Chapter 17

Rebuilding Automatic Transmissions and Transaxles

After studying this chapter, you will be able to:

- Disassemble an automatic transmission.
- Inspect the internal parts of an automatic transmission.
- Reassemble an automatic transmission.
- Disassemble an automatic transaxle.
- Inspect the internal parts of an automatic transaxle.
- Reassemble an automatic transaxle.
- Check endplay of an automatic transmission or transaxle.
- Perform air pressure checks on an automatic transmission or transaxle.

Technical Terms

Endplay
Soft parts
V-blocks
Leopard spotting
Clutch clearance

Introduction

Rebuilding, or overhauling, automatic transmissions and transaxles requires extensive knowledge and careful work habits. This chapter will outline automatic transmission and transaxle overhaul procedures. If you have studied the information in Chapter 3 and in Chapters 8–10, you will be familiar with the components and tools discussed in this chapter.

This chapter presents *general* procedures for rebuilding automatic transmissions and transaxles. Always refer to the manufacturer's service manual for specific information. It will contain accurate instructions for disassembling, cleaning, inspecting, and rebuilding the unit at hand. Note that certain procedures performed as part of the rebuilding operation—valve body service, for example—were covered in Chapter 15.

Note: For transaxle final drive rebuilding information, refer to Chapter 18.

Although a typical automatic transmission or transaxle contains many parts, it can be successfully rebuilt if you follow logical procedures.

Special service tools are sometimes needed when rebuilding an automatic transmission or transaxle. These tools can be purchased from the vehicle dealer or ordered directly from the manufacturer. Refer to Chapter 2 for more information on special service tools used to service automatic transmissions and transaxles.

Automatic Transmission and Transaxle Disassembly

Before beginning disassembly of a transmission or transaxle, clean the outside of the unit thoroughly and mount the unit in a holding fixture, **Figure 17-1.** If a holding fixture is not available, place the assembly on a clean workbench. The workbench should be constructed so that transmission fluid can drain into a catch basin.

As you remove the major parts of the transmission or transaxle, set them aside for further disassembly. Then work on one subassembly (pump, clutch pack, or servo, for example) at a time. This will help you keep things straight.

Removing External Components

The first step in disassembly is to remove the torque converter holding tool and the torque converter from the transmission or transaxle. Before proceeding, check the converter housing for dents or obvious leakage, and for stripped converter attaching bolt holes. Check the converter crankshaft pilot projection for burrs or damage, and check the oil pump driving lugs (if used) for wear or burrs. Then check input and output shaft endplay as shown in **Figure 17-2.** ***Endplay*** (back-and-forth movement of the shaft) should be checked before the transmission or transaxle is disassembled (and again after it is reassembled). Record the endplay readings for later reference. Excessive endplay indicates wear of the thrust washers and other parts. This should be corrected during the rebuilding process.

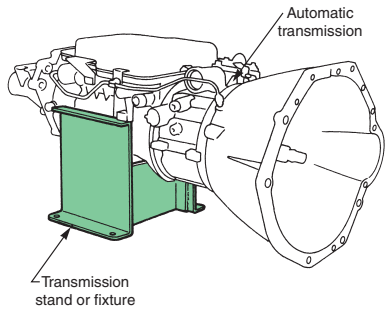


Figure 17-1. *It is much easier to overhaul a transmission or transaxle if it is placed in a special holding fixture. (Nissan)*

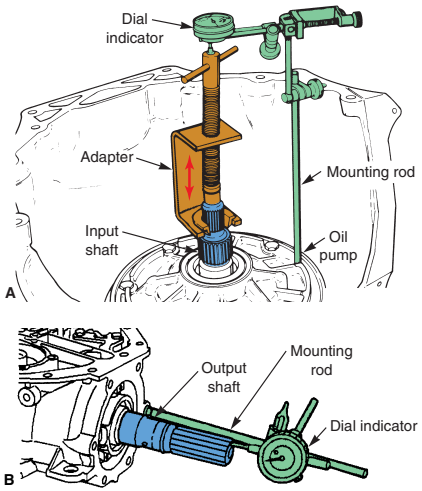


Figure 17-2. *Always check endplay before disassembling the transmission. The service manual will contain the endplay specifications and the procedures for setting up the dial indicators. A—Checking input shaft endplay. B—Checking output shaft endplay. (General Motors)*

After checking endplay, remove the oil pan. Check the pan for metal particles, varnish buildup, and sludge. Excessive sludge indicates that the holding members are burnt and the fluid has been overheated. Metal particles usually indicate that the torque converter, oil pump, planetary gearsets, or other moving parts are badly worn. If this is the first time the oil pan has been removed for service, it is normal to see a few aluminum particles in the pan. These particles were left over from case machining operations at the factory.

Removing the oil pan gives you access to the filter and valve body. The filter may be pressed into a case passageway and held in place with a clip on the valve body, or it may be bolted directly to the valve body. Remove the filter at this time.

After the filter has been removed, the valve body bolts can be unfastened and the valve body can be removed from the case. As you lift the valve body from the case, carefully note the position of all valve body parts, including springs, oil feed tubes, linkage attachments, and check balls. If applicable, you should also remove the vacuum modulator, push rod, and throttle valve from the case at this time. See **Figure 17-3.** Place the assembled valve body and related parts, as well as any modulator parts, together on the workbench.

If you are disassembling a transaxle, remove any side or top covers; then remove the side or top valve body. Note the location of all tubes and check balls. If the transaxle uses a transfer plate, remove it also.

Remove the bolts holding the extension housing to the case. Extension housings are sometimes called tailshaft housings. The extension housing should pull off over the output shaft after the bolts are removed. A few extension housings contain an output shaft bearing, which supports the output shaft. In this design, the bearing snap ring must be expanded before the extension housing can be slid from the shaft.

After removing the extension housing, you can remove the governor. This step applies only to governors mounted on the output shaft, not those mounted in the case. If you are disassembling a transaxle with a drive chain, check the chain for wear as shown in **Figure 17-4.** Then remove the chain and sprocket assembly. If the transaxle uses transfer gears, remove the gears and carefully check the teeth for wear. See **Figure 17-5.**

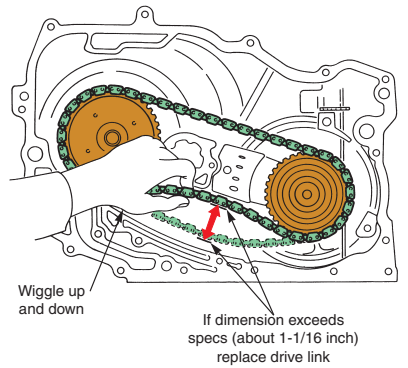


Figure 17-4. *Always check the drive chain for wear before disassembly. To disassemble, remove any snap rings that may be holding the sprockets to their shafts. Position the chain tensioner away from the chain. Then remove the chain and sprockets as an assembly by carefully sliding both sprockets off the transaxle shafts. Save any thrust washers placed between the cover and the sprockets. (DaimlerChrysler)*

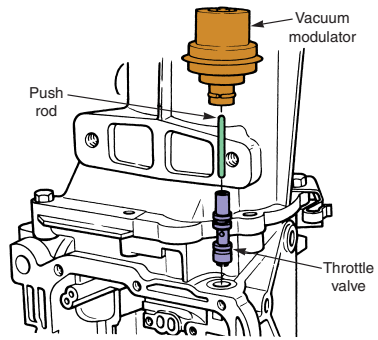


Figure 17-3. *The vacuum modulator and throttle valve can be removed now to prevent damage. Do not lose the pushrod, if the modulator uses one. (Ford)*

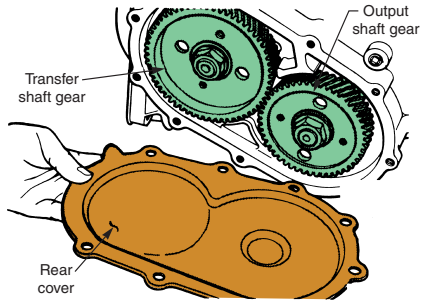


Figure 17-5. *Drive gears are installed behind a sheet metal cover. They should be checked for wear or damage. (General Motors)*

Remove the front oil pump seal as shown in **Figure 17-6.** It is generally easier to remove the seal before the oil pump is removed because the extra weight of the transmission/transaxle assembly allows you to use the slide hammer more efficiently. The front pump seal should always be changed when the pump is serviced.

The oil pump can be removed next. Manufacturers sometimes recommend removing the input shaft before removing the oil pump. However, some transmissions and transaxles are constructed so that the input shaft is pressed into the front clutch drum. In these designs, the shaft cannot be removed before the pump.

The pump usually fits tightly in the case, and some pressure must be applied to remove it. Some pumps can be removed by prying them out with a screwdriver or pry bar (once the valve body has been removed). Others must be removed with slide hammers or special pullers, **Figure 17-7.**

When removing the oil pump, always look for thrust washers, which may fall out of place. A few oil pumps have a clutch apply piston installed in their inner face. When this is the case, a set of friction discs and clutch plates is installed directly behind the pump. These parts should be removed and placed with the pump for later service.

