

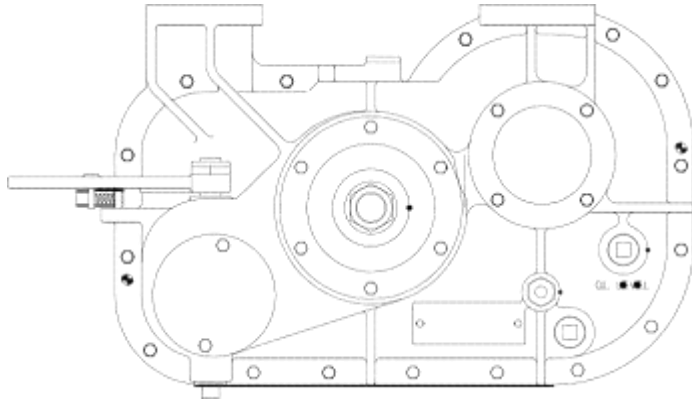
# TML Power Take-Off

# Operation and Maintenance

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Read through the safety information and operating instructions carefully before using your Waterous PTO.

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## Safety Information



Read through the safety information and operating instructions before using your Waterous PTO.

### **WARNING**

Death or serious personal injury might occur if proper operating procedures are not followed. The operator, as well as other individuals using the apparatus must be familiar with these operating instructions as well as other operating instructions and manuals for the apparatus, water hydraulics and component limitation.

### **WARNING**

#### **Unexpected Truck Movement May result in serious personal injury or death**

Failure to properly shift transmission in accordance to the transmission operating instructions may result in unexpected truck movement which may result in serious personal injury or death.

### **WARNING**

If the truck attempts to move, reduce engine speed to idle. Put truck transmission in NEUTRAL and repeat shifting instructions.

#### **NOTICE:**

When towing, disconnect the drive shaft that connects the pump transmission's rear output (coupling) shaft to the vehicles differential. Failure to do so may result in damage from lack of lubrication.

## Introduction

This publication contains operation and maintenance instructions for Waterous Model TML split shaft, full torque power take-offs (PTOs). Refer to the Service Parts Lists

for the reference numbers when ordering repair parts. Also, provide the serial number of the TML when placing inquiries or orders.

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## General Description

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These PTOs are designed for driving a wide variety of heavy duty, truck mounted power equipment. When mounted in the chassis drive line, they are capable of transmitting full torque to the rear axle, as multiplied by the transmission. With the transmission in "direct drive" they transmit full engine power to the equipment being driven.

The helical gears in the PTO are oversize to provide an added safety factor, and are hardened and ground to insure long life and quiet, trouble-free operation. Ball bearings are used throughout the case. Several gear ratios are available to permit closely matching the driven shaft speed to individual engine speed and power requirements.

The shift mechanism within the gear case consists of a sliding, internal toothed collar which is always in engagement with a gear integral with the drive shaft. A fork shifts the collar forward to engage it with the PTO drive gear or to the rear to engage it with a gear integral with the coupling shaft. When in PTO position, the shift collar transmits power from the drive shaft through the drive gear to the driven shaft gear. When in ROAD position, the collar transmits power directly from the drive shaft through the coupling shaft to the propeller shaft, and rear axle(s). In this position, the drive gear remains stationary while the shaft rotates. The gear case is shifted through a standard mechanical linkage, or by an optional electric shift, without leaving the cab.

The PTO output for the model TML is available with SAE Class B and C hydraulic motor mounts, a 1350 series end yoke or a keyed shaft facing either forward or to the rear. Combinations are also available. The PTO output is located on the right hand side of the PTO, and turns in a counter- engine wise direction.

## Options

### ***Electric Shift***

Although the gear case is supplied with a manual shift as standard, an optional electric shift is available. This feature uses an automotive type actuator to shift from ROAD to PTO. It permits fast, positive shifting and eliminates the need for complicated mechanical control linkages. A two position switch, mounted on the truck instrument panel or other convenient location, actuates the shift unit. A pull- out lever incorporated in the shift switch prevents unintentional movement.

