

Service Manual Trucks

Group **43**

Range Shift Troubleshooting Procedures T300 Series Mack
Transmissions

T300



Foreword

The descriptions and service procedures contained in this manual are based on designs and methods studies carried out up to August 2011.

The products are under continuous development. Vehicles and components produced after the above date may therefore have different specifications and repair methods. When this is believed to have a significant bearing on this manual, supplementary service bulletins will be issued to cover the changes.

The new edition of this manual will update the changes.

In service procedures where the title incorporates an operation number, this is a reference to a Labor Code (Standard Time).

Service procedures which do not include an operation number in the title are for general information and no reference is made to a Labor Code (Standard Time).

Each section of this manual contains specific safety information and warnings which must be reviewed before performing any procedure. If a printed copy of a procedure is made, be sure to also make a printed copy of the safety information and warnings that relate to that procedure. The following levels of observations, cautions and warnings are used in this Service Documentation:

Note: Indicates a procedure, practice, or condition that must be followed in order to have the vehicle or component function in the manner intended.

Caution: Indicates an unsafe practice where damage to the product could occur.

Warning: Indicates an unsafe practice where personal injury or severe damage to the product could occur.

Danger: Indicates an unsafe practice where serious personal injury or death could occur.

Mack Trucks, Inc.

Greensboro, NC USA

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Range Shift Troubleshooting Procedures T300 Series Mack Transmissions

Safety Information

Attention

The information in this manual is not all inclusive and cannot take into account all unique situations. Note that some illustrations are typical and may not reflect the exact arrangement of every component installed on a specific chassis.

The information, specifications, and illustrations in this publication are based on information that was current at the time of publication.

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Advisory Labels

Cautionary *signal words* (Danger-Warning-Caution) may appear in various locations throughout this manual. Information accented by one of these signal words must be observed to minimize the risk of personal injury to service personnel, or the possibility of improper service methods which may damage the vehicle or cause it to be unsafe. Additional Notes and Service Hints are used to emphasize areas of procedural importance and provide suggestions for ease of repair. The following definitions indicate the use of these advisory labels as they appear throughout the manual:

 DANGER
<p>Activities associated with Danger indicate that death or serious personal injury may result from failing to heed the advisory. Serious personal injury may be equated to career-ending injury.</p>

 WARNING
<p>Activities associated with Warning indicate that personal injury may result from failing to heed the advisory. In this case, personal injury is not equated to career-ending injury, but results in possible change in quality of life.</p>

 CAUTION
<p>Activities associated with Caution indicate that product damage may result from failing to heed the advisory. Caution is not used for personal injury.</p>

Note: A procedure, practice, or condition that is essential to emphasize.

Note: A helpful suggestion that will make it quicker and/or easier to perform a procedure, while possibly reducing service cost.

Service Procedures and Tool Usage

Anyone using a service procedure or tool not recommended in this manual must first satisfy himself thoroughly that neither his safety nor vehicle safety will be jeopardized by the service method he selects. Individuals deviating in any manner from the instructions provided assume all risks of consequential personal injury or damage to equipment involved.

Also note that particular service procedures may require the use of a special tool(s) designed for a specific purpose. These special tools must be used in the manner described, whenever specified in the instructions.

DANGER

Engine-driven components such as Power Take-Off (PTO) units, fans and fan belts, driveshafts and other related rotating assemblies, can be very dangerous. Do not work on or service engine-driven components unless the engine is shut down. Always keep body parts and loose clothing out of range of these powerful components to prevent serious personal injury. Be aware of PTO engagement or nonengagement status. Always disengage the PTO when not in use.

WARNING

1. Before starting a vehicle, always be seated in the driver's seat, place the transmission in neutral, apply the parking brakes and push in the clutch pedal.
2. Before working on a vehicle, place the transmission in neutral, set the parking brakes, and block the wheels.
3. Before towing the vehicle, place the transmission in neutral and lift the rear wheels off the ground, or disconnect the driveline to avoid damage to the transmission during towing.

REMEMBER, SAFETY . . . IS NO ACCIDENT!

Mack Trucks, Inc. cannot anticipate every possible occurrence that may involve a potential hazard. Accidents can be avoided by recognizing potentially hazardous situations and taking necessary precautions. Performing service procedures correctly is critical to technician safety and safe, reliable vehicle operation.

The following list of general shop safety practices can help technicians avoid potentially hazardous situations and reduce the risk of personal injury. DO NOT perform any services, maintenance procedures or lubrications until this manual has been read and understood.

- Perform all service work on a flat, level surface. Block wheels to prevent vehicle from rolling.
- DO NOT wear loose-fitting or torn clothing. Remove any jewelry before servicing vehicle.
- ALWAYS wear safety glasses and protective shoes. Avoid injury by being aware of sharp corners and jagged edges.
- Use hoists or jacks to lift or move heavy objects.
- NEVER run engine indoors unless exhaust fumes are adequately vented to the outside.
- Be aware of hot surfaces. Allow engine to cool sufficiently before performing any service or tests in the vicinity of the engine.
- Keep work area clean and orderly. Clean up any spilled oil, grease, fuel, hydraulic fluid, etc.
- Only use tools that are in good condition, and always use accurately calibrated torque wrenches to tighten all fasteners to specified torques. In instances where procedures require the use of special tools which are designed for a specific purpose, use only in the manner described in the instructions.
- Do not store natural gas powered vehicles indoors for an extended period of time (overnight) without first removing the fuel.
- Never smoke around a natural gas powered vehicle.

