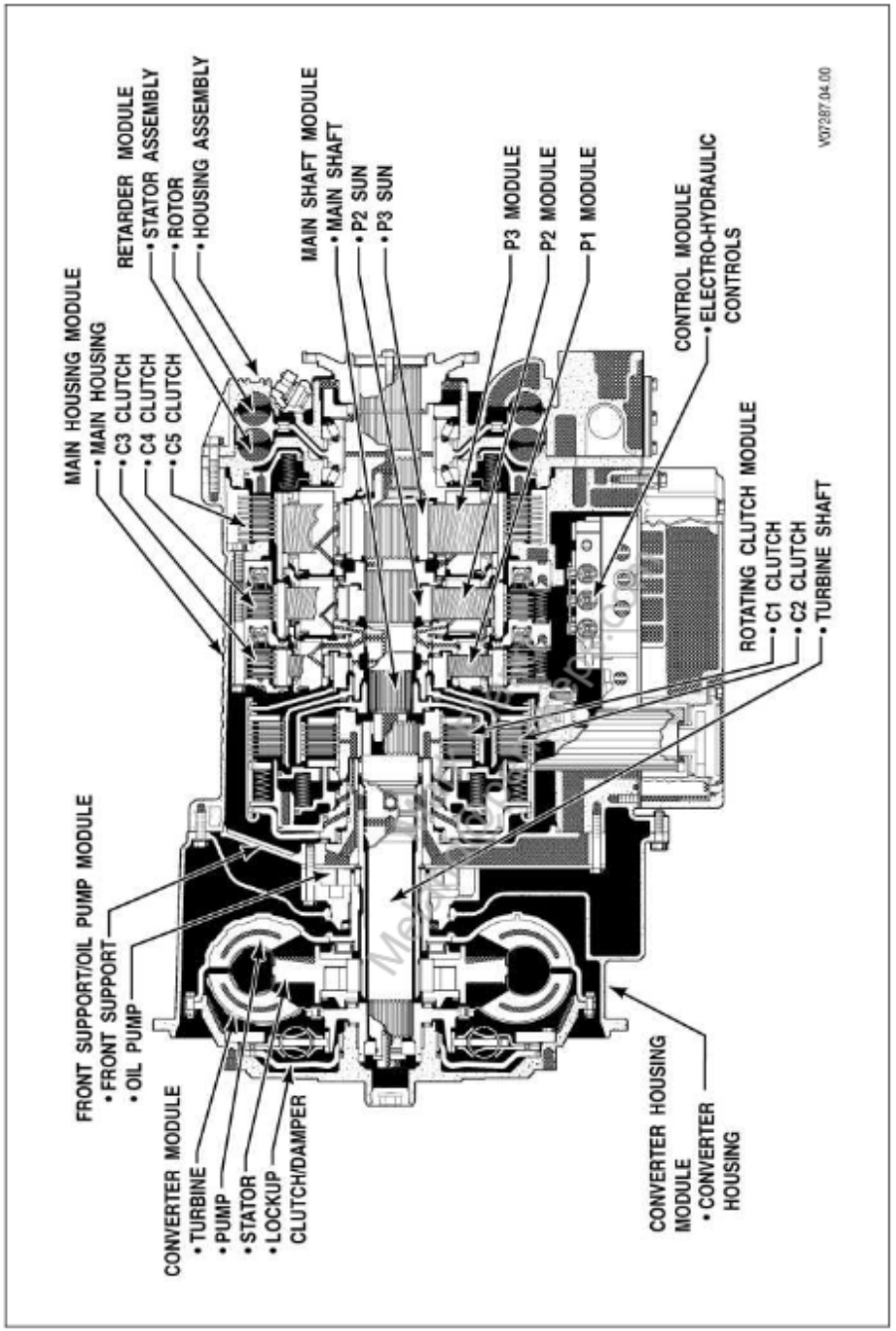


Figure 1–4. 4000 Product Family Transmission—Cross Section (With Retarder)

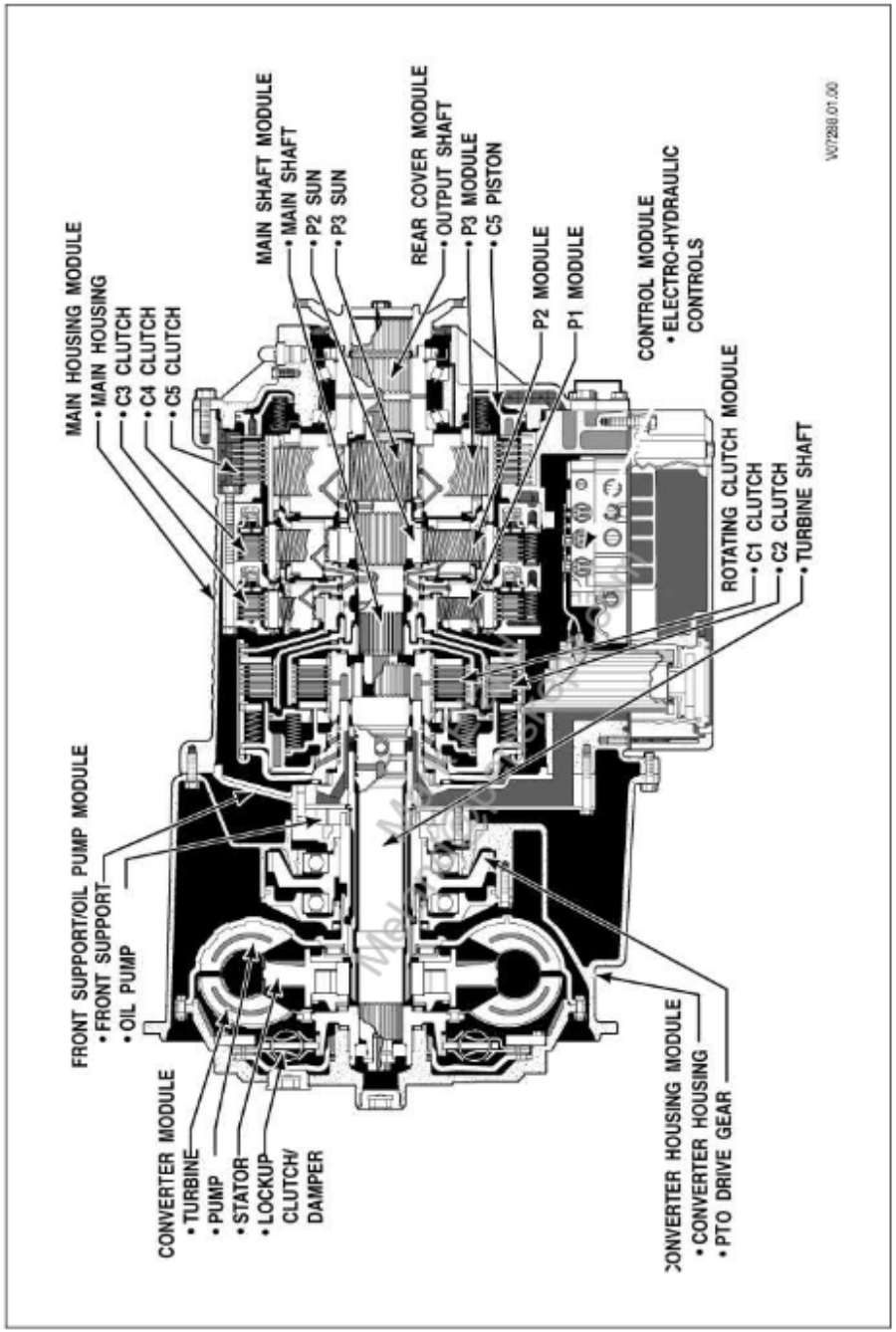


Figure 1–5. 4000 Product Family Transmission—Cross Section (With PTO Provision)

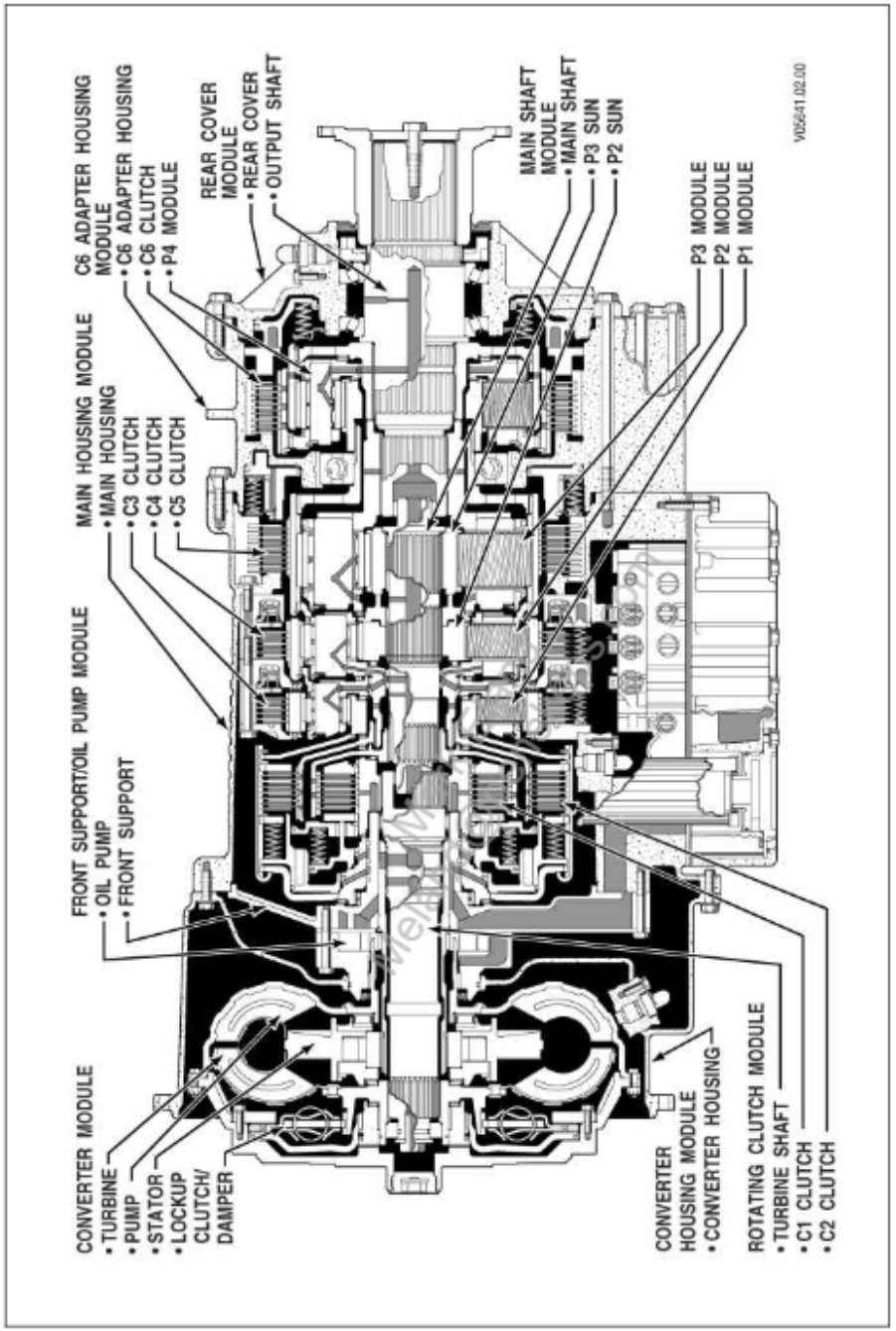


Figure 1–6. 4000 Product Family Transmission—Cross Section (7-Speed)

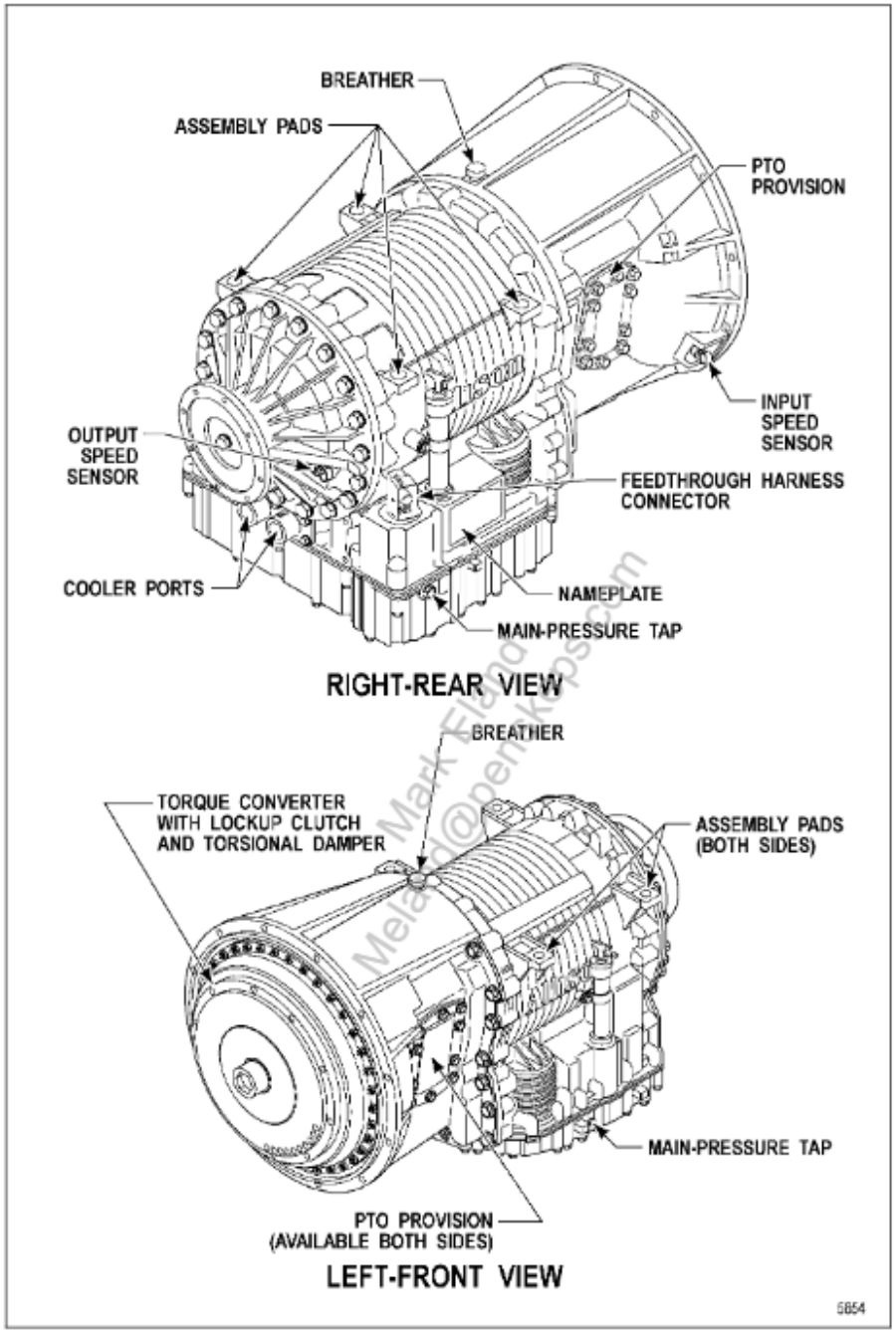


Figure 1–7. 3000 Product Family Transmission (With PTO Provision)

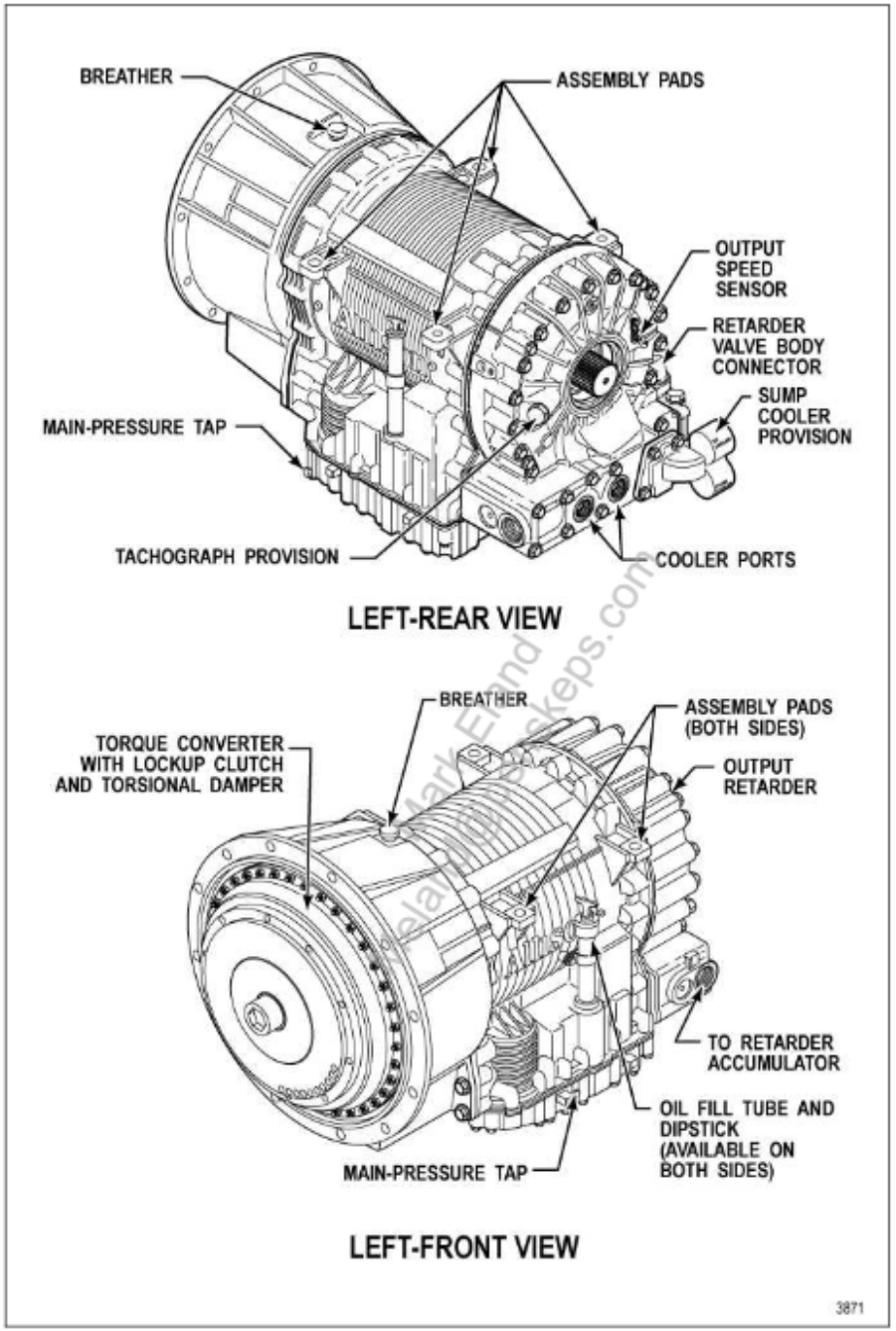


Figure 1–8. 3000 Product Family Transmission (With Retarder)

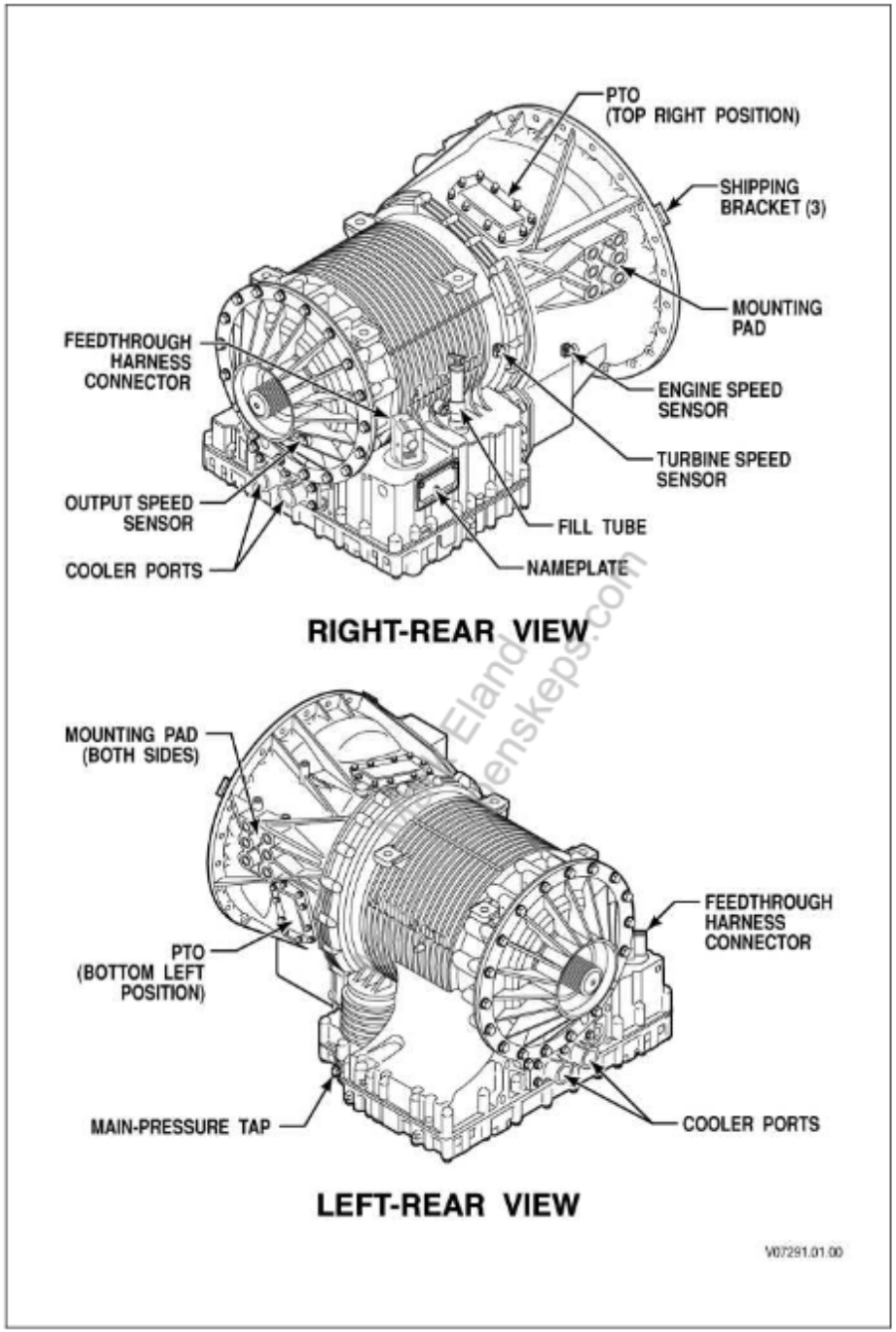


Figure 1–9. 4000 Product Family Transmission (With PTO Provision)

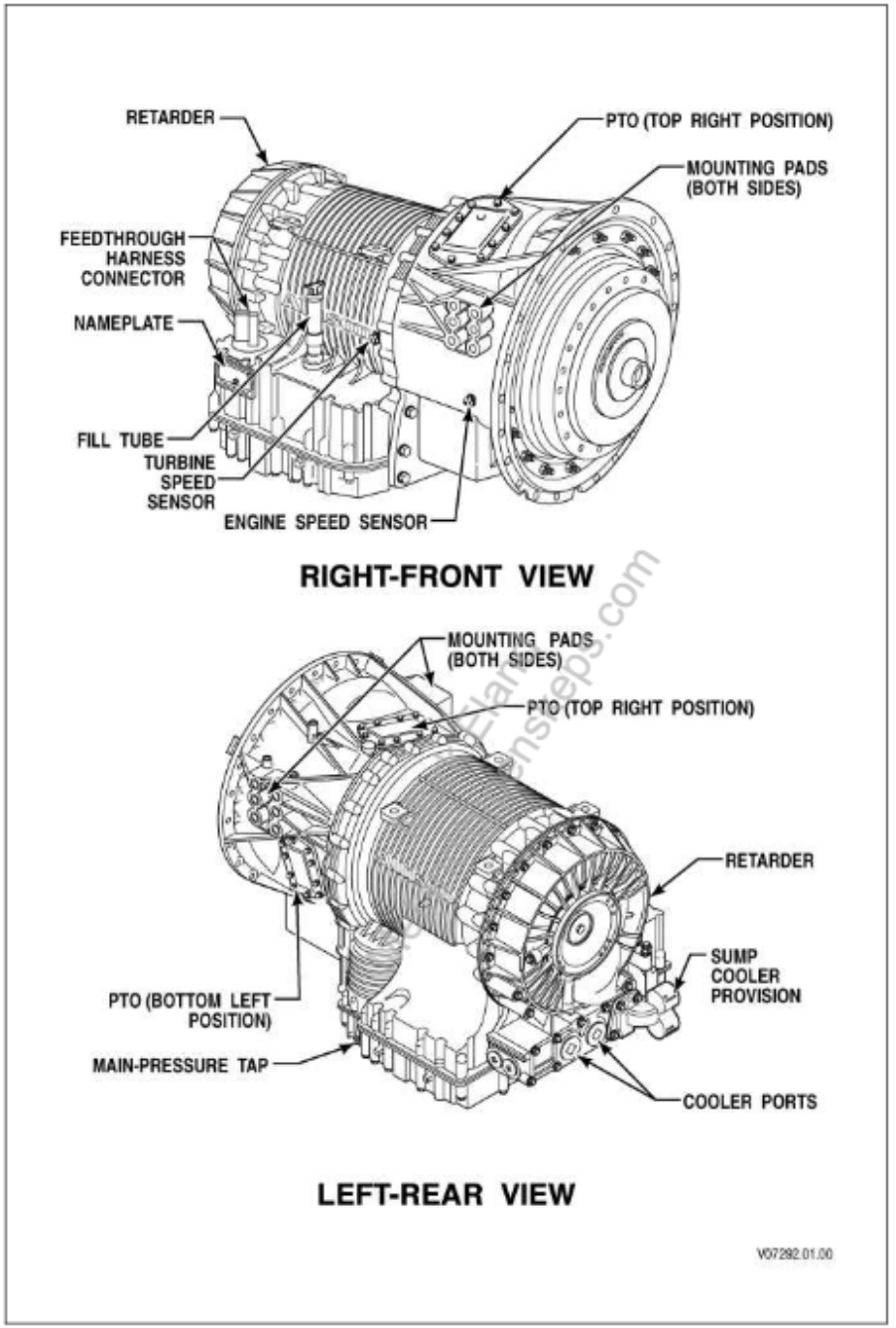


Figure 1–10. 4000 Product Family Transmission (With Retarder and PTO Provision)