### ***Tachometer Drive***

The tachometer drive provision includes a drive gear and a driven gear with an extension which operates at one half drive shaft speed. The driven gear extension protrudes from the PTO drive shaft housing at a 45 degree angle. It rotates in a clockwise direction, viewed facing the connection. A standard commercial tachometer, calibrated at twice shaft speed, or a speed counting shaft may be installed.

### ***Speedometer Drive***

This provision, similar to the tachometer drive, is mounted in the coupling shaft housing, and turns at one half coupling shaft speed. The regular odometer/speedometer may be connected to the speedometer drive to indicate actual road miles. If required for maintenance records, a separate odometer may be connected to the tachometer drive, and the two readings compared. If another speedometer ratio is needed, a suitable drive joint must be installed.

### ***Parking Brake***

A PTO mounted parking brake is available for use under all operating conditions. The brake mounts on the PTO coupling shaft and locks the propeller shaft without affecting PTO operation. The installation of a suitable cable or linkage (not supplied by Waterous) permits operating the brake with the existing parking brake lever.

# Shifting Instructions

## Manual PTO Shift

Two series of Allison automatic transmissions are commonly used in heavy duty trucks. Each series is available with the shift patterns controlled hydraulically or both electronically and hydraulically. This later type is commonly referred to as the ATEC transmission.

In each automatic transmission, either the non-ATEC or the ATEC, certain sequences must occur in proper order after the shift control is moved to either PTO or ROAD position.

Split shaft transmissions, automatic transmissions and engines will vary in operation due to manufacturing tolerances, lubrication temperature, etc. This variance in each may or may not affect the ease of completing a full shift into either PTO or ROAD. Operator training and experience in shifting procedures is a requirement to becoming skilled in a smooth, complete shift into either PTO or ROAD.

**When the PTO shift is activated, the operator may hear a noise associated with the movement of the shift unit. This does NOT mean that the shift has been completed.**

After the shift to PTO operation is completed, the green PUMP ENGAGED and OK TO PUMP lights in the cab must be on before leaving the cab to operate the PTO from the operators panel. **DO NOT LEAVE THE CAB IF THE GREEN PUMP ENGAGED AND OK TO PUMP LIGHTS ARE NOT ON.**

### WARNING

**Unexpected Truck Movement.  
May result in serious personal injury or death.**

Failure to properly shift the PTO in accordance to the PTO operating instructions may result in unexpected truck movement which may result in serious personal injury or death.

### Shift to PTO as follows:

- 1.
2. Reduce engine to idle speed, put truck transmission into **NEUTRAL**.
3. Set truck parking brake.
4. Move PTO shift control to **PTO** position.
5. Green PUMP ENGAGED light should be on.

### NOTICE

If green PUMP ENGAGED light is not on, momentarily shift truck transmission into REVERSE while keeping pressure on the manual shift rod. Return to NEUTRAL. Green PUMP ENGAGED light should be on.

6. Lock PUMP shift control in **PTO** position.
7. Shift truck transmission into PTO gear (**DRIVE**).

### NOTICE

Shifting truck transmission into PTO gear (DRIVE) above engine idle speed may cause damage to the equipment.

8. Green OK TO PUMP light should be on.
9. Increase engine speed above idle and hold for a few seconds. Watch speedometer to make sure it shows some value of road speed.

**NOTE: Some trucks have a speedometer that will not show a value of road speed in a stationary position.**

### WARNING

If the truck attempts to move, reduce engine speed to idle. Put truck transmission in NEUTRAL and repeat shifting instructions.

10. After leaving truck cab, block wheels using wheel chocks.
11. To confirm that the PTO is engaged:
  - THROTTLE READY light on operator's panel is illuminated.
  - Other safety interlocks are activated.

