CHAPTER 5

CLUTCH SERVICE

OBJECTIVES

After studying Chapter 5, the reader should be able to:

1. Perform the maintenance operations needed to keep a clutch operating properly.
2. Diagnose the cause of common clutch problems and recommend the proper repair method.
3. Remove and replace a clutch assembly.
4. Inspect used clutch components to determine if they are usable.
5. Complete the ASE tasks for clutch diagnosis and repair (see Appendix A).

KEY TERMS

Axial runout (p. 101)
Bench bleed (p. 118)
Blanchard grinding (p. 100)
Bleed (p. 116)
Bore runout (p. 107)
Chatter (p. 102)
Clutch pedal free travel (p. 87)
Clutch slippage (p. 89)
Clutch spin down (p. 89)
Disc alignment (p. 111)
Disc runout (p. 105)
Drag (p. 89)
Face runout (p. 101)
Grab (p. 110)
Gravity bleeding (p. 116)
Radial runout (p. 102)

INTRODUCTION

Most automotive technicians perform three different levels of clutch service.

1. **Preventive maintenance:** check pedal free travel and fluid levels and make the necessary adjustments to ensure proper operation.
2. **Troubleshooting and diagnosis:** determine the cause of a clutch concern and make recommendation for repair.
3. **Repair or overhaul:** repair the clutch to get the vehicle back in proper operation.

This chapter, as well as the following service chapters, will be arranged in this order: description of the maintenance and adjustment operations, the troubleshooting procedures, and the normal repair procedures in this service field.

CLUTCH SERVICE

Typical service for a clutch includes checking **clutch pedal free travel**, or *free play,* inspecting mechanical linkage systems and checking the fluid level in hydraulic systems. These operations are normally performed along with the other routine service checks.

Too much free travel might cause the clutch to not release completely, and too little free travel might cause the clutch to not engage completely. The second case is much more common because clutch pedal free travel will decrease as the clutch disc facing wears. There is no free travel on some self-adjusting or hydraulic clutches used on many vehicles. When diagnosing a clutch or transmission concern, the first step is always a clutch pedal free travel check.

Clutch Pedal Free Travel

To check and adjust clutch pedal free travel:

1. Push the clutch pedal downward by hand. As the pedal moves, you should feel a light resistance from the clutch pedal return spring. After a short period of travel, you should feel a much greater resistance as the release bearing contacts the release levers of the pressure plate assembly. The first portion is free travel (Figure 5-1). Some manufacturers recommend checking and measuring free travel at the clutch fork or lever. In this case, push on the end of the fork in the direction of release, and again, you should feel some resistance for a short distance, which is the free travel.
2. Measure the amount of free travel using a ruler or tape measure. Compare the distance measured with the specifications (Figure 5-2). Free travel that is more or less than the specifications indicates the need for a clutch adjustment. It should be noted that some manufacturers recommend measuring free travel with the engine running. If no

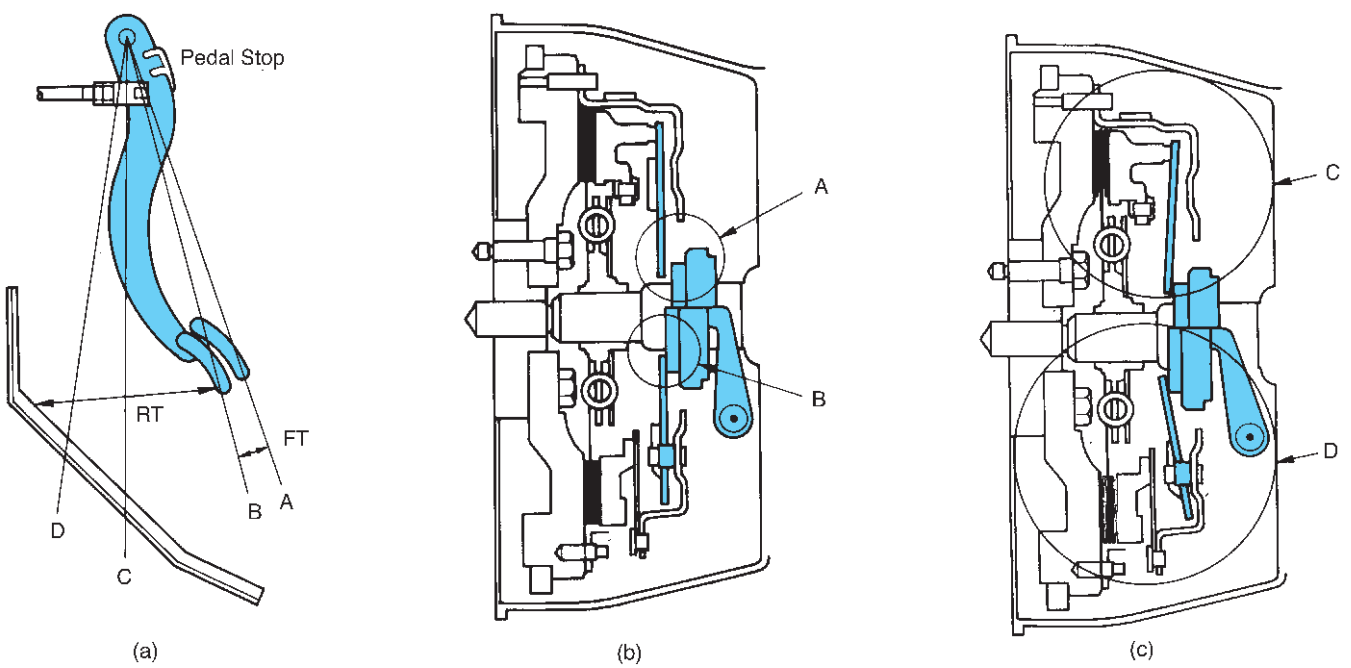


FIGURE 5-1 As the clutch pedal is depressed (a), it will move through its free travel as the release bearing moves to contact the release levers (b). The pressure plate then moves away from the flywheel, allowing the marcel of the disc to expand (c). When the pedal reaches the floor, there should be an air gap at both sides of the disc (d).

specifications are available, many technicians will use 3/4 to 1 in. (20 to 25 mm) at the clutch pedal and 1/8 to 1/4 in. (3 to 6 mm) at the clutch fork as a rule of thumb.

TECH TIP

Hook the end of a tape measure onto the pedal or the sole of your shoe, and run it through the steering wheel. Note the reading at the steering wheel as you move the pedal through its travel.

REAL WORLD FIX

A 1994 Saab 900 (90,000 miles) had a clutch problem so the clutch assembly and cable were replaced. The clutch now begins engaging with the pedal about 1" off the floor, way too soon. The technician cannot find any adjustment or parts that indicate that the linkage is self-adjusting.

Following advice, the technician moved the fuse box aside, and found the adjustment spring. Pulling the spring forward allowed the cable to readjust and fixed this problem.

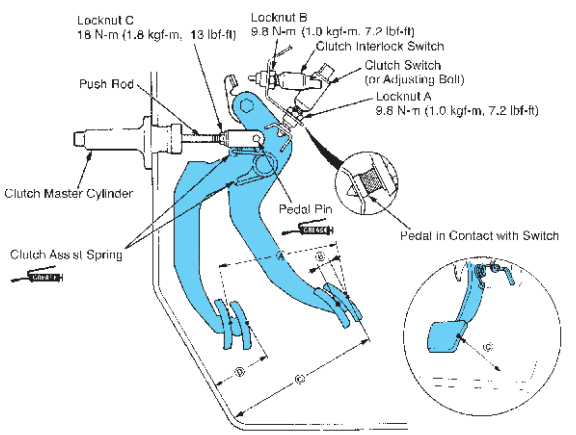
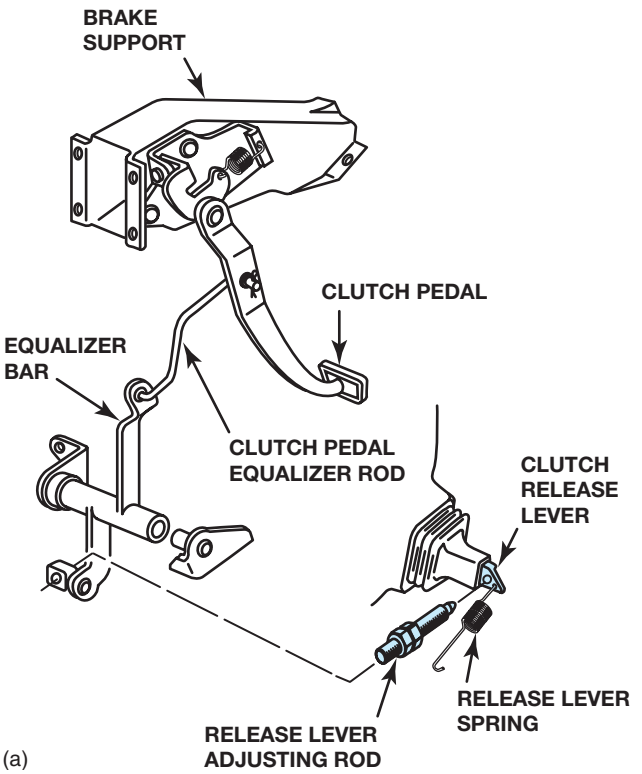


FIGURE 5-2 Clutch pedal travel is measured at the pedal, and the distances are specified by the vehicle manufacturer. *(Courtesy of American Honda Motor Company)*

3. If an adjustment is necessary, locate the adjuster and shorten the linkage as necessary to correct the amount of free travel (Figure 5-3). As a final check, operate the clutch pedal through its full range of travel. It should operate smoothly without any unusual lags, skips, binding, roughness, or noise.



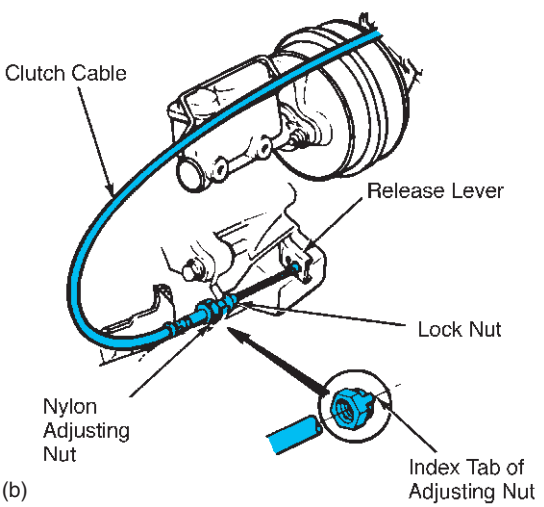


FIGURE 5-3 Clutch pedal free travel is normally adjusted at a clutch rod (a) or cable housing (b). *(b is Courtesy of Ford Motor Company)*

TECH TIP

With modern self-adjusting clutches, a decrease in free travel indicates excessive clutch wear, and this vehicle is due for a clutch replacement.

TECH TIP

Clutch hydraulic fluid is hygroscopic (it absorbs water), so the hydraulic system should be drained, flushed, and filled with new fluid to prevent corrosion and increase the service life of the components.

Clutch Fluid Level

Clutch hydraulic fluid level is checked by looking at the fluid level at the clutch master cylinder reservoir (Figure 5-4). Many reservoirs will be marked to indicate the correct fluid level. If there are no markings, assume that the fluid level should be between 1/4 and 1/2 in. (6 and 13 mm) from the top. Normally, the fluid level will rise slightly as the clutch facing wears. A low fluid level usually indicates a leak in the system.

FIGURE 5-4 The hydraulic clutch fluid is checked looking at the fluid level through the plastic reservoir.

PROBLEM DIAGNOSIS

Problem solving for clutches is difficult because most clutch assemblies are inaccessible and normally operate silently. Operational checks determine if the clutch is operating properly and from these results, determine if a disassembly for visual inspection is necessary (Figure 5-5). Disassembly is usually the last resort because of the time required to remove the transaxle or transmission.

Clutch Slippage

Clutch slippage can be checked easily in a shop; a more thorough check can be made on a road test.

To check for slippage in a shop:

1. Check and adjust clutch pedal free travel.
2. Warm up the engine to operating temperature, block the wheels, and apply the parking brake completely.
3. Shift the transmission into high gear and let out the clutch pedal smoothly. The engine should stall immediately. A delay indicates slow engagement and slipping.

To check for slippage on a road test:

1. Check and adjust clutch pedal free travel.
2. Drive to an area with very little traffic. Accelerate slowly and drive at 15 to 20 mph (24 to 32 kph) in the highest transmission gear. Use the lowest speed at which the vehicle will operate smoothly.
3. Depress the accelerator completely to wide-open throttle and listen to the engine rpm or watch the tachometer. The engine speed should increase steadily as the vehicle accelerates. If the engine speed flares upward, the clutch is slipping and needs service. Slipping becomes even more evident if this test is made while driving up a hill.

Clutch Spin Down

Hard shifting into gear from neutral, sometimes accompanied by gear clash, can be caused by a clutch that is not releasing completely. This is called **drag** and is easily checked by a spin-down test. **Clutch spin down** is the time it takes for the clutch disc and transmission gears to spin to a stop when the clutch is released. This time will vary depending on clutch disc diameter and transmission drag.

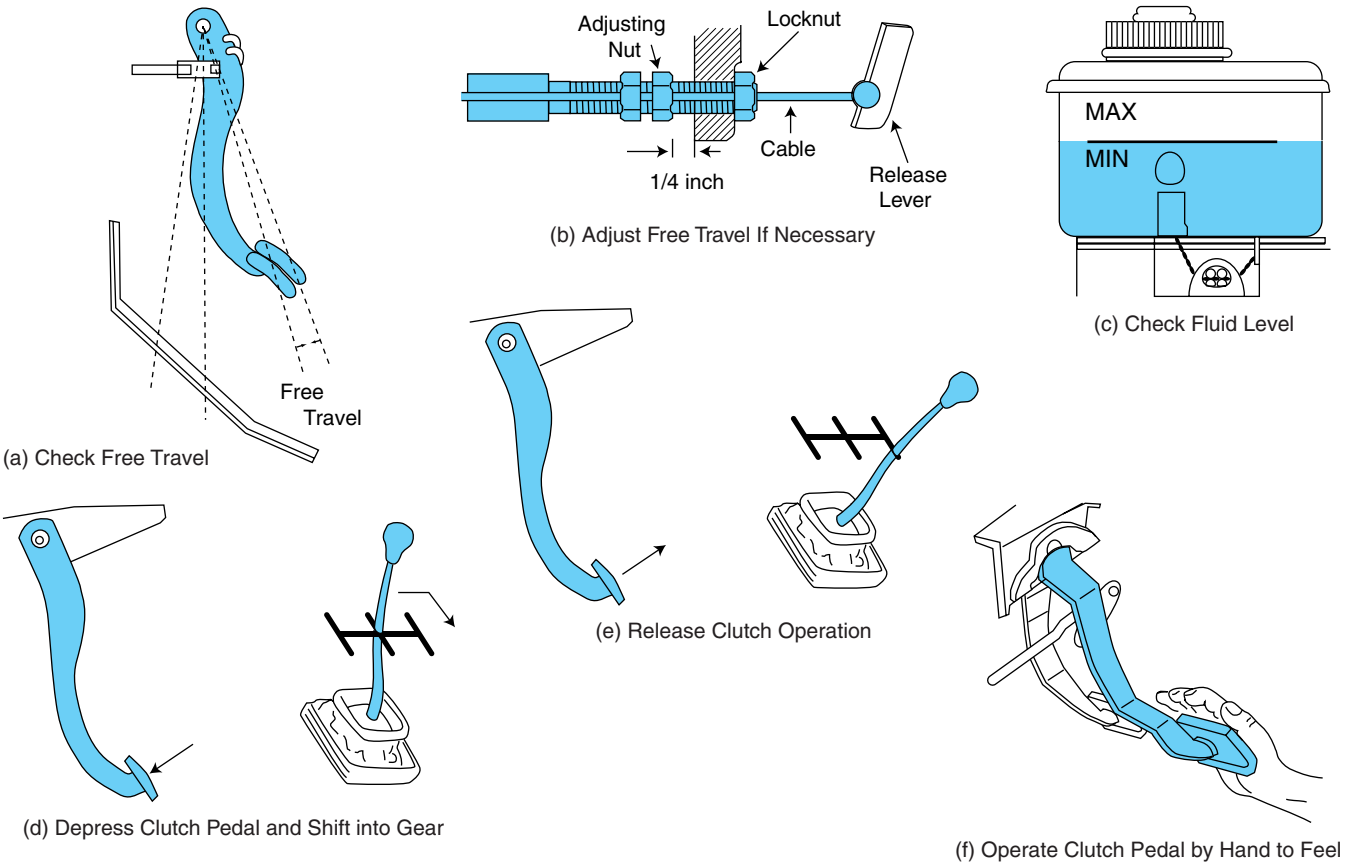


FIGURE 5-5 When diagnosing clutch problems, begin by checking clutch pedal feel and the amount of free travel (a). Adjust the free travel if necessary (b). On hydraulic clutches, check the fluid level and condition (c). Next, start the engine, depress the clutch pedal, and check for gear clash as you shift into reverse (d). Now let up on the clutch to check the engagement (e); if checking for slippage, use high gear. If any problems are indicated, operate the pedal by hand to feel the operation better (f).

To check clutch spin down:

1. Check and adjust clutch pedal free travel.
2. Warm up the engine and transmission to operating temperatures.
3. With the engine running at idle speed and the transmission in neutral, push in the clutch pedal, wait 9 seconds, and shift the transmission into reverse (a nonsynchronized gear). The shift should occur silently. Gear clash or grinding indicates a dragging clutch that has not released completely.

