

# Transmission ZF S5-47 Troubleshooting Guide-Service Tips



ZF Industries

## DESCRIPTION AND OPERATION

### Description

The model number for the ZF transmission (7003) is S5-47. This model number can be divided into three parts. First, "S" designates a synchronized transmission. Second, "5" designates the number of forward gears. Finally, "47" is the approximate maximum input torque capacity in tens of lb-ft. In this case 47 equals 470 lb-ft. input torque capacity.

The S5-47 ZF transmission is available in both wide ratio and close ratio versions. The wide ratio version is available for all F-Series vehicles over 8500 lbs. GVW, all engines (6007), except F-Super Duty equipped with a diesel engine. The close ratio version is available only in F-Series vehicles with a 7.3L diesel engine and a GVW over 8500 lbs. The ratios are as follow:

	1st	2nd	3rd	4th	5th	Reverse
<b>Close Ratio (Diesel)</b>	<b>5.08</b>	<b>2.60</b>	<b>1.53</b>	<b>1.0</b>	<b>0.77</b>	<b>4.66</b>
<b>Wide Ratio (Gasoline / Diesel)</b>	<b>5.72</b>	<b>2.94</b>	<b>1.61</b>	<b>1.0</b>	<b>0.76</b>	<b>5.24</b>

The transmission features an aluminum case (7005) with an integral clutch housing. Because of the aluminum case, the tapered roller bearings of the transmission shafts must be fitted under preload. This is because heat expansion of the aluminum case is greater than that of the steel alloy mainshaft and countershaft cluster gear (7113). If the bearings were not pre-loaded, this would result in excessive end play when the case is warm, loaded operating conditions. The transmission also features shrink-fit gears on the countershaft cluster gear. Shrink-fit gears are connected to the countershaft cluster gear by friction only, rather than connected through splines. The gear is heated and lightly pressed onto the countershaft cluster gear. The subsequent cooling of the gear provides the shrink fitting. The countershaft cluster gear is serviced as an assembly.

NOTE: For vehicles equipped with the 7.3L diesel engine this transmission requires use of synthetic Motorcraft MERCON® ATF XT-2-QDX or MERCON® equivalent.

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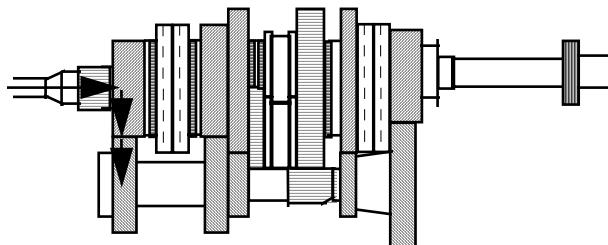


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### DESCRIPTION AND OPERATION

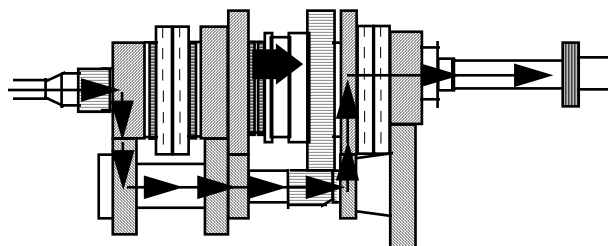
#### Powerflow

##### Powerflow in Neutral



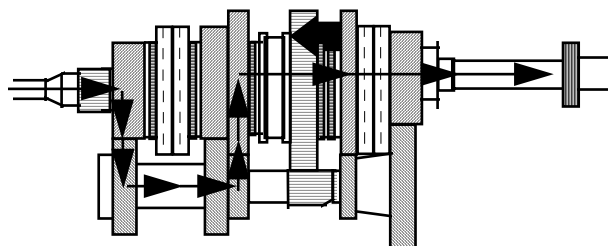
- The input gear drives the countershaft.
- The countershaft gears drive the 1st, 2nd and 3rd gears on the output shaft.
- All synchronizers are centered.
- No gears are engaged to the output shaft.
- The output shaft is not engaged to the input shaft.

##### Powerflow in 1st Gear



- The input gear drives the countershaft.
- The countershaft gears drive the 1st, 2nd and 3rd gears on the output shaft.
- The 1-2 synchronizer hub is splined to the output shaft.
- When the synchronizer sleeve is shifted rearward, the 1st gear is engaged to the output shaft through the synchronizer hub.
- The output shaft rotates once every 5.08 CR or 5.72 WR rotations of the crankshaft.

##### Powerflow 2nd Gear



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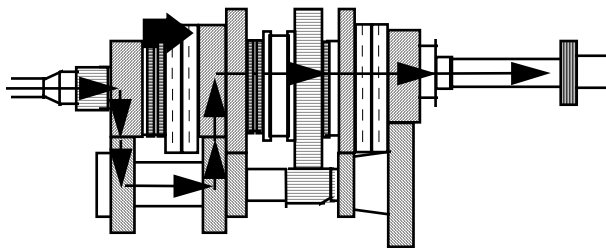
### DESCRIPTION AND OPERATION

#### Powerflow (Continued)

##### Powerflow 2nd Gear

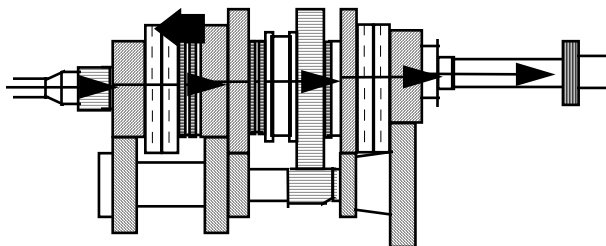
- The input gear drives the countershaft.
- The countershaft gears drive the 1st, 2nd and 3rd gears on the output shaft.
- The 1-2 synchronizer hub is splined to the output shaft.
- When the synchronizer sleeve is shifted forward, the 2nd gear is engaged to the output shaft through the synchronizer hub.
- The output shaft rotates once for every 2.60 CR or 2.94 WR rotations of the crankshaft.

##### Powerflow in 3rd Gear



- The input gear drives the countershaft.
- The countershaft gears drive the 1st, 2nd and 3rd gears on the output shaft.
- The 3-4 synchronizer hub is splined to the output shaft.
- When the synchronizer sleeve is shifted rearward, the 3rd gear is engaged to the output shaft through the synchronizer hub.
- The output shaft rotates once for every 1.53 CR or 1.61 WR rotations of the crankshaft.