### Shift to ROAD as follows:

1. With engine speed at idle, put truck transmission in **NEUTRAL**.
2. When speedometer slows to zero, move PTO shift control to **ROAD** position.
3. Lock PTO shift control in **ROAD** position.
4. Engage truck transmission (**DRIVE**)

### NOTICE

If you hear a loud grinding noise when you attempt to move the truck, the shift to ROAD has not been completed. Shift into NEUTRAL while keeping pressure on PTO shift lever.

If grinding is a common occurrence after Step 3 is performed, it may be prevented by shifting the truck transmission into NEUTRAL, then to REVERSE, back to NEUTRAL and finally to DRIVE.

5. After shifting the truck transmission to **DRIVE**, release the parking brake and move the vehicle forward to confirm a shift to **ROAD** has been completed.

## Electric PTO Shift

Two series of Allison automatic transmissions are commonly used in heavy duty trucks. Each series is available with the shift patterns controlled hydraulically or both electronically and hydraulically. This later type is commonly referred to as the ATEC transmission.

In each automatic transmission, either the non-ATEC or the ATEC, certain sequences must occur in proper order after the PTO shift control is moved to either PTO or ROAD position.

Split shaft transmissions, automatic transmissions and engines will vary in operation due to manufacturing tolerances, lubrication temperature, etc. This variance in each may or may not affect the ease of completing a full shift into either PTO or ROAD. Operator training and experience in shifting procedures is a requirement to becoming skilled in a smooth, complete shift into either PTO or ROAD.

**When the PTO shift is activated, the operator may hear a noise associated with the movement of the shift unit. This does NOT mean that the shift has been completed.**

After the shift to PTO operation is completed, the green PTO ENGAGED and THROTTLE READY lights in the cab must be on before leaving the cab to operate the PTO from the operators panel. **DO NOT LEAVE THE CAB IF THE GREEN PTO ENGAGED AND THROTTLE READY LIGHTS ARE NOT ON.**

Some truck builders may install a manual override for the electric PTO shift. The controls are normally installed from the PTO transmission to the operators panel.

### WARNING

**Unexpected Truck Movement.  
May result in serious personal injury or death.**

Failure to properly shift the PTO in accordance to the PTO operating instructions may result in unexpected truck movement which may result in serious personal injury or death.

### **Shift to PTO as follows:**

1. Bring truck to complete stop.
2. Reduce engine to idle speed, put truck transmission into **NEUTRAL**.
3. Set truck parking brake.
4. Move PTO shift control to **PTO** position.

**NOTE: Green PTO ENGAGED light may not illuminate.**

5. Shift truck transmission into PTO gear (**DRIVE**).

### NOTICE

Shifting truck transmission into PTO gear (**DRIVE**) above engine idle speed may cause damage to the equipment.

6. Green PTO ENGAGED and THROTTLE READY lights should be on.

### NOTICE

If green PTO ENGAGED and THROTTLE READY light are not on, momentarily shift truck transmission from PTO gear (**DRIVE**) to **NEUTRAL**, then **REVERSE**, then **NEUTRAL**, then back into PTO gear (**DRIVE**). Lights should be on. If lights are not on, repeat procedure.

7. Increase engine speed above idle and hold for a few seconds. Watch speedometer to make sure it shows some value of road speed.

**NOTE: Some trucks have a speedometer that will not show a value of road speed in a stationary position.**

### WARNING

If the truck attempts to move, reduce engine speed to idle. Put truck transmission in **NEUTRAL** and repeat shifting instructions.

8. After leaving truck cab, block wheels using wheel chocks.
9. To confirm that the PTO is engaged:
  - THROTTLE READY light on operator's panel is illuminated.
  - Other safety interlocks are activated.

### **Shift to ROAD as follows:**

1. With engine speed at idle, put truck transmission in **NEUTRAL**.
2. When speedometer slows to zero, move PTO shift control to **ROAD** position.
3. Engage truck transmission (**DRIVE**).