The 9-second time period is very long; you will find some cars that will shift quietly and cleanly into reverse in 3 or 4 seconds. If a clutch fails a spin-down check, it probably needs to be replaced.

Clutch Diagnosis Chart

Most clutch problems are cured by replacing the pressure plate, clutch disc, release bearing, and pilot bearing. The exception is when there is a problem with the linkage, which is on the outside and can be easily repaired or replaced. A trouble chart like the one in Figure 5-6 can be used as a final check before replacing a clutch. The service performed to diagnose each problem follows almost the same procedure: check for proper free travel and for proper linkage operation; if the problem has not been corrected, remove and replace (R&R) the clutch.

REAL WORLD FIX

A Jeep Wrangler (120,000 miles) sometimes gets stuck in first or reverse, and the only way to get it out of gear is to shut the engine off. The transmission shifts okay most of the time.

Following advice, the transmission was removed, and an inspection revealed a seizing pilot bushing. Replacement of the bushing fixed this problem.

Chart A

Problem	*Description*	*Diagnosis/Service*
Noise	Squeaks or scrapes as the pedal is depressed, engine off Squeals as the pedal is depressed, engine running Unusual noises during operation	Clutch Pedal Operation Clutch Pedal Noise Check
Grab	Grabs or chatters during engagement Abrupt/severe engagement	Clutch Pedal Operation Check Inspect engine mounts
Drag	Does not disengage completely	Clutch Spin Down Check
Slip	Does not engage completely	Clutch Slippage Check
Vibrations	Speed-related vibrations that increase as the engine speed increases	Determine that another engine system is not the cause; Balance or R&R flywheel and pressure plate.
Hard pedal	Requires a high amount of force to operate pedal	Check for binding cable or picots; Lube or R&R

Chart B

Possible Cause of Problem	*Slip*	*Grab*	*Chatter*	*Drag*	*Noise*
Worn or glazed facings	X	X	X		
Broken facing				X	
Facing stuck to flywheel or pressure plate					X
Warped disc				X	
Broken damper springs					X
Flattened Marcel springs		X			
Excessive disc runout				X	
Disc binding on clutch shaft				X	
Worn splines in disc			X	X	X
Grease or oil on facings	X	X	X		
Clutch cover distorted			X	X	
Weak or broken pressure plate springs	X				
Warped or grooved pressure plate	X	X	X		
Broken release lever or pivot				X	
Pressure plate binding on stands	X	X			
Uneven release levers			X	X	
Worn levers	X			X	
Excessive free travel				X	
Insufficient free travel	X				
Insufficient pedal or bearing travel		X		X	
Worn linkage			X	X	X
Worn fork					X
Worn throw-out bearing					X
Leaky hydraulic system				X	
Air in hydraulic system			X		
Worn pilot bearing					X
Flywheel step height out of specs	X				
Bad motor mounts		X	X		
Firewall/pedal mount flex				X	

FIGURE 5-6 Chart A indicates the checks that are made to determine the cause of common clutch problems; the numbers at the right refer to the sections in this chapter. Chart B indicates the probable causes for the five most common complaints.

Clutch Pedal Operation Check

This check requires an assistant, but it is fairly quick and easy.

To perform a clutch pedal operation check:

1. With the hood open and the engine off have an assistant work the clutch pedal slowly through full apply and release while you check for noises and inspect for improper movement of the linkage and pivot points. You can often pinpoint the location of noises by placing your hand at different points to feel for the vibration that accompanies some noises or to dampen a noise. The noise will often go away when you apply pressure to the problem area (Figure 5-7).
2. As an assistant moves the pedal slowly and evenly, inspect the linkage points from under the hood or vehicle for improper movement, binding, or noise. Also, check for excessive flexing of the engine bulkhead or firewall. On vehicles with self-adjusting clutches, ensure that the adjuster cam and locking mechanism is operating correctly (Figure 5-8). On vehicles with hydraulic clutches, check that the slave cylinder is moving completely (Figure 5-9).
3. When checking a vehicle equipped with a clutch–starter interlock switch, turn the ignition switch to the crank position and depress the clutch pedal. As the pedal nears the end of its travel, the starter should begin cranking.

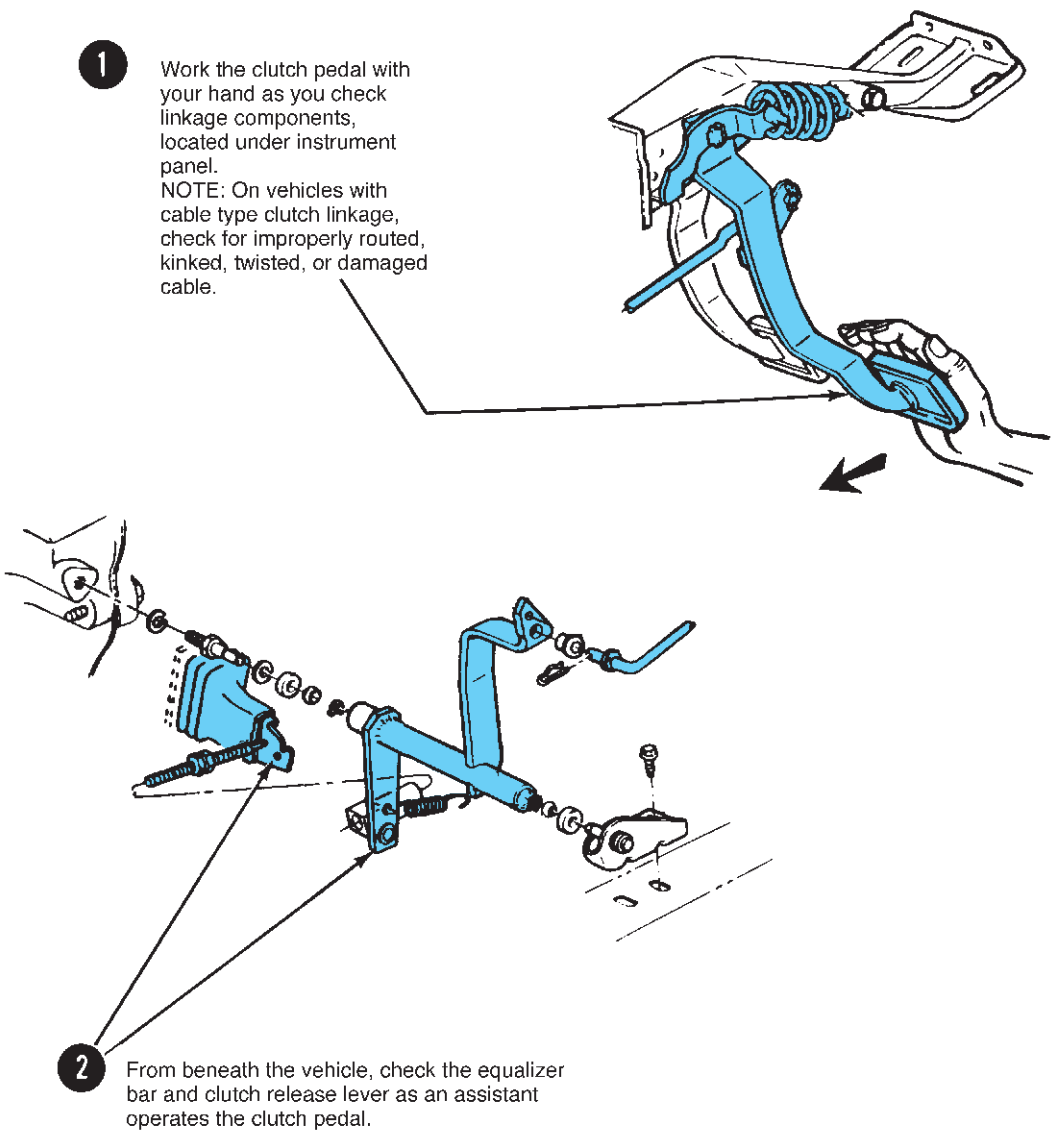


FIGURE 5-7 Check for noises by moving the pedal by hand as you check the various parts of the linkage. If necessary, the linkage can be disconnected to isolate different portions. *(Courtesy of Ford Motor Company)*

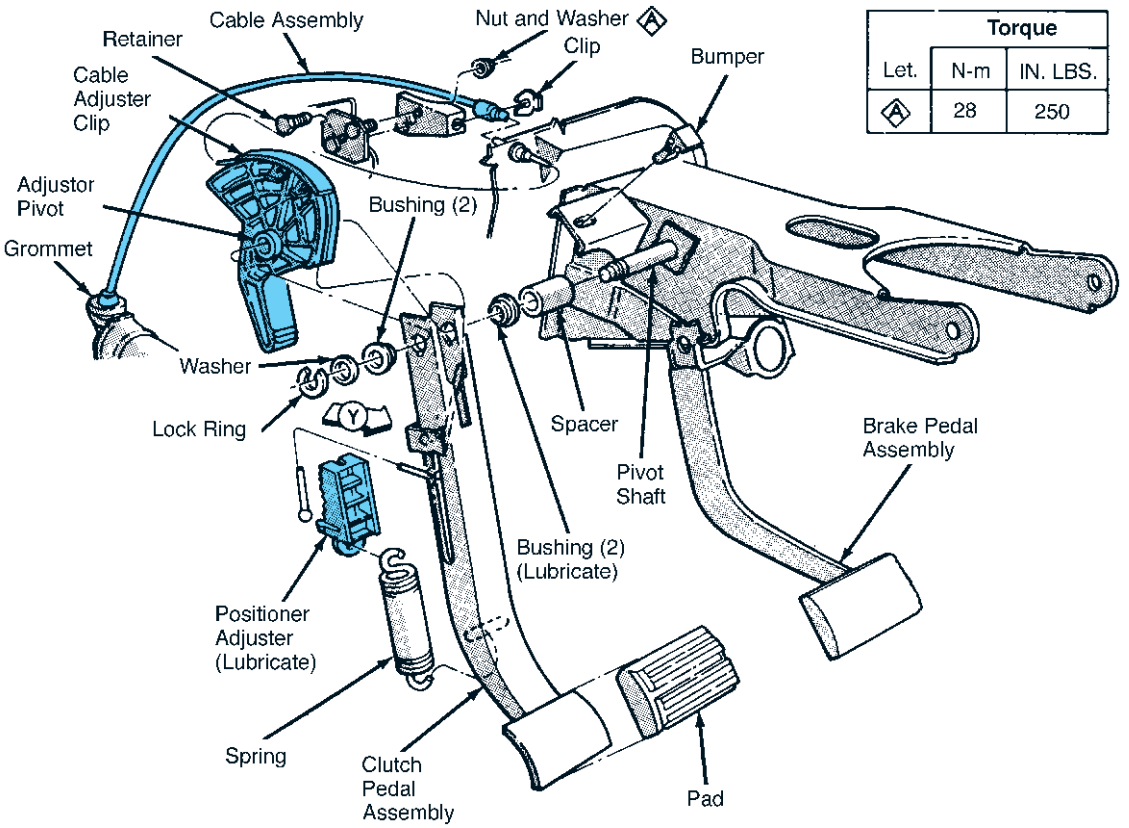


FIGURE 5-8 With a self-adjusting clutch, check the cable, cable adjuster clip (cam), and positioner adjuster for proper operation. *(Courtesy of DaimlerChrysler Corporation)*

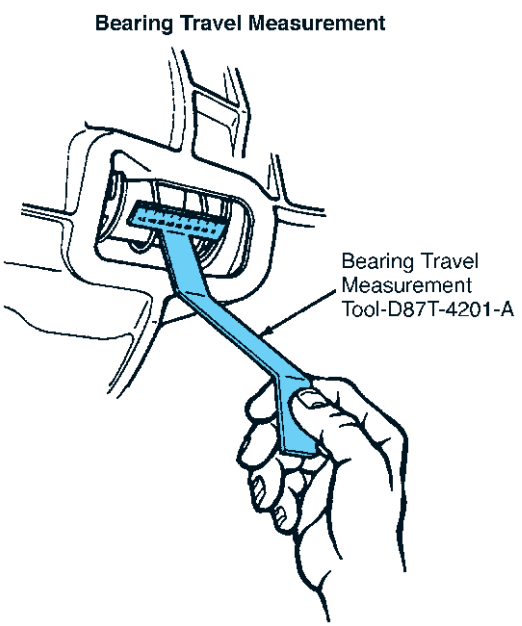


FIGURE 5-9 If the hydraulic clutch problem is failure to release, check for proper bearing travel. Insufficient bearing travel indicates a faulty hydraulic system. *(Courtesy of Ford Motor Company)*

REAL WORLD FIX

The clutch on a 1991 Dodge Ram pickup (260,000 km) did not release completely. Adjusting the cable helped, but the end of the adjustment was reached. The transmission and clutch were removed. The clutch was carefully inspected, and it showed little wear and no damage.

Following advice, a new cable was purchased, and it was determined that the old cable had stretched. Installation of the new cable repaired this problem.

Clutch Pedal Noise Check, Engine Running

This check is used to pinpoint the causes of squeaks or growling noises that occur and may change as the clutch pedal is depressed (Figure 5-10). During the check, the engine should be running at idle speed and the clutch linkage free travel must be

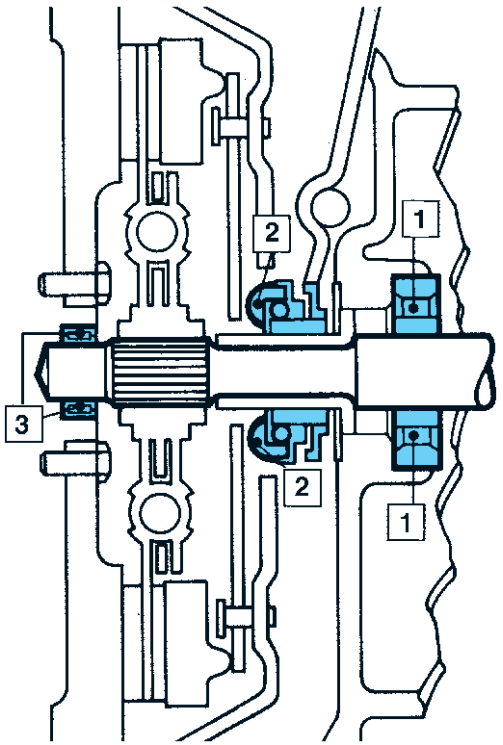


FIGURE 5-10 Any of these three bearings can cause noise. A faulty transmission input shaft bearing (1) will cause noise while the clutch is engaged; a faulty release bearing (2) will cause noise with the pedal depressed; and a faulty pilot bearing (3) will cause noise while the clutch is released. *(Courtesy of LUK Clutches)*

properly adjusted. On self-adjusting or hydraulic zero-free-play systems, it will be necessary to pry back the release lever or fork to isolate transmission bearing noise from release bearing noise, and this may be impractical on some vehicles. The common bearing noise problems fall into one of four categories:

1. Problem noise stops as clutch pedal is released completely—transmission bearing or gear rollover problem. This problem is covered in Chapter 8.
2. Problem noise begins as the clutch pedal is depressed just beyond free travel—faulty release bearing.
3. Problem noise and vibration occur at one-fourth to one-half pedal travel—faulty pressure plate-to-release bearing contact.
4. Problem noise after clutch is released completely—faulty pilot bearing.

To perform a clutch pedal noise check:

1. Check and adjust clutch pedal free travel.
2. Warm up the engine and transmission to operating temperature.
3. Set the parking brake. With the engine at idle speed and the transmission in neutral, depress the clutch pedal slowly and steadily as you listen for unusual noises.

If noise begins as the clutch releases and the transmission gears spin down, shift the transmission into gear to ensure that they are stopped. Noise at this time is definitely coming from the pilot bearing or release bearing. Shift back into neutral, and let the clutch out slightly so that the transmission gears are spinning again. Now the pilot bearing will have stopped with the release bearing still spinning. If the noise stops, it is caused by a faulty pilot bearing; if the noise continues, it is a faulty release bearing.

REAL WORLD PROBLEM

Imagine that you are working in a general automotive repair shop and these problems are brought to you.

Case 1

The vehicle is a 15-year-old pickup, and the complaint is an engine speed flare-up under load. You suspect the problem is a slipping clutch, and your road test confirms an improper engine speed increase at 20 mph as you make a full-throttle acceleration in fourth gear. When you check for clutch pedal free travel, you find there is none. What should you do next?

Case 2

The vehicle is a 6-year-old FWD compact sedan with 85,000 miles on the odometer, and a noise complaint. As you apply the clutch to change gears, a squealing, sometimes growling noise occurs, and this noise continues until the pedal is completely released. What do you think is wrong? What will you do to fix it? What should you recommend to the customer?

REAL WORLD FIX

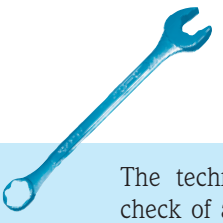
The clutch and release bearing in a 1995 Mustang (122,000 mi) were replaced six months ago, but it came back with a release bearing squeal complaint.The clutch and release bearing were replaced again, but three days later, it returned with the same complaint.

The vehicle was raised and operated on a hoist, and the release fork could be seen to vibrate as the noise occurred. Lifting the fork slightly would stop the noise. Removing the transmission allowed lubrication of the release fork pivot, and fixed this problem.

REAL WORLD FIX

A 2000 Subaru Outback (59,000 miles) came in with a customer complaint of the clutch pedal engagement occurring too high and a clutch pedal vibration during engagement. The vehicle had been to the dealer several times for this problem, and the clutch had been replaced twice.