Introduction

Overview

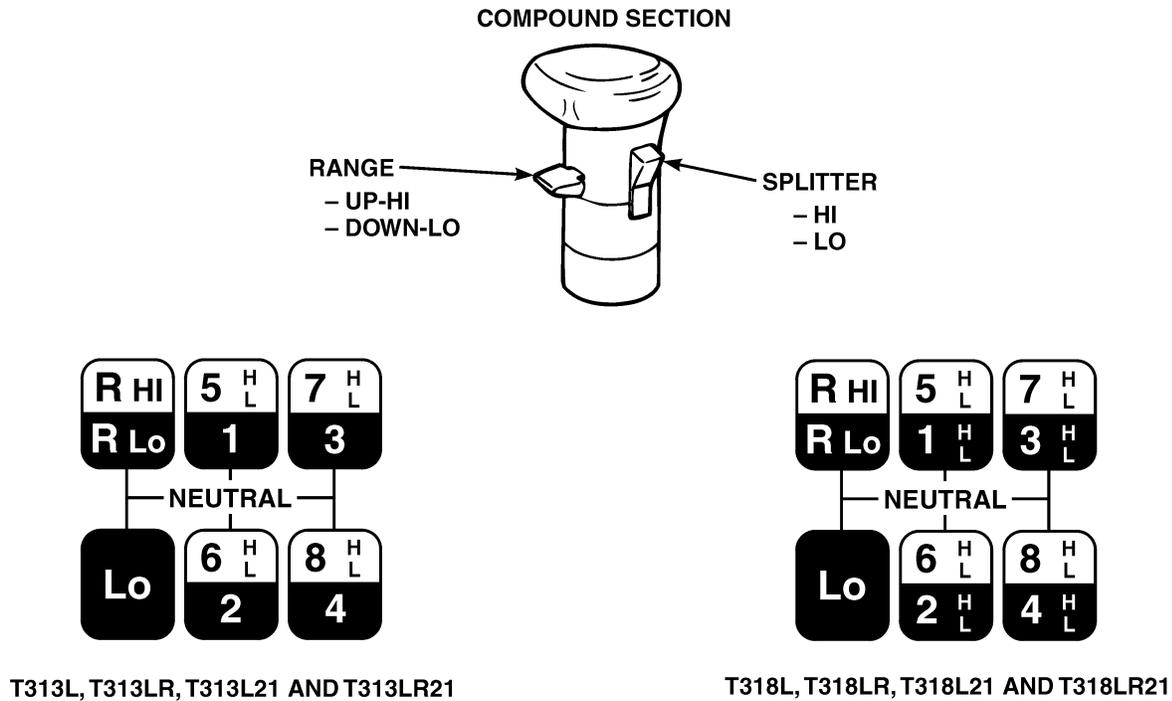
About This Manual

Range Shift

This publication will discuss various problems that may occur during a range shift, outline possible causes, and suggest inspections, measurements, adjustments and repairs that are appropriate. Please refer to the applicable T300 Service Manual for more detailed instructions in the general overhaul procedures to be followed. Due to the limited size of this publication, it is necessary to assume that the reader is familiar with the proper precautions and procedures for working on a T300 transmission.

Range Selector Valves (Shift Knob)

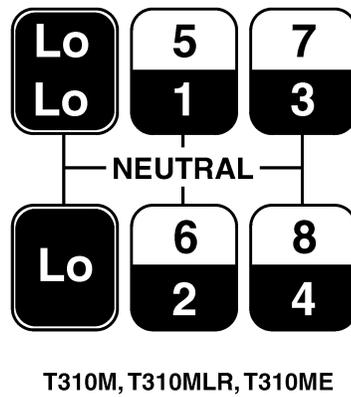
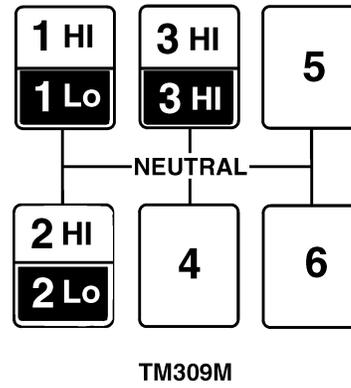
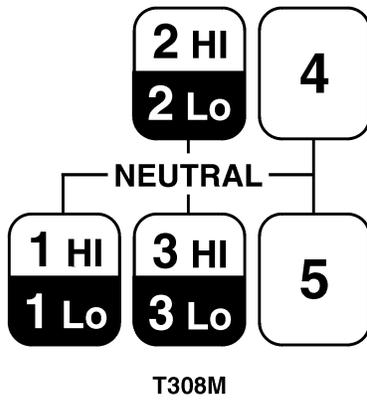
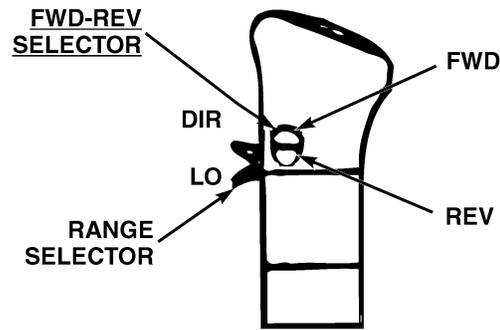
The following illustrations depict the three selector knob configurations and corresponding MACK transmissions.