### NOTICE

If you hear a loud grinding noise when you attempt to move the truck, the shift to **ROAD** has not been completed. Shift into **NEUTRAL**, wait for grinding noise to stop and re-engage truck transmission.

If grinding is a common occurrence after Step 3 is performed, it may be prevented by shifting the truck transmission into **NEUTRAL**, then to **REVERSE**, back to **NEUTRAL** and finally to **DRIVE**.

4. After shifting the truck transmission to **DRIVE**, release the parking brake and move the vehicle forward to confirm a shift to **ROAD** has been completed.

# Electric Shift Manual Override

Two series of Allison automatic transmissions are commonly used in heavy duty trucks. Each series is available with the shift patterns controlled hydraulically or both electronically and hydraulically. This later type is commonly referred to as the ATEC transmission.

In each automatic transmission, either the non-ATEC or the ATEC, certain sequences must occur in proper order after the shift control is moved to either PTO or ROAD position.

Split shaft transmissions, automatic transmissions and engines will vary in operation due to manufacturing tolerances, lubrication temperature, etc. This variance in each may or may not affect the ease of completing a full shift into either PTO or ROAD. Operator training and experience in shifting procedures is a requirement to becoming skilled in a smooth, complete shift into either PTO or ROAD.

**When the PTO shift is activated, the operator may hear a noise associated with the movement of the shift unit. This does NOT mean that the shift has been completed.**

After the shift to PTO operation is completed, the green PTO ENGAGED and THROTTLE READY lights in the cab must be on before leaving the cab to operate the PTO from the operators panel. **DO NOT LEAVE THE CAB IF THE GREEN PTO ENGAGED AND THROTTLE READY LIGHTS ARE NOT ON.**

If the vehicle builder has provided a means to manually override the electric PTO shift, the override control will be located at the operators panel or in the cab. The override control will consist of a rod to the panel or a cable or rod mechanism to the inside of the cab. The rod or cable will be attached to the shift arm on the PTO transmission.

**NOTE: This instruction is written based on an override control rod directed to the operators panel from the short arm of the lever on the PTO transmission. Other rod or cable arrangements may require reversal of stated action to accomplish the desired shift.**

If the PTO transmission is equipped with an override, shifting manually is done as follows:

It is recommended that this procedure be performed using two people; one person in the cab and one at the override control position.

## ⚠ WARNING

**Unexpected Truck Movement.  
May result in serious personal injury or death.**

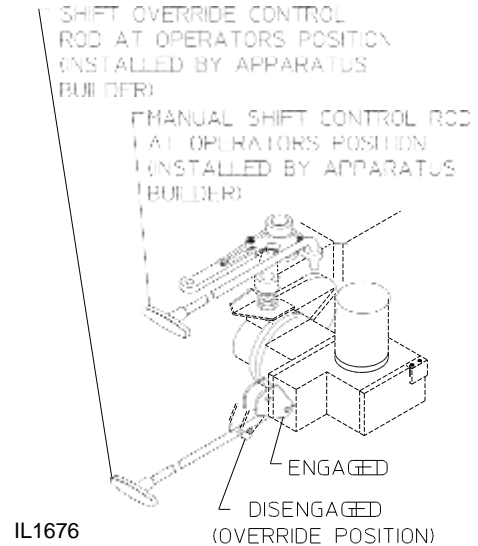
Failure to properly shift PTO in accordance to the PTO operating instructions may result in unexpected truck movement which may result in serious personal injury or death.

### Shift to PTO as follows:

1. Bring truck to complete stop.
2. Reduce engine to idle speed, put truck transmission in **NEUTRAL**.

3. Set truck parking brake.
4. Pull the shift override control rod out at the operators position to disengage the electric shift unit from the PTO transmission shift arm. See Figure 1.

Figure 1. Electric Shift Manual Override



5. Push manual shift control rod in for **PTO** position.
6. Move in-cab PTO shift control into **PTO** position.
7. Green PTO ENGAGED light should be on.