Following advice, the technician removed the clutch and found a worn release bearing support. Installation of a sleeve on the transmission release bearing support and resurfacing of the flywheel fixed this problem.



TECH TIP

The technician is the final quality control check of all the parts as they are assembled. Having to redo a job means lost time and money. Thoroughness while making a repair may take a little more time, but it will ensure a first-rate operation. The goal for a clutch job should be "new vehicle" operation (Figure 5-11). A good technician does not need to blame failures on faulty parts.

CLUTCH REPLACEMENT

Clutch replacement, commonly called a *clutch job,* is a fairly expensive and labor intensive repair. During disassembly, each part should be checked to determine if it is the cause of the failure and if it is suitable for reuse. During reassembly, each phase is normally accompanied by checks for proper clearances or operation so that any faulty parts or assemblies can be corrected as early in the assembly as possible.

REAL WORLD FIX

The clutch in a 1988 Chevrolet Corsica (119,000 mi) would not disengage. A broken pressure plate or clutch disc was suspected, so the transaxle was removed. Inspection showed normal clutch wear, nothing to prevent disengagement. A new pressure plate, disc, and throw-out bearing were installed, and the flywheel was machined. The clutch still would not disengage. A small leak was found at the slave cylinder, so the entire hydraulic system was replaced with an OEM assembly. The new assembly was full of fluid, so bleeding was not necessary. The slave cylinder push rod travel has normal movement during clutch pedal travel application. At the suggestion of the parts supplier, a flywheel shim was installed to compensate for the thinner machined flywheel, but this did not help.

Close inspection revealed that the release fork was bent and worn. Replacement of the fork and its bushings fixed this problem. It is important to spend a few minutes inspecting all of the clutch components to ensure a complete and proper repair.

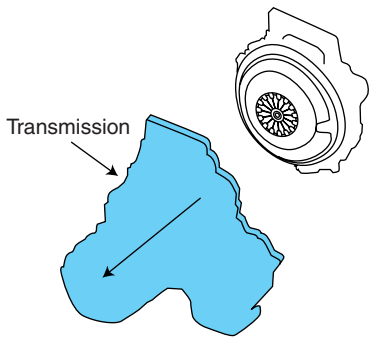
Clutch replacement normally involves replacing four items: the pressure plate assembly, clutch disc, release bearing, and pilot bearing (Figure 5-12). If there is a problem with the clutch operation, the pressure plate and disc are usually damaged in some way and need replacement. With today's labor cost, it is unwise to install a part that is not operating completely right. The release and pilot bearings are often replaced for insurance purposes. These two parts are not very expensive, and their replacement will ensure correct operation for the life of the new disc and pressure plate. For convenience, some parts suppliers package all four parts in one package (Figure 5-13).

A clutch job begins with removal of the transaxle/transmission; this operation is described in Chapter 8. The service operation described here is very general. As you remove and replace the clutch, you should follow the procedure given in a service manual for the vehicle you are repairing.

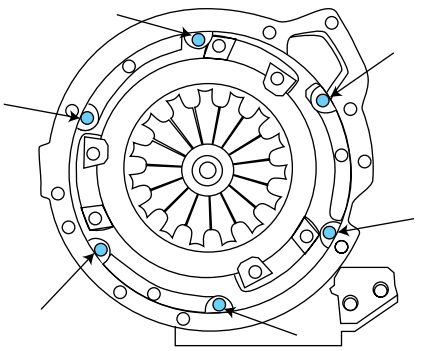
Clutch Removal

To remove a clutch:

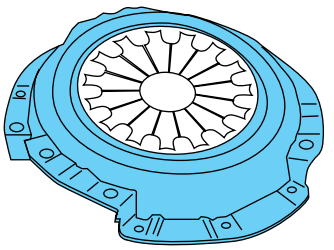
1. After the transmission is removed, mark the flywheel and pressure plate cover with index marks so that you can realign them if the original pressure plate assembly is to be reused (Figure 5-14). Many manufacturers balance the pressure plate and flywheel assembly; repositioning the pressure plate on the flywheel can cause an annoying vibration.
2. Remove the bolts securing the pressure plate cover to the flywheel two turns at a time and in an alternating fashion, back and forth across the pressure plate. Completely removing the bolts, one at a time, can cause distortion of the pressure plate cover. Note the bolts as they are removed. Pressure plate bolts are normally grade 8 bolts and usually have a special shank to help center and drive the pressure plate cover. As the last bolt is removed, be prepared to support the pressure plate assembly and



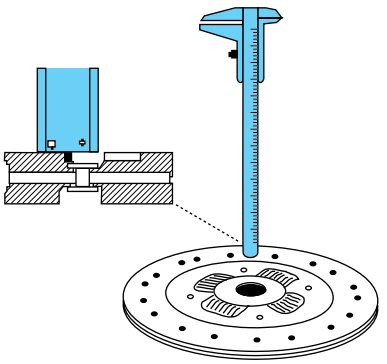
(a) Remove Transmission/Transaxle



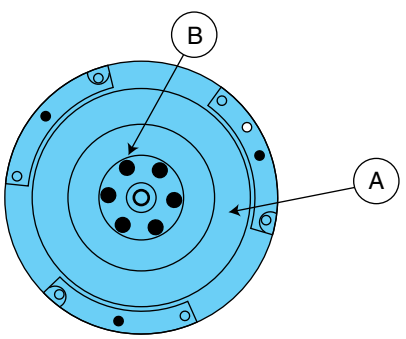
(b) Remove Retainer Bolts Evenly



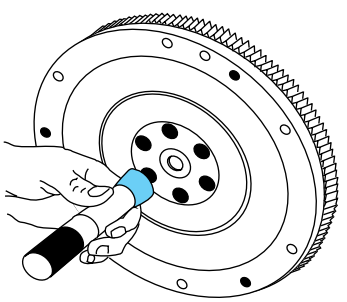
(c) Inspect Pressure Plate Assembly



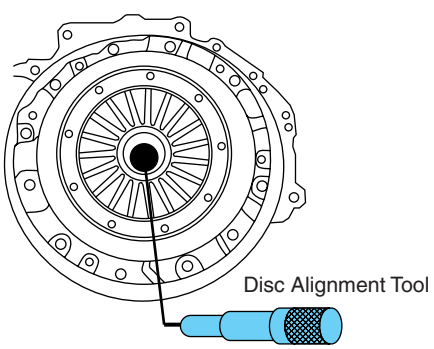
(d) Inspect Disc



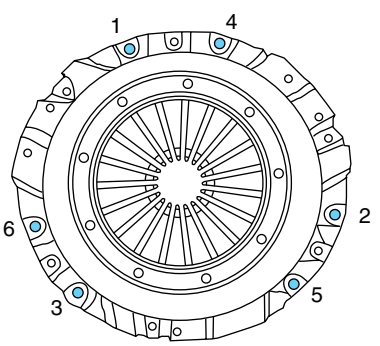
(e) Inspect Flywheel



(f) Replace Pilot Bearing

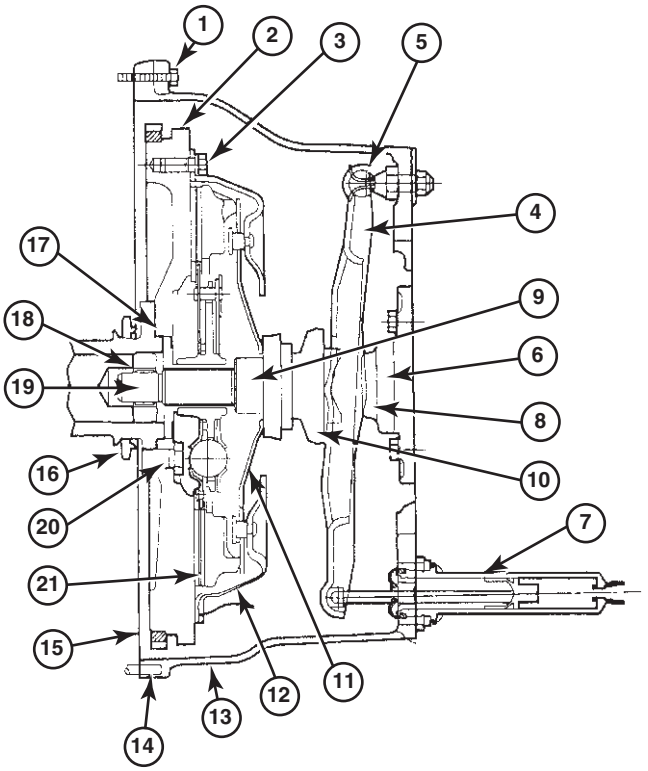


(g) Align Disc and Install Pressure Plate Assembly



(h) Tighten Retaining Bolts to the Correct Torque

FIGURE 5-11 The sequence for a clutch job is to remove the transmission/transaxle (a); remove the clutch components (b); inspect the pressure plate assembly (c), disc (d), flywheel (e); replace the pilot bearing (f); install and align the disc and pressure plate assembly (g); and tighten the bolts to the correct torque and in the correct sequence (h).



1. CHECK CLUTCH HOUSING BOLTS. TIGHTEN IF LOOSE. BE SURE HOUSING IS FULLY SEATED ON ENGINE BLOCK.
2. CHECK FLYWHEEL. SCUFF SAND FACE TO REMOVE GLAZE. CLEAN SURFACE WITH WAX AND GREASE REMOVER. REPLACE FLYWHEEL IF SEVERELY SCORED, WORN OR CRACKED. SECURE FLYWHEEL WITH NEW BOLTS (IF REMOVED). DO NOT REUSE OLD BOLTS. USE MOPAR LOCK N'SEAL ON BOLTS.
3. TIGHTEN CLUTCH COVER BOLTS 2–3 THREADS AT A TIME, ALTERNATELY AND EVENLY (IN A STAR PATTERN) TO SPECIFIED TORQUE. FAILURE TO DO SO COULD WARP THE COVER.
4. CHECK RELEASE FORK. REPLACE FORK IF BENT OR WORN. MAKE SURE PIVOT AND BEARING CONTACT SURFACES ARE LUBRICATED.
5. CHECK RELEASE FORK PIVOT (IN HOUSING). BE SURE PIVOT IS SECURE AND BALL END IS LUBRICATED.
6. TRANSMISSION INPUT SHAFT BEARING WILL CAUSE NOISE, CHATTER, OR IMPROPER RELEASE IF DAMAGED. CHECK CONDITION BEFORE INSTALLING TRANSMISSION.
7. CHECK SLAVE CYLINDER. REPLACE IT IF LEAKING. BE SURE CYLINDER IS PROPERLY SECURED IN HOUSING AND CYLINDER PISTON IS SEATED IN RELEASE FORK.
8. CHECK INPUT SHAFT SEAL IF CLUTCH COVER AND DISC WERE OIL COVERED. REPLACE SEAL IF WORN, OR CUT.
9. INSPECT RELEASE BEARING SLIDE SURFACE OF TRANS. FRONT BEARING RETAINER. SURFACE SHOULD BE SMOOTH, FREE OF NICKS, SCORES. REPLACE RETAINER IF NECESSARY. LUBRICATE SLIDE SURFACE BEFORE INSTALLING RELEASE BEARING.
10. DO NOT REPLACE RELEASE BEARING UNLESS ACTUALLY FAULTY. REPLACE BEARING ONLY IF SEIZED, NOISY, OR DAMAGED.
11. CHECK CLUTCH COVER DIAPHRAGM SPRING AND RELEASE FINGERS. REPLACE COVER IF SPRING OR FINGERS ARE BENT, WARPED, BROKEN, CRACKED. DO NOT TAMPER WITH FACTORY SPRING SETTING AS CLUTCH PROBLEMS WILL RESULT.
12. CHECK CONDITION OF CLUTCH COVER. REPLACE CLUTCH COVER IF PLATE SURFACE IS DEEPLY SCORED, WARPED, WORN, OR CRACKED. BE SURE COVER IS CORRECT SIZE AND PROPERLY ALIGNED ON DISC AND FLYWHEEL.
13. INSPECT CLUTCH HOUSING. BE SURE BOLTS ARE TIGHT. REPLACE HOUSING IF DAMAGED.
14. VERIFY THAT HOUSING ALIGNMENT DOWELS ARE IN POSITION BEFORE INSTALLING HOUSING.
15. CLEAN ENGINE BLOCK SURFACE BEFORE INSTALLING CLUTCH HOUSING. DIRT, GRIME CAN PRODUCE MISALIGNMENT.
16. CHECK REAR MAIN SEAL IF CLUTCH DISC AND COVER WERE OIL COVERED. REPLACE SEAL IF NECESSARY.
17. CHECK CRANKSHAFT FLANGE (IF FLYWHEEL IS REMOVED). BE SURE FLANGE IS CLEAN AND FLYWHEEL BOLT THREADS ARE IN GOOD CONDITION.
18. CHECK PILOT BEARING. REPLACE BEARING IF DAMAGED. LUBE WITH MOPAR HIGH TEMP. BEARING GREASE BEFORE INSTALLATION.
19. CHECK TRANSMISSION INPUT SHAFT. DISC MUST SLIDE FREELY ON SHAFT SPLINES. LIGHTLY GREASE SPLINES BEFORE INSTALLATION. REPLACE SHAFT IF SPLINES OR PILOT BEARING HUB ARE DAMAGED.
20. CHECK FLYWHEEL BOLT TORQUE. IF BOLTS ARE LOOSE, REPLACE THEM. USE MOPAR LOCK N'SEAL TO SECURE NEW BOLTS.
21. CHECK CLUTCH DISC FACING. REPLACE DISC IF FACING IS CHARRED, SCORED, FLAKING OFF, OR WORN. ALSO CHECK RUNOUT OF NEW DISC. RUNOUT SHOULD NOT EXCEED 0.5 mm (0.02 in.).

FIGURE 5-12 Cluth replacement includes a variety of checks and operations. *(Courtesy of DaimlerChrysler Corporation)*

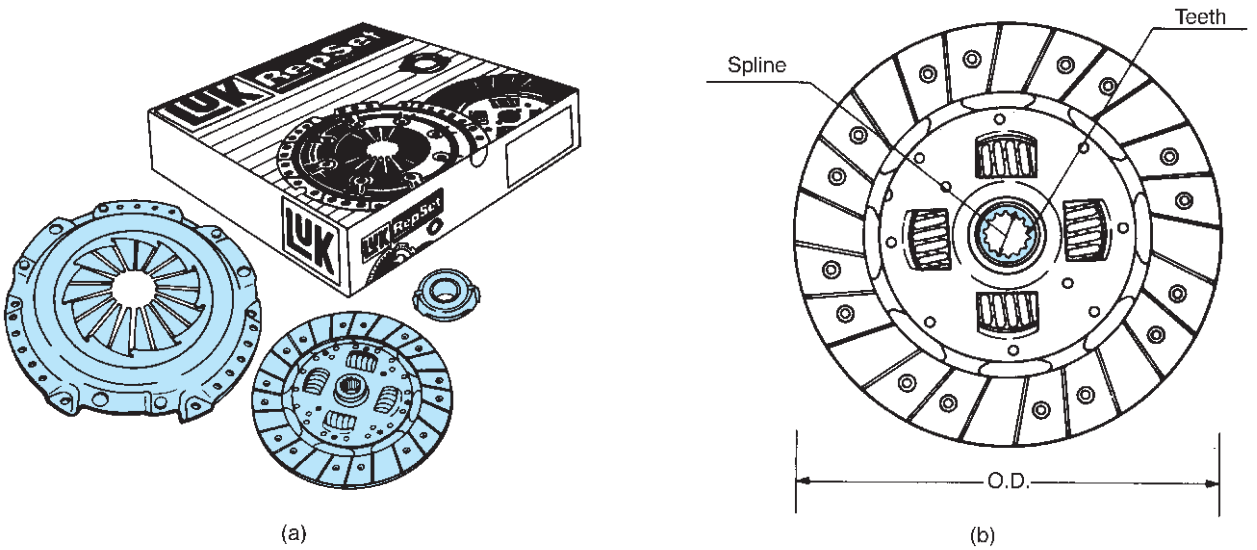
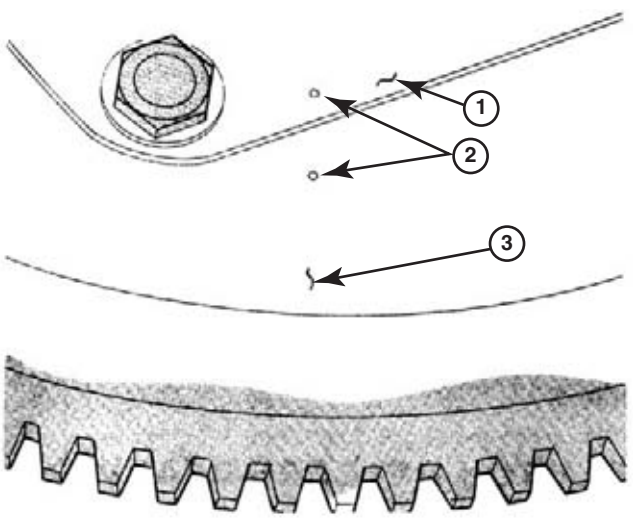


FIGURE 5-13 Some suppliers package a replacement disc and pressure plate assembly along with the release bearing in one package (a). Sometimes the pilot bearing is also included. The critical dimensions for the replacement disc are shown in (b). *(Courtesy of LUK Clutches)*



1. PRESSURE PLATE COVER
2. PUNCH MARKS
3. FLYWHEEL

FIGURE 5-14 If the pressure plate assembly is to be reinstalled, index marks should be put on the flywheel and cover so that they can be realigned in the same position. *(Courtesy of DaimlerChrysler Corporation)*

TECH TIP

Because the old disc might have asbestos-based facing, try to prevent dust from becoming airborne. Do not breathe any of this dust. Never blow the dust from the assembly using compressed air and an air gun. To remove the dust, some technicians will vacuum the assembly provided that the vacuum cleaner is equipped with a HEPA (high-efficiency particulate air filter). Asbestos fibers can pass right through a normal shop vacuum with the standard filter. The clutch dust can also be removed by one of the various wet washing systems available (Figure 5-15).