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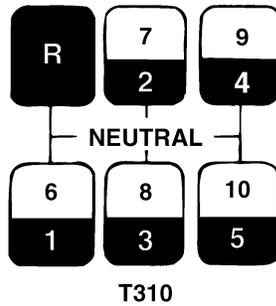
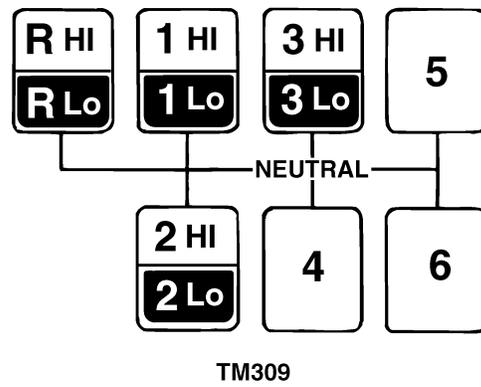
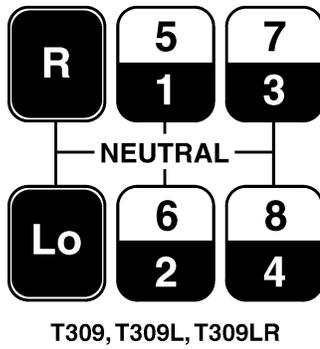
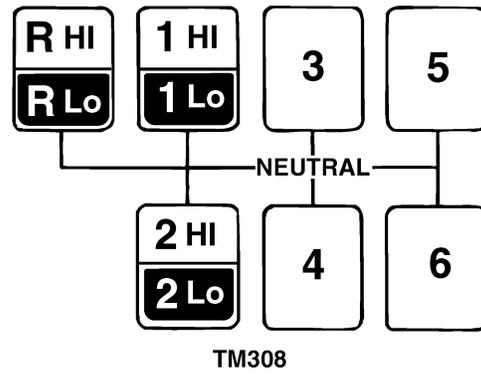
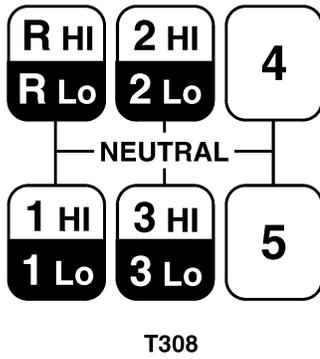
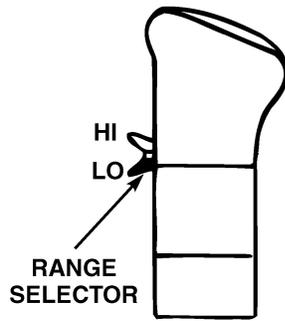
Fig. 1 T313 and T318 Transmissions



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Fig. 2 Multi-Speed Reverse Transmissions

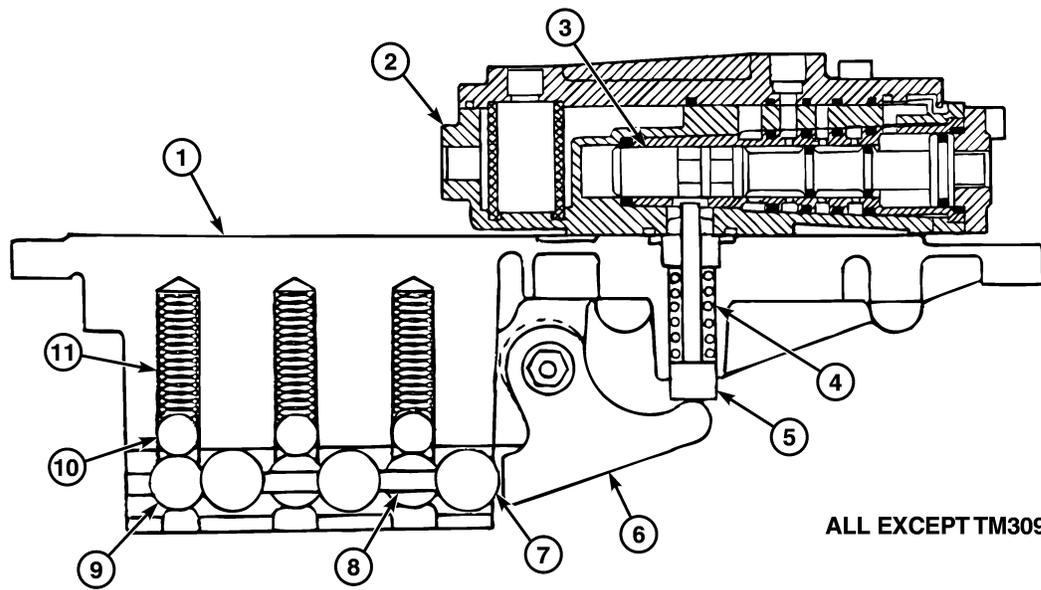


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Fig. 3 Short Compound Transmissions