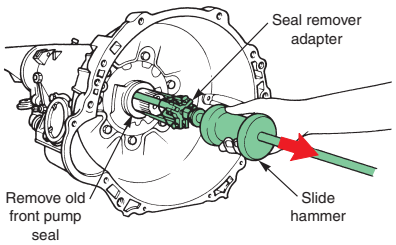


Figure 17-6. *It is easier to remove the front pump seal with the transmission or transaxle assembled. The weight of the unit allows the slide hammer to exert more force on the seal. (Ford)*

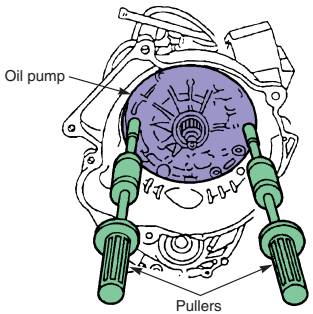


Figure 17-7. *Some pumps can be removed by pushing them out from the rear. On many transmissions and transaxles, however, the pump cannot be reached from the rear and must be removed with a slide hammer or special puller. (Ford)*

Removing Internal Components

With all the external parts out of the way, the internal components, such as the input shaft, bands, clutch packs, planetary gearsets, and output shaft, can be removed. Removal steps are similar for all manufacturers. The major factor affecting disassembly is whether or not the transmission or transaxle uses a center support.

On units without center supports, removing internal components is usually a simple matter once the oil front pump is removed. A typical procedure might involve loosening the front band adjuster, sliding the band out of the case, and then removing the forward clutch packs, front planetary gearset, and input shell as an assembly. Be sure to save all thrust washers, as they come out with these parts.

Once the front components have been removed, the rear planetary gearsets and holding members, as well as the output shaft, can be removed. Rear gearsets are removed through the front of the case. The output shaft will usually come out through the rear of the case.

Note that some clutch packs are held in place by a snap ring located on the sun gear, inside the input shell. This snap ring must be removed before the clutch pack and other internal parts can be removed. In addition, some rear planetary gearsets are held in place by a snap ring on the front of the output shaft. This snap ring must be removed in order to completely disassemble these components. Make sure the shaft does not fall out of the case after the snap ring is removed. Also, do not distort or stretch snap rings when removing them. Use snap ring pliers or another suitable tool.

As mentioned, some automatic transmissions have a center support. The center support in an automatic transmission may be retained by one or two case bolts located under the valve body and, sometimes, by bolts on the outside of the case. Other center supports are held in place by a retaining ring in the case, **Figure 17-8.** The center support keeps the rear clutches and gearsets in place. Always make sure the center support bolts or retaining rings have been removed before attempting to remove the center support and mechanical components.

Caution: Attempting to drive the rear clutch, planetary gearset, and shaft assemblies from the case without first removing the center support fasteners will severely damage these components, the center support, and the case.

Once the center support has been removed, the rear planetary gearsets, bands, clutches, and output shaft can

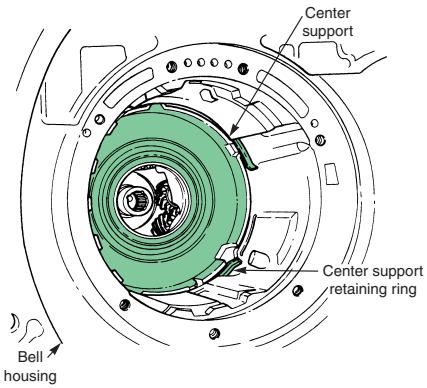


Figure 17-8. *Many modern transmissions and transaxles have a center support. The support shown here is held in place with a retaining ring, which must be removed before removing the rear planetary gearset and holding members, as well as the output shaft. (Ford)*

be removed. The gearsets, holding members, and output shaft can usually be removed through the front of the case. It may be necessary to remove the parking gear before removing the output shaft.

Once the mechanical components mentioned are removed, any internally mounted accessories can be removed. Examples of these parts include some servos, accumulators, clutch apply pistons (usually used at rear of case), and governors. If these parts are not mounted inside the case—for example, if they mount inside the oil pan—they will be removed with the other external components.

Note that many servos and accumulators are under strong spring pressure. Always consult the service manual before removing any retaining rings or bolts. It may be easier to leave the servos and accumulators installed in the case until it is time to inspect them and replace their seals. If the transmission is filled with sludge and debris, however, these parts should be removed at this time for a thorough cleaning.

Automatic Transmission and Transaxle Parts Cleaning

All automatic transmission or transaxle parts must be cleaned thoroughly. This is very important because small dirt particles or varnish formation can cause a passageway to plug up, a valve to stick, or a seal to leak.

Carefully scrape all old gasket material from the case, oil pan, and other parts. Pay attention to the gaskets on hydraulic control assemblies, such as the front pump, the valve body, and the spacer plates.

Clean all metal parts, including the case, with a safe solvent. It may be necessary to soak parts overnight. Do *not* clean clutch friction linings or seals with solvent. To avoid having a confusing pile of parts, always remember to work on one subassembly at a time while cleaning.

Warning: *Never* clean parts with gasoline or other flammable solvents. A fire could result!

Dry the cleaned parts with compressed air (if possible) or allow them to air dry. Do *not* use rags or shop towels to dry the parts, because they will leave lint on the parts. The lint left behind can cause valves to stick. It is better to leave slight deposits of solvent on the parts than to dry them with rags or shop towels. Once cleaned, cover the disassembled parts with a clean lint-free cloth if they are to sit out overnight.

Drain the torque converter. If there is a drain plug, remove it and set the converter upright with the drain at the lowest point. On converters without a drain plug, lay the center opening face down. This will allow most of the old transmission fluid to drain from the converter.

If the internal parts were very dirty or heavily coated with varnish, the torque converter will be full of dirt and varnish. A torque converter that is filled with dirt or metal particles can be cleaned with a converter flusher. Converter flushers were introduced in Chapter 3. A heavily varnished converter, however, is difficult to clean and is often replaced.

If there is evidence of fluid contamination, the oil cooler and cooler lines must be flushed out. One way to do this is to use an oil cooler and line flusher and follow up with a blast of compressed air directed into one of the cooling lines. Have a drain pan available to catch solvent flowing from the other line. Do *not* apply full air pressure to the cooling lines, as this could rupture the oil cooler. A badly contaminated oil cooler cannot be completely cleaned. Therefore, the radiator should be replaced or the cooler should be bypassed by installing an external oil cooler when a badly contaminated unit is encountered.

Parts Inspection and Repair

Once the transmission or transaxle is disassembled and cleaned, the parts can be inspected, replacement parts can be ordered, and subassemblies can be rebuilt. In this section, parts inspection and repair will be covered when describing the service of each subassembly. During an actual rebuild, internal parts will be inspected during and immediately after the unit is taken apart and cleaned. You should inspect transmission or transaxle parts one subassembly at a time. In this way, you can order replacement parts right away, eliminating time lost waiting for parts.

Note: During inspection, it is not absolutely necessary to check the *soft parts,* such as gaskets, lip seals, O-rings, seal rings, and friction discs. These parts are replaced during a rebuild. Checking the soft parts, however, will often help you to determine what caused the transmission or transaxle to fail.

Shaft Service

Automatic transmission and transaxle shafts, including input, output, and stator shafts, require little service. Check seal ring grooves and bushing surfaces for wear, scoring, and overheating. Inspect shaft splines for wear or damage, **Figure 17-9.** Any shaft with worn or damaged splines should be replaced. If you suspect that a shaft is bent or warped, it can be checked with ***V-blocks*** and a dial indicator as shown in **Figure 17-10.**

Figure 17-9. *After the transmission or transaxle has been disassembled, check shaft splines, bearing journals, and ring grooves for wear.*

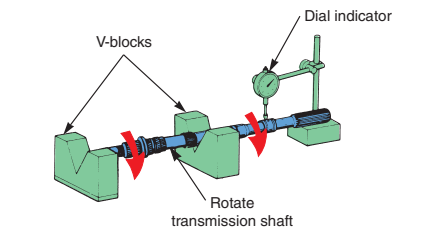


Figure 17-10. *Input and output shafts can be checked for bends or warpage using V-blocks and a dial indicator. Never attempt to straighten a bent or warped shaft. (Toyota)*

Planetary Gearset Service

Check the teeth of the planetary gears for wear, nicks, and chipping. **Figure 17-11** shows a gearset that has been destroyed. **Figure 17-12** shows a sun gear being inspected for tooth damage. Slightly nicked gears can cause noises and vibration, and eventually, they will fail completely. Splines found on the gearset members should also be checked for wear and damage. Check the clearance between the planet gears and the planet carrier to determine the amount of endplay, **Figure 17-13.** Planetary gearsets often contain bushings or needle bearings that wear out. These should be carefully checked, as well. Any parts that are worn or damaged should be replaced.

