# SECTION 07: TRANSMISSION

## CONTENTS



## ILLUSTRATIONS

## 1. DESCRIPTION

X3 Series coaches featuring Metropolitan Transportation Authority (MTA) specifications are provided with an Allison automatic transmission

- ALLISON AUTOMATIC TRANSMISSION

The 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.

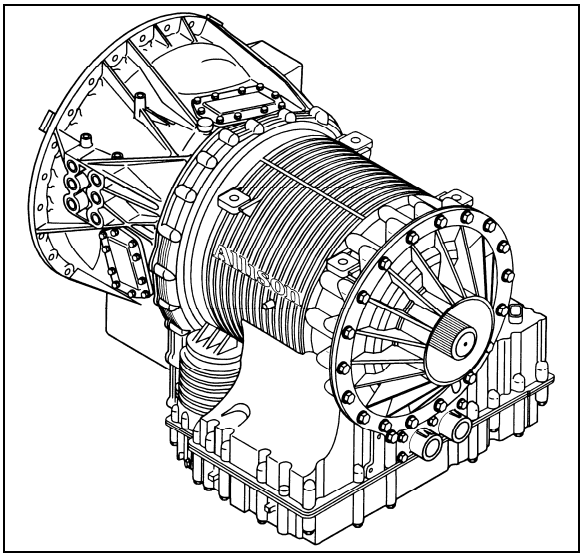


**FIGURE 1: ALLISON TRANSMISSION** 07136

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. Five-digit trouble codes greatly reduce the time it takes to pinpoint potential problems. (Refer to paragraph *"8. TROUBLESHOOTING"* in this section).

- Retarder

This 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 pedal.

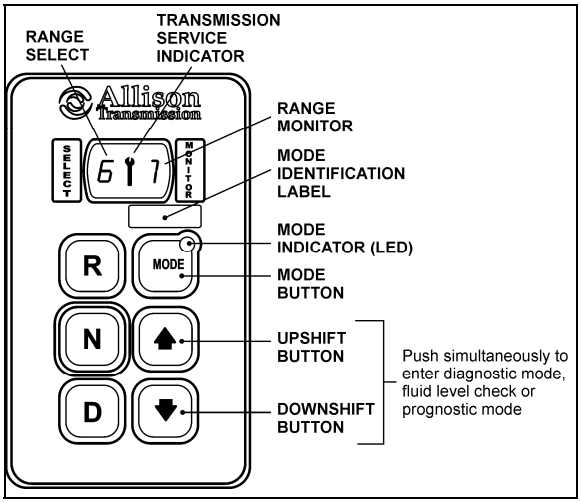



**FIGURE 2: ALLISON TRANSMISSION CONTROL PAD** 07142

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. 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"*.

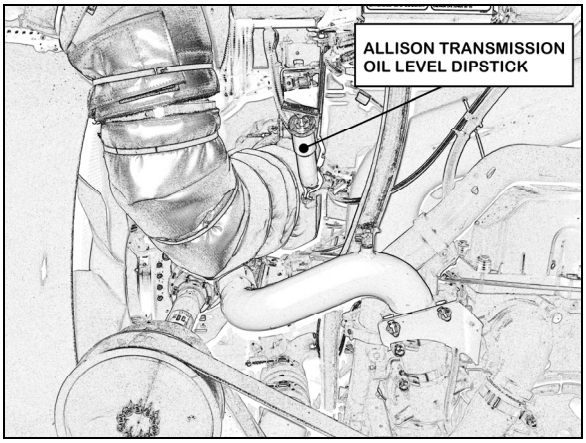



**FIGURE 3: OIL LEVEL DIPSTICK (AUTO. TRANS.)** 07113

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.

#### 3.1.1 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.

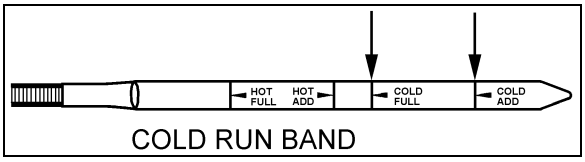



**FIGURE 4: COLD CHECK** 07050

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 160ºF (71ºC) to 200ºF (93ºC) 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.