Interlock System Function

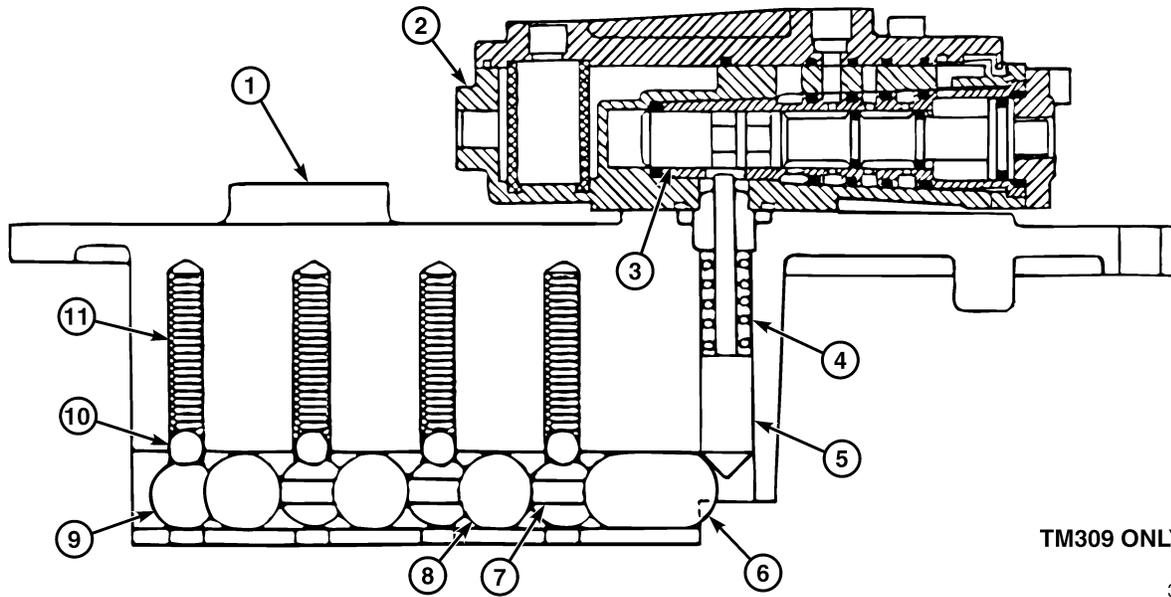


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Fig. 4 Three Rail Shift Cover Interlock System

1. Shift Cover	6. Interlock Rocker
2. Range Shift Valve (Shown as cutaway and rotated for view of steel spool valve)	7. Interlock Ball
3. Steel (Locking) Spool Valve	8. Interlock Pin
4. Plunger Spring	9. Shift Rail
5. Plunger	10. Poppet Ball
	11. Poppet Ball Spring



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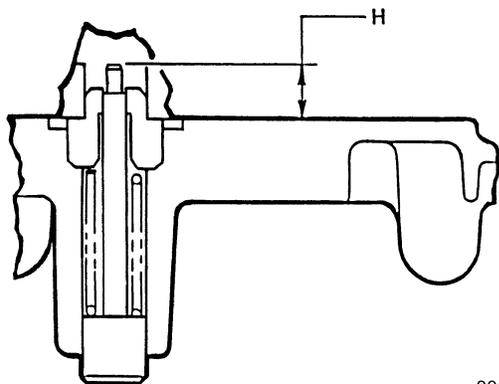
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Fig. 5 Four Rail Shift Cover Interlock System

<p>1. Shift Cover 2. Range Shift Valve (Shown as cutaway and rotated for view of steel spool valve) 3. Steel (Locking) Spool Valve 4. Plunger Spring 5. Plunger</p>	<p>6. Large Interlock Pin 7. Interlock Pin 8. Interlock Ball 9. Shift Rail 10. Poppet Ball 11. Poppet Ball Spring</p>
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Note: These transmissions have no interlock pin adjustment. Measure the height of the interlock pin with the transmission in neutral. The interlock pin height "H" in these transmissions should be between 0.350 and 0.430 inch (8.89 and 10.92 mm), regardless of valve spool depth. If the height is not within this range, some of the shift cover parts need to be replaced. Check the interlock pin projection with the transmission in any gear. The projection should be greater than 0.510 inch.



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Fig. 6 Interlock Pin Height

Troubleshooting

Malfunction Troubleshooting

Troubleshooting Procedure

You must read and understand the precautions and guidelines in Service Information, group 4, "General Safety Practices, Transmissions" before performing this procedure. If you are not properly trained and certified in this procedure, ask your supervisor for training before you perform it.

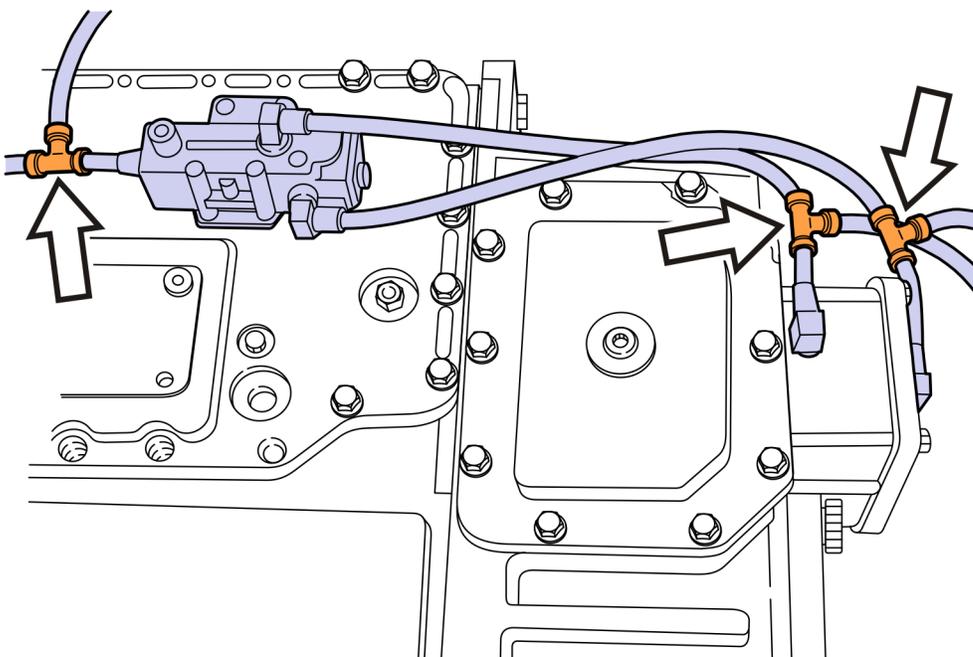
It is very difficult to determine where and why a range shift is not working properly. Considerable lost time can be spent trying to repair an area that is not the problem. Therefore, it is recommended that the diagrams shown in the center of this book be used to systematically determine the cause of the malfunction. The numbers and letters on the diagrams refer to the more detailed discussion which follows.