##### Powerflow 4th Gear



- The input gear drives the countershaft.
- The countershaft gears drive the 1st, 2nd and 3rd gears on the output shaft.
- The 3-4 synchronizer hub is splined to the output shaft but no gears are engaged to the output shaft.
- When the synchronizer sleeve is shifted forward, the input shaft is locked to the output shaft through the synchronizer hub.
- The output shaft rotates once for every rotations of the crankshaft.

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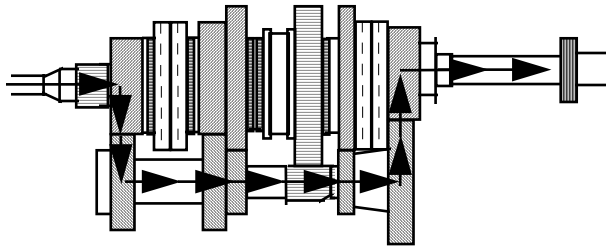


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### DESCRIPTION AND OPERATION

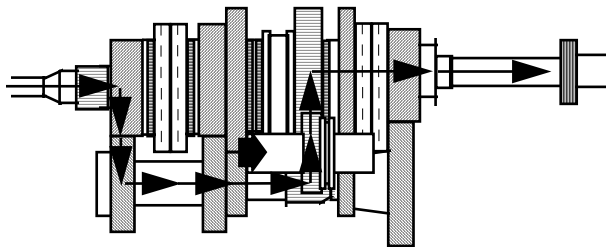
#### Powerflow (Continued)

#### Powerflow in 5th Gear



- The input gear drives the countershaft.
- The countershaft gears drive the 1st, 2nd and 3rd gears on the output shaft, and the 5th gear synchronizer.
- The 5th gear synchronizer is splined to the countershaft.
- When the synchronizer sleeve is shifted forward, the 5th gear is engaged to the countershaft.
- The countershaft 5th gear drives the output shaft 5th gear.
- The output shaft is driven in overdrive. Less than one 0.77 CR or 0.76 WR rotation of the crankshaft is needed to each rotation of the output shaft.

#### Powerflow in Reverse Gear



- The input gear drives the countershaft.
- The countershaft gears drive the reverse idler gear, after the idler is slid into engagement.
- The reverse idler gear drives the teeth cut along the outside of the 1-2 synchronizer sleeve (which is splined to the output shaft through the hub, which reverses the rotation of the output shaft drives it in reduction).

# Transmission ZF S5-47

## Troubleshooting Guide-Service Tips



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### DIAGNOSIS AND TESTING

#### Inspection and Verification

A troubleshooting guide has been put together to assist diagnosing transmission-related problems. Use the transmission noise evaluation procedure and troubleshooting guides on the following pages, or refer to Section 08-00 in the 1996 Ford Service Manual. Remember, it is important to get an accurate description of the complaint before any diagnosis can be performed. Ask questions as to whether it occurs hot or cold, during shifting, driving at a particular speed or in a particular gear. If possible, have the customer demonstrate the concern.

#### Cold Transmission

- Drive the vehicle in all gears (1-5 and reverse gears).
- Evaluate the noise in neutral. Check if there are any noise changes in a particular gear, i.e., 4th gear. In 4th gear the countershaft cluster gear (7113) is not under load.
- Check if the noise increases when the transmission (7003) is warming up.
- See if the noise is related to engine speed, road speed or gear selection.

#### Warm Transmission

- Check all gears plus reverse gear and make note of any noise changes in a particular gear.
- Check noise in neutral while parked. Check if the noise disappears at a certain engine rpm or with the clutch pedal depressed.
- Drive in the gear in which the noise is most noticeable. Press in the clutch pedal and leave the gear engaged. If the noise changes or disappears, the noise may be amplified by the vibration of the engine (6007).
- Drive under the same condition again. Press the clutch pedal in and shift into neutral. Release the clutch pedal while the vehicle is coasting down the road. Evaluate the noise, as the rear axle assembly (4006) turns the mainshaft.

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### DIAGNOSIS AND TESTING

#### ADDITIONAL TESTING FOR 4X4 TRUCKS (Non-Electronic Shift)

- Check for any noise change when shifting the transfer case (7A195) between 4X2, 4 high, 4 low or into neutral.
- With the vehicle at a complete stop and the transfer case in neutral, shift through all the gears and evaluate noise at different engine rpm. Check for any noises in neutral at different engine rpm.

#### NOTE:

To isolate clutch concerns from transmission concerns, operate the transmission at no-load. On 4X4 models, place the transfer case in neutral. Remove the driveshaft on 4X2 models. Run the engine at 3000 rpm and operate the transmission throughout ranges with the clutch engaged. If hard shifting concern (power to transmission) disappears, the concern may be in the clutch system. An improperly operating clutch can result in hard shifting that is most noticeable in 1st, 2nd and reverse. The hydraulic release mechanism must work properly. Continued operation with a defective clutch system may result in premature wear or damage of synchronizer (7124).

Hard shifting or difficulty engaging gears may be the result of improper clutch function. Check the release system travel. Minimum travel for the concentric slave cylinder bearing (4.9L and 5.8L engines) and the external system slave cylinder push rod (7.3L and 7.5L engines) is 11 mm (7/16 inch). If system travel is less than 11 mm, this is an indication of problems in the release system such as excessive flexing of the instrumental panel (04304), cracked instrumental panel reinforcement at the clutch master cylinder mounting and air or water in the hydraulic clutch hose. Refer to Section 08-00 in the 1996 Ford Service Manual.

If release system is greater than 11 mm (7/16 inch), and the clutch is suspected, check for clutch reserve as follows:

1. Set the parking brake control (2780) and put the transmission in neutral.
2. With the clutch pedal fully depressed, shift into reverse, then shift half-way between reverse and neutral to defeat the synchronizer.
3. Allow the clutch pedal to fully return and adjust the position of shift control selector lever and housing to obtain light contact between the gear teeth. A slight grind will occur.
4. Slowly depress the clutch pedal until grinding stops. Measure the clutch pedal travel from this position to the full down position (clutch reserve position).