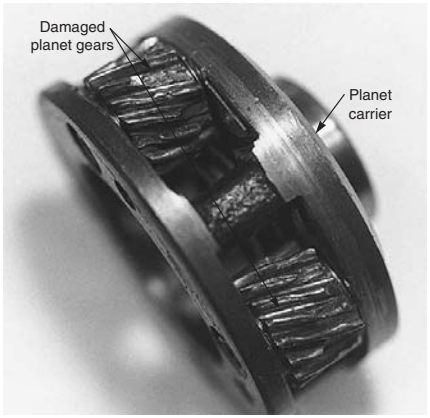


Figure 17-11. *Worn or damaged planet gears can result in a noisy transmission or transaxle. Severely damaged gears will strip off or jam, resulting in a no-drive condition. (BBU, Inc.)*

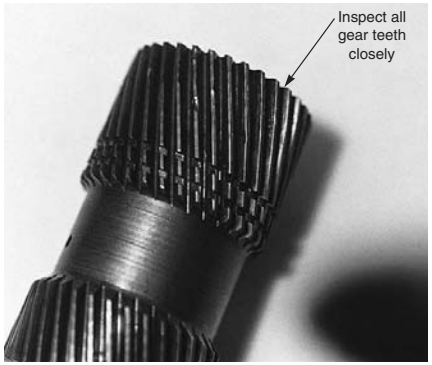


Figure 17-12. *Gear teeth on all of the planetary gears should be closely inspected for chips, cracks, scoring, and wear. Also, check for worn snap ring grooves or bushings. Replace any damaged gears. (DaimlerChrysler)*

Visually inspect needle bearings and Torrington (flat) bearings and try to rotate them by hand. If you feel any roughness when turning a clean bearing or a gear that rides on a bearing, replace the bearing. If you suspect that a bearing inside a gearset is worn, take the time to disassemble the gearset and check the bearing.

Bushings can be checked visually. If a bushing shows signs of wear or scoring, replace it. A bushing that looks good can be excessively worn. Check bushings for wear by inserting the mating shaft or race into the bushing and trying to rock the shaft or race back and forth. If the shaft or race rocks excessively, the bushing is loose and should be replaced.

Clutch Pack Service

One of the most important parts of automatic transmission overhaul is the proper checking and rebuilding of the clutch packs. These operations are discussed in the following sections.

Clutch Pack Disassembly and Inspection

To begin disassembly, use a screwdriver to remove the snap ring that holds the plates and friction discs in the clutch drum. See **Figure 17-14.** Then, remove the plates and discs. Unless they are excessively worn, the discs and plates will fall out when the drum is turned over. Keep all the steel plates together, noting if there are any reaction plates (thicker steel plates) at the top and bottom of the stack, **Figure 17-15.** Never interchange one set of clutch pack parts with another.

Inspect the steel plates. Look for discoloration, which is caused by overheating and is often a sign of a badly slipping clutch pack. A common sign of overheating is ***leopard spotting,*** **Figure 17-16.** Look for worn or scored

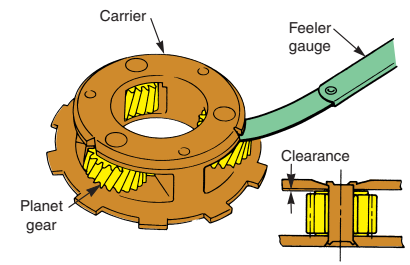


Figure 17-13. *The planet gears and planet carrier can be checked for wear with a feeler gauge, as shown here. Disassembly is not required to make this check. (Nissan)*

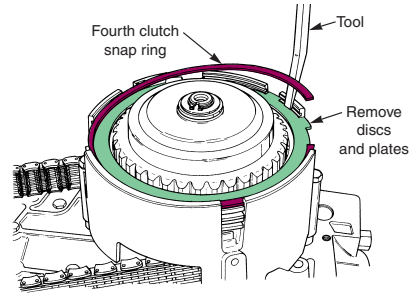


Figure 17-14. *The clutch packs should be disassembled to check for burned friction discs and other problems. Most clutch packs are held together with a large snap ring, as shown here. (General Motors)*

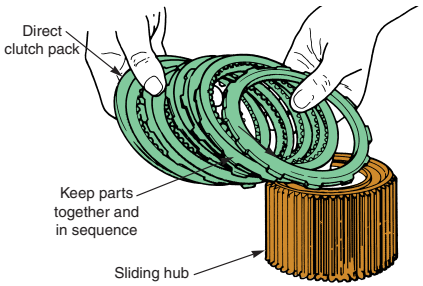


Figure 17-15. *Inspect the clutch plates for wear, burning, scoring, and other damage. Also, check the drum, bushings, hub splines, and thrust washers. Replace parts that show signs of wear or damage. (DaimlerChrysler)*

Figure 17-16. *Steel plates showing leopard spots are often found when the transmission or transaxle is disassembled. Leopard spots are named for their resemblance to a leopard's coat and are a sign of severe clutch overheating. The dark spots are areas where the metal has become so overheated that it has lost its strength and resistance to wear.*

plates, a sign of prolonged slippage. See **Figure 17-17.** Also, check the tangs for wear or damage. **Figure 17-18** shows a used steel plate. This plate is shiny, which is normal for a used plate, and could be reused if necessary. If there is any doubt about the condition of the plates, they should be replaced. Steel plates are sometimes included in a transmission overhaul kit.

Friction discs are normally replaced as part of a transmission overhaul and are usually included in a transmission overhaul kit. Worn or damaged discs may be charred, glazed, or heavily pitted. The friction lining may scrape off easily with your fingernail. **See Figure 17-19.** In some instances, all the friction material will be missing from the friction discs. **Figure 17-20** shows a friction disc that has lost almost all its friction material.

Check the condition of the channels on the inside surface of the clutch drum and the splines on the clutch hub. Severe disc damage may cause the hub splines to be stripped. Worn or damaged parts should be replaced.

Figure 17-17. *This plate was scored by the scraping action of foreign material between the plate and the friction disc. The foreign material may be from another part of the transmission or transaxle, or it may be the result of severe damage to the friction discs.*

Figure 17-18. *A normally worn steel plate will be shiny as shown here. This steel plate could be reused if necessary. Before deciding that the plate is good, however, check it for warping and damage to the teeth.*

Removing the Apply Piston

Rebuilding a clutch pack requires the use of a special spring compressor, **Figure 17-21.** Install the spring compressor and compress the return spring. Remove the retaining snap ring with snap ring pliers or a screwdriver. Release the spring compressor; then remove the spring retainer and the return spring or springs.

Remove the clutch apply piston from the drum, **Figure 17-22.** If the piston sticks in the drum, it can sometimes be removed by slamming the drum downward on a block of wood or a wooden workbench. This will often jar the piston loose. Compressed air can also be used to blow the piston from the drum. Place the drum downward on the workbench and insert an air nozzle in the oil feed hole in the center of the drum. A short burst of air should push out the piston.

Figure 17-19. *If friction disc material can be scraped off with a fingernail, the friction material is burned. A disc in this condition cannot be reused and should be discarded.*

Figure 17-20. *The friction material of a friction disc will sometimes wear away completely, leaving the steel backing exposed. This disc should be replaced. Water in the transmission will also cause the friction material to separate from the steel backing.*

Warning: When using compressed air to remove a piston, point the open end of the drum away from yourself and others. Direct the piston into a pile of rags or another soft surface so that it does not fly out and become damaged or cause injury. Also, use a regulated amount of air pressure.

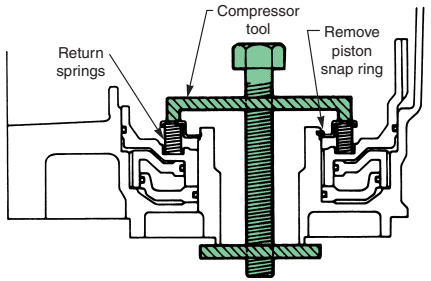


Figure 17-21. *A special compressor must be used to remove the clutch apply piston in order to get at the seals of the clutch assembly. Universal tools are available that fit all types of assemblies. (DaimlerChrysler)*

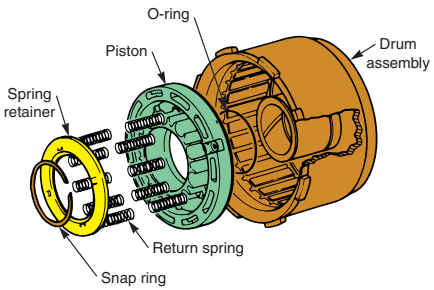


Figure 17-22. *Exploded view of a clutch apply piston and related parts shows parts that must be removed during rebuilding. (Nissan)*

With the piston out of the drum, remove the piston seals. Hard or cracked seals indicate that the clutch has been overheated. If there is also a seal around the interior (hub) of the clutch drum (inner piston seal), remove it, **Figure 17-23.** Then, thoroughly clean the piston and piston bore.

