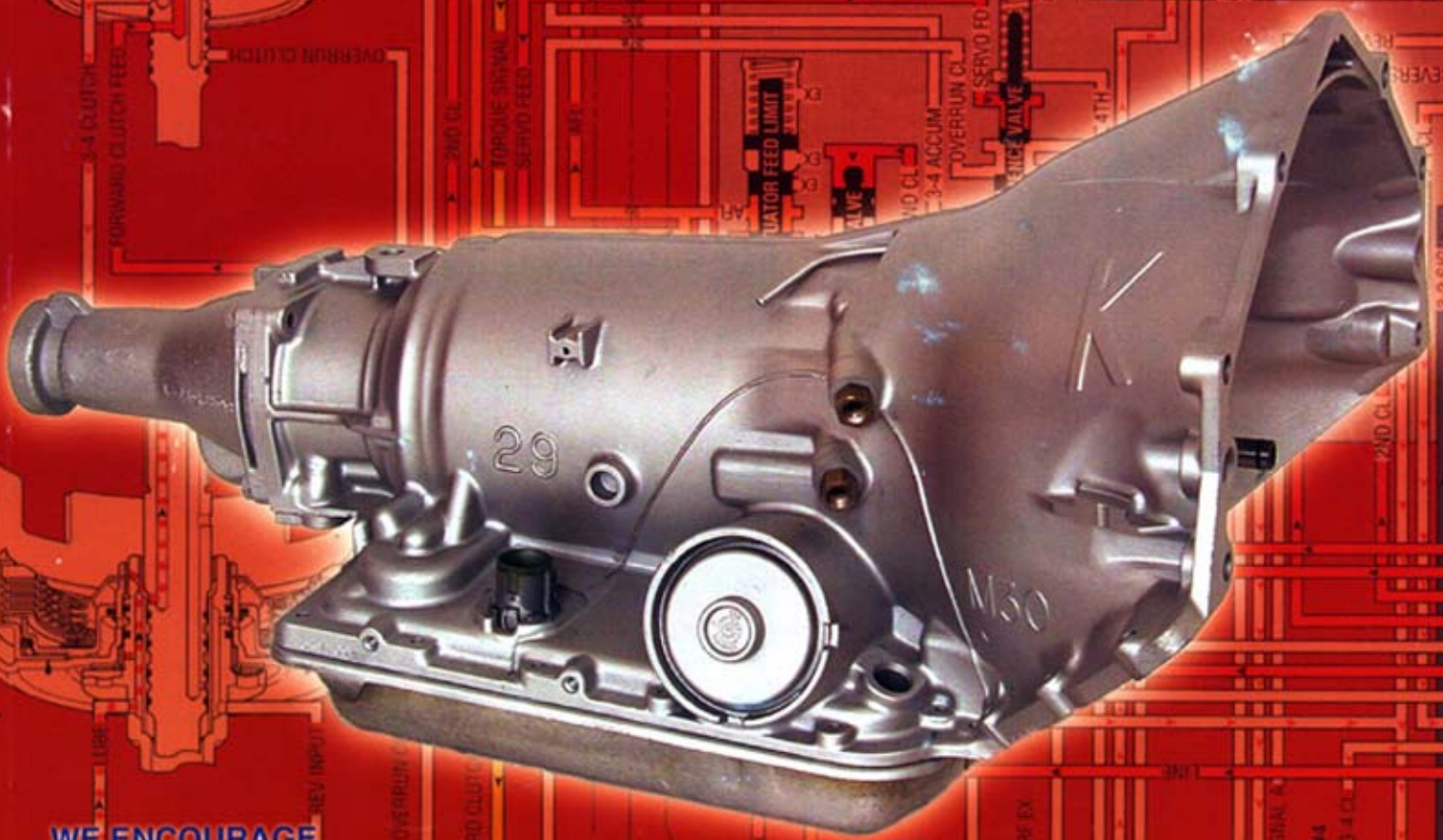
GM 4L60/4L60E Rebuild Procedures

By Cliff McCormick



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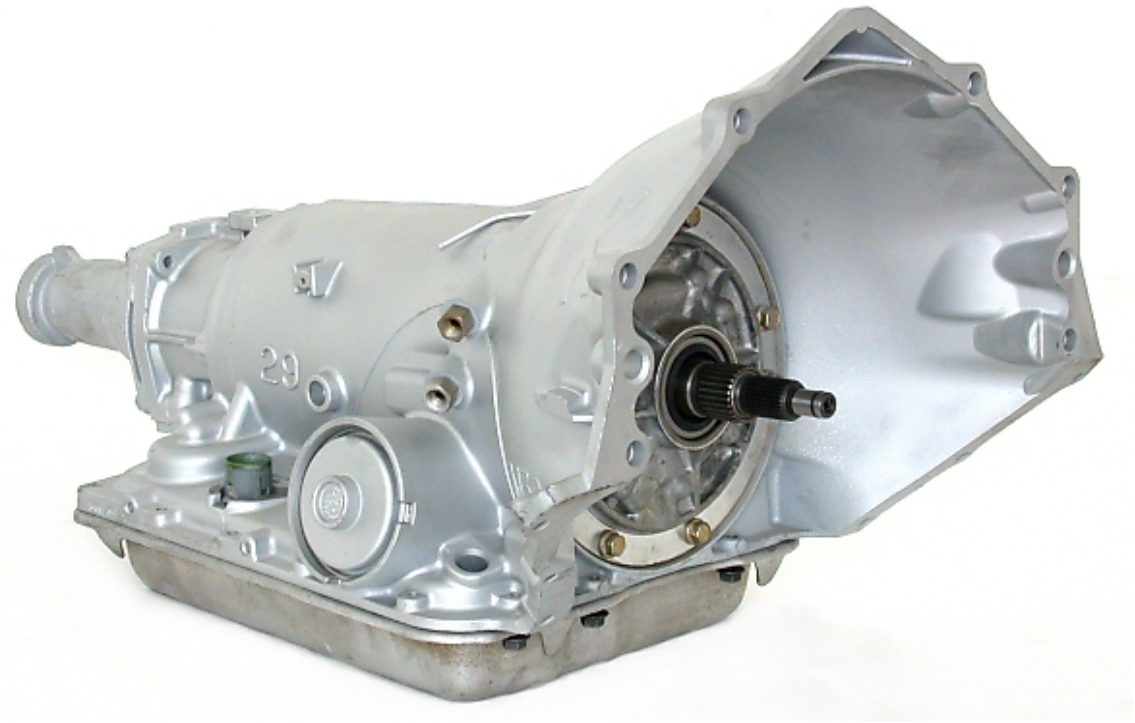
GM 4L60E/4L60 (700R4)

Rebuild Procedures



Written by: Clifford McCormick

Program Introduction…

The General Motors 4L60 (also known as the THM700R4) has been with us now for over two decades and, along with the completely computer controlled 4L60E version, has quickly become one of the most widely used late-model GM rear wheel drive transmissions found in cars and lighter-duty pickup trucks. This unit's time-tested durability and wide gear ratio spread of from 3.06:1 to 0.70:1 make it the perfect unit for a really wide range of different applications. Although many of the head or lead rebuilders in today's transmission shops 'cut their teeth' on this unit, many rebuild technicians join our industry each year, and usually need to find their way through this unit pretty quickly since it's definitely one of the 'bread-and-butter' transmissions, one that brings a lot of work into your shop. There may be parts of the rebuild process that you are not very familiar with, or you may be new to this particular type of transmission. In either case, you need some point of reference- something that will show you how to proceed when you are not sure (or have no idea whatsoever), and that is exactly what this book is designed to do.

You will not find a photocopied section out of a factory manual between these covers. In fact, you will notice a substantial difference between the book you are holding and any other books written on the subject. This is because, as this book was being written, the author was rebuilding a 4L60E step by step as he was writing this book. This helped assure that there would be no missing steps (and it was also real handy for taking pictures along the way…). This book was written for transmission rebuilders by a transmission rebuilder, in plain English rather than complex 'factoreze' terminology. Although a 4L60E was used throughout most of these pages, the areas where the 4L60 procedures substantially differ from the 4L60E procedures or assemblies will have a separate 4L60 section.

So, whether you've already done a few of the 4L60E units, or are about to tackle your first one, this book will show you how to get through the sticky parts of a rebuild, as well as the most thorough way to get through the job, start to finish.

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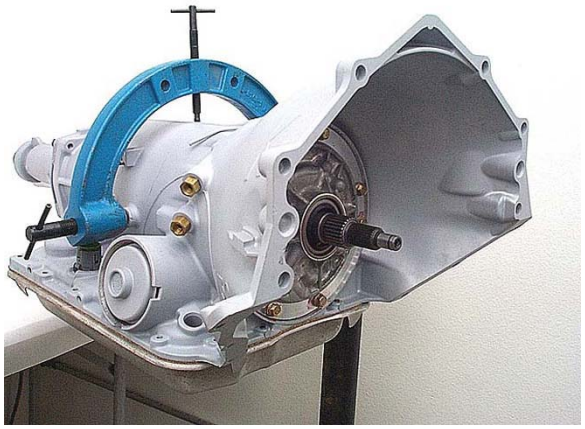
4L60E/4L60 Rebuild Procedures

Unit Disassembly

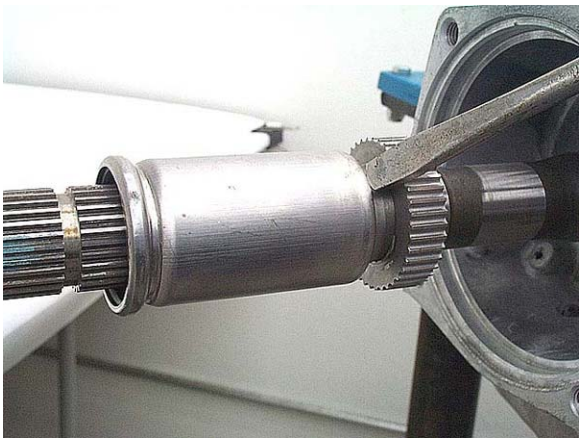
Step 1: Place the unit into the holding fixture, if available.



Step 2: Use a chisel or large screwdriver to remove the rear seal from the extension housing.

Step 3: Remove the output speed sensor if it is still in the extension housing.

Step 4: Remove the extension housing, and housing-to-case rubber seal. Remove the yoke seal from the output shaft if equipped by tapping on it *gently* with a large screwdriver. Remove the o-ring from the yoke seal.



Step 5: Remove the servo cover snap ring. Pull the cover out until the servo cover o-ring is in the snap ring groove. Pull the cover o-ring through the slot in the side of the servo bore with a pick, and rotate the servo cover back and forth while pulling on the o-ring until the o-ring breaks or the servo cover and 4th piston pop out of the bore. If the o-ring breaks, remove it from the case and the cover and piston should pop right out of the case.

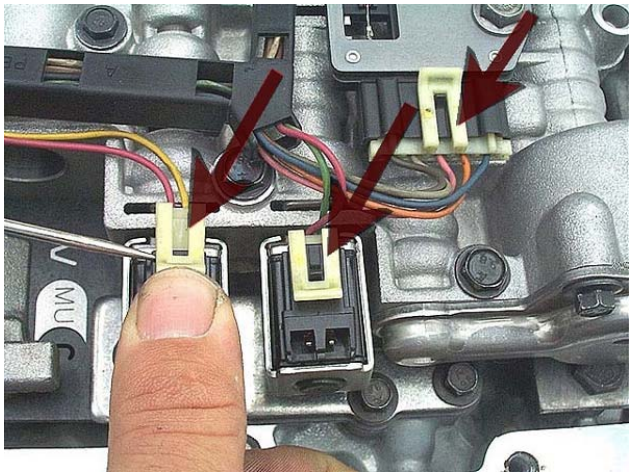


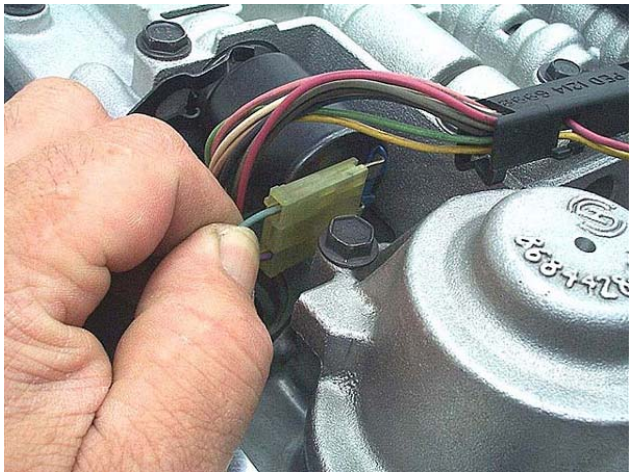

Step 6: Remove the rest of the servo components from the servo bore. If the servo assembly appears stuck, carefully pull on the servo pin snap ring with a pair of pliers.

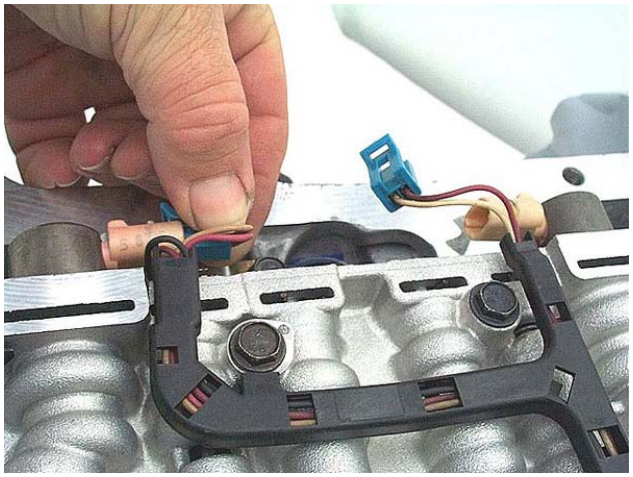

Step 7: Turn the unit over so that the pan is facing you. Remove the pan and pan gasket from the bottom of the unit.