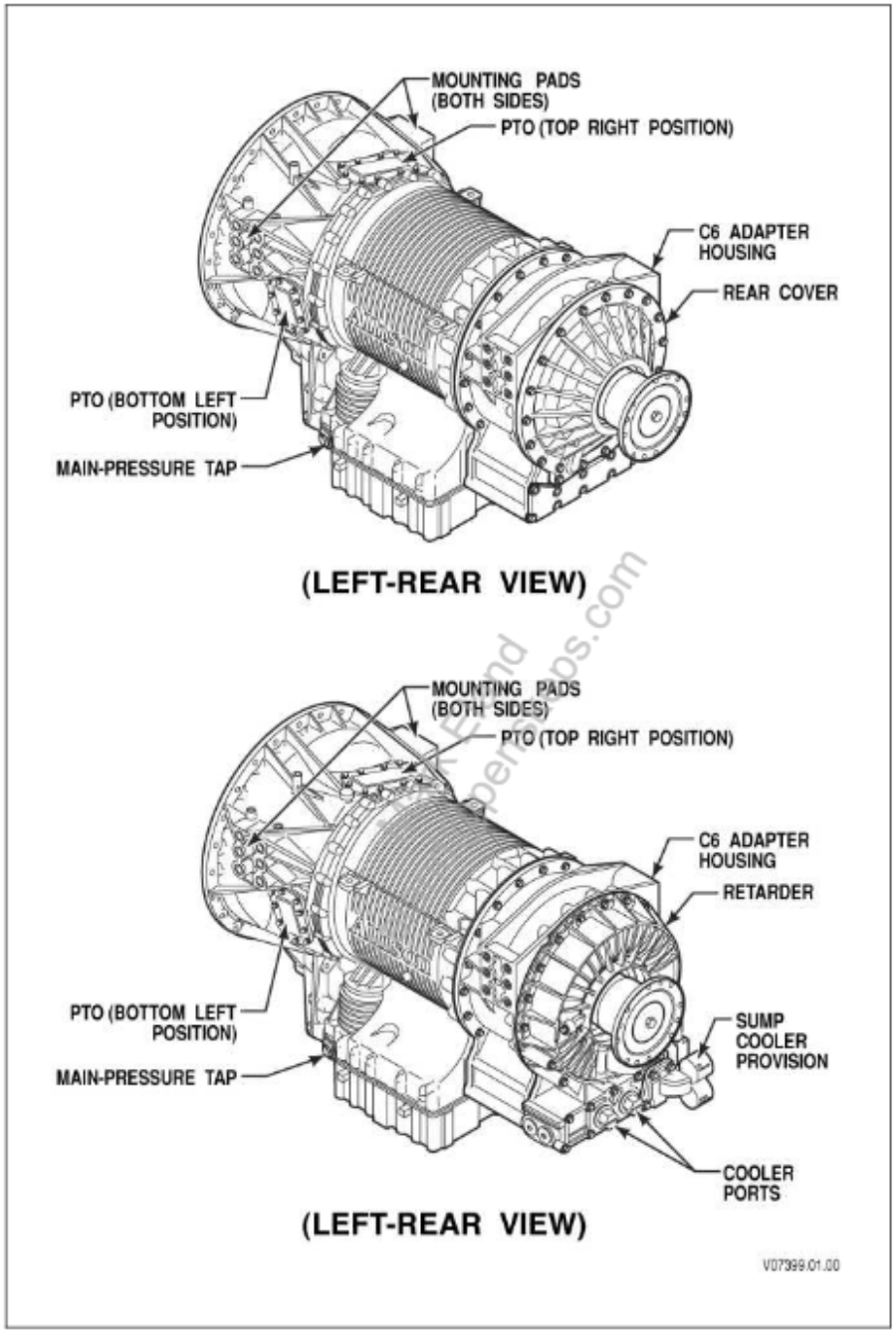
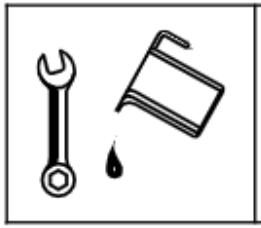


Figure 1–11. 4000 Product Family Transmission (7-Speed)



PREVENTIVE MAINTENANCE

Section 2

2.1 PROGNOSTICS

A Prognostics system, consisting of control valve module hardware, shift selector, and Transmission Control Module (TCM) calibration is available to monitor fluid life, fluid filter life, and clutch life.

If fluid change, filter change, or clutch service is not performed within a set period of time, a Diagnostic Trouble Code (DTC) sets with a **CHECK TRANS** light, and/or a **TRANS SERVICE** indicator (shown as the wrench icon) in the shift selector or as an additional light in the dash.

Prognostics can be reset through the Allison DOC® or, if calibrated to allow manual reset, through manipulating the shift selector.

2.1.1 TRANS SERVICE Indicator (Wrench Icon). The **TRANS SERVICE** indicator illuminates in the event a service condition relating to a transmission clutch, fluid or filter life occurs. The **TRANS SERVICE** indicator is located on the shift selector display. Refer to Figure 2–1.

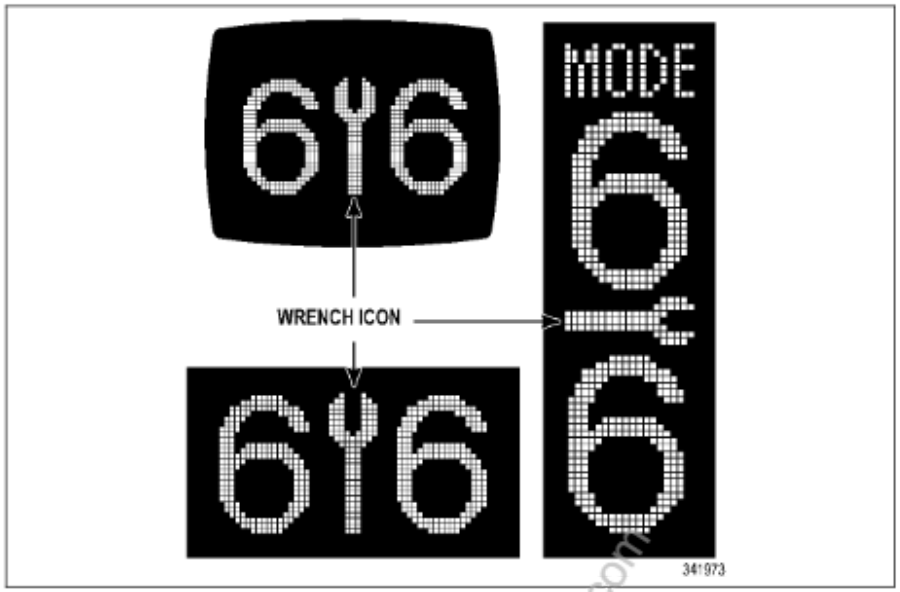


Figure 2–1. Typical Allison 5th Generation TRANS SERVICE Indicator

2.1.2 Prognostics Prerequisites. The following requirements must be met to use the Prognostics features and functions:

- With the exception of 7-speed models, the vehicle harness has a wire for the Filter Life Indicator (FLI) switch (wire 118).

NOTE: Since there is no FLI (PS2) switch in 7-speed models, prognostics calculate filter life.

- The OEM has ordered your calibration from Allison Transmission with Prognostics enabled.

NOTE: It is important to note that if Prognostics is disabled, it is not available at all in the calibration. This is different than the OEM ordering your calibration with Prognostics off. Defaulting Prognostics off means it could be enabled in the future provided the other conditions are met to use Prognostics.

- Use of Allison Transmission High Capacity Main and Lube Filters.
- Use of TES 295® or TES 389 fluid.
- Using Allison 5th Generation Controls with Prognostics keypad pushbutton or bump-shift lever selector. Refer to Figure 2–2.

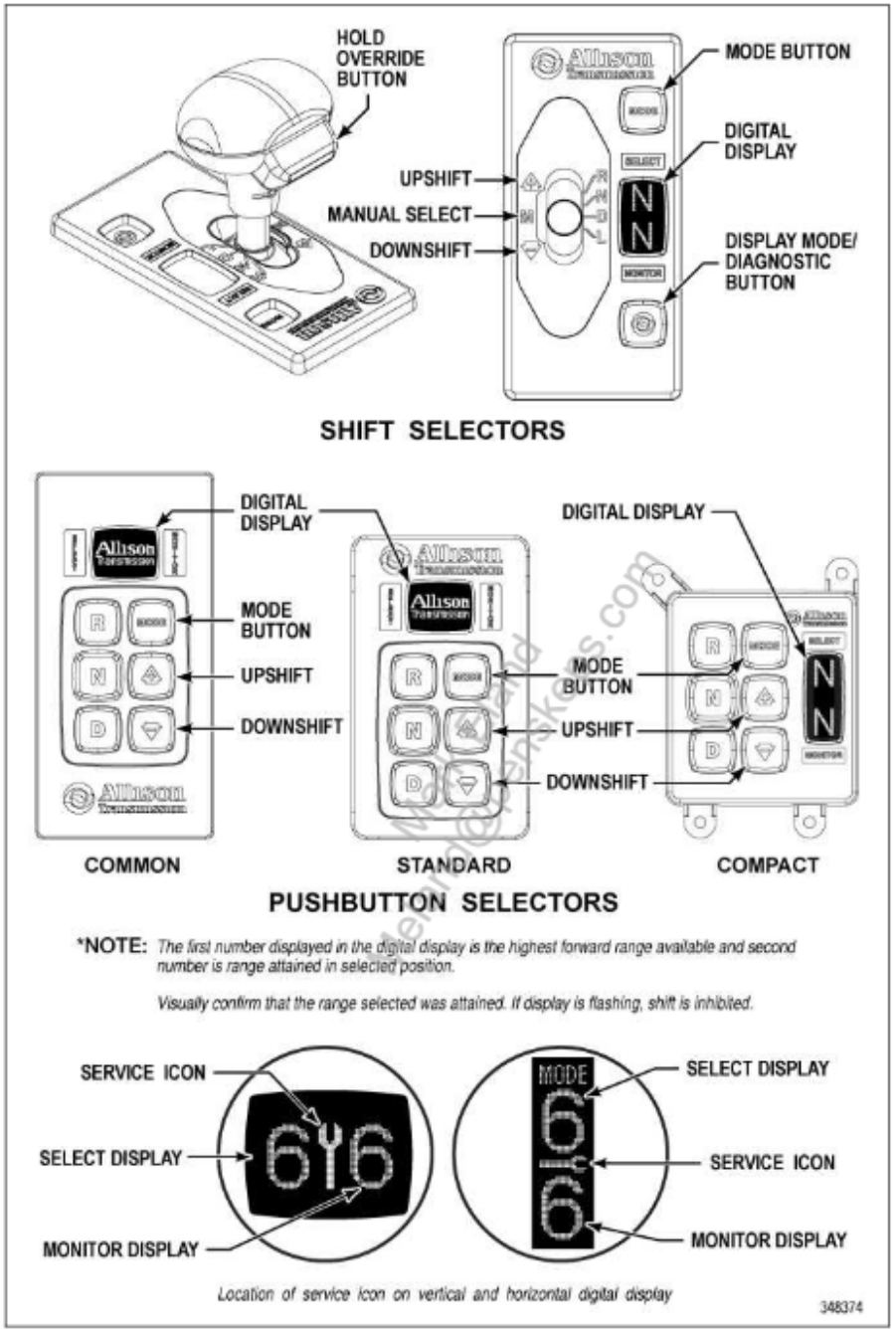


Figure 2–2. Typical Allison 5th Generation Prognostics Shift Selectors

NOTE: Allison Transmission may approve some OEM selectors for Prognostics, provided the **TRANS SERVICE** indicator or message display is integrated by the OEM.

2.1.3 Prognostics Features Availability. The vehicle manufacturer specifies whether they want Allison Prognostics Feature Package to be made available in the calibration and in what configuration, for example defaulted on or off. The Oil Life Monitor (OM), Filter Life Monitor (FM), and Transmission Health Monitor (TM) are the individual functions included in the Allison Prognostics Feature Package. These individual functions cannot be turned on or off separately within the Allison Prognostics Feature Package.

The transmission calibration can be made for the vehicle manufacturer (or the customer) so the Prognostics Feature is in one of the following states:

- Available and the Prognostics Features are defaulted on and therefore monitoring OM, FM, and TM presently.
- Available and the function is defaulted off and therefore available but not monitoring OM, FM, and TM presently.
- Disabled and therefore not available within this TCM calibration.

2.1.4 Procedure To Turn Prognostics On And Off. Methods to turn the Prognostics Package Features on or off (provided all other requirements are met), include the following:

1. Through the shift selector (if allowed by TCM programming).
2. Using the Allison DOC®, CMC can be toggled to enabled or disabled for the Allison Prognostics Feature Package provided the OEM ordered a calibration that has the Allison Prognostics Feature Package as a programmable feature.

NOTE: Prognostics should not be turned on after recalibration of the TCM until all other requirements for the fluid filters, selector, and harness are met. Non-7-speed calibrations utilize an FLI switch (PS2) that requires chassis harness wire 118. DTC P0848, Transmission Fluid Pressure Switch 2 Circuit High will be active if wire 118 is unused on non-7-speed prognostics enabled calibrations. All Allison 5th Generation selectors are compatible with prognostics.

NOTE: The strip pushbutton selectors do not include a Vacuum Fluorescent Display (VFD). These installations require the installation of a separate SAE J1939 compatible displays to alert the operator of conditions monitored by the optional prognostics feature.

The OEM initially specifies how they want the calibration configured for operator access regarding reset for Prognostics functions through the selector. The vehicle owner may then have the CMC toggled to either enabled or disabled to allow or disallow the Prognostics Package reset from the shift selector via programming features in Allison DOC®.

WARNING: To help avoid unexpected vehicle movement that might cause death, serious injury, or property damage, always have your foot on the brake, the throttle released, and the engine at idle before making a **N** (Neutral) to **D** (Drive); **N** (Neutral) to **R** (Reverse); **D** (Drive) to **R** (Reverse); or **R** (Reverse) to **D** (Drive) selection.

The Prognostics feature can be turned on with the Allison DOC® or, if the specific calibration allows it, the operator can do the following:

1. Set the vehicle brakes to prevent movement of the vehicle.
2. With engine off, turn the ignition on (do not start the engine). Wait for initialization to complete (wait for N N to display in the selector).
3. Move the bump-shift lever selector or press the keypad (for a pushbutton) through the following sequence of range positions, pausing no more than 3-seconds between consecutive shifts: **N-D-N-R-N-D-N-R-N-D-N-R-N**.
4. Watch for the **TRANS SERVICE** indicator located in the shift selector display to illuminate and then turn off. This indicates that the operator has successfully enabled the Allison Prognostics Feature Package, consisting of the OM, FM, and TM.

NOTE: If another **TRANS SERVICE** indicator is installed in the dash or incorporated in an OEM message display, it too should also briefly illuminate in similar fashion as the **TRANS SERVICE** indicator.

Disabling the Prognostics feature can be done with Allison DOC® or, if the specific calibration allows it, the operator can do the following:

1. Set the vehicle brakes to prevent movement of the vehicle.

2. With engine off, turn the ignition on (do not start the engine). Wait for initialization to complete (wait for N N to display in the selector).
3. Move the bump-shift lever selector or press the keypad (for a pushbutton) through the following sequence of range positions, pausing no more than 3-seconds between consecutive shifts: **N-D-N-R-N-D-N-R-N-D-N-R-N.**
4. Watch for the **TRANS SERVICE** indicator located in the shift selector display to illuminate and then turn off. This indicates that the operator has successfully disabled the Allison Prognostics Feature Package, consisting of the OM, FM, and TM.

NOTE: If another **TRANS SERVICE** indicator is installed in the dash or incorporated in an OEM message display, it too should also briefly illuminate in similar fashion as the **TRANS SERVICE** indicator.

2.1.5 Normal Prognostics Indication At Engine Start. Once Prognostics is monitoring the system, normal operation at engine start is as follows:

1. A system bulb check illuminates the **TRANS SERVICE** indicator located in the shift selector display for approximately 0.5 seconds.
2. If Prognostics features are enabled, the **TRANS SERVICE** indicator illuminates again for 3-seconds after the bulb check.
   – If Prognostics features are disabled, the **TRANS SERVICE** indicator does not illuminate again after the bulb check.

NOTE: If the shift calibration permits a maximum allowable gear in primary mode that is different than the maximum allowable gear in secondary mode, Prognostics enabling/disabling is only permitted in the shift mode with the highest maximum allowable range. If you have a higher range set of gears in secondary mode than in primary mode to enable Prognostics, push the **MODE** button so MODE appears on the selector display first.

NOTE: The three Prognostics functions, OM, FM, and TM, are enabled or disabled as a package and cannot be enabled or disabled individually.

2.1.6 Setting Fluid Type. To select transmission fluid type do the following:

- With the engine off and the ignition on, perform the following sequence on the selector, **N-R-N-D-N-R-N-D-N-R-N-D-N**.

The **TRANS SERVICE** indicator flashes if TES 389 is the current setting and illuminates solidly if TES 295® is the current setting. To change the transmission fluid type, wait 5 seconds after entering transmission fluid type mode and perform one of the following sequences to select the proper transmission fluid type:

- **N** (Neutral) **R** (Reverse) **N** (Neutral) to select TES 295® (the **TRANS SERVICE** indicator illuminates solidly showing TES 295® has been selected).
- **N** (Neutral) **D** (Drive) **N** (Neutral) to select TES 389 (the **TRANS SERVICE** indicator begins to flash showing TES 389 has been selected).

The selector exits 30 seconds after entering transmission fluid type mode or the ignition may be turned off to exit earlier. Only one transmission fluid type selection may be made after entering transmission fluid type mode. All other attempts will be ignored. Transmission fluid type mode needs to be entered again if the wrong type of transmission fluid is selected.

NOTE: Verify prognostics setting for fluid type, displayed in Allison DOC®, matches type of fluid in the transmission.

2.1.7 Oil Life Monitor (OM). Based on the vehicle's duty cycle, this feature determines fluid life and alerts the operator when a fluid change is required.

Oil life is calculated based on hours of engine and transmission operation. Miles are approximated from the hours and calibrated information. The number of shifts per mile (shift density) determines the duty cycle of the transmission and the oil life limits are based on the observed duty cycle. Hours are accumulated when the engine is running, including when the vehicle is stationary for PTO operation, or for extended idle time.

NOTE: Oil life is continuously calculated on the following cumulative effects:

- Operating hours
- Retarder accumulator applies (if equipped)
- Output revolutions
- Shift density (shifts per mile)

Calendar-based fluid change requirements still apply and are not incorporated into Prognostics. Refer to 2.7 TRANSMISSION FLUID AND FILTER CHANGE INTERVALS.

2.1.7.1 Percentage Fluid Life Remaining Display.

With engine off and ignition on, push the **DISPLAY MODE/DIAGNOSTIC** (DMD) button twice on the bump-shift lever selector to enter OM mode. With engine off and ignition on, push the ↑ (Upshift) and ↓ (Downshift) arrows simultaneously twice on the keypad pushbutton selector to enter OM mode. The oil life left is displayed as a percentage between 0 and 99 in the shift selector display window (refer to Figure 2–3).

Figure 2–3. Percentage Fluid Life Remaining Display

2.1.7.2 Maintenance Required Notification.

When operating parameters reach or exceed a calibrated value the TCM illuminates the **TRANS SERVICE** indicator on the shift selector.

2.1.7.3 OM Reset.

The OM may be reset back to 99% by either of these methods:

- Display the OM information and press and hold the **DISPLAY MODE/DIAGNOSTIC** (DMD) button for 10 seconds.
- With the ignition on and the engine off, shift between **N-D-N-D-N-R-N** to reset the value displayed to 99, pausing no more than 3-seconds between consecutive shifts.

The **TRANS SERVICE** indicator illuminates briefly following a reset to acknowledge the reset was successful.

Reset with Allison DOC®. If the value displayed remains unchanged, then it is possible the reset may be restricted to Allison DOC® only.

2.1.7.4 OM Maintenance History

NOTE: Fluid must accumulate for at least 50 hours of operation before the OM feature may be reset again.

Allison DOC® may also be used to review reset history and the mileage recorded at the time of reset. Fluid life remaining is displayed from 100% to -100% when viewing records in the service tool. A negative percentage indicates how far past due it is on the oil change. A historical record of the last six resets, including mileage at the time of each reset, may also be viewed using the Allison DOC® Diagnostics Program.

2.1.8 Filter Life Monitor (FM). For non-7 speed calibrations, filter deterioration is sensed by a differential pressure switch (PS2) located in the control valve module. The pressure difference between filtered lockup pressure and unfiltered main pressure is compared to a calibrated value. If the TCM determines the filter has deteriorated, the prognostic service indicator icon displays on the shift selector. All 7-speed prognostics calibrations calculate remaining filter life and do not have an FLI switch (PS2) located the control valve module.

2.1.8.1 Filter Life Status Display.

With engine off and ignition on, push the **DISPLAY MODE/DIAGNOSTIC** (DMD) button three times on the bump-shift lever selector to enter FM mode. With engine off and ignition on, push the ↑ (Upshift) and ↓ (Downshift) arrows simultaneously three times on the keypad pushbutton selector to enter FM mode.

Figure 2–4. Filter Life Display

The message “OIL FILTER OK” or “REPLACE FILTERS” is displayed in the selector display window. An acceptable filter life status is displayed as “OIL FILTER OK”. An unacceptable filter life status is displayed as “REPLACE FILTERS”.

2.1.8.2 Maintenance Required Notification.

The FLI pressure switch for non-7 speed calibrations signals the TCM when fluid exiting the main filter drops below a predetermined pressure. Change both the main and lube filters when the **TRANS SERVICE** indicator in the selector display indicates the main filter should be changed. The differential

pressure limit is verified for a period of time to be sure there is no false indication of the need to change filters.

2.1.8.3 FM Reset.

The FM for non-7 speed calibrations automatically resets once the new filters have been installed and the FLI pressure switch no longer detects low pressure at the filter.

The FM can also be reset manually by either of these methods:

- Press and hold the **MODE** button for 10 seconds while in FM mode.
- With ignition on, engine off and brakes applied, shift between **N-R-N-R-N-D-N** pausing less than 3-seconds between each selector movement.

The **TRANS SERVICE** indicator illuminates briefly following a reset to acknowledge the reset was successful. If the value displayed remains unchanged, it is possible the reset may be restricted to Allison DOC® only. The FM still resets automatically even if restricted from manual reset through the selector.

NOTE: For 7-speed calibrations, the FM must be reset manually, since there is no FLI switch (PS2) located the control valve module.

2.1.8.4 FM Maintenance History.

Allison DOC® Diagnostics Program may be used to display the amount of transmission operation from the initial service indication until the filter reset occurred. Allison DOC® indicates the FM as expired “YES” or “NO”.

2.1.8.5 Filter Life Indicator (FLI) Switch (PS2) Operation.

Filter deterioration is sensed by a PS2 located in non 7-speed control valve modules. Measure the resistance of PS2. If the resistance measures more than 4 Ω closed or less than 20,000 Ω with the switch open then replace the switch. PS2 is a normally closed (N/C) switch.

2.1.9 Transmission Health Monitor (TM). Transmission health monitors the running clearance of clutches C1, C2, C3, C4, and C5 to determine clutch plate wear. Clutch running clearance, based upon clutch fill volume, indicates remaining clutch life. The C6 and lockup clutches are not monitored.

2.1.9.1 Clutch System Status Display.

With engine off and ignition on, push the **DISPLAY MODE/DIAGNOSTIC** (DMD) button four times on the bump-shift lever selector to enter TM mode.

With engine off and ignition on, push the ↑ (Upshift) and ↓ (Downshift) arrows simultaneously four times on the keypad pushbutton selector to enter TM mode.

2.1.9.2 Maintenance Required Notification.

An acceptable clutch life status is displayed as “TRANS HEALTH OK” which means clutch system maintenance is not required at this time. An unacceptable clutch life status is displayed as “TRANS HEALTH LO” means clutch system maintenance is required (refer to Figure 2–5).

Figure 2–5. TM Display

2.1.9.3 TM Reset

The TM feature automatically resets when appropriate conditions are detected. TM can only be manually reset using Allison DOC®. When resetting TM with the service tool, individual clutches or all clutches can be reset. Operator reset through the shift selector is not allowed.

