

# SECTION 07: TRANSMISSION

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## 1. DESCRIPTION

XL vehicles may be provided with either a manual or an automatic transmission.

### 1.1 Manual Transmission

The Spicer PS130-6B, 6-speed, has 6 forward speeds and 1 reverse speed.

The Spicer PS145-7A, 7-speed, has 7 forward speeds and 1 reverse speed.

### 1.2 Automatic Transmission

The B500(R) World 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.

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).

#### 1.2.1 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. 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, the following precautions are to be taken to protect the electronic control components:

1. Disconnect the wiring harness connectors at the transmission electronic control unit.
2. Disconnect the positive and negative battery connections, and any electronic control ground wires connected to the frame or chassis.
3. Cover electronic control components and wiring to protect them from hot sparks, etc.
4. Do not connect welding cables to electronic control components.

### 3. MAINTENANCE

#### 3.1 Manual Transmission

##### 3.1.1 Oil Recommendations

The following lubricants are recommended in order of preference.

TEMPERATURE	GRADE	TYPE
Above 0°F (-18°C) Below 0°F (-18°C)	SAE 30, 40, or 50 SAE 30	Heavy Duty Engine Oil meeting MIL-L-2104D or MIL-L-46152 B, API-SF or API-CD specifications (MIL-L-2104 B & C, OR 46152 are also acceptable)
Above 0°F (-18°C) Below 0°F (-18°C)	SAE 90 SAE 80	Straight Mineral Gear Oil R & O Type API-GL-1
Above 0°F (-18°C) Below 0°F (-18°C)	SAE 90 SAE 80	* Mild EP Gear Oil MIL-L-2105 or API-GL-4
All	CD SAE 50 CD SAE 30	Synthetic Engine Oil meeting MIL-L-2104 D or MIL-L-46152 B, API-SF or API-CD specifications
All	EP SAE 75W90 EP SAE 75W140	* Synthetic Gear Oil meeting MIL-L-2105C or API-GL5 specifications

\*EP gear oils are not recommended when lubricant operating temperatures are above 230°F (110°C).

##### 3.1.2 Oil Check

Manual transmission oil should be checked when engine is stopped and cold. Check level, and add if necessary, every 6,250 miles (10 000 km) or twice a year, whichever comes first.

**Warning:** Before servicing the coach, park safely over a repair pit, apply parking brake, stop engine and set main battery disconnect switch (XL-40) or battery master switch (XL-45) to the "OFF" position.

Unscrew the fill plug and check if the oil level is at plug thread level (Fig. 1).

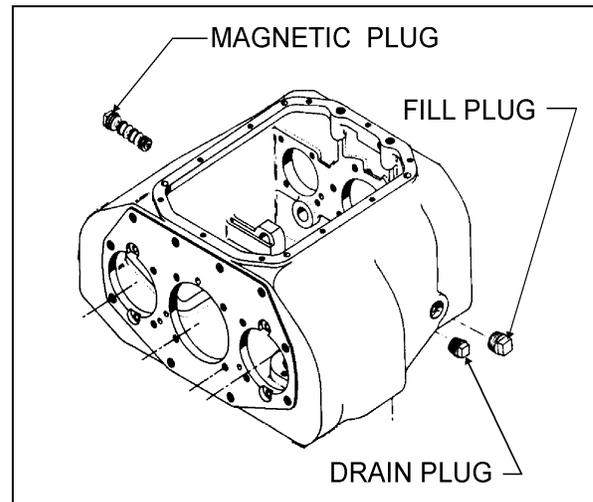


FIGURE 1: PLUGS

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### 3.1.3 Oil Change

OIL CHANGE INTERVALS
Change break-in oil after 3,000 miles (4 800 km) of initial operation, then every 50,000 miles (80 000 km) or once a year, whichever comes first.

#### Drain manual transmission as follows :

1. Unscrew the drain plug (Fig.1) and allow the oil to drain into a suitable container.
2. Inspect plug and replace if necessary. Reinstall plug.

#### Refill manual transmission as follows :

1. Remove fill plug.
2. Add oil until it overflows through fill plug opening.
3. Clean oil from the transmission case and the fill plug.
4. Reinstall plug.

**Caution:** Do not overfill transmission. Oil breakdown due to excessive heat and/or sludge deposits impairing proper operation of transmission may result.

### 3.1.4 Metal Particles

The magnetic plug attracts metal particles. When metal particles are of abnormal size, the transmission must be disassembled. See Spicer "Service Manuals" annexed to this section.

## 3.2 Automatic Transmission

To gain access to the dipstick, open the engine compartment rear door; dipstick is located on your L.H. side (Fig. 2).

To check the transmission oil level, a cold check and a hot check must be performed. A cold check must be made between 60°F (16°C) and 140°F (60°C). The transmission oil temperature gauge indicates the operating temperature; it is located on the central dashboard.

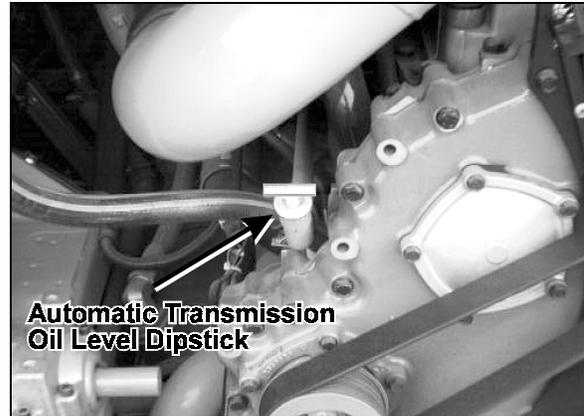


FIGURE 2: OIL LEVEL DIPSTICK

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**Note:** Perform the cold check first to verify the transmission oil level before performing the hot check.

The hot check can be performed when the transmission oil reaches the normal operating temperature of 160°F (71°C) to 200°F (93°C).

Clean all dirt from around the end of the oil fill 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 in accordance with the following procedures and record any abnormal level on your "Maintenance Records".

**Warning:** 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.**

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**Do not wear loose clothing and, stay away from rotating parts during procedure; personal injury could occur.**

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.

### 3.2.1 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.*

2. Run the engine for at least one minute. 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. Then shift to Neutral (N) and allow the engine to idle (500 - 800 rpm).
3. While the engine is running, remove the dipstick from the tube and wipe it clean (Figs. 2 & 3).