Step 8: Remove the filter by rotating it to loosen the filter neck from the seal, then pulling the filter straight up.

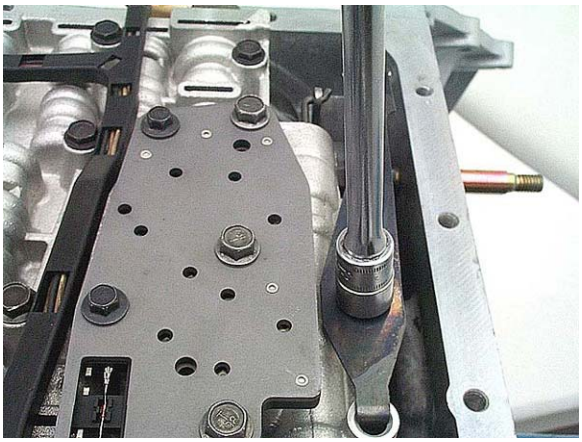
Step 9: Disconnect the electrical wiring from the solenoids and the pressure switch assembly.



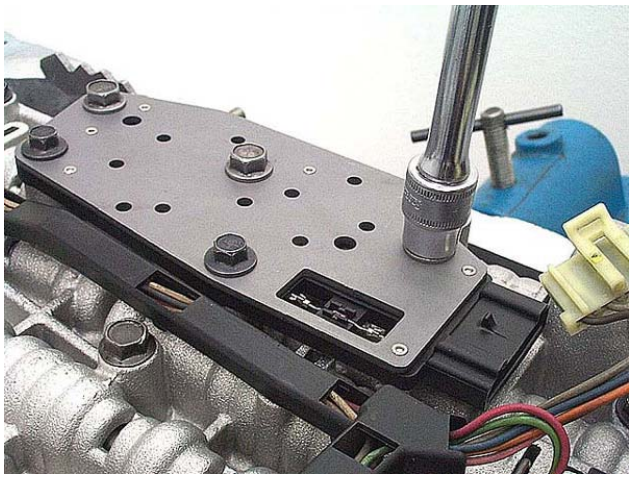




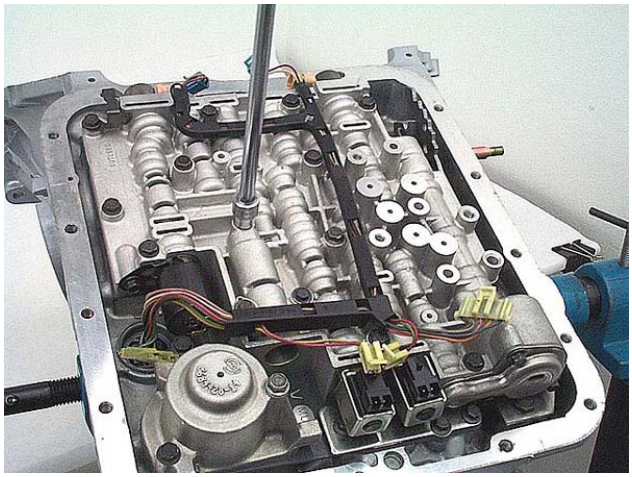
Step 10: Remove the manual lever detent spring.

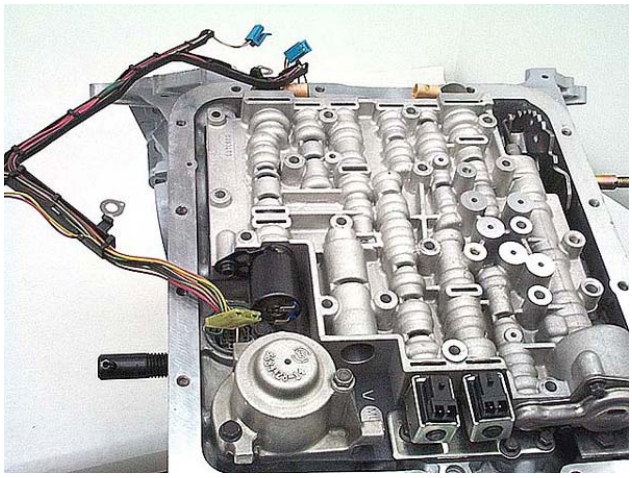


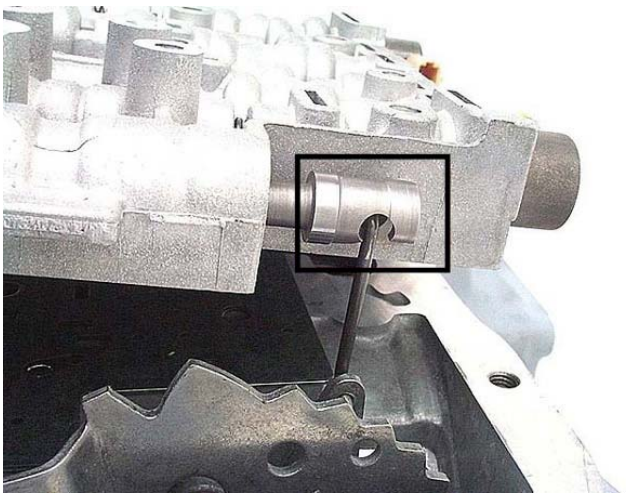
Step 11: Remove the pressure switch assembly. Inspect the underside of the switch assembly for ripped seals or particle contamination within the switch. Replace the assembly if any of these problems are found.



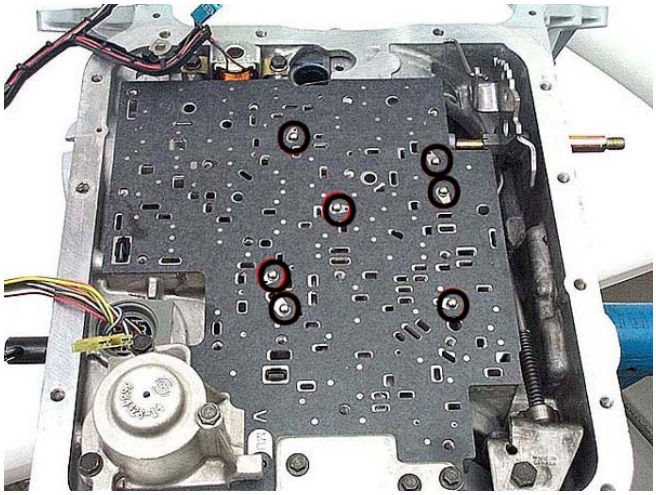
Step 12: Remove all valve body bolts. Pull the wiring harness over the side of the unit, clear of the valve body. Lift the valve body off of the case, sliding the manual valve link out of the manual valve.



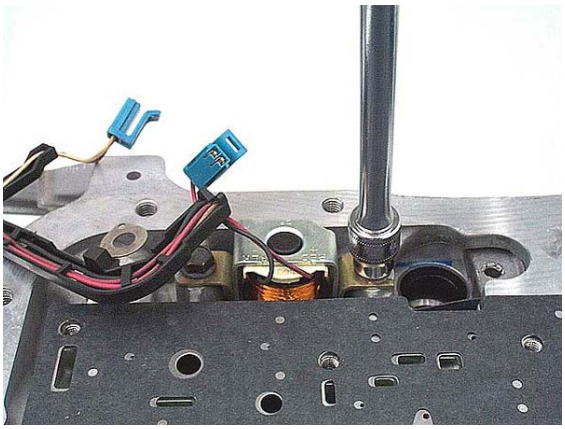


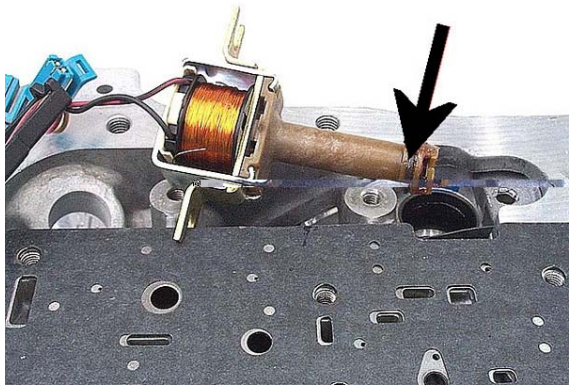


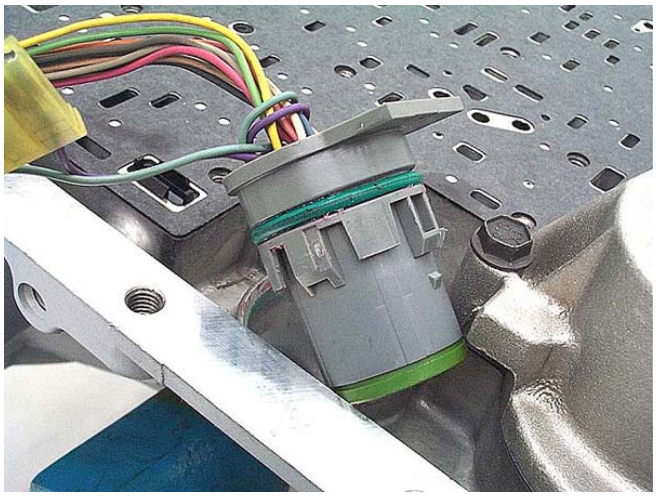
Step 13: Remove the seven checkballs from the separator plate.



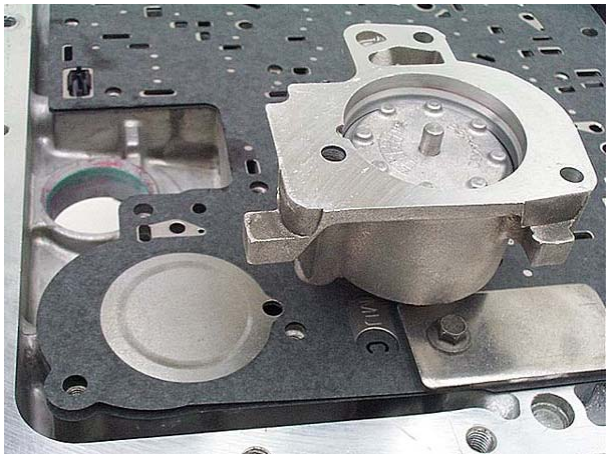
Step 14: Remove the TCC solenoid bolts, then remove the TCC solenoid from the unit. Remove the o-ring from the solenoid neck. Remove the harness case connector and harness from the case.

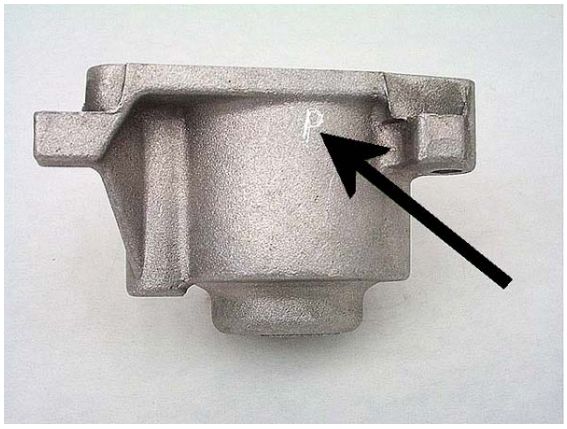




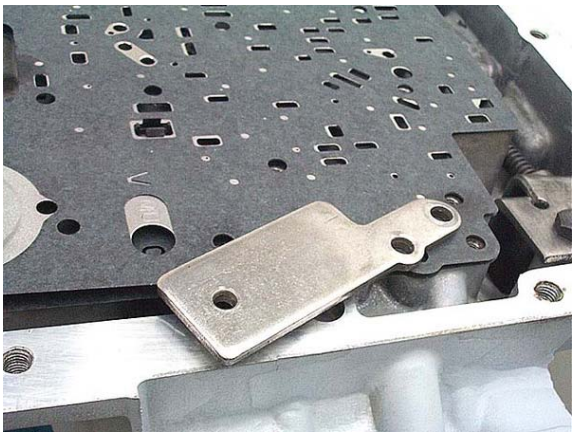


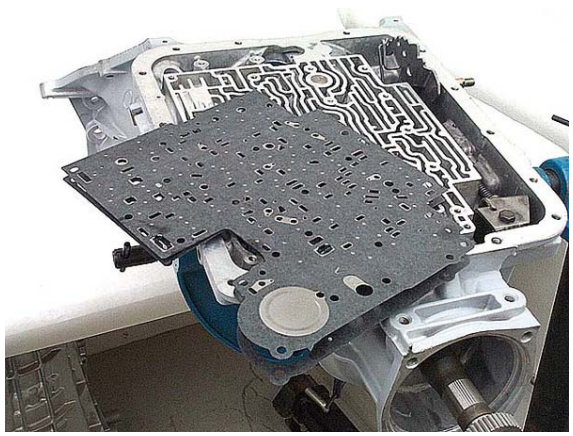
Step 15: Remove the 1-2 accumulator housing, piston and spring. Note whether the piston came out of the housing first or the springs did. Most 4L60Es placed the piston against the separator plate, with the springs up inside the housing, but there are exceptions. You can make a mark, or small 'P' near the end of the housing where the piston rides to help during unit assembly.



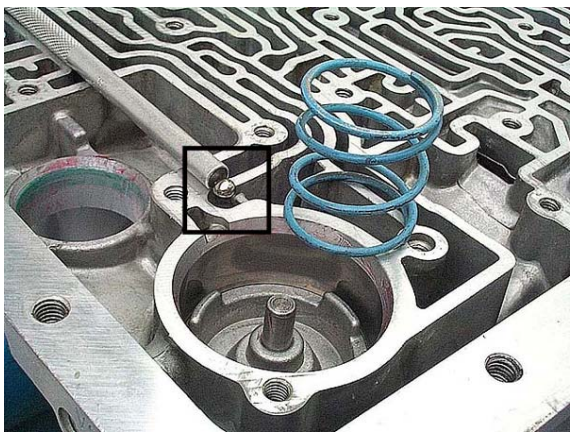


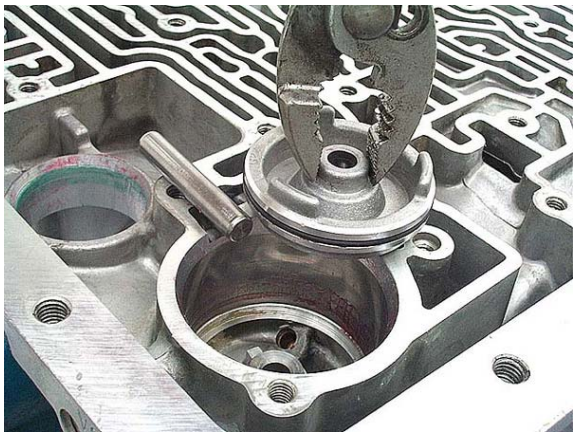
Step 16: Remove the separator plate stiffener plate. Remove the separator plate from the case.





