

SECTION 07: TRANSMISSION

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1. DESCRIPTION

XLII Series Bus Shells are provided with an Allison automatic transmission.

1.1 ALLISON AUTOMATIC TRANSMISSION

The B500 or B500R (with retarder) Allison Transmission has 6 speeds with two top range (fifth and sixth) overdrives. Total coverage is determined by dividing the highest gear ratio by the lowest gear ratio. Total coverage expresses the transmission gear ratio versatility. Transmissions with larger total coverage number have a wider variety of available ratios.

An electronic control allows the transmission to shift at exactly the right point on the engine's fuel consumption curve for best economy. Early lockup maintains the highest possible mechanical efficiency through the closely-spaced gear steps, culminating in two overdrive ratios. This combination allows progressive shifting techniques, where engine speeds are reduced for higher efficiency and lower fuel consumption.

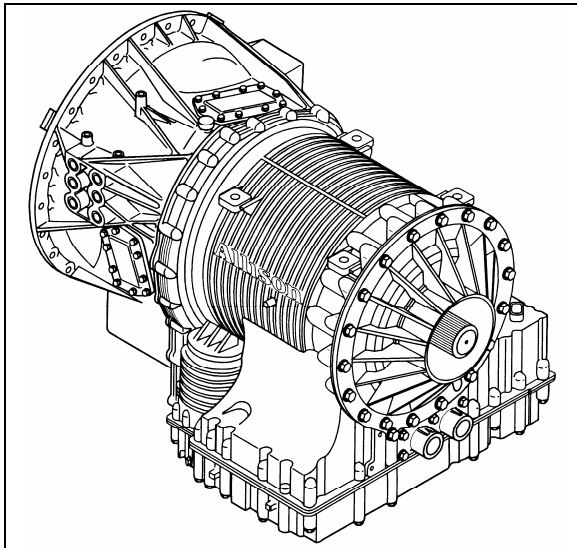


FIGURE 1: ALLISON TRANSMISSION

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Gear selection and torque converter modes are controlled by a microcomputer-based electronic transmission management system. It is fed information regarding throttle position, operator range selection, engine speed, turbine speed, transmission output speed and various system pressures from special electronic sensors. With this information, it computes shift points and clutch pressures to meet immediate needs. Using closed loop adaptive logic; the electronic control looks at a number of parameters during the shift, and makes minute adjustments to match the shift to desired profile stored in its

memory. It then looks at these adjustments and resets the parameters, which allow the transmission to quickly compensate for variations in load, terrain or environment and to adjust for clutch wear and engine power changes. A Diagnostic Data Reader can be connected to the electronic control unit to provide a self-check of all systems in the transmission. Four-digit trouble codes greatly reduce the time it takes to pinpoint potential problems. (Refer to heading "10. TROUBLESHOOTING" in this section).

1.1.1 Retarder (if applicable)

This optional auxiliary braking device for the automatic transmission is integrated into the basic envelope of the transmission and transmits its braking force directly to the propeller shaft. It requires no additional length and adds only 75 pounds (34 kg) of weight. Operation of the retarder is controlled electronically by the driver's use of the brake and/or by hand control lever.

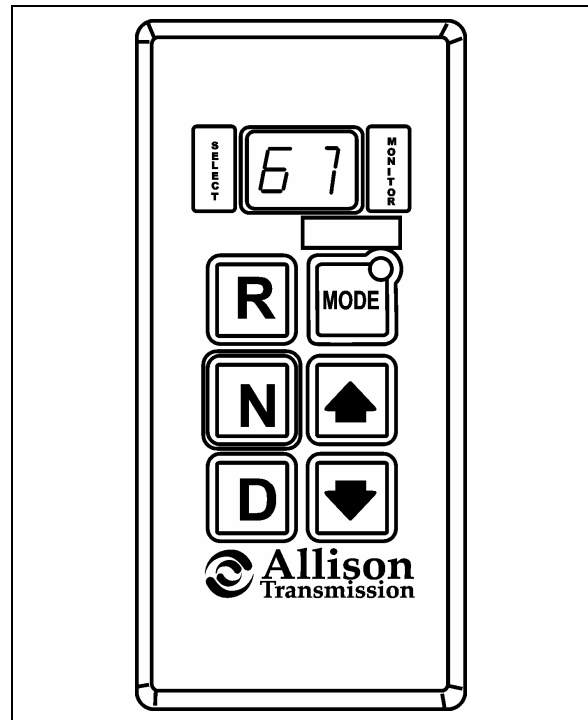


FIGURE 2: ALLISON TRANSMISSION CONTROL PAD 07025

When activated, fluid enters a cavity and provides resistance to the turning of rotor blades revolving with the output shaft. This effectively slows the vehicle to the point where the service brakes are needed only for final stopping. The retarder is fully modulated and is compatible with ABS.

2. WELDING PROCEDURES

These procedures are intended only for vehicles equipped with transmission electronic controls. When frame or other welding is required on the vehicle, precautions are to be taken to protect the electronic control components. Refer to section 00: GENERAL INFORMATION, paragraph 3: "Precautions to be observed before welding" for complete procedure.

3. ALLISON TRANSMISSION MAINTENANCE

To gain access to the dipstick, open the engine compartment rear doors; dipstick is located on the radiator side of the engine (Fig. 3).

3.1 MANUAL FLUID LEVEL CHECK



DANGER

When checking the oil level, be sure that the parking brake and/or emergency brakes are set and properly engaged, and the wheels are chocked. Unexpected and possible sudden vehicle movement may occur if these precautions are not taken.

- Special care must be taken not to touch the engine coolant tubing and/or exhaust pipe, since this could cause severe burns.
- Do not wear loose clothing and, stay away from rotating parts during procedure; personal injury could occur.

Clean all dirt from around the end of the oil filler tube before removing the dipstick. Dirt or foreign matter must not be permitted to enter the oil system since it will cause valves to stick, undue wear of transmission parts, and clogged passages. Check the oil level using the procedures in Cold Check and Hot Check. Record any abnormal level on your "Maintenance Records".

Always check the oil level reading at least twice when the engine is running. Consistency is important in maintaining the accuracy of the reading. If inconsistent readings persist, check the transmission breather to ensure it is clean and free of debris.

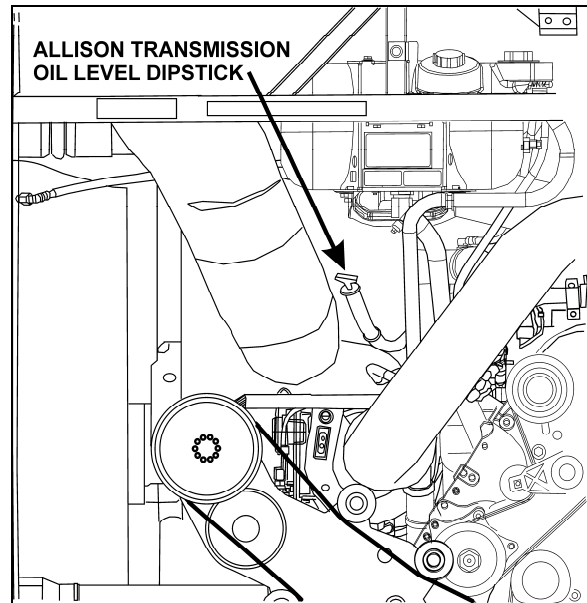


FIGURE 3: OIL LEVEL DIPSTICK (AUTO. TRANS.) 07113

3.2 COLD CHECK

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.

1. If the engine has been shut down for an extended period of time, park the vehicle on a level surface and apply the parking brake.