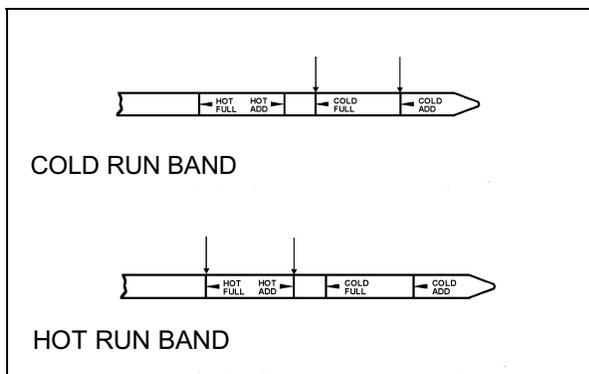


FIGURE 3: DIPSTICK

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4. Insert the dipstick into the tube and then remove, checking the oil level reading (Fig. 3). Repeat the check procedure to verify the reading. If the oil reading is within the "Cold Run" band, the level is satisfactory for operating the transmission until the oil is hot enough to perform a "Hot Run" check. If the oil reading is not within the "Cold Run" band, add or drain oil as necessary to bring the level within the "Cold Run" band.
5. 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:** *An accurate fluid level check cannot be made unless the engine is idling (500-800 rpm) in Neutral, the transmission fluid is at the proper temperature, and the vehicle is on a level surface.*

### 3.2.2 Hot Check

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

1. Operate the transmission in Drive (D) range until normal operating temperature is reached 160°F (71°C) to 200°F (93°C).
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. While the engine is running, remove the dipstick from the tube and wipe it clean.
4. Insert the dipstick into the tube and then remove, checking the oil level reading. Repeat the check procedure to verify the reading.

The safe operating level is anywhere within the "Hot Run" band on the dipstick (Fig. 3).

- If the oil level is not within the "Hot Run" band, add or drain oil as necessary to bring the oil level within the band.

**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 automatic system of verification via the shift selector has priority over the Hot Check.**

### 3.2.3 Readout of the Oil Level Sensor

The Oil Level Sensor (OLS) is designed to measure transmission oil level only when the following combination of operating conditions exist:

- Engine must be at idle;
- NEUTRAL** must be selected;
- Zero output speed;
- Transmission oil must be within a "normal" temperature band (160-250°F; 70-120°C); and
- Once the first four (4) conditions are met, there must be a "waiting" period (approx. 2 min., to facilitate consistent oil drainback) before oil level measurement begins.

To enter OLS readout mode (after meeting the conditions noted above), simultaneously press the UPSHIFT and DOWNSHIFT arrows on the shifter.

If the five (5) conditions noted above are present, the display will immediately enter the reading mode. If the "waiting" period has not elapsed, the left digit of the display will become a "chasing" digit and the right digit will count down from (8) to (1) until the waiting period is complete.

After attaining the reading mode, the display will flash "OL-OK", "LO-01", "HI-02", etc., where the suffix "01" or "02" indicates the volume of oil (in quarts) either low or high.

At any time in this sequence, simultaneously pressing the UPSHIFT and DOWNSHIFT arrows

directs the ECU to enter the transmission diagnostic mode as described under "10. Troubleshooting" in this section. D, N, or R may also be selected on the shifter at any time - the OLS mode will abort and normal transmission will commence. Shifts are not inhibited.

### Oil Level Sensor (OLS) Codes

<u>CODE</u>	<u>CAUSE OF CODE</u>
OL-OK	Oil Level Is Correct
LO-01	One Quart Low
LO-02	Two Quarts Low
HI-01	One Quart High
HI-02	Two Quarts High
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

### 3.2.4 Keeping Oil Clean

Oil must be handled in clean containers, fillers, etc., to prevent foreign material from entering the transmission. Place the dipstick in 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 which, if introduced into the transmission, can cause the clutch plates to fail.**

**3.2.5 Oil Recommendations**

Hydraulic oils used in the transmission have an important influence on transmission reliability and durability. In order of preference DEXRON-III and DEXRON-IIIE, MIL-L-2104D, and type C-4 oils (Allison approved SAE 10W or SAE 30) are recommended. Type C-4 oil is the only oil approved for use in off-highway applications. Use type SAE 30 where ambient temperature is consistently above 86°F (30°C). Some DEXRON-II oils are also qualified as type C-4 oils and may be used in off-highway applications. However, a DEXRON-II fluid which is not a qualified type C-4 oil must never be used in off-highway applications. Consult your local Allison dealer or distributor to determine if a DEXRON-II oil is also a qualified type C-4 oil.

Before using type C-4 oils, consult the vehicle manufacturer to ensure that materials used in tubes, hoses, seals, etc., are compatible with type C-4 oils. Also, consult your local Allison dealer or distributor to determine if the oil you have selected is an approved type C-4 oil. Ford Motor Company specification oils M2C33-F, M2C138-CJ and M2C166-H may be used and may be intermixed with DEXRON-II oil.

<b>OIL SPECIFICATIONS AND AMBIENT TEMPERATURE OPERATING CONDITIONS</b>	
Oil type	Ambient temperature
MIL-L-2104D, DEXRON-II, C-4	120°F (48°C) to -25°F (-32 °C )
MIL-L-46167	-25°F (-32°C) to -60°F (-51°C)

The use of an arctic preheat kit is recommended at temperatures below -25°F (-32°C). If a preheat kit is not available, the ECU will restrict full operation until the sump temperature is increased. The chart below shows the temperature ranges in which the transmission will operate. It should be noted that at lower sump temperature, the transmission's operation may be restricted.

Transmission Oil Temperature	"DO NOT SHIFT" Light	Operation
Below -26°F (-32°C)	ON	Neutral only
-24°F (-31°C) to +19°F (-7°C)	OFF	Start with neutral and reverse, normal upshifts
+20°F (-6°C) to 260°F (126°C)	OFF	Full operation in all ranges
Above 260°F (126°C)	ON	Inhibits 5th and 6th ranges

### 3.2.6 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.

### 3.2.7 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.*

### 3.2.8 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.

### 3.2.9 Oil and Filter Change

Transmission 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" for oil and filter change intervals.

More frequent changes may be required when operations are subject to high levels of contamination or overheating.

**TABLE 1: OIL AND OIL FILTER CHANGE INTERVALS**

Change break-in oil after 3,000 miles (4 800 km) of initial operation and subsequently every 25,000 miles (40 000 km) or once a year, whichever comes first.
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The procedure for changing the transmission 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.
2. Remove the drain plug from under the transmission (Fig. 4) 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. 4).
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 N•m).
6. Inspect the drain plug and O-ring. Replace if necessary. Reinstall the drain plug and tighten to 18-24 lbf•ft (25-32 N•m).

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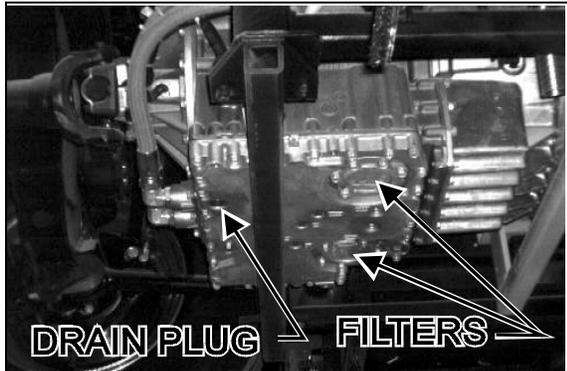


FIGURE 4: PLUG AND FILTERS

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### Refill

Refill with 37 US qts (39 liters) and check the oil level using the previously described procedure. The refill amount is less than the initial fill because some of the oil remains in the external circuits and transmission cavities.