## NOTICE

If green PTO ENGAGED light is not on, momentarily shift truck transmission into REVERSE while keeping pressure on the manual shift rod. Return to NEUTRAL. Green PTO ENGAGED light should be on.

8. Shift truck transmission into PTO gear (**DRIVE**).

## NOTICE

Shifting truck transmission into PTO gear above engine idle speed may cause damage to the equipment.

9. Green THROTTLE READY light should be on.
10. Increase engine speed above idle and hold for a few seconds. Watch speedometer to make sure it shows some value of road speed.

**NOTE: Some trucks have a speedometer that will not show a value of road speed in a stationary position.**

## ⚠ WARNING

If the truck attempts to move, reduce engine speed to idle. Put truck transmission in NEUTRAL and repeat shifting instructions.

11. After leaving truck cab, block wheels using wheel chocks.
12. To confirm that the PTO is engaged:
  - THROTTLE READY light on operator's panel is illuminated.
  - Other safety interlocks are activated.

**Shift to ROAD as follows:**

1. With engine at idle speed, put truck transmission in **NEUTRAL**.
2. When speedometer drops to zero, pull manual shift rod out for **ROAD** position. Push the override control rod in to engage shift unit.
3. Move in-cab PTO shift control into **ROAD** position.
4. Engage truck transmission (**DRIVE**).

**NOTICE**

If you hear a loud grinding noise when you attempt to move the truck, the shift to ROAD has not been completed. Shift into NEUTRAL, wait for grinding noise to stop and re-engage truck transmission, while keeping pressure on the manual shift control rod.

5. After shifting the truck transmission to **DRIVE**, release the parking brake and move the vehicle forward to confirm a shift to **ROAD** has been completed.

# Maintenance

## Indicating Lights Operation

Check the operation of the PTO shift indicating lights at least weekly as follows:

**NOTE: Block wheels with wheel chocks before beginning.**

1. With the PTO in the ROAD position, truck transmission in NEUTRAL and the parking brake engaged, ensure that the PTO ENGAGED and THROTTLE READY lights in the cab are off.
2. Shift to PTO following the shifting instructions section of this document.
  - a. Ensure that the green PTO ENGAGED and THROTTLE READY lights in the cab are on.
  - b. Ensure that the green THROTTLE READY light on the operator's panel is on.
3. Apply the service (foot) brake and release the parking brake.
  - a. Ensure that the green THROTTLE READY light in the cab is off.
  - b. Ensure that the green THROTTLE READY light on the operator's panel is off.
4. Engage the parking brake and shift truck transmission to NEUTRAL.
  - a. Ensure that the green THROTTLE READY light in the cab is off (automatic truck transmission only).
5. Shift to ROAD following the shifting instructions section of this document.
  - a. Ensure that the green PTO ENGAGED and THROTTLE READY lights in the cab are off.
  - b. Ensure that the green THROTTLE READY light on the operator's panel is off.

## Tachometer Readings

### Mechanical Tachometer:

Speed of drive tachometer gear is 1/2 of input shaft speed.

## Fluid Levels

1. Check fluid level monthly by removing fluid level plug at rear of case. The fluid should be level with bottom of hole.

### NOTICE

If fluid level is low, locate source of leak and repair. If fluid level is high, loosen drain plug until fluid drops to proper level. If excessive water drains out, change fluid and determine source of water leakage and repair.

**NOTE: Fluid temperature should not exceed 250 for an extended period of time or premature seal wear and damage may occur.**

Fluid can be added thru the fluid level hole or by removing the breather and adding fluid thru this opening. Use any high grade, SAE 80W-90 gear lubricant.

2. Change fluid annually or after each 100 hours of operation, whichever comes first. Clean the breather and magnetic drain plug thoroughly whenever the transmission fluid is changed.