3.1.2 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 (160ºF to 200ºF / 71ºC to 93ºC). 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).

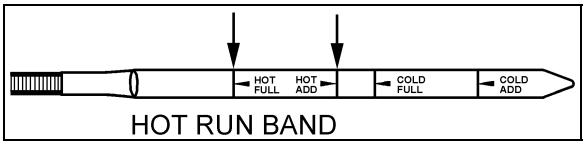



**FIGURE 5: HOT CHECK** 07049

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.***

3.2 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:

- **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 below:

| CODE | CAUSE OF CODE |
|---|---|
| O L…O K | Oil level is correct |
| O L…L O… 1 | Oil Level is LOw 1 quart |
| O L…L O… 2 | Oil Level is LOw 2 quart |
| O L…L O… 3 | Oil Level is LOw 3 quarts |
| O L…L O… 4 | Oil Level is LOw 4 or more quarts |
| O L…H I… 1 | Oil Level is HIgh 1 quart |
| O L…H I… 2 | Oil Level is HIgh 2 quarts |
| O L…H I… 3 | Oil Level is HIgh 3 or more quarts |
| O L… – (fc) | Oil Level is invalid. Source of invalid reading is defined by a two-character fault code (fc) |

*NOTE*

*Note that the quantities LO 4 and HI 3 are the largest values displayed and that the actual variation in oil level may exceed these numbers.*

*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.*

If the fluid level check cannot be completed, an Invalid for Display fault is reported. This condition is reflected by the display of "OL", followed by "–", followed by one or two additional characters. The displayed characters define the cause of the fault, which may be either a system malfunction or an improper condition for conducting the check.

| CODE | CAUSE OF CODE |
|---|---|
| OL…-…0X | Waiting period is not complete |
| OL…-…EL | Engine speed (rpm) too low |
| OL…-…EH | Engine speed (rpm) too high |
| OL…-…SN | N (neutral) must be selected |
| OL…-…TL | Sump oil temperature too low |
| OL…-…TH | Sump oil temperature too high |
| OL…-…SH | Output shaft rotation |
| OL…-…FL | Sensor failure |

To exit the Oil Level Display Mode, press any range button: "R", "N" or "D" at any time.

### 3.3 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.

### 3.4 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.

### 3.5 RECOMMENDED AUTOMATIC TRANSMISSION FLUID

Hydraulic fluids used in the transmission are important influences on transmission performance, reliability and durability. **Castrol TranSynd™ Synthetic Fluid** and **DEXRON-III®** 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 Prevost Parts.

*NOTE*

*The prognostics package requires the use of TranSynd™ or an Allison approved TES-295 licensed fluid in the transmission and Allison High Capacity filters. If any other fluids or filters are used, Prognostic mode* ***must be disabled****. Prognostic information will not be accurate with any other fluids or filters and could result in missed maintenance activities resulting in transmission damage.*

- To be sure a fluid is qualified for use in Allison transmission, check for the **DEXRON-III®** license number 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 Dexron-III® fluids.

Customers may choose from a wide variety of approved non-TES 295 like Dexron-III® 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-III® | -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 -25ºF (-32ºC). If a preheat kit is not available, the TCM will restrict full operation until the sump temperature is increased.*

3.6 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.

3.7 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.

3.8 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.

3.9 CONTROL SYSTEM PROGNOSTICS

The transmission control system includes the provision for the user to monitor various transmission operating parameters. Transmission operating parameters monitored by the prognostics feature are:

- Oil Life Monitor
- Filter Life Monitor
- Transmission Health Monitor

*NOTE*

*The prognostics package requires the use of TranSynd™ or an Allison approved TES-295 licensed fluid in the transmission and Allison High Capacity filters. If any other fluids or filters are used, Prognostic mode* ***must be disabled****. Prognostic information will not be accurate with any other fluids or filters and could result in missed maintenance activities resulting in transmission damage.*

*Refer to TES 295 Approved Fluids list, found under the Service/Fluids heading on the home page of the Allison Transmission web site.*

***www.allisontransmission.com***

When a specified threshold is detected for any of the serviceable conditions, the TRANSMISSION SERVICE indicator is illuminated to alert the operator. Failure to attend to the service condition and reset the TRANSMISSION SERVICE indicator within a defined operating period will result in illumination of the CHECK TRANS light on the dashboard telltale panel, indicating the increased probability that the service condition will develop into a more serious condition.