## 4. GEAR SHIFT LINKAGE ADJUSTMENT (Manual Transmission)

### 4.1 Adjustment

1. Put the transmission lever in "NEUTRAL" position.
2. Loosen nuts (1, Fig. 5) and nuts (2, Fig. 5).
3. Adjust the gear shift lever in neutral position:
  - a. Put the shifter lever in first gear and measure the distance A on the gear shaft (Fig. 5).
  - b. Put the shifter lever in second gear and measure the distance B on the gear shaft (Fig. 5).
4. Put the shifter lever in neutral. (The middle position between points A and B is the "NEUTRAL FRONT REAR" position).
5. Hold the lever at approximately 2 1/2" from the seat transverswise.
6. Adjust tolerance at shift lever pivot to the 1-1/5" (31 mm).
7. Rotate the rear shaft "C" to get the rear U-joint "D" at horizontal position.
8. Tighten all loose nuts (1) and (2).

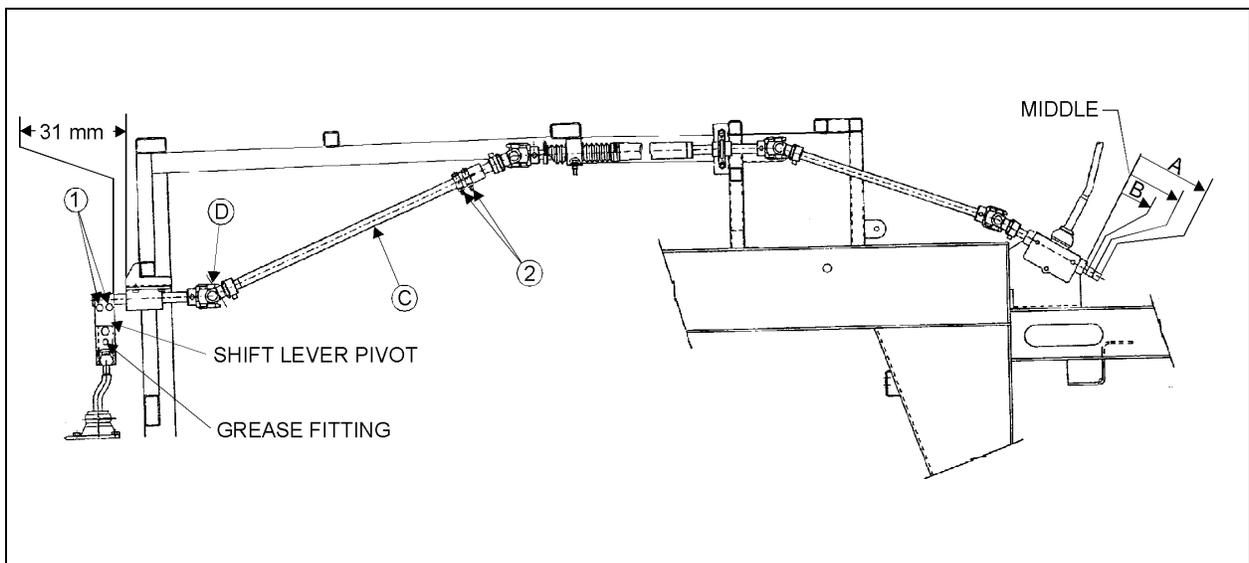


FIGURE 5: GEAR SHIFT LINKAGE

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## 4.2 Lubrication

Grease with good quality lithium-base grease NLGI No. 1 (Fig. 5):

- The shift lever pivot: service every 6,250 miles (10 000 km), grease 1 fitting.
- Shift control rod universal joints: service every 25,000 miles (40 000 km); grease 4 fittings.

Only during disassembly: grease the following with NLGI No. 1:

1. The shift lever housing;
2. Transmission lever ball; and
3. Axle bearing.

## 5. TRANSMISSION REMOVAL

### 5.1 Automatic Transmission

The following procedure deals with the removal of the 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 main battery disconnect switch (XL-40) or battery master switch (XL-45) 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 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 N•m) (see "3.2.9 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.

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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. Turn the converter to gain access to the attaching screws.

**Caution:** *Do not rotate crankshaft counterclockwise to avoid loosening the crankshaft pulley retaining screw.*

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

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

16. Remove the transmission rubber mount above transmission by removing the nut, bolt and washer over the rubber and its support. Remove the bracket from transmission (only if the vehicle is equipped with a retarder).
17. Slowly pull transmission straight out to clear engine.
18. Remove the transmission.

### 5.2 Manual Transmission

The following procedures deal with the removal of the transmission without removing the power plant cradle from vehicle. The method used to support the transmission depends upon conditions and available equipment.

1. Set transmission shift lever to "Neutral" position, apply parking brake, then set main battery disconnect switch (XL-40) or battery master switch (XL-45) 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 surrounding transmission.
4. Remove cross member from under transmission.
5. Remove the transmission drain plug and allow oil to drain. Reinstall drain plug.

**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. Disconnect propeller shaft from transmission and remove its safety guard. Refer to Section 09, "PROPELLER SHAFT".
7. Remove fiberglass transmission protection.
8. Disconnect gear shift linkage as follows:
  - a. Remove the two bolts that secure the coupling lever to the shift rod (1, Fig. 5).
  - b. Push the shift rod all the way into bushing.
9. Remove return spring and disconnect yoke. Remove clutch slave cylinder from transmission without disconnecting hoses.
10. Disconnect speedometer sensor, back-up signal switch and neutral start switch.

**Note:** *Removing clutch slave cylinder will enable the release yoke to turn up and pull free from the release bearing thrust pads.*

11. Remove any locking tie, clamp and bracket that may interfere with the removal of transmission.
12. Support transmission using a suitable transmission jack, then remove the twelve clutch/engine mounting screws.

**Caution:** *Make sure transmission-to-engine alignment is maintained when removing transmission. Do not let the rear end of transmission drop down and hang unsupported in the spline hubs of the clutch discs to avoid bending or distorting the friction discs.*

13. Slowly pull transmission straight out to clear the input shaft.
14. Remove the transmission.

## 6. MANUAL TRANSMISSION DISASSEMBLY AND REASSEMBLY

Refer to Spicer "Service Manuals" annexed to this section.

## 7. CLEANING AND INSPECTION OF THE TRANSMISSION

### 7.1 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; and
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.*

#### 7.1.1 Breather

The breather is located at the top of the transmission. 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 transmission. Spraying steam, water or cleaning solution directly at the breather can force the water or solution into the transmission. Always use a wrench of proper size to remove or replace the breather. Pliers or pipe wrench can crush or damage the stem and produce metal chips which could enter the transmission.