Often, clutch apply pistons and clutch assemblies are installed in the rear of the case. Disassembly and assembly procedures for these assemblies are similar to those for other clutch packs.

Note: If the check ball is missing, do not attempt to install a replacement check ball. Replace the apply piston.

Inspect the piston for cracks. Also check that the air bleed check ball is free.

Obtain new piston seals. Compare the new seals to the old ones to ensure that you are installing the proper seals on the piston. In addition, check the fit of the new seals by placing them in the piston bore. They should fit snugly. A bulge, or buckle, in an outer piston seal means the seal's diameter is too large. A gap between an outer piston seal and the piston bore means the diameter is too small.

Before installing the new piston seals, lubricate them with transmission fluid. Petroleum jelly can also be used, but other types of oil or grease will damage the seals. Carefully install the new piston seals on the clutch drum hub and clutch piston, as applicable. The new seals should fit snugly, but *not too* snugly. Lip seals must be installed on a piston so the sealing lip will be directed toward the hydraulic pressure (toward the back of the drum).

Install the clutch piston in its bore. The type of piston seal determines the installation method. If O-ring seals are

Figure 17-23. *Inner piston seals can usually be removed with a small pick. Inspect the seals carefully for damage and excessive wear.*

used, the piston can be pressed or tapped into the bore after being thoroughly lubricated.

A piston using a lip seal must be worked into place with a feeler gauge or a special seal installation tool. A satisfactory tool can be made from a stiff piece of wire and a small length of copper tubing. Use the tool to push in the seal as you press on the piston. See **Figure 17-24.** Once the piston is in place, check its installation by trying to turn it. If you cannot turn the piston, the seal is not properly positioned.

Once you are sure the piston is properly installed, put the piston return spring(s) and spring retainer back in position on the piston. Then, use the spring compressor tool to move the return spring(s) and retainer past the groove for the retaining snap ring. Install the snap ring, and make sure it is snug in its groove. See **Figure 17-25.**

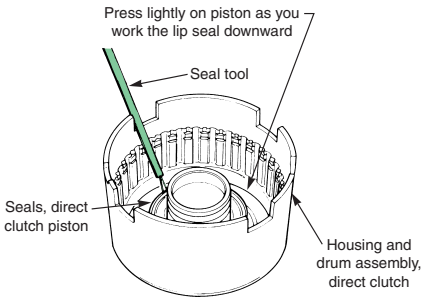


Figure 17-24. *This special tool can be fabricated from copper tubing and wire to make lip seal installation easier. This tool will be much less likely than a feeler gauge to cut the new seal. (General Motors)*

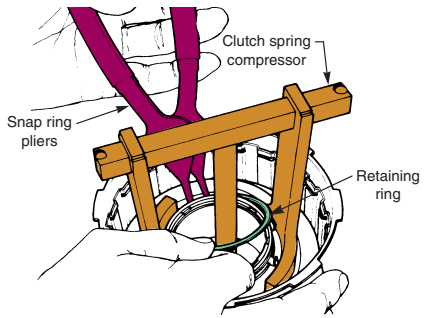


Figure 17-25. *To reassemble the apply piston and return spring assembly, depress the return springs below the snap ring groove and install the snap ring. Sometimes it is easier to install the snap ring by hand or with a small screwdriver than it is to install it using the snap ring pliers. (Ford)*

If the clutch pack uses a reaction plate next to the apply piston, install it now. Then install the friction discs and steel plates, alternating them and using new parts as required. Always use new friction discs. Some technicians reuse the steel plates after buffing the plates to remove the shiny surface. Some friction disc manufacturers recommend that if reused, the old steel plates be installed without buffing. These manufacturers state that buffing the steel plates causes rapid wear of the new friction discs. It is often quicker, and therefore cheaper, to install new steel plates.

If the clutch pack uses a reaction plate at the top, install it before installing the outer snap ring.

Caution: A dry friction disc will burn severely the first time the clutch is applied. To prevent this, soak new friction discs in clean transmission fluid before installing them. Allow them to soak for about 15 minutes or until they stop bubbling. Always use the correct type of automatic transmission fluid. The vehicle owner's manual should list the proper ATF. The fluid type may also be stamped on the transmission dipstick.

With the clutch pack now assembled, measure the ***clutch clearance,*** or the distance between the pressure plate and outer snap ring. Clutch clearance is checked with a feeler gauge, **Figure 17-26.** The exact placement of the feeler gauge will vary between makes. Most

Figure 17-26. *One of the most critical parts of transmission rebuilding is checking the clutch pack clearance. Incorrect clearances must be fixed by replacing the pressure plate or snap ring with one of the proper thickness.*

manufacturers have clearance adjustment kits, consisting of snap rings or pressure plates of varying thicknesses. Replacing a snap ring or pressure plate with one of a different thickness will change the clearance.

Clutch clearance is an indicator of how tightly the plates and discs are packed. This is important because it affects transmission operation. If the clearance is too large, the clutch will not be applied tightly and may slip. If the clearance is too small, the shift may be rough or the clutch may be lightly applied when it should be released. Proper clearance helps ensure good shifts and long clutch life.

Clutch pack operation can often be checked with compressed air, **Figure 17-27.** Air is directed to the fluid inlet port of the clutch, applying the piston. Piston action can be observed to verify that the clutch will operate when installed in the transmission.

Caution: *Never* apply air pressure to the clutch piston unless the clutch plates and friction discs are installed. If the plates and discs are not installed, air pressure may push the piston far enough to jam it in its bore.

Repeat the clutch pack rebuilding sequence for every clutch pack in the transmission.

Band Service

Check band friction linings for overall wear. Look for burn marks, glazing, and nonuniform wear. See **Figure 17-28.** Check to see that grooves are still visible and check for flaking. If any material can be scraped off, the band should be replaced. Look for cracks or embedded metal particles. Also, check bands for cracked ends, broken ears, or distortion. See **Figure 17-29.** Bands showing signs of wear or damage must be replaced.

The drum surface that the band rides on should also be inspected. If the surface shows signs of severe scoring, overheating, or wear, the drum should be replaced; slightly worn drums can be turned down on a lathe. If the surface must be turned down more than a few thousandths of an inch (hundredths of a millimeter) to remove scoring or wear, the clutch drum or gearset member that the band rides on should be replaced. A surface that is shiny must be sanded with emery cloth to remove the shine. Some drums should be sanded *around* the surface perimeter, while others should be sanded in an up-and-down direction. Check the appropriate service literature to determine the direction in which the drum should be sanded. A new band should always be used when the band's mating surface has been sanded.

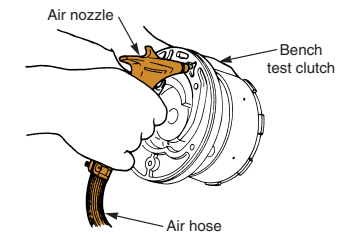


Figure 17-27. *Clutch pack operation should be checked with air pressure before transmission assembly. This will ensure that the clutch pack operates properly when it is installed. The clutch plates and friction discs should lock together when air is applied to the proper passage. (Subaru)*

Caution: Soak new bands in clean ATF for about 15 minutes or until they stop bubbling. Always use the correct fluid.

Figure 17-28. *The friction material has worn away on the edge of this band. The band must be replaced.*

Figure 17-29. *When servicing bands, be sure to check the drum surface that the band rides on for signs of scoring, overheating, and wear. Note that the surface of this drum has been sanded to remove the shine.*

Servo and Accumulator Service

Band servos and accumulators should always be disassembled to replace seals, inspect for worn hard parts, and remove accumulated sludge. The inspection and repair of servos and accumulators was covered in Chapter 15.

Overrunning Clutch Service

All overrunning clutches in the transmission or transaxle should be checked to ensure that they turn freely in the direction they should and lock up in the other direction. See **Figure 17-30.** Any overrunning clutch that turns in both directions must be replaced. Also, any clutch showing signs of wear should be replaced. Make sure the new clutch turns in the proper direction when installed.

CVT Belt and Pulley Service

CVT belt and pulley arrangements are similar, but each one has specific repair processes. Always consult the proper service information before beginning disassembly. Belt removal on most CVTs requires a special tool that is a combination of a holding fixture and a clamping tool. The CVT assembly is placed in the holding fixture. A U-shaped clamping ring is positioned around the sliding portion of the drive pulley and locked to levers on the tool. When the levers are depressed, force is applied to the clamping ring, driving the bottom portion of the pulley downward to the fully open position. With both pulleys in the fully open position, the belt can be easily removed.

Once the belt has been removed, check the belt and pulley sheaves for wear and damage. Replace any defective parts. To reinstall the belt, place it in position in the pulleys and lubricate all parts with the correct type of fluid. Then slowly release the levers on the special tool. Finally, inspect the belt to ensure that it is properly reinstalled.