CAUTION

The oil level rises as sump temperature increases. DO NOT fill above the "Cold Run" band if the transmission oil is below normal operating temperature. During operation, an overfull transmission can become overheated, leading to transmission damage.

2. Run the engine at idle in «N» (Neutral) for about one minute.
3. Shift to Drive (D) and operate the engine for 30 seconds at 1000-1500 rpm; then shift to Reverse (R) to clear the hydraulic system of air.
4. Move the vehicle to a level surface, put transmission in «N» (Neutral), and set the parking brake.
5. Finally shift to Neutral (N) and allow the engine to idle (500 - 800 rpm).
6. While the engine is running, remove the dipstick from the tube and wipe it clean (Figs. 4 & 5). Insert the dipstick into the fill tube, pushing down until it stops.

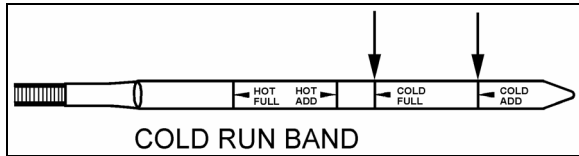


FIGURE 4: COLD CHECK

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7. Remove the dipstick and observe the fluid level. Repeat the check procedure to verify the reading. If the fluid on the dipstick is within the COLD CHECK band, the level is satisfactory for operating the transmission until the oil is hot enough to perform a **Hot Check**. If the fluid level is **not** within this band, add or drain fluid as necessary to bring the level within the COLD CHECK band.
8. Perform a **Hot Check** at the first opportunity after the normal operating temperature of 160°F (71°C) to 200°F (93°C) is attained.

**CAUTION**

DO NOT operate the transmission for extended periods of time until a **Hot Check** has verified proper fluid level. Transmission damage can result from extended operation at improper fluid level conditions.

**CAUTION**

Obtain an accurate fluid level by imposing the following conditions:

- Engine is idling (500-800 rpm) in «N» (Neutral).
- Transmission fluid is at normal operating temperature.
- The vehicle is on a level surface.

3.3 HOT CHECK

**CAUTION**

The oil **must be hot** to ensure an accurate check for this procedure. The oil level rises as temperature increases.

To perform a **Hot Check**, do the following:

1. The **Hot Check** can be performed when the transmission oil reaches the normal operating temperature (160°F to 200°F / 71°C to 93°C). The transmission oil temperature can be checked with the dashboard message center display (MCD)

when selecting the Gauge Mode (refer to the “Operator’s Manual” for added information).

2. Park the vehicle on a level surface and shift to Neutral (N). Apply the parking brake and allow the engine to idle (500 - 800 rpm).
3. Remove the dipstick from the tube and wipe it clean. Insert the dipstick into the fill tube, pushing down until it stops.
4. Remove the dipstick and observe the fluid level. The safe operating level is anywhere within the HOT RUN band on the dipstick. Repeat the check procedure to verify the reading.
5. If the level is **not** within this band, add or drain fluid as necessary to bring the level within the HOT RUN band. (Fig. 5).

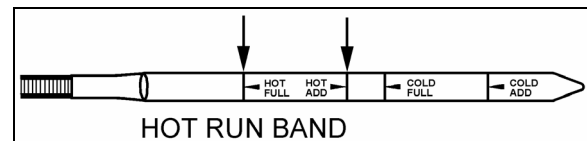


FIGURE 5: HOT CHECK

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6. Be sure fluid level checks are consistent. Check level more than once and if readings are not consistent, check to be sure the transmission breather is clean and not clogged. If readings are still not consistent, contact your nearest Allison dealer or distributor.

NOTE

The Cold Check is more appropriate for verifying the oil level after the first fill-up. In case of conflict, the Hot Check has priority over the Cold Check; the fluid level check using the pushbutton shift selector has priority over the Hot Check.

3.4 FLUID LEVEL CHECK USING THE PUSHBUTTON SHIFT SELECTOR

Oil level codes are obtained as follows:

1. Park vehicle on a level surface, select «N» (neutral) on the pushbutton shift selector and apply parking brake.
2. Press simultaneously the ▲ (Up) and ▼ (Down) arrow buttons once.
3. Oil level codes are displayed in 2 minutes (e.g. display will flash and 8, 7, 6, 5, ...; countdown will occur during the 2 minutes) once the following parameters are met:

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- **Waiting time, vehicle must be stationary for at least 2 minutes to allow the oil to settle;**
- **Engine at idle;**
- **Oil at normal operating temperature, between 140°F (60°C) and 220°F (104°C);**
- **Transmission in «N» (Neutral);**
- **Transmission output shaft stopped;**
- **Oil level sensor present and working.**

After 2 minutes, the display will flash one of the codes shown hereafter:

CODE	CAUSE OF CODE
O L...O K	Oil level is correct
O L...L O...01	One quart low
O L...L O...02	Two quarts low
O L...H I...01	One quart high
O L...H I...02	Two quarts high

NOTE

Failure to meet one of the above parameters will stop the two minute countdown. One of the codes shown hereafter will indicate the cause of the countdown interruption. Once all parameters are met, the countdown will continue from where it left off.

CODE	CAUSE OF CODE
OL...0X	Waiting time too short
OL...50	Engine speed (rpm) too low
OL...59	Engine speed (rpm) too high
OL...65	Neutral must be selected
OL...70	Sump oil temperature too low
OL...79	Sump oil temperature too high
OL...89	Output shaft rotation
OL...95	Sensor failure

To exit the Oil Level Display Mode, press any range button: «R», «N» or «D».

3.5 IMPORTANCE OF PROPER FLUID LEVEL

It is important that the proper fluid level be maintained at all times because the transmission fluid cools, lubricates, and transmits hydraulic power. If the fluid level is too low, the converter and clutches do not receive an adequate supply of fluid. If fluid level is too high, the fluid can aerate, causing the transmission to shift erratically or overheat.

3.6 KEEPING OIL CLEAN

Oil must be handled in clean containers, fillers, etc., to prevent foreign material from entering the transmission. Place the dipstick on a clean surface area while filling the transmission.



CAUTION

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

3.7 RECOMMENDED AUTOMATIC TRANSMISSION FLUID

Hydraulic fluids used in the transmission are important influences on transmission performance, reliability and durability. **Castrol TranSynd™ Synthetic Fluid, DEXRON-III®** and **DEXRON-VI®** fluids are recommended for on-highway applications.

- **TranSynd™** is a full synthetic transmission fluid developed by Allison Transmission and Castrol Ltd. This fluid meets Allison specifications for Severe Duty and Extended Drain Intervals. TranSynd™ is fully qualified to the Allison TES295 specifications and is available through Allison distributors and dealerships.

- To be sure a fluid is qualified for use in Allison transmission, check for the **DEXRON-III®** or **DEXRON-VI®** license numbers on the container or consult the lubricant manufacturer. Consult your Allison Transmission dealer or distributor before using other fluid types.

Customers may use TranSynd™/TES 295 equivalent and extend drain intervals. Equivalent TranSynd™ fluid must meet or exceed TES 295 requirements. Customers may choose from a wide variety of approved non-TES 295 like Dexron-III®, Dexron-VI® or approved Schedule 1 TES-389 fluids.

The Transmission Fluid Operating Temperature Requirements table lists the minimum fluid temperatures at which the transmission may be safely operated without preheating. Preheat with auxiliary heating equipment or by running the equipment or vehicle with the transmission in «N» (Neutral) for a minimum of 20 minutes before attempting range operation.

