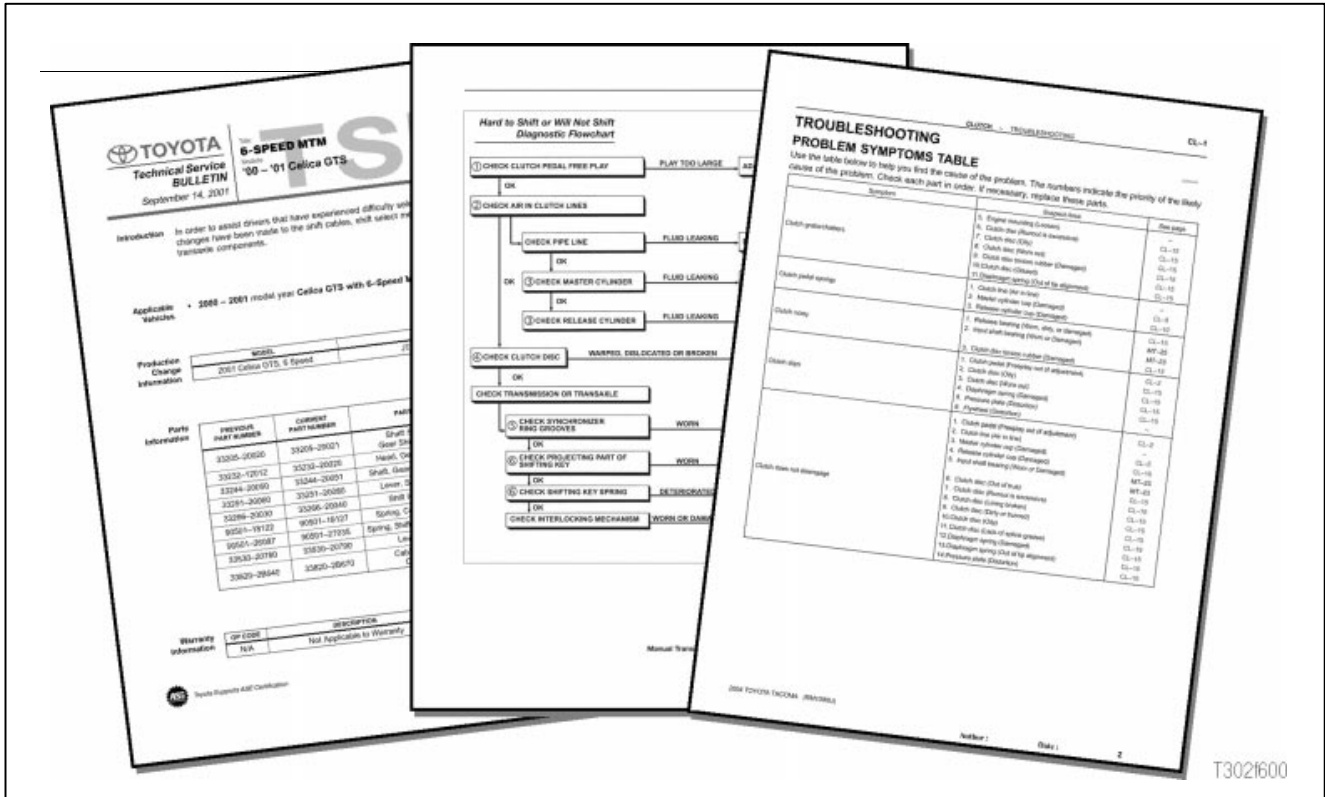


# Section 6

## Diagnostic Procedures



- Learning Objectives:**
1. Describe manual transmission, transaxle and transfer case component inspection and diagnostic procedures
  2. Identify clutch component inspection procedures:
    - a. Flywheel runout
    - b. Minimum thickness
    - c. Hotspots
  3. Measure transmission components for wear, runout and preload:
    - a. Synchronizers
    - b. Gear end play
  4. Describe manual transmission, transaxle, transfer case and clutch assembly and disassembly procedures
  5. Describe synchronizer measurement procedures

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# Diagnostic Procedures

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**Introduction** Proper diagnosis is the key to repairing the customer's vehicle the *first time*. By applying the basic knowledge of all the components that make up the manual transmission system, diagnosis can become an easy and rewarding part of automotive repair. The technician who can effectively diagnose and correct a problem will instill customer confidence in his ability and reflects positively on the dealership. A positive service experience helps to ensure the likelihood that the customer will return to your dealer for subsequent service needs.