If the type of range shift malfunction which occurs can be described as a range shift that will not complete, proceed to **I. Troubleshooting with Air Gauges**. If the type of malfunction which occurs can be described as gear clash during the range shift, proceed to **II. Determining the Cause of Clash During a Range Shift**. If the type of malfunction occurs when operating a compound case side-mounted PTO with the optional compound neutralizing feature, proceed to **III. Missing Parts for Optional Compound Neutralizing**.

A **SUMMARY CHART** of Range Shift Troubleshooting is included at the end.

I. Troubleshooting with Air Gauges

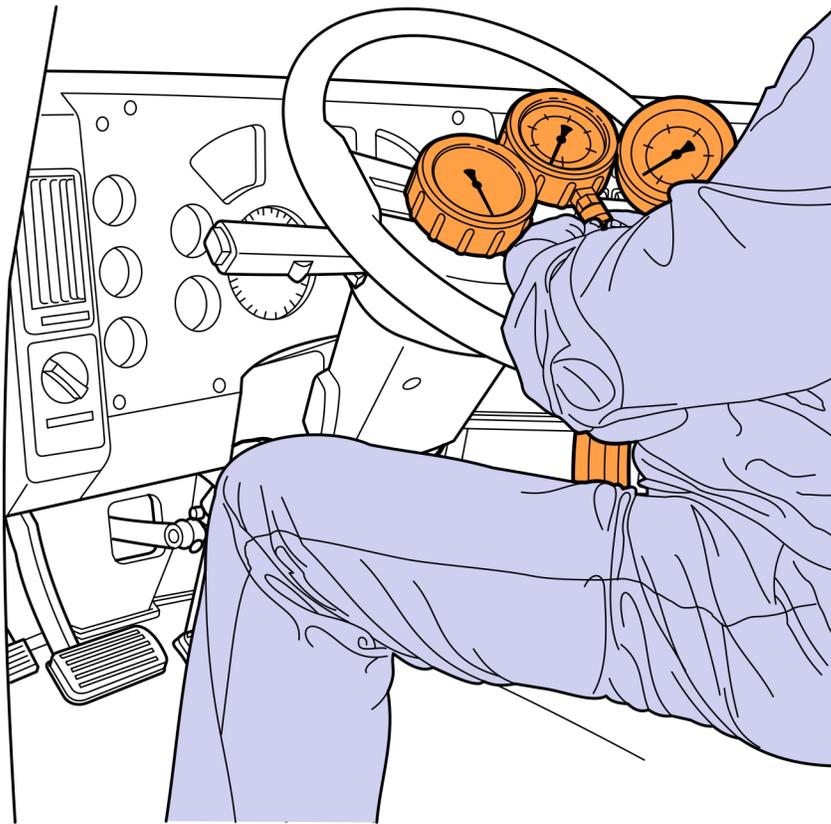
Drain the system. Install tee fittings at the locations indicated and connect gauges per the illustration. Start the engine to build up the air pressure and proceed to the next steps.



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Fig. 7 Air Gauge Tee Fitting Installation

Connect tool J-42206 (dual air pressure gauge) to the tee fittings, or you may use two separate gauges with lines long enough to reach the cab. See Figure 8.



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Fig. 8 Air Gauges

Start the engine and wait for air pressure to build back up to normal. Road test the truck. Two people should be in the cab: the driver and an observer to watch the gauges. When the range shift is operating normally, one gauge should read normal air pressure, and the other should read no air pressure.

Observe the gauges as the range shift is being made. The line with pressure should drop to no pressure, and the other should increase to normal pressure. Pressure change should occur only after preselecting the range AND moving the shift lever to neutral.

When the range shift does NOT operate properly, observe the gauges. If the gauges DO show proper air pressure change (as described previously), this suggests that the problem may be in the transmission range shift cylinder or the synchronizer assembly; therefore, you should proceed to **I.B. COMPOUND RANGE SHIFT CYLINDER AND SYNCHRONIZER** under I. Troubleshooting with Air Gauges.

If the gauges do NOT show proper air pressure change, this suggests that the problem may be in the range shift valve or main case top cover; therefore, you should proceed to **I.A. MAIN CASE COVER AND RANGE SHIFT VALVE** (below).

Static Test

Record the chassis air pressure and the range valve inlet pressure.
Are they equal?
Shift from low range to high range then high to low range.
Do the low and high range pressure gauges indicate the change in pressure (from full chassis psi to zero and zero to full chassis psi) with no time lag?
Record the pressures in both ranges.
Are there any air leaks in either range positions?
Insure that the Range Interlock is working in all lever positions?
Does the unit have the compound neutralizing feature?
Following the "Rear Case, Side-Mounted PTO Operating Procedures" in the vehicles operator's handbook, can the transmission successfully shifted into and out of compound neutral?
Record the pressures when in compound neutral and when back in low range.
Are there any leaks when in compound neutral?