Step 17: Remove the checkball from the case near the 3-4 accumulator bore. Remove the 3-4 accumulator spring, piston and piston pin from the accumulator bore.

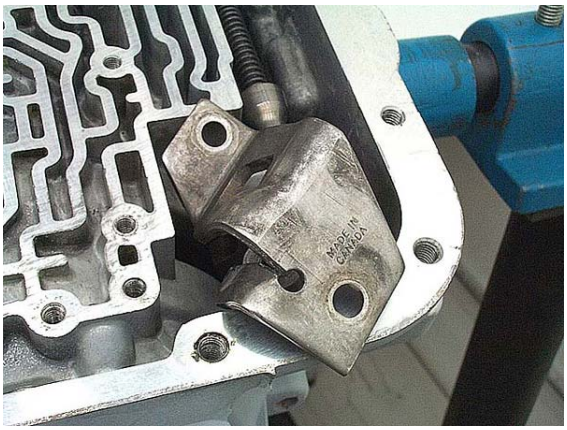




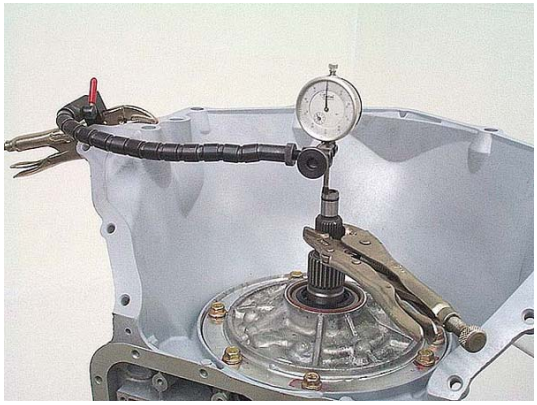
Step 18: Use a magnet to remove the 2-4 band anchor plug from the case.

Step 19: If you haven't already done so, remove the manual valve link from the manual valve lever.

Step 20: Remove the park rod guide.



Step 21: Rotate the unit so that the turbine shaft points straight up. Before removing the front pump, save yourself some work later on and check main unit endplay now. Mount a dial indicator to the case, with the peg resting on the turbine shaft tip. Using a pair of vicegrips lightly clamped to the turbine shaft splines, pull the input shaft in and out, noting the travel distance. If travel is within 0.005" and 0.020", it is acceptable. As long as no major components inside the unit need to be replaced, the original selective washer under the thrust bearing on top of the input drum is the correct thickness for reassembly. If main unit endplay was not within specification, write down what the endplay was. You will want to refer to it after disassembly is complete in Step #40.

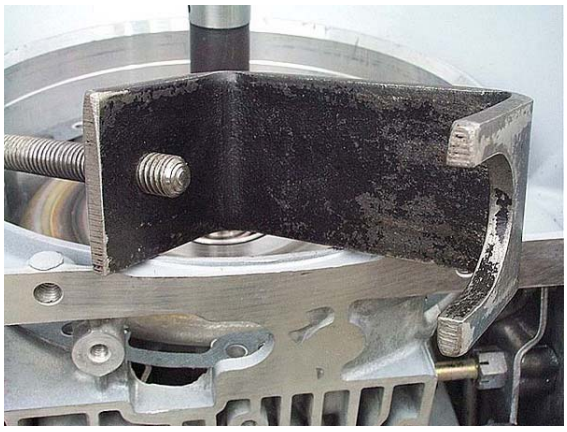


Step 22: Remove the turbine shaft o-ring.

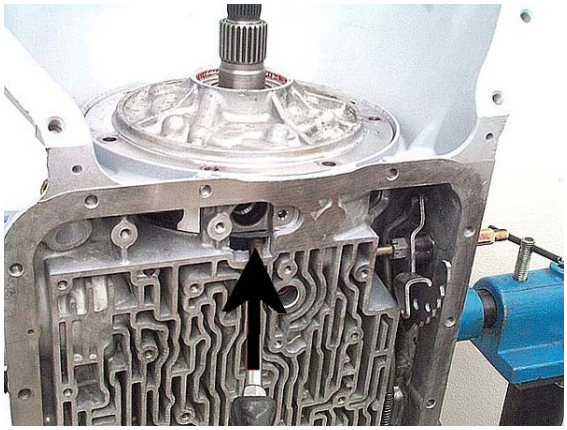
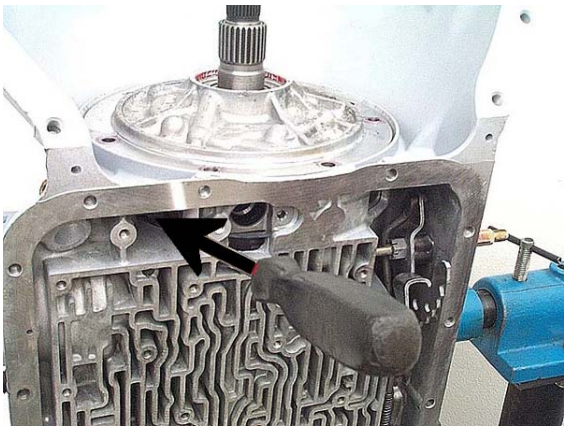
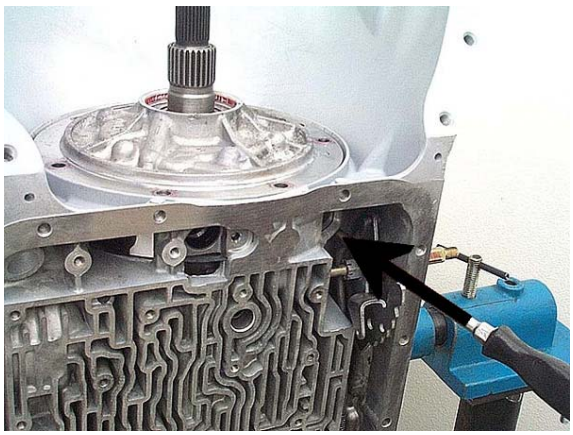
Step 23: Remove the front seal. It's much easier now, with the weight of the unit holding the pump still, than it will be later.

Step 24: Remove the front pump bolts, then remove the o-rings from the pump bolts.

Step 25: Using a suitable puller, remove the front pump.

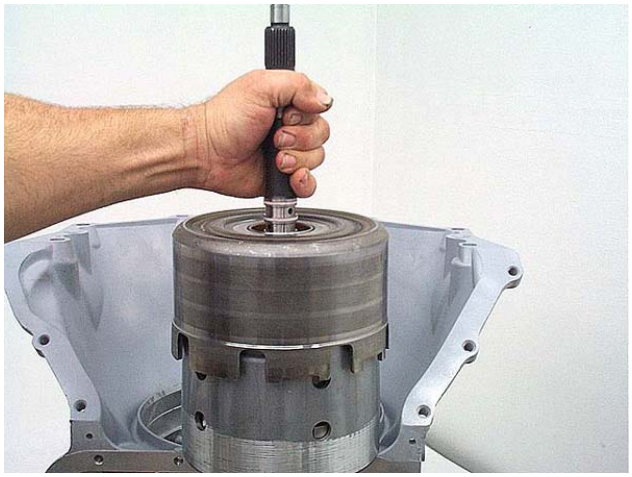



If you are going to pry the pump out rather than using a puller, be careful. Gently pry in several places, including the area between the reverse input drum and the pump.

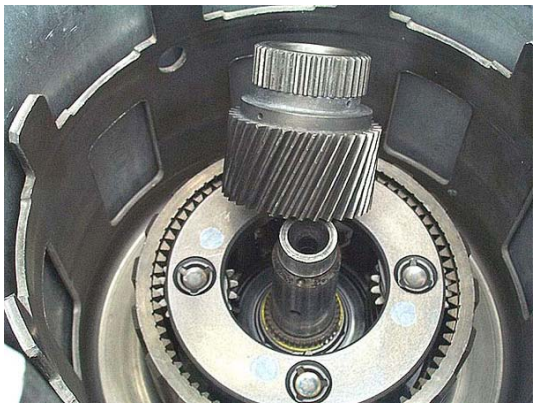

Locate and save the plastic pump-to-reverse input drum thrust washer.

Step 26: Grab the turbine shaft and pull the input drum and reverse input drum from the case. Separate the two drums and retrieve the thrust bearing and selective shim from the top of the input drum.

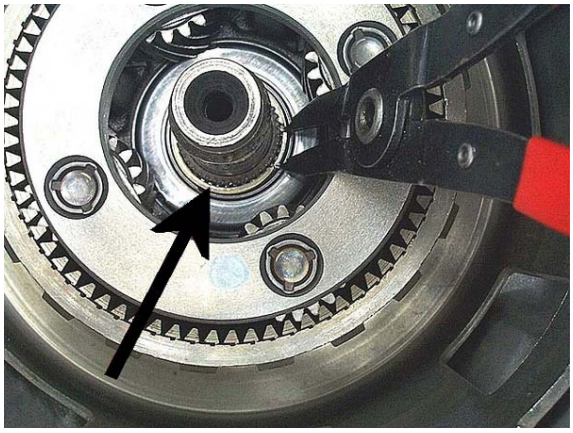


Step 27: Remove the 2-4 band from the case.

Step 28: Remove the front sun gear from the case.

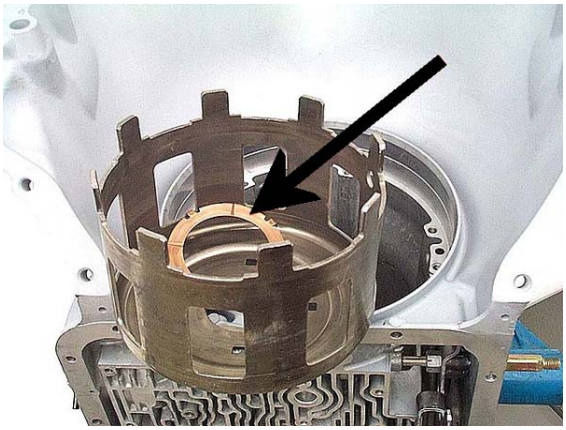
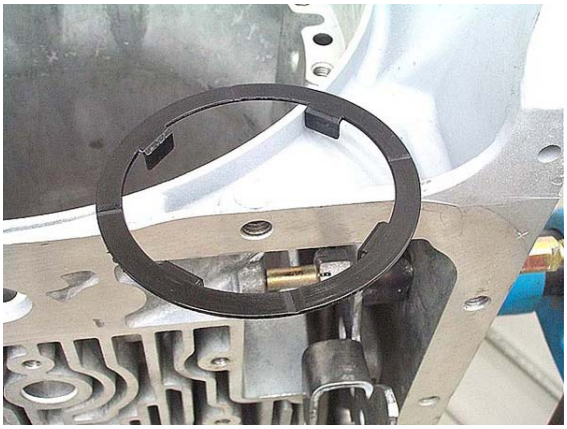


Step 29: Hold the output shaft up into the case with one hand while using a pair of small thin snap ring pliers to remove the output shaft snap ring from above the front planet. It may seem a bit like a juggling act, but you don't want the output shaft to hit your toe when you remove the snap ring. It hurts. Once the snap ring is off, slide the output shaft out of the case.



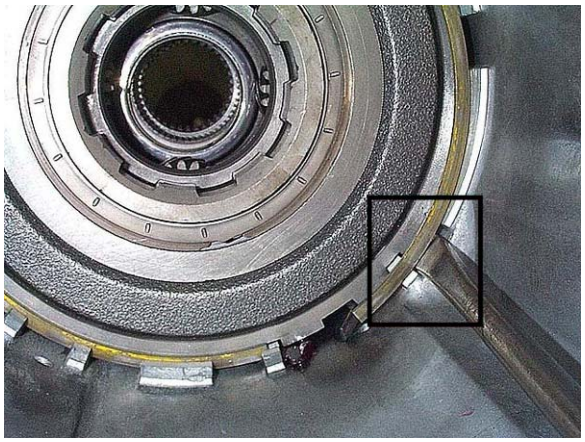
Step 30: Grab the outside of the ring gear hub and lift the planet, hub and shaft assembly out of the case. Separate the planet from the ring gear and retrieve the thrust bearing from between the planet and the ring gear.


Step 31: Lift the sun gear shell out of the case and remove the metal thrust washer from the inside of the sun gear shell. Locate and retrieve the plastic thrust washer that was *under* the shell. It may have stuck to the backside of the shell or may be sitting on the low roller clutch inner race.

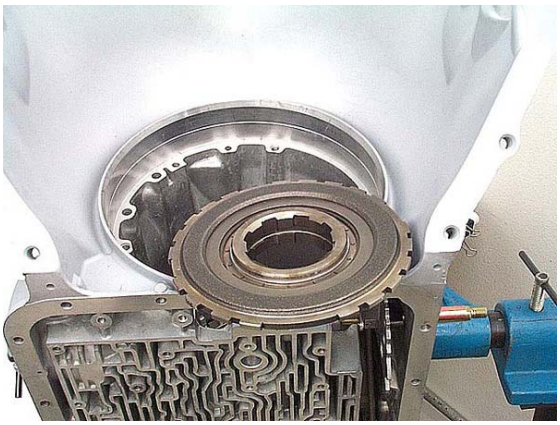



Step 32: Remove the rear sun gear from the rear planet.