Diagnosis verifies the customer complaint and identifies the symptoms that pinpoint the cause *before* the transmission is removed from the vehicle. Once the unit is removed, time spent in diagnosis will pay off by focusing your inspection on specific components and systems.

During diagnosis, observe other potential problems to ensure the customer is aware of any additional service needs. This awareness reduces the likelihood the customer will have to return later or that they might feel the repair was not done properly the first time.

Experienced technicians are able to determine the cause and select appropriate repairs using specific tests and diagnostic procedures. Visual inspections reveal potential causes for further testing. Listening for noises can give clues, performing shift tests and test drives help identify customer concerns and verify the repair.

Toyota technicians utilize a six-step diagnostic procedure to verify and resolve customer concerns.

## Six-Step Diagnostic Procedure

To perform a complete diagnostic check, these six steps should be followed:

1. Verify the customer complaint
2. Identify the symptoms
3. Isolate the cause
4. List recommended repairs and possible related repairs
5. Repair the cause
6. Verify proper operation

|                               |   |
|-------------------------------|---|
| Verify the Customer Complaint | Verifying the customer complaint is the single most important step in diagnosis. Check to see that all the information you need to begin is on the work order. If more information is needed, contact the service writer or customer to clarify the complaint and acquire the needed information to begin the diagnostic procedure. If you are unable to verify the customer complaint, it may be necessary to test-drive the vehicle with the customer or the service writer. It is impossible to repair a complaint that cannot be verified or is a normal characteristic of a specific vehicle.  |
| Identify the Symptoms         | <p>During the test drive and inspection of the vehicle, identify the symptoms. Flow charts are provided to deal with specific problem areas. They provide a logical sequence to follow in completing this step and the following step— isolate the cause.</p> <p>Note any abnormal operating conditions that may cause related or future problems for the customer. This not only helps to create a good professional image but also eliminates the chance of the customer coming back with a similar problem and believing the problem was not repaired the first time.</p>  |
| Isolate the Cause             | Check to see what components and/or parts are causing the main complaint. Determine what it will take to make the proper repairs. Look for any related components that could cause a similar complaint or future complaints. For example, a slipping clutch complaint may be caused by an oil soaked clutch disc. The oil leak must be repaired to eliminate the same problem occurring again.  |
| List Recommended Repairs      | Following the inspection and test drive, you should have all the information you need to discuss the complaint and repairs with the service writer. Be sure to bring up any related repairs you feel may cause similar or future problems. If the customer does not want to do all the repairs at this time, note them on the work order for future reference.  |
| Repair                        | <p>The technician can now proceed with the necessary repairs. The repair may be as simple as a clutch adjustment or hydraulic component replacement and bleeding, or may require transmission removal and disassembly. Whatever the repair, consult the Toyota Information System (TIS) to access:</p> <ul style="list-style-type: none"> <li>• <b>Repair Manuals</b> for procedures, specifications and adjustments.</li> <li>• <b>Technical Service Bulletins (TSBs)</b> for providing the most current repair information on a component.</li> <li>• <b>Special Service Tools (SSTs)</b> for performing the repair manual procedures correctly.</li> </ul> |

**Verify Operation** When repairs are completed, the technician should verify that the complaint has been corrected. This is accomplished by test driving the vehicle and verifying the operation of the component that has been repaired.

**Common Tests** To aid in the diagnostic process, there are some common tests used to pinpoint the cause of clutch, transmission and transaxle complaints:

- Visual Check
- Engine Off Shift Test
- Engine Running Shift Test
- Road Test

**Visual Check** During a visual check, look under the hood and under the vehicle for abnormal conditions.

Under hood checks:

- Clutch master cylinder fluid level and mechanical linkage
- Broken engine motor mounts
- Transaxle/transmission and bell housing bolt tightness

Under vehicle checks:

- Damage to transaxle/transmission case, mounts and support
- Worn, bent, or loose shift linkage
- Loose or missing transaxle/transmission or clutch housing mounting bolts
- Fluid leaks from the clutch master cylinder, release cylinder or transaxle/transmission
- Half shaft condition: bent or torn boots

**NOTE** When diagnosing fluid leaks, remember that gravity pulls fluid downward and wind under the vehicle pushes the fluid rearward. To locate the source of the leak, look forward and above the location of the fluid drips.