Transmission Fluid Operating Temperature Requirements

Fluid type	Minimum operating temperature	
	Celsius	Fahrenheit
TranSynd™	-30	-22
DEXRON-VI®	-25	-13



CAUTION

Disregarding minimum fluid temperature limits can result in transmission malfunction or reduced transmission life.

NOTE

The use of an arctic preheat kit is recommended at temperatures below -25°F (-32°C). If a preheat kit is not available, the TCM will restrict full operation until the sump temperature is increased.

3.8 OIL CONTAMINATION

At each oil change, examine the drained oil for evidence of dirt or water. A nominal amount of condensation will emulsify during operation of the transmission. However, if there is evidence of water; check the cooler (heat exchanger) for other signs of leakage. This, however, may also indicate leakage from the engine oil system.

3.9 METAL PARTICLES

Metal particles in the oil (except for minute particles normally trapped in the oil filter) indicate damage has occurred in the transmission. When these particles are found in the sump, the transmission must be disassembled and closely inspected to find the source. Metal contamination will require complete disassembly of the transmission and cleaning of all internal and external circuits, coolers, and all other areas where the particles could lodge.



CAUTION

If excessive metal contamination has occurred, replacement of the oil cooler and replacement of all bearings within the transmission is recommended.

3.10 COOLANT LEAKAGE

If engine coolant leaks into the transmission oil system, immediate action must be taken to prevent malfunction and possible serious damage. The transmission must be completely disassembled, inspected, and cleaned. All traces of the coolant contamination must be removed. Friction clutch plates contaminated with ethylene glycol must be replaced.

TABLE 1

Recommended Fluid and Filter Change Intervals Using Dexron-III / Dexron-VI / Non-TranSynd™/Non-TES 295/Mixture							
Severe ³ MTH equipped with retarder				General ⁴ MTH without retarder			
Fluid	Filters			Fluid	Filters		
	Main	Internal	Lube/ Auxiliary		Main	Internal	Lube/ Auxiliary
12,000 Miles (20 000 km) 6 Months	12,000 Miles (20 000 km) 6 Months	Overhaul	12,000 Miles (20 000 km) 6 Months	25,000 Miles 40 000 km 12 Months	25,000 Miles 40 000 km 12 Months	Overhaul	25,000 Miles (40 000 km) 12 Months

2 inch Control Module (1.75 approximately) – Requires High-Capacity Filter kit Allison P/N 571709

TABLE 2

Recommended Fluid and Filter Change Intervals ¹ Using 100% TranSynd™/TES 295 Approved Fluid ²							
Severe ³ MTH equipped with retarder				General ⁴ MTH without retarder			
Fluid	Filters			Fluid	Filters		
	Main	Internal	Lube/ Auxiliary		Main	Internal	Lube/ Auxiliary
150,000 Miles (240 000 km) 48 Months	75,000 Miles (120 000 km) 36 Months	Overhaul	75,000 Miles (120 000 km) 36 Months	300,000 Miles 480 000 km 48 Months	75,000 Miles (120 000 km) 36 Months	Overhaul	75,000 Miles (120 000 km) 36 Months

TABLE 3

Recommended Fluid and Filter Change Intervals Using 100% TranSynd™/TES 295 Approved Fluid And Gold Series Filters							
MTH equipped with retarder				MTH without retarder			
Fluid	Filters			Fluid	Filters		
	Main	Internal	Lube/ Auxiliary		Main	Internal	Lube/ Auxiliary
	Initial Break-in 5,000 miles (8,000 km)				Initial Break-in 5,000 miles (8,000 km)		
50,000 Miles (80 000 km) 24 Months	50,000 Miles (80 000 km) 24 Months	Overhaul	50,000 Miles (80 000 km) 24 Months	150,000 Miles 240 000 km 48 Months	50,000 Miles 80 000 km 24 Months	Overhaul	50,000 Miles (80 000 km) 24 Months

¹ Extended TranSynd™/TES 295 fluid and filter change intervals are only allowed with Allison High-Capacity filters.

² Less than 100% concentration of TranSynd™/TES 295 approved fluid is considered a mixture and should utilize non-TES 295 change intervals. If the customer replaces non-TranSynd™/non-TES 295 fluid with TranSynd™/TES 295 equivalent, the change interval recommendations of non-TranSynd™/non-TES 295/mixture must be followed. Upon the next oil change, if the customer reinstall TranSynd™/TES 295 equivalent, the fluid & filter change recommendation outlined in 100% TES 295 approved fluids must be followed.

³ Severe vocation= All retarder, On/Off highway, transit and intercity coach with duty cycle greater than one (1) stop per mile.

⁴ General vocation= intercity coach with duty cycle less than or equal to one (1) stop per mile and all other vocations not listed in severe vocation.

3.11 OIL AND FILTER CHANGE

Allison transmissions are factory fill with **Castrol TranSynd™** fluid. Oil change must be performed with the vehicle on a flat and level surface and with parking brake applied. Oil and oil filter change frequency is determined by the severity of service and operating conditions of the transmission and by the filter equipment installed. See "TABLE 1, TABLE 2 or TABLE 3" for oil and filter change intervals. More frequent changes may be required when operations are subject to high levels of contamination or overheating. Filters must be changed at or before recommended intervals.

IMPORTANT NOTE

Allison Transmission recommends that customers use fluid analysis as the primary method for determining fluid change intervals. Many customers have a systematical annual transmission fluid change while, in many cases, fluid analysis could demonstrate that the transmission fluid is still in good condition and a fluid change is not required. In the absence of a fluid analysis program, the fluid change interval listed in TABLE 1, TABLE 2 & TABLE 3 should be used.

IMPORTANT NOTE

Your transmission is equipped with **High Capacity filters**. High Capacity filters allow for increased fluid and filter change intervals in transmissions utilizing TES 295 approved fluid/TranSynd™. High Capacity filters eliminate the requirement of the initial 5000 miles (8000km) main filter change.

Former Gold Series filter kits are completely cancelled and serviced with current High Capacity filter kits. However, if you are using stocked Gold Series filter kits with TES 295 approved fluid/TranSynd™, use TABLE 3 for oil and filter change intervals.

The procedure for changing the transmission oil and oil filters is as follows:

Drain

1. The transmission should be at an operating temperature of 160°F (71°C) to 200°F (93°C) when the oil is drained. This will ensure quicker and more complete fluid drainage.

NOTE

Remove transmission protective panel located underneath transmission for easier access.

2. Remove the drain plug from under the transmission (Fig. 6) and allow the oil to drain into a suitable container. Check the condition of the oil as described previously.
3. To replace the integral filters, remove twelve bolts (6 on each cover), two filter covers, two O-rings, two square cut seals and the two filters from the bottom of the control module (Fig. 6).
4. To install filters, pre-lube and install the two O-rings, the two square cut seals followed by the filters (lube the O-ring in filter cartridge only) into the filter compartment. Index each filter/cover assembly to holes in channel plate/sump. Push the cover assembly in by hand to seat the seals.

**CAUTION**

Do not use bolts to draw the cover to sump. This can damage the cover, seal, or sump.