2.1.9.4 TM Maintenance History.

The Allison DOC® may be used to display the amount of transmission operation from the initial service indication until the service reset. The Allison DOC® also displays “OK” or “Not OK” for each clutch.

2.1.10 Prognostics In Allison DOC®. Allison DOC® has been designed to aid the technician in troubleshooting and maintaining Allison transmissions equipped with Allison 5th Generation Controls. Allison DOC® can be used with a desktop PC or with a laptop PC in the cab of the vehicle.

2.1.10.1 Viewing History

The Prognostics screen shows information stored on the TCM related to oil life, filter life and data for use in prediction transmission health.

1. Select the Prognostics tab —The Prognostics window displays on the PC.

2.1.10.2 Enabling/Disabling Prognostics Package.

Using the Allison DOC®, the CMC can be toggled to enable or disable the Allison Prognostics Feature Package, provided the OEM ordered a calibration that has the Allison Prognostics Feature Package available as a programmable feature.

2.1.10.3 Reset Prognostics Monitors.

Using the Allison DOC® causes the TCM to reset the Prognostics monitors.

To reset the Oil Life Monitor:

1. Display the Action Request Menu.
2. Click the Reset Prognostics Information menu item.
3. Click the Reset Oil Life Monitor menu item.
4. A dialog box is displayed asking if you are sure you want to reset the OM.
5. Click the **YES** button to reset the OM.

To reset the Filter Life Monitor:

1. Display the Action Request Menu.
2. Click the Reset Prognostics Information menu item.
3. Click the Reset Filter Life Monitor menu item.
4. Click the **YES** button to reset the FM.
5. A confirmation window appears stating the FM was reset successfully. Click the **OK** button.

To reset the Transmission Health Monitor:

1. Display the Action Request Menu.
2. Click the Reset Prognostics Information menu item.
3. Click the Reset Transmission Health Monitor menu item.
4. A dialog box is displayed asking which clutch should be reset.
5. Click the number of the clutch to be reset, or click the **ALL** button to reset all clutches.

NOTE: If the **ALL** button was pressed, a dialog bow displays asking if the transmission was overhauled and if the OM should also be reset.

6. A confirmation window displays stating that the TM indicator was reset successfully.
7. Click the **OK** button.

2.2 PERIODIC INSPECTION AND CARE

2.2.1 Transmission Inspection. Clean and inspect the exterior of the transmission at regular intervals. Severity of service and operating conditions determine the frequency of these inspections. Inspect the transmission for:

- Loose bolts—transmission and mounting components.
- Fluid leaks—repair immediately.
- Loose, dirty, or improperly adjusted throttle sensor.
- Damaged or loose hoses.
- Worn, frayed, or improperly routed electrical harnesses.
- Worn or damaged electrical connectors.
- Dented, worn or out-of-phase driveline U-joints and slip fittings.
- Clogged or dirty breather (vent assembly).
- Check transmission fluid for evidence of engine coolant.

2.2.2 Vehicle Inspection.

Check the vehicle cooling system occasionally for evidence of transmission fluid which indicates a faulty oil cooler.

2.2.3 Welding on Vehicle.

CAUTION: When welding on the vehicle:

- DO NOT WELD on the vehicle without disconnecting all control system wiring harness connectors from the TCM.
- DO NOT WELD on the vehicle without disconnecting TCM battery power and ground leads.
- DO NOT WELD on any control components.
- DO NOT CONNECT welding cables to any control components.

Label ST2067EN describes on-vehicle welding precautions and is available from your authorized Allison service dealer and should be installed in a conspicuous place. A vehicle used in a vocation that requires frequent modifications or repairs involving welding **must** have an on-vehicle welding label.

WARNING: Do not jump start a vehicle with arc welding equipment. Arc welding equipment's dangerously high currents and voltages cannot be reduced to safe levels.

2.2.4 Painting on Vehicle.

2.2.4.1 Electrostatic Painting

If the vehicle chassis or body is painted using an electrostatic painting process, electrical voltage must not be discharged through the Transmission Control Module (TCM). To prevent this possibility, Allison recommends installing the TCM after the electrostatic paint process is complete. If the TCM is installed prior to electrostatic painting, make sure:

- the TCM is not painted and
- the elements being painted are properly and continuously grounded during the entire painting process.

NOTE: Allison Transmission is not responsible for TCM damage resulting from improper grounding during electrostatic painting of the vehicle.

During electrostatic painting, the paint droplets receive an electrostatic charge attracting them to the grounded surfaces. Voltages at the spray gun can exceed several thousand volts. The charge which builds up on an improperly grounded chassis or body can be discharged through the TCM, resulting in damage to the TCM.

2.2.4.2 Painting of Transmission Control Components

While it may be desirable to paint chassis mounted components to enhance the overall vehicle appearance and/or provide corrosion protection, the transmission control components must not be painted. Painting transmission control components can:

- compromise the integrity of connectors and connector seals.
- reduce thermal conductivity from inside the TCM to ambient air.
- cover labels or other identification, hindering the process to service these components.

2.2.4.3 Jump Starting

Observe the following precautions when jump starting a vehicle:

- Battery positive side fuse rated at 10 to 15 amps in series to pin 10 and pin 70 of TCM required to protect against reverse polarity.
- Ignition fuse rated at 5 to 15 amps in series to pin 63 of TCM.
- Do not connect cables to transmission electronic control components such as the TCM.

- Do not exceed 26.5 volts when jump starting or charging batteries equipped with a 12 volt TCM (A61/A62/A63).
- Do not exceed 36 volts when jump starting or charging batteries equipped with a 12/24 volt TCM (A63).

If jump start voltage is under or over the DTC threshold voltage, P0882/P0883 may set while jump starting the vehicle. After starting the vehicle clear the active/inactive DTCs from history. Refer to Troubleshooting Manual TS7149EN for additional information.

2.3 IMPORTANCE OF PROPER TRANSMISSION FLUID LEVEL

Transmission fluid cools, lubricates, and transmits hydraulic power. Always maintain proper fluid level. If fluid level is too low, the torque converter and clutches do not receive an adequate supply of fluid and the transmission overheats. If the level is too high, the fluid aerates—causing the transmission to shift erratically and overheat. Fluid may be expelled through the breather or dipstick tube when the fluid level is too high.

2.4 TRANSMISSION FLUID CHECK

2.4.1 Manual Fluid Check Procedure.

WARNING: To help avoid personal injury or property damage caused by sudden and unexpected vehicle movement, do not check fluid level until you:

1. Put the transmission in **N** (Neutral).
2. Apply the parking brake and emergency brakes and make sure they are properly engaged.
3. Chock the wheels and take and any other steps necessary to keep the vehicle from moving.

2.4.2 Cold Check Procedure. The purpose of the cold check is to determine if the transmission has enough fluid to be operated safely until a hot check can be made.

CAUTION: The fluid level rises as fluid temperature increases. DO NOT fill above the “COLD CHECK” band if the transmission fluid is below normal operating temperatures. During operation, an overfull transmission can become overheated, leading to transmission damage.

Complete a COLD CHECK procedure using the dipstick as follows:

1. Park the vehicle on a level surface, put the transmission in **N** (Neutral) and set the parking brake.
2. With the engine idling (500–800 rpm), shift to **D** (Drive) and then to **R** (Reverse) to clear air from the hydraulic circuits.
3. Run the engine at idle (500–800 rpm) in **N** (Neutral) for about one minute.
4. Clean debris from around the end of the fill tube before removing the dipstick.
5. Remove the dipstick and wipe it clean.
6. Insert the dipstick into the fill tube, pushing down until it stops, but still in its loose or unscrewed position.
7. Remove the dipstick and observe the fluid level. If the fluid on the dipstick is within the COLD CHECK band (Figure 2–6), the fluid level is satisfactory. If the fluid level is not within this band, add or drain as necessary to bring the level within the COLD CHECK band.
8. Perform a hot check at the first opportunity after the normal operating sump temperature of 71°C-93°C (160°F-200°F) is reached.

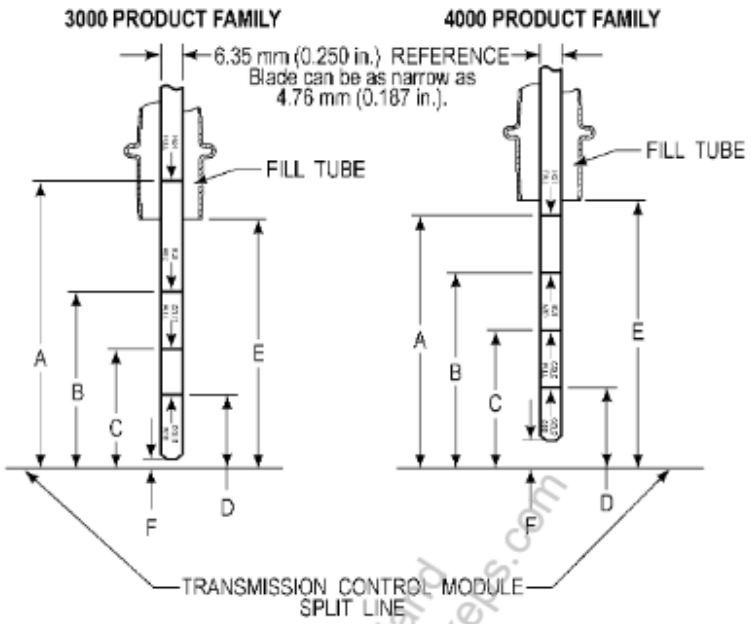
2.4.3 Hot Check Procedure.

CAUTION: When performing the Hot Check procedure, the fluid must be at operating temperature to be sure of an accurate check and help prevent transmission damage. The fluid level rises as temperature increases. During operation, an overfull transmission can become overheated leading to transmission damage.

To complete a HOT CHECK procedure using the dipstick do the following:

1. Be sure fluid has reached normal operating temperature of 71-93°C (160-200°F). If a transmission temperature gauge is not present, measure fluid level when the engine water temperature gauge has stabilized.
2. Park the vehicle on a level surface and shift to **N** (Neutral).
3. Apply the parking brake and allow the engine to idle (500-800 rpm).
4. Clean debris from around the end of the fill tube before removing the dipstick.
5. Remove the dipstick and wipe it clean.
6. Insert the dipstick into the fill tube, pushing down until it stops, but still in its loose or unscrewed position.

7. Remove the dipstick and observe the fluid level. The safe operating level is anywhere within the HOT RUN band on the dipstick (Figure 2–6).
8. If the fluid level is not within the HOT RUN band, add and/or drain as necessary to bring the fluid level to within the HOT RUN band.
9. Measure fluid level more than once. Be sure fluid level measurements are consistent. If readings are not consistent, be sure the transmission breather is clean and not clogged.



OIL SUMP	TRANSMISSION/SUMP DESCRIPTION	DIMENSION A	DIMENSION B	DIMENSION C	DIMENSION D	DIMENSION E	DIMENSION F**
2.00 in. and 4.00 in.	4000 PRODUCT FAMILY	106.7 mm (4.20 in.)	76.2 mm (3.00 in.)	66.0 mm (2.60 in.)	*	132.6 mm (5.22 in.)	13.8 mm (0.54 in.)
2.00 in.	3000 PRODUCT FAMILY	101.6 mm (4.00 in.)	73.7 mm (2.90 in.)	50.8 mm (2.00 in.)	*	86.6 mm (3.41 in.)	5.9 mm (0.23 in.)
4.00 in.	3000 PRODUCT FAMILY	101.6 mm (4.00 in.)	63.5 mm (2.50 in.)	45.7 mm (1.80 in.)	*	86.6 mm (3.41 in.)	5.9 mm (0.23 in.)

NOTE: Calibrate level marking locations with respect to transmission control module split line and fill tube.
Scale none.
*Dimension determined by installation.
**Reference dimension only. Actual dimension to be determined by installation.

5864

Figure 2–6. Standard 3000 and 4000 Product Family Dipstick Markings

2.4.4 Electronic Check Procedure. An Oil Level Sensor (OLS) is standard for all 3000 and 4000 families (except for 4700/4800 retarder series). The OLS has a detection range of up to LO 4 to HI 3 that can display on the selectors. The actual oil level to add may be greater than 4 liters (4.22 quarts) if the transmission is more than 4 liters (4.22 quarts) low from the full mark. The actual fluid volume to drain may be more than 3 liters (3.17 quarts) if the transmission is overfull by more than 3 liters (3.17 quarts). The transmission fluid level can be displayed on the shift selector or Allison DOC® display. Use the following procedure to display fluid level information.

NOTE: For the Allison DOC®, refer to the Allison DOC® User Guide GN7588EN.

1. Park the vehicle on a level surface and shift to **N** (Neutral). Apply the parking brake.
2. To enter oil level display mode:
   - Pushbutton shift selector—simultaneously press the ↑ (Upshift) and ↓ (Downshift) arrows once.
   - Bump-Shift Lever selector—press the **DISPLAY MODE/DIAGNOSTIC** (DMD) button once.
3. Correct fluid level is displayed as shown in Figure 2–7.

NOTE: The sensor display and the transmission dipstick may not agree exactly because the OLS compensates for fluid temperature.

Figure 2–7. Correct Fluid Level Display

4. Low fluid level is displayed and the number indicates the number of quarts of fluid the transmission requires (refer to Figure 2–8).

NOTE: Confirm a low fluid level condition by making a manual fluid level check.

Figure 2–8. Low Fluid Level Display

5. High fluid level is displayed followed by a number and the number indicates the number of quarts the transmission is overfilled (refer to Figure 2–9).

Figure 2–9. High Fluid Level Display

2.4.5 Fluid Level Display Criteria. If the proper conditions to measure oil level have been met, a countdown timer or oil level fault code will be displayed. The actual time remaining before a valid oil level reading can be taken will be displayed as: SETTLING 1:42; where 1:42 indicates the time remaining in minutes and seconds.

NOTE: The TCM delays the fluid level check until the following conditions are met:

- The fluid temperature is above 40°C (104°F) or below 104°C (220°F).
- The transmission is in **N** (Neutral).
- The vehicle has been stationary for approximately two minutes to allow the fluid to settle.
- The engine is at idle.

Invalid for Display is activated when conditions do not allow the fluid level to be determined. Refer to Table 2–1 to review the codes and conditions, and correct as necessary.

Table 2–1. Fluid Level Fault Codes

Code	Cause of Code
SETTLING / X	Settling time too short
ENGINE RPM / TOO LOW	Engine speed (RPM) too low
ENGINE RPM / TOO HIGH	Engine speed (RPM) too high
MUST BE / IN NEU	**N** (Neutral) must be selected
OIL TEMP / TOO LOW	Sump oil temperature too low
OIL TEMP / TOO HI	Sump oil temperature too high
VEH SPD / TOO HI	Output shaft speed
SENSOR FAILED	Sensor failure

To exit the oil level display mode:

- Pushbutton shift selector—press any range button on the pushbutton shift selector.
- Bump-Shift Lever selector—press the **DISPLAY MODE/DIAGNOSTIC** (DMD) button twice.
- For Allison DOC®, follow directions in the Allison DOC® User Guide GN7588EN.

2.5 KEEPING FLUID CLEAN

Prevent foreign material from entering the transmission by using clean containers, fillers, etc. Lay the dipstick in a clean place while filling the transmission.

CAUTION: Containers or fillers that have been used for antifreeze solution or engine coolant must **NEVER** be used for transmission fluid. Antifreeze and coolant solutions contain ethylene glycol which, if put into the transmission, can cause the clutch plates to fail.

2.6 FLUID RECOMMENDATIONS

Only use fluids meeting Allison Transmission specification TES 295® or TES 389 in the transmission. For a list of currently approved transmission fluids,

go to the Allison Transmission web site at: *www.allisontransmission.com*, select SERVICE, FLUIDS.

Take the Windows NT® following into consideration when selecting the appropriate fluid type for the transmission:

- Fluids meeting TES 295® specification are preferred over TES 389 fluids for use in all 3000/4000 Product Family transmission applications.
- TES 295® fluids are fully qualified for Severe Duty and Extended Drain intervals.
- A TES 295® fluid allows you to operate at a lower ambient temperature than a TES 389 type fluid. Refer to Table 2–2.
- A TES 389 fluid is the minimum fluid requirement approved for use in 3000 and 4000 Product Families transmissions.
- To extend the TES 389 fluid drain intervals beyond the recommended mileage or hours change interval, use a fluid analysis program. Refer to 2.7.3 Fluid Analysis.
- When choosing a fluid type to use, consider what the minimum fluid operating temperature of the fluid will be based on the ambient temperatures reached in the geographical location for the vehicle. Preheat with auxiliary heating equipment or by running the equipment or vehicle with the transmission in neutral for a minimum of 20 minutes before attempting range operation.

Table 2–2. Transmission Fluid Minimum Operating Temperature Requirements

Fluid type	Minimum Operating Temperature	
	Celsius	Fahrenheit
TES 295®	-35	-31
TES 389	-25	-13

2.7 TRANSMISSION FLUID AND FILTER CHANGE INTERVALS

CAUTION: Transmission fluid and filter change frequency is determined by the severity of transmission service. To help avoid transmission damage, more frequent changes may be necessary than recommended in the general guidelines due to operating conditions and duty cycle.

For the appropriate recommended change interval guidelines for your specific transmission configuration, refer to Table 2–3, Table 2–4, or Table 2–5.

CAUTION: Transmission fluid and filters **must be changed** whenever there is evidence of dirt or high temperature conditions. A high temperature condition is indicated when the transmission fluid is discolored, has a strong odor, or has exceeded oil analysis limits.

There are three methods recommended by Allison Transmission to help you determine when to change the fluid and filters in your Allison Transmission. The methods are as follows:

- When a Prognostics indicator becomes active (shown by illuminating the **TRANS SERVICE** indicator in the selector VF display).

NOTE: The strip pushbutton selector has no display and is not prognostics capable.

- When recommendations listed in the Fluid and Filter Change Interval Tables are met. Refer to Table 2–3, Table 2–4, or Table 2–5.
- When a fluid analysis program indicates a fluid change is necessary. Filter changes must still occur based on either of the events occurring above.

2.7.1 Fluid And Filter Changes. If using gold series filters, change the main filter after the first 8000 km (5000 miles) then follow the recommended fluid and filter change intervals found in Table 2–4 and Table 2–5.

The tables are provided only as a general guide for fluid and filter change intervals. Local conditions, severity of operation, or duty cycle may require more or less frequent fluid change intervals that differ from the published recommended fluid change intervals of Allison Transmission. Use fluid analysis to optimize transmission protection and fluid change intervals. Change filters at or before the recommended intervals. Refer to SIL 10-TR-99.

2.7.2 High Capacity Filters. Allison 3000/4000 Product Families transmission high capacity filters allow extended filter change intervals when used with an Allison approved TES 295® fluid. High capacity filters can be identified by P/N 29545777 or P/N 29545780 stamped into the filter end cap. Previous Allison 3000/4000 Product Families transmission filters can be identified by P/N 29538231 or P/N 29538232 stamped into the filter end cap. When replacing gold series filters with high capacity filters in transmissions containing 100 percent Allison approved TES 295® fluid, following the high capacity fluid and filter change intervals is allowed. Refer to Table 2–3, Table 2–4, and Table 2–5.

Table 2–3. Prognostics On Fluid and Filter Change Intervals

	Fluid Change Intervals	High Capacity** Main and Lube Filter Change Intervals	Suction Filter Assembly Change Interval
TES 295® Fluids*	Whichever is first of the following: • If the **TRANS SERVICE** indicator in the shift selector is illuminated steady for 2 minutes after **D** (Drive) is selected • 60 calendar months** **NOTE:** Always replace main and lube filters with the fluid change**.	Whichever is first of the following: • If the **TRANS SERVICE** indicator in the shift selector is flashing on and off for 2 minutes after **D** (Drive) is selected • Any time the fluid is changed • 60 calendar months**	At time of transmission overhaul

Table 2–3. Prognostics On Fluid and Filter Change Intervals *(cont'd)*

	Fluid Change Intervals	High Capacity** Main and Lube Filter Change Intervals	Suction Filter Assembly Change Interval
TES 389 Fluids*	Whichever is first of the following: • If the **TRANS SERVICE** indicator in the shift selector is illuminated steady for 2 minutes after **D** (Drive) is selected • 24 calendar months** **NOTE:** Always replace main and lube filters with the fluid change**.	Whichever is first of the following: • If the **TRANS SERVICE** indicator in the shift selector is flashing on and off for 2 minutes after **D** (Drive) is selected • Any time the fluid is changed • 24 calendar months**	At time of transmission overhaul

* Either TES 295® or TES 389 fluid types are required to use the Oil Life Monitor (OM) feature with Prognostics on as shown in this table. A mixture of TES 389 and TES 295® fluid must continue to use the TES 389 schedule shown in this table until two fluid changes with only TES 295® fluid have occurred, at which time the TES 295® schedule may be used.
** Allison Transmission High Capacity filters are required in order to use the Filter Life Monitor (FM) feature with Prognostics as shown in this table.

Table 2–4. Prognostics Disabled or Turned Off Fluid and Filter Change Intervals

General Vocation* Refer to Table 2–5 for additional information on severe vocations.			
	Fluid Change Intervals	**High Capacity*** Main and Lube Filter Change Intervals**	**Suction Filter Assembly Change Interval**
TES 295® Fluids**	Whichever is first of the following: • 480 000 km (300,000 miles) • 6000 hours of operation • 48 calendar months **NOTE:** Always replace main and lube filters with the fluid change***.	Whichever is first of the following: • Any time the fluid is changed • 120 000 km (75,000 miles) • 3000 hours of operation • 36 calendar months	At time of transmission overhaul
TES 389 Fluids**	Whichever is first of following: • 40 000 km (25,000 miles) • 1000 hours of operation • 12 calendar months **NOTE:** Always replace main and lube filters with the fluid change***.	Whichever is first of the following: • Any time the fluid is changed • 40 000 km (25,000 miles) • 1000 hours of operation • 12 calendar months	At time of transmission overhaul

* General Vocation includes all non-retarder transmissions not identified as severe, and intercity coaches with duty cycles of less than one stop per mile.
**A mixture of TES 389 and TES 295® fluid must continue to use the TES 389 schedule shown in this table until two fluid changes with only TES 295® fluid have occurred, at which time the TES 295® schedule may be used.
***This information is based on using Allison Transmission High Capacity filters and a TES 389 or TES 295® fluid type with Prognostics Features not available or turned off.

Table 2–5. Prognostics Disabled or Turned Off Fluid and Filter Change Intervals

Severe Vocation*			
	Fluid Change Intervals	**High Capacity** Main and Lube Filter Change Intervals**	**Suction Filter Assembly Change Interval**
TES 295® Fluids***	Whichever is first of the following: • 240 000 km (150,000 miles) • 6000 hours of operation • 48 calendar months **NOTE:** Always replace main and lube filters with the fluid change**.	Whichever is first of the following: • Any time the fluid is changed • 120 000 km (75,000 miles) • 3000 hours of operation • 36 calendar months	At time of transmission overhaul
TES 389 Fluids***	Whichever is first of the following: • 20 000 km (12,000 miles) • 500 hours of operation • 6 calendar months **NOTE:** Always replace main and lube filters with the fluid change **.	Whichever is first of the following: • Any time the fluid is changed • 20 000 km (12,000 miles) • 500 hours of operation • 6 calendar months	At time of transmission overhaul

* Severe Vocation includes all retarder-equipped transmissions, or vocations for On/Off Highway, Refuse, Transit, and Intercity Coach with duty cycle greater than one (1) stop per mile.
** This information is based on using Allison Transmission High Capacity filters and a TES 389 or TES 295® fluid type with Prognostics Features not available or turned off.
*** A mixture of TES 389 and TES 295® fluid must continue to use the TES 389 schedule shown in this table until two fluid changes with only TES 295® fluid have occurred, at which time the TES 295® schedule may be used.

2.7.3 Fluid Analysis. Transmissions used in high cycle rate applications should use fluid analysis to make sure fluid is changed as soon as needed. Transmission protection and fluid change intervals may be optimized by monitoring fluid oxidation according to the tests and limits, refer to Table 2–6. Refer to the Technician's Guide for Automatic Transmission Fluid, GN2055EN, or SIL 17-TR-96 for additional information.

Table 2–6. Fluid Oxidation Measurement Limits

Test	Limit
Viscosity	±25% change from new fluid
Total Acid Number (TAN)	+3.0* change from new fluid
Solids	0.2 percent by volume

*mg of potassium hydroxide (KOH) to neutralize a gram of fluid.

2.8 TRANSMISSION FLUID CONTAMINATION

2.8.1 Fluid Examination. At each fluid change, examine the drained fluid for evidence of dirt or water. A normal amount of condensation will appear in the fluid during operation.

2.8.2 Water. Obvious water contamination of the transmission fluid or transmission fluid in the heat exchanger water indicates a leak between the water and fluid areas of the cooler. Inspect and pressure test the cooler to confirm the leak. Replace leaking coolers.

NOTE: Cooler water can also be contaminated by engine oil. Be sure to locate the actual source of cooler water contamination.

2.8.3 Engine Coolant. Engine coolant in the transmission hydraulic system requires immediate action to prevent malfunction and possible serious transmission damage. Completely disassemble, inspect, and clean the transmission. Remove all traces of the coolant and varnish deposits resulting from engine coolant contamination (ethylene glycol).

Any trace of glycol or greater than 0.2 percent water contamination requires complete disassembly and cleanup of the transmission and replacement of seals, gaskets, clutch plates, and bearings. Solenoid resistance should be measured and checked against the specifications. Solenoids not within specification should be replaced. Refer to SIL 18-TR-98.