This clutch reserve dimension should be at least 38 mm (1 1/2 inches). If the reserve is less than 38 mm (1 1/2 inches), and there are no hydraulic control system concerns, remove the transmission and check for excessive clutch wear. On the 7.3L diesel and 7.5L engines, check for contamination of clutch release hub and bearing and binding on the bearing retainer. Replace the clutch assembly or clutch release hub and bearing as required.

#### NOTE:

On the 5.8L vehicles, the case (7005) is ribbed in order to reduce gear and gear rollover noises.

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## DIAGNOSIS AND TESTING

### Symptom Chart

#### NOISE WHILE STOPPED—TRANSMISSION IN NEUTRAL

CONDITION	POSSIBLE SOURCE	ACTION
<ul style="list-style-type: none"> <li>Noise Present with Clutch Pedal Fully Depressed</li> </ul>	<ul style="list-style-type: none"> <li>Engine noise</li> <li>Clutch release hub and bearing failure.</li> <li>Pilot bearing failure.</li> <li>Misaligned transmission.</li> </ul>	<ul style="list-style-type: none"> <li>REFER to appropriate Service Manual section for these areas.</li> </ul>
<ul style="list-style-type: none"> <li>Noise Disappears When Engine Exceeds 1500 rpm Without Depressing Clutch Pedal</li> </ul>	<ul style="list-style-type: none"> <li>Neutral rollover is caused by the engine firing pulses transmitted through the gear set. Some neutral rollover is normal on the 7.5L application. The dual mass flywheel on the 7.3L diesel and the two stage clutch on the 4.9L and 5.8L should eliminate this concern on these engines.</li> </ul>	<ul style="list-style-type: none"> <li>CHECK engine idle quality and speed. A rough or low idle will aggravate this concern.</li> </ul>
<ul style="list-style-type: none"> <li>Noise Present at Engine Speeds Above Idle</li> </ul>	<ul style="list-style-type: none"> <li>Insufficient lubrication.</li> <li>Damaged tapered roller or caged needle roller bearing.</li> <li>Scuffed gear tooth contact surfaces.</li> </ul>	<ul style="list-style-type: none"> <li>DRAIN oil (when required) and FILL with the correct oil, conforming to Ford specification ESP-M2C-166H Type "H" or MERCON®.</li> <li>INSPECT for failure. Pay special attention to the mainshaft front bearing (pocket bearing), located between the Input Shaft and the mainshaft. TURN the gears on the mainshaft to check for failure of needle bearings by feeling for roughness.</li> <li>DISASSEMBLE transmission and check gear tooth contact surfaces. REPLACE gears as required.</li> </ul>

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## DIAGNOSIS AND TESTING

### Symptom Chart

#### NOISE WHILE STOPPED—TRANSMISSION IN NEUTRAL (Continued)

CONDITION	POSSIBLE SOURCE	ACTION
<ul style="list-style-type: none"> <li>Noise on PTO-Equipped Transmissions</li> </ul>	<ul style="list-style-type: none"> <li>Incorrect PTO gear mesh due to: Wrong model PTO, incorrect installation, defective PTO.</li> </ul>	<ul style="list-style-type: none"> <li>REMOVE the PTO and INSTALL a cover. EVALUATE for noise without PTO.</li> <li>CHECK the mating teeth on countershaft cluster gear and also on the gear of the Input shaft for damage. If any parts are damaged, REPLACE. CONTACT PTO supplier/manufacturer to VERIFY model usage, shimming and PTO quality.</li> </ul>

#### NOISE WHILE DRIVING

CONDITION	POSSIBLE SOURCE	ACTION
<ul style="list-style-type: none"> <li>Noise is Present in All or Several Gears. Noise Occurs at High and Low Speeds and May Vary with Engine Speed</li> </ul>	<ul style="list-style-type: none"> <li>Worn or rough output shaft rear bearing.</li> <li>Needle bearing under mainshaft gears damaged.</li> <li>Wrong preload on main or cluster shaft bearings.</li> <li>PTO installed incorrectly.</li> </ul>	<ul style="list-style-type: none"> <li>DISASSEMBLE transmission and INSTALL new output shaft rear bearing on mainshaft.</li> <li>REPLACE needle bearing and gear.</li> <li>DISASSEMBLE transmission and CORRECT preload.</li> <li>CHECK PTO installation.</li> </ul>
<ul style="list-style-type: none"> <li>Rattle Noise When Taking Off from a Stop and Driving at Less Than 1000 rpm</li> </ul>	<ul style="list-style-type: none"> <li>'Lugging Rattle.'</li> </ul>	<ul style="list-style-type: none"> <li>OPERATE truck without 'lugging.' Condition will not shorten the life of the transmission.</li> </ul>
<ul style="list-style-type: none"> <li>Clunking Noise When Shifting or Speeding Up or Slowing Down. Condition is Worse on Bumpy Surfaces</li> </ul>	<ul style="list-style-type: none"> <li>Freeplay in the system (clutch through axle and fuel injector shutoff timing). Some clunk is normal with the 4.9L and 5.8L.</li> <li>Loose yoke nut.</li> </ul>	<ul style="list-style-type: none"> <li>CHECK for excessive backlash of rear axle assembly. Clunk cannot be corrected by repairing transmission unless a defect is evident.</li> <li>INSTALL a new spiral lock nut. No staking required. TIGHTEN to 270 Nm (200 lb-ft).</li> </ul>