5. Install twelve bolts and both covers, and then tighten to 38-45 lbf-ft (51-61 Nm).
6. Inspect the drain plug and O-ring. Replace if necessary. Reinstall the drain plug and tighten to 18-24 lbf-ft (25-32 Nm).
7. Reinstall transmission protective panel

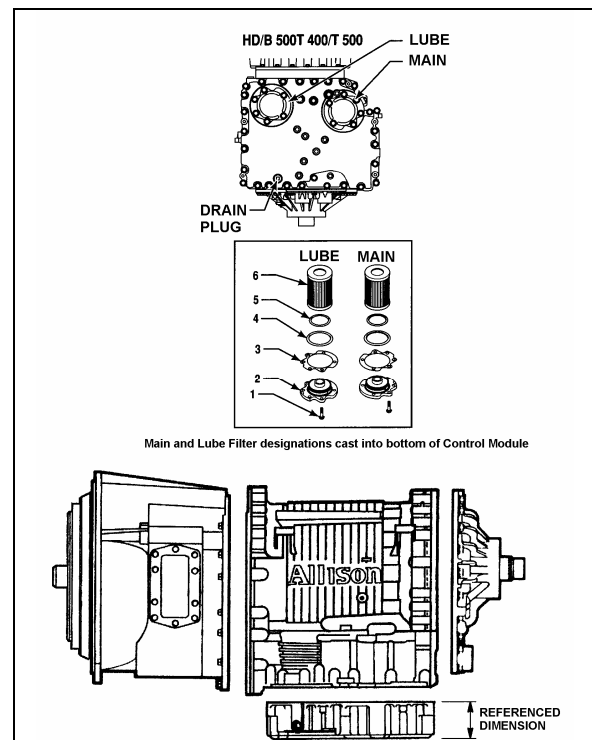


FIGURE 6: DRAIN PLUG AND FILTERS

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Fluid loss with filter change only

When changing main and lube filters at recommended intervals, approximate fluid loss for each filter as follows:

- Main filter = 2 quarts (1.9 liters)
- Lube filter = 8 quarts (7.6 liters)

Refilling Transmission

The amount of refill fluid is less than the amount used for the initial fill. Fluid remains in the external circuits and transmission cavities after draining the transmission.

NOTE

Quantities listed above are approximations and do not include external oil cooler lines.

Using the oil level dipstick filler tube, refill with 24 US qts (23 liters) [28 US qts (26.5 liters) if equipped with retarder] and check the oil level using the **Fluid Level Check Using Pushbutton Shift Selector** procedure in this section.

4. INSTALLATION OF ALLISON TRANSMISSION BRACKETS

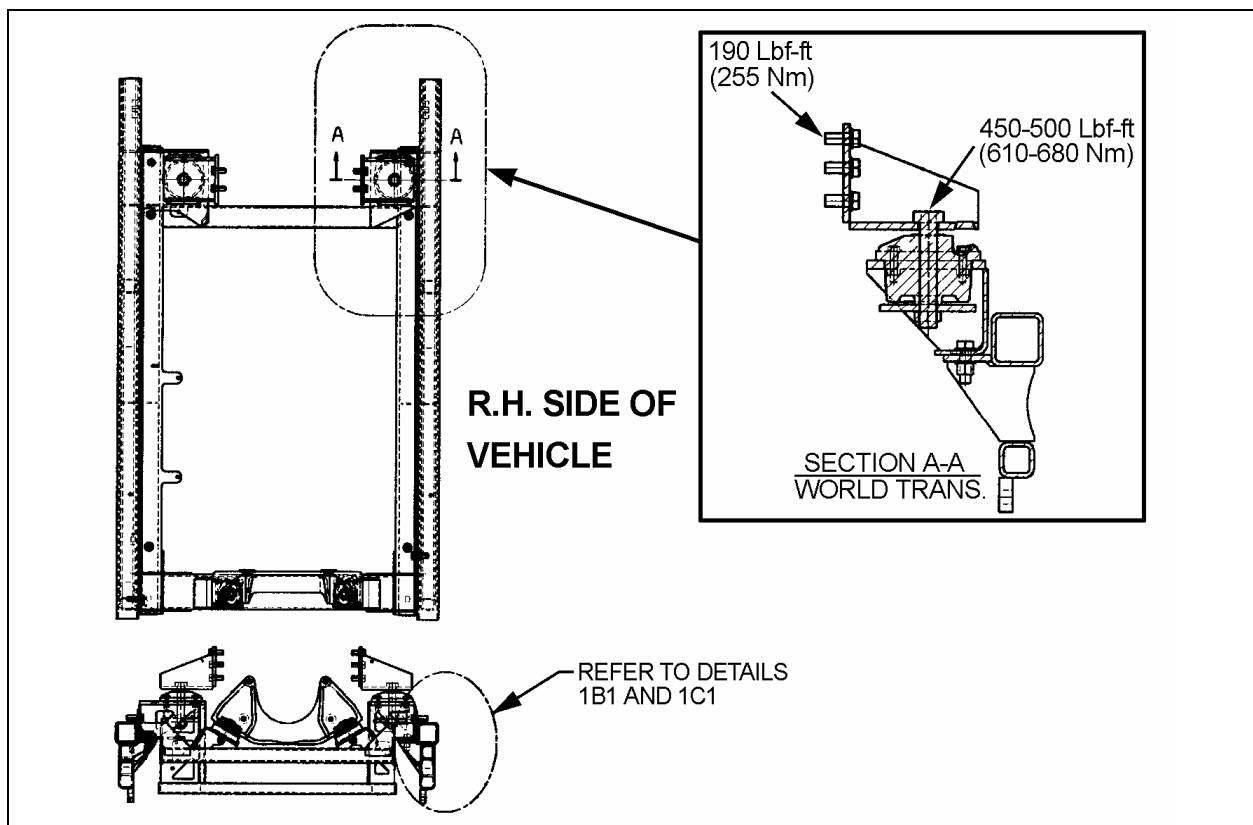


FIGURE 7: ALLISON TRANSMISSION BRACKETS

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5. ALLISON TRANSMISSION REMOVAL

The following procedure deals with the removal of the Allison transmission without removing the power plant cradle from vehicle. The methods used to support the transmission and engine depend upon conditions and available equipment.

1. Select transmission's "NEUTRAL" position, apply parking brake, then set battery master switch to the "OFF" position.

2. Jack up vehicle, then place safety supports underneath body.



CAUTION

Only the recommended jacking points must be used as outlined in Section 18, "BODY".

NOTE

For more clearance between the tag axle and transmission, the tag axle may be unloaded and jacked up or retracted (if applicable).

3. Remove engine splash guards and protective panels surrounding transmission.
4. Remove cross member from under transmission.
5. Remove the transmission drain plug and allow oil to drain. Inspect the drain plug washer and replace it if necessary. Reinstall the drain plug and tighten to 33-41 lbf-ft (45-56 Nm) (see "3.11 Oil and Filter Change" in this section).

**WARNING**

It is better to drain oil when it is still warm. Avoid contact with oil since it can be very hot and cause personal injury.

6. Remove transmission dipstick and filler tube.
7. Disconnect propeller shaft from transmission and remove its safety guard. Refer to Section 09, "PROPELLER SHAFT".
8. Disconnect the two oil cooler hoses from transmission. Cover hose ends and fittings to prevent fluid contamination.

**WARNING**

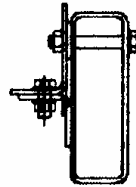
A significant amount of oil may drain from oil lines when they are disconnected.

9. Disconnect all sensors on L.H. side of the transmission.
10. Disconnect main wiring harness.
11. Disconnect the air supply line (steel-braided hose) from retarder control valve (if applicable).
12. Remove any locking tie, clamp and bracket that may interfere with the removal of transmission.
13. Support transmission using a suitable transmission jack.
14. Remove the access plug from the flywheel housing on the R.H. side below starter. From access plug, remove the 12 converter-to-flexible plate attaching screws. Cranking the engine to gain access to the attaching screws may be done by turning the crankshaft pulley using a suitable adapter (fig. 9).

**CAUTION**

Do not rotate alternator shaft clockwise to avoid removing tension on belt.