2.8.4 Metal. Metal particles in the fluid (except for minute particles normally trapped in the oil filter) indicate internal transmission damage. If these particles are found in the sump, the transmission must be disassembled and closely inspected to find their source. Metal contamination requires complete transmission disassembly. Clean all internal and external hydraulic circuits, cooler, and all other areas where the particles could lodge.

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

2.9 TRANSMISSION FLUID AND FILTER CHANGE PROCEDURE

2.9.1 Drain Fluid.

NOTE: Do not drain the transmission if replacing only the filters.

WARNING: Avoid contact with hot fluid or the sump when draining transmission fluid. Direct contact with hot fluid or the hot sump may result in bodily injury.

1. Drain the fluid when the transmission is at normal operating sump temperature: 71°C–93°C (160°F–200°F). Hot fluid flows quicker and drains more completely.
2. Remove the drain plug from the oil pan and allow the fluid to drain into a suitable container.
3. Examine the fluid as described in 2.8 TRANSMISSION FLUID CONTAMINATION, 2.8.1 Fluid Examination.

2.9.2 Replace Filters.

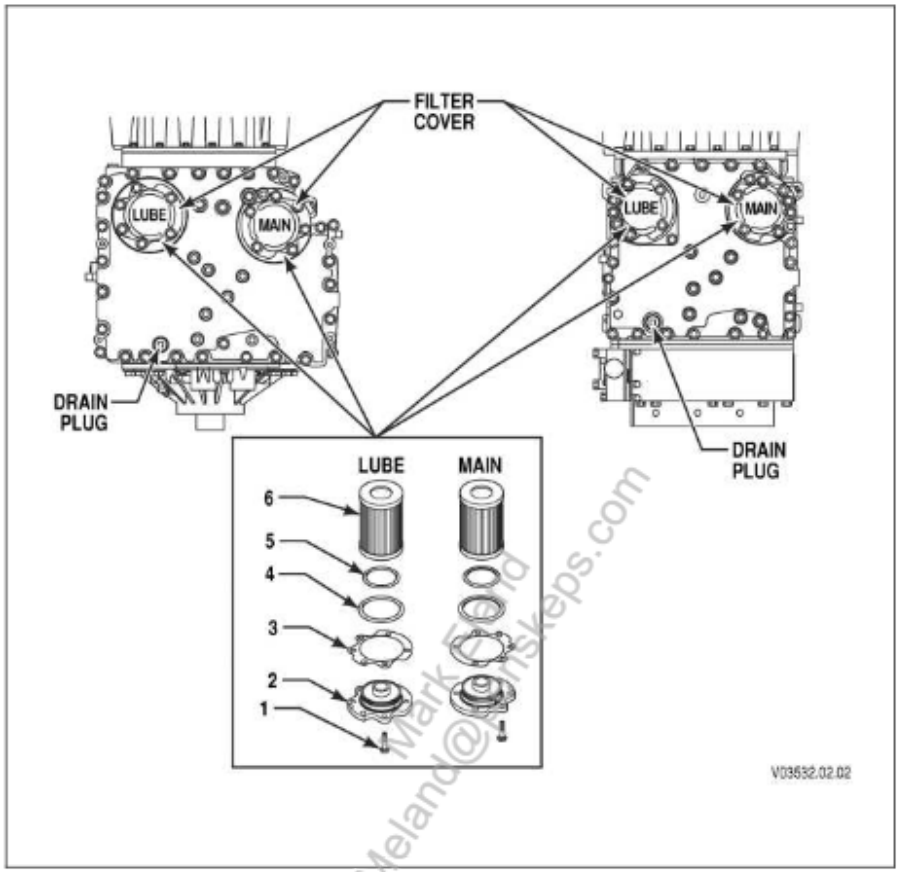


Figure 2–10. Location of Filters for Service

1. Remove twelve bolts (1), two filter covers (2), two gaskets (3), two O-rings (4), two O-rings (5), and two filters (6) from the bottom of the control module.
2. When reinstalling parts, lubricate and install new O-rings (4) and (5) on each cover. Lubricate O-ring inside filter 6 and push filter onto each cover (2). Install new gaskets (3) on each cover (2) and align bolt holes in gasket with holes in cover.
3. Install filter cover assemblies into the filter compartments. Align each filter/cover assembly with the holes in the bottom of the control module. Push the cover assemblies in by hand to seat the seals.

CAUTION: Do not use the bolts to draw the filter covers to the control module. Do not use an impact wrench to tighten the bolts. Using an impact wrench to tighten the bolts may cause stripped threads and expensive parts replacement. Use a torque wrench to tighten the bolts.

4. Install six bolts into each cover assembly and tighten to 51–61 N·m (38–45 lb ft).
5. Replace the drain plug O-ring. Install the drain plug and tighten to 25–32 N·m (18–25 lb ft).

2.9.3 Refill Transmission. The fluid refill volume will be less than the volume listed for the initial fill due to some fluid remaining in the external circuits as well as in various transmission component cavities. After refill, verify the fluid level is correct.

NOTE: Quantities listed in Table 2–7 are approximate and do not include external lines and cooler hoses.

Table 2–7. Transmission Fluid Capacity

Transmission	Sump	Initial Refill		Refill	
		Liters	Quarts	Liters	Quarts
3000 Product Family	4 inch	27	29	18	19
	2 inch	25	26	16	17
4000 Product Family*	4 Inch	48	51	40	42
	2 Inch	41	43	33	35

* Subtract 2.8 Liters (3 Quarts) for transmissions without PTO.

2.10 FLUID LEAK DIAGNOSIS

2.10.1 Finding the Leak.

1. Identify the fluid. Determine whether the fluid is engine oil, automatic transmission fluid, or hydraulic fluid from a particular 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. Refer to the following list for possible points of transmission fluid leaks and their causes.

- Transmission mating surfaces:
  - Attaching bolts not correctly aligned
  - Improperly installed or damaged gasket
  - Mating surface(s) damaged
- Housing leak:
  - Fill tube or plug seal damaged or missing
  - Fill tube bracket dislocated
  - Oil cooler connector fittings loose or damaged
  - Output shaft seals worn-out or damaged
  - Pressure port plugs loose
  - Porous casting
- Leak at converter end:
  - Converter seal damaged
  - Seal lip cut—check converter hub for damage
  - Garter spring missing from seal
  - Converter leak in weld area or O-ring seal
  - Porous casting
- Fluid comes out of fill tube:
  - Overfilled—incorrect dipstick
  - Plugged vent
  - Water or coolant in fluid—fluid appears milky
  - Incorrect electronic fluid indication
  - Drain-back holes plugged

3. Visually inspect the suspected area. Inspect all gasket mating surface for leaks.
4. If the leak still cannot be identified, 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 leak source still cannot be identified, use the powder method, and/or the black light and dye method as explained below.

2.10.2 Powder Method.

1. Clean the suspected area.
2. Apply an aerosol-type white powder to the suspected area.
3. Operate the vehicle under normal operating conditions.

4. Visually inspect the suspected area and trace the leak path over the white powder.

2.10.3 Black Light and Dye Method. A dye and black light kit for finding leaks is available. Refer to the manufacturer's directions when using the kit. Refer to the kit directions for the color of the fluid/dye mix.

1. Pour the specified amount of dye into the transmission fill tube.
2. Operate the vehicle under normal operating conditions.
3. Direct the black light toward the area suspected of leaking. Dyed fluid will appear as a brightly colored path leading to the leak.

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

- Gaskets:
  - Fluid level/pressure is too high
  - Plugged vent or drain-back holes
  - Improperly tightened fasteners or damaged threads
  - Warped flanges or sealing surfaces
  - Scratches, burrs, or other damage to sealing surfaces
  - Damaged or worn-out gasket
  - Cracked or porous casting
  - Improper sealant used, where applicable
- Seals:
  - Fluid level/pressure is too high
  - Plugged vent or drain-back hole
  - Damaged seal bore
  - Damaged or worn-out seal
  - Improper seal installation
  - Cracks in component
  - Output shaft surface scratched, nicked, or damaged
  - Loose or worn-out bearing causing excess seal wear
- Sealing Flange:
  - Inspect the sealing flange for bends; replace the sealing flange if bent

2.11 BREATHER

2.11.1 Location and Purpose. The breather is located on top of the transmission converter housing. The breather prevents air pressure buildup within the transmission and its passage must be kept clean and open.

2.11.2 Maintenance. The amount of dust and dirt encountered will determine the frequency of breather cleaning. Use care when cleaning the transmission.

> **CAUTION: DO NOT SPRAY STEAM, WATER OR CLEANING SOLUTION DIRECTLY AT THE BREATHER. Spraying steam, water or cleaning solution at the breather can force water or cleaning solution into the transmission and contaminate the transmission fluid.**

2.11.3 Replacement. Always use a correctly sized wrench to remove or replace the breather. Using pliers or a pipe wrench can crush or damage the breather stem and produce metal particles which could enter the transmission. Tighten the breather to 12–16 N·m (9–12 lb ft).

2.12 TROUBLESHOOTING

> **NOTE:** For Diagnostic Trouble Codes (DTCs) troubleshooting, connector repair procedures, and system wiring diagrams refer to Troubleshooting Manual TS7149EN.

2.12.1 Before Starting. Identify the fault condition and its probable cause before attempting to repair the transmission.

2.12.2 CHECK TRANS Light. When the Transmission Control Module (TCM) detects a serious fault, the **CHECK TRANS** light illuminates and action is automatically taken to protect operator, vehicle, and the transmission. A DTC will nearly always be registered when the **CHECK TRANS** light is on; however, not all DTCs turn on the **CHECK TRANS** light.

Illumination of the **CHECK TRANS** light indicates that a condition was detected that requires service attention. Operation may or may not be restricted. Depending upon the cause for the **CHECK TRANS** light illumination, the TCM may or may not respond to shift selector requests. The transmission may be locked in a range. That range will be shown on the shift selector display. Both upshifts and downshifts may be restricted when the **CHECK TRANS** light is illuminated.

Each time the engine is started, the **CHECK TRANS** light illuminates briefly and then goes off. This momentary lighting shows the light circuit is working properly.

2.12.3 Entering Diagnostic Mode.

NOTE: The strip style pushbutton shift selector has no display or diagnostic capabilities. Use the Allison DOC® to display DTCs.

NOTE: An Oil Level Sensor (OLS) is standard with 5th Generation Controls except on 4700/4800 retarder equipped models.

---

1. Accessing Oil Level, Prognostics, and DTCs using a lever shift selector.

   The **DISPLAY MODE/DIAGNOSTIC** (DMD) button provides access to oil level, Prognostics and DTC information.

   To access oil level, Prognostics, and DTCs:

   - Move the bump-shift lever to **N** (Neutral) and apply the parking brake.
   - Press the **DISPLAY MODE/DIAGNOSTIC** (DMD) button once to access oil level information.
   - Press the **DISPLAY MODE/DIAGNOSTIC** (DMD) button again to access the Oil Life Monitor (OM) (if Prognostics is available).
   - Press the **DISPLAY MODE/DIAGNOSTIC** (DMD) button again to access the Filter Life Monitor (FM) (if Prognostics is available).
   - Press the **DISPLAY MODE/DIAGNOSTIC** (DMD) button again to access the Transmission Health Monitor (TM) (if Prognostics is available).
   - Press the **DISPLAY MODE/DIAGNOSTIC** (DMD) button again to access the DTC information.
   - Press the **MODE** button to view subsequent code positions d2 through d5.
   - To exit DTC mode, move the bump-shift lever to any range. After approximately 10 minutes of inactivity at the bump-shift lever selector, the diagnostic mode automatically exits and returns to normal operating mode.

2. Accessing oil level, Prognostics, and DTCs using a keypad pushbutton shift selector.

   To access oil level, Prognostics, and DTCs, do the following:

- Select **N** (Neutral) and apply the parking brake.
- Simultaneously press the ↑ (Upshift) and ↓ (Downshift) arrows once to access oil level information.
- Simultaneously press the ↑ (Upshift) and ↓ (Downshift) arrows again to access the Oil Life Monitor (OM) (if Prognostics is available).
- Simultaneously press the ↑ (Upshift) and ↓ (Downshift) arrows again to access the Filter Life Monitor (FM) (if Prognostics is available).
- Simultaneously press the ↑ (Upshift) and ↓ (Downshift) arrows again to access the Transmission Health Monitor (TM) (if Prognostics is available).
- Simultaneously press the ↑ (Upshift) and ↓ (Downshift) arrows again to access the DTCs.
- Press the **MODE** button to view subsequent code positions d2 through d5.
- To exit DTC mode, press any range button, **D** (Drive), **N** (Neutral). **R** (Reverse). After approximately 10 minutes of inactivity at the pushbutton shift selector, the diagnostic mode automatically exits and returns to normal operating mode.

2.12.4 Diagnostic Trouble Codes (DTCs). DTCs can be displayed on the display portion of the shift selector or Allison DOC®. A DTC is either active or historic. An active DTC is any DTC that is current in the TCM decision making process. Historic DTCs are retained in the TCM memory and do not necessarily affect the TCM decision making process.

2.12.5 Displaying Diagnostic Trouble Codes (DTCs). Up to five DTCs may be displayed one at a time from the selector once the diagnostic display mode has been initiated. Each DTC is 5 characters in length. The DTC status active or inactive is shown below the DTC (refer to Figure 2–11).

Figure 2–11. DTC Display

Press the **MODE** button to read the next DTC in the queue (if any) or requests to exit diagnostics mode. The diagnostics mode times out and returns the selector to normal operating mode after approximately 10 minutes of inactivity.

The first character identifies the area of the function of the device which malfunctioned.

- B = Body
- C = Chassis
- P = Powertrain
- U = Network or Datalink

The second character identifies whether the DTC is controlled by the manufacturer or by SAE/ISO.

- 0 or 2 = SAE/ISO controlled
- 1= Manufacturer controlled
- 3 = Either SAE/ISO or Manufacturer controlled

The third position is a hexadecimal value identifying the area of the vehicle system.

- 0 = Fuel and Air Metering and Auxiliary Emission Controls
- 1 = Fuel and Air Metering and Auxiliary Emission Controls
- 2 = Fuel and Air Metering and Auxiliary Emission Controls
- 3 = Ignition System or Misfire
- 4 = Auxiliary Emission Controls
- 5 = Vehicle Speed, Idle Control and Auxiliary Inputs
- 6 = Computer and Auxiliary Outputs
- 7 = Transmission
- 8 = Transmission
- 9 = Transmission
- A = Hybrid

The final two digits identify a specific fault.

The process for displaying DTCs differs between the two shift selector styles:

- Keypad Pushbutton selectors with Prognostics On:
  - Simultaneously press the ↑ (Upshift) and ↓ (Downshift) arrows five times.
  - Press the **MODE** button to read the next code in the queue, if any.

NOTE: For 4700/4800 transmissions equipped with a retarder, press the ↑ (Upshift) and ↓ (Downshift) arrows four times.

- Keypad Pushbutton selectors with Prognostics Off
  - Simultaneously press the ↑ (Upshift) and ↓ (Downshift) arrows two times.
  - Press the **MODE** button to read the next code in the queue, if any.

NOTE: For 4700/4800 transmissions equipped with a retarder, press the ↑ (Upshift) and ↓ (Downshift) arrows once.

- Bump-Shift Lever selectors with Prognostics On:
  - Press the **DISPLAY MODE/DIAGNOSTIC** five times.
  - Press the **MODE** button to read the next code in the queue, if any.

NOTE: For 4700/4800 transmissions equipped with a retarder, press the **DISPLAY MODE/DIAGNOSTIC** button four times.

- Bump-Shift Lever selectors with Prognostics Off:
  - Press the **DISPLAY MODE/DIAGNOSTIC** two times.
  - Press the **MODE** button to read the next code in the queue, if any.

NOTE: For 4700/4800 transmissions equipped with a retarder, press the **DISPLAY MODE/DIAGNOSTIC** button once.

2.12.6 Exiting Diagnostic Mode. Use any of the following methods to exit the diagnostic display mode:

1. With pushbutton shift selectors, simultaneously press the ↑ (Upshift) and ↓ (Downshift) arrows once or press any range button, **D** (Drive), **N** (Neutral), or **R** (Reverse). If the shift is not inhibited by an active DTC, the TCM commands the transmission to shift to the selected range.
2. With bump-shift lever selectors, momentarily press the **MODE** button once or move the bump-shift selector to any shift position other than the one selected when diagnostic display mode was activated. If the shift is inhibited due to a service condition, the TCM continues to command the current transmission range attained. Return the lever to its previous position.

3. Wait until time-out (approximately 2 minutes). The systems automatically return to the normal operating mode.
4. Turn off the vehicle engine with the ignition switch, which turns power off to the TCM.

2.12.7 DTC List and Descriptions.

Table 2–8. DTC List and Descriptions

DTC	Description	CHECK TRANS Light	Inhibited Operation Description
C1312	Retarder Request Sensor Circuit Low	No	May inhibit retarder operation if not using J1939 datalink
C1313	Retarder Request Sensor Circuit High	No	May inhibit retarder operation if not using J1939 datalink
P0122	Pedal Position Sensor Circuit Low Voltage	No	Use default throttle values. Freezes shift adapts.
P0123	Pedal Position Sensor Circuit High Voltage	No	Use default throttle values. Freezes shift adapts.
P0218	Transmission Fluid Over Temperature	Yes	Use default sump temp
P0562	System Voltage Low	No	Inhibit TCC Operation, DNA
P0602	TCM Not Programmed	Yes	Lock in Neutral
P0604	Control Module Random Access Memory (RAM)	Yes	Lock in Neutral
P0614	Torque Control Data Mismatch—ECM/TCM	Yes	Allows operation only in reverse and second range
P0634	TCM Internal Temperature Too High	Yes	SOL OFF (hydraulic default)
P0642	Sensor Reference Voltage “A” Circuit Low	Yes	Default sensor data used
P0643	Sensor Reference Voltage “A” Circuit High	Yes	Default sensor data used

Table 2–8. DTC List and Descriptions *(cont'd)*

DTC	Description	CHECK TRANS Light	Inhibited Operation Description
P0657	Actuator Supply Circuit Voltage 1 Open (HSD1)	Yes	SOL OFF, DNA, Inhibit TCC operation, Inhibit main modulation
P0658	Actuator Supply Circuit Voltage 1 Circuit Low (HSD1)	Yes	DNS, SOL OFF (hydraulic default)
P0659	Actuator Supply Circuit Voltage 1 Circuit High (HSD1)	Yes	DNS, SOL OFF (hydraulic default)
P0703	Brake Switch Circuit	No	No Neutral to Drive shifts for refuse packer. TCM inhibits retarder operation if a TPS code is also active.
P0708	Transmission Range Sensor Circuit High	Yes	Ignore defective strip selector inputs
P070C	Transmission Fluid Level Sensor Circuit Low	No	None
P070D	Transmission Fluid Level Sensor Circuit High	No	None
P0712	Transmission Fluid Temperature Sensor Circuit Low	Yes	Use default sump temp
P0713	Transmission Fluid Temperature Sensor Circuit High	Yes	Use default sump temp
P0715	Turbine Shaft Speed Sensor Circuit	Yes	DNS, Lock in current range
P0716	Turbine Shaft Speed Sensor Circuit Performance	Yes	DNS, Lock in current range
P0717	Turbine Shaft Speed Sensor Circuit No Signal	Yes	DNS, Lock in current range
P071A	RELS Input Failed On	Yes	Inhibit RELS operation
P071D	General Purpose Input Fault	Yes	None

Table 2–8. DTC List and Descriptions *(cont'd)*

DTC	Description	CHECK TRANS Light	Inhibited Operation Description
P0720	Output Shaft Speed Sensor Circuit	Yes	DNS, Lock in current range
P0721	Output Shaft Speed Sensor Circuit Performance	Yes	DNS, Lock in current range
P0722	Output Shaft Speed Sensor Circuit No Signal	Yes	DNS, Lock in current range
P0725	Engine Speed Sensor Circuit	No	Default to turbine speed
P0726	Engine Speed Sensor Circuit Performance	No	Default to turbine speed
P0727	Engine Speed Sensor Circuit No Signal	No	Default to turbine speed
P0729	Incorrect 6th Gear Ratio	Yes	DNS, Attempt 5th, then 3rd
P0731	Incorrect 1st Gear Ratio	Yes	DNS, Attempt 2nd, then 5th
P0732	Incorrect 2nd Gear Ratio	Yes	DNS, Attempt 3rd, then 5th
P0733	Incorrect 3rd Gear Ratio	Yes	DNS, Attempt 4th, then 6th
P0734	Incorrect 4th Gear Ratio	Yes	DNS, Attempt 5th, then 3rd
P0735	Incorrect 5th Gear Ratio	Yes	DNS, Attempt 6th, then 3rd, then 2nd
P0736	Incorrect Reverse Ratio	Yes	DNS, Lock in Neutral
P0741	Torque Converter Clutch (TCC) System Stuck Off	Yes	None
P0752	Shift Solenoid 1 Valve Performance–Stuck On	Yes	DNS
P0776	Pressure Control Solenoid (PCS) 2 Stuck Off	Yes	DNS, RPR

Table 2–8. DTC List and Descriptions *(cont'd)*

DTC	Description	CHECK TRANS Light	Inhibited Operation Description
P0777	Pressure Control Solenoid (PCS) 2 Stuck On	Yes	DNS, RPR
P077F	Incorrect Reverse 2 Ratio	Yes	DNS, Lock in Neutral
P0796	Pressure Control Solenoid (PCS) 3 Stuck Off	Yes	DNS, RPR
P0797	Pressure Control Solenoid (PCS) 3 Stuck On	Yes	DNS, RPR
P0842	Transmission Fluid Pressure Switch 1 Circuit Low	Yes	DNS, Lock in current range
P0843	Transmission Fluid Pressure Switch 1 Circuit High	Yes	DNS, Lock in current range
P0847	Transmission Fluid Pressure Switch 2 Circuit Low	Yes	None
P0848	Transmission Fluid Pressure Switch 2 Circuit High	Yes	None
P0880	TCM Power Input Signal	No	None
P0881	TCM Power Input Signal Performance	No	None
P0882	TCM Power Input Signal Low	Yes	DNS, SOL OFF (hydraulic default)
P0883	TCM Power Input Signal High	No	None
P088A	Transmission Filter Maintenance Alert	No	None
P088B	Transmission Filter Maintenance Required	No	None
P0894	Unexpected Mechanical Gear Disengagement	Yes	DNS, Lock in first

Table 2–8. DTC List and Descriptions *(cont'd)*

DTC	Description	CHECK TRANS Light	Inhibited Operation Description
P0897	Transmission Fluid Deteriorated	No	None
P0960	Main Pressure Modulation Solenoid Control Circuit Open	Yes	None
P0962	Main Pressure Modulation Solenoid Control Circuit Low	Yes	DNS, SOL OFF (hydraulic default)
P0963	Main Pressure Modulation Solenoid Control Circuit High	Yes	None
P0964	Pressure Control Solenoid (PCS) 2 Control Circuit Open	Yes	DNS, SOL OFF (hydraulic default)
P0966	Pressure Control Solenoid (PCS) 2 Control Circuit Low	Yes	DNS, SOL OFF (hydraulic default)
P0967	Pressure Control Solenoid (PCS) 2 Control Circuit High	Yes	DNS, SOL OFF (hydraulic default)
P0968	Pressure Control Solenoid (PCS) 3 Control Circuit Open	Yes	DNS, SOL OFF (hydraulic default)
P0970	Pressure Control Solenoid (PCS) 3 Control Circuit Low	Yes	DNS, SOL OFF (hydraulic default)
P0971	Pressure Control Solenoid (PCS) 3 Control Circuit High	Yes	DNS, SOL OFF (hydraulic default)
P0973	Shift Solenoid 1 Control Circuit Low	Yes	DNS, SOL OFF (hydraulic default)
P0974	Shift Solenoid 1 Control Circuit High	Yes	DNS, SOL OFF (hydraulic default)
P0976	Shift Solenoid 2 Control Circuit Low	Yes	7-speed: Allow 2 through 6, N, R. Inhibit TCC operation

Table 2–8. DTC List and Descriptions *(cont'd)*

DTC	Description	CHECK TRANS Light	Inhibited Operation Description
P0977	Shift Solenoid 2 Control Circuit High	Yes	7-speed: Allow 2 through 6, N, R
P097A	Shift Solenoid 1 Control Circuit Open	Yes	Lock in range
P097B	Shift Solenoid 2 Control Circuit Open	Yes	7-speed: Allow 2 through 6, N, R
P0989	Retarder Pressure Sensor Circuit Low	No	None
P0990	Retarder Pressure Sensor Circuit High	No	None
P1739	Incorrect Low Gear Ratio	Yes	Command 2nd and allow shifts 2 through 6, N, R
P1790	Gear Shift Module 1 Calibrated Invalid	Yes	Shift selector language or units incorrect
P1791	Gear Shift Module 2 Calibrated Invalid	Yes	Shift selector language or units incorrect
P1891	Throttle Position Sensor PWM Signal Low	No	Use default throttle values
P1892	Throttle Position Sensor PWM Signal High	No	Use default throttle values
P2184	Engine Coolant Temperature Sensor 2 Circuit Low	No	Use default engine coolant values
P2185	Engine Coolant Temperature Sensor 2 Circuit High	No	Use default engine coolant values
P2637	Torque Management Feedback Signal A	Yes	Inhibit SEM
P2641	Torque Management Feedback Signal B	Yes	Inhibit LRTP
P2669	Actuator Supply Circuit Voltage 2 Open (HSD2)	Yes	SOL OFF, Inhibit TCC operation, Inhibit Main modulation, DNA
P2670	Actuator Supply Circuit Voltage Low (HSD2)	Yes	DNS, SOL OFF (hydraulic default)