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## DIAGNOSIS AND TESTING

### Symptom Chart

#### NOISE WHILE DRIVING (Continued)

CONDITION	POSSIBLE SOURCE	ACTION
<ul style="list-style-type: none"> <li>Noise While Driving in One Gear Increases with Road Speed</li> </ul>	<ul style="list-style-type: none"> <li>Worn, imperfect or chipped gear teeth on the affected gear.</li> </ul>	<ul style="list-style-type: none"> <li>REPLACE affected mating gears.</li> </ul>
<ul style="list-style-type: none"> <li>Whining Noise at High Engine rpm in 3rd and 5th Gear</li> </ul>	<ul style="list-style-type: none"> <li>Worn input shaft gear and countershaft drive gear.</li> </ul>	<ul style="list-style-type: none"> <li>CHECK noise level in 4th gear under same engine conditions. If noise level is less, REPLACE the input shaft and countershaft cluster gear. INSPECT and REPLACE other gears as required.</li> </ul>
<ul style="list-style-type: none"> <li>Shift Lever Buzz Present While Driving, Not Present During a Neutral Engine Run Up While Parked</li> </ul>	<ul style="list-style-type: none"> <li>Upper shift control selector lever damaged or loose.</li> <li>Lower shift control selector defective.</li> </ul>	<ul style="list-style-type: none"> <li>CHANGE shift control selector lever. If buzz is still present, SEE in which gear the buzz occurs. DISASSEMBLE and INSPECT specific gear. CHECK guide pieces for clearance.</li> <li>REPLACE lower shift lever. Shift lever E9TZ-7210-G is less sensitive to vibration than earlier design.</li> </ul>
<ul style="list-style-type: none"> <li>Shift Lever Rattle in Neutral Engine Run Up, Primarily Diesel 4X4</li> </ul>	<ul style="list-style-type: none"> <li>Shift lever may not have plastic bushing at the pivot.</li> <li>Shift lever boot incorrectly installed.</li> </ul>	<ul style="list-style-type: none"> <li>CHECK by temporarily removing the shift lever boot. REPLACE if the noise is gone.</li> <li>Shift lever boot must make air-tight seal to shift lever. REPLACE shift lever boot if stretched or sealing surface is damaged.</li> </ul>

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## DIAGNOSIS AND TESTING

### Symptom Chart

#### NOISE WHILE DRIVING (Continued)

CONDITION	POSSIBLE SOURCE	ACTION
<ul style="list-style-type: none"> <li>Moan or Vibration on F-Super Duty at Road Speeds Greater Than 50 mph</li> </ul>	<ul style="list-style-type: none"> <li>Aftermarket modifications to frame or driveshaft.</li> </ul>	<ul style="list-style-type: none"> <li>INSPECT non-factory driveshafts for:                             <ul style="list-style-type: none"> <li>— 0 to 51 inches long - 3 inch diameter tube is OK.</li> <li>— Up to 55 inches long - 3 1/2 inch diameter tube is required.</li> <li>— Up to 59 inches long - 4 inch diameter tube is required.</li> <li>— Working angles greater than 1/2 degree but less than 3 degrees.</li> <li>— System balanced to within 0.4 in/oz. at the ends and 0.8 in/oz. at the driveshaft center bearing bracket.</li> </ul> </li> </ul>
<ul style="list-style-type: none"> <li>Hard Shift (Particularly 1st, 2nd and Reverse)</li> </ul>	<ul style="list-style-type: none"> <li>Clutch not releasing completely.</li> <li>Operator not fully depressing clutch pedal.</li> <li>Flexing of instrumental panel.</li> <li>Hydraulic clutch hose routed too close to exhaust manifold.</li> <li>Air/water in hydraulic clutch hose.</li> <li>Insufficient reserve of synchronizer (a defective clutch system can result in premature loss of synchronizer reserve).</li> </ul>	<ul style="list-style-type: none"> <li>REFER to Section 08-00 in the 1996 Ford Service Manual.</li> <li>INTERVIEW operator.</li> <li>REPAIR instrumental panel.</li> <li>MOVE or SHIELD hydraulic clutch hose.</li> <li>BLEED clutch system.</li> <li>REPLACE complete synchronizer and corresponding gear, if required.</li> </ul>

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## DIAGNOSIS AND TESTING

### Symptom Chart

#### SHIFT CONCERNS

CONDITION	POSSIBLE SOURCE	ACTION
<ul style="list-style-type: none"> <li>Notchy Shifting</li> </ul>	<ul style="list-style-type: none"> <li>Some notchiness is normal (especially in 3rd gear).</li> </ul>	<ul style="list-style-type: none"> <li>For excessive notchiness, REPLACE with revised synchronizers: 1/2 F6TZ-7124-B 3/4 F6TZ-7124-C 5/R F6TZ-7124-A</li> </ul>
<ul style="list-style-type: none"> <li>Grinding Noise During Shifting</li> </ul>	<ul style="list-style-type: none"> <li>Synchronizer cone too smooth (after a few thousand miles).</li> <li>Synchronizer ring defective.</li> <li>Insufficient wear limit of synchronizer ring.</li> </ul>	<ul style="list-style-type: none"> <li>MAKE 3 to 5 hard shifts with high engine rpm. If noise is still present, DISASSEMBLE and CHECK for damage (darkened patches OK). REFER to Synchronizers in the Cleaning and Inspection portion of the 1996 Ford Service Manual.</li> <li>CHANGE synchronizer.</li> <li>CHANGE synchronizer.</li> </ul>
<ul style="list-style-type: none"> <li>Walking or Jumping Out on Rough Roads</li> </ul>	<ul style="list-style-type: none"> <li>Interference or resistance in the mechanism preventing full engagement of the sliding collar.</li> <li>If sliding collar has been shifted completely into position, some other malfunction could move sliding collar and shift lever out of its proper location.</li> </ul>	<ul style="list-style-type: none"> <li>REMOVE and DISASSEMBLE transmission and CHECK profile of internal grooves in the sliding sleeve.</li> <li>CHECK for shift lever interference. The stub lever, gear shift finger or shift forks could be worn. REMOVE transmission and REPLACE damaged parts.</li> </ul>
<ul style="list-style-type: none"> <li>Note Whether the Unit Walks Out of Gear Under Drive or on a Coast Load. Also, Whether the 'Walkout' Occurs on Smooth or Only on Rough Roads. A Number of Items that Would Prevent Full Engagement of Gears Are:</li> </ul>	<ul style="list-style-type: none"> <li>Worn or loose engine mounts.</li> <li>Shift fork pads or groove in sliding collar worn excessively.</li> <li>Transmission and engine out of alignment either vertically or horizontally.</li> </ul>	<ul style="list-style-type: none"> <li>CHECK engine mounts.</li> <li>REMOVE and DISASSEMBLE transmission and REPLACE damaged parts.</li> <li>VERIFY transmission is tightly bolted to the engine.</li> </ul>