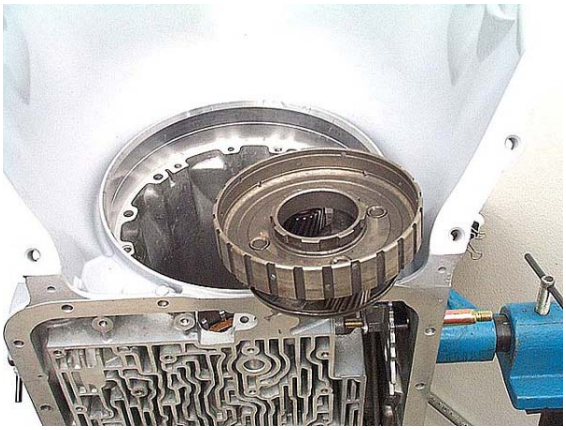
Step 33: Remove the snap ring holding the low roller clutch assembly into the case.

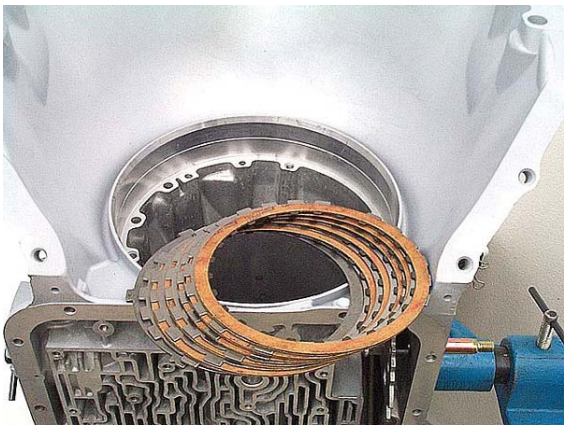


Step 34: Slide the output shaft back into the rear of the case. Using a soft mallet, tap on the rear end of the output shaft to knock the low roller clutch out of the case lugs. Once the roller clutch assembly is clear of the lugs, remove the output shaft from the case. Reach into the case and remove the low roller clutch from the case.

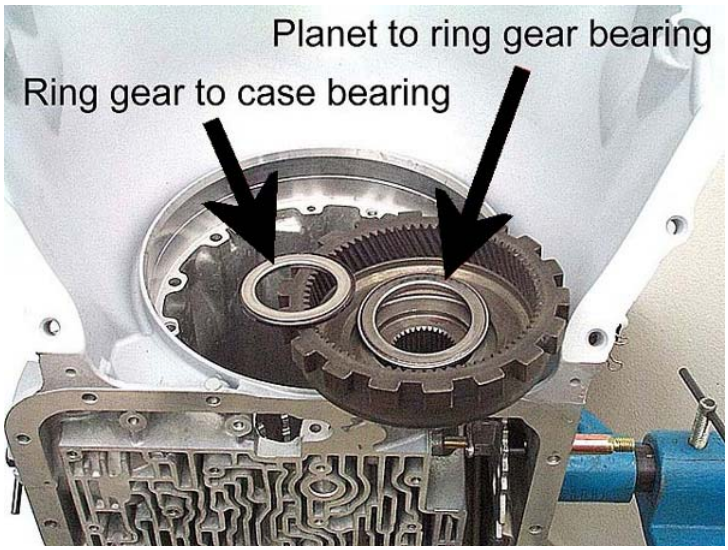


Step 35: Remove the rear planet from the case. Some of the low-reverse clutch plates may come out with it.



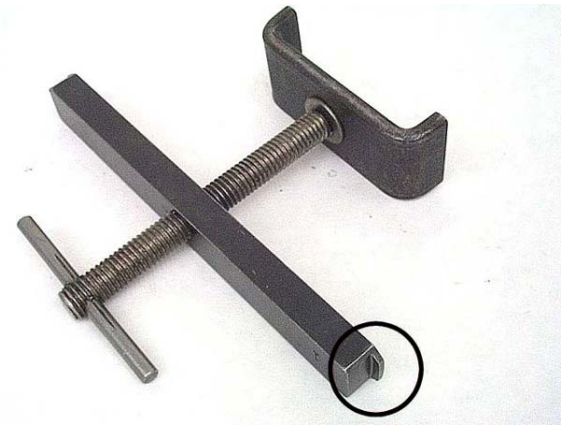


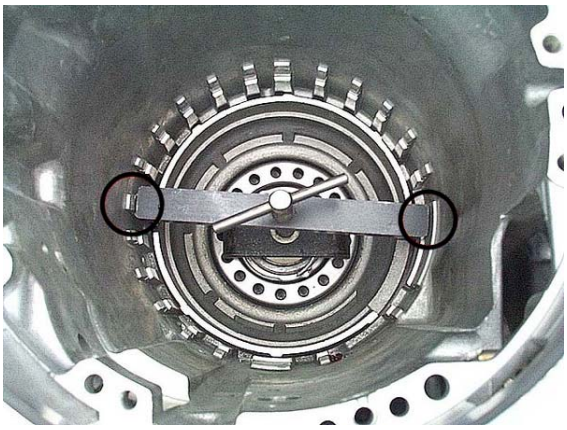
Step 36: Reach through the rear ring gear with your finger and remove the rear ring gear from the case. Any low-reverse clutch plates that didn't come out with the planet will come out with the ring gear. Locate and save the rear ring gear thrust bearing, which may be on the ring gear or sitting in the bottom of the case.

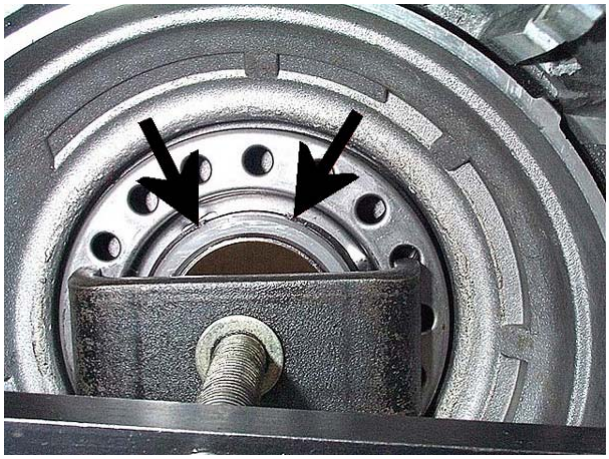


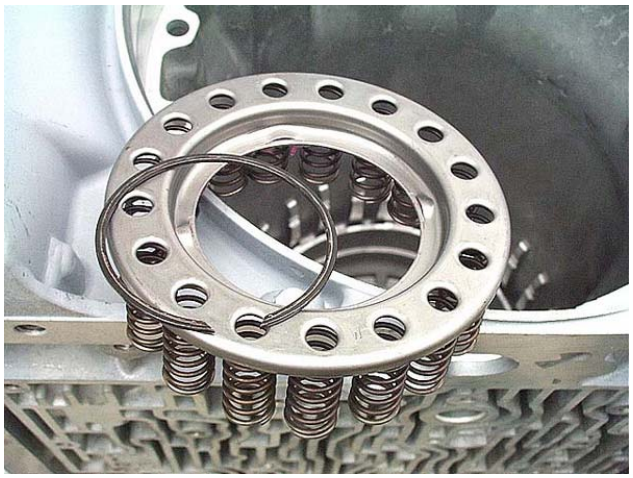
Step 37: If it hasn't come out of the case yet, retrieve the anti-clunk spring from the case.

Step 38: Using a suitable return spring compressor, compress the low-reverse clutch return spring assembly and remove the retaining snap ring. Release the compressor and remove the compressor and return spring assembly from the case.

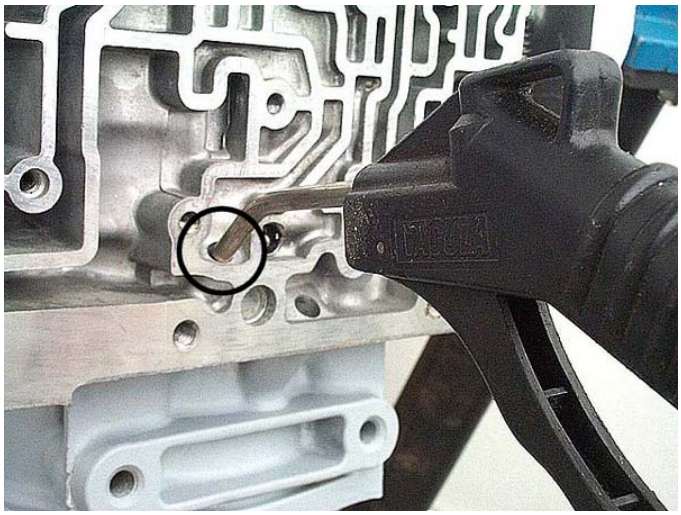








Step 39: Blow compressed air into the passage shown to pop the low-reverse piston out of its case bore. Remove the piston from the case. Remove the seals from the piston.



Step 40: Evaluate the condition of the major components inside the unit. If no major components need to be replaced, and **Step #21** showed that you needed to adjust endplay, now is the time to get the correct endplay shim for the input drum. If endplay was too great, you need a thicker shim. If endplay was too little, you need a thinner shim.

Pump Assembly-4L60E

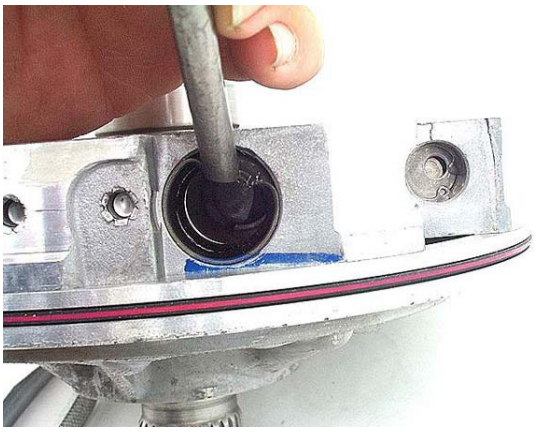
Attention- Now is the time to correct a torque converter drainback problem. Almost all instances of this problem are caused by excessive clearance in one of three pump areas, two of which are addressed here. These areas are:

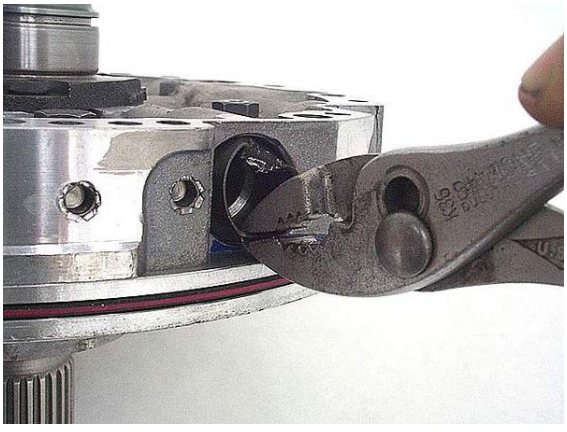
1. Torque converter hub to pump bushing clearance. This clearance must be kept under .005". If excessive, check both torque converter hub OD and pump body bushing ID. Make certain that a replacement bushing size checks out okay with the torque converter hub that is going to be used.

2. Pump rotor and pump slide to top-of-pump-pocket clearance, which should be *less than* 0.003". These clearance checks are covered in detail further on in this section. Take the time to check and adjust this clearance to avoid drainback and other problems.

3. Stator support bushing to turbine shaft journal clearance. This unit requires a good fit between the stator bushings and the turbine shaft to avoid drainback.

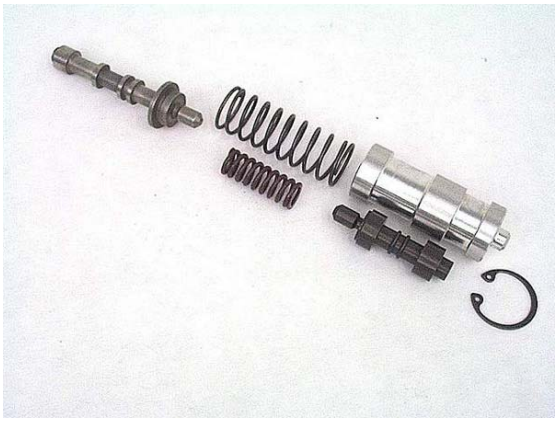
Step 1 (4L60E only): Use a bushing chisel or other suitable cutting device to fold over one side of the lipped-sleeve type of filter neck seal. Remove the seal from the pump body with a pair of pliers.





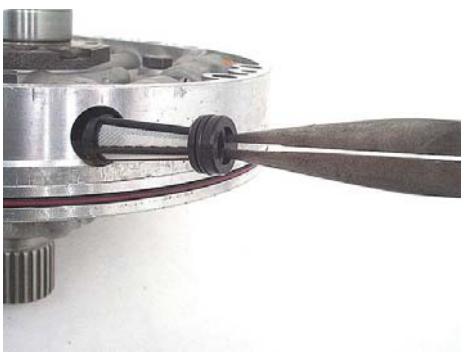
Step 2: Remove the pressure regulator boost valve retaining snap ring (4L60E shown). The boost valve and pressure regulator valve assembly should pop out of the pump. Later, when the pump halves are separated, you can gently push or pry any parts out of the bore that don't want to come out peaceful-like.

Note- The following valve assemblies may be easier to remove before separating the pump halves because, when separated, the halves may slightly distort the valve bores, making them bind the valves a bit during removal.



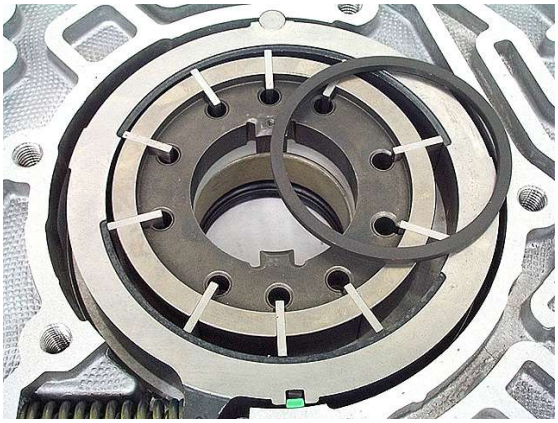
Step 3: Remove the TCC apply valve retaining snap ring from the valve bore. The retaining plate, valve and springs should fall out of the bore.