Table 2–8. DTC List and Descriptions *(cont'd)*

DTC	Description	CHECK TRANS Light	Inhibited Operation Description
P2671	Actuator Supply Circuit Voltage 2 High (HSD2)	Yes	DNS, SOL OFF (hydraulic default)
P2684	Actuator Supply Circuit Voltage 3 Open (HSD3)	Yes	SOL OFF, Inhibit TCC operation, Inhibit Main modulation, DNA
P2685	Actuator Supply Circuit Voltage 3 Low (HSD3)	Yes	DNS, SOL OFF (hydraulic default)
P2686	Actuator Supply Circuit Voltage 3 High (HSD3)	Yes	DNS, SOL OFF (hydraulic default)
P2714	Pressure Control Solenoid (PCS) 4 Stuck Off	Yes	DNS, RPR
P2715	Pressure Control Solenoid (PCS) 4 Stuck On	Yes	DNS, SOL OFF (hydraulic default)
P2718	Pressure Control Solenoid (PCS) 4 Control Circuit Open	Yes	DNS, SOL OFF (hydraulic default)
P2720	Pressure Control Solenoid (PCS) 4 Control Circuit Low	Yes	DNS, SOL OFF (hydraulic default)
P2721	Pressure Control Solenoid (PCS) 4 Control Circuit High	Yes	DNS, SOL OFF (hydraulic default)
P2723	Pressure Control Solenoid (PCS) 1 Stuck Off	Yes	DNS, RPR
P2724	Pressure Control Solenoid (PCS) 1 Stuck On	Yes	DNS, RPR
P2727	Pressure Control Solenoid (PCS) 1 Control Circuit Open	Yes	DNS, SOL OFF (hydraulic default)
P2729	Pressure Control Solenoid (PCS) 1 Control Circuit Low	Yes	DNS, SOL OFF (hydraulic default)

Table 2–8. DTC List and Descriptions *(cont'd)*

DTC	Description	CHECK TRANS Light	Inhibited Operation Description
P2730	Pressure Control Solenoid (PCS) 1 Control Circuit High	Yes	DNS, SOL OFF (hydraulic default)
P2736	Pressure Control Solenoid (PCS) 5 Control Circuit Open	Yes	Inhibit retarder operation
P2738	Pressure Control Solenoid (PCS) 5 Control Circuit Low	Yes	Allow 2 through 6, N, R. Inhibit retarder and TCC operation
P2739	Pressure Control Solenoid (PCS) 5 Control Circuit High	Yes	Inhibit retarder operation
P273F	Retarder Oil Temperature Sensor Over Temperature Condition	No	None
P2742	Retarder Oil Temperature Sensor Circuit Low	No	Use default retarder temp values
P2743	Retarder Oil Temperature Sensor Circuit High	No	Use default retarder temp values
P2761	Torque Converter Clutch (TCC) Pressure Control Solenoid (PCS) Control Circuit Open	Yes	Inhibit TCC operation
P2763	Torque Converter Clutch (TCC) Pressure Control Solenoid (PCS) Control Circuit High	Yes	Inhibit TCC operation
P2764	Torque Converter Clutch (TCC) Pressure Control Solenoid (PCS) Control Circuit Low	Yes	7-speed: allow 2 through 6, N, R. Inhibit TCC operation
P2789	Transmission Clutch Life Expired (Clutch Adaptive Learning at Limit)	Yes	None
P2793	Gear Shift Direction Circuit	Yes	Ignores PWM input from shift selector

Table 2–8. DTC List and Descriptions *(cont'd)*

DTC	Description	CHECK TRANS Light	Inhibited Operation Description
P2808	Pressure Control Solenoid (PCS) 6 Stuck Off	Yes	DNS, RPR
P2809	Pressure Control Solenoid (PCS) 6 Stuck On	Yes	DNS, RPR
P2812	Pressure Control Solenoid (PCS) 6 Control Circuit Open	Yes	DNS, SOL OFF (hydraulic default)
P2814	Pressure Control Solenoid (PCS) 6 Control Circuit Low	Yes	DNS, SOL OFF (hydraulic default)
P2815	Pressure Control Solenoid (PCS) 6 Control Circuit High	Yes	DNS, SOL OFF (hydraulic default)
U0073	CAN Communication Bus 1 Off	No	Use default values
U0074	CAN Communication Bus 2 Off	No	Use default values
U0100	Lost Communications with ECM A	Yes	Use default values
U0103	Lost Communication With Gear Shift Module 1	Yes	Maintain range selected, observe gear shift direction circuit
U0291	Lost Communication With Gear Shift Module 2	Yes	Maintain range selected, observe gear shift direction circuit
U0304	Gear Shift Module 1 Incompatible	Yes	Ignore shift selector inputs
U0333	Gear Shift Module 2 Incompatible	Yes	Ignore shift selector inputs
U0404	Gear Shift Module 1 Invalid Data	Yes	Maintain range selected, observe gear shift direction circuit

Table 2–8. DTC List and Descriptions *(cont'd)*

DTC	Description	CHECK TRANS Light	Inhibited Operation Description
U0592	Gear Shift Module 2 Invalid Data	Yes	Maintain range selected, observe gear shift direction circuit

2.13 TRANSMISSION STALL TEST

2.13.1 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 check 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.

2.13.2 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 Allison DOC® to the vehicle diagnostic data connector.
8. Install a temperature gauge with the probe in the transmission converter-out (to cooler) line. Allison DOC® displays sump temperature only.
9. Install wheel chocks.
10. A driver is in the driver's position.
11. The vehicle's 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 can lead to hydraulic line failure and high temperature fluid leakage.

WARNING: To help avoid personal injury and equipment damage while conducting a transmission stall test, the vehicle must be 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.

2.13.3 Performing a Transmission Stall Test.

1. Start the engine. While in **N** (Neutral) allow the transmission to 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 all engine accessories **OFF**.

4. To place Allison DOC® in clutch test mode, select **D** (Drive) on the shift selector, then select **4** (Fourth Range) on the Range Panel.

NOTE: Do not use the shift selector to try and attain **4** (Fourth Range). Using **4** (Fourth Range) from the shift selector reduces the torque imposed on the transmission driveline. Do not perform a transmission stall test in **R** (Reverse). Make sure you select **4** (Fourth Range) from the Range Panel displayed on the computer screen during the clutch test mode.

CAUTION: To help avoid transmission or driveline damage, full throttle stall tests **must not be performed** in **R** (Reverse) range, all models, or low ranges, 7-speed models.

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 **N** (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.
12. Proceed to 2.13.7 Neutral Cool-Down Check Procedure.

2.13.4 Driving Transmission Stall Test.

NOTE: If the vehicle's engine acceleration at a stop is controlled or limited, 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.

2.13.5 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 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 Allison DOC® 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) hose. Allison DOC® displays sump temperature only.

2.13.6 Performing A Driving Transmission Stall Test.

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.

1. Start the engine. While in **N** (Neutral) allow the transmission to warm 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 all engine accessories **OFF**.
4. While located in an isolated area, begin the driving transmission stall test.
5. Select a hold range that will limit road speed (usually 2nd range or 3rd range). Never perform a driving stall test in **R** (Reverse) or Low range (7-speed models).
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 breaks while maintaining 100 percent full throttle. When the vehicle comes to a complete stop, record engine speed.
8. Record converter out (to cooler) temperature.
9. Reduce the engine speed to idle and shift the transmission to **N** (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.
12. Proceed to 2.13.7 Neutral Cool-Down Check Procedure.

2.13.7 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.

2.13.8 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 stall speed to 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.

2.14 CHECKING CLUTCH PRESSURES

Measuring individual clutch pressures helps determine if a transmission malfunction is due to a mechanical or an electrical problem. Proper pressure measurements require transmission and vehicle (or test stand) preparation, recording of data, and comparing recorded data against specifications provided. These instructions are for all 3000 and 4000 Product Family transmissions.

NOTE: Determine if there are Diagnostic Trouble Codes (DTCs) set which are related to the transmission difficulty you are evaluating. Proceed to make mechanical preparations for measuring clutch pressures after DTCs have first been evaluated.

2.14.1 Transmission and Vehicle Preparation.

1. Remove the plugs from the pressure tap locations where the measurement is desired. Refer to Figure 2–12.

CAUTION: Be sure the hydraulic fittings have the same thread as the plugs removed (7⁄16-20 UNF-2A). Fittings must be straight thread, O-ring style. Failure to do this results in damage to the control valve module.

2. Install hydraulic fittings suitable for attaching pressure gauges or transducers.

3. Connect pressure gauges or transducers. J-26417-A Pressure Gage Set is available for this purpose.
4. Make sure that engine speed can be monitored. Allison DOC® may be used for this purpose.
5. Make sure that transmission sump fluid temperature can be measured. Allison DOC® may be used for this purpose.
6. Make sure the transmission has enough fluid for cold operation until an operating temperature fluid level can be set.
7. Bring the transmission to normal operating temperature of 71-93ºC (160-200ºF). Inspect for fluid leaks in the added pressure gauge/transducer lines. Repair leaks as needed. Make sure that fluid level is correct.

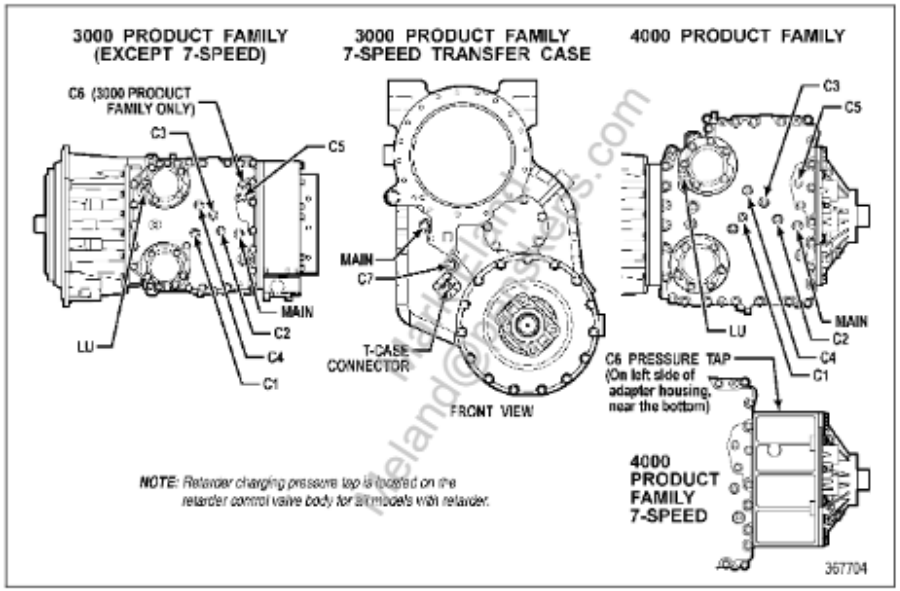


Figure 2–12. Clutch Pressure Check Points

2.14.2 Recording Data.

1. The Allison DOC® can check individual range clutch pressures with the vehicle stationary. Clutch Test instructions are located in the Action Request section of the Allison DOC® User Guide GN7588EN, and in the Allison DOC® Technician's Library. Follow instructions to check clutch pressures in individual ranges.

2.14.2.1 Main Modulation

NOTE: For Non-Shift Energy Management transmission calibrations, Step Main Mod logic is active during the 1-2 shift. For SEM transmission calibrations, Variable Main Mod logic is active.

Refer to the Allison DOC® Technician's Library for a description of the Full Main Pressure Action Request. For Main Mod ON/OFF pressure specifications at idle, refer to Table 2–9 for 3000 Product Family Transmissions, and Figure 2–14 4000 Product Family transmissions.

2.14.2.2 Lockup and Clutch Pressures

Lockup clutch pressure can only be measured by driving the vehicle in a range where lockup can be obtained. Record the pressure values at the engine speed and sump fluid temperature values shown in Figure 2–13 for 3000 Product Family Transmissions, and Figure 2–14 for 4000 Product Family Transmissions. The lockup clutch is functioning correctly when engine speed and turbine speed values are equal as shown in the Allison DOC® recorded data, and the lockup pressure meets specification.

Operate the transmission at the conditions shown in Figure 2–13 for 3000 Product Family Transmissions, and Figure 2–14 for 4000 Product Family Transmissions. Record engine speed, transmission sump fluid temperature, Main Mod solenoid state on or off, main hydraulic pressure, and clutch pressures in the ranges where a problem is suspected.

2.14.2.3 Torque Converter Pressure

Occasionally, knowing the approximate torque converter pressure is helpful when troubleshooting symptoms like "transmission will not go to range" and some transmission overheat concerns.

Because torque converter pressure cannot be monitored within the torque converter itself, "torque converter out" pressure is used to approximate torque converter pressure. To measure "torque converter out" pressure, place a pressure gauge in a fitting that has been drilled with a pressure tap into the "To Cooler" line. Take this reading with the transmission in N (Neutral) and the engine running above 1400 rpm. Torque converter out pressure should measure between 276-552 kPa (40-80 psi).

2.14.3 Comparing Recorded Data to Specifications.

NOTE: Use Allison DOC® to monitor the Main Mod solenoid state while taking main pressure and clutch pressure readings. The pressure specifications (listed in Figure 2–13 for 3000 Product Family Transmissions, and Figure 2–14 for 4000 Product Family Transmissions) and the actual main pressure and clutch pressures on the gauges are dependent on current test conditions. These conditions include range attained, input speed, fluid temperature, and whether the Main Mod solenoid is on or off. Note that the Main Mod solenoid OFF state increases pressures above the Main Mod solenoid ON pressures.

1. If clutch pressures are within specifications, return the transmission and vehicle to their original configuration and proceed with electrical troubleshooting.
2. If clutch pressures are not within specification, take corrective action to replace the internal parts of the transmission necessary to correct the problem.
3. Measure pressure values after the transmission has been repaired.
4. Return the transmission to its original configuration. Remove instrumentation and install any components removed for pressure testing. Pressure tap plugs should be reinstalled and tightened to 10-13 N·m (7-10 lb ft.).

Table 2–9. 3000 Product Family Transmissions Idle Check (Input Speed 600 ± 20 rpm)

SET			CHECK					
Input rpm	Range	Clutch(es) Applied	Main Pressure kPa/(psi)*		Lube Pressure kPa/(psi)*		Cooler Flow LPM/(GPM)*	
			Spec	Actual	Spec	Actual	Spec	Actual
580-620	1C Main Mod OFF	C1, C5	1240-1850 (180-270)		10-40 (1-6)		5-25 (1.3-6.6)	
	1C Main Mod ON		870-1480 (125-215)		10-40 (1-6)		5-25 (1.3-6.6)	
580-620	2C Main Mod OFF	C1, C4	1240-1850 (180-270)		10-40 (1-6)		5-25 (1.3-6.6)	
	2C Main Mod ON		870-1480 125-215		10-40 (1-6)		5-25 (1.3-6.6)	
580-620	Neutral Main Mod OFF	C5	1510-2150 (220-315)		10-40 (1-6)		5-25 (1.3-6.6)	
	Neutral Main Mod ON		1170-1780 (170-260)		10-40 (1-6)		5-25 (1.3-6.6)	

Table 2–9. 3000 Product Family Transmissions Idle Check (Input Speed 600 ± 20 rpm) *(cont'd)*

SET			CHECK					
Input rpm	Range	Clutch(es) Applied	Main Pressure kPa/(psi)*		Lube Pressure kPa/(psi)*		Cooler Flow LPM/(GPM)*	
580-620	Reverse Main Mod OFF	C3, C5	1450-2040 (210-295)		10-40 (1-6)		5-25 (1.3-6.6)	
	Reverse Main Mod ON**		1170-1750 (170-255)		10-40 (1-6)		5-25 (1.3-6.6)	

* Conversions not exact

** Reverse range is not included in Allison DOC® clutch test mode. To check main pressure at idle in reverse, select reverse at the shift selector.

SET			CHECK											
Input rpm	Range	Clutch(s) Applied	Main Pressure kPa(psi)*		Applied Clutch Pressure kPa(psi)*		Non-Applied Clutch Pressure kPa(psi)*		Lube Pressure kPa(psi)*		Lockup Pressure kPa(psi)*		Cooler Flow LPM/GPM*	
			Spec	Actual	Spec	Actual	Spec	Actual	Spec	Actual	Spec	Actual	Spec	Actual
2080-2120	Reverse	C3 C5	1800-2210 (260-325)		1700-2210 (245-325)		0-75 (0-11)		140-270 (20-40)		0-75 (0-11)		50-95 (13-25)	
2080-2120	Neutral Main Mod OFF	C5	1800-2300 (260-335)		1700-2300 (245-335)		0-75 (0-11)		140-270 (20-40)		0-75 (0-11)		50-95 (13-25)	
	Neutral Main Mod ON		1250-1850 (180-270)		1150-1850 (165-270)		0-75 (0-11)		140-270 (20-40)		0-75 (0-11)		50-95 (13-25)	
2080-2120	1C	C1 C5	1550-1970 (225-290)		1450-1970 (210-290)		0-75 (0-11)		140-270 (20-40)		0-75 (0-11)		50-80 (13-21)	
2080-2120	2C	C1 C4	1550-1970 (225-290)		1450-1970 (210-290)		0-75 (0-11)		140-270 (20-40)		0-75 (0-11)		50-80 (13-21)	
2080-2120	2L	C1 C4	1080-1450 (155-210)		980-1450 (140-210)		0-75 (0-11)		140-270 (20-40)		980-1450 (140-210)		50-95 (13-25)	
2080-2120	3C	C1 C3	1550-1970 (225-290)		1450-1970 (210-290)		0-75 (0-11)		140-270 (20-40)		0-75 (0-11)		50-80 (13-21)	
2080-2120	3L	C1 C3	1080-1450 (155-210)		980-1450 (140-210)		0-75 (0-11)		140-270 (20-40)		980-1450 (140-210)		50-95 (13-25)	
2080-2120	4C	C1 C2	1550-1970 (225-290)		1450-1970 (210-290)		0-75 (0-11)		125-270 (18-40)		0-75 (0-11)		50-80 (13-21)	
2080-2120	4L	C1 C2	1080-1450 (155-210)		980-1450 (140-210)		0-75 (0-11)		125-270 (18-40)		980-1450 (140-210)		50-95 (13-25)	
2080-2120	5C	C2 C3	1550-1970 (225-290)		1450-1970 (210-290)		0-75 (0-11)		125-270 (18-40)		0-75 (0-11)		50-80 (13-21)	
2080-2120	5L	C2 C3	1080-1450 (155-210)		980-1450 (140-210)		0-75 (0-11)		125-270 (18-40)		980-1450 (140-210)		50-95 (13-25)	
2080-2120	6C	C2 C4	1345-1970 (195-290)		1240-1970 (180-290)		0-75 (0-11)		125-270 (18-40)		0-75 (0-11)		50-80 (13-21)	
2080-2120	6L	C2 C4	1000-1380 (145-205)		900-1380 (130-205)		0-75 (0-11)		125-270 (18-40)		900-1380 (130-205)		50-95 (13-25)	

* Conversions not exact

367713

Figure 2–13. 3000 Product Family Transmissions Flow and Pressure Check (Input Speed 2100 ± 20 rpm)

Table 2–10. 4000 Product Family Transmissions Idle Check (Input Speed at 600 ± 20 rpm)

SET			CHECK					
Input rpm	Range	Clutch(es) Applied	Main Pressure kPa/(psi)*		Lube Pressure kPa/(psi)*		Cooler Flow LPM/(GPM)*	
			Spec	Actual	Spec	Actual	Spec	Actual
580-620	1C Main Mod OFF	C1, C5	1240-1900 (180-275)		10-105 (1-15)		15-35 (4-10)	
	1C Main Mod ON		870-1480 (125-215)		10-105 (1-15)		15-35 (4-10)	
580-620	2C Main Mod OFF	C1, C4	1240-1900 (180-275)		10-105 (1-15)		15-35 (4-10)	
	2C Main Mod ON		870-1480 (125-215)		10-105 (1-15)		15-35 (4-10)	
580-620	Neutral Main Mod OFF	C5	1515-2200 (220-320)		10-105 (1-15)		15-35 (4-10)	
	Neutral Main Mod ON		1170-1775 (170-260)		10-105 (1-15)		15-35 (4-10)	

Table 2–10. 4000 Product Family Transmissions Idle Check (Input Speed at 600 ± 20 rpm) *(cont'd)*

SET			CHECK					
Input rpm	Range	Clutch(es) Applied	Main Pressure kPa/(psi)*		Lube Pressure kPa/(psi)*		Cooler Flow LPM/(GPM)*	
580-620	Reverse Main Mod OFF	C3, C5	1450-2200 (210-320)		10-105 (1-15)		15-35 (4-10)	
	Reverse Main Mod ON**		1170-1750 (170-255)		10-105 (1-15)		15-35 (4-10)	
580-620	Low C (7 Speed) Main Mod OFF	C1, C6	1240-1900 (180-275)		10-105 (1-15)		15-35 (4-10)	
	Low C (7 Speed) Main Mod ON		870-1480 (125-215)					

* Conversions not exact

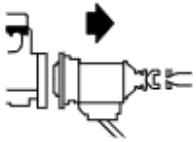
** Reverse range is not included in Allison DOC® clutch test mode. To check main pressure at idle in reverse, select reverse at the shift selector.

SET			CHECK											
Input rpm	Range	Clutch(s) Applied	Main Pressure kPa (psi)*		Applied Clutch Pressure kPa (psi)*		Non-Applied Clutch Pressure kPa (psi)*		Lube Pressure kPa (psi)*		Lockup Pressure kPa (psi)*		Cooler Flow LPM/GPM*	
			Spec	Actual	Spec	Actual	Spec	Actual	Spec	Actual	Spec	Actual	Spec	Actual
1780-1820	Reverse	C3	1880-2300 (268-335)		1670-2300 (246-335)		0-75 (0-11)		140-240 (20-35)		0-75 (0-11)		55-105 (14-28)	
		C5												
1780-1820	Neutral Main Mod OFF	C5	1880-2300 (268-335)		1670-2300 (246-335)		0-75 (0-11)		140-240 (20-35)		0-75 (0-11)		55-105 (14-28)	
	Neutral Main Mod ON		1250-1850 (180-270)		1160-1850 (165-270)		0-75 (0-11)		140-240 (20-35)		0-75 (0-11)		55-105 (14-28)	
1780-1820	Low C (7 Speed)	C1	1550-1970 (225-285)		1450-1970 (210-285)		0-75 (0-11)		140-240 (20-35)		0-75 (0-11)		55-105 (14-28)	
		C5												
1780-1820	1C	C1	1550-1970 (225-285)		1460-1970 (210-285)		0-75 (0-11)		140-240 (20-35)		0-75 (0-11)		55-105 (14-28)	
		C5												
1780-1820	2C	C1	1550-1970 (225-285)		1460-1970 (210-285)		0-75 (0-11)		140-240 (20-35)		0-75 (0-11)		55-105 (14-28)	
		C4												
1780-1820	2L	C1	1080-1450 (155-210)		980-1450 (140-210)		0-75 (0-11)		140-255 (20-37)		980-1450 (140-210)		55-105 (14-28)	
		C4												
1780-1820	3C	C1	1550-1970 (225-285)		1460-1970 (210-285)		0-75 (0-11)		140-240 (20-35)		0-75 (0-11)		55-105 (14-28)	
		C3												
1780-1820	3L	C1	1080-1450 (155-210)		980-1450 (140-210)		0-75 (0-11)		140-255 (20-37)		980-1450 (140-210)		55-105 (14-28)	
		C3												
1780-1820	4C	C1	1550-1970 (225-285)		1460-1970 (210-285)		0-75 (0-11)		120-215 (17-31)		0-75 (0-11)		55-105 (14-28)	
		C2												
1780-1820	4L	C1	1080-1450 (155-210)		980-1450 (140-210)		0-75 (0-11)		120-215 (17-31)		980-1450 (140-210)		55-105 (14-28)	
		C2												
1780-1820	5C	C2	1550-1970 (225-285)		1460-1970 (210-285)		0-75 (0-11)		120-215 (17-31)		0-75 (0-11)		55-105 (14-28)	
		C3												
1780-1820	5L	C2	1080-1450 (155-210)		980-1450 (140-210)		0-75 (0-11)		120-215 (17-31)		980-1450 (140-210)		55-105 (14-28)	
		C3												
1780-1820	6C	C2	1340-1970 (195-285)		1240-1970 (180-285)		0-75 (0-11)		120-215 (17-31)		0-75 (0-11)		55-105 (14-28)	
		C4												
1780-1820	6L	C2	1000-1400 (145-205)		900-1400 (130-205)		0-75 (0-11)		120-215 (17-31)		900-1400 (130-205)		55-105 (14-28)	
		C4												

* Conversions not exact

367731

Figure 2–14. 4000 Product Family Transmissions Flow and Pressure Check (Input Speed 1800 ± 20 rpm)



TRANSMISSION DISASSEMBLY

Section 3

3.1 DRAINING TRANSMISSION

Drain the transmission fluid before removing the transmission from the vehicle.

1. Remove the drain plug from the oil pan. Examine the drained fluid for evidence of contamination (refer to 2.8 TRANSMISSION FLUID CONTAMINATION, 2.8.1 Fluid Examination). Reinstall the drain plug.
2. Remove the transmission fill tube if it interferes with transmission removal. Plug the fill tube hole in the main housing to keep dirt from entering the transmission.