# Transmission ZF S5-47 Troubleshooting Guide-Service Tips



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## DIAGNOSIS AND TESTING

### Symptom Chart

#### SHIFT CONCERNS (Continued)

CONDITION	POSSIBLE SOURCE	ACTION
<ul style="list-style-type: none"> <li>Walk or Jump Out on Rough Roads</li> </ul>	<ul style="list-style-type: none"> <li>Use of heavy shift lever extensions.</li> <li>Shifter Interlock springs broken or missing.</li> <li>Detent spring plug not pressed in properly.</li> <li>No preload in drive gear, mainshaft or countershaft cluster gear, caused by worn bearings.</li> <li>Grated selector teeth.</li> </ul>	<ul style="list-style-type: none"> <li>USE original equipment shift lever. INSTALL heavy duty shift rail detent springs (E8TZ-7E218-A).</li> <li>REMOVE detent spring plug on detent and REPLACE shifter interlock springs.</li> <li>REPLACE with new detent spring plug and PRESS in 1 mm (3/64 inch).</li> <li>REMOVE and DISASSEMBLE transmission and REPLACE defective bearings (necessary to reset bearing preload).</li> <li>CHANGE synchronizer and gear.</li> </ul>
<ul style="list-style-type: none"> <li>Excessive Shift Lever Movement in 3rd Gear</li> </ul>	<ul style="list-style-type: none"> <li>3-4 synchronizer body snap ring not seated in groove on output and fifth gear driveshaft.</li> </ul>	<ul style="list-style-type: none"> <li>DISASSEMBLE and REPLACE affected parts, paying special attention to 3-4 synchronizer, input gear, input shaft pocket bearing and shift fork.</li> </ul>
<ul style="list-style-type: none"> <li>Gear Cannot Be Engaged</li> </ul>	<ul style="list-style-type: none"> <li>Clutch not releasing (see hard shift).</li> <li>Gear selector interlock sleeve jammed in transmission.</li> <li>Damage to teeth or sliding collar or improper installation (dog teeth worn).</li> <li>Jammed pressure pieces in synchronizer.</li> <li>Shift rails out of proper position.</li> </ul>	<ul style="list-style-type: none"> <li>CHECK clutch per procedure in Section 08-00 in the 1996 Ford Service Manual.</li> <li>If bent or damaged, REPLACE the gear selector interlock sleeve.</li> <li>REPLACE or CORRECT synchronizer. CHECK for damage on the corresponding mainshaft gear in clutch teeth area. REPLACE as required.</li> <li>REMOVE and DISASSEMBLE transmission and REPLACE pressure pieces.</li> <li>REPLACE all shift rails, detent and gear selector interlock sleeve.</li> </ul>

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## DIAGNOSIS AND TESTING

### Symptom Chart

#### SHIFT CONCERNS (Continued)

CONDITION	POSSIBLE SOURCE	ACTION
<ul style="list-style-type: none"> <li>Sticking in Gear</li> </ul>	<ul style="list-style-type: none"> <li>Clutch not releasing (see hard shift above).</li> <li>Gear selector interlock sleeve jammed in transmission.</li> <li>Sliding collar tight on splines (dog teeth damaged).</li> </ul>	<ul style="list-style-type: none"> <li>CHECK clutch per procedure in Section 08-00 in the 1996 Ford Service Manual.</li> <li>If bent or damaged. REPLACE the gear selector interlock sleeve.</li> <li>REMOVE and DISASSEMBLE transmission.</li> </ul>
<ul style="list-style-type: none"> <li>Stuck in Gear</li> </ul>	<ul style="list-style-type: none"> <li>Shift rails out of proper position.</li> </ul>	<ul style="list-style-type: none"> <li>REPLACE all shift rails, detents and gear selector interlock sleeve.</li> </ul>
<ul style="list-style-type: none"> <li>High Shift Efforts</li> </ul>	<ul style="list-style-type: none"> <li>Lack of lubricant or wrong lubricant used, causing build-up of sticky and sludgy deposits on splines of sliding collar.</li> <li>Case bushing rough, or dragging.</li> </ul>	<ul style="list-style-type: none"> <li>INSPECT through the PTO openings. If sludge is present, REMOVE and CLEAN the transmission.</li> <li>PLACE transmission in 4th gear and ROTATE the mainshaft by hand while the clutch is depressed. If a roughness is felt, REMOVE the case bushing, INSPECT and REPLACE the bearing and input shaft, if required (input bearing preload must be RESET if input shaft is replaced).</li> </ul>

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## DIAGNOSIS AND TESTING

### Symptom Chart

#### SHIFT CONCERNS (Continued)

CONDITION	POSSIBLE SOURCE	ACTION
<ul style="list-style-type: none"> <li>High Shift Efforts (Continued)</li> </ul>	<ul style="list-style-type: none"> <li>Clutch not releasing (see hard shift above).</li> </ul>	<ul style="list-style-type: none"> <li>INSTALL a new input shaft and input pocket bearing (necessary to reset bearing preload).</li> </ul>
<ul style="list-style-type: none"> <li>High Shift Effort in One Gear Only</li> </ul>	<ul style="list-style-type: none"> <li>Sliding sleeve tight on splines.</li> <li>Synchronizer teeth chipped or badly mutilated.</li> <li>Binding or interference of shift lever with other object or rods inside the cab.</li> <li>Mainshaft gears seized or galled on either the thrust face or diameters.</li> <li>Synchronizer (wear limit too low, fractures).</li> <li>Synchronizer cone smoothness.</li> </ul>	<ul style="list-style-type: none"> <li>REMOVE transmission and REPLACE affected synchronizer.</li> <li>REMOVE and DISASSEMBLE transmission and REPLACE damaged parts.</li> <li>CHECK shift operation in cab.</li> <li>REMOVE and DISASSEMBLE transmission, REPLACE synchronizer and other affected parts.</li> <li>REMOVE and DISASSEMBLE transmission, REPLACE synchronizer and other affected parts.</li> <li>MAKE 3 to 5 hard shifts with high engine rpm.</li> </ul>
<ul style="list-style-type: none"> <li>High Shift Efforts in Cold Weather, All Gears</li> </ul>	<ul style="list-style-type: none"> <li>Incorrect, high-viscosity fluid.</li> </ul>	<ul style="list-style-type: none"> <li>INSTALL Type H or MERCON® fluid. ROAD TEST the vehicle to IDENTIFY possible damage caused by the wrong fluid. Synthetic Motorcraft MERCON® ATF XT-2QDX or MERCON® equivalent will improve cold weather shiftability.</li> </ul>