TECH TIP

Install an alignment tool or dummy clutch shaft into the clutch disc to support it while you remove the pressure plate.

clutch disc; they can be heavy. Remove the pressure plate and disc.

3. Remove the pilot bearing from the crankshaft (Figure 5-16). A puller is normally used for this. Most pullers are designed to enter the pilot bearing, expand to lock into it, and pull the bearing out as force from a slide hammer or puller bolt is exerted on it.
4. Remove the release bearing from the clutch fork and bearing retainer quill.

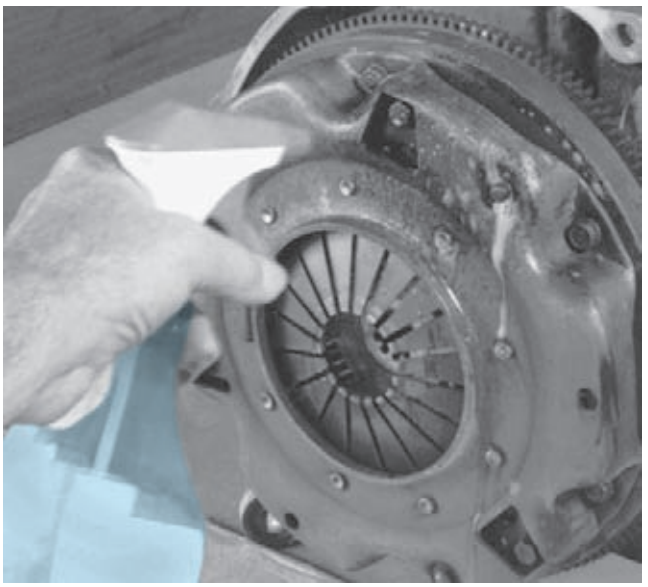


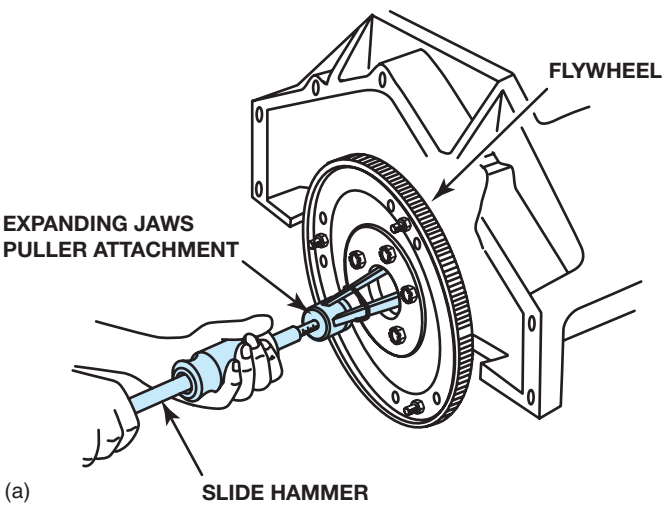
FIGURE 5-15 Before disassembly, it is a good practice to wash the pressure plate assembly and flywheel with a mixture of soap and water. This prevents airborne asbestos fibers and precleans the clutch cover.

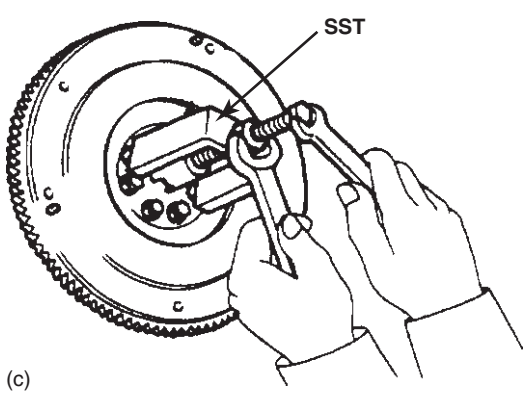
TECH TIP

Another pilot bushing removal method is to thread a coarse bolt into the bushing so it bottoms against the crankshaft. Further tightening will move the bushing outward.

TECH TIP

A somewhat messy alternative method to remove a pilot bearing is to fill the cavity behind the bearing with chassis grease and drive a close-fitting round rod or dowel into the grease. This will create a hydraulic force behind the bearing, forcing it outward. Soap or wet tissue can also be used.





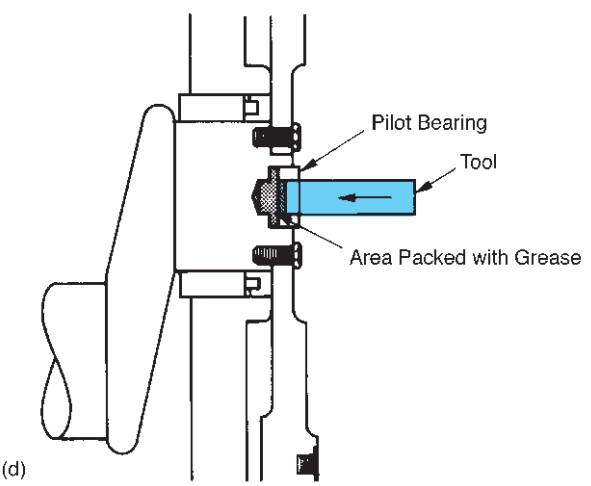


FIGURE 5-16 A pilot bearing is removed by catching it with an expanding puller attached to a slide hammer (a) a puller set is shown (b) using a special-purpose puller (c), or filling it with grease and driving a round tool into the bearing (d). *(b is courtesy of LUK Clutches; c is Courtesy of Toyota Motor Sales USA, Inc.)*

REAL WORLD FIX

The clutch in a Chevrolet Camaro (68,000 mi) did not disengage completely. The master cylinder fluid level was correct, and the clutch fork travel was measured at 1 1/8".

Removal of the transmission and clutch assembly showed a clutch disc falling apart; pieces of lining were wedged in the pressure plate and disc. Replacement of the disc fixed this problem.

NOTE: Clutch lining breakup is often a sign of severe clutch operation.

REAL WORLD FIX

A 1994 Nissan Pathfinder (125,000 mi) made a groaning, whirring noise as the clutch was engaged. The clutch disc and pressure plate were replaced, but the noise came back after 12,000 miles. A new clutch disc, pressure plate, release bearing, and pilot bushing were installed during the clutch replacement.

Pulling the transmission allowed inspection of the parts, and a faulty pilot bushing was found. An updated pilot bushing was installed and lubricated.

REAL WORLD FIX

The clutch in a 1998 Dodge Dakota pickup (140,000 mi) sometimes will not disengage completely. There is also a whirring noise when the clutch is released. The clutch master cylinder and slave cylinder have been replaced, but this did not help.

Following advice, the technician removed the transmission, and the pilot bearing fell apart as the transmission was removed. The release bearing was also found to be bad. The clutch disc and pressure plate were okay, but because of the mileage and that they were already removed for the pilot bearing replacement, it was decided to replace them. Replacement of the clutch parts fixed this problem.

Clutch Component Inspection

An experienced technician checks each part as it is disassembled to determine if it is reusable or why it failed. This identifies any condition that needs special attention before the clutch is reassembled. If the clutch is slipping, the disc and the pressure plate should be replaced. The following sections explain the normal checks to be made during a clutch job.

Flywheel. The friction surface of the flywheel should be checked for grooves, nicks, and heat damage; these faults indicate a need for resurfacing or replacement (Figure 5-17). **Blanchard grinding**, moves a spinning grinding stone around the flywheel surface, is the recommended method of resurfacing because it leaves a truly flat surface with a series of circular, nondirectional scratches (Figure 5-18). The finish is the same as those found on some new flywheel or pressure plate surfaces, and it promotes rapid disc facing-to-flywheel breakin. When machining a stepped flywheel, be sure that the same thickness of metal is removed from each of the two surfaces.

Many modern flywheels are forged steel, which tends to warp (potato chip shape) or dish if overheated. This is

TECH TIP

If the friction surface is flat and smooth but highly polished or glazed, some technicians will sand the friction surface using a disc sander with 80- to 120-grit paper (Figure 5-19). When doing this, the sander is kept in motion while attempting to duplicate the ground finish of a new unit without cutting grooves.

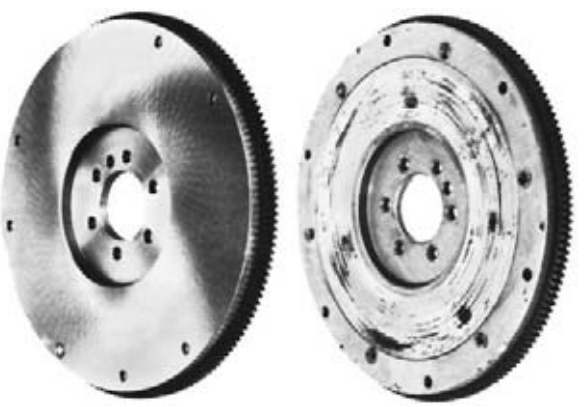


FIGURE 5-17 A new (left) and typical worn flywheel (right). This worn flywheel should be resurfaced. *(Courtesy of McLeod Industries, Inc.)*

1. THE MASTER CONTROL PANEL – INCLUDES ALL SWITCHES
2. GRINDING HEAD SWIVEL LOCK LEVER
3. DEPTH OF GRIND DIAL
4. GRINDING HEAD DOWN FEED WHEEL
5. WHEEL DRESSER
6. GRINDING HEAD SWIVEL HANDLE
7. COOLANT NOZZLE

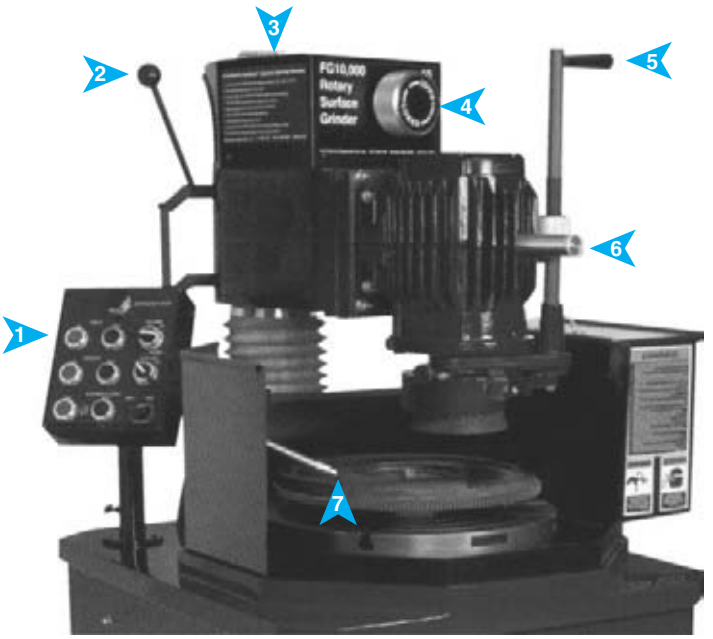


FIGURE 5-18 A flywheel grinder rotates the flywheel as a spinning stone is lowered onto the surface. Various styles of flywheels, including stepped ones (inset), can be resurfaced using this machine. *(Courtesy of Van Norman Equipment Co., Inc.)*

checked by placing a straightedge across the flywheel in several locations. Over 0.0005 in. (0.013 mm) of warpage per inch of diameter is considered excessive. This means that a 12-in.-diameter flywheel can have 0.006 in. (12 × 0.0005) of warpage error.

If there is a vibration complaint or an odd wear pattern at the hub of the disc or pressure plate release levers, the flywheel should be checked for excessive runout. **Face** or **axial runout** is checked by positioning a dial indicator with the indicating stylus at the outer edge of the flywheel face (Figure 5-20).

To measure flywheel axial runout, you should:

1. Mount the dial indicator so the measuring stem is parallel to the crankshaft and pointing directly toward the flywheel, and adjust the indicator to read zero.
2. Rotate the flywheel while watching the dial indicator. Maintain an even pressure, either inward or outward, to maintain zero crankshaft end play.
3. The variation in reading is the amount of axial runout.

REAL WORLD FIX

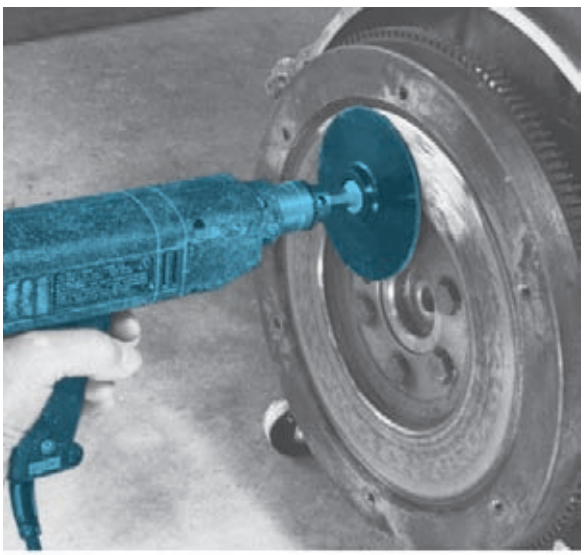
A 1997 Hyundai Tiburon came in with a clutch problem, and an inspection revealed that the flywheel had broken loose from center. Closer inspection showed that center hub did not seat properly onto the crankshaft. A used replacement flywheel had the same problem so the technician asked for advice on iATN.

A fellow technician sent information about a Hyundai TSB #99-20-004, and this bulletin identified a spacer that corrects this problem. Installation of this new part fixed this problem.

TECH TIP

Set up the dial indicator to measure lengthwise flywheel/crankshaft motion, and push and pull on the flywheel and crankshaft in a direction that is parallel to the crankshaft. The dial indicator is measuring crankshaft end play. Normal crankshaft end play should be about 0.002 to 0.010 in. (0.05 to 0.25 mm). Movement greater than specified indicates worn crankshaft thrust bearings.

While rotating the crankshaft to measure flywheel runout, be sure to keep an inward pressure on the flywheel to prevent end play from affecting the runout readings.



(a)

(b) Before

(c) After

FIGURE 5-19 If not too badly scored (a), a glazed flywheel can be refinished using a sanding disc (b); the finished surface should show nondirectional sanding scratches (c).

To measure flywheel radial runout, you should:

1. Remount the dial indicator so it is at the edge of the flywheel, pointing directly toward the center of the flywheel.
2. Adjust the dial indicator to read zero.
3. Rotate the flywheel while watching the dial indicator.
4. The variation in reading is the amount of radial runout.

Radial runout has a greater effect on balance and vibration than on clutch operation. Runout in either direction greater than 0.010 in. (0.25 mm) is considered excessive; runout as little as 0.005 in. (0.1 mm) can cause **chatter**.

If the flywheel is to be removed, it is a good practice to place index marks at the crankshaft flange for faster alignment during reassembly.

It is also a good practice to inspect the starter ring gear teeth. If they are damaged, replace either the starter gear or flywheel.

Pressure Plate Assembly. A used pressure plate assembly should be inspected visually for friction surface damage, release lever wear, lever pivot wear, and cover distortion. There is no way to effectively check for proper spring strength. Like the flywheel, the friction surface will tend to polish or glaze

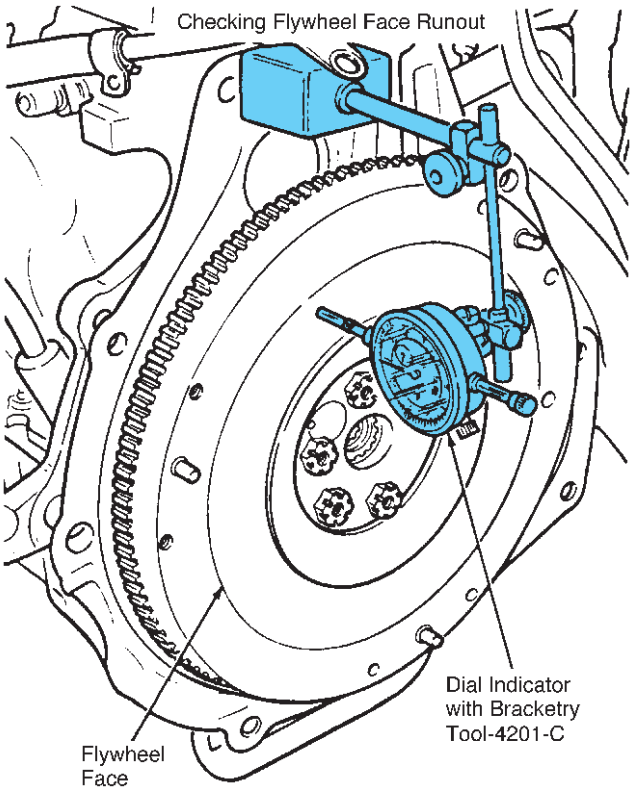


FIGURE 5-20 This dial indicator is set up to measure flywheel face or axial runout. *(Courtesy of Ford Motor Company)*

TECH TIP

It is easy to cut your hand or fingers if you handle a flywheel by the edges. Long bolts can be threaded into the pressure plate bolt holes to provide convenient handles (Figure 5-21).

from normal use. If there is excessive slippage, grooves, heat checks, and warping can occur (Figure 5-22). Warpage can be checked by placing a straightedge across the friction surface and will show up as a gap between the straightedge and the inner portion of the pressure plate ring.