 DANGER
<p>To prevent possible death or damage to personnel and equipment, two people are required (driver and observer) when road testing the vehicle for pressure readings during range changes.</p>

Dynamic Test

Road test the vehicle with two people: the driver and an observer to monitor the gauges and taking note of the pressures during the range changes.	
Is it grinding from:	(a) Hi to Lo range _____ (b) Lo to Hi Range _____ (c) Both _____
Does the range become disengaged?	(a) Out of Hi _____ (b) Out of Lo _____ (c) Both _____ (d) No Lo Range – will not complete shift _____ (e) No Hi Range – will not complete shift _____

I.a. Main Case Cover And Range Shift Valve

I.A.1. Air Supply Problem

Verify that there is no restriction of the air supply to the range shift control system.

I.A.1.a. Remove the air line which is connected to the end cap of the range shift valve located toward the center of the transmission. Air pressure should be available in this line with the selector valve (mounted on the shift lever) in the low range position. If pressure is available, proceed to I.A.2. If pressure is not available, check the air lines running to and from the selector valve for breaks, kinks, or other damage.

I.A.1.b. Check the range selector valve for restriction or other source of incorrect operation.

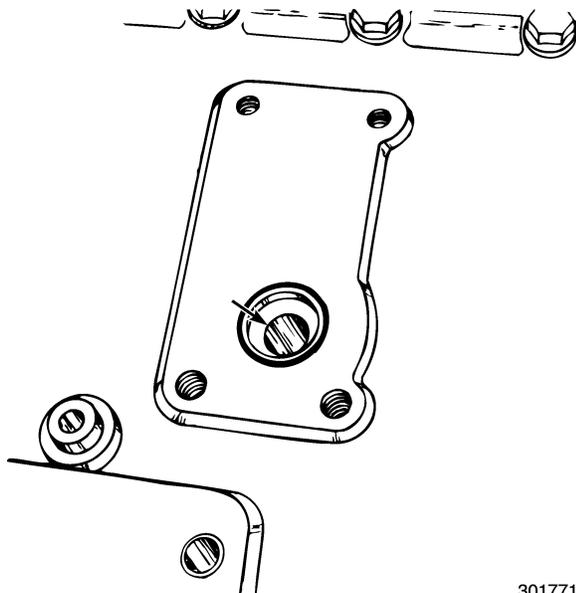
I.A.2. Interlock Pin

Check for a condition which could cause the interlock pin to fail to retract.

I.A.2.a. Ensure that the interlock pin is not sticking due to a binding condition with its locating sleeve.

I.A.2.b. Check the spring which retracts the pin to be sure it is not broken or missing.

I.A.2.c. Check the bore in the main case top cover to be sure the interlock pin moves freely in it. Clean the bore with a fine emery cloth if the pin does not move freely.



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Fig. 9 Main Case Top Cover Interlock Bore

I.A.2.d. Check the interlock pin. It should be clean, with no burrs or corrosion. The pin should be flat on the top, with the edge just slightly chamfered (just enough so you can't cut your finger on it). Replace the pin if the top has been rounded, excessively chamfered, or beveled. Do not grind the pin — replace it if necessary.

I.A.3. Range Shift Valve Stuck

Note: Range shift valves are no longer repairable. No repair kits are available. A range shift valve that is determined to be defective (i.e., stuck, leaking) must be replaced.

I.B. Compound Range Shift Cylinder And Synchronizer

Drain the chassis air pressure and remove the compound range shift cylinder.

I.B.1. Blocked Static Shift

If the failure of the range shift to complete occurs when the vehicle is not in motion, verify that the range clutch is installed in the transmission correctly. The letter "R" on the clutch and on the blocking pin ends should be installed toward the rear of the transmission.

I.B.2. Wrong Blocking Pins or Installed Wrong

Verify that the clutch assembly contains the correct blocking pins and that they are installed correctly. When assembled, the end of each blocking pin on the side of the clutch which is stamped "R" should also be stamped "R."

I.B.3. Cracked Support Tubes

Inspect the support tubes for any evidence of cracks. If cracks are found, tubes should be replaced.

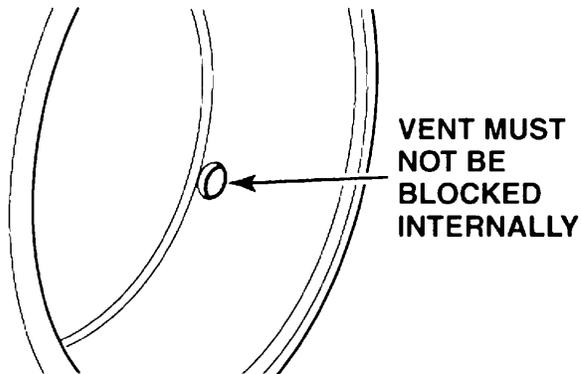
I.B.4. Check for Non-Current Parts

Inspect the entire clutch assembly and its mating pieces for incompatible parts, such as a mixture of current and non-current parts. Update to only current-production parts.