15. Remove the 12 screws retaining the torque converter housing to the flywheel housing.



DETAIL 1C1
XL2-40 & 45E
TYP. 2 SIDES



DETAIL 1B1
XL2-45
TYP. 2 SIDES

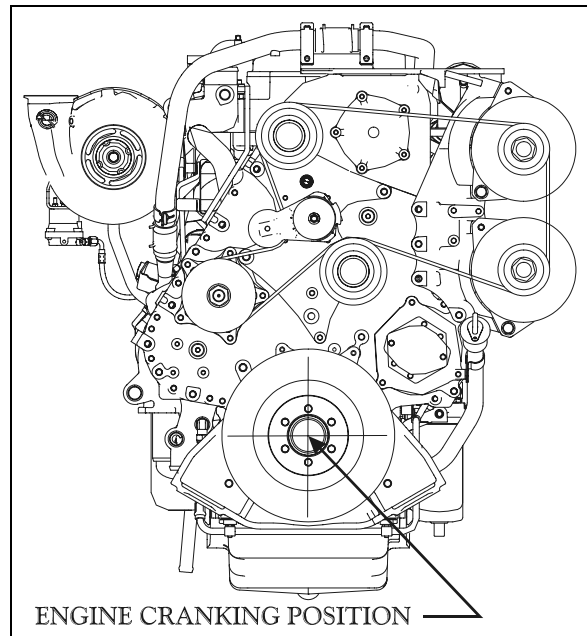
FIGURE 8: DETAILS FOR XLII VEHICLES

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**CAUTION**

Make sure transmission-to-engine alignment is maintained when removing screws to avoid damaging torque converter housing.

16. Slowly pull transmission straight out to clear the engine.
17. Remove the transmission.



ENGINE CRANKING POSITION

FIGURE 9: ENGINE CRANKING POSITION

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6. TRANSMISSION OIL COOLER REMOVAL

6.1 TRANSMISSION WITHOUT RETARDER


Stop engine and allow engine to cool. Close both heater line shutoff valves (refer to Section 05 "Cooling").

To drain the cooling system, proceed as per Section 05 "Cooling", paragraph 5: Draining. If the cooling system is contaminated, flush system as per Section 05 "Cooling", paragraph 7: Flushing.

1. Disconnect and remove the engine air intake duct mounted between the air cleaner housing and the turbocharger inlet.

	CAUTION
To avoid damage to turbocharger, cover the turbocharger inlet opening to prevent foreign material from entering.	

2. Disconnect the two transmission hoses from oil cooler. Cover hose ends and fittings to prevent fluid contamination.

	WARNING
A significant amount of oil may drain from oil lines when they are disconnected.	

3. Unfasten the constant-torque hose clamps and remove the two hoses.

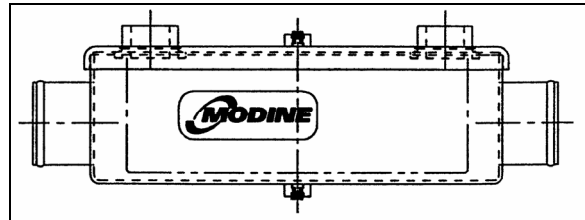



FIGURE 10: MODINE OIL COOLER 07072

4. Unscrew the four holding nuts and remove the U-bolts, remove the oil cooler from engine compartment.
5. Reinstall transmission oil cooler by using reverse procedure.


6.2 TRANSMISSION WITH RETARDER

Stop engine and allow engine to cool. Close both heater line shutoff valves (refer to Section 05 "Cooling").

1. To drain the cooling system, proceed as per Section 05 "Cooling", paragraph 5: Draining. If the cooling system is contaminated, flush system as per Section 05 "Cooling", paragraph 7: Flushing.
2. Disconnect and remove the engine air intake duct mounted between the air cleaner housing and the turbocharger inlet.

	CAUTION
To avoid damage to turbocharger, cover the turbocharger inlet opening to prevent foreign material from entering.	

3. Disconnect the transmission hoses from oil cooler. Cover hose ends and fittings to prevent fluid contamination.

	WARNING
A significant amount of oil may drain from oil lines when they are disconnected.	

4. Unfasten the constant-torque hose clamps and remove the two hoses.
5. Unscrew the holding bolts and nuts and remove the oil cooler from engine compartment.

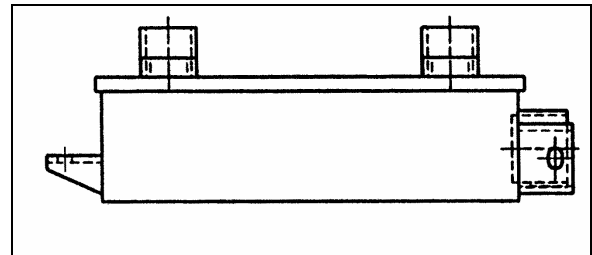


FIGURE 11: COOLER WITH RETARDER 07073

6. Reinstall transmission oil cooler by using reverse procedure.

7. CLEANING AND INSPECTION OF THE ALLISON AUTOMATIC TRANSMISSION

The exterior of the transmission should be cleaned and inspected at regular intervals. The length of service and severity of operating conditions will determine the frequency of such inspections. Inspect the transmission for:

1. Loose bolts (transmission and mounting components);
2. Oil leaks (correct immediately);

3. Loose, dirty, or improperly adjusted throttle sensor linkage;
4. Damaged or loose oil lines;
5. Worn or frayed electrical harnesses, improper routing;
6. Worn or out of phase drive line U-joint and slip fittings.

**CAUTION**

DO NOT pressure wash the transmission electrical connectors. Water and detergent will cause the contacts to corrode or become faulty.

7.1 BREATHER

The breather is located on the engine, flywheel side near the valve cover. It serves to prevent pressure build-up within the transmission and must be cleaned to keep the passage opened. The prevalence of dust and dirt will determine the frequency at which the breather requires cleaning. Use care when cleaning the engine. Spraying steam, water or cleaning solution directly at the breather can force the water or solution into the transmission. Always use care when removing the hose connector from transmission to prevent the entry of foreign matter.

8. ALLISON TRANSMISSION INSTALLATION

NOTE

For more clearance between the tag axle and transmission, the tag axle may be unloaded and jacked up, or retracted (if applicable).

1. With the access plug removed, align one of the 12 attaching screw holes in the flexible plate with the access opening (starter side).
2. Place the transmission on a transmission jack.
3. Install a headless guide bolt into one of the 12 threaded holes for flexible plate attaching screws in the flywheel.
4. Lubricate the flywheel center pilot boss with molybdenum disulfide grease (Molycote G, or equivalent).
5. Raise transmission and position the flywheel pilot boss into the flexible plate adapter. Align the guide bolt previously installed in the

flywheel with the flexible plate hole facing the access opening in the flywheel housing.

**DANGER**

Severe damages and/or personal injury can occur if transmission is not adequately supported.

6. Seat the transmission against the engine flywheel housing. NO FORCE IS REQUIRED. If interference is encountered, move the transmission away from engine, then investigate the cause.

**CAUTION**

The torque converter housing must be seated against the flywheel housing prior to tightening any screws. DO NOT USE SCREWS TO SEAT THE HOUSING.