### 7.2 Manual Transmission

#### 7.2.1 Cleaning

**Warning:** *Use a petroleum-based solvent.*

**Warning:** *Do not use gasoline to clean parts. Gasoline can explode, causing serious physical injury.*

**Caution:** *Do not use water or steam to clean internal components, it could corrode them.*

## 8. TRANSMISSION INSTALLATION

### 8.1 Automatic Transmission

**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.

**Warning:** 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, 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 N•m).
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 N•m). Place a wrench on crankshaft pulley attaching screw to turn the converter to gain access to the threaded holes.
9. Reinstall the access plug.
10. If the vehicle is equipped with a retarder; install the bracket on the transmission and tighten the bolt to 71-81 lbf•ft (96-110 N•m). Install the transmission rubber mount between the rubber support and the frame with a bolt, nut and washer. Tighten the nut until the tolerance of  $58 \pm 2$  mm is met (Fig. 6).

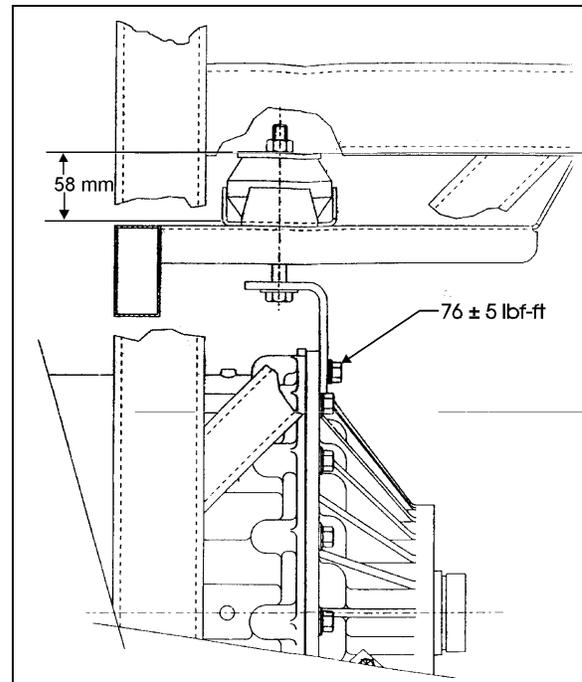


FIGURE 6: NUT TOLERANCE

07014

11. Remove jack from under transmission.

12. Connect all sensors.
13. Connect the main wiring harness.

**Note:** For proper adjustment, refer to paragraph "4. GEAR SHIFT LINKAGE ADJUSTMENT", in this section.

14. Connect the air supply line (steel-braided hose) to the retarder control valve (if applicable).
15. Connect the two transmission oil cooler hoses as they were previously.
16. Reinstall clamps and brackets, and replace locking ties previously removed during removal procedure.
17. Install propeller shaft and its safety guard. Refer to Section 09, "PROPELLER SHAFT".
18. Install transmission dipstick and filler tube.
19. Install cross member under transmission.
20. Install engine splash guards.
21. Adjust the retarder pressure to  $80 \pm 3$  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 at back of engine compartment, on R.H. side (Fig. 7).



FIGURE 7: AIR PRESSURE REGULATOR

07016

22. Make sure that the drain plug is in place, then remove the transmission dipstick and pour approximately 37 US qts (39 L) of DEXRON-IIIE or DEXRON-III 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.

## 8.2 Manual Transmission

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

1. Place the transmission on a transmission jack.
2. Ensure clutch brake is in position on transmission input shaft.
3. Position the clutch release bearing with the flat section on top.
4. Shift transmission into 5th gear, then raise it and position the input shaft into clutch discs. Align input shaft splines with those on clutch discs by rotating the output shaft. As the input shaft enters the clutch discs, rotate the clutch release yoke backwards until the release yoke fingers clear the pads on release bearing housing. Rotate the clutch release yoke into proper position as transmission is pushed into place.

**Caution:** Avoid hanging the weight of the transmission on the clutch or forcing the transmission into the clutch or flywheel housing. This can cause bent or sprung clutch discs and prevent the clutch from releasing.

**Caution:** The clutch housing must be seated against the flywheel housing prior to tightening any screw. Do not use screws to seat the housing.

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- 5. Install all clutch/engine screws, then tighten them gradually in a criss-cross manner around the housing. Recommended torque is 44-50 lbf•ft (60-68 N•m).
- 6. Remove jack from under transmission.
- 7. Install clutch slave cylinder and its return spring.

**Note:** Refer to Section 02, "CLUTCH" for adjustment.

- 8. Connect speedometer sensor, back-up signal switch and neutral start switch.
- 9. Reinstall clamps, brackets, and replace locking ties previously removed during removal procedure.
- 10. Shift transmission to neutral, then secure the coupling lever bolts.

**Note:** Refer to paragraph "4. GEAR SHIFT LINKAGE ADJUSTMENT" of this section, for proper adjustment.

- 11. Install fiberglass transmission protection.
- 12. Install propeller shaft and its safety guard. Refer to Section 09, "PROPELLER SHAFT".
- 13. Install cross member under transmission.
- 14. Install engine splash guards.
- 15. Install tag axle wheels (if previously removed).

**10.2.1 Diagnostic Code Memory**

Diagnostic codes are logged in a list in memory (sometimes referred to as the queue), positioning the most recently occurring code first and containing up to five codes. The codes contained in the list have the information recorded as shown in the chart below. Access to the code list position, main code, sub code and active indicator is available through either the shifter display or the Pro-Link Diagnostic Data Reader (DDR). Access to the ignition cycle counter and event counter is obtained through the DDR only.

Code List Position	Main Code	Sub Code	Active Indicator	Ignition Cycle Counter	Event Counter
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- 16. Make sure that the drain plug is in place, then refill transmission. Check and adjust oil level.
- 17. Adjust the servo clutch pressure to 40 psi with the air pressure regulator. For more information, refer to Section 12, "BRAKE AND AIR SYSTEM", under heading "AIR PRESSURE REGULATOR". The regulator is located at back of engine compartment, on R.H. side (Fig. 7).

**9. ALLISON TRANSMISSIONS PRINCIPLES OF OPERATION**

Refer to "Allison Transmission, MD Series, Principles of Operation, SA 2454".

**10. TROUBLESHOOTING**

**10.1 Manual Transmission**

Refer to the Troubleshooting section in the Spicer "Service Manual PS130-6B (6-speed)" or "PS145-7A (7-speed)" depending on which transmission is installed on your vehicle. Manuals are annexed to this section.

**10.2 Automatic Transmission**

Refer to "Allison Transmission, MD Series, Troubleshooting Manual, SA 2158A".

d1	21	12	YES	00	10
d2	41	12	YES	00	04
d3	23	12	NO	08	02
d4	34	12	NO	13	01
d5	56	11	NO	22	02
Displayed on shifter display and DDR			YES= ACTIVE= "MODE ON"	Ignition cycle counter and event counter are not available on shifter display	

**Note:** All information is available with a diagnostic tool (DDR).

The following paragraphs define the different parts of the code list.

**Code List Position**

The position (1 through 5) which a code occupies in the code list in memory. Positions are shown as "d1" (Diagnostic Code #1) through "d5."