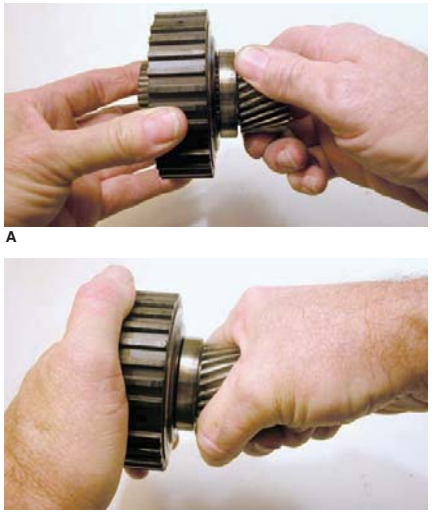


Figure 17-30. *Testing a one-way clutch. A—Clutch turns easily in one direction. B—Clutch does not turn at all in opposite direction.*

Oil Pump Service

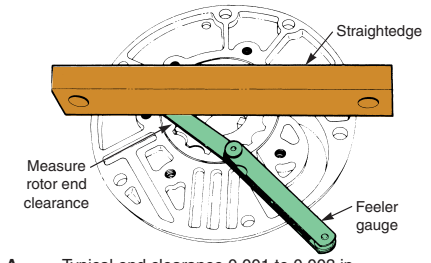
The front oil pump must be disassembled to check it properly. Most pumps are held together by bolts. Some pumps contain the pressure regulator valve and other valves. A few pumps contain a clutch apply piston assembly.

Once the pump has been taken apart, check it for wear in areas where the gears, rotors, or vanes ride against the stationary pump body. Badly worn, scored, or pitted pumps can usually be detected visually, **Figure 17-31**. Scratch the suspect area with a fingernail to confirm the presence of wear or scoring. In addition, the condition of the pump can be assessed with the help of feeler gauges, **Figure 17-32.**

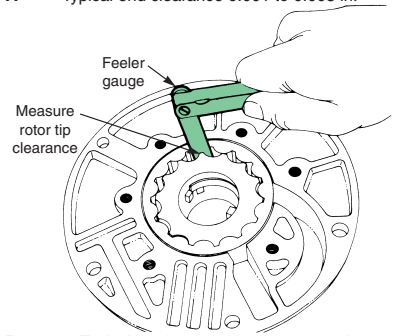
Since the oil pump is designed to provide much more pressure than needed, a slightly worn pump can be reused. When reusing an old pump, make sure the wear is slight and the parts are reinstalled in their original positions. The pump's internal elements usually have factory marks to help ensure proper installation.

Always replace the front pump seal, no matter how good it appears. Replace the pump bushing, if needed. The pump bushing is critical since a worn bushing can cause the new seal to leak. Proper removal and installation tools should always be used, **Figure 17-33.** Stake the bushing in place to prevent it from moving. Some transmissions and transaxles have high pump bushing failure rates. Aftermarket kits have been developed to solve this problem, **Figure 17-34**.

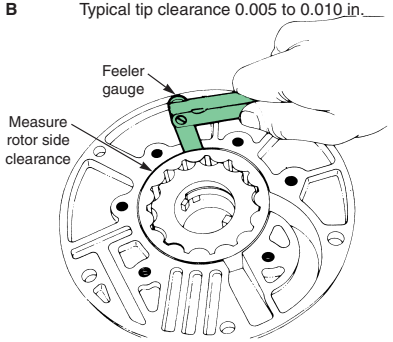
Figure 17-31. *This pump body is severely scored at the pump gear-riding surface. A pump body in this condition should not be reused. When the pump body shows this much wear, check the pump cover for similar wear.*



A Typical end clearance 0.001 to 0.003 in.



B Typical tip clearance 0.005 to 0.010 in.



C Typical side clearance 0.004 to 0.008 in.

Figure 17-32. *These three checks will determine whether the pump can be reused. These checks apply to gear and rotor pumps. Always refer to the service manual for wear specifications. A—Checking the clearance between rotor or gear faces and a straightedge laid across pump body (end clearance). B—Checking the clearance between the tips of the inner and outer rotor lobes or gear teeth (tip clearance). C—Checking the clearance between the outer rotor or gear and the pump body (side clearance). (DaimlerChrysler)*

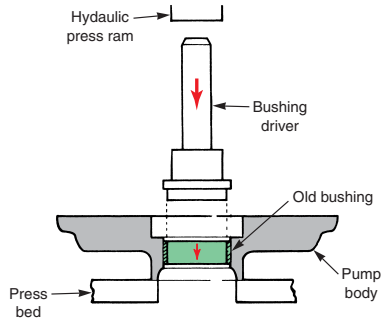


Figure 17-33. *Worn pump bushings can be replaced with new bushings. The old bushing is pressed out, as shown here. Always check the service manual for exact specifications and use the proper bushing removal and installation tools. (Ford)*

If the pump body contains the pressure regulator or other valves, remove them and make sure they are free in their bores. If the valves are sticking, they can be lightly polished to free them. If the valves do not move freely after polishing, replace the pump. **Figure 17-35** shows a typical valve and sleeve removed from the pump body. If the valves in the pump have seals, replace the seals before reinstalling the valves.

Note: There are many variations in pump design and placement. Three major types of pumps are used. The pump may be placed immediately behind the converter and driven by converter lugs, or it may be placed in the valve body and driven by a shaft. Due to these variations, only a general outline of pump rebuilding can be given in this chapter. Always consult the proper service manual before rebuilding any pump.

To reassemble a vane pump, begin by installing the outer slide and the bottom vane ring. Then insert the vanes in the vane rotor, **Figure 17-36.** The vanes must face in the proper direction. Next, install the upper vane ring to hold the vanes in position. Install the pressure regulator components and then install the cover. Finally, torque the fasteners to specifications.

To reassemble a gear or rotor pump, install the gears in the proper order in the pump body. Be sure to install the inner and outer gears so that any marks face upward. Then place the pump cover over the pump body and install and tighten the bolts in the order specified by the manufacturer. Always use a torque wrench to tighten the bolts. If the pump incorporates a clutch apply piston, replace the seals as explained in the clutch pack rebuilding section and then reassemble the pump as explained above.

Figure 17-34. *The kit shown here is used to repair a chronic bushing failure problem on a common truck transmission. It also corrects torque converter slippage and resultant computer control system problems. The replacement bushing is an improved type that resists wear. Instructions furnished with the kit explain how to drill and enlarge lube holes to further increase bushing life, and how to install an improved converter drainback valve. (Superior)*

Figure 17-35. *Exploded view of an oil pump–mounted valve and its aluminum sleeve. The valve and sleeve should be carefully checked for sticking, scoring, or other damage. As with a valve body, be sure that all pump-mounted valve components are reinstalled in their original positions. (Sonnax)*

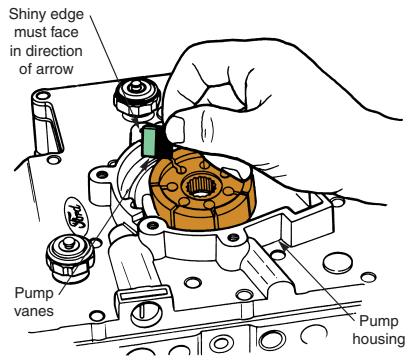


Figure 17-36. *The pump must be carefully reassembled to provide proper pressures and long service. This vane pump is mounted in the side valve body of a common transaxle. (Ford)*

Note: Some pumps installed in the case require that a special tool called an aligning band be placed around the two halves of the pump to ensure that they are properly aligned before the bolts are tightened.

Seal Ring Service

Seal rings are critical to proper transmission and transaxle operation, since they seal in hydraulic fluid going from the valve body to the bands and clutch packs. Seal rings can be made of metal or Teflon. They should always be replaced during a rebuild.

After removing the old seal rings, check the ring grooves, **Figure 17-37.** They must not be worn. Look for nicks or ridges on the groove walls that could prevent the new ring from seating properly, allowing leaks. Groove width can usually be checked with the new ring and a feeler gauge, **Figure 17-38.**

Check the bore surfaces that the seal rings ride against, as well. The bore surfaces must be round and smooth, with no ridges or signs of wear. Place the replacement ring squarely in the bore to see that it conforms to the bore and that the bore is round. The ring should touch the bore all the way around.

Parts having worn or damaged seal ring grooves or bores should be replaced. Always install new seal rings carefully, using plenty of transmission fluid as a lubricant.