Step 4: Remove the pump output screen from the side of the stator support.

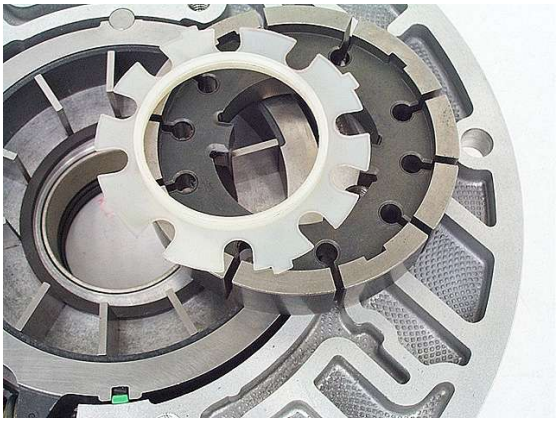


Step 5: Remove the five 13mm bolts that hold the two pump halves together, and separate the pump halves.

Step 6: Remove the top pump vane ring (which may be sticking to the stator support.



Step 7: Lift out the pump rotor. There may be a plastic pump vane guide ring either in the pump pocket or stuck to the pump rotor. Remove this guide ring.



Step 8: Remove the pump rotor vanes and bottom vane guide ring.

WARNING: The following step involves removing a very high tension spring or set of springs from the pump body. These springs can cause serious injury if not properly controlled during removal or installation!

Step 9: Pry the pump slide spring out of the spring pocket, covering the spring pocket with your rag-covered hand.

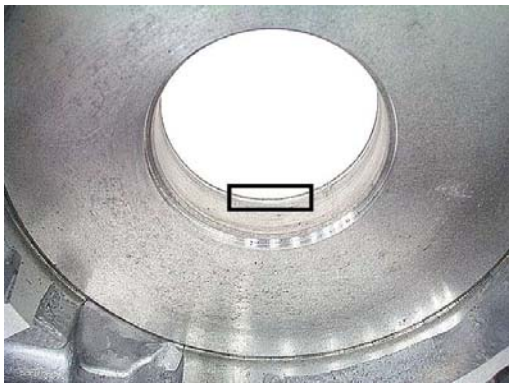
Step 10: Remove the pump slide from the pump pocket. Inspect the bottom of the pump pocket and the side of the pump pocket where the slide side seals rub. If there is any noticeable wear or scoring, the pump body must be replaced. Remove the slide side seals and slide top or bottom seal ring and rubber support ring. If the seal ring sticks in place, use an air nozzle to shoot air under/around it to unseat it.

Step 11: Remove the slide swivel pin and pin spring, if equipped. This pin is not only a swivel point for the slide, it also acts as a seal. Inspect the pin closely for any wear from the slide.

Step 12: Remove the front pump seal by deforming it as shown, then prying it from the seal bore.

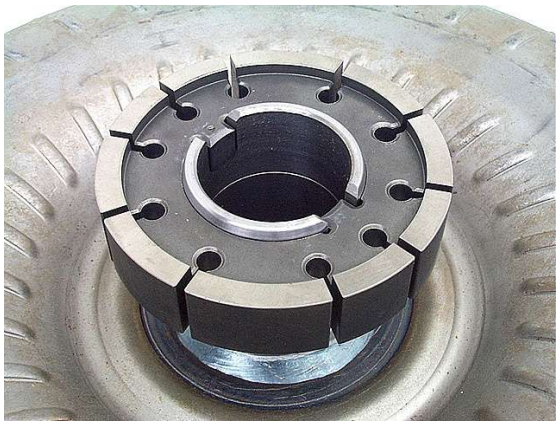
Step 13: Remove pump body o-ring if equipped.

Step 14: Remove pump body bushing (unless the bushing is going to be re-used.



CAUTION: The pump body bushing bore may have a ridge at the front of the bore to keep the bushing from moving out of the bore. The bushing must **not** be pressed past this ridge, otherwise the ridge may be removed. Always look for this ridge before removing the pump bushing.

Step 15: Check the rotor-to-torque converter hub fit. Although there isn't any official specification for this clearance value, the rotor's ID should fit the end of the converter hub snugly, without a lot of noticeable side-to-side movement. The pump rotor and slide are of selective thicknesses. If the rotor needs to be replaced, make sure to get the correct thickness. Step #12 shows how to measure this.



Step 16: If there was a lot of contamination throughout the unit, use a small punch to remove the line pressure blow-off ball retaining pin. The spring and ball should then fall out of the hole.

Step 17: Gently flat sand the passage walls of the pump, as well as the stator support passages if equipped, only enough to get rid of high spots around bolt holes and edges. Inspect all pump parts for wear or damage, replacing any bad parts you may find. Thoroughly clean all pump parts.

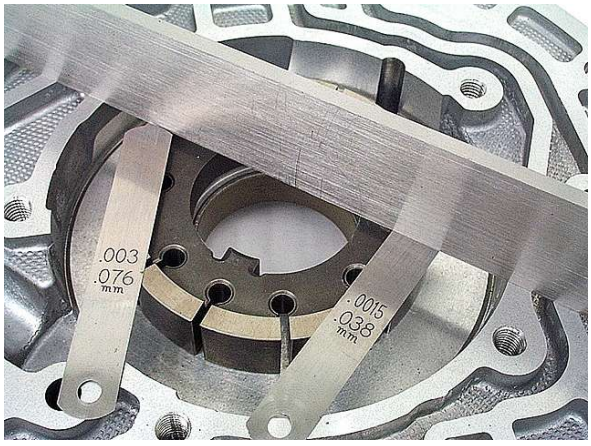
Step 18: Coat a new front pump bushing with an anaerobic thread locking compound such as Loctite™ to help hold the bushing in place. Install the bushing into the pump body, being very careful to press the bushing into the bore squarely. When the bushing is still a little bit above flush with the bottom of the pump pocket, use a larger bushing driver to press the bushing down square with the bore. Use the correct driver to drive the bushing into the correct position. If there is a bushing bore ridge, be sure that you stop driving the bushing before contacting this ridge.

CAUTION: Make certain that you wipe off **any** excess locking compound from the bushing after pressing it into place. If any of this compound gets into the pump rotor area, a destroyed pump is practically assured.

IMPORTANT: After the bushing is installed, check the clearance between the bushing and the torque converter hub you are going to use. This clearance must be no greater than 0.004". If you have too much clearance, check the clearance with a different converter or try installing a bushing from a different manufacturer.

NOTE: New bushings may have a high durability coating on the inside of the bushing. These coatings usually have a dark gray or light green color. These coated bushings have been working quite well, so it is a good idea to use this type bushing to avoid friction damage and a spun bushing.

Step 19: Place the rotor into the pump bore where it normally rides. Lay a straight edge across the rotor. Measure the clearance between the straight edge and the rotor at several points around the rotor. The clearance must be between 0.0015"-0.0025".



Step 20: Remove the rotor. Place the slide swivel pin into its pocket. Lower the slide into the pump body where it normally rides against the swivel pin. Lay a straight edge across the slide. Measure the clearance between the straight edge and the slide at several points around the slide. The clearance must be between 0.002"-0.003".

Step 21: The pump rotor and slide come in selective thicknesses. If either have to be replaced, be sure to get the correct thickness. If the clearance is close but not within these specifications, sand or replace the parts as necessary. If the clearance is too tight, flat sand the rotor or slide until the clearance is correct. If the clearance is too loose, you can flat sand the pump body to tighten up the clearance. Be certain to clean the parts after any sanding operation.

Step 22: Clean any old sealer from the inside of the pump seal bore. Using a wire wheel or brush, remove the sealer coating from the outside of the front seal. Coat the outside of the seal with an anaerobic thread locking compound such as Loctite™. This keeps the seal from popping out after installation. Using an arbor press or gently tapping with a hammer, press the seal all the way into the bore. Again, be sure to wipe off any excess locking compound from the pump.

Step 23: Coat the pump pocket with assembly lube, then install the slide seal ring and rubber support ring into the slide groove. Install the pump slide into the pump body.

Step 24: With the pump on the bench and the slide facing up, install the slide side teflon seal and rubber support strip into the groove on the side of the pump slide. The teflon seal goes against the pump bore and the rubber strip goes into the slide groove.

Step 25: Pressing the slide toward the side seals to compress the rubber support strip, install the pump slide swivel pin spring and swivel pin.

CAUTION: The following step involves working with high tension springs!

Installing the rather stout pump slide spring or springs can be hazardous to your health. If you lose control of them during installation, they can leave quite a welt where they bounce off of your forehead. Here's one way to avoid this:

Step 26:

- Put the spring(s) in a pair of vicegrips. Swivel the pump slide to the widest spring pocket position. Compress the spring with the grips until the springs are just a bit shorter than the pocket.

- Holding the springs over the pocket, tap the springs with a small hammer. This should knock the springs from the grips to the pocket, leaving your forehead or glasses intact.

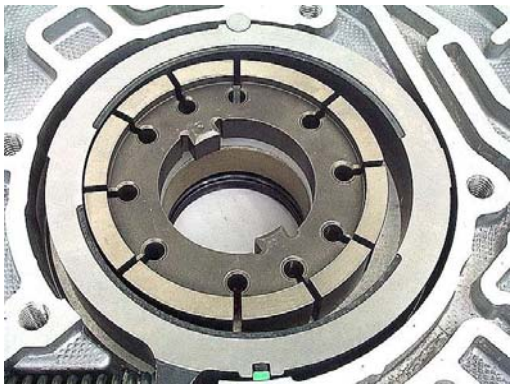
- After the spring pops into the pocket, be sure to press the spring with your thumbs all the way below flush with the top of the spring pocket.

- Smooth out any burrs or dents that the grips may have left on the pump walls.

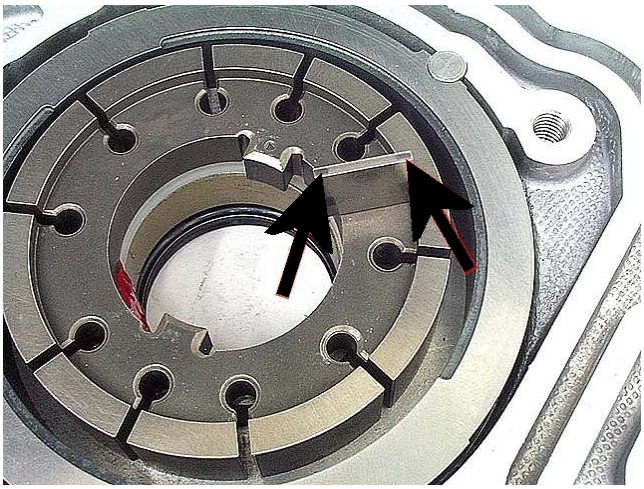
WARNING: You can also use a screwdriver or prybar to pry the springs into place rather than the vicegrip method, but if you lose control of the spring or the screwdriver, the spring may launch itself out of the pocket and toward your eyeball at an impressively high velocity while you're busy gouging your thumb with your screwdriver, so again, be real careful here, particularly if you use the prying method to install this spring!

Step 27: Place a pump vane ring into the bottom of the pump pocket. Place the plastic rotor guide ring (if equipped) into place on the pump rotor, holding it in place with assembly lube.

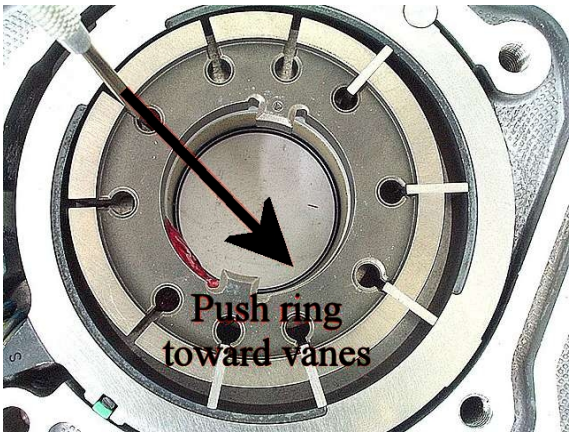
Step 28: Place the rotor into the pump pocket (guide ring down, if equipped).



Step 29: If you are using used pump vanes, find the side of each vane that has two 'rub marks' from riding against the vane rings, and aim that side of each vane toward the center of the rotor. Install half of the pump vanes in a semi-circle, making sure that the vanes don't go on top of the bottom vane ring.



Step 30: Using a pick in a vane slot, push the bottom vane ring against the installed vanes. This should provide enough clearance to install the rest of the vanes.



Step 31: Once all vanes are installed, check to make sure that all vanes are below flush with the top of the pump pocket. Install the top vane ring inside of the pump vanes. Squirt ATF all over the rotor and slide assembly. The pump body is done for now, so let's move on to the stator support.

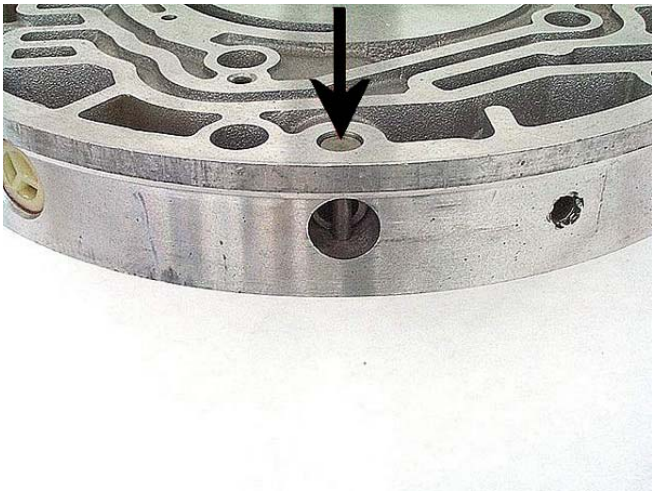
Step 32: Check the front stator bushing clearance between the bushing and the turbine shaft center journal. If it's not over 0.002", it can be re-used as long as the journal is in good shape.