NOTE: A significant amount of fluid may drain from the hydraulic lines when they are disconnected from the transmission.

3. Disconnect all hydraulic lines from the transmission. Remove the lines from the vehicle if they interfere with transmission removal. Plug all openings to keep dirt from entering the hydraulic system.
4. If an integral cooler is used, drain coolant from cooler and disconnect coolant hoses. Remove the hoses from the vehicle if they interfere with transmission removal. Plug all openings to keep dirt from entering the cooling system.

3.2 DISCONNECTING CONTROLS

1. Disconnect or completely remove controls. If controls are not removed from the transmission, position them so that they do not interfere with transmission removal.
2. Disconnect the external wiring harness at the feedthrough harness connector. Loosen the bolt that retains the 20-way feedthrough connector to the transmission. Refer to Figure 3–1 or Figure 3–2. Prevent dirt or moisture from entering a disconnected connector. Position the wiring harness so it does not interfere with transmission removal.
    a. For 3000 Product Family transmissions, disconnect the input (engine) and output speed sensors (refer to Figure 3–1).

b. For 4000 Product Family transmissions, disconnect the input (engine), turbine, and output speed sensors (refer to Figure 3–2).

NOTE: There may be residual transmission fluid in the retarder-accumulator hydraulic line.

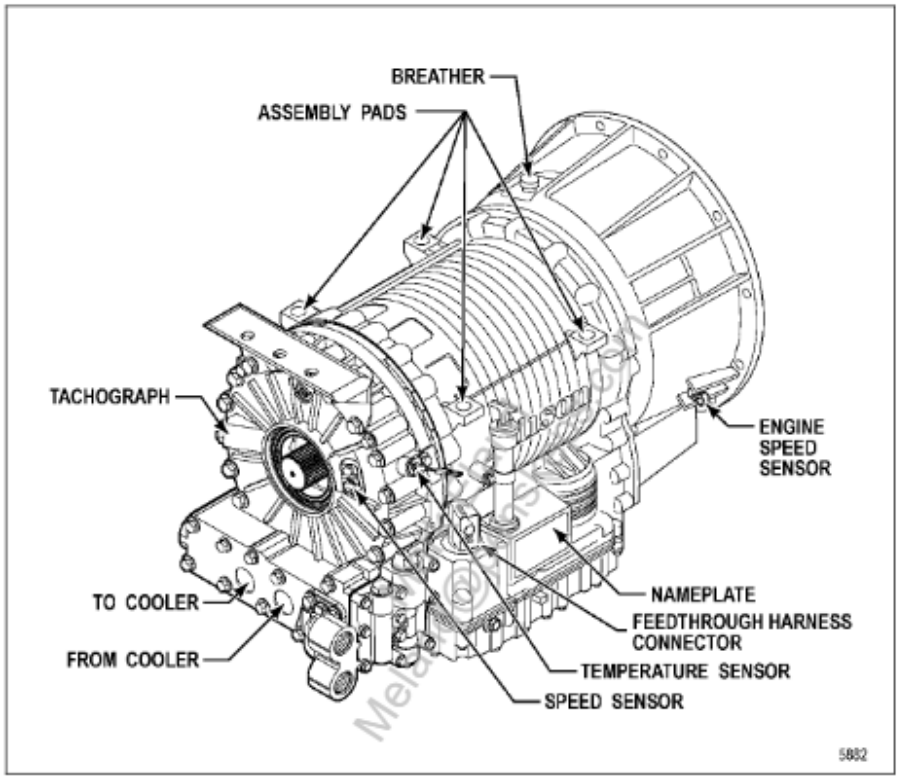


Figure 3–1. 3000 Product Family Disconnect Locations

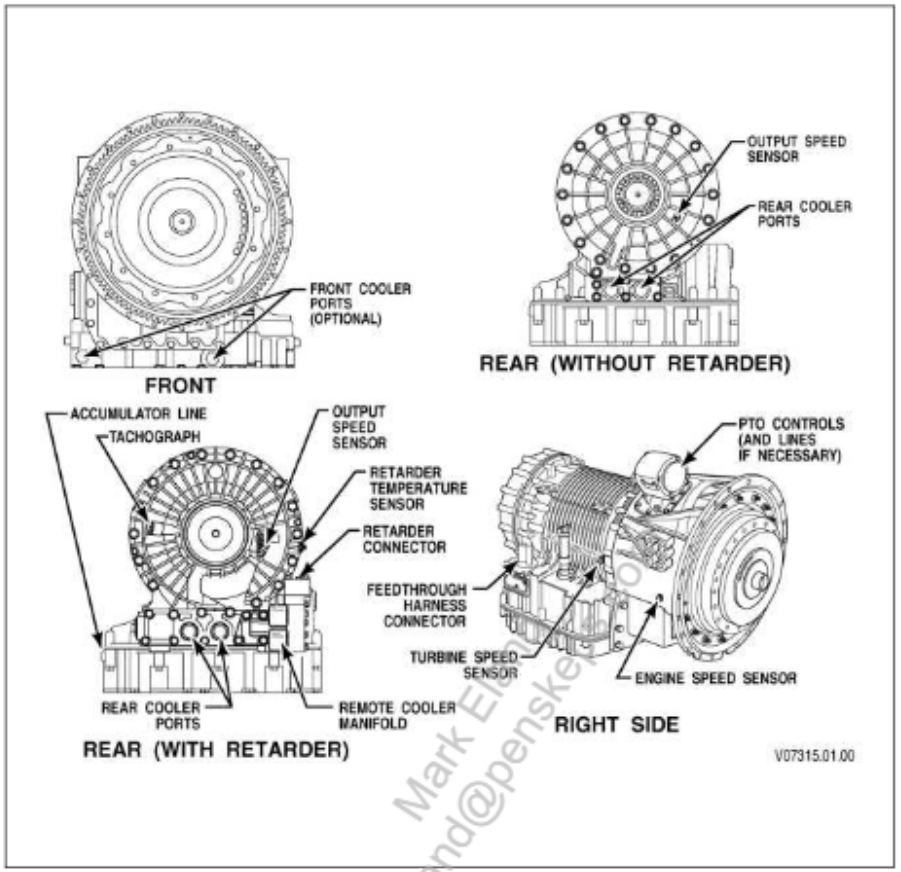


Figure 3–2. 4000 Product Family Disconnect Locations

3. If a retarder is used, disconnect the retarder accumulator hydraulic line from the retarder.
    a. Disconnect the wiring harness from the retarder temperature thermistor, the output speed sensor, and the retarder valve body connector. If used, disconnect the tachograph cable from the port on the rear of the retarder housing.
4. If PTO(s) equipped, disconnect the PTO(s) wiring harness.

3.3 UNCOUPLING FROM DRIVELINE, ENGINE, AND VEHICLE

1. Disconnect the vehicle drive shaft from the transmission output flange or yoke. Position the disconnected shaft to avoid interference when removing the transmission.

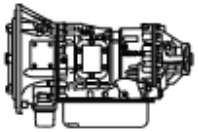
2. If PTO equipped, disconnect PTO connections such as:
    a. PTO hydraulic hoses
    b. PTO-powered equipment drive shaft
3. If transmission mountings support the rear of the engine, place a jack or other support under the engine.
4. Securely support the transmission with a hoist, jack, or other suitable removal equipment.
5. Remove all bolts, nuts, washers, spacers, and supports that attach the transmission to the vehicle and the engine.

3.4 REMOVING THE TRANSMISSION

1. Move the transmission away from the engine, approximately 110 mm (4.35 inches), until it is completely clear of the engine. If used, remove the adapter ring and/or gasket.
2. Raise or lower the transmission as necessary to remove it from the vehicle.

3.5 REMOVING OUTPUT FLANGE OR YOKE

If replacing the transmission, you may need to transfer the output flange or yoke to the replacement transmission. Remove the output flange or yoke by removing the M14 x 2.0 x 70 mm bolt, retainer plug and O-ring.



TRANSMISSION PREPARATION

Section 4

4.1 CHECKING INPUT COMPONENTS

4.1.1 Bolt Holes. Check all bolt holes on the front of the transmission and rear of the engine that are used in connecting the transmission to the engine. The threads must be undamaged and the holes free of chips or foreign material.

4.1.2 Pilot Boss. Check the pilot boss (at the center of the flywheel) for damage or raised metal that prevents free entry into the crankshaft hub (or adapter).

4.1.3 Starter Ring Gear. Check the starter ring gear for excessive wear or damage.

4.1.4 Transmission Mounting Flange. Check the transmission mounting flange for raised metal, dirt, or if used, pieces of gasket material.

4.1.5 Transmission-to-Engine Mounting. Inspect the transmission-to-engine mounting flange for raised metal, burrs, or pieces of gasket material (if used). Remove any of these defects. Inspect the threaded holes for damaged threads.

4.2 INSTALLING OUTPUT FLANGE OR YOKE

4.2.1 Output Oil Seal. Check the output oil seal for leaks or damage. Refer to the latest edition of the approved Service Manual for replacement instructions. If not replacing the oil seal, lubricate it with high-temperature grease or transmission fluid.

CAUTION: DO NOT attempt to polish the oil seal contact surface on the flange or yoke. Scratches or machine-type lead can cause the seal to leak.

4.2.2 Check Flange or Yoke. Check each flange or yoke for damage or wear. The oil seal contact surface must be smooth and regular to prevent oil leaking past the seal. Rotate the flange or yoke after installation to check for binding.

4.2.3 Install Output Flange or Yoke.

1. Install flange or yoke onto output shaft. Install the large O-ring on the retainer plug. Install the bolt into the bolt hole in the plug. Install a small O-ring over the threads of the bolt so that the O-ring seats against the retainer plug. Install retainer plug and bolts into the flange or yoke.
2. Tighten bolt to 70–80 N·m (52–59 lb ft).

4.3 INSTALLING POWER TAKEOFF (PTO)

Access to the PTO mounting pads and the space available to maneuver the transmission determine whether the PTO should be installed before or after the transmission is installed.

CAUTION: DO NOT use cork or other soft gaskets to install the PTO. Use only the shims/gaskets listed in the appropriate parts catalogs.

NOTE: DO NOT use sealing compounds—they are usually incompatible with automatic transmission fluid.

4.3.1 Install Guide Pins. Guide pins are included in the PTO manufacturer's installation kit.

Determine the required position of the guide pins in relation to the mounted position of the PTO. The guide pins must align with the two blind holes in the PTO pad. Install two headless guide pins into the converter housing PTO pad. Tighten the pins.

4.3.2 Install Gasket. Install the special gasket over the guide pins—ribbed surface away from the transmission.

4.3.3 Mount the PTO. Mount the PTO on the guide pins, meshing the PTO driven gear with the transmission PTO drive gear. Retain the PTO by installing a bolt in the top bolt hole. Install the remaining bolts. Tighten all bolts to 51-61 N·m (38-45 lb ft).

4.4 INSTALLING FILL TUBE AND SEAL

4.4.1 Location.

- 3000 Product Family—fill tube may be mounted on either the right or left side. The unused fill tube provision must have a plug to fill the tube opening.
- 4000 Product Family—fill tube is on the right side.

CAUTION: Install the fill tube bracket with the correct length bolt. A bolt that is too long may cause cracks and leaks in the main housing. Refer to the appropriate parts catalog for the correct bolt.

4.4.2 Installation. Install the fill tube seal into the main housing. Insert the fill tube through the seal. Align the tube bracket with its bolt location. Install the fill tube bolt and tighten to 24–29 N·m (18–21 lb ft).

- On 3000 Product Family Transmissions, the unused hole is blocked using a fill tube seal and a new plug. Install the fill tube seal into the unused fill tube hole. Install the new plug so that the underside of the plug head contacts the fill tube seal.

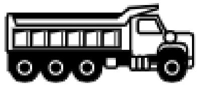
4.5 CHECKING PLUGS AND OPENINGS

Carefully check all sides and the bottom of the transmission for loose or missing plugs.

4.5.1 Pressure Plugs. Check that 0.4375–20 UNF-2A pressure plugs are tightened to 10–13 N·m (7–10 lb ft).

4.5.2 Fluid Drain Plug. Check that the drain plug is tightened to 25–32 N·m (18–24 lb ft).

4.5.3 Cleanliness. Check the openings into which the cooler lines connect for deformities or obstructions. Check the transmission electrical connectors for cleanliness. Clean electrical connectors with LPS cleaner only (refer to SIL 17-TR-94).



PREPARING VEHICLE FOR TRANSMISSION INSTALLATION

Section 5

5.1 ENGINE, TRANSMISSION ADAPTATION REQUIREMENTS

You must make sure a new transmission installation can be adapted to the vehicle's engine. Use the measurements described in this section to make sure correct transmission-to-engine adaptation. Refer to Figure 5–1 or Figure 5–2 and/or AS66–420 or AS67–420. Typical arrangement of adaptation components is shown in Figure 5–3.

5.1.1 Flywheel Housing Pilot Bore Diameter. The flywheel housing pilot bore diameter must measure.

- 3000 Product Family—447.68–447.81 mm (17.625–17.630 inches)
- 4000 Product Family—511.18–511.30 mm (20.125–20.130 inches)

5.1.2 Flywheel Housing Bore Runout. Flywheel housing bore runout cannot exceed 0.51 mm (0.020 inch) TIR.

5.1.3 Flywheel Housing Face Squareness. The flywheel housing face cannot be out-of-square more than 0.51 mm (0.020 inch) TIR.

5.1.4 Crankshaft Hub Pilot or Adapter Diameter. The crankshaft hub pilot or hub adapter pilot diameter must measure between 50.94–50.99 mm (2.006–2.008 inch).

5.1.5 Crankshaft Hub Pilot or Adapter Squareness. The crankshaft hub or hub adapter cannot be out-of-square more than 0.13 mm (0.005 inch) TIR.

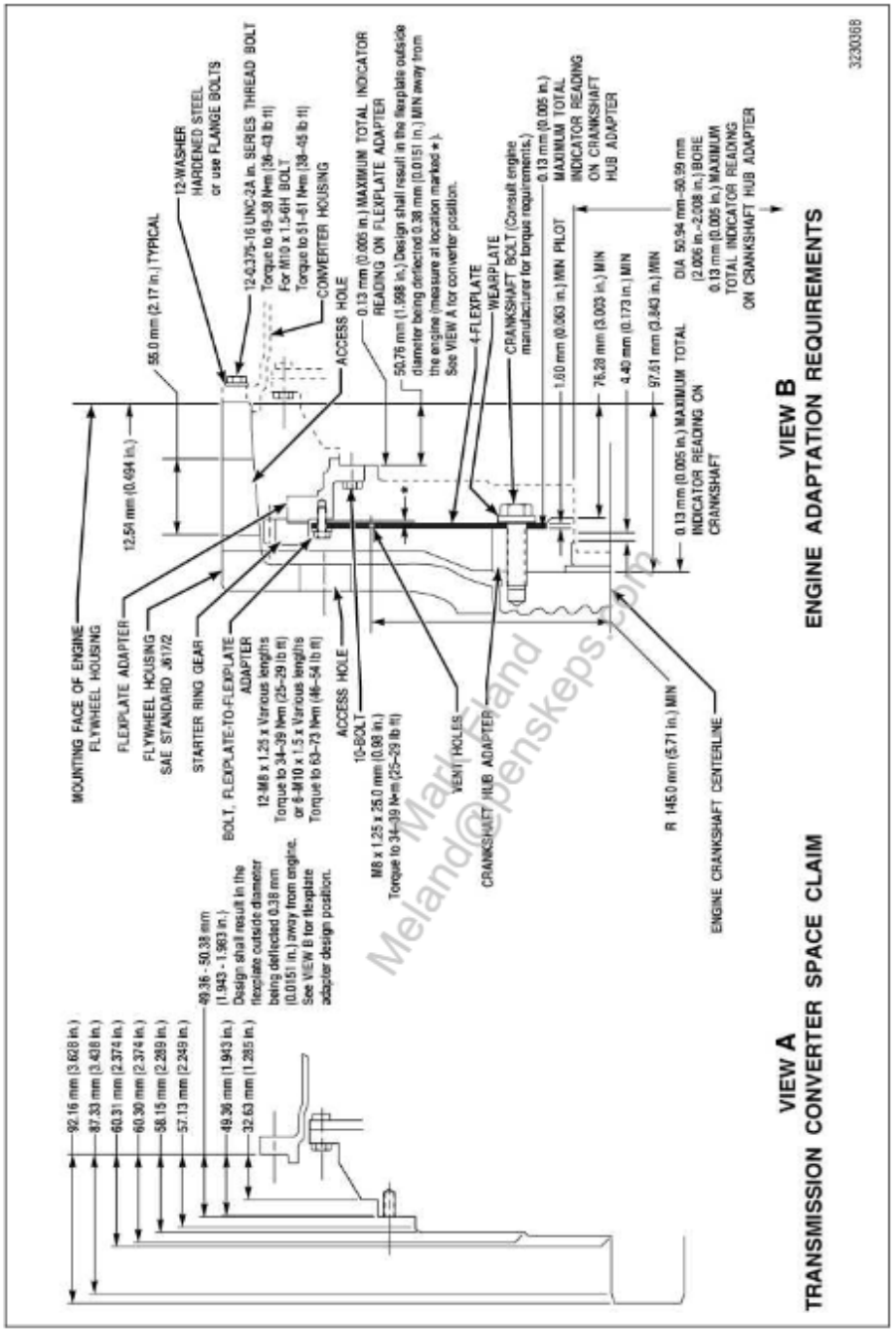


Figure 5–1. 3000 Product Family Engine Adaptation

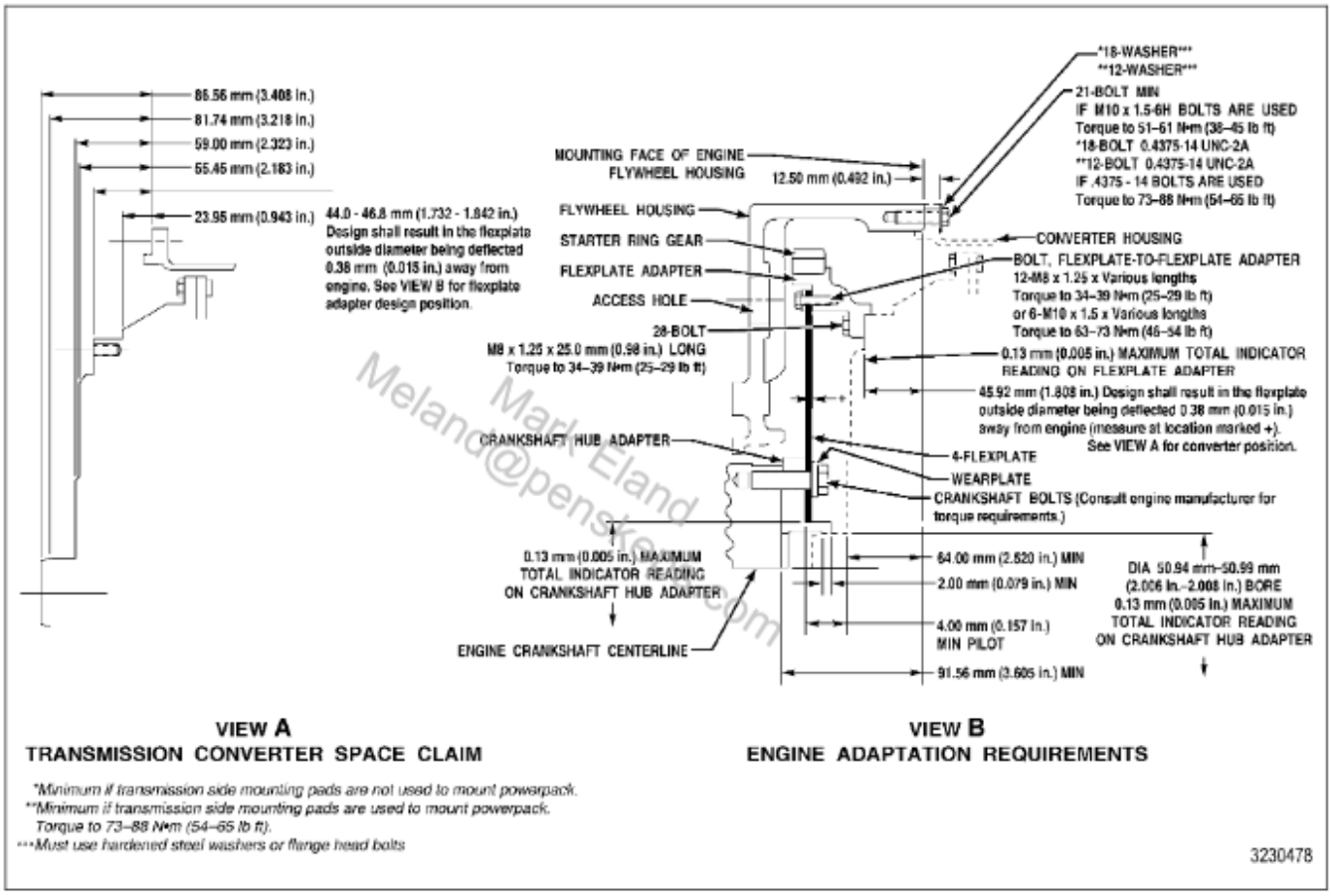


Figure 5–2. 4000 Product Family Engine Adaptation

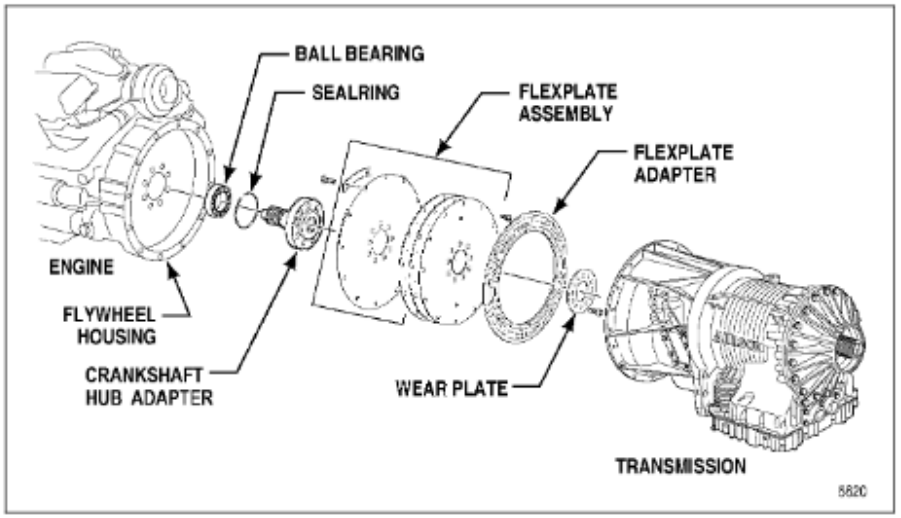


Figure 5–3. Arrangement of Adaptation Components

5.1.6 Crankshaft Hub Pilot or Adapter Concentricity. The crankshaft hub pilot or the hub adapter pilot concentricity cannot exceed 0.13 mm (0.005 inch) TIR.

5.1.7 Flexplate Bolt Hole Flatness. Flexplate flatness in the area of the bolt holes is not a measurement required for the 3000 and 4000 Product Family transmissions.

5.1.8 Torque Converter Axial Location. Using a depth gauge, measure from the face of the torque converter housing to the torque converter flexplate adapter mounting face (refer to Figure 5–4). The torque converter axial location should measure:

- 3000 Product Family—49.36–50.38 mm (1.943–1.983 inch)
- 4000 Product Family—44.0–46.8 mm (1.732–1.842 inch)

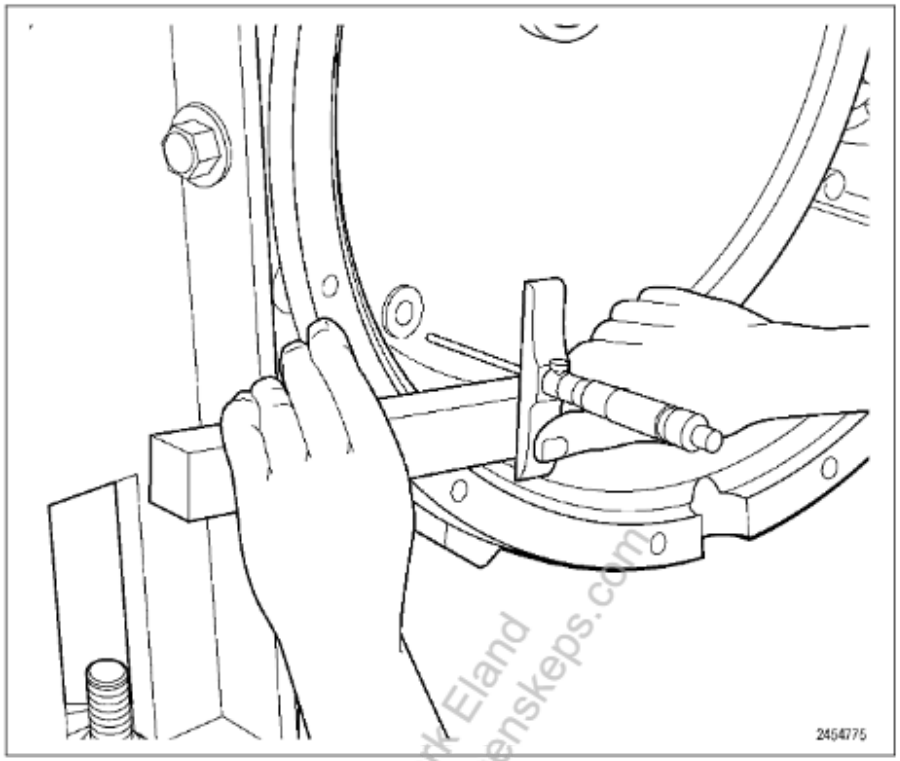


Figure 5–4. Converter Axial Location Measurement

5.2 CHECKING FLEXPLATE DRIVE ASSEMBLY

5.2.1 Flexplate Inspection. Check the flexplate for cracks, distortion, or elongated bolt holes. Replace a worn or damaged flexplate.