7. Start all torque converter housing screws, and then tighten four of them gradually and in a criss-cross sequence around the housing. Tighten the 12 remaining screws. Recommended torque is between 42-50 lbf-ft (57-68 Nm).
8. Remove the guide bolt through the access opening in the flywheel housing. Replace it with a self-locking screw, finger-tighten then start the remaining screws; tighten to 17-21 lbf-ft (23-28 Nm). Place a wrench on the crankshaft pulley attaching screw to turn the converter to gain access to the threaded holes.
9. Reinstall the access plug.
10. Remove jack from under transmission.
11. Connect all sensors.
12. Connect the main wiring harness.
13. Connect the air supply line (steel-braided hose) to the retarder control valve (if applicable).
14. Connect the two transmission oil cooler hoses as they were previously.
15. Reinstall clamps and brackets, and replace locking ties previously removed during removal procedure.
16. Install propeller shaft and its safety guard. Refer to Section 09, "PROPELLER SHAFT".

Section 07: TRANSMISSION

17. Install transmission dipstick and filler tube.
18. Install cross member under transmission.
19. Install engine splash guards.
20. Adjust the retarder pressure to 80 ± 3 psi with the air pressure regulator. For more information refer to Section 12, "BRAKE AND AIR SYSTEM", under heading "AIR PRESSURE REGULATOR". The air pressure regulator is located in the engine compartment, above the rear junction box (Fig. 12).

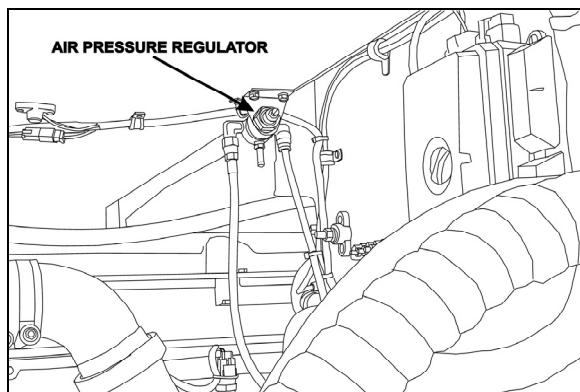


FIGURE 12: AIR PRESSURE REGULATOR (TYPICAL) 07037

23. Make sure that the drain plug is in place, and then remove the transmission dipstick and pour approximately 24 US quarts (23 L) of automatic transmission fluid through the filler tube. Check and adjust oil level.



CAUTION

Do not overfill the transmission. Overfilling can cause oil aeration (milky appearance) and overheating. If overfilling occurs, drain oil as required to bring it to the proper level.

9. TROUBLESHOOTING

9.1 ALLISON AUTOMATIC TRANSMISSION

For complete information about Allison transmission troubleshooting, refer to "Allison 4th Generation Controls – Troubleshooting Manual: 3000 and 4000 Product families (TS3989)".

9.1.1 4th Generation Transmission Control Module

The Allison automatic transmission has a new Transmission Control Module (TCM) which

involves specific diagnostic incident codes. The TCM is located in the coach rear junction box.

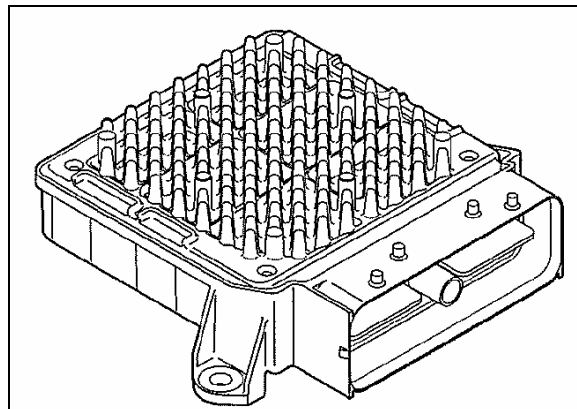


FIGURE 13: TRANSMISSION CONTROL MODULE 07140

TCM Replacement

The TCM is a non-serviceable electronic device. When it fails, it must be replaced using the following procedure:

- Open the coach engine compartment R.H. side door;
- Open the rear junction box in order to get access to the TCM;
- Remove the electrical cable connectors;
- Unscrew the TCM unit;
- Replace by reversing the procedure.



CAUTION

Place the ignition key switch to the "OFF" position.

9.1.2 Diagnostic Troubleshooting Codes (DTC) — Allison 4th Generation Controls

Diagnostic codes (DTC) are numerical indications relating to a malfunction in transmission operation. These codes are logged in a list in the TCM memory with the most severe or most recent code listed first. A maximum of five codes (numbered d1 to d5) may be listed in memory at one time. As codes are added, the oldest inactive code is dropped from the list. If all codes are active, the code with the lowest priority that is not included on the severity list is dropped from the list.

Diagnostic codes (DTC) and code information may be accessed through the pushbutton shift selector or using an Allison DOC™ diagnostic tool.

The TCM separately stores the active and inactive codes. An active code is any code that is current in the TCM decision-making process. Inactive codes are codes that are retained in the TCM memory and will not necessary affect the TCM decision-making process. Inactive codes are useful in determining if a problem is:

- Isolated ;
- Intermittent ;
- Result from a previous malfunction.



The TCM may automatically delete a code from memory if it has not recurred. If the MODE INDICATOR (LED) is not illuminated, the displayed code is not active. An illuminated MODE INDICATOR (LED) during normal operation signifies secondary shift mode operation.

9.1.3 Diagnostic Codes – Allison 4th Generation Controls

When the diagnostic mode is entered, the first code (position d1) is displayed as follows:

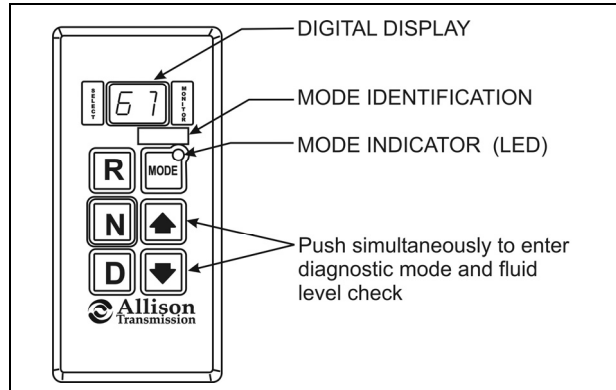
Example: Code P0722

Displayed as: **d1...P...07...22**

The code list position is the first item displayed, followed by the DTC. Each item is displayed for about one second. The display cycles continuously until the next code list position is accessed by pressing the **MODE** button. The following example shows how DTC P0722 is displayed on the pushbutton shift selector.

SELECT	d	1	MONITOR
		P	
	0	7	
	2	2	

- d1 (code list position) – The position which a code occupies in the list. Positions are displayed as « d1 » through « d5 » (code list position 1 through code list position 5).
- P0722 (DTC) – The diagnostic troubleshooting code number referring to the general condition or area of fault detected by the TCM.



9.1.4 Diagnostic Code Display And Clearing Procedure – Allison 4th Generation Controls

Diagnostic codes can be read and cleared by two methods:

- Using an Allison DOC™ diagnostic tool. For specific instructions on how to use an Allison DOC™ diagnostic tool, refer to the User Guide.
- Using the pushbutton shift selector.

To begin the diagnostic process:

1. Bring the vehicle to a stop at a safe location.
2. Apply the parking brake.

To display stored codes:

1. Simultaneously press the ▲ (Up) and ▼ (Down) arrow buttons twice to access the Diagnostic Display Mode.
2. Observe the digital display for code (d1).

NOTE
 To access the Oil Level Display Mode, simultaneously press the ▲ (Up) and ▼ (Down) arrow buttons once. Consult paragraph: « ALLISON TRANSMISSION OIL LEVEL CHECK USING THE PUSHBUTTON SHIFT SELECTOR » at the end of this section.

3. Press the MODE button to see the next code (d2) – repeat for subsequent codes (d3, d4 & d5).

NOTE
 Be sure to record all codes displayed before they are cleared. This is essential for troubleshooting.