Set the pressure plate on the flywheel. All of the mounting points should meet the flywheel evenly and completely. Any air gaps indicate a distorted clutch cover. Release lever wear occurs at the contact surface with the release bearing; this area should appear smooth and polished with no metal removed. Release lever height should be checked after the pressure plate and disc are bolted to the flywheel. Soft reddish-brown rust and highly polished or shiny rough areas around the lever pivots are indications of wear at these points. If any problems are noticed, the pressure plate assembly should be replaced.

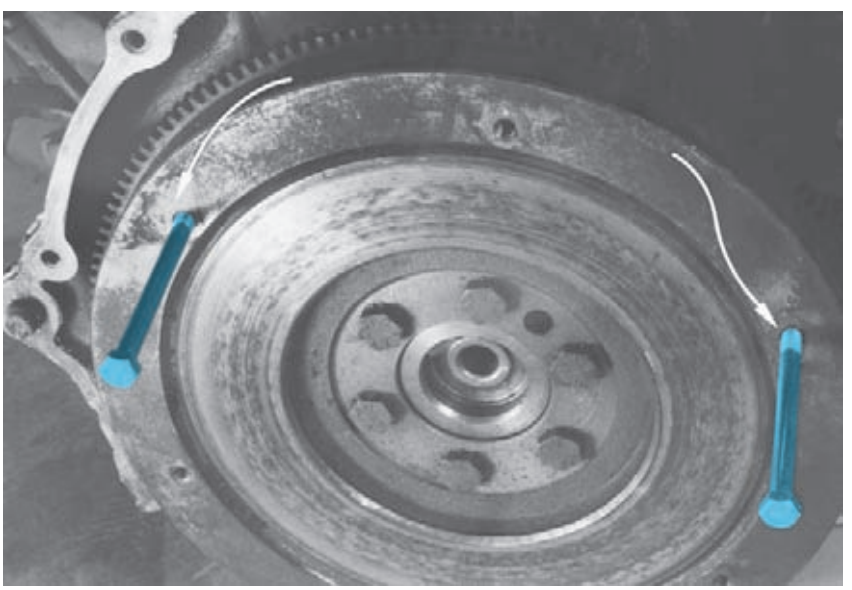


FIGURE 5-21 Two long bolts (arrows) have been threaded into the flywheel to serve as handles for carrying and positioning.

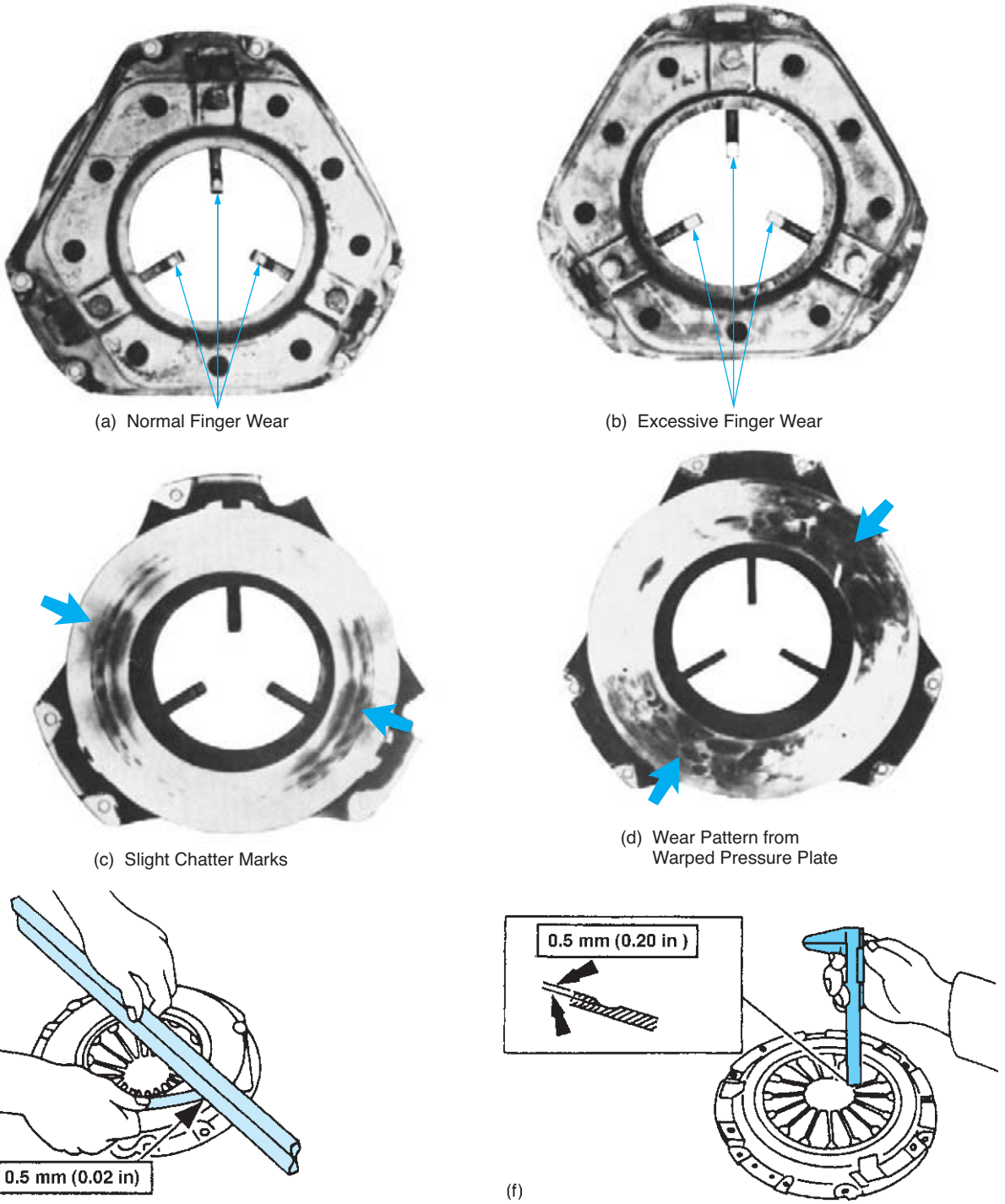


FIGURE 5-22 Commonly encountered pressure plate faults are excessive finger wear (b and f), chatter marks (c), and excessive warpage (d and f). *(Courtesy of Ford Motor Company)*

Clutch Disc. If installing a used disc, it should be checked for facing thickness, damper spring condition, wear of the hub splines, and warpage or axial runout (Figure 5-23). The thickness of the facing can be checked by two different methods. The most popular method is to measure the height of the facing surface above the rivets; this is also called *rivet head depth* (Figure 5-24).

The second method is to place cardboard or a shop cloth over the facing to keep it clean and squeeze the facings together to compress the marcel spring. If no specifications are

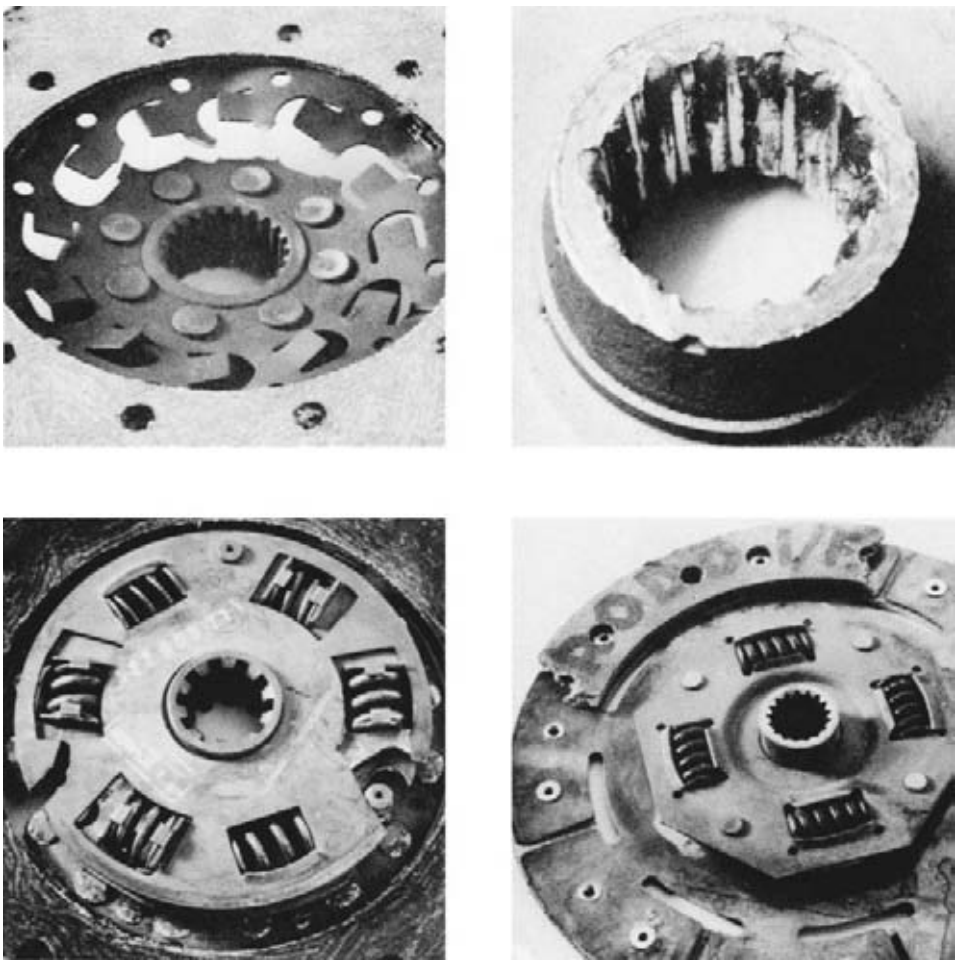


FIGURE 5-23 Clutch disc failure comes in many forms; a good technician will determine and correct the cause of abnormal failures so they won't occur again. *(Courtesy of LUK Clutches)*

REAL WORLD FIX

The clutch in a 1995 VW GTI (107,000 mi) has been replaced and the flywheel was resurfaced at the same time. But now there is a noticeable clutch chatter. The technician was told that during the flywheel resurfacing, only the clutch mating surface was machined. The technician feels that the step height could be incorrect, but he could not find the specification.

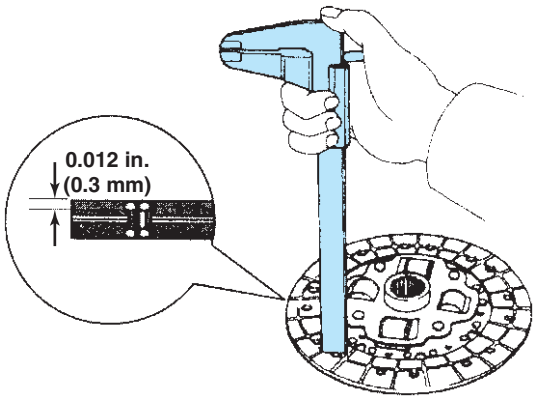
After contacting iATN, international Automotive Technician Network, a fellow technician provided the step-height specification. A check of the flywheel showed that it's step was at the limit, but the clutch surface also had 0.003 in. of runout. Remachining the flywheel fixed this problem.

available, the minimum thickness of the compressed disc should be 0.280 in. (7.1 mm).

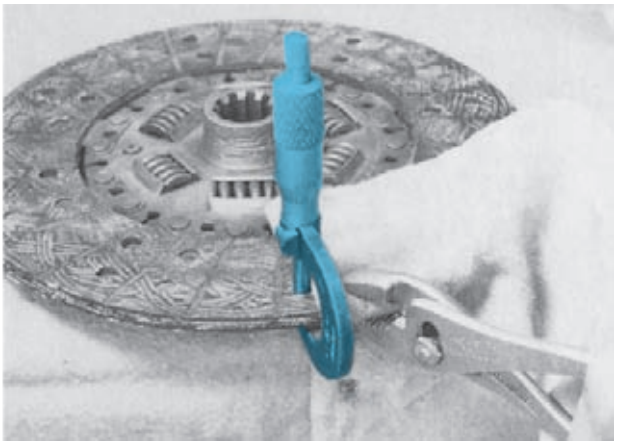
The damper springs and hub splines are checked visually for reddish rust and shiny worn areas as well as loose, broken, or missing springs. **Disc runout** warpage is checked by making an axial runout check. This usually requires a pair of tapered centers or an expanding arbor at true center to the hub

TECH TIP

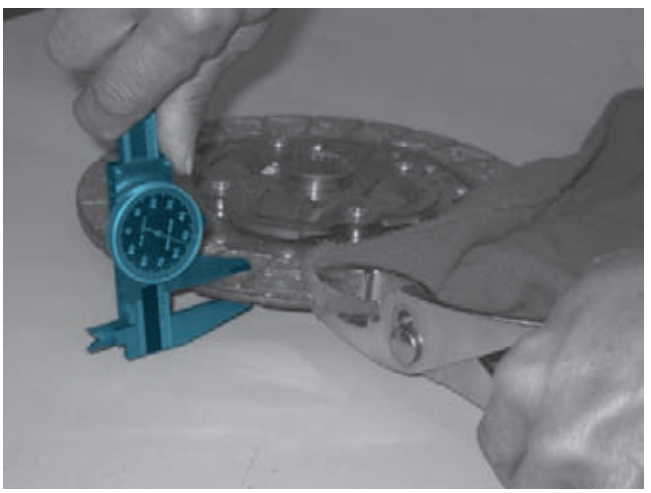
With a new disc, rivet head depth will be about 0.050 in. (1.2 mm); a disc with less than 0.015 to 0.020 in. (0.38 to 0.5 mm) should be replaced.



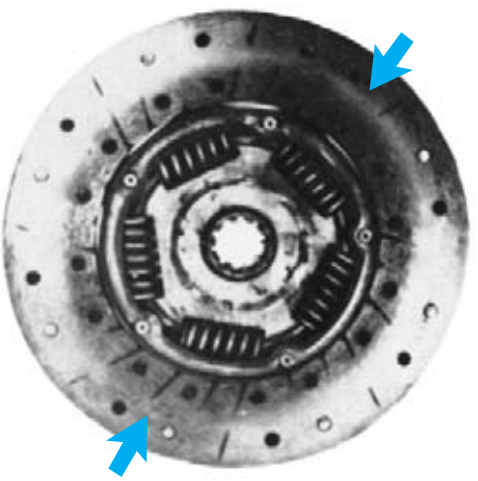
(a)



(c)



(b)



(d) Wear Pattern from Warped Pressure Plate

FIGURE 5-24 Remaining clutch disc facing can be measured using a vernier caliper (a); overall disc thickness can be measured using a vernier caliper (b) or micrometer (c). There is no need to measure a disc that is worn down to the grooves (d). *(a is courtesy of Toyota Motor Sales USA, Inc.; d is courtesy of Ford Motor Company)*

splines; a tight-fitting clutch shaft spline will work. The disc is rotated while watching for runout or wobbling of the facing surfaces (Figure 5-25). More than 0.020 in. (0.5 mm) is excessive, and the disc should be replaced.

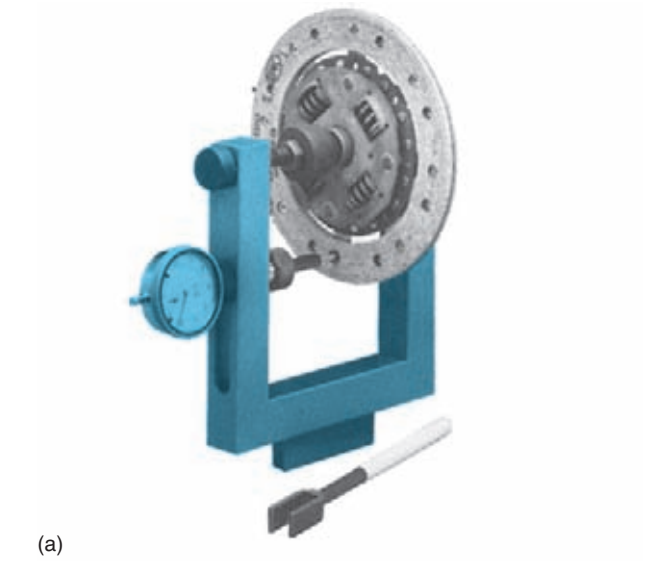
TECH TIP

A quick check for warpage is to set the disc against the flywheel. The facing should contact the flywheel evenly all around the disc.

Clutch/Bell Housing. There should be no oil or grease residue inside the bell housing. If oil is present, check the crankshaft seal and the plugs sealing the camshaft or oil galleys. If there has been early failure of the pilot or release bearings, clutch pedal vibration, or the transmission is jumping out of gear, the face and bore surfaces of the bell housing should be checked for excessive runout. These checks are made with a dial indicator that is attached to the crankshaft, flywheel, pressure plate, or disc, depending on the equipment available and how far the clutch is disassembled.

To check clutch housing face runout, you should:

1. Mount a dial indicator onto the flywheel with its mounting post running through the bell housing bore. The measuring stem should be against the transmission



(a)

(b)

FIGURE 5-25 (a) It is a good practice to check a disc for lateral runout by rotating it on the transmission clutch shaft or a tool for that purpose. (b) Also check to make sure that the disc slides freely on the shaft splines. *(a is courtesy of LUK Clutches)*

mounting surface with the measuring stem parallel to the crankshaft.