5.2.2 Engine Crankshaft End Play. Make sure engine crankshaft end play is within the engine manufacturer's specifications.

NOTE: When assembling the flexplate to the crankshaft hub or hub adapter, make sure the outer flexplate bolt holes are aligned.

5.2.3 Flexplate Assembly Installation. Install the flexplate onto the engine crankshaft hub using the bolts and torque values specified for that engine. Refer to Figure 5–1 or Figure 5–2 for the proper position of an installed flexplate.

5.3 CHASSIS AND DRIVELINE INSPECTION

Inspect the chassis and driveline components for the following conditions, and correct them as appropriate:

- Transmission mounts—broken or worn-out
- Bolts and other hardware—damaged, missing, or incorrect
- Isolators (rubber mounts)—damaged or missing
- Driveline angles—runout, or balance which does not conform to the manufacturer's recommendations
- Driveline yoke slip joints:
  - freedom of movement
  - damaged or worn-out
  - correctly lubricated
  - correctly indexed
- Driveline midship or hanger bearings—damaged or misaligned
- Universal joints:
  - freedom of movement
  - damaged or worn-out
  - correctly lubricated
  - correctly indexed
- Vehicle differential backlash—manufacturer's specification
- Universal joint coupling—alignment and differential damage
- Cross-frame members and rear support members—condition and location
- Auxiliary transmission:
  - shaft alignment
  - alignment of yoke or flange
  - backlash
  - fluid leaks

5.4 TOOLS AND PROCEDURES FOR CHECKING TRANSMISSION ADAPTATION

5.4.1 Adaptation Requirements Checksheet.

Transmission performance may be adversely affected by improper tolerances existing between engine-to-transmission mating components.

Vibration, converter section oil leaks, a worn front bushing or bearing, and/or a worn engine crankshaft thrust bearing are frequently the result of exceeding recommended tolerances in engine-to-transmission mating components. When these conditions are encountered, check certain important measurements before installing a repaired or new transmission. These measurements are summarized and detailed below. Figure 5–5, specifies the tolerance by transmission model. For additional information on the adaptation requirements and specifications, refer to 5.1 ENGINE, TRANSMISSION ADAPTATION REQUIREMENTS.

RO Number _____ Technician Name/Number _____

138670

THE ADAPTATION REQUIREMENTS CHECKSHEET

	H 40/50 EP™	1000/2000 Series SAE No. 2 Housing	1000/2000 Series SAE No. 3 Housing	3000 Series	TC10 4000 Series	Ref. Fig.	Record Reading
FLYWHEEL HOUSING: BORE DIAMETER	17.625 $\frac{+0.005}{-0.000}$ in.	17.625 $\frac{+0.005}{-0.000}$ in.	16.125 $\frac{+0.005}{-0.000}$ in.	17.625 $\frac{+0.005}{-0.000}$ in.	20.125 $\frac{+0.005}{-0.000}$ in.		
	(447.68 $\frac{+0.13}{-0.00}$ mm)	(447.68 $\frac{+0.13}{-0.00}$ mm)	(409.58 $\frac{+0.13}{-0.00}$ mm)	(447.68 $\frac{+0.13}{-0.00}$ mm)	(511.18 $\frac{+0.13}{-0.00}$ mm)	2	
BORE ECCENTRICITY (Limits are for installed engines.)	0.020 in. T.I.R. (0.51 mm)	0.020 in. T.I.R. (0.51 mm)	0.020 in. T.I.R. (0.51 mm)	0.020 in. T.I.R. (0.51 mm)	0.020 in. T.I.R. (0.51 mm)	3	
FACE SQUARENESS (Limits are for installed engines.)	0.020 in. T.I.R. (0.51 mm)	0.020 in. T.I.R. (0.51 mm)	0.020 in. T.I.R. (0.51 mm)	0.020 in. T.I.R. (0.51 mm)	0.020 in. T.I.R. (0.51 mm)	4	
CRANKSHAFT HUB AND/OR ADAPTOR: CONVERTER PILOT DIAMETER	2.006-2.008 in (50.94-50.99 mm)	1.703-1.705 in. (43.26-43.31 mm)	1.703-1.705 in. (43.26-43.31 mm)	2.006-2.008 in. (50.94-50.99 mm)	2.006-2.008 in. (50.94-50.99 mm)	5 & 6	
FACE SQUARENESS (T.I.R. per inch of diameter or T.I.R. per 25 mm of diameter)	0.005 in. (0.13 mm)	0.005 in. (0.13 mm)	0.005 in. (0.13 mm)	0.005 in. (0.13 mm)	0.005 in. (0.13 mm)	7	
PILOT ECCENTRICITY (With respect to crankshaft center of rotation)	0.005 in. T.I.R. (0.13 mm)	0.010 in. T.I.R. (0.25 mm)	0.010 in. T.I.R. (0.25 mm)	0.005 in. T.I.R. (0.13 mm)	0.005 in. T.I.R. (0.13 mm)	8	
FLEXPLATE: CHECK FOR RADIAL CRACKS	For all models						
CHECK FOR ELONGATED MOUNTING HOLES	For all models						
CHECK FOR ANY SIGNS OF DISTRESS OR WEAR	For all models						
MOUNTED FLEXPLATE: INPUT DAMPER AXIAL LOCATION (AED™)	1.98-2.09 in. (50.36-53.06 mm)	N/A	N/A	N/A	N/A		
CONVERTER AXIAL LOCATION (EXCEPT AED™)	N/A	1.201-1.361 in. (30.50-34.56 mm)	1.581-1.741 in. (40.15-44.21 mm)	1.943-1.983 in. (49.36-50.38 mm)	1.732-1.842 in. (44.0-46.8 mm)	10	
FLATNESS (Area adjacent to each converter mounting hole)	N/A	0.030 in. T.I.R. (0.076 mm)*	0.030 in. T.I.R. (0.076 mm)*	N/A	N/A	9	

* When measured at 11.5 inch (292 mm) diameter.

NOTE: This form is to be completed and retained with the Repair Order records when performing Allison Transmission Warranty, ETC or Policy repairs.

Figure 5–5. Adaptation Requirements Checksheet

5.4.2 Measuring Equipment. The following measuring equipment (refer to Figure 5–6) is required:

- 600 mm (24 inch) precision caliper.
- 50–100 mm (2–4 inch) telescoping gauge.
- 25–76 mm (1–3 inch) outside micrometer.
- Dial indicator and mounting attachments—base, posts, and clamps.
- 0–150 mm (0–6 inch) depth micrometer.

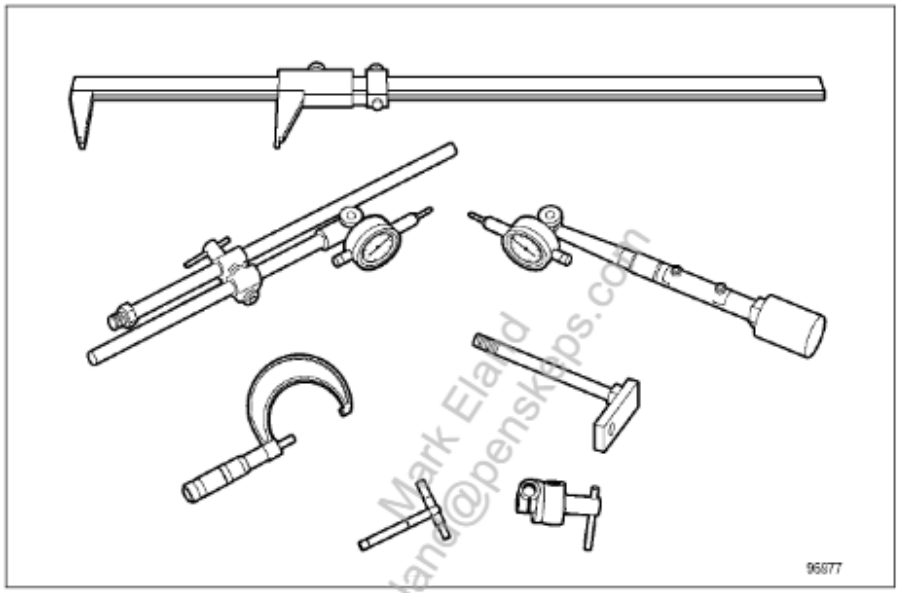


Figure 5–6. Typical Set Of Tools Used To Determine The Adaptation Requirements Of An Automatic Transmission

5.4.3 Flywheel Housing Pilot Bore Diameter.

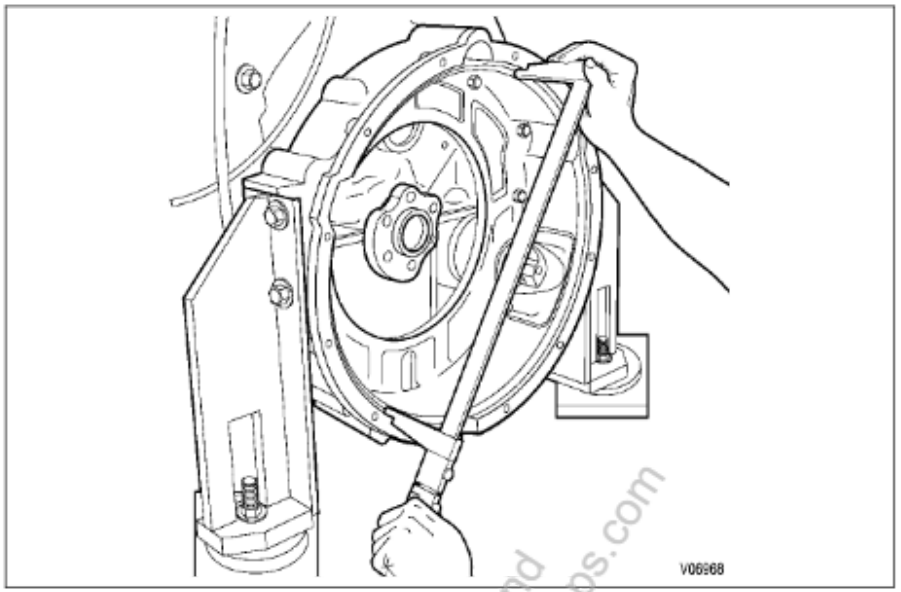


Figure 5–7. Measuring Flywheel Housing Bore Diameter — Inside Caliper Method

5.4.4 Flywheel Housing Bore Runout.

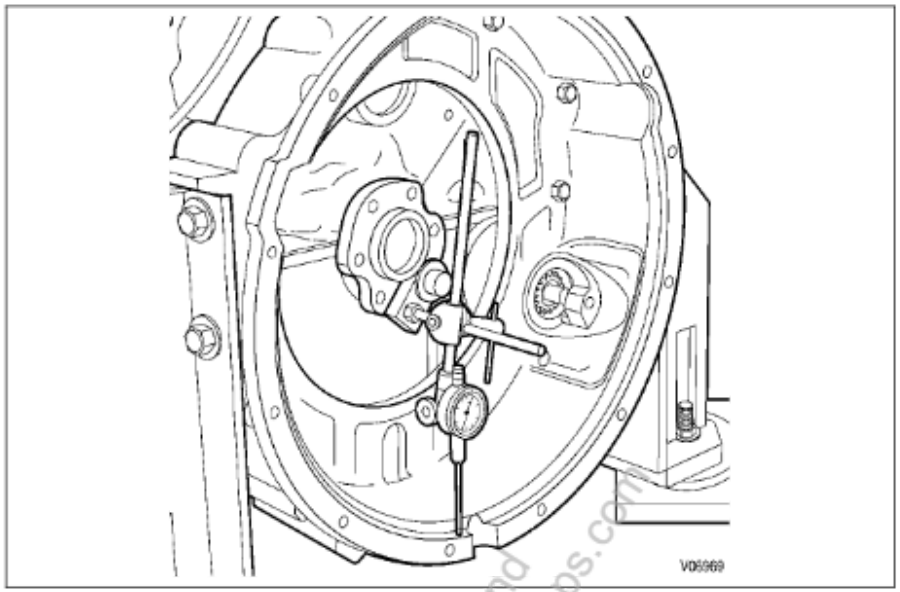


Figure 5–8. Measuring Flywheel Housing Bore Eccentricity Of The Flywheel Housing Bore

Refer to Figure 5–8 and measure the flywheel housing bore using a dial indicator as follows:

- Securely fasten the base of the dial indicator support extension to the crankshaft hub.
- Rotate the crankshaft so the dial indicator sweeps the entire flywheel housing bore.
- Record the maximum and minimum readings. The difference in these readings should not be greater than the tolerances specified in Figure 5–5.

5.4.5 Flywheel Housing Face Squareness.

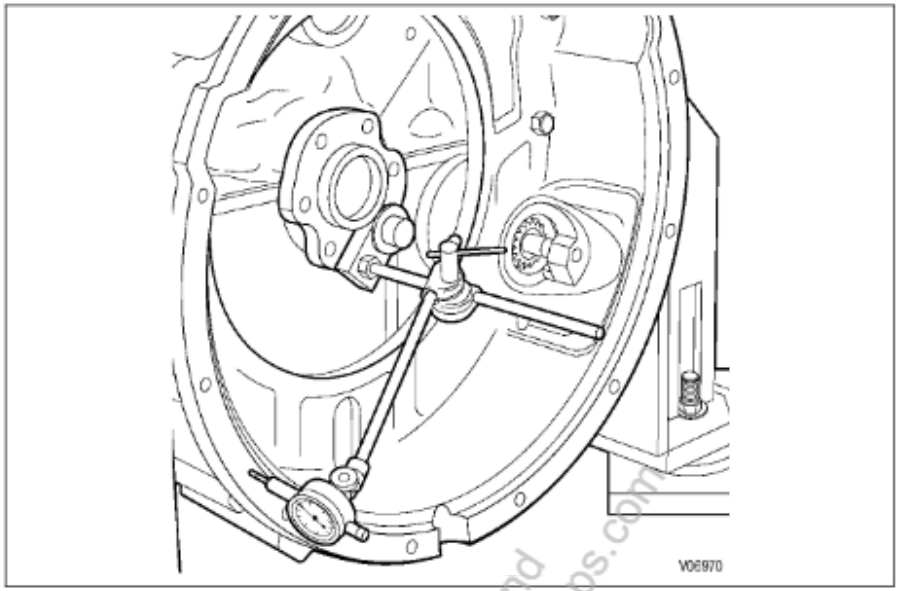


Figure 5–9. Measuring Flywheel Housing Face Squareness

Refer to Figure 5–9 and measure the squareness of the flywheel housing face using a dial indicator as follows:

- Securely fasten the dial indicator to the crankshaft hub.
- While pressing the crankshaft rearward to remove all crankshaft end play, rotate the crankshaft so the dial indicator sweeps the entire surface of the flywheel housing face.
- Record the maximum and minimum readings. The difference in these two readings should not be greater than the tolerance specified in Figure 3–14.

5.4.6 Crankshaft Hub Pilot or Adapter Diameter.

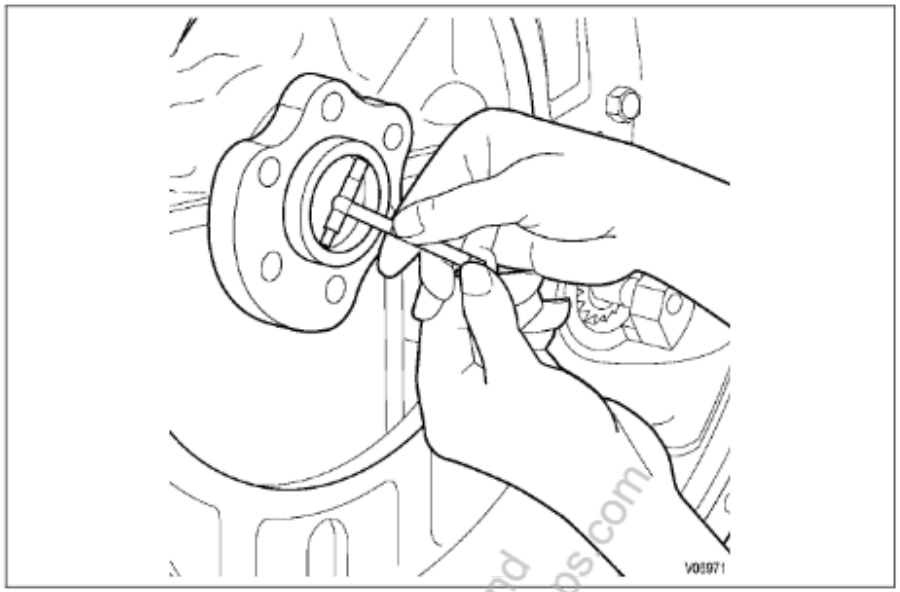


Figure 5–10. Measuring Converter Hub Pilot Diameter — Outside Micrometer Method

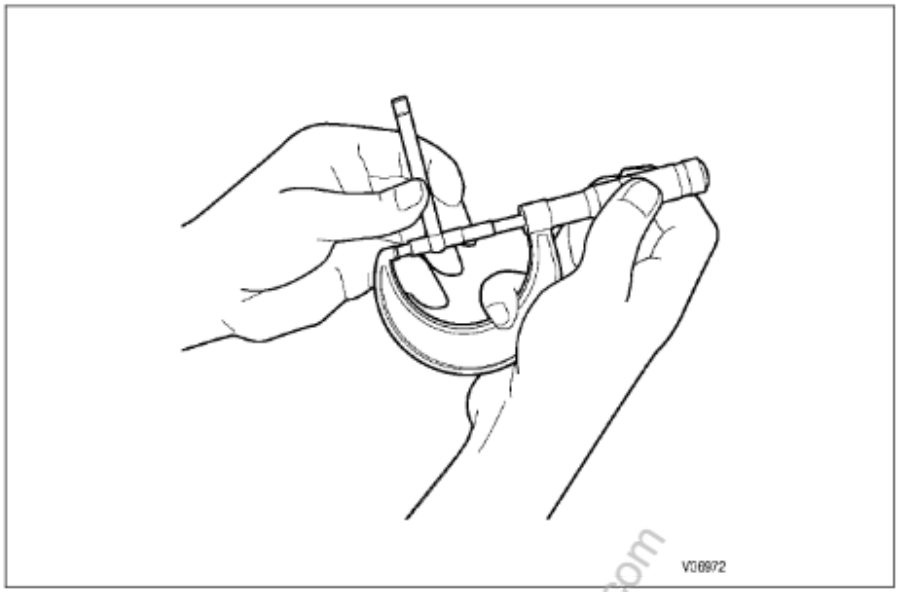


Figure 5–11. Measuring Converter Hub Pilot Diameter — Outside Micrometer Method

5.4.7 Crankshaft Hub or Adapter Squareness.

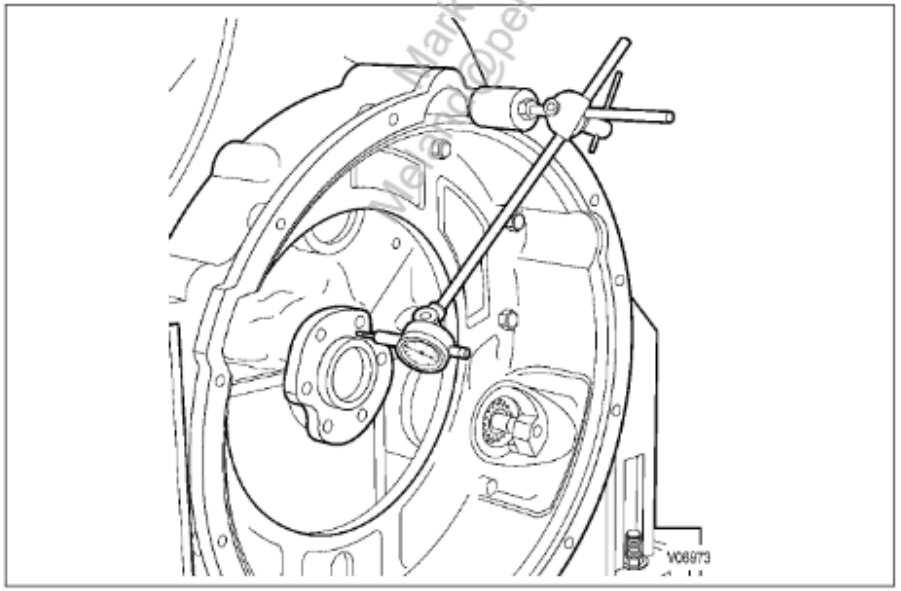


Figure 5–12. Measuring Crankshaft Hub Face Squareness

Refer to Figure 5–12 and measure the squareness of the crankshaft hub face as follows:

- Securely fasten the base of the dial indicator to the flywheel housing and adjust the indicator to measure the outer edge of the crankshaft hub face.
- While pressing the crankshaft rearward to remove all crankshaft end play, rotate the crankshaft so the dial indicator sweeps the entire diameter of the crankshaft hub face.
- Record the maximum and minimum readings. The difference in these two readings should not be greater than the tolerance specified in Figure 5–5.

NOTE: This tolerance is given as Total Indicator Runout (TIR) per inch of diameter or TIR per 25 mm (0.98 inch) of diameter. Multiply the tolerance from the checksheet by the diameter at which the reading is taken.

5.4.8 Crankshaft Hub or Adapter Eccentricity

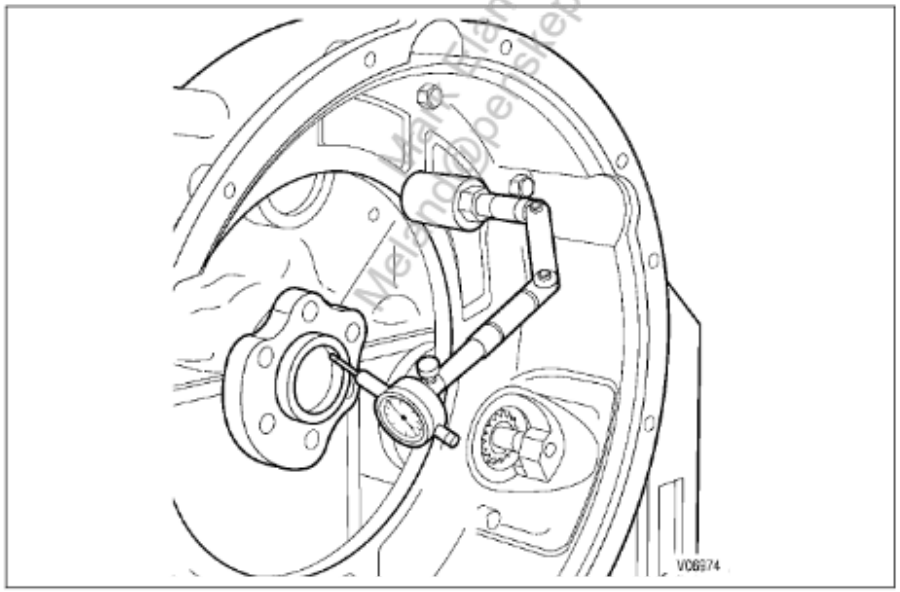


Figure 5–13. Measuring Crankshaft Hub Eccentricity

Refer to Figure 5–13 and measure the crankshaft hub eccentricity as follows:

- With the dial indicator fastened to the flywheel housing, rotate the crankshaft so the indicator sweeps the entire inside diameter of the crankshaft hub.
- Note the maximum and minimum readings. The difference of these readings should not be greater than the tolerance specified in 5.4.8 Crankshaft Hub or Adapter Eccentricity, and Figure 3–14.

5.5 COOLER, FILTER, AND LINES

5.5.1 Inspection. Perform the following and correct any faulty conditions:

- Transmission fluid cooler and related coolant lines:
  - Inspect for contamination—clean and flush as necessary
  - Inspect for deterioration
  - Inspect for faulty connectors or kinks
  - Clean and flush transmission fluid cooler, both coolant and oil sides. Pressure check both sides using a 276 kPa (40 psi) air supply.
- Hydraulic lines:
  - Inspect for contamination—clean and flush as necessary
  - Inspect for deterioration
  - Inspect for faulty connectors or kinks

5.5.2 After Overhaul. A complete cleanup of the transmission system after an overhaul cannot be assumed. Repeated cleaning and flushing may not remove all debris from the transmission fluid cooler system. Replace the transmission “from cooler” (lube) filter after 8000 km (5000 miles). Refill the transmission to the correct fluid level (refer to 2.4 TRANSMISSION FLUID CHECK).