### Amount required if system is drained and refilled

4 quarts (approximately)

## Shift Linkage

Periodically check all shift linkage for freedom of movement and clean as necessary.

## Towing

When towing, disconnect the drive shaft that connects the pump transmission's rear output (coupling) shaft to the vehicles differential. Failure to do so may result in damage from lack of lubrication.



## PTO Shift Troubleshooting Guide

It is important to know what to do if you experience shifting problems with your PTO. This troubleshooting guide will help you diagnose, isolate and correct problems as they are encountered.

For problems not covered in this guide, or for additional technical assistance, please contact the Waterous Service Department.

Problem	Is the chassis transmission in DRIVE (automatic) or in its PTO gear (Manual)?	Possible Cause	Recommended Action
<p><b>PTO won't engage</b></p> <p>PTO shift control is in the PTO position and PTO ENGAGED light does not illuminate.</p>	No	Butt-tooth condition	Place the chassis transmission in Drive (automatic) or in its PTO gear (manual).
		Malfunctioning shift indicating switch or switch out of adjustment	Replace or adjust the shift indicating switch or bracket.
	Manual override linkage binding.	Repair or replace to eliminate binding.	
	Excessive driveline torque	Shift the chassis transmission into REVERSE momentarily, then NEUTRAL, then DRIVE. ----- Consider reducing engine idle speed. ----- It may be necessary to contact the chassis transmission manufacturer for assistance.	
	No power to shift unit.	Repair as needed to restore power supply.	
	Failed shift motor - check current draw, should be 20A at startup and 10A through the cycle.	Replace the shift motor.	
	Failed shift unit - unit has power and draws correct amperage but will not activate.	Repair or replace the electric shift unit.	

**PTO Shift Troubleshooting Guide (continued)**

Problem	Is the PTO ENGAGED light on?	Possible Cause	Recommended Action
<p><b>PTO will not engage and there is a grinding noise emanating from the PTO.</b></p> <p>PTO shift control is in the PTO position and:</p> <p>1. The chassis transmission is in DRIVE (automatic) or in its PTO gear (manual).</p> <p>or</p> <p>2. The chassis transmission is in NEUTRAL.</p>	No	Manual override linkage binding	Repair or replace to eliminate binding.
	Yes	Excessive driveline torque.	Shift the transmission into REVERSE momentarily, then NEUTRAL, then DRIVE. ----- Consider reducing engine idle speed. ----- It may be necessary to contact the chassis manufacturer for assistance.
		Weak shift unit or non-Waterous supplied shift unit.	Replace shift unit with a high-torque shift unit provided by Waterous.
		Damage to internal PTO transmission components.	See PTO inspection instructions
		Malfunctioning shift indicating switch or switch out of adjustment.	Adjust the shift indicating switch or replace the bracket.
Damage to internal PTO components.	See PTO inspection procedure.		
<p><b>Chassis engine stalls after placing the PTO shift control in PTO and placing the chassis transmission DRIVE (automatic) or in its PTO gear (manual).</b></p>	No	PTO has not shifted out of ROAD due to excessive driveline torque.	Shift the transmission into REVERSE momentarily, then NEUTRAL, then DRIVE. ----- Consider reducing engine idle speed. ----- It may be necessary to contact the chassis manufacturer for assistance.
		Damage to internal PTO shifting components.	See PTO inspection instructions.
	Yes	Device driven by PTO has seized.	Repair driven device as necessary.

**PTO Shift Troubleshooting Guide (continued)**

<b>Problem</b>	<b>Is the chassis transmission in DRIVE (automatic) or in its PTO gear (manual)?</b>	<b>Possible Cause</b>	<b>Recommended Action</b>
<b>PTO ENGAGED light is on but Throttle Ready light will not illuminate (Units built 6/20/03 and later)</b>	No	Chassis transmission not in the proper gear.	Place the chassis transmission in DRIVE (automatic) or in its PTO gear (manual).
	Yes	Parking brake is not applied.	Apply parking brake.
		Problem with high range lockup or safety interlock systems.	Contact the apparatus manufacturer or consider alternate wiring for high range lockup.
		Problem with chassis transmission or transmission electronic control unit.	Contact the chassis transmission manufacturer for assistance.