2. Adjust the dial indicator to read zero.
3. Rotate the crankshaft while reading the indicator (Figure 5-26). Maintain a forward or rearward pressure to eliminate crankshaft end play.
4. Any variation in reading is the amount of face runout.

To check clutch housing bore runout, you should:

1. Reposition the dial indicator so the measuring stem is inside the bore and pointing outward.
2. Adjust the dial indicator to read zero.

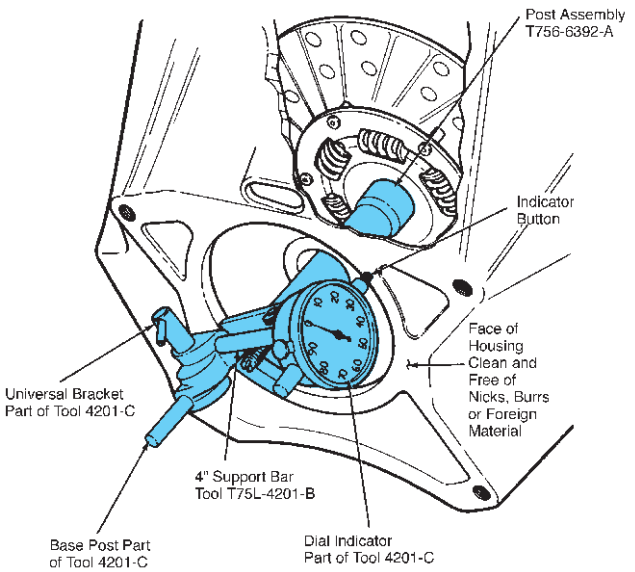


FIGURE 5-26 A dial indicator is mounted to the clutch disc or the pressure plate assembly and the crankshaft is rotated to check for runout at the face of the clutch housing. It can also be mounted to the crankshaft to check for runout of the clutch housing surface. *(Courtesy of Ford Motor Company)*

TECH TIP

The limit for face runout is about 0.010 in. (0.25 mm). If there is excessive runout, check for loose mounting bolts or dirt between the bell housing and the engine block. If the runout cannot be corrected, normally the bell housing is replaced, but it is possible to put shims between the bell housing and the engine block for correction.

TECH TIP

A wiggle bar is often used with a dial indicator to gain access to small areas (Figure 5-27a). The limit for bore runout is about 0.010 in. (0.25 mm).

3. Rotate the crankshaft while watching the indicator reading.
4. Any variation in reading is the amount of **bore runout**.

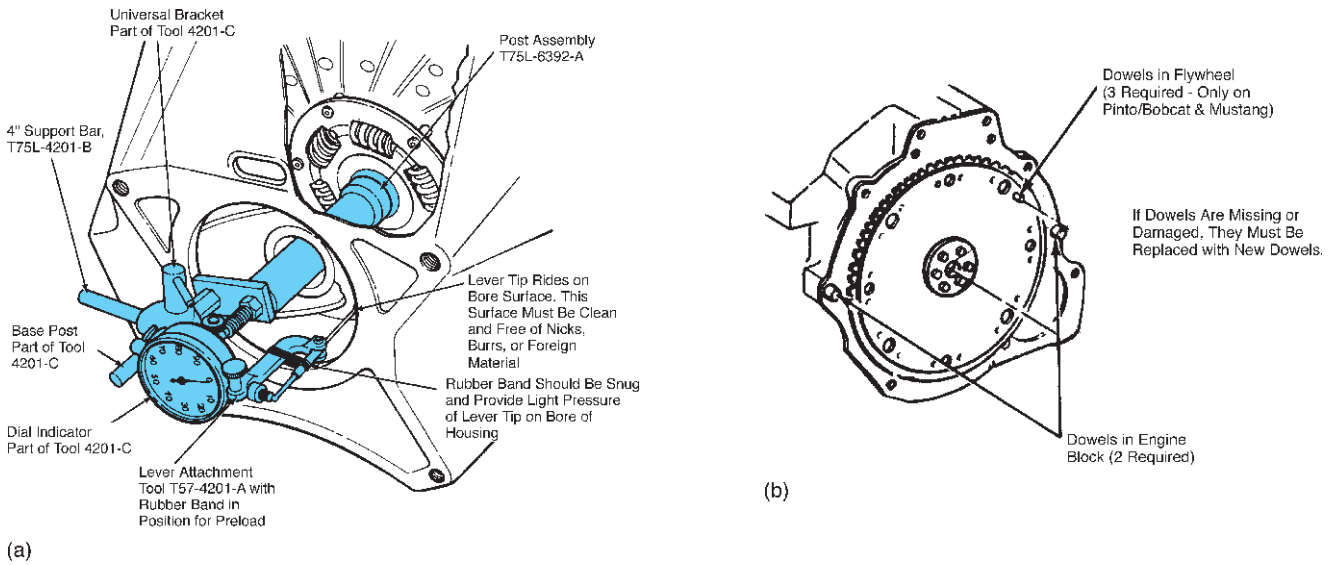


FIGURE 5-27 (a) This dial indicator has a lever or wiggle bar added to check clutch housing bore runout. (b) Excessive runout can be caused by damaged or missing dowels; if the dowels are good, runout can be corrected by installing eccentric dowels. *(Courtesy of Ford Motor Company)*

Bore runout can be corrected by using eccentric dowel pins to reposition the bell housing (Figure 5-27b). These are available in different sizes and positioned to move the bell housing the right distance in the correct direction to center the bore to the crankshaft.

Release Bearing. Other than feeling for roughness or seeing obvious wear or discoloration, there are no effective bench checks for release bearings. This is one reason why they are normally replaced with the disc and pressure plate.

The release bearing used on some older vehicles is a two-part assembly. The old bearing is pressed off the sleeve, and the new bearing is pressed onto it (Figure 5-28). Some vehicles use different lengths of release bearings. You should always check the replacement for correct length and type (Figure 5-29). Remember that a curved face bearing should never be used with a pressure plate with curved fingers.

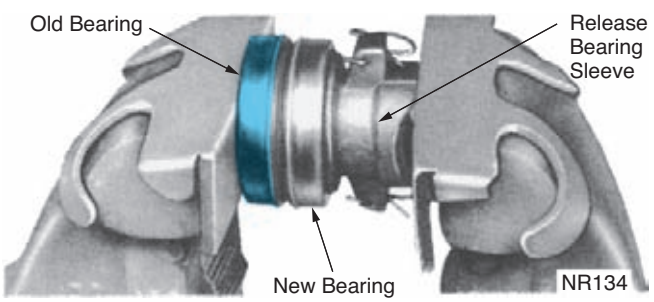


FIGURE 5-28 Some release bearings are mounted on a sleeve, and the old bearing can be used to install the new one, as shown here. *(Courtesy of DaimlerChrysler Corporation)*

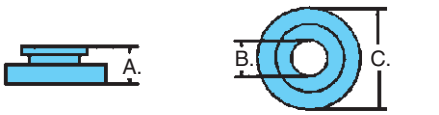
REAL WORLD FIX

The clutch in a 1991 Acura (65,000 mi) did not release. Even though the clutch was replaced 10,000 miles ago and still appeared good, the pressure plate and disc were replaced and the flywheel resurfaced. The clutch now released, but it had a chatter problem. The pedal did not feel right. Closer inspection showed a slight binding in the clutch cable. It was replaced, but this did not help.

Closer inspection revealed an improper return spring connection to the release bearing. Smoothing a damaged area where the release bearing operated and replacement of the release bearing and spring fixed this problem.

TECH TIP

Experienced technicians pick up and hold a new disc by the very outside edge or center hole, never touching the facing (Figures 5-30). A pressure plate assembly is handled by the cover, not the face of the pressure ring.



A. Height
B. I.D.
C. Bearing Face

Part No.	16001	16010	16021
Dim. A	1.485"	1.290"	1.635"
Dim. B	1.375"	1.375"	1.375"
Dim. C	2.930"	2.560"	2.930"
Application	GM., Used When Replacing Diaphragm Pressure Plate w/ 3-Finger Type	GM., All High-Cone Diaphragms & 12" B&B	GM., Used when 1600 Is Too Short for Proper Adjustment

FIGURE 5-29 Some vehicles use release bearings of different lengths; the critical dimensions are shown. *(Courtesy of McLeod Industries, Inc.)*

FIGURE 5-30 A new disc should be held by the edges or center spline to prevent contamination of the facing, which can cause chatter.

Clutch Replacement

During replacement, the clutch components must be kept clean and dry. All grease and oil that contacts the friction surfaces must be cleaned off. Small amounts of oil on the clutch facing will cause the clutch to grab or chatter.

When replacing a modular clutch assembly, the entire assembly is unbolted from the flexplate and a new assembly is installed. The new modular assembly has the clutch disc already centered between the flywheel and pressure plate (Figure 5-31).

The procedure described here begins with new or thoroughly checked and cleaned parts. Again, it is recommended that you follow the procedure described in a service manual when replacing the clutch on a particular vehicle. Before beginning assembly, check the new parts to ensure that they are the correct size and type.

To replace a clutch assembly:

1. Check the flywheel bolts to make sure that they are tight and torqued to specifications. Check the pilot bearing recess to ensure that it is clean, and drive the new pilot bearing into the crankshaft recess. The best tool for this is a commercial or shop-made driver with a stem the same size as the bearing bore and a face that is larger than the diameter of the bearing (Figure 5-32a).

   The new pilot bearing is driven in until it is fully seated or has entered completely into the crankshaft. Most pilot bearings do not require lubrication.

TECH TIP

A substitute for a special pilot bearing tool is a bushing driver or an old clutch shaft with a flat washer positioned between the bearing and the clutch shaft splines (Figure 5-32b).

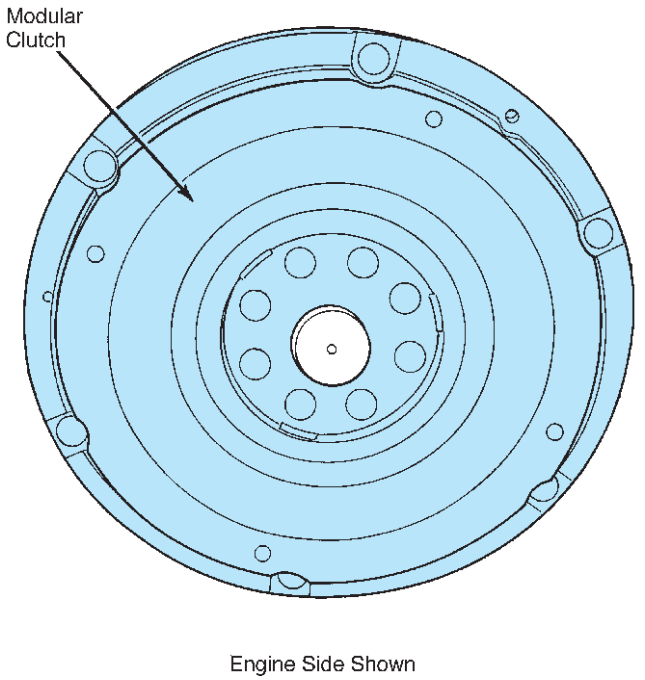


FIGURE 5-31 When replacing a modular clutch, the new modular assembly has a new flywheel, clutch disc, and pressure plate is bolted onto the flexplate. *(Courtesy of DaimlerChrysler Corporation)*

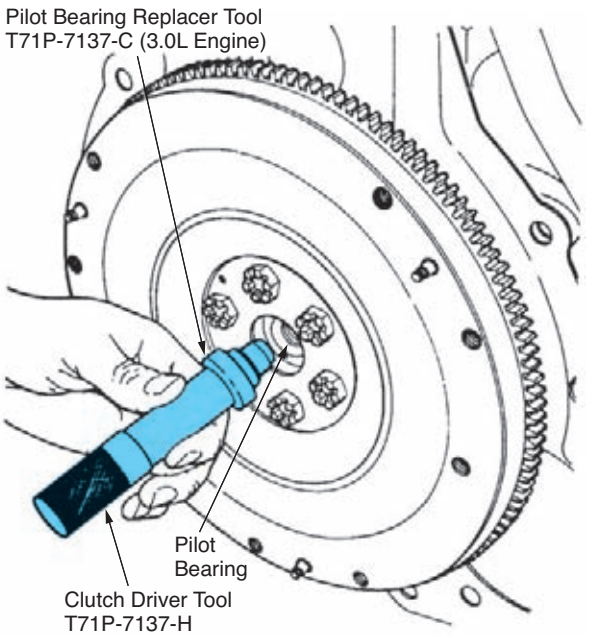
TECH TIP

Roller bearings with exposed rollers should be lubricated with a thin film of grease; a few drops of motor oil is all you should put on a sintered bushing.

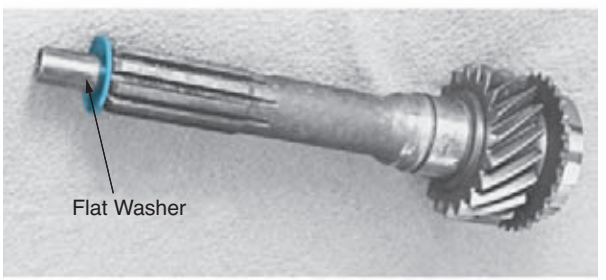
2. Place the new clutch disc over the transmission clutch shaft and make sure that it slides freely over the splines. Next, determine which side of the disc goes against the flywheel; it will often be marked "flywheel side." If not, the damper assembly normally faces the pressure plate.

TECH TIP

Oil or grease on the clutch lining can cause **grab**. Avoid using too much lubricant at the various locations, and handle the disc properly to keep the lining surfaces clean.



(a)



(b)

FIGURE 5-32 (a) A new pilot bearing should be installed using a driver. (b) If a clutch shaft is used as a driver, a flat washer should be placed on the shaft to prevent damaging the bearing. *(a is courtesy of Ford Motor Company)*

REAL WORLD FIX

A 1994 Honda Civic (216,000 mi) was towed into the shop with a bad clutch. The slave cylinder was leaking, and the clutch was slipping. Disassembly showed a completely worn-out disc. A new clutch disc, release bearing, and slave cylinder were installed, and the flywheel was resurfaced at this time. On engine start-up, the clutch would not release. The pedal felt good, and the release lever moved properly.

Disassembly showed that the disc was installed correctly, but the splines were wrong so the disc did not slide easily on the transmission shaft. Installation of the correct disc fixed this problem.

REAL WORLD FIX

A 1994 Acura NSX (65,000 mi) had a bad clutch. Because of the cost of the replacement parts, the vehicle owner requested that only the friction discs be replaced. The flywheel and intermediate plate (two-plate clutch) were touched up using an abrasive pad. The transmission splines were lubricated using synthetic grease. But, the clutch would not release.

This two-plate clutch requires an initializing adjustment to set the clearance between the mid plate and the flywheel. Making this adjustment fixed this problem.

TECH TIP

To determine the correct clutch disc position, place each side of the disc against the flywheel and rotate it; the side that contacts the flywheel bolts or does not let the clutch facing contact the flywheel is the wrong side (Figure 5-33).