5.6 CHECKING CONTROLS

5.6.1 Inspection. Inspect the following and correct any faulty conditions:

- Shift selector:
  - improper operation
  - poor electrical connections
  - improper harness routing
- Cab and chassis wiring harness:
  - poor electrical connections
  - frayed insulation

  - wiring damage
- Throttle sensor components, if present:
  - freedom of movement
  - improper routing
  - bellows damage
  - improper or loose cable mounting
- PTO controls, if present:
  - damage
  - wear
  - improper operation
  - lubrication
  - electrical harness connections and wiring damage
- Temperature gauge:
  - capillary tube damage (if used)
  - sensor damage
- Retarder controls:
  - damage
  - wear
  - poor electrical connections
  - frayed insulation
  - wiring damage
- Fluid pressure gauge tubing:
  - damage
  - kinks
  - improper routing

5.6.2 Throttle Position Sensor (TPS) Adjustment—Using Diagnostic Tool. When properly installed by the equipment manufacturer, the TPS should not require adjustment. Confirm that the throttle sensor has been installed to manufacturer specification (refer to Figure 5–15) before adjusting the throttle position sensor. The idle position should be approximately 8.9 mm or 0.97 volts or higher, and full throttle position should be approximately 35.7 mm or 3.889 volts or lower. The TPS is self-calibrating, meaning there is no optimum closed position or wide open position. As long as the travel is within 8.5–35.7 mm range, the TPS is set properly. A total stroke of 15.2–22.9 mm **must be maintained.**

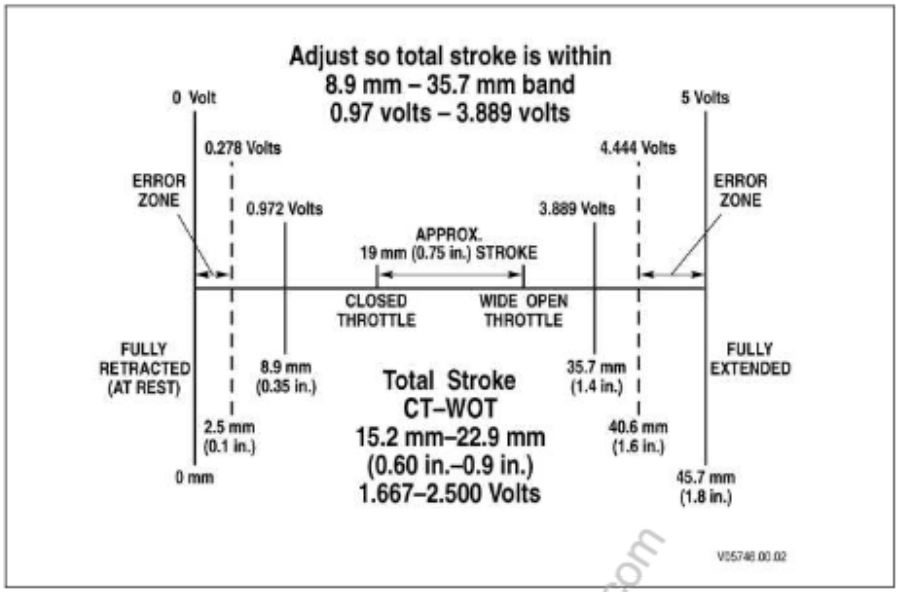


Figure 5–14. Throttle Position Determination Diagram

Watch the TPS movements as the controls move it through a full stroke. Be sure the following conditions do not exist:

- Misalignment or obstruction to smooth movement through the full stroke.
- Idle and full throttle positions are not within an error zone (Figure 5–14).

Error codes occur if the idle position is less than 2.5 mm, or when the full throttle position is more than 40.6 mm. When idle or wide open throttle positions are in the error zones, the TCM logs a code. When a TPS code is logged, the TCM assumes a default throttle setting which will negatively effect shift quality.

5.6.3 Hitch-Pin Throttle Position Sensor Installation.

1. Install the throttle sensor body as follows:
    a. Clamp cable end using clamp and shims (refer to Figure 5–15).
    b. Secure the sensor body using the mounting holes provided.
    c. Install a heat shield if any part of the throttle sensor is near the exhaust manifold, turbochargers, or any other heat source.

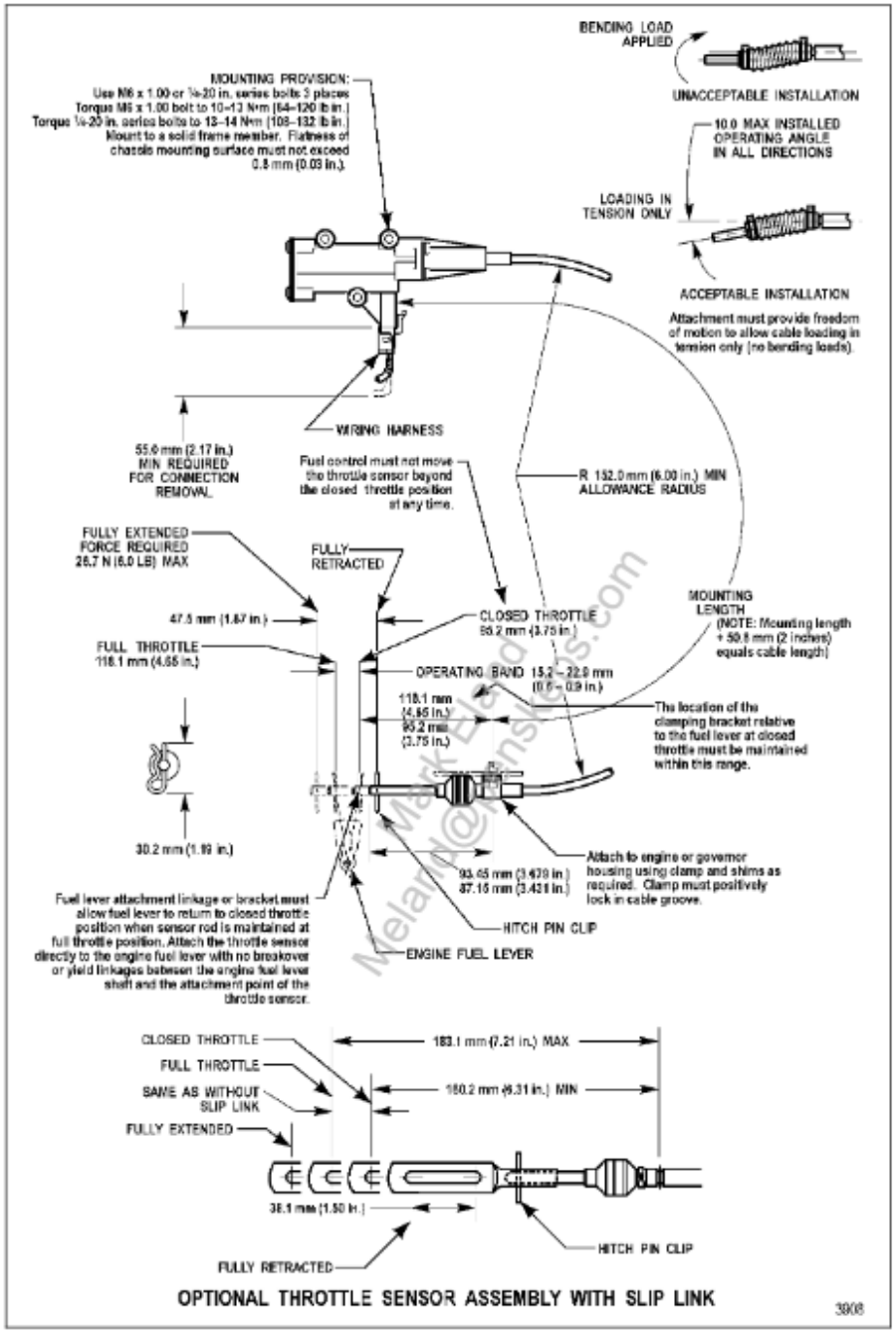
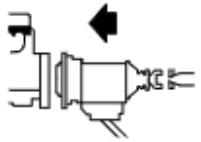


Figure 5–15. Hitch-Pin Throttle Position Sensor Installation Diagram

2. Adjust the throttle sensor as follows:
    a. The engine fuel lever must be at the closed throttle position.
    b. Install the hitch pin cable end of the sensor to the engine fuel lever with brackets so that at the idle position the cable end is 11–17 mm (0.44–0.67 inch) from its fully retracted position, and at wide open throttle the cable end is pulled 15–22.9 mm (0.60–0.90 inch) from the idle position.
    c. Check the stroke distance of the throttle sensor, from closed to wide open. Stroke distance must be from 15–22.9 mm (0.60–0.90 inch).
    d. Recheck for zero clearance at the fuel lever. Make sure that the 15.2–22.9 mm (0.60–0.90 inch) dimension has not changed.
    e. Design throttle sensor linkage brackets and levers to nominal dimensions so that the system stays within tolerance bands throughout its operating life.

NOTE: The throttle position signal may be provided via communication link on electronically controlled engines.



INSTALLING TRANSMISSION INTO VEHICLE

Section 6

6.1 HANDLING

6.1.1 Preventing Damage. Handle the transmission carefully to prevent damage to components in the installation path.

6.1.2 Control of Transmission Movements. Use a hoist or transmission jack that allows precise control of transmission movements during installation.

6.2 MOUNTING TO ENGINE

Use the following procedure to mount the transmission to the engine (refer to Figure 5–3):

1. Align one of the flexplate's bolt holes with the access opening in the engine flywheel housing.
2. Lubricate the center pilot boss with molybdenum disulfide grease (Molycote G, or equivalent).
3. Install a headless guide bolt into one of the flexplate bolt holes in the flexplate adapter or torque converter mounting lug (refer to Figure 5–4). Align the guide bolt with the flexplate hole at the access opening.
4. Push the transmission toward the engine while guiding the pilot boss on the torque converter into the flexplate hub adapter and the guide bolt into the hole on the flexplate.
5. Seat the transmission squarely against the engine flywheel housing—no force is required. If interference is encountered, move the transmission away from the engine and investigate the cause.
6. Align the bolt holes in the converter housing with those in the engine flywheel housing.
7. Install all transmission-to-engine bolts finger tight.

CAUTION: The entire converter housing circumference must be flush against the engine flywheel housing before tightening any bolts. DO NOT use the bolts to seat the housing.

8. Tighten four bolts at equally-spaced intervals around the converter housing bolt circle. Use the torque specified by the engine or vehicle manufacturer—usually M10 x 1.5-6H bolts tightened to 51–61 N·m (38–45 lb ft), or $^{7}/_{16}$-14 bolts tightened to 73–88 N·m (54–65 lb ft) or $^{3}/_{8}$-16 bolts tightened to 49–58 N·m (36–43 lb ft).
9. Remove the flexplate guide bolt through the engine flywheel housing access opening. Replace it with a self-locking bolt. Tighten the bolt finger tight.

NOTE: DO NOT tighten any flexplate-to-flexplate adapter bolts until all of the bolts have been installed and tightened finger tight.

10. Rotate the engine crankshaft to install the remaining self-locking bolts into the flexplate adapter. After all bolts have been installed finger tight, tighten M8 bolts to 34–39 N·m (25–29 lb ft) and M10 bolts to 63–73 N·m (46–54 lb ft).
11. Install the flywheel housing access cover, if used.

6.3 INSTALLING TRANSMISSION MOUNTING COMPONENTS

CAUTION: Use the type and grade of mounting bolts recommended by the vehicle manufacturer.

1. Install all bolts, washers, spacer, isolators, or supports required to support the transmission in the vehicle frame or chassis.
2. Tighten the bolts to the torque values recommended by the vehicle manufacturer.

6.4 COUPLING TO DRIVELINE

1. Couple the driveline companion flange or universal joint yoke to the flange or yoke on the transmission. Use the bolts and torque values recommended by the vehicle manufacturer.
2. Check the universal joint angularity of all U-joints in the driveline. Determine if they are within specification.

6.5 CONNECTING OUTPUT RETARDER ACCUMULATOR

The output retarder is connected to the vehicle air system by an air supply line attached to the retarder control solenoid mounted on the end of the retarder accumulator (refer to Figure 6–1).

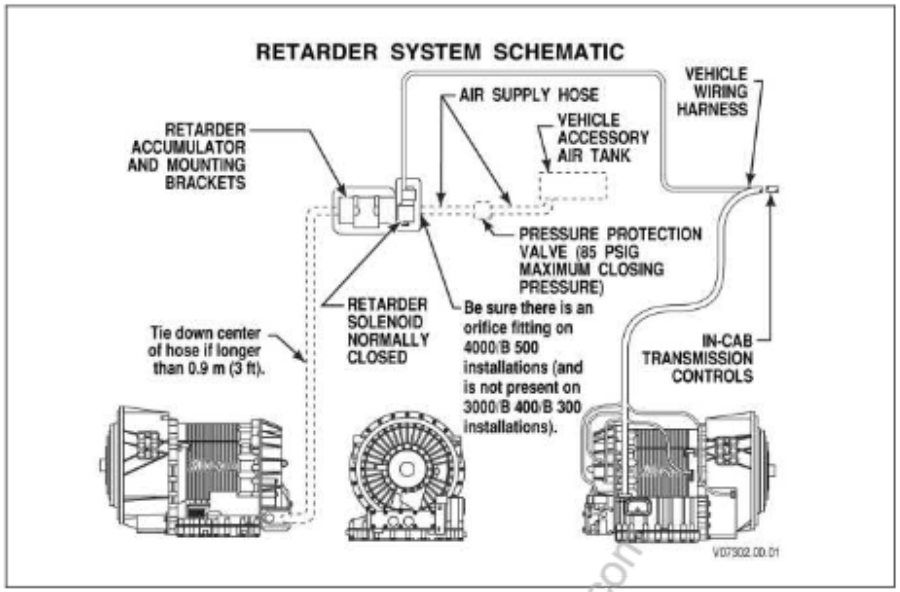


Figure 6–1. Output Retarder Accumulator Installation

NOTE: Make sure a pressure protection valve is correctly installed between the vehicle brake air system and the accumulator control solenoid.

1. Connect the air supply hose fitting to the retarder air control solenoid. Tighten the fitting to 16–22 N·m (12–16 lb ft).
2. Connect the hydraulic hose between the retarder and the accumulator. Refer to Table 6–1 for torque specifications.

6.6 CONNECTING POWER TAKEOFF (PTO) CONTROLS

If not already mounted, mount the PTO(s) onto the transmission (refer to 4.3 INSTALLING POWER TAKEOFF (PTO)).

CAUTION: PTO units using transmission main pressure to engage the PTO gear must have a positive main pressure shut-off at the solenoid valve when the PTO is not engaged. Failure to provide this feature may cause inadvertent clutch apply and PTO damage.

1. Check the PTO harness routing for kinks and sharp bends. Avoid routing the cable close to exhaust pipes or manifold. The PTO harness must not rub or interfere with adjacent parts.

2. Connect controls to the PTO.
3. Check for proper PTO control operation.
4. Couple the PTO output to its driven equipment. Check couplings or universal joints for correct assembly and alignment. If the driven component is not a direct mount arrangement, check the PTO drivelines for angularity, phasing, and offsets.

6.7 CONNECTING PARKING BRAKE CONTROL

1. Connect and properly adjust the parking brake.
2. If present, adjust the brake shoe-to-drum clearance as specified by the manufacturer.

This does not apply to 4000 Product Family transmissions.

6.8 CONNECTING HYDRAULIC FITTINGS

Refer to Table 6–1 and/or Table 6–2 for recommended torque for cooler line fittings.

SAE-defined hydraulic fittings that may be fastened to transmission components or support equipment should be tightened to the following specifications:

Table 6–1. Straight Thread Torque Specification

Fitting Identification	Aluminum	Steel
	Retarder Housing/Cooler Ports/Accumulator	Oil Cooler
	Torque Specification	
#12 Straight thread, O-ring side	56–69 N·m (42–50 lb ft)	93–101 N·m (69–74 lb ft)
#16 Straight thread, O-ring side	88–110 N·m (65–81 lb ft)	152–166 N·m (112–122 lb ft)
#20 Straight thread, O-ring side	118–146 N·m (87–107 lb ft)	198–218 N·m (146–160 lb ft)

Table 6–2. Flare Thread End Torque Specification

Fitting Identification	Fitting Identification
#12 37° Flare End of Fitting to Hose	108–119 N·m (80–87 lb-ft)
#16 37° Flare End of Fitting to Hose	148–154 N·m (110–113 lb-ft)
#20 37° Flare End of Fitting to Hose	173–182 N·m (128–134 lb-ft)

6.9 CONNECTING ELECTRICAL COMPONENTS

NOTE: Allison Transmission electronic control systems are designed and manufactured to comply with all FCC and other guidelines regarding radio frequency interference/electromagnetic interference (RFI/EMI) for transportation electronics. Manufacturers, assemblers, and installers of radio-telephone or other two-way communication radios have the sole responsibility to correctly install and integrate those devices into Allison Transmission-equipped vehicles to customer satisfaction. For further information, refer to TS7149EN Allison 5th Generation Controls Troubleshooting Manual.

1. Remove the cover from the transmission feedthrough connector and carefully connect the transmission external wiring harness to the 20-way feedthrough connector. Keep dirt and debris out of the connector. Tighten the bolt to 2.0–3.2 N·m (18–28 lb inch). DO NOT OVER TORQUE.
2. Connect the external wiring harness.
   – For the 4000 Product Family, connect engine, turbine, and output speed sensors, retarder control connector (if retarder is present), and the retarder temperature sensor.
   – For the 3000 Product Family, connect the retarder temperature thermistor, the output speed sensor, and the retarder valve body connector. Also connect the tachograph cable, if used, to the port on the rear of the retarder housing.
3. If used, connect the PTO(s) connector(s). The PTO connector is NOT part of the Allison Transmission external wiring harness.
4. Make sure the speed sensors, the PTO connector, and other connections are securely seated and latched by pulling on the connector—NOT THE WIRES.

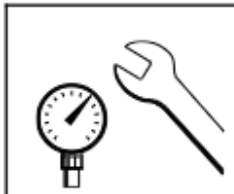
5. The transmission has a sump fluid temperature sensor on the internal wiring harness. A retarder fluid temperature sensor is installed in the retarder on retarder-equipped models. Actual temperature reading can be made with a diagnostic tool. Hot fluid conditions in the sump or retarder are read through the diagnostic tool by programming an output function.
6. A temperature sensor may be installed in the “To Cooler” line that is interfaced to an OEM–provided transmission fluid temperature gauge in the dash. No temperature gauge installations are available on integral cooler installations. If equipped, install the temperature sensor in the "To Cooler" line.
7. Install and connect other vehicle electrical components disconnected or removed—such as auxiliary transmission fluid heaters, etc.
8. Check that all unused hydraulic openings are plugged.

6.10 CONNECTING SPEEDOMETER DRIVE

The TCM provides an electronic speedometer speed signal over a chassis harness wire and/or as a transmission output speed message using a vehicle data link. Consult the OEM for speedometer signal integration procedures as needed.

6.11 FILLING HYDRAULIC SYSTEM

1. Select a transmission fluid (refer to 2.6 FLUID RECOMMENDATIONS).
2. Fill the transmission with the required amount of fluid (refer to Table 2–7).
3. Run the engine for about one minute and check the fluid level (refer to 2.4 TRANSMISSION FLUID CHECK).



CHECKS AND ADJUSTMENTS

Section 7

7.1 INSTALLATION CHECKLIST

Use this checklist after transmission installation. As items are checked, mark them off this list.

- **Torque Values:**
  - All control module bolts—51–61 N·m (38–45 lb ft)
  - Speed sensor bolts—24–29 N·m (18–21 lb ft)
  - Flexplate-to-crankshaft hub bolts—Consult Engine Manufacturer Specifications
  - M8 (8mm) Flexplate-to-flexplate adapter bolts—34–39 N·m (25–29 lb-ft) M10 Flexplate-to-flexplate adapter bolts—63–73 N·m (46–54 lb ft)
  - Fluid drain plug—25–32 N·m (18–24 lb ft)
  - Fluid fill tube bracket—24–29 N·m (18–21 lb ft)
  - Control module pressure taps—10–13 N·m (7–10 lb ft)
  - Cooler fittings: Refer to Table 6–1 and/or Table 6–2
  - Cooler port cover bolts—51–61 N·m (38–45 lb ft)
  - Flexplate adapter-to-converter cover bolts—34–39 N·m (25–29 lb ft)
  - Output flange bolts—70–80 N·m (52–59 lb ft)
  - PTO cover bolts—51–61 N·m (38–45 lb ft)
  - PTO mounting bolts—51–61 N·m (38–45 lb ft)
  - Breather—12–16 N·m (9–12 lb ft)
  - PTO pressure hose to transmission—10–13 N·m (7–10 lb ft)
  - 20-way transmission connector bolt—2.0–3.2 N·m (18–28 lb inch)
  - Rear cover bolts—90–110 N·m (66–81 lb ft)
  - TPS to transmission bracket M6 bolts— 10–13 N·m (84–120 lb inch) 1/4-20 bolts—12–15 N·m (108–132 lb inch)

- **Cooler Fluid Lines and Air Hose for:**
  - No leaks
  - Connection tightness
  - Correct routing
- **Throttle Sensor for:**
  - Proper adjustment
  - Correct routing of cable and harness
- **Driveline for:**
  - Proper indexing of universal joints
  - Proper drive shaft angles
  - Driveline backlash
  - Lubricated universals and slip-joints
- **Hydraulic System for:**
  - Recommended fluid – Allison approved TES 295® or TES 389 fluid
  - Correct fluid level in transmission
  - Fill tube tight
  - Fill tube cap tight
  - Breather clean and free of restrictions
  - No fluid leaks during operation
- **Instruments and Electrical Equipment for:**
  - Proper wiring and electrical connections
  - Instruments, gauges, and lights work correctly
  - Shift Selector display is on and **CHECK TRANS** light is off
  - Fluid temperature gauge
- **Power Takeoff (PTO) (if installed) for:**
  - Controls connected and operative
  - Correctly coupled to driven equipment
  - Lubrication line correctly installed and routed—if used

7.2 ROAD TEST AND VEHICLE OPERATION CHECKLIST

7.2.1 Driveability.

NOTE: Refer to the latest edition of the 3000 and 4000 Product Family Operator's Handbook or Owner's Manuals for operating instructions.

Drive-away checks are performed to verify proper transmission and support equipment installation and operation. The following steps outline drive-away check procedures:

1. Check fluid—fill the transmission with the appropriate fluid.
2. Start the vehicle—check for proper system response during start-up:
    a. Turn on the vehicle's master/ignition switch.
    b. The **CHECK TRANS** light should come on.
    c. Start the engine.
    d. The **CHECK TRANS** light should go off.
    e. **N** (Neutral) should appear in the shift selector display.
3. Clear Trouble Codes—during installation, it is common for false codes to be stored in the electronic control's TCM. These codes must be cleared prior to road testing the vehicle.
4. Road Test the Vehicle—allow the electronic control time to converge shifts.
5. Check for Proper Operation—check all components for proper mounting and operation, and check for transmission fluid leaks at gasket surfaces, lines, and hoses.
6. Recheck for Trouble Code—use the Allison DOC® or shift selector to determine if codes were set during the road test. Refer to 2.12 TROUBLESHOOTING.
7. Troubleshoot—if codes exist after the road test, problems must be found and corrected. Refer to TS7149EN, Allison 5th Generation Controls Troubleshooting Manual for additional information.

7.2.2 Service and Maintenance. Refer to the current issue of the 3000 and 4000 Product Family Service Manuals for detailed transmission service and maintenance instructions. Refer to the latest Allison 5th Generation Controls Troubleshooting Manual for detailed electronic control system troubleshooting.

7.2.3 Road Test Checklist. Complete the following checklist.

- **Neutral Start Circuit:**
  - Starts only in **N** (Neutral)
- **Instruments:**
  - **CHECK TRANS** light and shift selector display
  - Transmission fluid pressure gauge—if used
  - Speedometer
  - Temperature gauge—if used
  - Reverse warning system—if used
- **Transmission Fluid:**
  - Fluid level meets specifications—cold, neutral, level
  - No leaks
- **No-Load Governed Engine Speed:**
  - No-load governed speed of engine
  - Adjust governor as necessary—refer to the manufacturer's specifications for the engine-transmission being tested.
- **Output Retarder:**
  - Operation of the output retarder, if installed, while descending a grade or slowing on a level road.
- **PTO—if installed:**
  - PTO operation—Refer to the appropriate Operator's Manual.
- **Shift Sequence:**
  - Transmission upshifts and downshifts smoothly through all ranges
- **Other Checks:**
  - Stall test
  - Shift quality
- **Comments:**

CUSTOMER SERVICE

Section 8

8.1 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.

Check the telephone directory for the Allison Transmission service outlet nearest you or use Allison Transmission's Sales and Service Locator tool on the Allison Transmission web site at *www.allisontransmission.com*. You may also refer to Allison Transmission's Worldwide Sales and Service Directory SA2229EN.

8.2 SERVICE LITERATURE

Allison Transmission, Inc. service literature provides fully illustrated instructions for operation, maintenance, troubleshooting, service, overhaul, and parts support for your transmission. For maximum performance and service life from your unit, you may order additional publications via fax, phone or web.

FAX: 317-471-4996
TOLL FREE: 888-666-5799
INTERNATIONAL: 317-471-4995
www.allisontransmissionpublications.com

NOTE: Surcharge will be applied for orders placed via phone or FAX

For more information about Allison products please visit *www.allisontransmission.com*.

A World **Of Support**

From our headquarters in Indianapolis, Indiana to our manufacturing plants in Hungary and India, to approximately 1,400 Allison Authorized Distributors and Dealers around the globe, you are never far from the products, training, service and support you demand.

Our support starts from the moment an Allison transmission is specified. We work with you to ensure that the model and ratings fit your engine to create a tailored package of powerful performance and reliable efficiency. And when you need parts or service, you can count on global access to factory-trained specialists and genuine Allison replacement parts.

allisontransmission.com

One Allison Way
Indianapolis, Indiana USA 46222-3271

Information or specifications subject to change without notice or obligation.

allisontransmission.com

MT7151EN (201607)
ISO/QS 9000 and ISO 14001 Certified

Allison Transmission