<b>Problem</b>	<b>Is the PTO shift arm in contact with the shift indicating switch?</b>	<b>Possible Cause</b>	<b>Recommended Action</b>
<b>PTO shift control is in the ROAD position, but the PTO ENGAGED and/or Throttle Ready lights remain illuminated.</b>  NOTE: Chassis engine may stall if the chassis transmission is placed in DRIVE (automatic) or in PTO gear (manual).	No	Shift indicating switch stuck closed.	Replaced the shift indicating switch.
	Yes	Locking arm assembly is installed backwards inside the PTO (the shift arm should move away from the shift indicating switch when shifting to PTO).	Remove locking arm assembly and re-install correctly.

## PTO Shift Troubleshooting Guide (continued)

Problem	Possible Cause	Recommended Action
<b>PTO shift control is in the ROAD position and grinding sounds are heard emanating from the PTO.</b>	Chassis transmission is in gear when shifting PTO.	Place the chassis transmission in NEUTRAL before shifting to PTO.
	Butt-tooth condition - chassis transmission is in REVERSE.	Place the chassis transmission in DRIVE after shifting PTO to ROAD.
	Excessive driveline torque and/or rotation.	Ensure the driveline is not rotating before shifting to ROAD. ----- Consider reducing engine idle speed. ----- It may be necessary to contact the chassis transmission manufacturer for assistance.
	Damage to internal PTO shifting components.	See PTO inspection instructions.
<b>Manual PTO shift override control cannot be moved by hand.</b>	Electric shift unit is still engaged with the shift arm.	Operate the electric shift to disengage control.
	Binding or malfunctioning manual override shift linkage.	Repair or replace to eliminate linkage binding.
<b>The chassis engine stalls when the chassis transmission is placed in DRIVE (automatic) after moving the PTO shift control to the ROAD position.</b>	Shift indicating switch stuck closed.	Replace the shift indicating switch.
	Problem with chassis transmission or transmission electronic control unit.	Contact the chassis transmission manufacturer for assistance.

### PTO Shift Component Inspection

The following procedures should be followed when a problem with the PTO shift components is suspected:

1. Perform a shift force test on the PTO.
  - a. Place the chassis transmission in NEUTRAL and shut off the engine.
  - b. Set the apparatus parking brake.
  - c. Remove any manual override linkage from the shift arm.
  - d. Remove the electric shift unit (if so equipped) from the PTO.
  - e. Manually align the shift teeth by actuating the PTO shift arm and rotating the drive shaft until the shift collar is engaged in the PTO position.
  - f. Pull on the long side of the shift arm to shift the PTO between ROAD and PTO using a pull scale to measure the force required in pounds. The force required to shift the PTO should not exceed 18 pounds.

2. Drain the lubricant from the PTO and examine it for metal particles appearing in quantity and/or size which may indicate excessive wear to internal components. Also check the magnetic drain plug and the sump screen on the lube pump intake line (if so equipped) for debris. If there is little or no debris refill with clean lubricant and retest. If the problem persists or if large quantities or sizes of debris are found proceed to step 3.
3. Disassembly the PTO according to the overhaul instructions.
4. Inspect the PTO shift components, including:
  - a. Check for damage to the shift fork, shift shoes and shift shaft.
  - b. Check for damage to the engaging teeth on the drive gear, coupling shaft and shift collar. Note: it will be necessary to manually actuate the shift arm to inspect all of the teeth. Minor burrs found on the teeth of the shift collar, drive gear, or coupling shaft may be filed clean. If excessive damage is found the component(s) should be replaced.
  - c. Check to make sure that all bearings turn freely.
5. Contact Waterous to order any replacement parts or for further assistance.