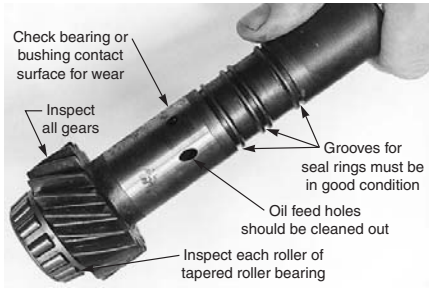


Figure 17-37. *If any of the shafts contain seal ring grooves, the grooves should be closely inspected for wear.*

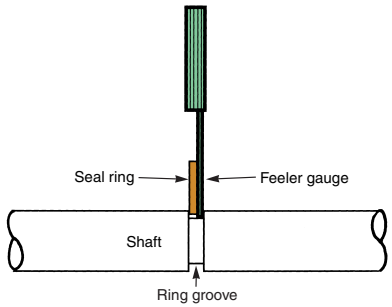


Figure 17-38. *Seal rings and grooves are vital to proper operation of the transmission or transaxle hydraulic system. They should be carefully checked to ensure that they can do a good job of sealing. Using a feeler gauge as shown here, the maximum end clearance of a new seal ring in its groove should be about 0.003"–0.006" (0.07mm–0.14mm).*

Bearing and Thrust Washer Service

All transmission bearings and thrust washers should be checked for wear and scoring. A badly worn thrust washer is shown in **Figure 17-39.** This washer should be replaced. General procedures for checking bushings and washers were discussed in Chapter 4. **Figure 17-40A** shows the procedure for checking bushing wear in a sun gear. **Figures 17-40B** and **17-40C** show the procedure used to replace a bushing. Note the use of special tools to remove the old bushing and install the new one.

Figure 17-39. *This thrust washer is badly worn and should be replaced. If you encounter a thrust washer showing this degree of wear, remember to inspect the part the washer rides against. Chances are good that the riding surface of the part is also worn out.*

There are many thrust washers in modern automatic transmissions and transaxles. Some of these thrust washers are made in selective thicknesses to control endplay. All thrust washers should be checked with a micrometer to ensure proper endplay. Use thicker or thinner washers as needed. For instance, if the endplay is 0.030" (0.762mm) too large, a 0.030" thicker thrust washer should be obtained. If endplay is insufficient, a thinner selective thickness washer should be used. Always recheck endplay to confirm that the proper washer was selected.

Miscellaneous Case Parts Service

Many small parts are installed in the case, including electrical switches and sensors, electrical case connectors, small screens in the pump output passages, seals, and check balls. These parts are as important as the major transmission components. They must be cleaned and carefully checked for wear and damage. Electrical parts should be checked according to the manufacturer's instructions, using the proper electrical test equipment. Seals, such as those used on the T.V. cable or the manual lever and shaft assembly, should always be replaced.

Reassembly

Once all automatic transmission or transaxle subassemblies have been rebuilt, they can be installed in the transmission case. Always refer to the manufacturer's service manual for the exact assembly procedures. It will give procedures and specifications for the type of transmission or transaxle being serviced. Exploded views are very useful during the reassembly process.

Note: Remember to soak the friction discs, bands, and all rubber parts in fresh transmission fluid before installation.

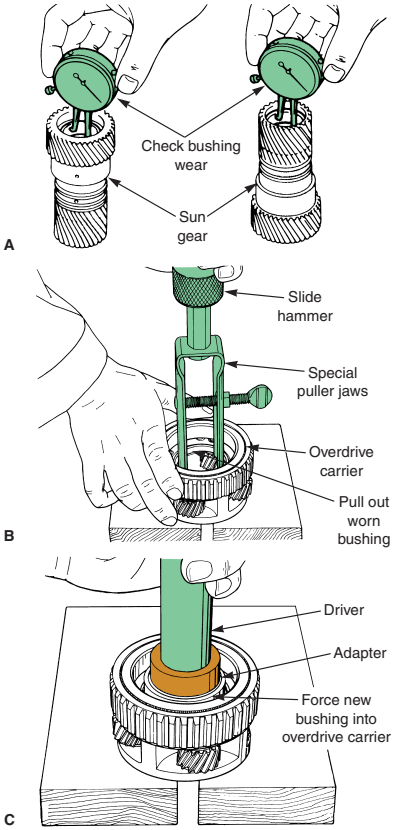


Figure 17-40. *Check all bushings for wear and replace those that are worn. A—Checking a sun gear bushing. B—Removing a planet carrier bushing. C—Installing a new planet carrier bushing. (DaimlerChrysler, General Motors)*

Begin reassembly with the rear of the case. If the case contains a low-and-reverse clutch that has not been serviced prior to this point, disassemble and clean it. Install new seals on the clutch apply piston. Install the piston, as well as the friction discs and steel plates. Make sure the clutch clearance is correct and install the retaining snap ring. If the unit uses a rear band, install the band in the case but do not install the band apply linkage. See **Figure 17-41.**

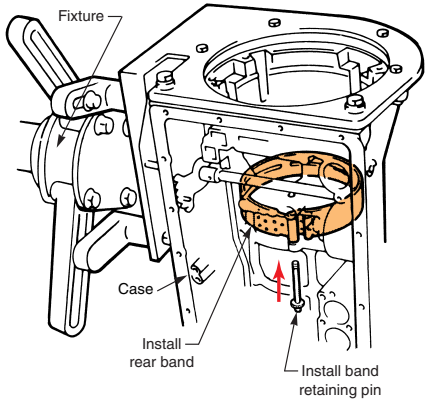


Figure 17-41. *The location of a band in the case on one type of transmission is shown. In most instances, the band should be installed before installing the drum or gearset member on which it will ride. (DaimlerChrysler)*

Install the rear planetary gearsets and the output shaft. Be careful to align all parts before installing any snap rings or bolts. After the snap rings or bolts are in place, make sure the output shaft will turn. Also, make sure that all the thrust washers are installed correctly.

If a center support is used, install it now. Install the center support snap ring and/or bolts and make sure the output shaft will still turn.

In many designs, the clutches must be assembled before they are installed in the case. The height of the assembly may be checked to ensure that it meets specifications. With some transmissions and transaxles, the clutches and front gearsets will be assembled prior to installation. Install any such assembly at this point. See **Figure 17-42.** Also, if the unit has a front band, install it now.

If the transmission or transaxle has a set of clutch plates and friction discs directly behind the front pump, install it now, making sure to alternate discs and plates. Next, place the proper gasket on the case and install the front pump.

Note: This step does not apply to transaxles with a valve body–mounted pump.

As you slowly tighten the pump fasteners, check that the input and output shafts can be turned by hand. If either shaft begins to bind, find the cause and correct it before proceeding. If a transaxle is being worked on, install the chain and sprockets now. Also, install the transaxle transfer gears, if applicable. See **Figure 17-43.**

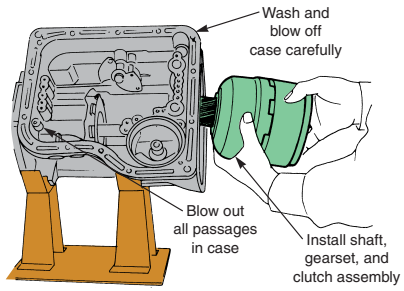


Figure 17-42. *A clutch and gearset assembly is shown being installed in the transmission case. Make sure that parts are properly seated. (Nissan)*

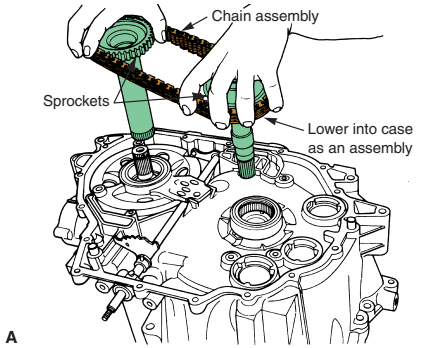
Caution: *Never* install a transmission on a vehicle if the input and output shafts are binding. The transmission will be badly damaged if it is operated with binding shafts.

Check the output shaft endplay using a dial indicator, as shown in **Figure 17-44.** If the endplay is not within specifications, the original selective fit thrust washer must be replaced. Most units have only one selective-fit thrust washer. Do not try to adjust endplay by changing other washers.

Note: Some makers specify input and output shaft endplay specifications. Check both input and output shaft endplay when specified. Never attempt to compensate for excessive endplay at one shaft by reducing endplay at the other shaft.

If not done already, install the servos in the transmission case. Then, install the band apply linkage and adjust the bands to specifications. In many cases, the proper band adjustment is obtained by changing the length of the band apply pin. Proper pin length is usually obtained using a special tool and a torque wrench, as illustrated in **Figure 17-45.** The special tool is installed along with the existing band apply pin. Then the pin is applied against the band using the torque wrench. The correct torque must be applied for the reading to be accurate. If the pin is the correct length, a white line will appear in the tool's window. If the pin is incorrect, a new pin must be obtained.