I.B.5. Range Shift Cylinder Problems

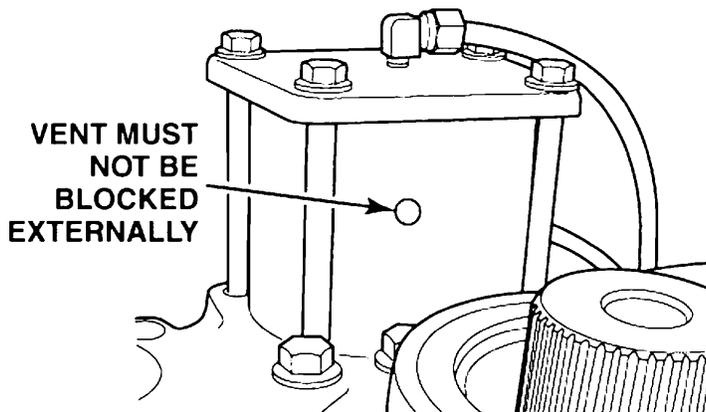
Disassemble the range shift air piston assembly. Check for any contamination in the system, O-rings that are cut, distorted, or worn, and pistons and cylinders that are scuffed, corroded, or scored. Repair or replace as needed.

Transmissions with the optional compound neutralizing feature should have the vent port free of debris both internally (Figure 10) and externally (Figure 11) to ensure that there is no blockage.



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Fig. 10 Range Shift Vent Port Internal



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Fig. 11 Range Shift Vent Port External

Note: The vent port only exists on the three-position range cylinder used for the optional compound neutralizing feature.

II. Determining the Cause of Clash During a Range Shift

Clash which occurs consistently during a shift to either high or low range is an indication that the synchronizer discs have been damaged. Torsional vibration caused by incorrect air suspension ride height is a primary cause of damaged synchronizers. Check and, if needed, correct the ride height using the appropriate gauge (see bulletin SB136012) before continuing with the checks below.

The following transmission components should also be inspected to eliminate other possible sources of this damage.

II.a. Blocked Static Shift

Verify that the range clutch is installed correctly. The letter "R" on the clutch and on the blocking pin ends should be installed toward the rear of the transmission.

II.B. Range Shift Not Interlocked

Using an incorrect shift procedure is the primary cause of the range shift not interlocking correctly. Another cause is a range shift that occurs without going through neutral first. A correct shift must go through neutral. This incorrect shift results in synchronizer disc damage. This can only occur when the range shift interlock system is not functioning correctly. Check for correct function of the interlock system with the following procedure.

II.B.1. Interlock Pin Height Check

Measure the height of the interlock pin with the transmission in neutral. This measured height should be between 0.350 and 0.430 inch (8.89 and 10.922 mm). If the height is not within this range, some of the shift cover parts need to be replaced. When the pin height is correct in neutral, check the projection with the transmission in any gear. The projection should be greater than 0.510 inch.

II.B.2. Missing Parts in Main Section Shift Cover

If the projection is less than 0.510 inch, check for missing parts in the shift rail interlock area, particularly the balls and pins.

II.B.3. Shift Rail Bore Wear

If all of the parts are correctly installed, check for excessive wear of the shift cover bores in which the shift rails slide. If the bore is worn to an extent that it cannot correctly position the rail, it may be the source of low interlock pin projection. In this case, the cover should be replaced to correct the interlock operation.

II.B.4. Excessive Range Shift Valve Wear

If the interlock pin projection is greater than 0.510 inch, check the range shift valve spool for excessive wear in the area that contacts the pin. Should wear appear excessive, the valve should be replaced. Range shift valve repair kits are no longer available. Also inspect the large interlock pin on the TM309 for excessive wear at the contact area.