To access the Prognostic Mode functions, simultaneously press the ▲ (Up) and ▼ (Down) arrow buttons repeatedly. See the reference table at the end of this section.

- Oil Life Monitor

The display message denotes the calculated remaining life of the transmission fluid. This value is based on the established life for the required baseline fluid, and then is continuously adjusted for cumulative effects of such operating parameters as operating time, retarder operation, output shaft revolutions and shift frequency.

**Display:** The display is a two-digit number, denoting percentage of the fluid life which remains. New fluid is displayed as 99%.

The TRANSMISSION SERVICE indicator will be illuminated, denoting a required change of transmission fluid, when the remaining fluid life reaches approximately 1–2 %. The indicator will be lit steadily upon each initialization of the TCM, and will remain on steady for approximately 1–2 minutes after the first selection of “D” (drive) range each time, until service is performed and the indicator is reset.

Failure to perform maintenance and reset the TRANSMISSION SERVICE indicator within a defined period will result in the illumination of the CHECK TRANS light on the dashboard telltale panel and diagnostic code P0897 Transmission Fluid at Limit will be set.

**Reset:** The TRANSMISSION SERVICE indicator can be reset by a message over the SAE J1939 communication interface, with the Allison DOC™ for PC diagnostic program, or by depressing and holding the MODE button for ten (10) seconds while the Oil Life Monitor function is displayed. It may also be reset by selecting N-D-N-D-N-R-N on the shift selector, pausing briefly (less than 3 seconds) between each selector movement, with the ignition on and the engine not running.

> **CAUTION**
>
> Required calendar-based oil & filter change intervals (based on month) still apply because Oil Life Monitor function cannot measure time while ignition power is OFF.
>
> If the Oil Life Monitor function has not indicated the need for a fluid change before 60 month (five years) have passed, it will be necessary to change the fluid and filters per calendar requirements and reset the system.

- Filter Life Monitor

The display message denotes operating status of the transmission main fluid filter, based on the measured pressure drop across the filter. The feature is not functional at transmission sump temperatures below 40 ºC (105 ºF). Both the main and lube filters **must be** changed when the TRANSMISSION SERVICE indicator shows the main filter should be changed.

**Display:** An acceptable filter life status is displayed as "OK". An unacceptable filter life status is displayed as "LO".

Once the programmed threshold for maximum filter pressure drop has been observed and verified, the diagnostic code P088A Transmission Filter At/Over Limit will be recorded to indicate that the filter has reached the end of its designed life. At the next initialization of the TCM, the TRANSMISSION SERVICE indicator will flash for approximately 1–2 minutes after the first selection of “D” (drive) range. Thereafter, the indicator will illuminate and flash upon each TCM initialization, continuing to flash for 1–2 minutes after the first selection of a drive range each time, until service is performed and the indicator is reset.

Failure to perform maintenance and reset the monitor after a calibration-defined number of warnings will result in the illumination of the CHECK TRANS light on the dashboard telltale panel and diagnostic code P088B will be recorded to indicate a highly deteriorated filter.

**Reset:** The feature will reset automatically when the main fluid filter has been changed and the pressure drop across the filter no longer exceeds the threshold value. A manual reset

can be performed by depressing and holding the MODE button for ten (10) seconds while the Filter Life Monitor function is displayed. It may also be reset by selecting N-R-N-R-N-D-N on the shift selector, pausing briefly (less than 3 seconds) between each selector movement, with the ignition on and the engine not running.

- Transmission Health Monitor

The display message denotes clutch life status, as determined by monitored changes and the calculated running clearance of the transmission clutches C1, C2, C3, C4 & C5.

**Display:** An acceptable clutch life status is displayed as "OK". An unacceptable clutch life status is displayed as "LO". The specific clutch(es) for which the function indicates "LO" cannot be identified with the shift selector. Allison DOC™ for PC-Service Tool displays clutch condition as OK or NOT OK for each clutch, C1 through C5.