**Main Code**

The general condition or area of fault detected by ECU.

**Sub Code**

The specific area or condition under the main code in which the condition was detected.

**Active Indicator**

Will be turned "On" when a fault condition is active (shifter will display "MODE ON" or the DDR will display "YES"). Will be set to "Off" when conditions exist to indicate fault condition is gone.

**Ignition Cycle Counter**

Used to clear diagnostic codes that are inactive from the code list in memory. A counter is incremented each time a normal ECU power down occurs following clearing of the Active Indicator. A code will be cleared from the list when the counter exceeds 25.

**Event Counter**

Used to count the number of occurrences of a diagnostic code that occurs prior to the incident being cleared from the code list. The most recent code will be in position "d1". If the most recent code is one which is already in the code list, that code will be moved to position "d1", the Active Indicator will be turned "On" (shifter will display "MODE ON" or the DDR will display "YES"), the Ignition Cycle Counter is cleared and "1" is added to the Event Counter.

**Clearing the Active Indicator and code Records from the Code List in Memory**

If the conditions causing a diagnostic code to be set are cleared, the Active Indicator can be manually cleared by holding the "MODE" button down continuously for 3 seconds until a tone is heard from the shifter.

To clear code records from the list, hold the "MODE" button down continuously for ten seconds until a second tone sounds. All diagnostic records in the list that are not active will then be cleared and the remaining records will be moved up the list.

**Code Reading and Code Clearing Procedures**

Diagnostic codes can be read and cleared by two methods: by using the Pro-Link 9000 DDR

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plugged in the receptacle located on L.H. lateral console (Shells)/L.H. side control panel (Coaches) or by using the shifter display. The use of the Pro-Link 9000 DDR is described in the instruction manual supplied with each tool. The method for reading and clearing codes described in this section refers only to entering of the Diagnostic Display Mode by the proper button selection.

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

The following descriptions explain how to use the shifter to read and clear codes.

### Reading Codes

1. Enter the diagnostic display mode by pressing the "↑" and "↓" (upshift and downshift arrows) buttons at the same time on the pushbutton shifter.

**Note:** *If a "DO NOT SHIFT" condition is present at this time, the lever should be in the same position as it was at the time of code detection. If not, this shifter tone will sound continuously.*

**Note:** *If an Oil Level Sensor (OLS) is present, the oil level will be displayed first. Diagnostic code display is achieved by depressing the UPSHIFT and DOWNSHIFT arrows or display MODE button a second time.*

2. Read the first code in the first of five code positions on the digital display of the shifter. For example, we will read code 25 11 in the first position. The display will change every two seconds as follows:

- a. Code list position --"d1";
- b. Main code --"25";
- c. Sub code --"11"; and
- d. Display will repeat cycle of a., b. and c. above.

3. Press the "MODE" button momentarily to view the second position (d2) in the same way as 2. above.

4. To view the third, fourth and fifth positions (d3, d4 and d5), momentarily press the "MODE" button as explained above.

5. Pressing the "MODE" button momentarily after the fifth position is displayed will cause the sequence of code positions to start over with the first position.
6. Any code which is active will be indicated by the "MODE ON" indicator (Active Indicator) being turned on while in that code position (while in the normal operation).
7. Any code position in the list which does not have a diagnostic code logged will display "- -" for both the main and sub code displays. All positions after a code codes.

### Clearing Codes

1. Clearing of the active indicator is automatically done at ECU power down on all but code 69 34.
2. Some codes will clear the active indicator automatically when the condition causing the code is no longer detected by the ECU (see Diagnostic Code List and Description, page 7 - 19).
3. Manual clearing is possible while in the diagnostic display mode and after the condition causing the code is corrected (output speed must be zero).
  - a. To clear all active indicators, hold the "MODE" button down continuously for 3 seconds until the shifter tone sounds for 0.5 seconds.
  - b. Release the "MODE" button to return to normal operating mode. If the condition causing the code was not active at the time, the active indicator will turn off.

**Caution:** *If clearing a code while locked in a Forward or Reverse position (fail-to-range), the transmission will still be in Drive or Reverse when the clearing procedure is completed. Neutral must be selected manually.*

### Exiting the Diagnostic Display Mode

The diagnostic display mode can be exited by any of the following procedures:

1. Press the "↑" and "↓" (upshift and downshift) buttons at the same time on the pushbutton shifter.
2. Press any range button, "D", "N" or "R", on the pushbutton shifter (the shift will be commanded if it is not inhibited by an active code).
3. Do nothing and wait until the calibrated time (approximately 10 minutes) has passed and the system automatically returns to the normal operating mode.
4. Turn off power to the ECU (turn off the vehicle at the ignition switch).
5. After the clearing of a code, the active indicator procedure described above has been performed.

### Clearing Records from the Code List in Memory

If the requirements for Manual Clearing the Active Indicator have been satisfied, and the "MODE" button is held down continuously for ten seconds while in the display mode until a tone sounds, all diagnostic records in the code list that are not active will be cleared and the remaining records will be moved up in the code list.

## Abbreviations Found in the Code Chart

The following responses are used throughout the following chart to command safe operation when diagnostic codes are set.

1. **DNS (Do Not Shift)** Response
  - a. Turn off lockup clutch and inhibit lockup operation.
  - b. Inhibit all shifts.
  - c. Turn on *DO NOT SHIFT* light.
  - d. Pulse the tone generator for 8 seconds when the condition is first detected.
  - e. Blank the select digit in the display.
  - f. Ignore any range selection inputs and disable the button feedback tone for the pushbutton shifter.
2. **SOL OFF (Solenoid Off)** Response
  - a. All solenoids are commanded off (turning solenoids "A" and "B" off electrically causes them to be on hydraulically).
3. **RPR (Return to Previous Range)** Response
  - a. When the ratio or C3 pressure switch tests associated with a shift are not passed, the ECU commands the same range as commanded at the beginning of the shift.
4. **NNC (Neutral No Clutches)** Response
  - a. When certain ratio or C3 pressure switch tests are not passed, the ECU commands a neutral condition with no clutches applied.