NOTE

The Diagnostic Display Mode can be entered for viewing codes at any speed. Codes can only be cleared when the output speed = 0 and no output speed sensor failure is active

Active indicators (MODE INDICATOR LED) and inactive codes can be cleared manually, while in the diagnostic display mode, after the condition causing the code is identified.

To clear active indicators and inactive codes:

1. While in Diagnostic Display Mode, press and hold the MODE button for 10 seconds to clear both active indicators and inactive codes.
2. Begin operating as normal. Have the transmission checked at the earliest opportunity by an Allison Transmission distributor or dealer.

NOTE

*All active indicators are cleared at TCM power down.
Some codes will clear their active indicator when the condition causing the code is no longer detected by the TCM.*

The Diagnostic Display Mode can be exited by any of the following methods:

- Press simultaneously the ▲ (Up) and ▼ (Down) arrow buttons at the same time on the pushbutton shift selector.
- Press any range button «D», «N» or «R» on the pushbutton shift selector (the shift will be commanded if it is not inhibited by an active code).
- Wait until the calibrated time (approximately 10 minutes) has passed. The system will automatically return to the normal operating mode.
- Turn off power to the TCM (shut off the engine using the ignition key).

NOTE

If clearing a code while locked in a «D» (Drive) or «R» (Reverse) position (fail-to-range), the transmission will still be in «D» (Drive) or «R» (Reverse) when the clearing procedure is completed. «N» (Neutral) must be manually selected.

9.1.5 Diagnostic Code Response

The following responses are used in the "Diagnostic Troubleshooting Code List and Inhibited Operation Description" table to command safe operation when diagnostic codes are sent.

DNS - Do Not Shift Response

Release lock up clutch and inhibit lock up operation.
Inhibit all shifts.
Turn ON the CHECK TRANS light.
Display the range attained.
Ignore any range selection inputs from the shift selector.

DNA - Do Not Adapt Response

The TCM stops adaptive shift control while the code is active.

SOL OFF - SOLenoid OFF Response

All solenoids are commanded OFF (turning solenoids "A" and "B" off electrically cause them to be on hydraulically).

RPR - Return to Previous Range Response

When the speed sensor ratio or C3 pressure switch test associated with a shift not successful, the TCM commands the same range as commanded before the shift.

NNC - Neutral No Clutches Response

When certain speed sensor ratio or C3 pressure switch tests are not successful, the TCM commands a neutral condition with no clutches applied.

9.1.6 Diagnostic Troubleshooting Codes (DTC) List - Allison 4th Generation Controls

DTC	Description	CHECK TRANS Light	Inhibited Operation Description
C1312	Retarder Request Sensor Failed Low	No	May inhibit retarder operation if not using J1939 datalink
C1313	Retarder Request Sensor Failed High	No	May inhibit retarder operation if not using J1939 datalink
P0122	Pedal Position Sensor Low Voltage	No	Use default throttle values. Freezes shift adapts.
P0123	Pedal Position Sensor High Voltage	No	Use default throttle values. Freezes shift adapts.
P0218	Transmission Fluid Over Temperature	No	Use hot mode shift schedule. Holds fourth range. TCC is inhibited. Freezes shift adapts.
P0602	TCM Not Programmed	Yes	Lock in Neutral
P0610	TCM Vehicle Options (Trans ID) Error	Yes	Use TID A calibration
P0613	TCM Processor	No	All solenoids off
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)
P063E	Auto Configuration Throttle Input Not Present	Yes	Use default throttle values
P063F	Auto Configuration Engine Coolant Temp Input Not Present	No	None
P0658	Actuator Supply Voltage 1 (HSD1) Low	Yes	DNS, SOL OFF (hydraulic default)
P0659	Actuator Supply Voltage 1 (HSD1) High	Yes	DNS, SOL OFF (hydraulic default)
P0702	Transmission Control System Electrical (TransID)	Yes	Use TID A calibration
P0703	Brake Switch Circuit Malfunction	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 Input	Yes	Ignore defective strip selector inputs
P070C	Transmission Fluid Level Sensor Circuit – Low Input	No	None
P070D	Transmission Fluid Level Sensor Circuit – High Input	No	None
P0711	Transmission Fluid Temperature Sensor Circuit Performance	Yes	Use default sump temp
P0712	Transmission Fluid Temperature Sensor Circuit Low Input	Yes	Use default sump temp
P0713	Transmission Fluid Temperature Sensor Circuit High Input	Yes	Use default sump temp
P0716	Turbine Speed Sensor Circuit Performance	Yes	DNS, Lock in current range
P0717	Turbine Speed Sensor Circuit No Signal	Yes	DNS, Lock in current range
P0719	Brake Switch ABS Input Low	No	TCM assumes ABS is OFF
P071A	RELS Input Failed On	Yes	Inhibit RELS operation
P071D	General Purpose Input Fault	Yes	None
P0721	Output Speed Sensor Circuit Performance	Yes	DNS, Lock in current range
P0722	Output Speed Sensor Circuit No Signal	Yes	DNS, Lock in current range
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 6 th Gear Ratio	Yes	DNS, Attempt 5 th , then 3 rd
P0731	Incorrect 1 st Gear ratio	Yes	DNS, Attempt 2 nd , then 5 th

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DTC	Description	CHECK TRANS Light	Inhibited Operation Description
P0732	Incorrect 2 nd Gear ratio	Yes	DNS, Attempt 3 rd , then 5 th
P0733	Incorrect 3 rd Gear ratio	Yes	DNS, Attempt 4 th , then 6 th
P0734	Incorrect 4 th Gear ratio	Yes	DNS, Attempt 5 th , then 3 rd
P0735	Incorrect 5 th Gear ratio	Yes	DNS, Attempt 6 th , then 3 rd , then 2 nd
P0736	Incorrect Reverse Gear ratio	Yes	DNS, Lock in Neutral
P0741	Torque Converter Clutch System Stuck Off	Yes	None
P0776	Pressure Control Solenoid 2 Stuck Off	Yes	DNS, RPR
P0777	Pressure Control Solenoid 2 Stuck On	Yes	DNS, RPR
P0796	Pressure Control Solenoid 3 Stuck Off	Yes	DNS, RPR
P0797	Pressure Control Solenoid 3 Stuck On	Yes	DNS, RPR
P0842	Transmission Pressure Switch 1 Circuit Low	Yes	DNS, Lock in current range
P0843	Transmission Pressure Switch 1 Circuit High	Yes	DNS, Lock in current range
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
P0894	Transmission Component Slipping	Yes	DNS, Lock in first
P0960	Pressure Control Solenoid Main Mod Control Circuit Open	Yes	None
P0962	Pressure Control Solenoid Main Mod Control Circuit Low	Yes	DNS, SOL OFF (hydraulic default)
P0963	Pressure Control Solenoid Main Mod Control Circuit High	Yes	None
P0964	Pressure Control Solenoid 2 (PCS2) Control Circuit Open	Yes	DNS, SOL OFF (hydraulic default)
P0966	Pressure Control Solenoid 2 (PCS2) Control Circuit Low	Yes	DNS, SOL OFF (hydraulic default)
P0967	Pressure Control Solenoid 2 (PCS2) Control Circuit High	Yes	DNS, SOL OFF (hydraulic default)
P0968	Pressure Control Solenoid 3 (PCS3) Control Circuit Open	Yes	DNS, SOL OFF (hydraulic default)
P0970	Pressure Control Solenoid 3 (PCS3) Control Circuit Low	Yes	DNS, SOL OFF (hydraulic default)
P0971	Pressure Control Solenoid 3 (PCS3) Control Circuit High	Yes	DNS, SOL OFF (hydraulic default)
P0973	Shift Solenoid 1 (SS1) Control Circuit Low	Yes	DNS, SOL OFF (hydraulic default)
P0974	Shift Solenoid 1 (SS1) Control Circuit High	Yes	DNS, SOL OFF (hydraulic default)
P0975	Shift Solenoid 2 (SS2) Control Circuit Open	Yes	7-speed: Allow 2 through 6, N, R
P0976	Shift Solenoid 2 (SS2) Control Circuit Low	Yes	7-speed: Allow 2 through 6, N, R Inhibit TCC operation
P0977	Shift Solenoid 2 (SS2) Control Circuit High	Yes	7-speed: Allow 2 through 6, N, R
P0989	Retarder Pressure Sensor Failed Low	No	None
P0990	Retarder Pressure Sensor Failed High	No	None
P1739	Incorrect Low Gear Ratio	Yes	Command 2 nd and allow shifts 2 through 6, N, R
P1891	Throttle Position Sensor PWM Signal Low Input	No	Use default throttle values
P1892	Throttle Position Sensor PWM Signal High Input	No	Use default throttle values
P2184	Engine Coolant Temperature Sensor Circuit Low Input	No	Use default engine coolant values
P2185	Engine Coolant Temperature Sensor Circuit High Input	No	Use default engine coolant values
P2637	Torque Management Feedback Signal (SEM)	Yes	Inhibit SEM
P2641	Torque Management Feedback Signal (LRTP)	Yes	Inhibit LRTP
P2670	Actuator Supply Voltage 2 (HSD2) Low	Yes	DNS, SOL OFF (hydraulic default)