# Transmission ZF S5-47 Troubleshooting Guide-Service Tips



ZF Industries

## DIAGNOSIS AND TESTING

### Symptom Chart

#### LEAK CONCERNS

CONDITION	POSSIBLE SOURCE	ACTION
<ul style="list-style-type: none"> <li>Leak at Case Cover</li> </ul>	<ul style="list-style-type: none"> <li>Reused or damaged case cover gasket.</li> </ul>	<ul style="list-style-type: none"> <li>REPLACE with new case cover gasket. Anaerobic Sealant E3AZ-19554-AA meeting Ford specification WSK-M2GA9 can be used with the new gasket.</li> </ul>
<ul style="list-style-type: none"> <li>Leak at Case Plug</li> </ul>	<ul style="list-style-type: none"> <li>Sealing ring missing from case plugs (transmissions with an E9TA prefix or later have sealing surface machined on the housing).</li> <li>Transmissions with an F4TA prefix have a sealing ring on the plug with rubber centering feature for improved sealing.</li> </ul>	<ul style="list-style-type: none"> <li>INSTALL a new sealing ring.</li> <li>INSTALL a new sealing ring.</li> </ul>
<ul style="list-style-type: none"> <li>Leak at Transfer Case Cover</li> </ul>	<ul style="list-style-type: none"> <li>Bolts loose or damaged transmission case deflector gasket.</li> </ul>	<ul style="list-style-type: none"> <li>REPLACE transmission case deflector gasket. TIGHTEN bolts to 38 Nm (28 lb-ft).</li> </ul>
<ul style="list-style-type: none"> <li>Leak at Detent Spring Plug</li> </ul>	<ul style="list-style-type: none"> <li>Reused or damaged detent spring plugs.</li> </ul>	<ul style="list-style-type: none"> <li>USE new detent spring plugs when reassembling. Do not DEFORM case around detent spring plug to retain.</li> </ul>
<ul style="list-style-type: none"> <li>Leak at Large Welch Plug Inside Flywheel Housing. Look for Cracks Around the Hole.</li> </ul>	<ul style="list-style-type: none"> <li>Improper assembly</li> </ul>	<ul style="list-style-type: none"> <li>RESEAL using Gasket Maker E2AZ-19562-B or equivalent meeting Ford specification WSK-M2G348-A5. If cracked, REPLACE flywheel housing.</li> </ul>
<ul style="list-style-type: none"> <li>Leak at Input Shaft Bearing Oil Passage Plug (Inside Flywheel Housing with 7.5L and 7.3L Engine and on Left Hand Side with 4.9L and 5.8L Engine)</li> </ul>	<ul style="list-style-type: none"> <li>Improper assembly</li> </ul>	<ul style="list-style-type: none"> <li>RESEAL using Gasket Maker E2AZ-19562-B or equivalent meeting Ford specification WSK-M2G348-A5. If cracked, REPLACE flywheel housing.</li> </ul>
<ul style="list-style-type: none"> <li>Leak at Output Shaft Oil Seal</li> </ul>	<ul style="list-style-type: none"> <li>Output yoke nut loose or improperly staked (4X2, except F-Super Duty).</li> </ul>	<ul style="list-style-type: none"> <li>REPLACE seal using new lock nut. TIGHTEN to 270 Nm (200 lb-ft).</li> </ul> <p><b>Caution: Do not re-use locknut.</b></p>

# Transmission ZF S5-47 Troubleshooting Guide-Service Tips



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## DIAGNOSIS AND TESTING

### Symptom Chart

#### LEAK CONCERNS (Continued)

CONDITION	POSSIBLE SOURCE	ACTION
<ul style="list-style-type: none"> <li>Leak at Input Oil Seal</li> </ul>	<ul style="list-style-type: none"> <li>Improper assembly. Seal lip may have rolled during assembly, garter spring may have become dislodged during a previous repair.</li> </ul>	<ul style="list-style-type: none"> <li>REPLACE front pump support seal, using extreme caution that input shaft does not contact the oil seal during reassembly (if the seal lip is rolled, leaking may not occur for several hundred miles).</li> </ul>
<ul style="list-style-type: none"> <li>Leak Between Quill Pipe and Flywheel Housing (7.3L and 7.5L Engines Only)</li> </ul>	<ul style="list-style-type: none"> <li>Damaged O-ring during assembly.</li> </ul>	<ul style="list-style-type: none"> <li>REMOVE quill pipe, INSPECT sealing surfaces and REPLACE O-ring. LUBRICATE O-ring prior to assembly to PREVENT damage.</li> </ul>
<ul style="list-style-type: none"> <li>Leak at Case Joint</li> </ul>	<ul style="list-style-type: none"> <li>Damaged mating surfaces or assembly error.</li> </ul>	<ul style="list-style-type: none"> <li>REPAIR or REPLACE damaged case. RESEAL with Gasket Maker E2AZ-19562-B or equivalent meeting Ford specification WSK-M2G348-A5. TIGHTEN bolt to 23 Nm (17 lb-ft).</li> </ul>



# Transmission ZF S5-47 Troubleshooting Guide-Service Tips



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## DIAGNOSIS AND TESTING

### Symptom Chart

#### MISCELLANEOUS CONCERNS

CONDITION	POSSIBLE SOURCE	ACTION
<ul style="list-style-type: none"> <li>Cracked Flywheel Housing</li> </ul>	<ul style="list-style-type: none"> <li>Drivetrain vibration caused by assembly error.</li> <li>Vehicle modification (drive shaft lengthened or shortened).</li> </ul>	<ul style="list-style-type: none"> <li>CHECK the integrity of driveshaft attachment.</li> <li>Non-factory should be inspected for:                             <ul style="list-style-type: none"> <li>— 0 to 51 inches long - 3 inch diameter tube is OK.</li> <li>— Up to 55 inches long - 3 1/2 inch diameter tube is required.</li> <li>— Up to 59 inches long - 4 inch diameter tube is required.</li> <li>— Working angles greater than 1/2 degree but less than 3 degrees.</li> <li>— System balanced at 3000 rpm to within 0.4 in/oz. at the ends and 0.8 in/oz. at the center support.</li> </ul> </li> </ul>
<ul style="list-style-type: none"> <li>Cracked Rear Engine Mount Transmission Attachment Ears</li> </ul>	<ul style="list-style-type: none"> <li>Broken front engine mounts.</li> <li>Vibration caused by a driveline imbalance.</li> <li>Rear mount upper flange not flat.</li> </ul>	<ul style="list-style-type: none"> <li>INSPECT and REPLACE front engine mounts if required.</li> <li>SEE above.</li> <li>REPLACE rear mount.</li> </ul>