**Engine Off Shift Test** The engine off shift test measures the effort it takes to move the synchronizer sleeve or gear, fork, and shift rail past the neutral detent and into mesh with the gear detent position.

The amount of force required to move the shift lever may vary between models. To determine an abnormal condition, compare the gear shift effort on a similar transaxle/transmission. When performing this test, be sure to listen for any unusual noises.

To perform this test:

- Disengage the clutch by depressing the clutch pedal.
- Shift the transmission/transaxle into gear and then shift back to neutral.
- Shift back to the originally selected gear. Note the amount of effort required.
- Repeat the check on all remaining gears. Note any shift requiring increased effort.

**Engine Running Shift Test** A similar test to the engine-off test is the engine running shift test. This test also checks for clutch drag.

To perform this shift test:

- Set the parking brake and start the engine.
- Idle the engine in neutral. Note any unusual noises.
- Disengage the clutch and shift into first gear. Note the amount of effort required to complete the shift and compare it to the engine-off test. Note any unusual noises. If the effort required to complete the shift is higher than the engine off shift test, it could indicate a clutch that is not fully disengaged. Release the parking brake, engage the clutch to move the vehicle slightly and check for any unusual noises or movement.
- Repeat this process for each gear position.

**Road Test** Once an initial check and visual inspection have been performed, and the customer's concern has not been identified, perform a road test. During the road test, check the shifts between gears, and listen for any unusual noises during acceleration and deceleration in each gear. Normal operation should be compared to that of a similar vehicle.

**NOTE**

During a road test, an output bearing noise can be isolated from other noises by disengaging the clutch, shifting to neutral and coasting. The only thing turning will be the output shaft in the transmission; or or in a transaxle, the differential, final drive gear, and output shaft.

A typical road test procedure includes:

- Check the transmission oil level.
- Warm up the transmission before the road test.
- With the vehicle stationary in neutral, and the engine idling:
  - Disengage the clutch
  - Engage the clutch and listen for noise, depress the pedal again noting any noises.
  - Repeat the steps above and wait three seconds, shift into reverse, first gear, and back to reverse. Wait twenty seconds and repeat this procedure. Note any differences in noise, shifting ability, pedal movement, and position at which the clutch engages.
  - Shift into reverse, release the pedal, and back up the vehicle while increasing engine speed to 2,500 rpm. Note any noises. Remember that reverse gear is a spur cut gear and will be noisier than forward gears.

**CAUTION**

When road testing a vehicle, particularly in reverse, be sure to exercise extreme caution. Be aware of vehicles, traffic and pedestrians in the area.

Drive the vehicle on the road:

- Start in first gear, accelerate, and upshift at 4,000 rpm through all the gears. Note shift quality and any noises.
- Decelerate using engine braking. Downshift in each gear and note any noises.
- On the highway, drive in fourth gear at 60 mph, accelerate and shift into fifth gear. Note any problems.

**NOTE**

During a shift, the synchronizer ring cuts through the lubricant and contacts the speed gear cone. If the lubricant is too thick or the synchronizer rings are worn, hard shifts will occur.

**NOTE**

Downshifts are normally harder to make than upshifts, since the synchronizer must speed up the gears during a downshift, requiring additional effort.

**Common  
Transmission/  
Transaxle  
Problems**

Some common problems and specific concerns with transmissions and transaxles include:

- **Oil leakage** – fluid escaping from the transaxle/transmission
- **Hard to shift** – a high force required to shift into gear
- **Will not shift** – can not shift into one or more gears
- **Locked into gear** – will not shift out of a gear
- **Jumps out of gear** – Pops out of gear into neutral during acceleration/deceleration
- **Gear clash/grinding during shift** – grinding noise and vibration while shifting
- **Noisy in neutral** – a grinding or growling noise
- **Noisy in one gear** – a grinding or growling bearing or gear noise in one gear
- **Noisy in all gears** – a grinding or growling bearing or gear noise in all gears

Experienced technicians encounter many of these problems, and utilize appropriate test and diagnostic procedures to identify and resolve the problem quickly and efficiently.

**Symptom Diagnosis Chart** Technicians often consult diagnosis charts to help determine the possible cause of a transaxle/transmission fault. Toyota repair manuals provide trouble shooting symptom tables to deal with clutch, transmission and transaxle problem areas. These charts provide possible causes for each symptom.