Step 33: Always replace the rear stator bushing. This bushing is responsible for maintaining centerline throughout the transmission more than any other bushing, and is subject to rather high loads.

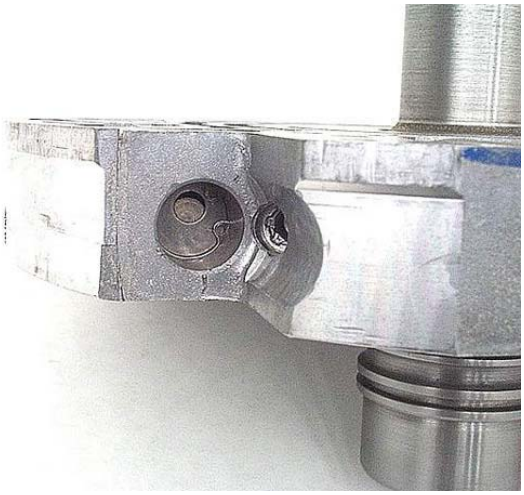
Step 34: Flat sand the passages of the stator support, paying close attention to the areas near the bolt holes.

Step 35: Install a new pump output screen into the side of the stator support. The replacement screen may be a different color, but should function properly. If you're reusing the screen, make sure that you put a new o-ring on it. It's got to seal against main line pressure.

Step 36: Install the line pressure blow-off ball and spring into the proper hole in the stator support. Push the spring in with a suitable tapered tool, and install the retaining pin to hold the spring in place. Make sure that the pin head goes below flush with the pump surface.

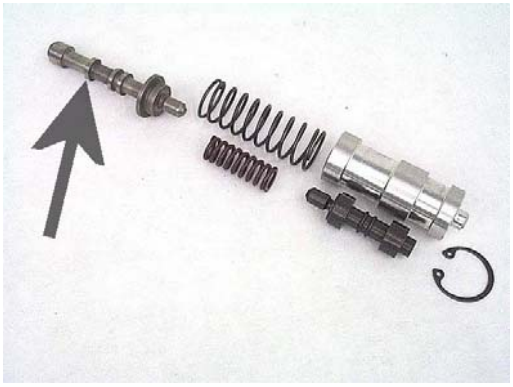


Step 37: Drop the two TCC apply valve springs into the TCC apply valve bore. Slide the valve into place after the springs, small diameter end first. Push on the valve with a small screwdriver to make sure that the valve strokes throughout its travel freely. Set the retainer plate in place, then install the retaining clip into the bore. Make sure that the entire snap ring properly locks into the snap ring groove.



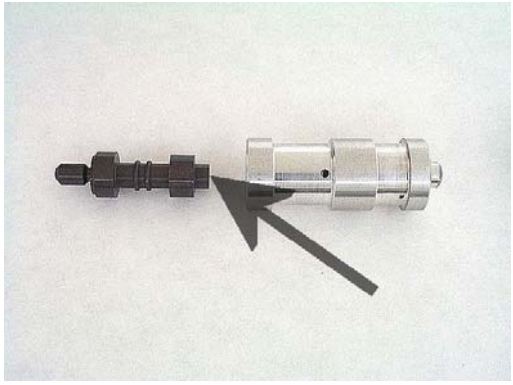
Pressure regulator valve train, 4L60E (the 4L60 setup is right after this one):

Step 38: Grind a flat spot about 1/8” to 3/16” wide on the second land of the pressure regulator valve.



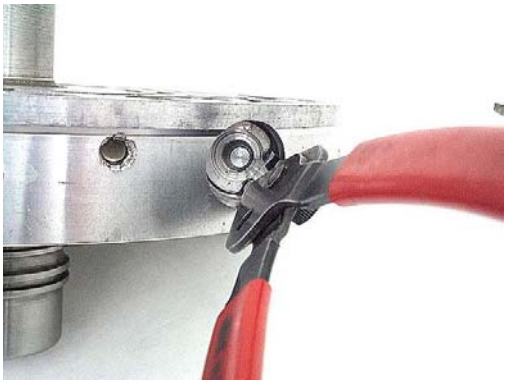
Step 39: Before assembling the boost valve and sleeve, drill the hole in the boost sleeve as shown to 0.042" (#60 drill) to improve line pressure response time. Make absolutely sure that there are no burrs left inside the sleeve from the drilling operation.

Step 40: Smear some assembly lube on the inner end of the boost valve, then slide the pressure regulator boost valve into the sleeve.



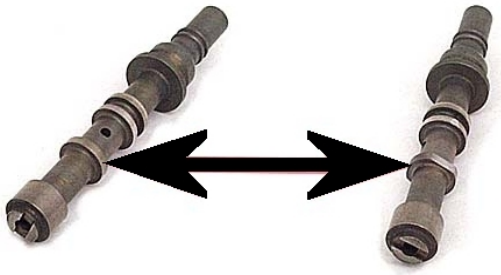
Step 41: Slide the pressure regulator valve and pressure regulator valve springs into the pressure regulator bore.

Step 42: Place the pressure regulator valve snap ring onto the snap ring pliers. Use the pliers to push the boost sleeve assembly into the bore. If you can't get the snap ring all the way into the groove this way, release the snap ring to hold the sleeve in the bore. Press the snap ring the rest of the way in with a pair of needle nose pliers or a small screwdriver until the snap ring is firmly locked into its groove.



Pressure regulator valve train, 4L60:

Step 43: Grind a flat spot about 1/8” to 3/16” wide on the second land of the pressure regulator valve.



In the following few steps, you will be installing the pressure regulator boost valve assembly into the pump. Simply put, this procedure can drive you crazy until you get familiar with it. The challenge is to hold the stator support while holding several parts in the pump bore while they are under spring tension, and installing a snap ring into the bore to hold the pressure regulator assembly in place without allowing the T.V. boost and reverse boost valve assemblies to slide apart during the process which would jam everything up, making you start this step all over again. Like I said, this can drive you nuts the first time or two, but keep the faith; you'll get it.

Step 44: Smear some assembly lube on the T.V. boost and reverse boost valves to help them stay in their sleeves, then install the boost valves into their sleeves making sure that the flat end of the T.V. boost valve points toward the open end of the sleeve.

Step 45: Slide the pressure regulator valve and spring into the stator support, making sure that it slides freely the full length of its travel.

Step 46: Slide the reverse boost valve and sleeve into the pressure regulator valve bore, with the exposed valve stem pointing outward as shown.

Step 47: Place the stator support in a vice between two blocks of wood. This is just to hold the support still, so don't apply a lot of pressure with the vice. Insert the t.v. boost valve assembly into the bore, open end down toward the pressure regulator valve. Gently push the sleeve into the bore while wiggling it around. The spring will push it back out, but this will get it into the correct position.

Step 48: Put the snap ring onto the snap ring pliers. Hold the snap ring over the TV boost valve sleeve. Use a screwdriver placed inside the snap ring to push the boost sleeves into the bore. Lower the snap ring into the bore, then release the snap ring into the bore groove.

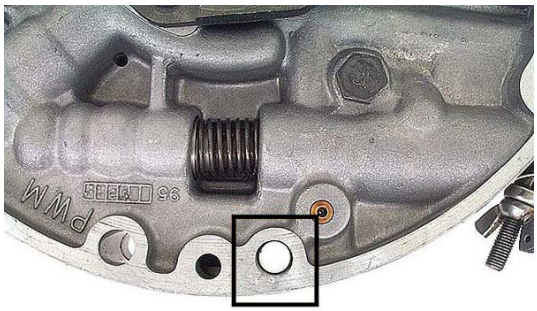
If you can't get the snap ring all the way into the groove this way, release the snap ring as far down in the bore as possible. Use another small screwdriver to press the snap ring the rest of the way into the groove until the snap ring is firmly locked into its groove.

Step 49, 4L60E only: Use the appropriate size bushing driver to install a new filter neck seal into the filter bore of the stator support.

Step 50: Lay the serviced pump body face-up on the bench and line up the stator support over it. You can use the two closely-spaced holes next to the pressure regulator valve bore as line-up markers.

Step 51: Loosely install the five pump body-to-stator support bolts. After the bolts bring the two parts together, back them out approximately 1/2 turn. Install the pump alignment strap over the joint between the two pump halves.

Step 52: Tighten the pump strap until it's good and snug. The stator support should still be able to rotate within the strap a little bit. Line up the bolt holes by eye. Torque the five pump bolts to 18 ft-lbs., using a star-shaped tightening pattern.



IMPORTANT: After the pump body and stator support are bolted together, make sure that the rotor can be turned by hand using the pump shaft, a converter hub, a pick or other suitable tool. Be very careful not to nick the front seal or bushing. If the rotor won't turn, disassemble and re-check your slide and rotor clearances.

Step 53: Installing the reverse input drum sealing rings will require the special tools designed for this purpose. While it is possible to work the rings into place without intentionally cutting them (*never* cut solid teflon rings to make them easier to install!), it is also **much** more likely that they'll be damaged if the proper tools aren't used.

- Coat the seal ring groove area with assembly lube.

- Place the ring expander tool over the stator support tower, lining up the bottom of the tool with the top of the lower seal ring groove. Quickly slide a new ring down the tool until it pops into the lower groove.

- Remove the expander tool and pre-compress the ring into the groove by hand, working your way around the ring from several angles.

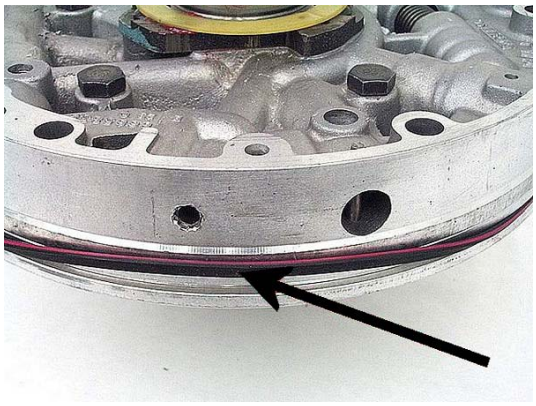
- After you've squished the ring into the groove as best as you can, center the ring in the groove and slide the ring sizer tool over the ring groove area.

Once the tool contacts the ring, be very careful not to push too hard on the tool. On one hand, it takes quite a bit of pressure to size the ring down enough for the tool to slide over the ring. On the other hand, if you haven't pre-compressed and centered the ring properly by hand, and one side of the ring is hanging out past the edge of the groove, you will accidentally slice the ring to pieces using *less effort* than it would have taken to properly compress the ring. You won't know whether you've wiped out the ring or not until you remove the sizer tool. Your only defense against cut rings is squishing the ring into the groove real good by hand, centering it, then using a gentle rocking and rotating motion on the sizer tool while gradually increasing downward pressure. Further hedge your bets against job delays caused by ring damage by having LOTS of spare rings around to 'practice' with.

- Repeat the above procedure to install the upper ring *after* the lower ring is properly installed.

Step 54: Place the reverse input drum thrust washer into position on the stator support using assembly lube to hold it in place.

Step 55: Install the pump o-ring into the pump body groove without twisting it, making sure that the line on the OD of the ring is visible all the way around the pump.



The pump is now ready for unit assembly

Input Drum Disassembly

Step 1: Remove the thrust bearing and selective washer from the top of the input drum.

Step 2: Inspect the three turbine shaft bushing journals for wear or damage. If problems are found, replace the drum.

Step 3: Remove the four teflon seal rings from the turbine shaft. Since there must be absolutely no damage to the sides of the ring grooves, the best way to remove the rings is to stab them through the middle with a pick. This breaks the ring without touching the side of the ring groove.

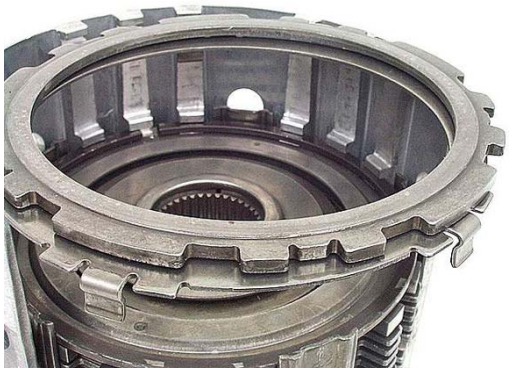
Step 4: Flip the drum over. To hold the drum upright while you work on it you can use a 4T60 input drum or other suitable device.

NOTE: To assist with easy viewing of the drum's internal parts, the drum shown has been cut open to expose the clutch and piston areas, and the turbine shaft has been removed. If your drum looks like this one, it's in serious trouble.

Step 5: Remove the 3-4 clutch snap ring and selective pressure plate.

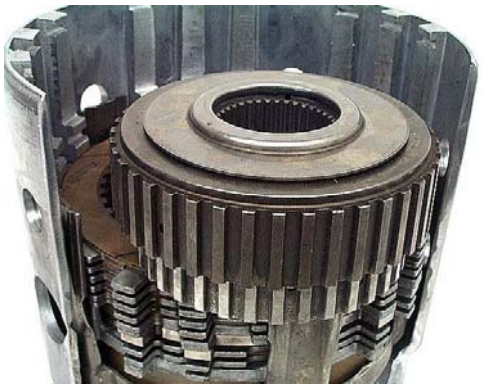
Step 6: Remove the 3-4 clutch friction and steel plates. Remove the five boost spring assemblies from the drum if equipped.

Step 7: Remove the 3-4 clutch apply plate. There may be either a single or double apply plate assembly, depending on model.