DTC	Description	CHECK TRANS Light	Inhibited Operation Description
P2671	Actuator Supply Voltage 2 (HSD2) High	Yes	DNS, SOL OFF (hydraulic default)
P2685	Actuator Supply Voltage 3 (HSD3) Low	Yes	DNS, SOL OFF (hydraulic default)
P2686	Actuator Supply Voltage 3 (HSD3) High	Yes	DNS, SOL OFF (hydraulic default)
P2714	Pressure Control Solenoid 4 (PCS4) Stuck Off	Yes	DNS, RPR
P2715	Pressure Control Solenoid 4 (PCS4) Stuck On	Yes	DNS, SOL OFF (hydraulic default)
P2718	Pressure Control Solenoid 4 (PCS4) Control Circuit Open	Yes	DNS, SOL OFF (hydraulic default)
P2720	Pressure Control Solenoid 4 (PCS4) Control Circuit Low	Yes	DNS, SOL OFF (hydraulic default)
P2721	Pressure Control Solenoid 4 (PCS4) Control Circuit High	Yes	DNS, SOL OFF (hydraulic default)
P2723	Pressure Control Solenoid 1 (PCS1) Stuck Off	Yes	DNS, RPR
P2724	Pressure Control Solenoid 1 (PCS1) Stuck On	Yes	DNS, RPR
P2727	Pressure Control Solenoid 1 (PCS1) Control Circuit Open	Yes	DNS, SOL OFF (hydraulic default)
P2729	Pressure Control Solenoid 1 (PCS1) Control Circuit Low	Yes	DNS, SOL OFF (hydraulic default)
P2730	Pressure Control Solenoid 1 (PCS1) Control Circuit High	Yes	DNS, SOL OFF (hydraulic default)
P2736	Pressure Control Solenoid 5 (PCS5) Control Circuit Open	Yes	Inhibit retarder operation
P2738	Pressure Control Solenoid 5 (PCS5) Control Circuit Low	Yes	Allow 2 through 6, N, R. Inhibit retarder and TCC operation
P2739	Pressure Control Solenoid 5 (PCS5) Control Circuit High	Yes	Inhibit retarder operation
P2740	Retarder Oil Temperature Hot	No	None
P2742	Retarder Oil Temperature Sensor Circuit – Low Input	No	Use default retarder temp values
P2743	Retarder Oil Temperature Sensor Circuit – High Input	No	Use default retarder temp values
P2761	TCC PCS Control Circuit Open	Yes	Inhibit TCC operation
P2763	TCC PCS Control Circuit High	Yes	Inhibit TCC operation
P2764	TCC PCS Control Circuit Low	Yes	7-speed: Allow 2 through 6, N, R. Inhibit TCC operation
P278A	Kickdown Input Failed ON	No	Inhibit kickdown operation
P2793	Gear Shift Direction Circuit	Yes	Ignores PWM input from shift selector
P2808	Pressure Control Solenoid 6 (PCS6) Stuck Off	Yes	DNS, RPR
P2809	Pressure Control Solenoid 6 (PCS6) Stuck On	Yes	DNS, RPR
P2812	Pressure Control Solenoid 6 (PCS6) Control Circuit Open	Yes	DNS, SOL OFF (hydraulic default)
P2814	Pressure Control Solenoid 6 (PCS6) Control Circuit Low	Yes	DNS, SOL OFF (hydraulic default)
P2815	Pressure Control Solenoid 6 (PCS6) Control Circuit High	Yes	DNS, SOL OFF (hydraulic default)
U0001	Hi Speed CAN Bus Reset Counter Overrun (IESCAN)	No	Use default values, inhibit SEM
U0010	CAN BUS Reset Counter Overrun	No	Use default values, inhibit SEM
U0100	Lost Communications with ECM/PCM (J1587)	Yes	Use default values
U0103	Lost Communication with Gear Shift Module (Shift Selector) 1	Yes	Maintain range selected, observe gear shift direction circuit
U0115	Lost Communication with ECM	Yes	Use default values
U0291	Lost Communication with Gear Shift Module (Shift Selector) 2	Yes	Maintain range selected, observe gear shift direction circuit
U0304	Incompatible Gear Shift Module 1 (Shift Selector) ID	Yes	Ignore shift selector inputs
U0333	Incompatible Gear Shift Module 2 (Shift Selector) ID	Yes	Ignore shift selector inputs
U0404	Invalid Data Received From Gear Shift Module (Shift Selector) 1	Yes	Maintain range selected, observe gear shift direction circuit
U0592	Invalid Data Received From Gear Shift Module (Shift Selector) 2	Yes	Maintain range selected, observe gear shift direction circuit

10. SPECIFICATIONS

ALLISON AUTOMATIC TRANSMISSION WITH OR WITHOUT RETARDER

XLII BUS SHELLS

Gross input power (maximum).....	525 HP (392 kW)
Gross input torque (maximum)	1650 Lbf-ft (2237 Nm)
Rated input speed (minimum-maximum)	1600-2300 rpm

Mounting:

Engine..... SAE #1 flywheel housing, flex disk drive

Torque converter:

Type One stage, three element, polyphase
Stall torque ratio TC 551-1.8
Lockup clutch with torsional damper Integral/standard

Gearing:

Type Patented, constant mesh, helical, planetary

Ratio:

First	3.51:1
Second.....	1.91:1
Third.....	1.43:1
Fourth.....	1.00:1
Fifth	0.74:1
Sixth	0.64:1
Reverse	4.80:1

Ratio coverage:

6 speed 5.48:1

*** Gear ratios do not include torque converter multiplication.**

Oil System:

Oil type..... TRANSYND, DEXRON-III, DEXRON-VI
Capacity (excluding external circuits) Initial fill 47 US qts (45 liters)
Oil change..... 24 US qts (23 liters)
Oil change (with retarder)..... 27.6 US qts (26 liters)

Oil Filters:

Make Allison Transmission
Type Disposable cartridge
Prévost number (2-filter replacement kit) 571709