II.C. Contaminated Friction Surfaces

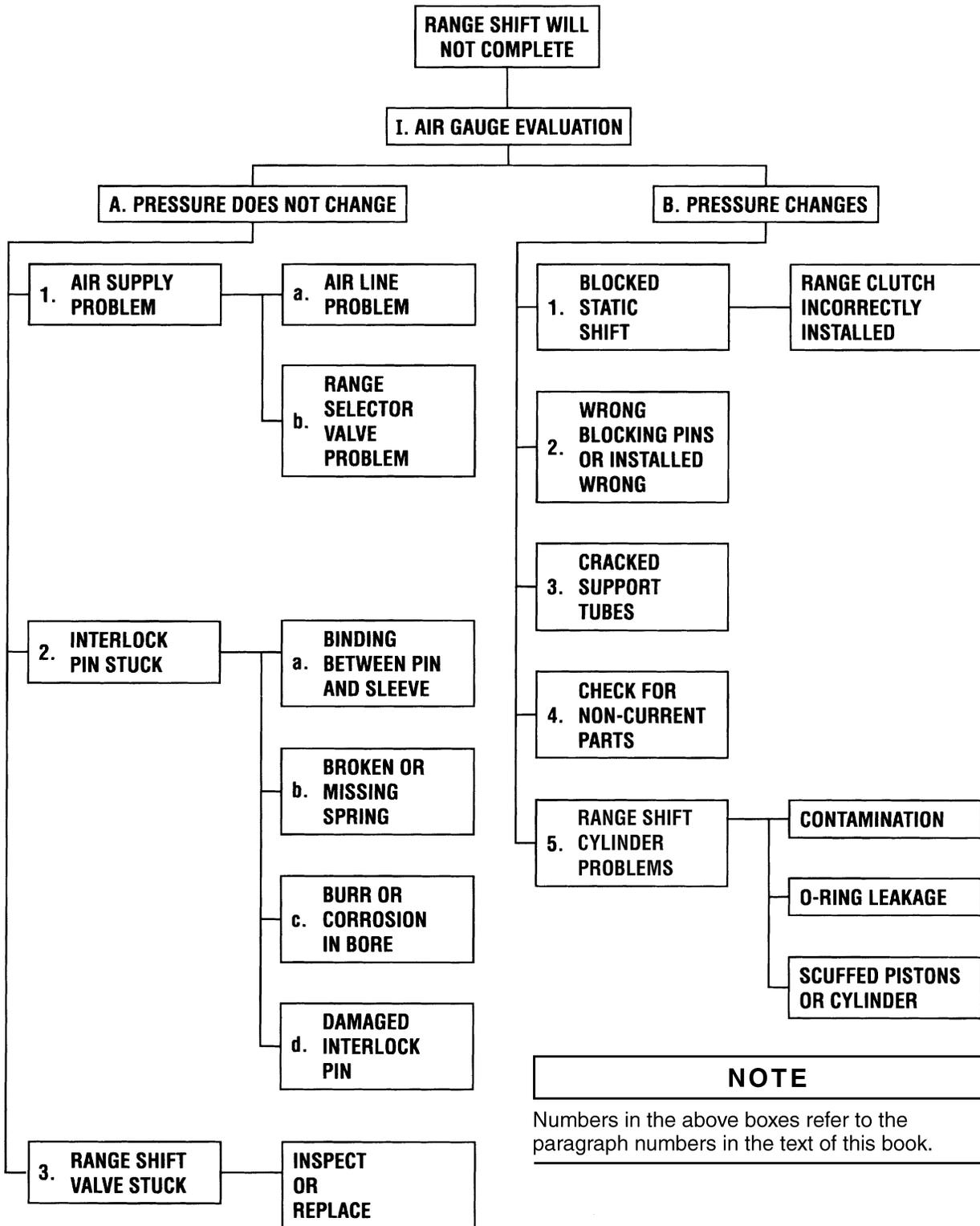
The friction discs may have lost their porous appearance or the grooves may appear to be filled with a build-up of material. This condition can occur due to operation of the transmission at a temperature which is too high for the lubricant used. If this condition exists, the discs should be replaced and the transmission operated only with lubricant which conforms to the most recent MACK gear oil specification. Refer to Maintenance and Lubrication Manual, TS494, for the latest MACK oil specification. Latest approved lubricants can also be found on-line at www.macktrucks.com.

Refer to Oil Cooler Manual, 10-101, for oil cooler-to-engine size and chassis weight requirements.

III. Missing Parts For Optional Compound Neutralizing

Compound case side-mounted PTOs should have been specified with the optional compound neutralizing feature. If the proper components do not exist, the range will not neutralize the vehicle and allow for stationary PTO operation. This feature requires a three-position range cylinder, a double check valve and a neutral switch. Refer to Service Bulletin, SB 324-011 for details. Also, all operators should understand the guidelines for compound side-mounted PTO operation with the optional compound neutralizing feature as specified in the Operator's Handbook and/or the Service Manuals.

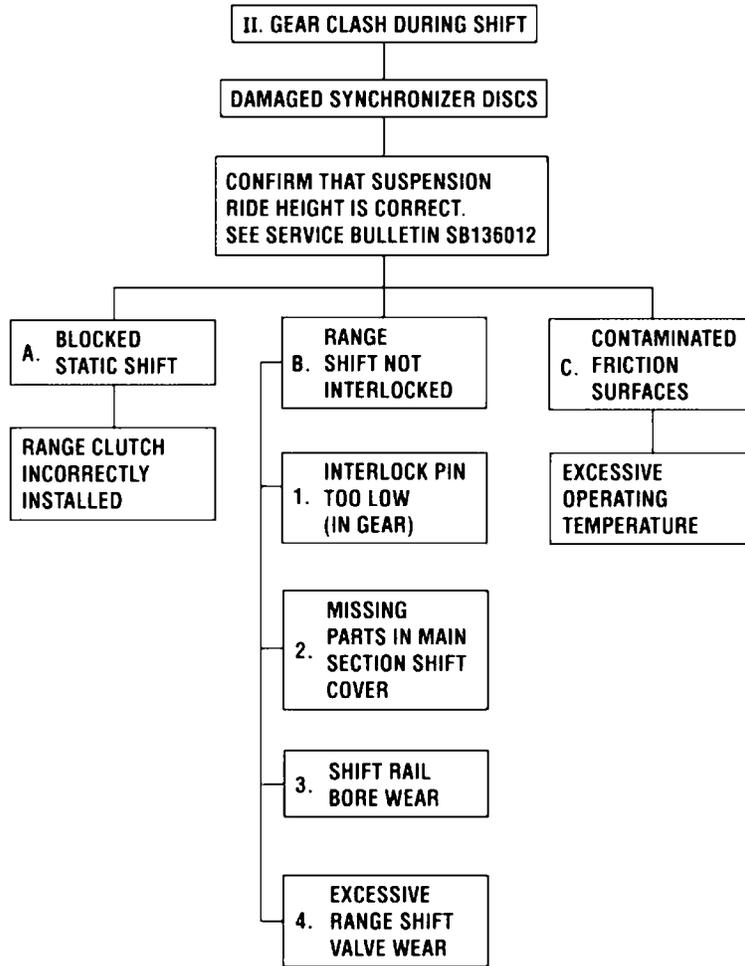
Range Shift Troubleshooting Summary Chart



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Fig. 12 Air Gauge Evaluation



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Fig. 13 Gear Clash During Shift



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