The TRANSMISSION SERVICE indicator will be illuminated, indicating the need for clutch maintenance, when the remaining clutch life reaches approximately 10%, or if the running clearance exceeds a maximum value which may indicate a non-wear-related issue. Thereafter, the indicator will be lit upon each initialization of the TCM, and will remain on steady during all vehicle operation until service is performed and the indicator is reset.

Failure to perform maintenance and reset the monitor after a number of warnings will result in the illumination of the CHECK TRANS light on the dashboard telltale panel and diagnostic code P2789 Clutch Adaptive learning at Limit will be set.

**Reset:** The feature will reset automatically upon elimination of the clutch clearance condition which initiated it. The indicator can also be manually reset using the Allison DOC™ for PC diagnostics program if necessary.

**The following table illustrates how to access Oil Level Check, Prognostics & Diagnostic Troubleshooting Codes functions on the Allison pushbutton shift selector.**

| ▲ (up) & ▼ (down) arrow buttons pressed simultaneously | Description | SELECT | MONITOR |
|---|---|---|---|
| **1st press** | **Allison transmission oil level check** | " - " | " - " |
| | Other codes will be displayed | | |
| **2nd press** | **Oil Life Monitor** | **" O "** | **" M "** |
| | Oil life remaining will range from 99% down to 00% | Some number from 9 to 0 | Some number from 9 to 0 |
| **3rd press** | **Filter Life Monitor** | **" F"** | **" M "** |
| | Present life of filter is OK | " O " | " K" |
| | Present life of filter is low | " L" | " O" |
| **4th press** | **Transmission Health Monitor** | **" O "** | **" K"** |
| | Shows "OK" until remaining life of one or more of the clutch(es) wear enough so that the programming changes | " O " | " K" |
| | One or more of the clutches C1 through C5 have worn enough to change the program | " L" | " O" |
| **5th press** | **Display of diagnostic codes** | **" d "** | **" 1"** |
| | Other codes will be displayed | | |

## TABLE 1

| Recommended Fluid and Filter Change Intervals Using Dexron-III / Non-TranSynd™/Non-TES 295/Mixture | | | |
|---|---|---|---|
| **Severe[3] All vehicles equipped with a retarder and not using High-Capacity Filters** | | | |
| **Fluid** | **Filters** | | |
| | **Main** | **Internal** | **Lube/ Auxiliary** |
| 12,000 Miles (20 000 km) 6 Months/ 500 Hrs | 12,000 Miles (20 000 km) 6 Months/ 500 Hrs | Overhaul | 12,000 Miles (20 000 km) 6 Months/ 500 Hrs |

## TABLE 2

| Recommended Fluid and Filter Change Intervals[1] Using 100% TranSynd™/TES 295 Approved Fluid[2] | | | |
|---|---|---|---|
| **Severe[3] All vehicles equipped with a retarder and not using High-Capacity Filters** | | | |
| **Fluid** | **Filters** | | |
| | **Main** | **Internal** | **Lube/ Auxiliary** |
| 50,000 Miles (80 000 km) 24 Months/ 2000 Hrs | 50,000 Miles (80 000 km) 24 Months/ 2000 Hrs | Overhaul | 50,000 Miles (80 000 km) 24 Months/ 2000 Hrs |

## TABLE 3

| Recommended Fluid and Filter Change Intervals[1] Using 100% TranSynd™/TES 295 Approved Fluid[2] | | | |
|---|---|---|---|
| **Severe[3] All vehicles equipped with a retarder and using High-Capacity Filters** | | | |
| **Fluid** | **Filters** | | |
| | **Main** | **Internal** | **Lube/ Auxiliary** |
| 150,000 Miles (240 000 km) 48 Months/ 6000 Hrs | 75,000 Miles (120 000 km) 36 Months/ 3000 Hrs | Overhaul | 75,000 Miles (120 000 km) 36 Months/ 3000 Hrs |

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

[1] Extended TrandSynd™/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 coaches with duty cycle greater than one (1) stop per mile.