### Diagnostic code list and description

MAIN CODE	SUB CODE	DESCRIPTION	DO NOT SHIFT LIGHT	INHIBITED OPERATION DESCRIPTION
12	12	Oil level, low	No	No upshift above a calibration range

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MAIN CODE	SUB CODE	DESCRIPTION	DO NOT SHIFT LIGHT	INHIBITED OPERATION DESCRIPTION
12	23	Oil level, high	No	No upshift above a calibration range
13	12	ECU input voltage, low	Yes	DNS, SOL OFF (Hydraulic default)
13	13	ECU input voltage, medium low	No	None: Shift adaptive feature will not function.
13	23	ECU input voltage, high	Yes	DNS, SOL OFF (Hydraulic default)
14	12	Oil level sensor, low	No	None
14	23	Oil level sensor, high	No	None
21	12	Throttle position sensor, low	No	Use Throttle default value
21	23	Throttle position sensor, high	No	Use Throttle default value
22	14	Engine speed sensor reasonableness test	No	Use default engine speed
22	15	Turbine speed sensor reasonableness test	Yes	DNS, Lock in current range
22	16	Output speed sensor reasonableness or rapid decel test	Yes	DNS, Lock in current range
23	12	Primary Shifter or RSI Link Fault	No	Hold in last valid direction
23	13	Primary Shifter Mode Function Fault	No	Mode change not permitted
23	14	Secondary Shifter or RSI Link Fault	No	Hold in last valid direction
23	15	Secondary Shifter Mode Function Fault	No	Mode change not permitted
24	12	Sump oil temperature, cold	Yes	DNS
24	23	Sump oil temperature, hot	No	No upshifts above a calibration range
25	00	Output speed reasonableness test, detected at 0 speed, (L)	Yes	DNS, Lock in current range (L)
25	11	Output speed reasonableness test, detected at 0 speed, (1st)	Yes	DNS, Lock in current range (1 st)
25	22	Output speed reasonableness test, detected at 0 speed 2nd	Yes	DNS, Lock in current range (2nd)

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MAIN CODE	SUB CODE	DESCRIPTION	DO NOT SHIFT LIGHT	INHIBITED OPERATION DESCRIPTION
25	33	Output speed reasonableness test, detected at 0 speed, 3rd	Yes	DNS, Lock in current range (3rd)
25	44	Output speed reasonableness test, detected at 0 speed, 4th	Yes	DNS, Lock in current range (4th)
25	55	Output speed reasonableness test, detected at 0 speed, 5th	Yes	DNS, Lock in current range (5th)
25	66	Output speed reasonableness test, detected at 0 speed, 6th	Yes	DNS, Lock in current range (6th)
25	77	Output speed reasonableness test, detected at 0 speed, R	Yes	DNS, Lock in current range (R)
32	00	C3 pressure switch open, L range	Yes	DNS, Lock in current range (L)
32	33	C3 pressure switch open, 3rd range	Yes	DNS, Lock in current range (3rd)
32	55	C3 pressure switch open, 5th range	Yes	DNS, Lock in current range (5th)
32	77	C3 pressure switch open, R range	Yes	DNS, Lock in current range (R)
33	12	Sump oil temperature sensor, low	No	Use default value of 200° F (93° C)
33	23	Sump oil temperature sensor, high	No	Use default value of 200° F (93° C)
34	12	EEPROM, factory cal. compatibility number wrong	Yes	DNS, SOL OFF (Hydraulic default)
34	13	EEPROM, factory calibration block checksum	Yes	DNS, SOL OFF (Hydraulic default)
34	14	EEPROM, Power Off Block checksum	Yes	Use previous location, or factory calibration and reset adaptive
34	15	EEPROM, Diagnostic Queue Block Checksum	Yes	Use previous location, or clear diagnostic queue
34	16	EEPROM, Real Time Block Checksum	Yes	DNS, SOL OFF (Hydraulic default)
35	00	Power interruption (Code set after power restored)	No	NONE (Hydraulic default during interruption)

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MAIN CODE	SUB CODE	DESCRIPTION	DO NOT SHIFT LIGHT	INHIBITED OPERATION DESCRIPTION
35	16	Real Time EEPROM Write Interruption	Yes	DNS, SOL OFF (Hydraulic default)
36	00	Hardware/Software not compatible	Yes	DNS, SOL OFF (Hydraulic default)
41	12	Open or short to ground, A solenoid circuit	Yes	DNS, SOL OFF (Hydraulic default)
41	13	Open or short to ground, B solenoid circuit	Yes	DNS, SOL OFF (Hydraulic default)
41	14	Open or short to ground, C solenoid circuit	Yes	DNS, SOL OFF (Hydraulic default)
41	15	Open or short to ground, D solenoid circuit	Yes	DNS, SOL OFF (Hydraulic default)
41	16	Open or short to ground, E solenoid circuit	Yes	DNS, SOL OFF (Hydraulic default)
41	21	Open or short to ground, F solenoid circuit	No	Lock-up inhibited
41	22	Open or short to ground, G solenoid circuit	Yes	DNS, SOL OFF (Hydraulic default)
41	23	Open or short to ground, H solenoid circuit	No	Retarder allowed, differential lock inhibited
41	24	Open or short to ground, J solenoid circuit	No	Low and 1st inhibited
41	25	Open or short to ground, K solenoid circuit	No	K solenoid operation inhibited
41	26	Open or short to ground, N solenoid circuit	No	Low and 1st inhibited
42	12	Short to battery, A solenoid circuit	Yes	DNS, Lock in a range
42	13	Short to battery, B solenoid circuit	Yes	DNS, Lock in a range
42	14	Short to battery, C solenoid circuit	Yes	DNS, Lock in a range
42	15	Short to battery, D solenoid circuit	Yes	DNS, Lock in a range

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MAIN CODE	SUB CODE	DESCRIPTION	DO NOT SHIFT LIGHT	INHIBITED OPERATION DESCRIPTION
42	16	Short to battery, E solenoid circuit	Yes	DNS, Lock in a range
42	21	Short to battery, F solenoid circuit	No	Lock-up inhibited
42	22	Short to battery, G solenoid circuit	Yes	DNS, Lock in a range
42	23	Short to battery, H solenoid circuit	No	Retarder allowed, differential lock inhibited
42	24	Short to battery, J solenoid circuit	No	Low and 1st inhibited
42	25	Short to battery, K solenoid circuit	No	K solenoid operation inhibited
42	26	Short to battery, N solenoid circuit	No	Low and 1st inhibited
43	21	Low side driver, F solenoid circuit	No	Lock-up inhibited
43	25	Low side driver, K solenoid circuit	No	K solenoid operation inhibited
43	26	Low side driver, N solenoid circuit	No	Low and 1st inhibited
44	12	Short to ground, A solenoid circuit	Yes	DNS, SOL OFF (Hydraulic default)
44	13	Short to ground, B solenoid circuit	Yes	DNS, SOL OFF (Hydraulic default)
44	14	Short to ground, C solenoid circuit	Yes	DNS, SOL OFF (Hydraulic default)
44	15	Short to ground, D solenoid circuit	Yes	DNS, SOL OFF (Hydraulic default)
44	16	Short to ground, E solenoid circuit	Yes	DNS, SOL OFF (Hydraulic default)
44	21	Short to ground, F solenoid circuit	No	Lock-up inhibited
44	22	Short to ground, G solenoid circuit	Yes	DNS, SOL OFF (Hydraulic default)