**Symptom Diagnosis Chart**

| Symptom                   | Possible Cause  |
|---------------------------|---|
| <b>Oil Leakage</b>        | <ul style="list-style-type: none"> <li>• Oil level too high</li> <li>• Wrong lubricant</li> <li>• Faulty seal</li> <li>• Faulty gasket sealant</li> </ul>   |
| <b>Hard To Shift</b>      | <ul style="list-style-type: none"> <li>• Dragging clutch</li> <li>• Faulty control cable (FF)</li> <li>• Faulty synchronizer assembly</li> <li>• Damaged shift rail, detent, or interlock</li> <li>• Improper lubricant</li> </ul>  |
| <b>Will Not Shift</b>     | <ul style="list-style-type: none"> <li>• Damaged shift linkage</li> <li>• Damaged synchronizer</li> <li>• Restricted travel of shift fork</li> </ul>  |
| <b>Locked Into Gear</b>   | <ul style="list-style-type: none"> <li>• Damaged shift linkage</li> <li>• Damaged synchronizer</li> <li>• Worn or damaged internal shift linkage</li> </ul>   |
| <b>Jumps Out of Gear</b>  | <ul style="list-style-type: none"> <li>• Worn or damaged shift linkage</li> <li>• Interference with shift linkage movement</li> <li>• Broken or loose engine/transmission mounts</li> <li>• Worn pilot or input shaft bearing</li> <li>• Worn shift fork</li> <li>• Worn synchronizer</li> <li>• Worn spline teeth gears</li> </ul> |
| <b>Clash During Shift</b> | <ul style="list-style-type: none"> <li>• Clutch drag</li> <li>• Worn or damaged shift fork</li> <li>• Worn synchronizer ring</li> </ul>   |
| <b>Noisy in Neutral</b>   | <ul style="list-style-type: none"> <li>• Low oil level</li> <li>• Worn or damaged input shaft bearings</li> <li>• Worn countershaft bearings</li> </ul>   |
| <b>Noisy in One Gear</b>  | <ul style="list-style-type: none"> <li>• Damaged teeth on that gear set</li> </ul>  |
| <b>Noisy in All Gears</b> | <ul style="list-style-type: none"> <li>• Low oil level</li> <li>• Contact between transmission and vehicle body or exhaust</li> <li>• Loose mounting bolts</li> <li>• Worn or damaged gear teeth</li> </ul>   |

Fig. 6-1

## Diagnostic Flowcharts

The following conditions represent some common transmission and transaxle concerns. Each concern is supported by inspection procedures for related components.

### Hard to Shift or Will Not Shift

A Diagnostic Flowchart helps determine the specific cause of a problem by eliminating possible causes. For a hard to shift or will not shift complaint, there are six steps to determine if a common problem is to blame (Each step below is also represented in the flowchart in figure 6-2):

1. If the pedal play is too large, the clutch cannot disengage when the pedal is fully depressed. For vehicles equipped with adjustable release cylinders, the play of the pedal and release fork is checked separately.
2. Depress the clutch pedal several times. If the lever can be shifted smoothly, air may be mixed in the pipeline.
3. Fluid leakage at the release and/or master cylinder dust boots can be caused by damage or wear to the piston cup or cylinder bore.
4. Shifting may be sluggish or impossible as a result of problems in the clutch assembly or transmission/transaxle. If the clutch functions normally, then the transmission or transaxle is the next component to be inspected.
5. The synchronizer ring is an essential part of the synchromesh mechanism. Narrow grooves are provided on the inner surface of the synchronizer ring. The grooves help to increase the applied pressure on the conical surface of the gear and cut the oil film to increase the friction force needed for smooth synchronization. When the synchronizer ring grooves become worn, the ring and gear tend to slip and hard shifting results. To check the synchronizer ring, push it against the conical surface of the gear and check the clearance. As the ring grooves wear, the clearance decreases.
6. The synchronizer key is made with a raised portion in the middle. The hub sleeve is in contact with the raised portion. More force can be applied to the synchronizer ring to hold the gear. When the raised portion of the key wears, less force is applied to the synchronizer ring and hard shifting can occur.