## 3.10 OIL AND FILTER CHANGE INTERVAL

- Oil and Filter Change interval With Prognostics Mode Disabled

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 2 for oil and filter change intervals.*

- Oil And Filter Change Interval With Prognostics Mode Enabled

Oil Life Monitor and Filter Life Monitor of the Prognostics mode provide indicators of required maintenance actions. They are designed to maximize fluid and filter utilization. **Prognostics enabled requires the use of 100% TranSynd™ or an Allison approved TES-295 transmission fluid and Allison High Capacity filters**. If any other fluids or filters are used, Prognostic mode **must be disabled**. Prognostic information will not be accurate with any other fluids or filters and could result in missed maintenance activities resulting in transmission damage.

*IMPORTANT NOTE*

*The following schedule is to be used with Prognostics enabled.*

*100% concentration of TES-295 Allison approved fluids and Allison High Capacity Filters is **required**. Less than 100% concentration of TES-295 Allison approved fluids are considered a mixture and shall not be used with Prognostics mode or this change schedule. Utilization of previous Non-TES 295 fluid/filter change intervals (Table 1) is required.*

| | Severe Vocation |
|---|---|
| FLUIDS<br>Prognostics enabled | Change fluid when indicated by TRANSMISSION SERVICE indicator or 60 month (five years) whichever occurs first. In addition, change filters with fluid. |
| FILTERS<br>Prognostics enabled | Change filters (Main & Lube) when indicated by TRANSMISSION SERVICE indicator between fluid change or 60 month (five years) whichever occurs first. |

- Changing The Transmission Oil And Oil Filters

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

**Drain**

1. The transmission should be at an operating temperature of 160ºF (71ºC) to 200ºF (93ºC) 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

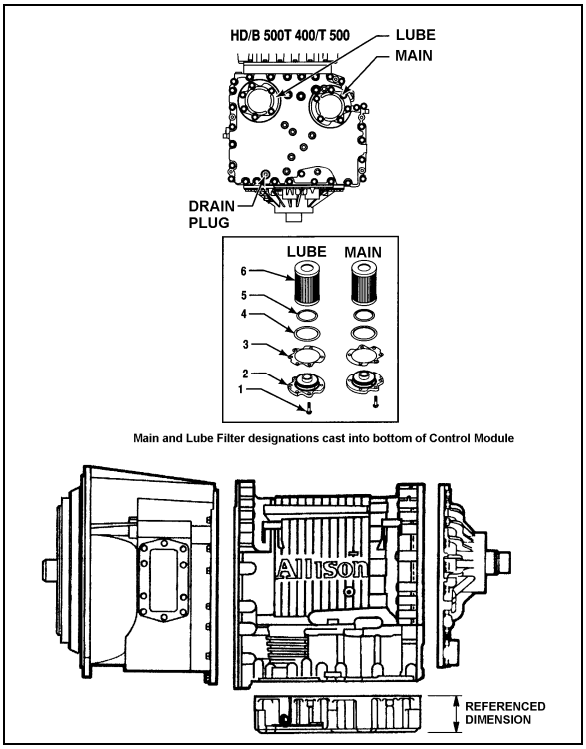



**FIGURE 6: DRAIN PLUG AND FILTERS** 07074

**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. 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 *"3.10 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.

*NOTE*

*Remove starter motor located on engine L.H. side. Removing the starter motor will allow access to unfasten the 12 converter-to-flexible plate attaching screws. Remove the plug located below starter motor and install cranking tool (88800014). Cranking the engine to gain access to the attaching screws may be done by turning the cranking tool using a suitable adapter (fig. 7).*

**CAUTION**

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

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

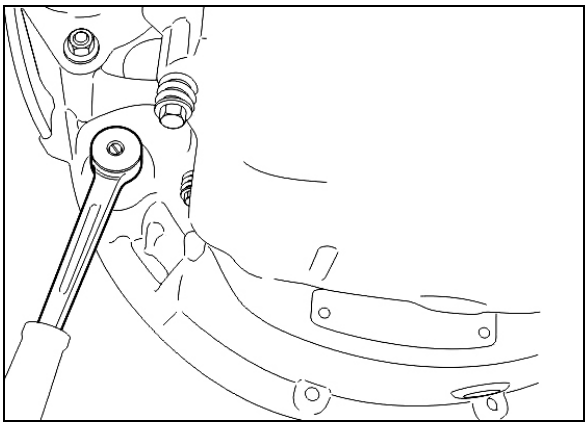


**FIGURE 7: VOLVO ENGINE CRANKING POSITION**

**CAUTION**

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

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

### 5. TRANSMISSION OIL COOLER REMOVAL

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. Remove the rear L.H. side tag axle wheel, then remove the rear L.H. side fender panel.
3. Disconnect the transmission hoses from oil cooler. Cover hose ends and fittings to prevent fluid contamination.