3. Position the **disc alignment** tool through the disc and into the pilot bearing to center the disc (Figure 5-34). Many shops use a tool with expanding collets that locks into the pilot bearing and tapered centering cones for the disc. An old transmission clutch shaft is a good substitute. If using commercial wooden or plastic alignment

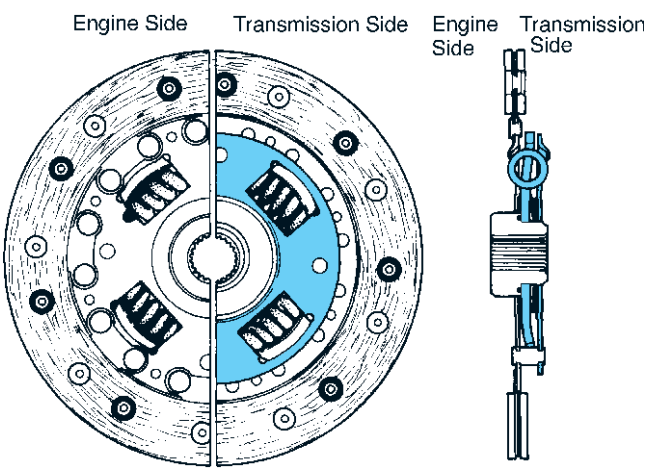


FIGURE 5-33 Many replacement discs will have a marking indicating the flywheel or pressure plate side; the damper assembly is normally on the pressure plate or transmission side. *(Courtesy of LUK Clutches)*

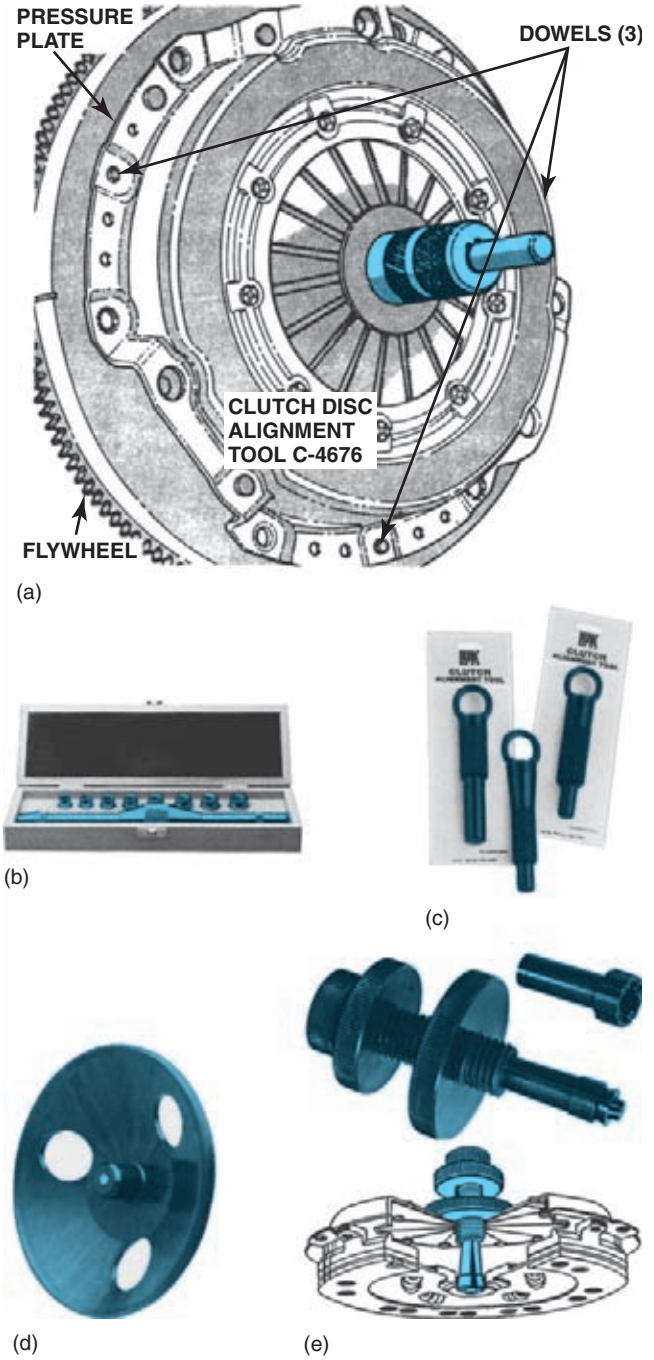


FIGURE 5-34 (a) Most manufacturers use special tools to hold the disc in alignment while the pressure plate bolts are tightened. These tools are also available from aftermarket sources in sets to fit many vehicles (b) or a specific vehicle (c and d). The tool shown in d is used for edge-centered discs. (e) A recently developed tool holds the disc centered to the pressure plate. *(a is courtesy of DaimlerChrysler Corporation; b, c, and d are courtesy of LUK Clutches; e is courtesy of Vim Tools)*

TECH TIP

A simple disc alignment tool can be made if a disc alignment tool is not available. This tool holds the disc in a centered position against the pressure plate as the pressure plate is installed. The materials needed to make the tool are a short length of 3/8" or 5/16" threaded rod, a large washer, and a nut, as shown in Figure 5-35. A hook to catch the center of the disc is formed at one end of the rod, and this hook should be flattened so it will be easier to remove. The washer must be large enough to press against the pressure plate levers/fingers. To use this tool, center the disc on the pressure plate, install the tool as shown, and tighten the nut enough to hold them together. Make sure the outer edge of the disc is centered to the pressure plate. Next, install the pressure plate, and then remove the tool.

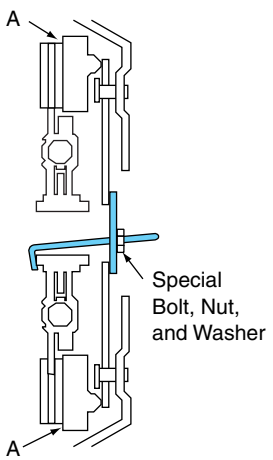


FIGURE 5-35 A simple, shop-made tool can be used to hold the disc centered against the pressure plate as the pressure plate is installed. The gaps at the edge of the disc and pressure plate (A) should be equal.

tools, make sure they fit closely enough to center the disc. Many transaxles do not use a pilot bearing. Clutches without a pilot bearing are OD (outside diameter) centered; the centering edge (outside) of the disc must be perfectly aligned with the flywheel. Another style of alignment tool holds the disc centered onto the pressure plate while the pressure plate is installed.

4. Install the pressure plate over the disc, making sure that it is properly aligned with the dowel pins and mounting bolt holes, and install the mounting bolts. If reusing a pressure plate, align your index marks made earlier. In some cases, you will need to do this before step 3.

REAL WORLD FIX

A Volkswagen Fox (127,000 mi) clutch would not release. The clutch components were replaced, but the clutch still would not release. The clutch pedal and cable were okay.

Removal of the clutch and comparing it with a new set of clutch components revealed that the wrong parts were used on the original replacement. Using the right parts fixed this problem.

NOTE: If installing a pressure plate equipped with a self-adjusting fulcrum ring, check the length of the adjusting ring actuation springs (Figure 5-36). If the length exceeds specifications, place the assembly in a press or drill press, and use an old release bearing to compress the diaphragm fingers to a released position. Then rotate the adjusting ring so that the springs are compressed to the proper length, release the press pressure, and install the pressure plate assembly.

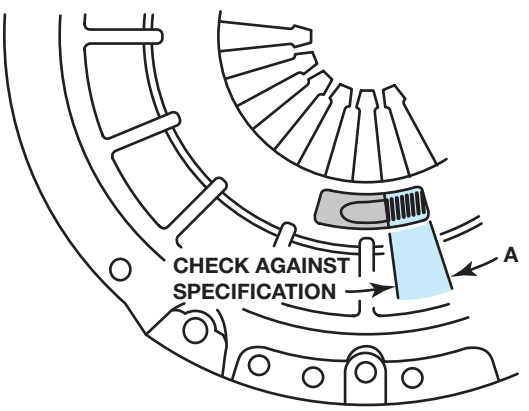


FIGURE 5-36 When installing a pressure plate with a self-adjusting fulcrum ring, check dimension A. If the distance exceeds the specification, follow the proper procedure to adjust it.

5. Tighten the mounting bolts two turns at a time alternating back and forth across the pressure plate (Figure 5-37). They should be tightened to the correct torque.

TECH TIP

Remove the alignment device and check to make sure that the pilot bearing is in the exact center of the disc (Figure 5-38).

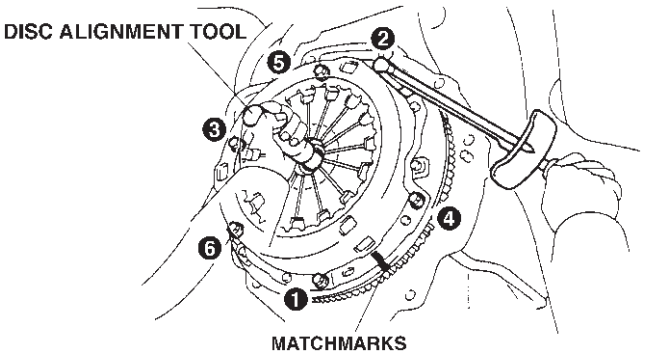


FIGURE 5-37 With the disc held centered, the pressure plate bolts should be tightened two turns at a time in a pattern like this. *(Courtesy of Toyota Motor Sales USA, Inc.)*

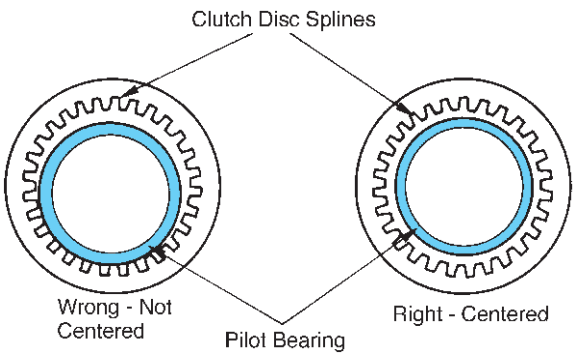


FIGURE 5-38 After the bolts have been tightened to the correct torque, sight down the splines to make sure that they are centered to the pilot bearing.

TECH TIP

The height variation of the release levers can be checked after the pressure plate is installed. Using a vernier or dial caliper, measure from the contact face for the release bearing to the clutch disc. All of the heights should be within 0.020 in. (50 mm) (Figure 5-39). The readings will be more accurate after the clutch has been applied a few times. Some technicians will assemble a pressure plate, disc, and flywheel off the vehicle, and then apply and release the clutch in a press before checking finger height.

6. Check the clutch linkage to make sure that it operates smoothly. On cable-operated clutches, this is a good time to remove, clean, and lubricate the cable.
7. Fill the groove inside the bore of the release bearing with grease, apply a thin film of grease on the fork contact areas, and slide the release bearing onto the transmission quill, making sure that the bearing collar slides smoothly (Figure 5-40). The quill portion of the transmission bearing retainer should be smooth and unworn. On clutch forks that use pivot balls, a thin film of grease should be put on the ball. On forks mounted on pivot shafts, the pivot bushings should be lubricated.

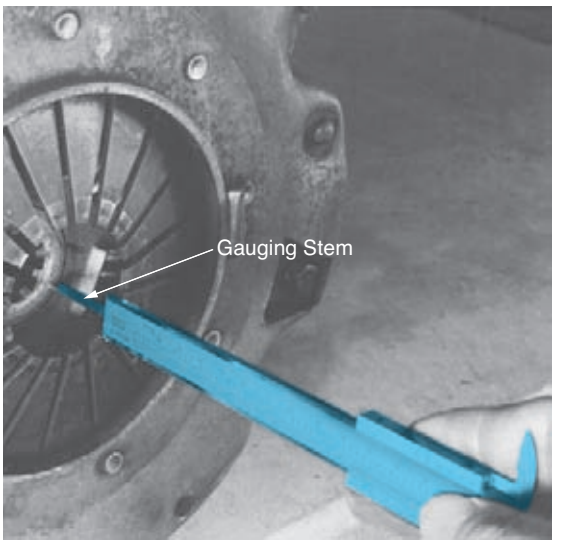


FIGURE 5-39 The height of the release levers can be measured after the pressure plate assembly has been installed by measuring from the fingers to the hub of the disc. The reasings should all be the same.

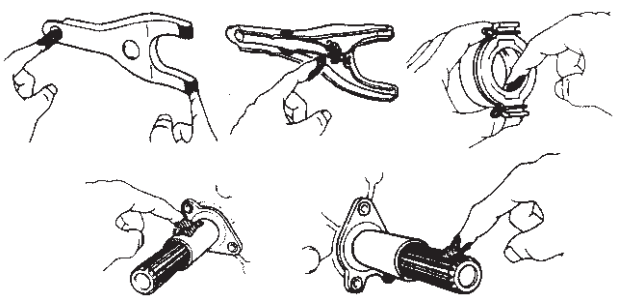
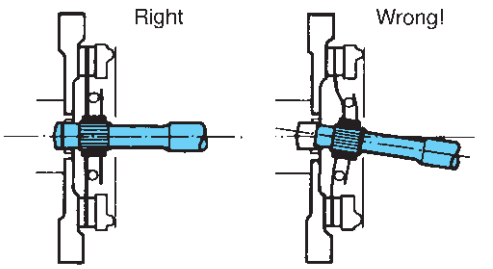


FIGURE 5-40 The contact points of the fork and release bearing along with the transmission quill and clutch splines should be lubricated with a very thin film of grease. *(Courtesy of Toyota Motor Sales USA, Inc.)*

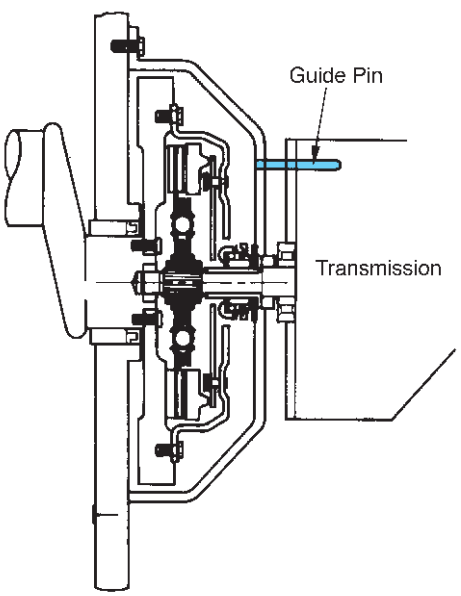
TECH TIP

Watch the release levers as the pressure plate is tightened onto the flywheel. They should start to move toward the flywheel when the clutch cover is about 1/8" to 3/16" from the flywheel.

8. Replace the transmission, being sure to observe these points:
   - Place a very thin film of grease on the clutch splines.
   - Never let the transmission hang on the clutch disc splines. A simple way to prevent this and also make the installation easier is to use a pair of guide pins to support the transmission while it is slid into place (Figure 5-41).
   - Make sure that no wires, cables, or hoses are trapped under the clutch housing or transmission as it is installed.
   - The transmission should be completely seated against the clutch housing or engine before the mounting bolts are tightened.
   - Tighten the transmission mounting bolts two turns at a time, working back and forth across the transmission until they are tightened to the correct torque. It should not be necessary to force the transmission into place.
   - Complete the transmission installation as described in Chapter 8.
   - Adjust the free travel before operating the clutch.



(a)



(b)

FIGURE 5-41 (a) "Hanging" a partially installed transmission on the disc will bend the center of the disc. (b) Installation of guide pins will support the transmission as you slide it into place. *(a is courtesy of LUK Clutches)*

REAL WORLD FIX

A 1985 Chevrolet K30 pickup (157,000 mi.) came in with no clutch. The hydraulic system was bled, and the clutch tested good. But during a road test, the clutch would no longer release. The clutch master cylinder, slave cylinder, and connecting hose were replaced, but the problem was still there.

The technician blocked the outlet line of the master cylinder, and a solid clutch pedal proved that the master cylinder worked properly. Closer inspection showed that there was no fluid movement at the reservoir when the clutch pedal was applied. Replacement of the hose between the reservoir and the master cylinder fixed this problem.

REAL WORLD PROBLEM

Imagine that you are working in a general automotive repair shop and these problems are brought to you.

Case 1

Your boss has taken in a job to replace the clutch disc in a high mileage FWD car and you have just removed the pressure plate assembly. The clutch disc is worn out, and both the pressure ring and the flywheel are grooved, checked, and polished from slippage. What parts should you replace or recondition as you complete this job?

Case 2

The mechanic in the bay next to you is completing a clutch job on a pickup and has asked you to help install the transmission. The two of you place the transmission on the guide pins. It slides in easily but stops about 3/4 in. from the clutch housing; it won't go any farther. What is wrong? What should you recommend to your partner?

REAL WORLD FIX

A 1992 Isuzu Rodeo (174,000 mi) came in with no clutch. A leaking clutch master cylinder was found and replaced, but this did not help. The transmission was difficult to shift. The transmission was removed and a new slave cylinder, clutch disc, pressure plate, release bearing, fork, and fork pivot stud were installed. The clutch still did not work properly.

An adjustable slave cylinder rod was located and installed. Adjustment of the clutch pedal free travel fixed this problem.

REAL WORLD FIX

A Mitsubishi pickup (173,000 mi) clutch was replaced, but the truck soon came back with a broken clutch lever. The customer stated that this was the second time the lever had broken. The clutch appeared okay, and it worked properly after the lever was replaced. What caused the unusual lever breakage?

An inspection showed that the engine balance shaft was out of time. Replacement of the camshaft timing belt and properly timing the balance shaft fixed this problem.

REAL WORLD FIX

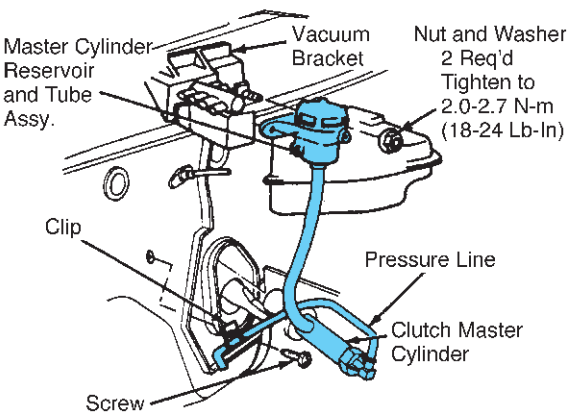
The clutch (pressure plate, disc, throwout bearing, and master cylinder) on a 1995 Camaro was replaced by another shop, but it did not release until the pedal was at the floor. The system was bled, but the slave cylinder did not travel far enough to allow disengagement.

Disassembly of the clutch revealed that the mechanic had installed the throw-out bearing backwards.

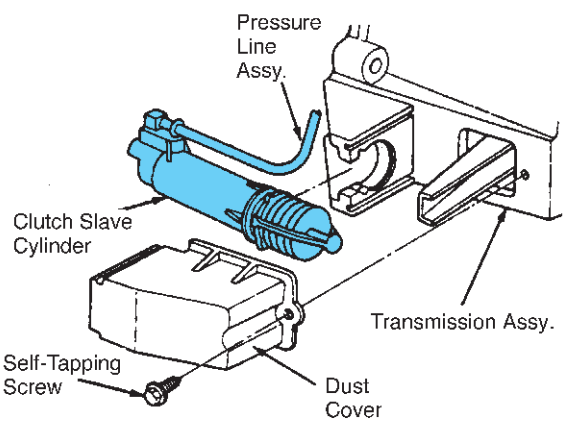
HYDRAULIC SYSTEM REPAIR

Fluid leaks or failure to release completely indicate the need for hydraulic system service. Clutch hydraulic systems have evolved from the early systems that had free travel adjustment and required clearance at the release bearing to newer systems that maintain a slight preload. The older systems used rebuildable master and slave cylinders much like brake components, whereas the newer systems use nonrebuildable cylinders that are serviced by replacement. The older systems used steel and reinforced rubber lines with threaded fittings, whereas the newer systems use plastic tubing sealed by O-rings and held together by locking pins at the connections (Figures 5-42).