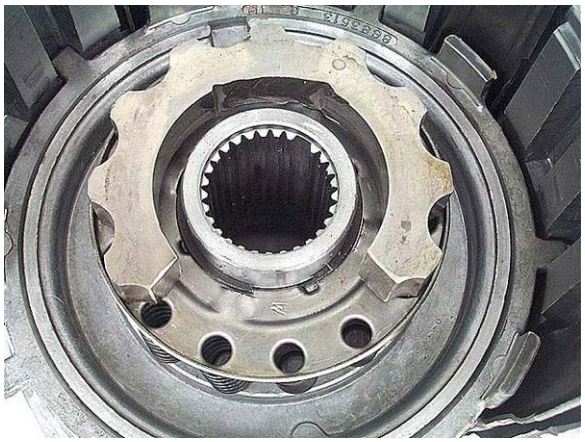
Step 8: Remove the forward clutch snap ring and pressure plate. This is one of the toughest snap rings you'll ever encounter, so expect some fighting with a screwdriver to get it out. Try not to beat up the drum too badly in the process.

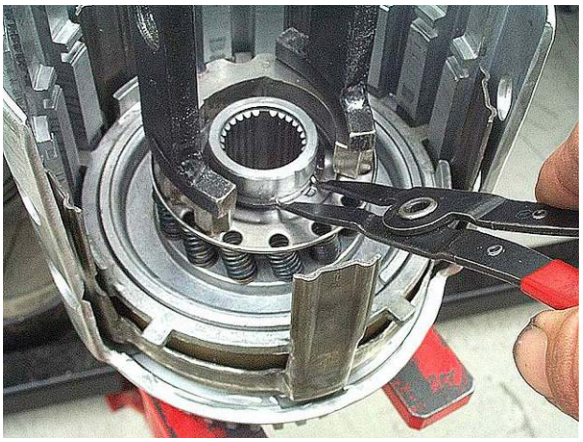
Step 9: Remove the forward sprag assembly. Remove the thrust bearing and lube seal from the input drum.



Step 10: Flip the drum over and bang it on the bench. The forward and overrun clutch assemblies should fall out of the drum. Although input drum reassembly is fully covered in another section, pay attention to the sequence and order of the plates that come out of the drum. Take note of the different types of plates that come out, and try to determine how they work with the different pistons in the drum. The way that stacked piston and clutch assemblies operate inside a common drum really can be quite fascinating, and this knowledge can come in very handy when working on other unfamiliar units.

Step 11: Use a modified pump gear or similar device to help in *evenly and squarely* compressing the return spring assembly in the input drum. Place the drum in a suitable compressor and remove the snap ring. Remove the drum from the compressor, then remove the return spring assembly from the drum.





Step 12: Grab the drum by the turbine shaft, flip it over and slam it against the bench again. Isn't transmission rebuilding fun? All piston assemblies except for the 3-4 piston should fall out of the drum. Separate the forward and overrun piston assemblies, and remove the lip seals from the overrun piston.

NOTE: Don't worry about the condition of the forward piston, or bother removing the lip seals from it. One of the most common 4L60E failures is a cracked aluminum forward piston, so during the Input Drum Assembly section you will be instructed to throw this piston in the trash, replacing it with a steel piston with molded seals.

Step 13: Remove the 3-4 clutch piston from the input drum. If your drum has an aluminum piston, remove the lip seals from the piston.

Step 14: Remove the forward piston housing inner o-ring from the input drum. All input drum parts are now ready for cleaning and inspection.

Input Drum Assembly

To make it easier to see the steps being covered, some images use a cutaway input drum.

Step 1: Using a small punch, gently tap on the 3-4 clutch apply circuit checkball to ensure a good seal in the capsule or drum pocket. Blow compressed air into the capsule to remove any particles.

Step 2: Install the forward piston housing inner o-ring into the input drum groove as shown. This is usually a green o-ring in most kits. Coat the ring with assembly lube. Coat the drum center tower and 3-4 piston bore with assembly lube.

Step 3: If you have an aluminum 3-4 piston, install new lip seals into the piston seal grooves, then install the piston into the input drum. If you're not using an aluminum 3-4 piston, install a new molded piston.

Updated Input Drum Pistons

IMPORTANT: A cracked aluminum forward piston is one of the most common problems you will encounter in the early 4L60E. These cracks can be practically invisible, so it's quite possible that a cracked piston can end up going back into a unit. To correct this problem, all input drum pistons have been updated from aluminum pistons with separate lip seals to steel pistons with molded rubber lip seals since 1997. You can use either an aluminum or steel piston for the 3-4 and overrun clutches, but if your unit has an aluminum forward clutch piston, throw it in the trash. It *must* be replaced by the steel forward piston.

Steel pistons will directly replace the earlier aluminum pistons with only one provision: If you replace an aluminum overrun piston with a steel piston, the return spring assembly must also be replaced. Since there are no nubs on the steel piston to retain the bottoms of the return springs, the return spring assembly has an added retaining plate to hold the bottoms of the springs in place. The springs must have this support, because without this support *centrifugal force* will cause the springs to sling out of position, causing clutch failure.

If your unit came with any molded pistons, they should always be replaced due to heat damage and hardening, as well as seal abrasion due to particles in the fluid.

Step 4: The forward clutch piston housing has a checkball capsule in it. Using a small punch and hammer, gently tap on the ball to seat it into the capsule. Blow out any debris from the capsule. Coat the forward piston seal surface and the inside and outside of the housing flange with assembly lube.

Step 5: Install a new forward steel piston into the piston housing. Although you may need a feeler blade to help push the seal into the housing, it can usually be installed by hand without tools. Try pushing the lip in with your thumbnail, if you have one.

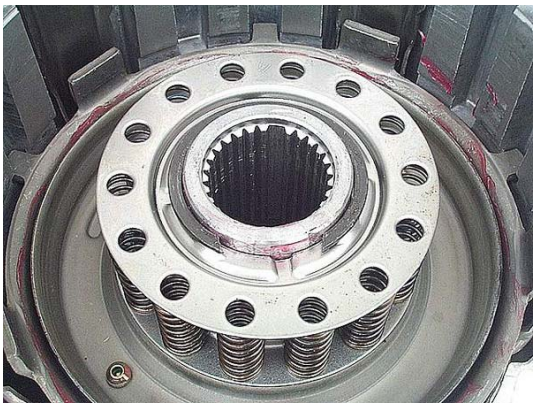
Step 6: Place the 3-4 clutch apply ring on the bench. Set the 3-4 clutch return spring assembly inside the apply ring. Place the forward piston and housing assembly on top of the 3-4 clutch return spring assembly, lining up the wide lugs on top of the forward piston with the fingers of the 3-4 clutch apply ring.

Step 7: Grab two fingers of the apply ring and lower it into the input drum with your thumbs, lining up the apply ring fingers with the wide slots inside the input drum.

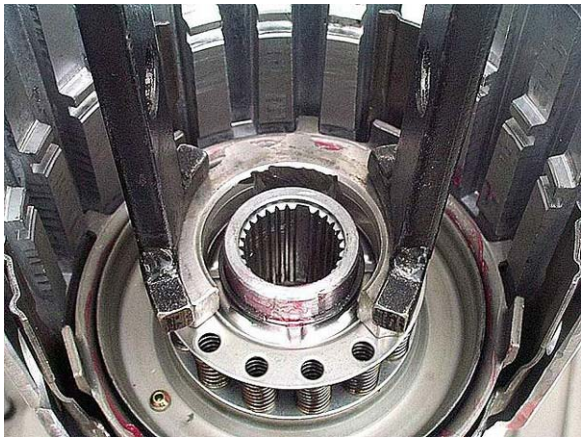
Step 8: You will need to help the inside piston seal over the last bump in the drum with a feeler blade or other suitable tool. Once the piston has cleared the last bump and is in the proper position, you will see about 3/16" of drum above the seal below the first step. When you press down on the piston, it will spring back a little bit. Coat the seal bore in the top of the forward piston with assembly lube.

Step 9: Install the overrun piston into the forward piston, using a feeler blade to guide the inner piston seal over the snap ring groove in the drum tower. When fully installed, the piston should appear in the position shown.

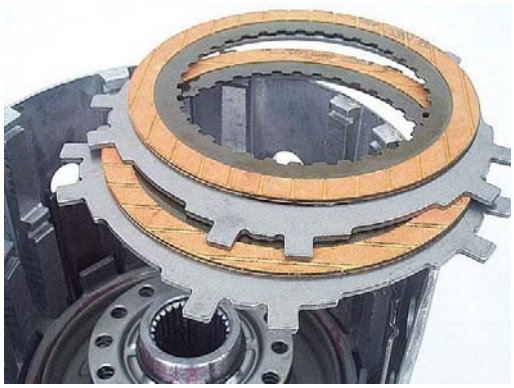
Step 10: Place the overrun piston return spring assembly onto the piston, making certain that the proper spring assembly is used for the piston you installed, according to the Updated Input Drum Pistons section listed above. Start the return spring assembly snap ring into position over the drum.

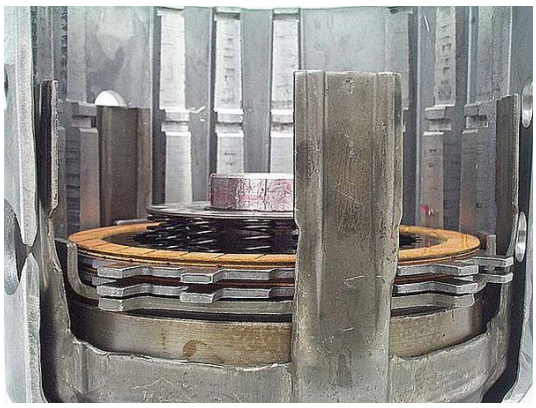


Step 11: Using an appropriate compressing tool, compress the overrun return spring assembly far enough to install the snap ring. Make sure that the ring goes inside of all four snap ring retaining tabs on the spring assembly.



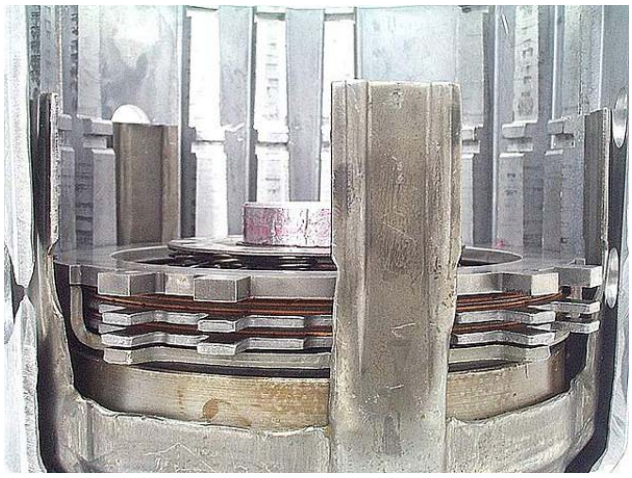
Step 12: Install the overrun clutch set, two friction and two steel plates, starting with a steel plate. The teeth of the steel plates must go into the narrow slots of the drum, between the wide forward piston lugs.





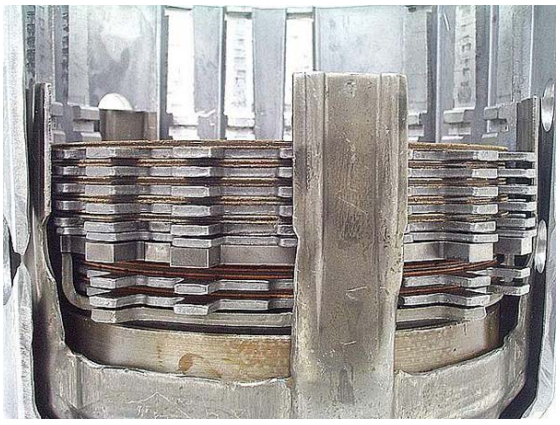
NOTE: There are several types of steel plates used in the input drum that are very similar, but will not interchange. The correct plates must be installed in the correct locations. Use this illustration to determine correct plate location. The plates are shown in their proper respective position within the input drum.

Step 13: Install the forward clutch apply plate.

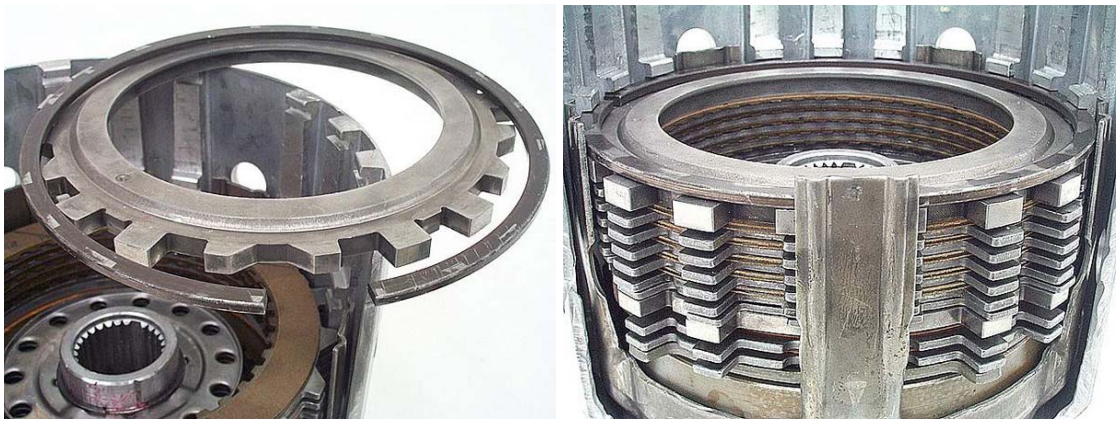


Step 14: Install the forward clutch waved plate.

Step 15: Install the forward clutch plates, starting with a steel plate against the waved plate.



Step 16: Install the forward clutch pressure plate and snap ring.