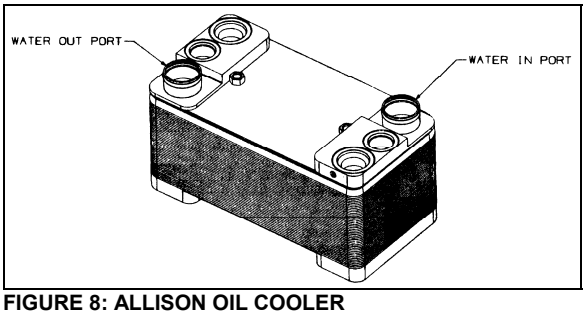



**FIGURE 8: ALLISON OIL COOLER**

**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.

## 6. CLEANING AND INSPECTION OF 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.

### 6.1 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.

## 7. 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 starter motor removed, align one of the 12 attaching screw holes in the flexible plate with the access opening.
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.

5. 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.

6. 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).
7. 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).

*NOTE*

*Remove the plug located below starter motor and install cranking tool (88800014). Crank the engine to gain access to the threaded holes by turning the cranking tool using a suitable adapter (Refer to fig. 7).*

*Reinstall starter motor and connect cables.*

*Reinstall access plug below starter motor.*

8. Remove jack from under transmission.
9. Connect all sensors.
10. Connect the main wiring harness.
11. Connect the air supply line (steel-braided hose) to the retarder control valve (if applicable).
12. Connect the two transmission oil cooler hoses as they were previously.
13. Reinstall clamps and brackets, and replace locking ties previously removed during removal procedure.
14. Install propeller shaft and its safety guard. Refer to Section 09, *"PROPELLER SHAFT".*
15. Install transmission dipstick and filler tube.
16. Install cross member under transmission.
17. Install engine splash guards.
18. Adjust the retarder pressure to 85 ± 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, on engine cradle R.H. side (Fig. 9).
19. 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.

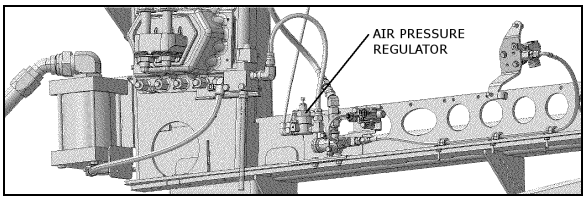



**FIGURE 9: AIR PRESSURE REGULATOR (TYPICAL)** 07130

## 8. ALLISON AUTOMATIC TRANSMISSION TROUBLESHOOTING

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

### 8.1 4TH GENERATION TRANSMISSION CONTROL MODULE

The Allison transmission has a new Transmission Control Module (TCM) which involves specific diagnostic incident codes. The TCM unit is located on the coach rear electrical panel.

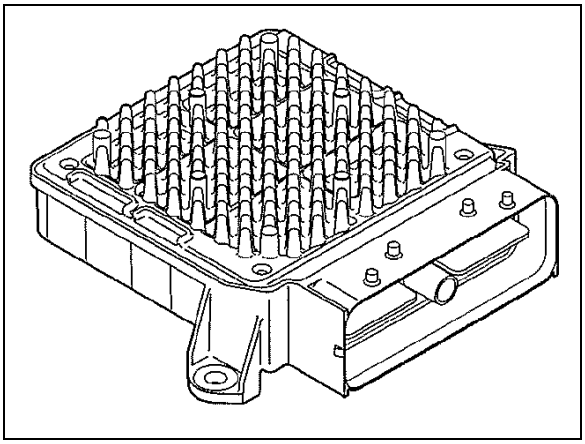


**FIGURE 10: TRANSMISSION CONTROL MODULE** 07140

TCM Replacement

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

- Open the engine compartment R.H. side door then remove the rear electrical panel cover 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 battery master switch to the ‘’OFF’’ position.