### Hard to Shift or Will Not Shift Diagnostic Flowchart

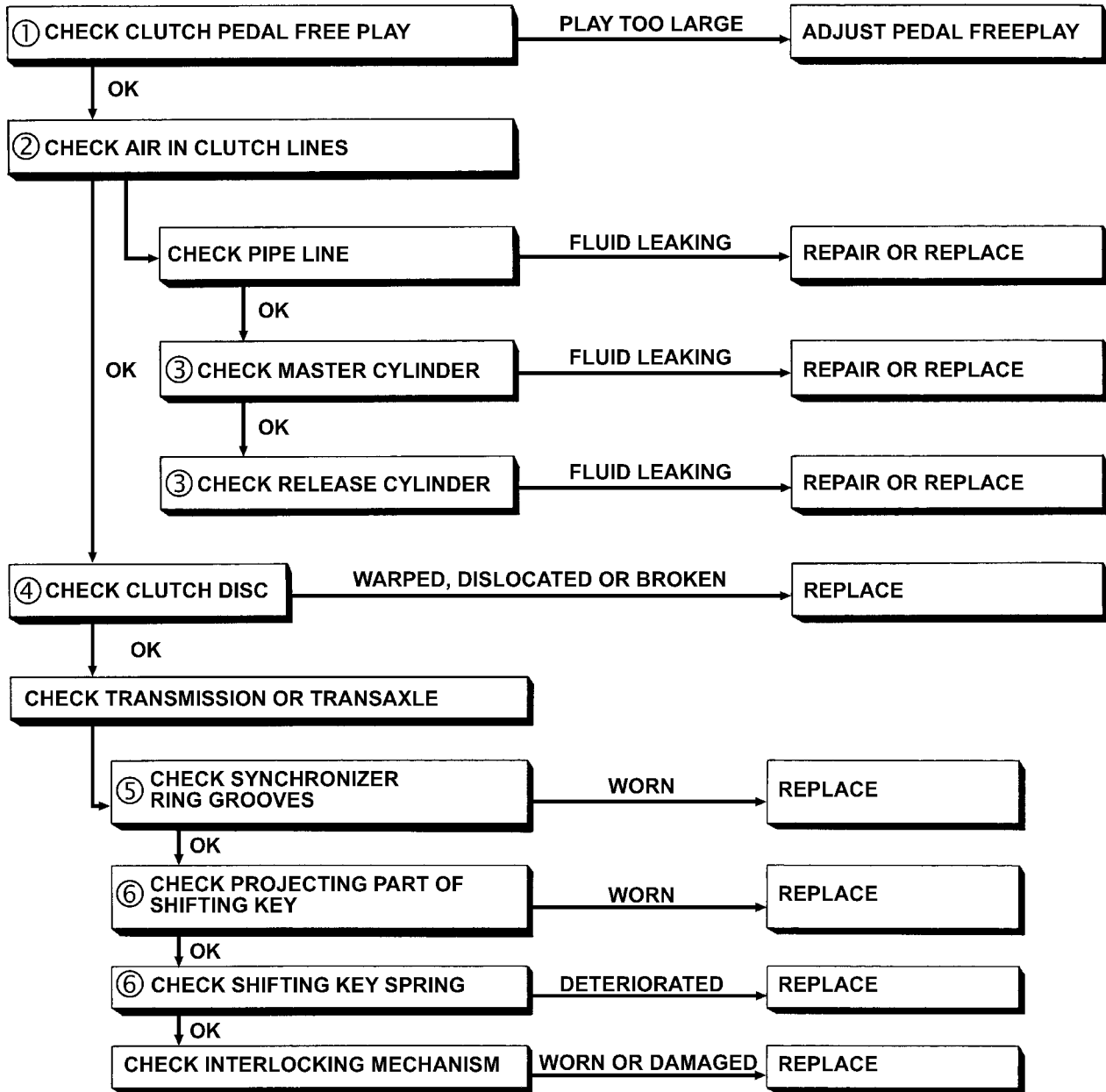