Other bands are adjusted using a special tool and a dial indicator. The tool is installed with the servo piston. Then, the dial indicator is installed and set to zero. Finally, the piston is pushed downward to tighten the band against the drum and the dial indicator is read. See **Figure 17-46.**



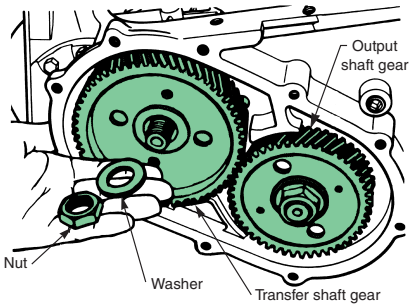


Figure 17-43. *Carefully install the drive chain or gears. A—The drive chain and sprockets are usually lowered into the case as an assembly. B—The drive gears can be installed separately. Be sure to install any washers and fasteners that were removed. (Ford, DaimlerChrysler)*

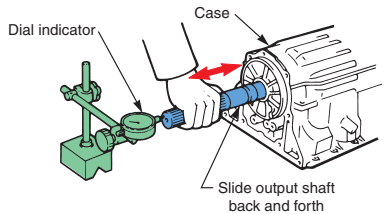


Figure 17-44. *After assembling all the drive train parts, recheck endplay to ensure that you have installed the proper selective thickness thrust washer. (DaimlerChrysler)*

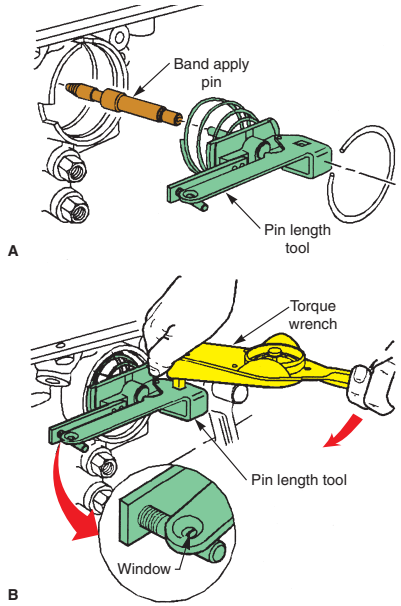


Figure 17-45. *A special tool must be used to adjust the band on many modern transmissions and transaxles. A—The tool is installed with the existing band apply pin. B—The band is applied with the torque wrench. If the pin is the correct length, a white line will appear in the tool's window. (General Motors)*

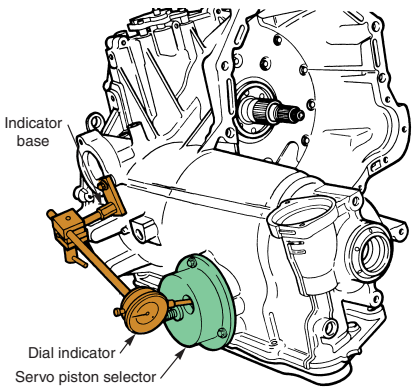


Figure 17-46. *Some bands are adjusted using a dial indicator and a special tool known as a servo piston selector. After installing the tool and the dial indicator, the piston is pushed downward and the indicator is read. (Ford)*

If the dial indicator reading is smaller than the manufacturer's specification, a shorter pin must be substituted. If the dial indicator reading is larger than the manufacturer's specification, a longer pin must be substituted.

Install the governor in the case or on the output shaft, as applicable, and install the extension housing. Then, install a new seal on the extension housing, **Figure 17-47.**

Before installing the valve body, perform an air pressure test on the transmission to make sure the clutch apply pistons and servos are working properly. Air pressure testing was discussed in Chapter 13. **Figure 17-48** shows air pressure being used to check piston operation on one type of transmission.

After air pressure tests are complete, install the valve body-to-case spacer plate, the spacer plate gaskets, and any check balls in the transmission case. Carefully match the holes in the spacer plate and the new spacer plate gaskets to ensure proper fluid flow.

Install the valve body and a new oil filter. Then, install the transmission oil pan using a new gasket. On a transaxle, install the side valve body and oil pan, if necessary. At this point, you are ready to install the torque converter.

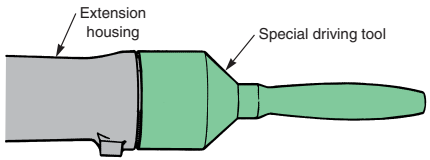


Figure 17-47. *After installing the extension housing, install a new rear seal using the proper driver. Worn extension bushings should also be replaced. (DaimlerChrysler)*

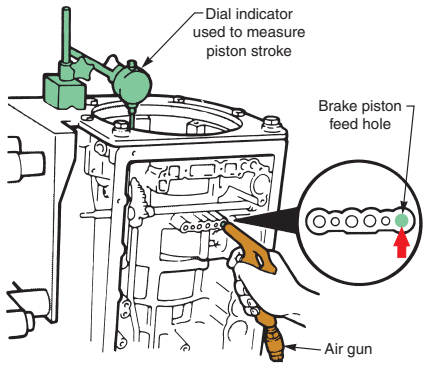


Figure 17-48. *Always perform an air pressure test on the transmission before installing the valve body. Band movement or a sharp thunk from the clutch packs indicates that the air pressure is operating the holding members and that all seals and passages should channel fluid properly. (DaimlerChrysler)*

Prior to installation, the converter can be checked for proper endplay as shown in **Figure 17-49.** The tool shown has an expanding pilot that can be tightened firmly into the splined hole for the turbine shaft. Make sure the tool is fully seated on the hub, and lock the tool in place by turning the threaded inner post. Mount a dial indicator on the tool. A typical procedure calls for positioning the plunger so it contacts the converter shell. With the dial indicator in place, zero the indicator. Then, pull up on the tool's handles. The reading obtained is the total endplay of the turbine and stator. If endplay is not within specifications, the torque converter must be replaced.

A rough check of endplay can sometimes be made by inserting a pair of snap ring pliers into the splined turbine hub and pulling upward. Observing the plier movement will indicate how much endplay there is.

The one-way clutch can also be checked at this time. Place snap ring pliers down through the pump drive hub and expand them into the internal splines on the one-way clutch. (These splines mate with external splines on the stator shaft.) Applying torque to the pliers should turn the stator easily in one direction (clutch unlocked) and not so easily in the other direction (clutch locked and turning the stator). A special tool that engages the one-way clutch inner race can also be used to check clutch operation. See **Figure 17-50.**

If the torque converter passes these tests, check the converter for wear at the hub. If there are no signs of wear, add at least 1 quart of fresh transmission fluid to the converter. See **Figure 17-51.**

Note: Some manufacturers recommend lowering the converter onto the transmission shafts, Figure 17-52. In this case, add only about 1 pint of fluid and spin the converter to distribute it to the outside of the converter internals.

Place the torque converter over the input shaft and push it into the converter housing. The internal splines of the converter will move into contact with the splines of the stator shaft and input shaft. It may be necessary to wiggle the converter while pushing on it to get it to engage with the transmission shafts. The converter may also need to be rotated to line up the lugs on the pump drive hub with the slots on the front pump. The lugs should fully engage the front pump. To verify that the torque converter is properly installed, some manufacturers recommend checking it with a measuring rule and a straightedge, **Figure 17-53.** The reading is then compared to factory specifications.

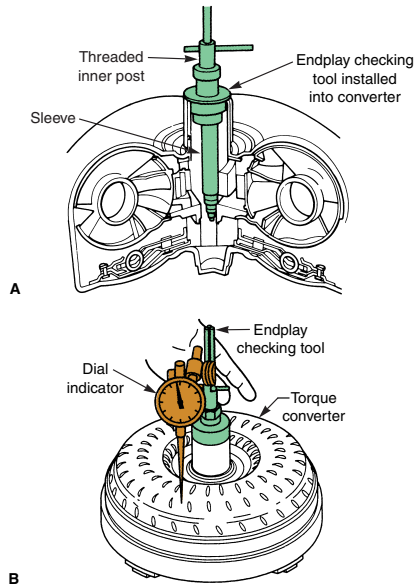


Figure 17-49. *Converter endplay can be checked with the special tool shown here. A—The endplay-checking tool must be fully seated on the converter hub and locked in place. B—After mounting the dial indicator on the tool, zero the indicator and pull up on the tool's handles. The reading obtained is the total endplay of the turbine and stator. (Ford)*

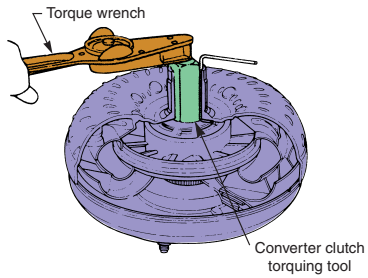


Figure 17-50. *Checking the converter stator one-way (overrunning) clutch with a special tool and a torque wrench. If the wrench turns easily in one direction and locks up in the other direction, the one-way clutch is working properly. (Ford)*

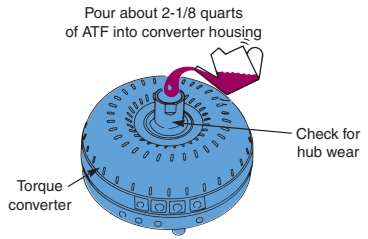


Figure 17-51. *Once the torque converter has been cleaned, check it out before reinstalling it. The pump drive hub can be checked for wear, and the internal operation of the converter can be checked. Add a measured amount of transmission fluid to the torque converter. (Nissan)*

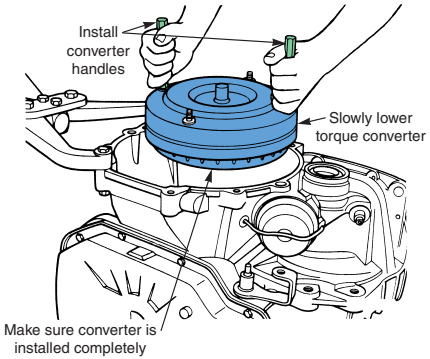


Figure 17-52. *To install the torque converter, turn the transmission or transaxle until the turbine shaft faces up and lower the converter into place. Make sure the converter is completely installed over the shaft splines or it will bind and be damaged when the transmission or transaxle is reinstalled in the vehicle. (Ford)*

Caution: Under no circumstances should you install the torque converter on the flywheel or flexplate before installing the transaxle or transmission on the engine. The splines of the transmission shafts, pump, and converter can be damaged.