A drop in fluid level at the reservoir indicates a fluid leak. Normally, facing wear will cause an increase, or rise, in the fluid level, so topping off the reservoir is not necessary or recommended. The cause of a fluid leak is usually found through visual inspection of the cylinders and lines to locate the wetness. Fluid leak repair is done by correcting the fault: tightening a line fitting, replacing an O-ring, or rebuilding or replacing a defective part (Figure 5-43).



(a)



(b)

FIGURE 5-42 On some cars, faulty clutch master (a) or slave (b) cylinders are removed and replaced with new units. *(Courtesy of Ford Motor Company)*

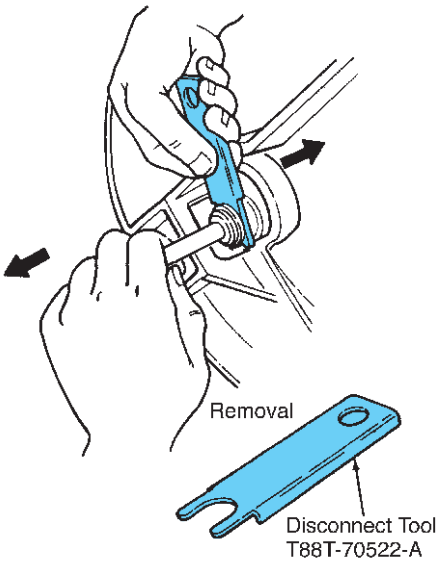


FIGURE 5-43 Most older cars used threaded line connections to the clutch master and slave cylinders. This vehicle uses a snap-in connector that requires a special tool for disassembly. *(Courtesy of Ford Motor Company)*

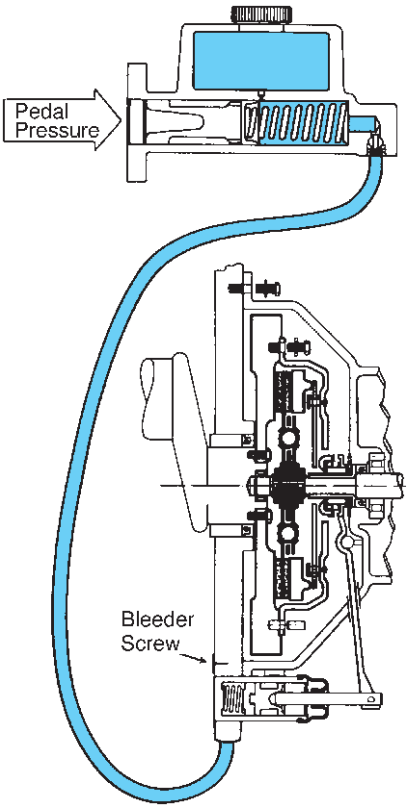


FIGURE 5-44 On many clutch systems, loosening the bleeder screw at the slave cylinder allows gravity to push the air out of the slave cylinder. Sometimes, it is necessary to have an assistant apply pressure at the pedal as the bleeder screw is opened. *(Courtesy of LUK Clutches)*

TECH TIP

We **bleed** a hydraulic system to remove air. Air is compressible, and air in a hydraulic system will cause a low, spongy clutch pedal or possibly, a failure to release completely.

Inability to release the clutch completely can be checked by observing slave cylinder travel as the clutch pedal is depressed. The slave cylinder should begin moving immediately and travel in a smooth, steady manner. Some manufacturers provide slave cylinder travel or extension specifications. For example, one manufacturer specifies 0.53 in. (13.5 mm) of slave cylinder motion for one complete stroke of the clutch pedal (see Figure 5-9). Insufficient slave cylinder travel indicates air in the system or a faulty slave or master cylinder.

In many cases, a clutch hydraulic system can be bled by **gravity bleeding**; in others, a helper is needed.

To bleed a clutch hydraulic system using the gravity method:

1. Clean the bleeder valve at the slave cylinder and place a shop cloth under it to catch escaping fluid.
2. Open the bleed valve by loosening the bleeder screw and observe the flow (Figure 5-44). If no flow occurs, have a helper depress the clutch pedal in a smooth, slow manner. Air bubbles coming from the bleed valve indicate that the system needed bleeding. After the air bubbles stop and a constant flow of fluid occurs, close the bleed valve and wipe up any spilled fluid. An alternative method is reverse, or back, bleeding. This is done by forcing fluid through the slave cylinder bleed valve and upward to the reservoir (Figure 5-45).
3. Check the fluid level and correct it, if necessary.

TECH TIP

A good tool for pumping fluid into the bleed value is a common squirt-type oil can that has never had oil in it.

REAL WORLD FIX

The clutch failed in the 1990 Nissan 300ZX (81,000 mi) because the clutch arm pivot ball broke, which allowed the slave cylinder to come apart. The broken part along with the slave cylinder, clutch disc, pressure plate, and release bearing were replaced. But, the clutch pedal would go the floor without releasing the clutch. The clutch master cylinder was replaced, and a clutch adjustment was made. The clutch worked so the vehicle was returned to the customer, but a few days later it returned with a slipping clutch.

The technician discovered that a bleed screw was located near the right headlight. Opening this bleeder let a lot of air out of the clutch line. Completely bleeding the clutch along with a free travel readjustment fixed this comeback.

REAL WORLD FIX

The clutch of a 1992 2.2-L Cavalier (45,000 mi) slips at high rpm upshifts and downshifts. It was replaced 14,000 miles ago for the same problem. The clutch was disassembled, but there was no sign of anything wrong.

Close inspection of the clutch master cylinder revealed a snap ring cocked in the bore that prevented the piston from returning completely. Proper installation of this snap ring fixed this problem. The incomplete return of the master cylinder piston caused a pressure on the release bearing, which held the clutch in a partially released condition.

REAL WORLD FIX

The 1997 Chevrolet Cavalier (35,000 mi) worked fine in city driving but after about 30 miles of driving, the pedal became mushy and it was hard to shift gears. The clutch system had been bled and the master cylinder had been replaced, with no positive result.

While the transaxle was being removed, the slave cylinder came apart, revealing a faulty unit. Replacement of the slave cylinder fixed this problem.

REAL WORLD FIX

The clutch on a 1989 Ford Ranger (122,000 mi) was replaced, but the clutch did not disengage. The pedal went to the floor. The hydraulic system was bled several times, even with the back end and each side of the vehicle lifted.

This master cylinder is mounted at a rather steep angle. Disconnecting the master cylinder mounting so it could be held level allowed the air to be bled out, and this fixed this problem.

REAL WORLD PROBLEM

Imagine that you are working in a general automotive repair shop and this problem was brought to you.

Case 1

The owner of a 3-year-old FWD car has a complaint of gear clash on shifting into first or reverse gear. When you start the car, your check confirms the problem, and you also notice a slightly mushy pedal operation. With the engine off, your inspection shows no free travel and the pedal going completely inspection to the floor with fairly normal resistance. Your underhood check shows that the fluid level in the clutch reservoir is okay and has no signs of leakage. What is probably wrong? What should you do next?

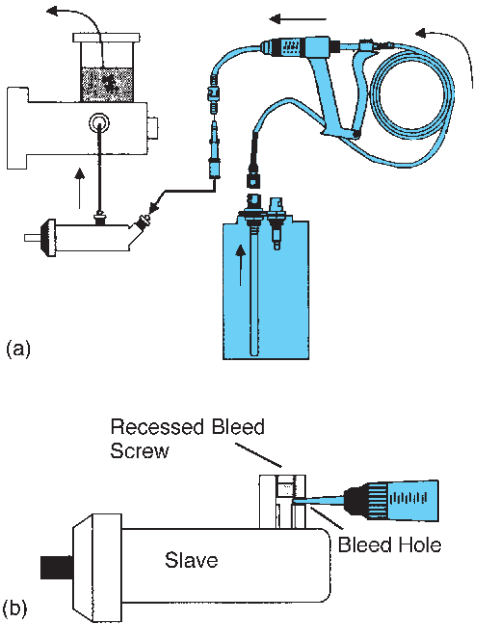


FIGURE 5-45 A clutch hydraulic system can be reverse bled by pumping fluid through the bleeder valve or hole and up to the reservoir; the air will leave the fluid at the reservoir. *(Courtesy of Phoenix Systems)*

TECH TIP

Some master and slave cylinders are mounted so that the cylinder portion is above the line connection, which makes it extremely difficult to bleed air from them. In some cases, it is possible to **bench bleed** them to remove all the air before installing on the vehicle (Figure 5-46). If you need to bleed one of these difficult systems, an alternative bleeding method is to have a helper partially apply the clutch while reverse bleeding using pressure surges from the fluid injector (Figure 5-47).

TECH TIP

Some clutch hydraulic systems will partially self-bleed if the clutch pedal is held completely depressed overnight using a brake pedal jack. Another bleeding method is to construct an adapter to the fluid reservoir so you can apply a vacuum to the fluid using a hand, electric, or air-powered vacuum pump. Reducing the air pressure on the fluid will cause the air bubble to expand and move upward to the reservoir.

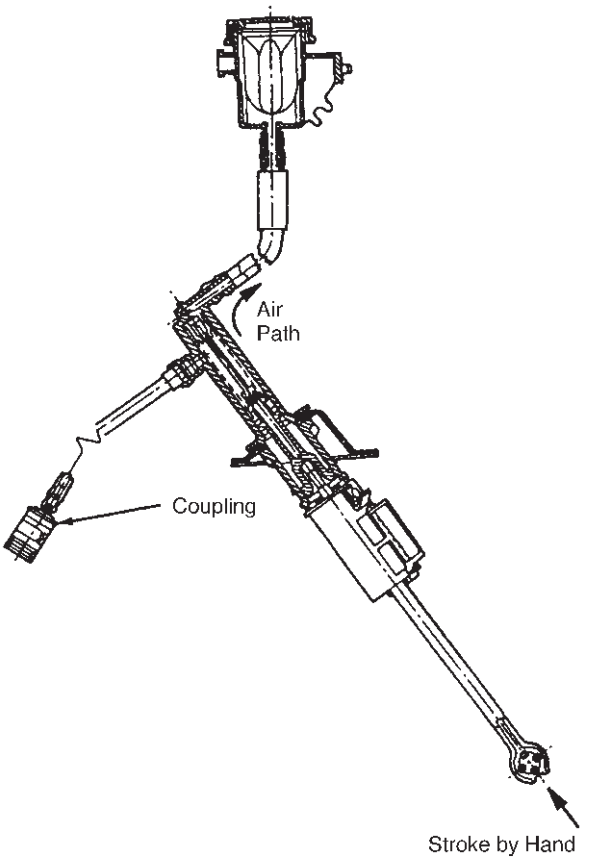


FIGURE 5-46 This clutch master cylinder is mounted with the push-rod end above the inlet and outlet, which makes bleeding difficult. It can be bench bled by stroking the push rod by hand before mounting the master cylinder. *(Courtesy of Ford Motor Company)*

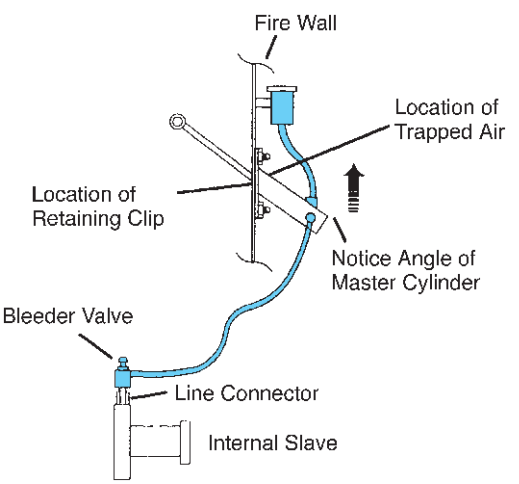


FIGURE 5-47 Another way of bleeding a difficult clutch master cylinder is to have an assistant depress the clutch pedal, build a pressure in the system using a fluid injector at the bleeder valve, and slowly release the pedal. The pressure surge will force the trapped air upward. This operation should be repeated several times. *(Courtesy of Phoenix Systems)*

SUMMARY

- Clutch system preventive maintenance ensures proper clutch pedal free travel and/or proper master cylinder fluid level.
- Excessive slippage, grab, chatter, and unusual noise are common indications of clutch problems.
- A clutch job requires transmission/transaxle removal to replace the pressure plate, disc, release bearing, and pilot bearing.
- Abnormal clutch failure requires additional checks to locate the root cause of the failure.
- The clutch disc must be kept clean and centered to the pilot bearing during installation.
- Newer hydraulic systems are replaced as an assembly. They are prefilled with fluid, eliminating the need for system bleeding.

REVIEW QUESTIONS

1. The clutch pedal free travel will _____ as the clutch disc facing wears.
2. Clutch pedal free _____ is the light resistance of the clutch pedal return spring as the clutch pedal is first depressed.
3. When checking for clutch slipping in the shop, the technician should have the _____ firmly applied.
4. When checking for a slipping clutch while on a road test, a clutch that is slipping will be most noticeable when driving _____.
5. Clutch drag will cause _____ when shifting.
6. When checking for a clutch noise, if the noise is noticed just beyond pedal free travel, the probable cause is the _____.
7. When checking for a clutch noise, if the noise is noticed when the clutch is completely disengaged the probable cause is the _____.
8. Clutch replacement normally involves replacing four components. What are they?
   a. _____
   b. _____
   c. _____
   d. _____
9. When removing a clutch _____, always remove the fasteners evenly.
10. The recommended method of surfacing the flywheel is _____.
11. Oil or grease on the clutch disc facing may cause it to _____ or _____.
12. An old transmission _____ shaft can be used as a clutch disc alignment tool.
13. Never let the transmission _____ on the clutch disc splines.
14. A drop in fluid level in the clutch master cylinder _____ indicates a fluid leak.
15. After a clutch master cylinder is replaced, it must be _____.

CHAPTER QUIZ

1. While discussing clutch adjustments, Student A says that free travel is always measured at the clutch pedal and should be between 3/4 and 1 in. (19 and 25 mm). Student B says free travel should be more than one inch in most newer vehicles. Who is correct?
   a. Student A
   b. Student B
   c. Both A and B
   d. Neither A nor B
2. A vehicle has a slipping clutch. Student A says slippage is most noticeable when accelerating in first gear. Student B says a clutch slip test can be performed in the shop. Who is correct?
   a. Student A
   b. Student B
   c. Both A and B
   d. Neither A nor B

3. Clutch chatter can be caused by (A) grease or oil on the clutch facing; (B) broken motor mounts. Which is correct?
   a. A only
   b. B only
   c. Both A and B
   d. Neither A nor B

4. Student A says that a long clutch spin down is also called drag. Student B says this can be caused by letting the transmission hang on the clutch shaft during installation. Who is correct?
   a. Student A
   b. Student B
   c. Both A and B
   d. Neither A nor B

5. Student A says that clutch slipping can be caused by a warped clutch disc. Student B says that slippage is the result of too much free travel. Who is correct?
   a. Student A
   b. Student B
   c. Both A and B
   d. Neither A nor B

6. A squeal begins as the clutch pedal is depressed about 1 in. (25 mm). This is probably caused by (A) a faulty transmission bearing; (B) a bad pilot bearing. Which is correct?
   a. A only
   b. B only
   c. Both A and B
   d. Neither A nor B

7. Student A says you should replace at least four parts when you do a clutch job: the pressure plate, disc, release bearing, and pilot bearing. Student B says that breathing the dust around a worn pressure plate or disc can cause lung cancer. Who is correct?
   a. Student A
   b. Student B
   c. Both A and B
   d. Neither A nor B

8. Of the following, which is not a normal problem with worn discs?
   a. facing worn down to the rivets
   b. broken damper springs
   c. expanded marcel
   d. worn splines

9. While discussing the installation of a clutch disc, Student A says the damper assembly is normally positioned next to the flywheel. Student B says that some discs are aligned by their outer edge. Who is correct?
   a. Student A
   b. Student B
   c. Both A and B
   d. Neither A nor B

10. Student A says that a pilot bearing can usually be removed using chassis grease and a round rod of the correct size. Student B says that all pilot bearings need a thin coating of grease after installation. Who is correct?
    a. Student A
    b. Student B
    c. Both A and B
    d. Neither A nor B

11. Improper clutch disc alignment can cause (A) difficulty and possible damage as the transmission is installed; (B) early failure of the pressure plate. Which is correct?
    a. A only
    b. B only
    c. Both A and B
    d. Neither A nor B

12. During clutch installation, the clutch disc can be aligned to the pilot bearing using
    a. a commercial clutch disc alignment tool.
    b. an old transmission shaft.
    c. a plastic dummy transmission shaft.
    d. any of these.

13. While discussing the installation of a pressure plate, Student A says that grade 2 or better bolts can be used for the mounting bolts. Student B says that you need to move from bolt to bolt at least a dozen times while tightening the bolts. Who is correct?
    a. Student A
    b. Student B
    c. Both A and B
    d. Neither A nor B

14. Student A says that the groove in the bore of the release bearing should be filled with grease before it is installed. Student B says that too much grease in and around a clutch can lead to grab and chatter. Who is correct?
    a. Student A
    b. Student B
    c. Both A and B
    d. Neither A nor B

15. Student A says that clutch hydraulic cylinders can be rebuilt in the same manner as brake system cylinders. Student B says that a special brake bleeder is needed to get the air out of the hydraulic system. Who is correct?
    a. Student A
    b. Student B
    c. Both A and B
    d. Neither A nor B