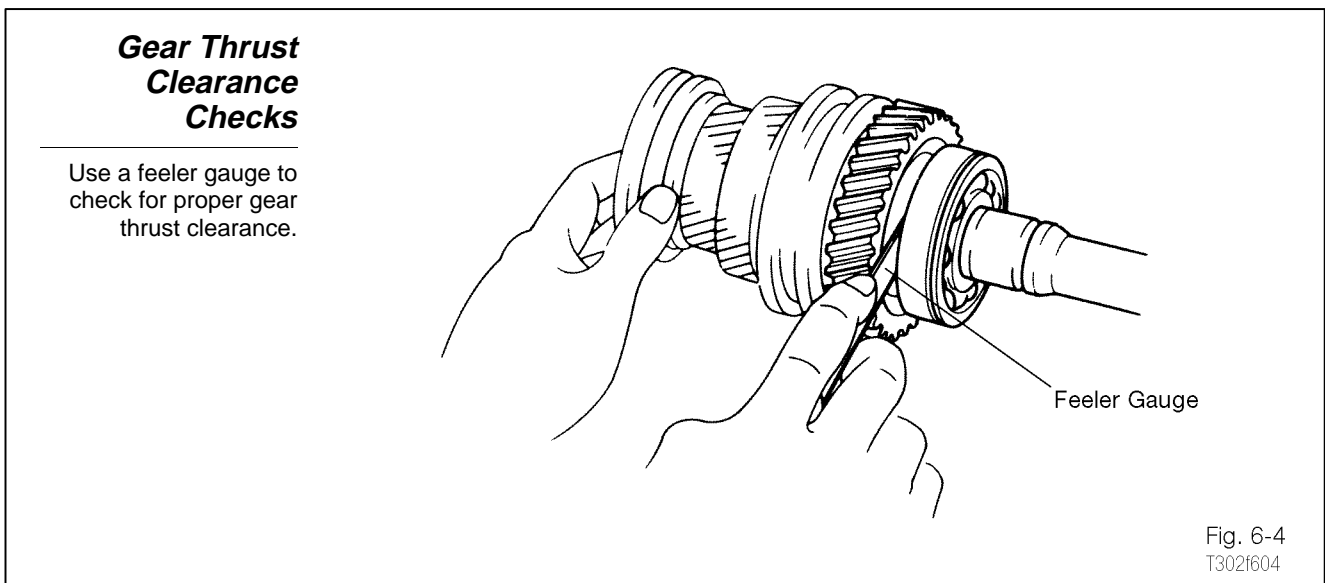
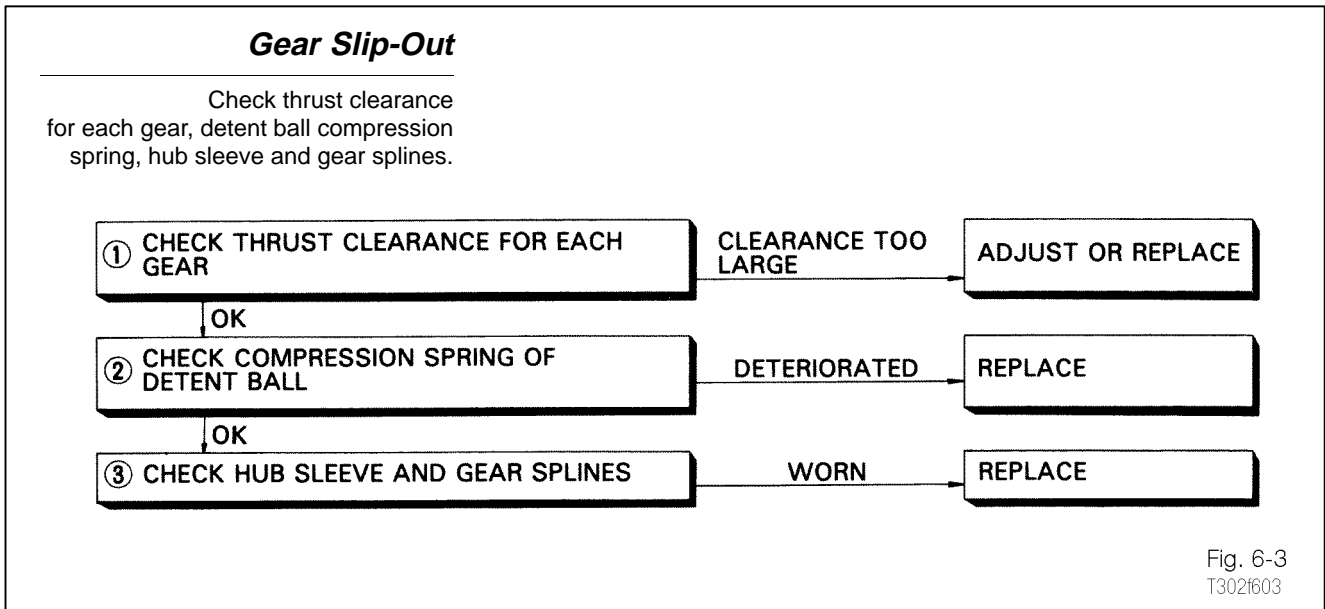