# Transmission ZF S5-47 Troubleshooting Guide-Service Tips



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## DIAGNOSIS AND TESTING

### Symptom Chart

#### BEARING FAILURE

CONDITION	POSSIBLE SOURCE	ACTION
<ul style="list-style-type: none"> <li>NOTE: The service life of most transmissions is governed by the life of the bearings. The majority of bearing failures can be related to driveline vibration or contamination of the fluid. Additional reasons for bearing failures are:</li> </ul>	<ul style="list-style-type: none"> <li>Extended start-up idle in extreme cold may lead to wear of input shaft pocket bearing.</li> <li>Any combination of operation at or above GVW in high ambient temperatures, on steep grades, or vehicles with high frontal areas (exceeding 60 square feet) can affect all bearings due to temperature buildup.</li> <li>Input shaft pocket bearing not lubricated due to missing, damaged or misinstalled front bearing oil scoop ring.</li> <li>Damage due to towing a vehicle greater than 80 km (50 miles) or at speeds exceeding 56 km/h (35 mph) with the driveshaft installed. Third gear bearings are especially susceptible to damage.</li> <li>Vibration break-up of retainer and brinelling of races-fretting corrosion.</li> <li>Incorrect preload causes faster wearing of the bearings, due to incomplete contact area.</li> <li>Lack of lubricant or wrong type.</li> <li>Acid etch of bearing due to water in lube.</li> <li>Worn out due to other part failure.</li> </ul>	<ul style="list-style-type: none"> <li>Synthetic Motorcraft MERCON® ATF XT-2-QDX or MERCON® equivalent provides improved lubrication when transmission temperatures remain below -29° C (20° F) for extended periods. Synthetic MERCON® is required in vehicles equipped with 7.3L diesel engine.</li> <li>Heat buildup may cause break down of the ATF. Synthetic MERCON® can withstand higher operating temperatures.</li> <li>REPLACE damaged components and VERIFY proper installation of front bearing oil scoop ring. CHECK for proper installation of the snap ring, which retains the 3-4 synchronizer, on the mainshaft next to the front bearing oil scoop ring.</li> <li>Provide correct towing procedures to tow operator.</li> <li>REFER to restrictions of mainshaft in the Miscellaneous Concerns portion of this symptom chart.</li> <li>Be sure to FOLLOW the appropriate bearing preload setting procedure in the Adjustments portion of the 1996 Ford Service Manual.</li> <li>CHECK for leaks and REPAIR as required. REPLACE with correct fluid.</li> <li>IDENTIFY and CORRECT source of water entry.</li> <li>REMOVE, DISASSEMBLE and CLEAN the transmission, then REPLACE damaged parts (necessary to reset bearing preload if any bearings are replaced).</li> </ul>

## REMOVAL

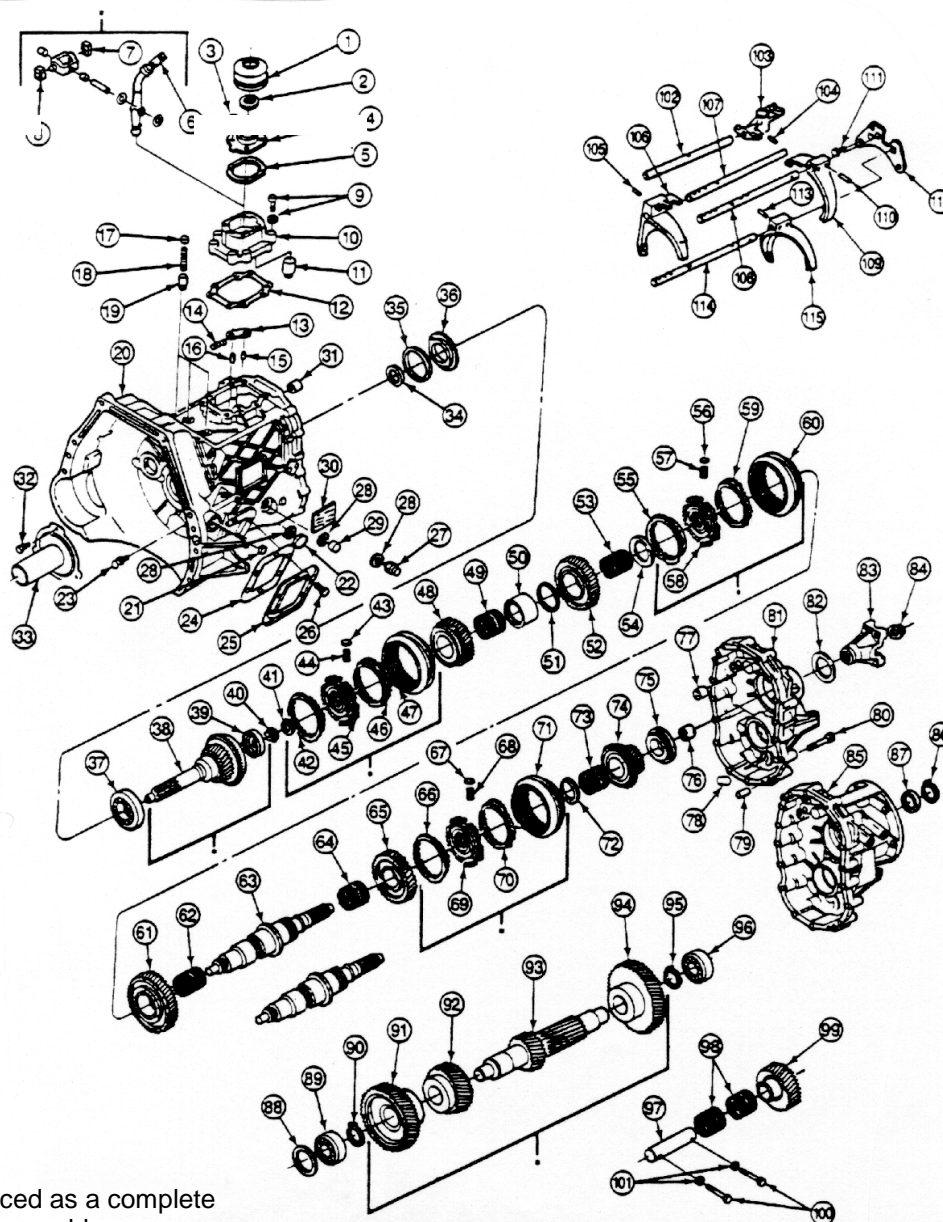
# Transmission ZF S5-47 Troubleshooting Guide-Service Tips