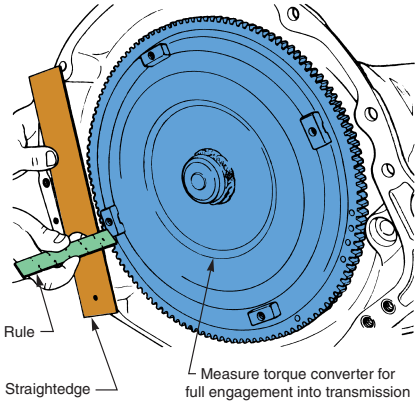


Figure 17-53. *After installing the torque converter, make sure it is completely seated on the input shaft and stator shaft. Also, make sure the lugs on the pump drive hub are fully engaged in the front pump. Measuring the installed depth of the torque converter with a rule and straightedge as shown helps verify that installation is correct. (DaimlerChrysler)*

Summary

The major steps in transmission/transaxle rebuilding are disassembly, cleaning, inspection, and reassembly. To begin rebuilding a transmission or transaxle, remove the torque converter and install the unit in a holding fixture.

Before beginning the disassembly procedure, make sure you have the proper tools and a service manual that covers the transmission model to be rebuilt. Clean the outside of the transmission/transaxle thoroughly and check shaft endplay. Then remove the oil pan, filter, and valve body. On a transaxle, remove the drive chain or transfer gears as necessary. Inspect and save all small parts. After the valve body has been taken off, the front pump (when used) and internal parts can be removed. Removal of the parts will vary according to the internal construction of the transmission or transaxle and whether or not it has a center support.

Carefully note the condition of all parts as they are removed from the case. Then remove any other accessory parts, such as servos, accumulators, and modulators, from the case.

After disassembly, thoroughly clean all internal parts and make further inspections for wear or damage. The converter and oil cooler lines should also be cleaned. Determine what replacement parts will be needed and order them.

The clutch packs are among the most critical parts of the transmission. They should be carefully inspected and serviced. Disassemble the clutch packs and inspect the plates for wear. The friction discs are usually replaced as part of an overhaul. The steel plates are often replaced.

Check the bands for wear, cracking, or burning. Defective bands should be replaced. Band servos should be disassembled, cleaned, and inspected. After the installation of new seals, the servos are ready to be reinstalled. Accumulators are rebuilt in the same manner as servos.

The one-way clutches should be checked to ensure that they turn in one direction only. Planetary gearsets should be checked for obvious defects, such as chipped teeth. Also, check the bushings, bearings, and washers at all locations in the transmission.

Check the transmission/transaxle shafts. Inspect the input and output shafts for wear, bending, or warpage. Also check all the case parts, such as screens, valves, and seals, for wear and damage. Seals should always be replaced.

To reassemble the transmission or transaxle, start by soaking all new friction discs and bands in transmission fluid. Then, install the output shaft, rear planetary gearsets, clutches, bands, and other components at the rear of the case. Remember to reinstall all snap rings in their original positions. Then, install the center support, if the transmission is equipped with one.

Install the front planetary gearsets and clutches as complete assemblies, as required. Measure the assembled height to ensure proper assembly. Install any bands or case-mounted clutches. Then, install the oil pump. Check the transmission endplay and make sure that all shafts turn.

Install the governor on the output shaft or in the case, as applicable. Then, install the extension housing and other output shaft parts. Install the drive chain or transfer gears as necessary.

Install the servos and adjust the bands. Also install any case-mounted accumulators, electrical switches, and other case parts. Then air pressure test the transmission. Install parts that are installed inside the oil pan, such as the valve body, spacer plates, check balls, filter, etc. Then, install the oil pan.

Check the converter for wear or internal damage, and then install it. Make sure the converter is installed properly on the transmission shafts and the pump drive hub (when used) is fully engaged in the front pump.

Review Questions—Chapter 17

Please do not write in this text. Place your answers on a separate sheet of paper.

1. When rebuilding an automatic transmission, you should work on one _____ at a time, so that parts are not mixed up.
2. Before disassembly, clean the _____ of the transmission or transaxle.
3. What can be learned from inspection of the oil pan and its contents?
4. Does the presence of a few aluminum particles in the oil pan mean that the transmission or transaxle is severely damaged? Why?
5. It is usually easier to remove the front pump seal with the _____ still installed.
6. A _____ _____ _____ may be installed on the back of some pumps. In this case, a set of _____ and _____ will be found directly behind the pump.
7. Many clutch packs and planetary gears are held in place by _____ _____.
8. During the rebuilding process, gaskets, seals, and friction discs should be replaced:
   (A) in all cases.
   (B) only if obviously damaged.
   (C) only if removed.
   (D) None of the above.
9. Leopard spotting is a sign of excessive _____.
10. What visual signs indicate that a clutch pack has been slipping?
11. Some technicians _____ steel plates before reinstalling them. This removes the _____ surface. However, it is often cheaper to install _____ plates.
12. If clutch clearance is too _____, the clutch pack may not apply tightly and may slip.
13. To remove a CVT belt, use a special tool to move the drive pulley to the completely _____ position.
14. Badly scored pumps can often be spotted by a _____ inspection. Pump wear can sometimes be determined by the use of _____ gauges. A slightly worn pump can be _____.
15. Fasteners such as _____ or _____ are used to hold the center support to the case.
16. Check the torque converter endplay with a _____ indicator.

Match the transmission component with the measuring device used to check it.

17. Clutch pack clearance _____
18. Band servo operation _____
19. Shaft straightness _____
20. Shaft bushings _____
21. Overheated steel plates _____
22. Thrust washer thickness _____

(A) Dial indicator and V-blocks
(B) Micrometer
(C) Air pressure
(D) Vacuum pump and gauge
(E) Feeler gauge
(F) Visual inspection
(G) Inserting and rocking the shaft

ASE-Type Questions—Chapter 17

1. Technician A says that endplay should be checked before the transmission is disassembled. Technician B says that a few aluminum particles in the oil pan do not indicate a severe transmission problem. Who is right?
   (A) A only.
   (B) B only.
   (C) Both A and B.
   (D) Neither A nor B.
2. All of the following tools can be used to remove the front pump from the transmission case *except:*
   (A) a special puller.
   (B) a slide hammer.
   (C) a hammer and punch.
   (D) a pry bar.
3. If the air bleed check ball is missing from the clutch piston, what should the technician do to correct the problem?
   (A) Replace the clutch apply piston.
   (B) Install an old valve body check ball in the bleed hole.
   (C) Block off the bleed hole with a small screw.
   (D) Block off the bleed hole with an oversize check ball.
4. Technician A says that new friction discs should be soaked in clean transmission fluid before being installed. Technician B says that compressed air is used to check clutch pack clearance. Who is right?
   (A) A only.
   (B) B only.
   (C) Both A and B.
   (D) Neither A nor B.
5. A drum with a slightly worn band apply surface should be:
   (A) turned on a lathe.
   (B) sanded front to back.
   (C) sanded around its diameter.
   (D) replaced.
6. The usual reason for servicing band servos is to replace:
   (A) springs.
   (B) pistons.
   (C) seals.
   (D) snap rings.
7. Technician A says a one-way clutch that turns in both directions can be reused. Technician B says a one-way clutch showing any signs of wear should be replaced. Who is right?
   (A) A only.
   (B) B only.
   (C) Both A and B.
   (D) Neither A nor B.
8. Transmission endplay may be corrected by replacing the:
   (A) case gaskets.
   (B) needle bearings.
   (C) thrust washers.
   (D) snap rings.
9. A transmission has been rebuilt. The output shaft turns easily, but the input shaft does not turn. Technician A says that this is a normal condition when any bushings have been replaced. Technician B says that both shafts should turn freely. Who is right?
   (A) A only.
   (B) B only.
   (C) Both A and B.
   (D) Neither A nor B.
10. Operation on the stator one-way clutch:
    (A) can be checked by applying air pressure to the torque converter assembly.
    (B) can be checked by turning the clutch hub with snap ring pliers.
    (C) can be checked by shaking the torque converter while listening for rattles.
    (D) cannot be checked.