Fig. 6-2  
T3021602

**Gear Slip-Out** When the thrust clearance for a gear becomes too large, the hub sleeve may not engage the gear splines completely. If the gear is not totally engaged, gear slip-out will occur.

**Gear Thrust clearance** Check thrust clearance for each gear, detent ball compression spring, hub sleeve and gear splines. Use a feeler gauge to check for proper gear thrust clearance.



**Shift Fork Component Wear** Positive shift feedback in shifting is created by the detent ball being pushed into the slots on the shift fork by a spring. Wear to these parts can aid in allowing gear slip out as the shift fork does not fully engage the spline teeth of the speed gear and hub sleeve.

**Shift Fork Component Wear**

Wear to these parts can aid in allowing gear slip out as the shift fork does not fully engage the spline teeth of the speed gear and hub sleeve.

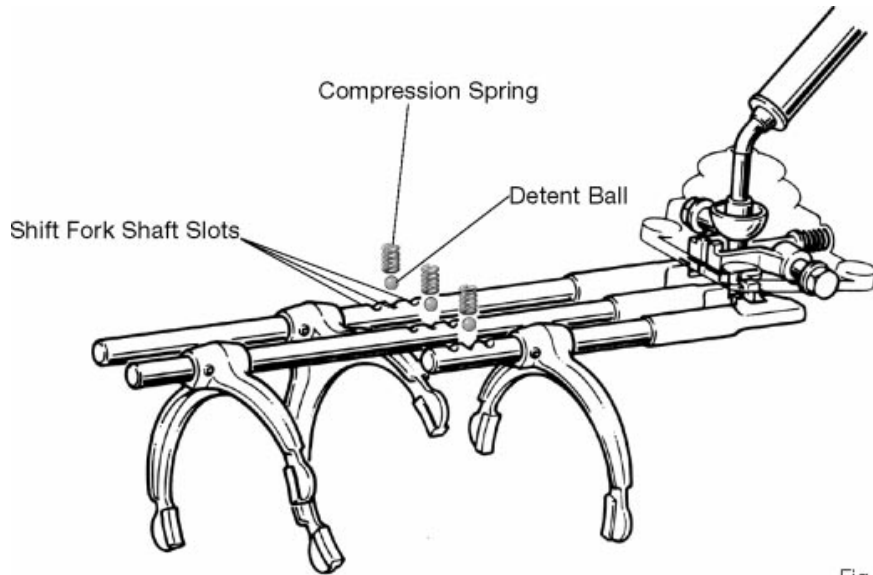


Fig. 6-5  
T3021605

**Worn Gear Splines** Tapered chamfers are provided where the hub sleeve and gear splines engage to prevent the gear from slipping out. When the parts are rotating, the gear and hub sleeve splines are forced together to create a positive engagement. Gear slip-out can occur when the splines become worn.

**Worn Gear Splines**

Gear slip out can occur when the splines become worn.

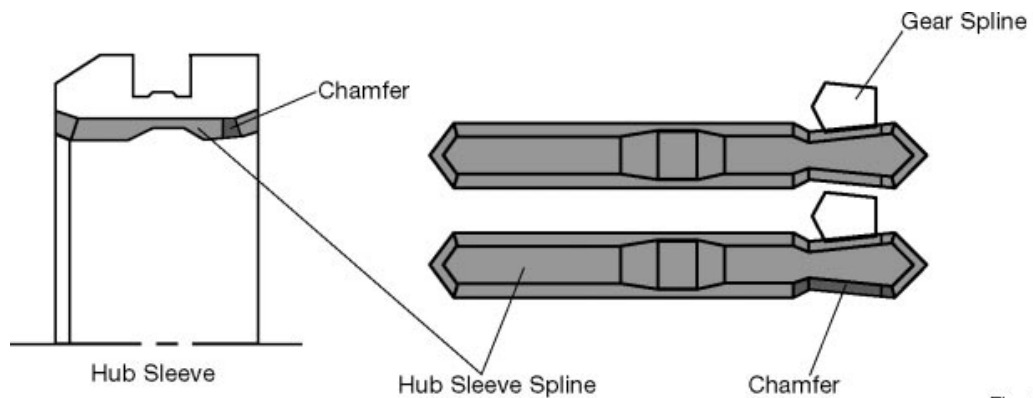


Fig. 6-6  
T3021606



**Notes**

A large grid area for taking notes, occupying most of the page.