## 8.2 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.

## 8.3 DIAGNOSTIC CODES – ALLISON 4TH GENERATION CONTROLS

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

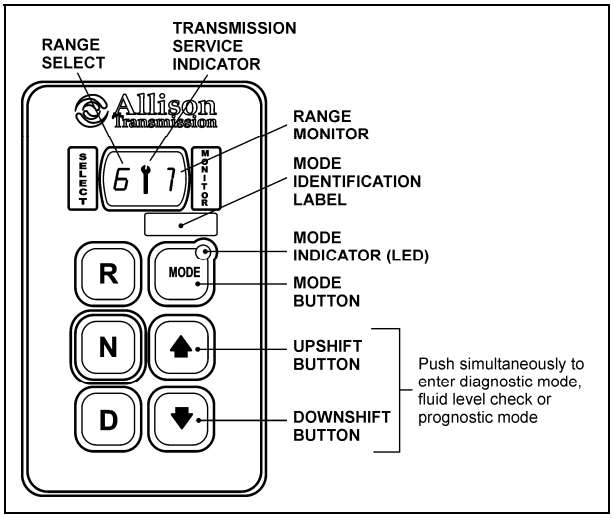
Example: Code P0722

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 | | | MONITOR |
|---|---|---|---|
| | d | 1 | |
| | | 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.




## 8.4 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.

| *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.* |

2. Observe the digital display for code (d1).

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.*<br><br>*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 switch).

| *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.* |

8.5 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.

## 8.6 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. |
| P0561 | System Voltage Performance | | |
| P0562 | System Voltage Low | | |
| P0563 | System Voltage High | | |
| 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) |
| P0667 | TCM Internal Temperature Sensor Circuit Range / Perform | | |
| P0668 | TCM Internal Temperature Sensor Circuit Low | | |
| P0669 | TCM Internal Temperature Sensor Circuit High | | |
| P0701 | Transmission Control System Performance | | |
| 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 |

| DTC | Description | CHECK TRANS Light | Inhibited Operation Description |
|---|---|---|---|
| P071A | RELS Input Failed On | Yes | Inhibit RELS operation |
| P071D | General Purpose Input Fault | Yes | None |
| P0720 | Output Speed Sensor Circuit | | |
| 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 6th Gear Ratio | Yes | DNS, Attempt 5th, then 3rd |
| P0730 | Incorrect Neutral Gear ratio | | |
| 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 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 |
| P0847 | Transmission Pressure Switch 2 Circuit Low | | |
| P0848 | Transmission Pressure Switch 2 Circuit High | | |
| P088A | Transmission Fluid Filter Deteriorated | | |
| P088B | Transmission Fluid Filter Very Deteriorated | | |
| 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 |
| P0961 | Pressure Control Solenoid (PCS) MM System Performance | | |
| 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) |
| P0965 | Pressure Control Solenoid (PCS) 2 System Performance | | |
| 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) |
| P0969 | Pressure Control Solenoid (PCS) 3 System Performance | | |
| P0970 | Pressure Control Solenoid 3 (PCS3) Control Circuit Low | Yes | DNS, SOL OFF (hydraulic default) |

| DTC | Description | CHECK TRANS Light | Inhibited Operation Description |
|---|---|---|---|
| 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<br>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) |
| 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) |
| P2719 | Pressure Control Solenoid (PCS) 4 System Performance | | |
| 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) |
| P2728 | Pressure Control Solenoid (PCS) 1 System Performance | | |
| 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 |
| P2737 | Pressure Control Solenoid (PCS) 5 System Performance | | |
| 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 |

## 9. SPECIFICATIONS

### ALLISON AUTOMATIC TRANSMISSION WITH RETARDER

X3-45 Coaches

Gross input power (maximum).....500 HP (373 kW)
Gross input torque (maximum) .....1525 Lbf-ft- (2068 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
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
Prevost Part Number (2-filter replacement kit).....571709