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## TRANSMISSION (4X2)

Model ZF S5-47, Disassembled View



\* Serviced as a complete sub assembly

# Transmission ZF S5-47

## Troubleshooting Guide-Service Tips



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### REMOVAL

Item	Part Number	Description
1	7E138	Gearshift Lever Boot
2	7D152	Snap Ring
3	N603264	Capscrew
4	7262	Gearshift Lever Boot Retainer
5	7207	Gasket
6	7210	Shift Lever
7	7C371	Guide Piece
8	7C371	Guide Piece
9	7C015	Hex Bolts and Washers
10	7203	Shift Lever Housing
11	7E218	Shift Detent Plunger Assy
12	7185	Gasket
13	7F194	5th-Reverse Interlock
14	7234	Shifter Interlock Spring
15	7B096	Interlock Roll Pin
16	7B096	Interlock Roll Pin
17	7L013	Detent Spring Plug
18	7N120	Spring
19	7247	Shift Rail Detent Plunger
20	7005	Case
21	7L018	Case Plug
22	7A010	Case Plug
23	7B602	Clutch Release Lever Stud
24	7166	Transmission Case PTO Gasket
25	7165	PTO Cover
26	304650	Bolt
27	15520	Backup Lamp Switch
28	7L101	Sealing Ring
29	7A010	Case Plug
30	—	ID Plate (Part of 7003)
31	7D362	Central Shift Rail Bearing
32	7A443	Bolt (3)
33	7050	Main Drive Gear Bearing Retainer
34	7052	Oil Seal
35	7029	Input Bearing Front Shim
36	7040	Oil Baffle

Item	Part Number	Description
37	7025	Case Bearing
38	7017	Input Shaft
39	7046	Front Bearing Oil Scoop Ring
40	7120	Input Shaft Pocket Ring
41	7B331	Small Parts Repair Kit
42	—	Gear Synchronizer Ring (Part of 7124)
43	7124	Pressure Piece
44	—	Spring (Part of 7B331)
45	—	3rd-4th Synchronizer Body (Part of 7124)
46	—	3rd Gear Synchronizer Ring (Part of 7124)
47	—	3rd-4th Sliding Sleeve (Part of 7124)
48	7186	3rd Gear
49	7133	Caged Needle Roller Bearing
50	7173	3rd Speed Bearing Spacer
51	7114	Thrust Washer
52	7103	2nd Gear
53	7133	3rd Speed Gear Bearing
54	7B331	Small Parts repair Kit
55	7124	2nd Gear Synchronizer Ring
56	7124	Pressure Piece
57	7124	Spring
58	7124	1st-2nd Synchronizer Body
59	7124	1st Gear Synchronizer Ring
60	7124	1st-2nd Sliding Sleeve
61	7100	1st Gear
62	7127	Gear Bearing
63	7061	Mainshaft
64	7127	Reverse Gear Bearing
65	7142	Reverse Gear
66	7124	Reverse Gear Synchronizer Ring
67	7124	Pressure Piece
68	7124	Spring
69	7124	5th-Reverse Synchronizer Body
70	7124	5th-Gear Synchronizer Ring

# Transmission ZF S5-47 Troubleshooting Guide-Service Tips



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## REMOVAL

Item	Part Number	Description
71	7124	5th-Reverse Sliding Sleeve
72	7B331	Small Parts Repair Kit
73	7121	5th Gear Bearing
74	7158	5th Gear
75	7R205	Output Shaft Rear Bearing
76	7072	Spacer
77	7D362	Central Shift Rail Bearing
78	7E290	Magnet
79	—	Dowel (Part of 7003)
80	7A443	Bolt
81	7A039	Extension Housing (4X2)
82	7052	Oil Seal
83	7089	Output Yoke (4X2)
84	7045	Output Yoke Locknut (4X2)
85	7A039	Extension Housing (4X4)
86	7B331	Small Parts Repair Kit
87	7052	Oil Seal
88	7119	Thrust Washer
89	7065	Output Shaft Bearing
90	7064	Output Shaft Snap Ring
91	7113	Countershaft Drive Gear
92	7113	Countershaft 3rd Gear
93	7113	Countershaft Cluster Gear
94	7113	Countershaft 5th Gear
95	7064	Output Shaft Snap Ring
96	7065	Output Shaft Bearing
97	7140	Reverse Idler Gear Shaft
98	7E139	Reverse Idler Gear Bearing
99	7141	Reverse Idler Gear
100	7214	Reverse Idler Gear Shaft Bolt
101	7K267	Sealing Ring
102	7240	Main Shaft Rail
103	7243	Shift Finger
104	7B096	Roll Pin
105	7B096	Roll Pin
106	7230	3-4 Shifter Fork
107	7241	3-4 Reverse Shift Rail
108	7242	5-Rev Shift Rail
109	7231	5-Rev Shift Fork

Item	Part Number	Description
110	7B096	Roll Pin
111	7A443	Bolt (3)
112	7K201	Gear Selector Interlock Plate
113	7B096	Roll Pin
114	7358	1-2 Shift Rail
115	7239	1-2 Shift Fork