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MAIN CODE	SUB CODE	DESCRIPTION	DO NOT SHIFT LIGHT	INHIBITED OPERATION DESCRIPTION
44	23	Short to ground, H solenoid circuit	No	Retarder allowed. differential lock inhibited
44	24	Short to ground, J solenoid circuit	No	Low and 1st inhibited
44	25	Short to ground, K solenoid circuit	No	K solenoid operation inhibited
44	26	Short to ground, N solenoid circuit	No	Low and 1st inhibited
45	12	Open circuit, A solenoid circuit	Yes	DNS, SOL OFF (Hydraulic default)
45	13	Open circuit, B solenoid circuit	Yes	DNS, SOL OFF (Hydraulic default)
45	14	Open circuit, C solenoid circuit	Yes	DNS, SOL OFF (Hydraulic default)
45	15	Open circuit, D solenoid circuit	Yes	DNS, SOL OFF (Hydraulic default)
45	16	Open circuit, E solenoid circuit	Yes	DNS, SOL OFF (Hydraulic default)
45	21	Open circuit, F solenoid circuit	No	Lock-up inhibited
45	22	Open circuit, G solenoid circuit	Yes	DNS, SOL OFF (Hydraulic default)
45	23	Open circuit, H solenoid circuit	No	Retarder allowed differential lock inhibited
45	24	Open circuit, J solenoid circuit	No	Low and 1st inhibited
45	25	Open circuit, K solenoid circuit	No	K solenoid operation inhibited
45	26	Open circuit, N solenoid circuit	No	Low and 1st inhibited
51	10	Offgoing ratio test (during shift), 1 to L	Yes	Low and 1st inhibited
51	12	Offgoing ratio test (during shift), 1 to 2	Yes	DNS, RPR

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MAIN CODE	SUB CODE	DESCRIPTION	DO NOT SHIFT LIGHT	INHIBITED OPERATION DESCRIPTION
51	21	Offgoing ratio test (during shift), 2 to 1	Yes	DNS, RPR
51	23	Offgoing ratio test (during shift), 2 to 3	Yes	DNS, RPR
51	43	Offgoing ratio test (during shift), 4 to 3	Yes	DNS, RPR
51	45	Offgoing ratio test (during shift), 4 to 5	Yes	DNS, RPR
51	65	Offgoing ratio test (during shift), 6 to 5	Yes	DNS, RPR
52	01	Offgoing C3PS test (during shift), L to 1	Yes	DNS, RPR
52	08	Offgoing C3PS test (during shift), L to N1	Yes	DNS, NNC
52	32	Offgoing C3PS test (during shift), 3 to 2	Yes	DNS, RPR
52	34	Offgoing C3PS test (during shift), 3 to 4	Yes	DNS, RPR
52	54	Offgoing C3PS test (during shift), 5 to 4	Yes	DNS, RPR
52	56	Offgoing C3PS test (during shift), 5 to 6	Yes	DNS, RPR
52	71	Offgoing C3PS test (during shift), R to 1	Yes	DNS, NNC
52	72	Offgoing C3PS test (during shift), R to 2	Yes	DNS, NNC
52	78	Offgoing C3PS test (during shift), R to N1	Yes	DNS, NNC
52	79	Offgoing C3PS test (during shift), R to 2 (R to NNC to 2)	Yes	DNS, NNC
52	99	Offgoing C3PS test (during shift), N3 to N2	Yes	DNS, RPR
53	08	Offgoing speed test (during shift), L to N1	Yes	DNS, NNC

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MAIN CODE	SUB CODE	DESCRIPTION	DO NOT SHIFT LIGHT	INHIBITED OPERATION DESCRIPTION
53	18	Offgoing speed test (during shift), 1 to N1	Yes	DNS, NNC
53	28	Offgoing speed test (during shift), 2 to N1	Yes	DNS, NNC
53	29	Offgoing speed test (during shift), 2 to N2	Yes	DNS, RPR
53	38	Offgoing speed test (during shift), 3 to N1	Yes	DNS, NNC
53	39	Offgoing speed test (during shift), 3 to N3	Yes	DNS, RPR
53	48	Offgoing speed test (during shift), 4 to N1	Yes	DNS, NNC
53	49	Offgoing speed test (during shift), 4 to N3	Yes	DNS, RPR
53	58	Offgoing speed test (during shift), 5 to N1	Yes	DNS, NNC
53	59	Offgoing speed test (during shift), 5 to N3	Yes	DNS, RPR
53	68	Offgoing speed test (during shift), 6 to N1	Yes	DNS, NNC
53	69	Offgoing speed test (during shift), 6 to N4	Yes	DNS, RPR
53	78	Offgoing speed test (during shift), R to N1	Yes	DNS, NNC
53	99	Offgoing speed test (during shift), N2 to N3 or N3 to N2	Yes	DNS, RPR
54	01	Oncoming ratio test (after shift), L to 1	Yes	DNS, RPR
54	07	Oncoming ratio test (after shift), L to R	Yes	DNS, NNC
54	10	Oncoming ratio test (after shift), 1 to L	Yes	DNS, RPR
54	12	Oncoming ratio test (after shift), 1 to 2	Yes	DNS, RPR

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MAIN CODE	SUB CODE	DESCRIPTION	DO NOT SHIFT LIGHT	INHIBITED OPERATION DESCRIPTION
54	17	Oncoming ratio test (after shift), 1 to R	Yes	DNS, NNC
54	21	Oncoming ratio test (after shift), 2 to 1	Yes	DNS, RPR
54	23	Oncoming ratio test (after shift), 2 to 3	Yes	DNS, RPR
54	27	Oncoming ratio test (after shift), 2 to R	Yes	DNS, NNC
54	32	Oncoming ratio test (after shift), 3 to 2	Yes	DNS, RPR
54	34	Oncoming ratio test (after shift), 3 to 4	Yes	DNS, RPR
54	43	Oncoming ratio test (after shift), 4 to 3	Yes	DNS, RPR
54	45	Oncoming ratio test (after shift), 4 to 5	Yes	DNS, RPR or SOL OFF (Hydraulic default)
54	54	Oncoming ratio test (after shift), 5 to 4	Yes	DNS,RPR
54	56	Oncoming ratio test (after shift), 5 to 6	Yes	DNS,RPR
54	65	Oncoming ratio test (after shift), 6 to 5	Yes	DNS,RPR
54	70	Oncoming ratio test (after shift), R to L	Yes	DNS,NNC
54	71	Oncoming ratio test (after shift), R to 1	Yes	DNS,NNC
54	72	Oncoming ratio test (after shift), R to 2	Yes	DNS,NNC
54	80	Oncoming ratio test (after shift), N1 to L	Yes	DNS,RPR
54	81	Oncoming ratio test (after shift), N1 to 1	Yes	DNS,RPR
54	82	Oncoming ratio test (after shift), N1 to 2	Yes	DNS,RPR

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MAIN CODE	SUB CODE	DESCRIPTION	DO NOT SHIFT LIGHT	INHIBITED OPERATION DESCRIPTION
54	83	Oncoming ratio test (after shift), N1 to 3	Yes	DNS,RPR
54	85	Oncoming ratio test (after shift), N1 to 5	Yes	DNS,RPR
54	86	Oncoming ratio test (after shift), N1 to 6	Yes	DNS, RPR
54	92	Oncoming ratio test (after shift), R to 2 (R to NNC to 2)	Yes	DNS, NNC
54	92	Oncoming ratio test (after shift), N1 to 2 (N1 to NNC to 2)	Yes	DNS, RPR
54	92	Oncoming ratio test (after shift), N2 to 2	Yes	DNS, RPR
54	93	Oncoming ratio test (after shift), N3 to 3	Yes	DNS, RPR
54	95	Oncoming ratio test (after shift), N3 to 5	Yes	DNS, RPR
54	96	Oncoming ratio test (after shift), N4 to 6	Yes	DNS, RPR
54	97	Oncoming ratio test (after shift), 2 to R (2 to NNC to R)	Yes	DNS, NNC
55	17	Oncoming C3PS test (after shift), 1 to R	Yes	DNS, NNC
55	27	Oncoming C3PS test (after shift), 2 to R	Yes	DNS, NNC
55	80	Oncoming C3PS test (after shift), N1 to L	Yes	DNS, RPR
55	87	Oncoming C3PS test (after shift), N1 to R	Yes	DNS, RPR
55	97	Oncoming C3PS test (after shift), 2 to R or NVL to R (2 to NNC to R)	Yes	DNS, NNC
56	00	Range verification test, L	Yes	DNS, 1st, Low, or SOL OFF (Low)
56	11	Range verification test, 1st	Yes	DNS, 6th
56	22	Range verification test, 2nd	Yes	DNS, 6th or 5th

**Section 07: TRANSMISSION**

MAIN CODE	SUB CODE	DESCRIPTION	DO NOT SHIFT LIGHT	INHIBITED OPERATION DESCRIPTION
56	33	Range verification test, 3rd	Yes	DNS, 5th or SOL
56	44	Range verification test, 4th	Yes	DNS, 3rd or 5th
56	55	Range verification test, 5th	Yes	DNS, SOL OFF (5th) or 3rd
56	66	Range verification test, 6th	Yes	DNS, 5th, 3rd, or SOL OFF (3rd)
56	77	Range verification test, R	Yes	DNS, N2 or N3
57	11	Range verification C3PS test, 1st	Yes	DNS, SOL OFF (3rd)
57	22	Range verification C3PS test, 2nd	Yes	DNS, 3rd
57	44	Range verification C3PS test, 4th	Yes	DNS, 5th or SOL OFF (3rd)
57	66	Range verification C3PS test, 6th	Yes	SOL OFF (5th), DNS
57	88	Range verification C3PS test, N1	Yes	DNS, N3
57	99	Range verification C3PS test, N2 or N4	Yes	DNS, N3
61	00	Retarder oil temperature, hot	No	None
62	12	Retarder oil temperature sensor, low	No	None
62	23	Retarder oil temperature sensor, high	No	None
63	00	Special function input	No	Depends on special function
64	12	Retarder modulation request sensor, low	No	Retarder operation inhibited
64	23	Retarder modulation request sensor, high	No	Retarder operation inhibited
65	00	Engine rating too high	Yes	DNS
66	00	Serial communications interface fault	No	Use default throttle values
69	12	ECU, A solenoid driver open	Yes	DNS, SOL OFF (hydraulic default)
69	13	ECU, B solenoid driver open	Yes	DNS, SOL OFF (hydraulic default)
69	14	ECU, C solenoid driver open	Yes	DNS, SOL OFF (hydraulic default)
69	15	ECU, D solenoid driver open	Yes	DNS, SOL OFF (hydraulic default)

**Section 07: TRANSMISSION**

MAIN CODE	SUB CODE	DESCRIPTION	DO NOT SHIFT LIGHT	INHIBITED OPERATION DESCRIPTION
69	16	ECU, E solenoid driver open	Yes	DNS, SOL OFF (hydraulic default)
69	21	ECU, F solenoid driver open	No	Lock-up inhibited
69	22	ECU, G solenoid driver open	Yes	DNS, SOL OFF (Hydraulic default)
69	23	ECU, H solenoid driver open	No	Retarder allowed, differential lock inhibited
69	24	ECU, J solenoid driver open	No	Low and 1 st inhibited
69	25	ECU, K solenoid driver open	No	K solenoid operation inhibited
69	26	ECU, N solenoid driver open	No	Low and 1st inhibited
69	32	ECU, SPI communications link fault	No	Hold in last valid direction
69	33	ECU, Central Operating Processor (COP) time-out	Yes	Reset ECU, Shutdown ECU on 2nd occurrence (power loss: hydraulic defaults)
69	34	ECU, EEPROM write time-out	Yes	DNS, SOL OFF (Hydraulic default)
69	35	ECU, EEPROM checksum	Yes	Induce COP time-out (reset ECU)
69	36	ECU, RAM self test	Yes	Induce COP time-out (reset ECU)
69	41	ECU, I/O ASIC addressing test	Yes	Induce COP time-out (reset ECU)
70	35	Software, minor loop overrun	Yes	Induce COP time-out (reset ECU)
70	35	Software, illegal write to access \$0000	Yes	Induce COP time-out (reset ECU)
70	35	Software, major loop overrun	Yes	Induce COP time-out (reset ECU)

# 11. SPECIFICATIONS

## AUTOMATIC TRANSMISSION WITH OR WITHOUT RETARDER

Gross input power (maximum) .....450 hp (335 kW)  
 Gross input torque (maximum) ..... 1460 lbf•ft (1978 N•m)  
 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 521-2.4;TC 531-2.3;TC 541-1.9;TC 551-1.8;TC 561-1.6  
 Lockup clutch with torsional damper ..... Integral/standard

### Gearing

Type ..... Patented, constant mesh, helical, planetary

	<b>Ratio*</b>
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 .....DEXRON-IIIE OR DEXRON III  
 Capacity (excluding external circuits) .....Initial fill 47 US qts (45 liters)  
 Oil change ..... 37 US qts (39 liters)

### Oil Filters

Make..... Allison Transmission  
 Type ..... Disposable cartridge  
 Supplier number..... 29503829  
 Prévost number..... 57-1687

## MANUAL TRANSMISSION

### SIX-SPEED

Make..... Spicer  
Model..... PS130-6B

#### Ratio:

LO..... 8.53:1  
1st..... 4.87:1  
2nd ..... 3.00:1  
3rd ..... 1.90:1  
4th..... 1.33:1  
5th..... 1.00:1  
Rev ..... 8.53:1

#### Fluid:

Type ..... Same as engine oil  
Capacity ..... 41 Pints (19.4 liters) at 0° Installation  
Torque Capacity..... 1300 lbf•ft (1761 N•m)

### SEVEN-SPEED

Make..... Spicer  
Model..... PS145-7A

#### Ratio:

LO..... 10.13:1  
1st..... 5.99:1  
2nd ..... 3.56:1  
3rd ..... 2.57:1  
4th..... 1.84:1  
5th..... 1.33:1  
6th..... 1.00:1  
Rev ..... 10.13:1

#### Fluid:

Type ..... Same as engine oil  
Capacity ..... 48 Pints (22.7 liters) at 0° Installation  
Torque Capacity..... 1450 lbf•ft (1964 N•m)