Step 17: Measure the forward clutch clearance between the pressure plate and the snap ring. The clearance should be 0.030"-0.063" (0.75mm-1.60mm). Adjust the clearance by changing the forward clutch pressure plate, which comes in the following sizes:

Plate Thickness ---------- ID Letter

0.180"-0.185" (4.61mm-4.71mm) ---- E

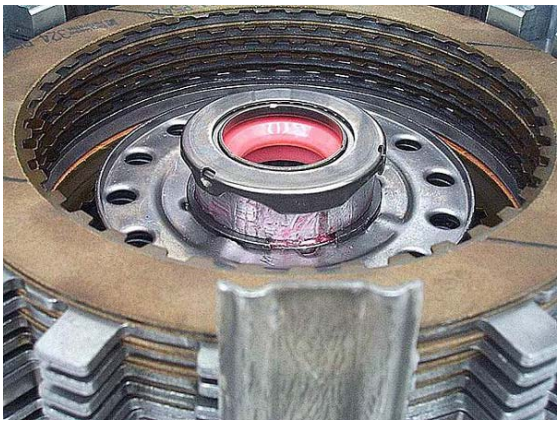
0.205"-0.208" (5.20mm-5.30mm) ---- D

0.227"-0.232" (5.79mm-5.89mm) ---- C

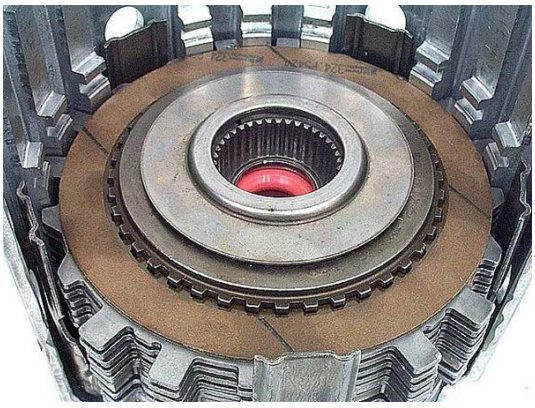
0.250"-0.255" (6.38mm-6.48mm) ---- B

0.274"-0.278" (6.97mm-7.07mm) ---- A

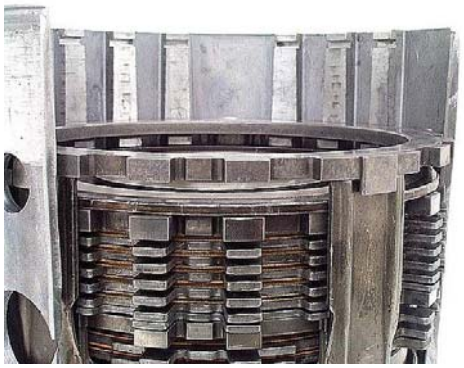
Step 18: Once proper clearance has been checked and corrected if necessary, remove the forward pressure plate and snap ring. Install the lube seal into the drum against the inner end of the turbine shaft. Place the thrust bearing as shown on top of the lube seal, using assembly lube to hold it in place.

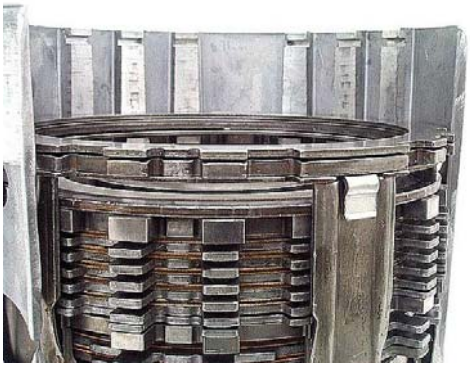
Step 19: Install the input sprag into the drum (which is shown being serviced in the Gear Train section), feeding it through both sets of clutches. You will know when the sprag is all the way down against the thrust bearing when you can push down on the sprag and still turn it easily in both directions. Once the sprag is in place, re-install the forward clutch pressure plate and snap ring.




Step 20: Install the 3-4 clutch apply plate next. There are two possible types of apply plate setup, and the clutch stack-up is different for each. You will find either a thick one-piece apply plate with built-in feet for the apply ring fingers,



or a thin stamped steel plate with feet for the apply ring fingers, with a stamped steel stepped plate on top of it, followed by an early 4L60-style 3-4 clutch steel plate with wide teeth to engage the drum slots.

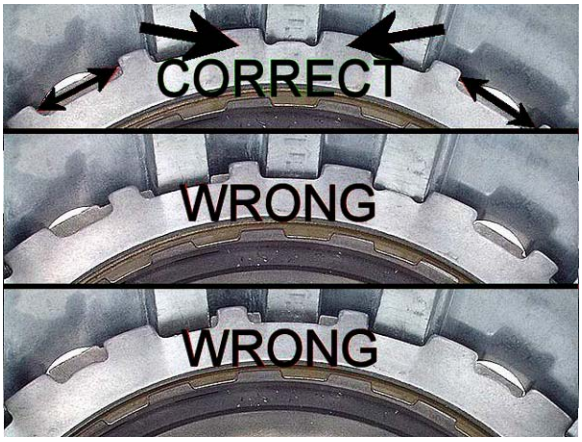


Step 21: When installing the 3-4 clutch pack, pay attention to the type of plates needed:

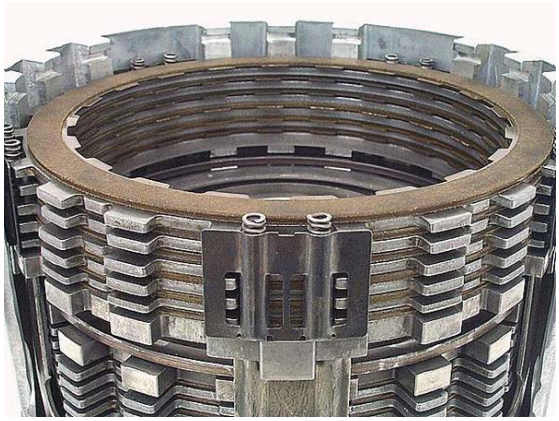
If your drum has the one-piece apply plate, use thick steel clutch plates which measure 0.107" thick.

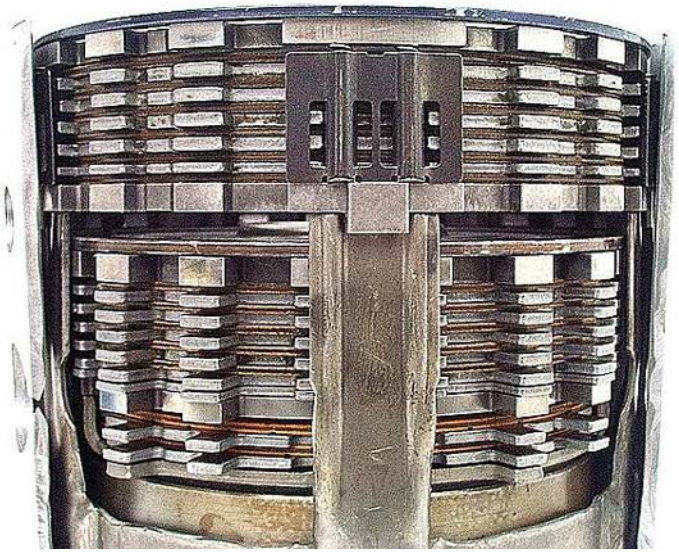
If your drum has the three-piece apply plate assembly, use thin steel clutch plates which measure 0.070" thick, keeping in mind that this version uses an early thin steel with wide teeth at the bottom of the clutch pack.

IMPORTANT: The 3-4 clutch steel plates have teeth of different widths around the plate, which must be installed into the drum in the proper manner in order to allow room for the 3-4 clutch boost springs. All wide steel plate teeth must go into narrow drum slots only, and pairs of narrow teeth must go into common wide drum slots only.



Step 22: Insert the 3-4 clutch boost springs into the clutch steel teeth spaces as shown. Install the backing plate and snap ring that came with the unit, which should slightly compress the boost springs a bit. You can also use the third image in this step as a drum assembly reference.





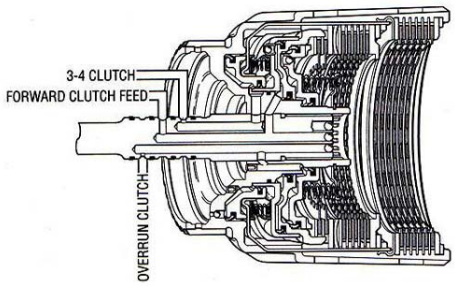
Step 23: Measure the clearance between the backing plate and the top friction plate. The factory clearance specification is 0.035"-0.083" (0.90mm-2.10mm), but it's a good idea to keep the clearance under 0.060" for a good, clean 2-3 shift. Clearance can be adjusted by either mixing thick and thin steels or by changing the selective backing plate to a plate of the proper thickness. The backing plates are available in three sizes:

0.154"-0.161" (3.90mm-4.10mm)

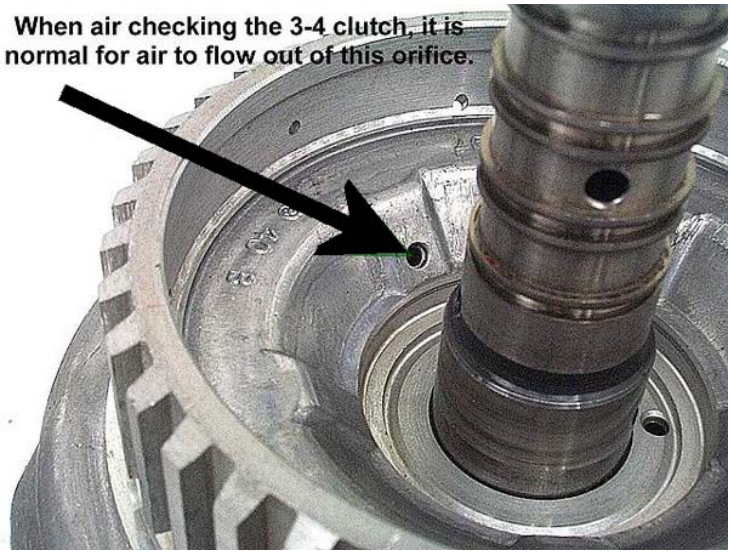
0.187"-0.196" (4.76mm-4.99mm)

0.224"-0.231" (5.68mm-5.88mm)

Step 24: Flip the drum over and air check all three clutch apply circuits through the turbine shaft. While checking the 3-4 clutch apply circuit, make sure that the checkball capsule is sealing properly. You should not be able to see, hear or feel any appreciable flow of air from this capsule.



NOTE: It is normal for air to escape from the orifice cup plug shown when air checking the 3-4 clutch apply circuit. Also, if you are watching the clutch packs when air checking the overrun clutch, you may notice the forward clutch applying as well. This is perfectly normal. If the input drum passes the air checks, the inside of the drum is finished. Flip the drum over to continue.



CAUTION: The following procedure involves installing solid teflon seal rings. If there is any process that we perform during a rebuild that could be considered an art form, this is it. Incorrectly installed solid teflon seal rings are one of the leading causes of early transmission failure after a rebuild. Develop the skills and 'feel' needed to properly install these rings, and develop them quickly. Don't shortcut the procedures by cutting the rings, or hoping that the drum or ring bore will size them down for you. In this case, you really want to use the special tools designed to install these rings.

Step 25: Using the special tools shown, install the turbine shaft seal rings in the following manner:

- Coat the entire seal ring groove area of the turbine shaft with assembly lube.

- Place the seal ring installer over the turbine shaft, adjusting the tool height adjustment bolt so that the bottom of the tool lines up with the top of the lowest empty seal ring groove.

- Quickly slide a new seal ring down the tool until it pops into the ring groove.

- To avoid damaging the seal rings with the ring sizer tool, use your fingers to pre-compress the ring into the groove, pushing on the ring from different angles. Center the ring in the groove, so that one side of the ring isn't hanging way out of the groove.


- This is the part where you can carve up the ring if you're not very careful. Slide the ring sizer tool down the turbine shaft until it contacts the top seal ring. Very gently push down on the sizer while moving the top of the sizer tool from side to side, and around in circles. This helps gently feed the ring into the groove.

- Remove the sizer tool and inspect the ring groove area, looking for thin slivers of seal ring material. If any slivers are found, then the ring is damaged and must be replaced.
- Repeat this procedure for the remaining seal ring grooves.

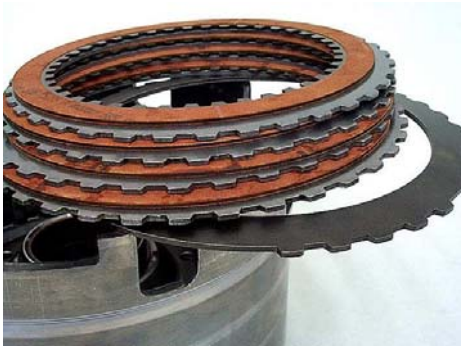
Step 26: Place the endplay shim and thrust bearing into position over the turbine shaft as shown, using assembly lube to hold them in place.

The input drum is now ready for unit assembly. You may want to reinstall the seal ring sizer to keep the seal rings compressed until unit assembly.

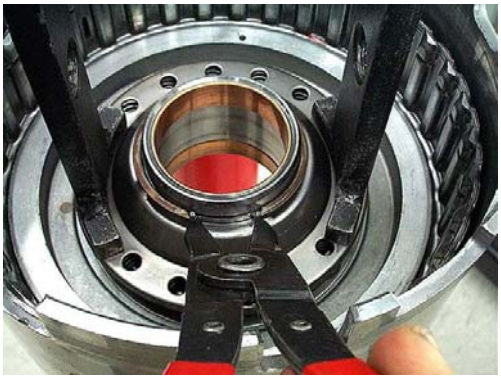
Reverse Drum

Step 1: Remove the clutch snap ring and pressure plate.

Step 2: Remove the clutch friction and steel plates, followed by the dished cushion plate.



Step 3: Place the drum into a suitable press to compress the return spring assembly. Compress the return springs, then remove the snap ring. Remove the drum from the press fixture.



Step 4: Remove the return spring assembly from the drum. Remove the piston, and take the lip seals off of the piston.

Step 5: Clean all parts and inspect for damage. Check for**:**

- A scored or burned band apply surface. The scratches seen here are normal, but you should not be able to feel any wear on this surface with your fingernail.

- Any scratches or damage to the seal ring bore.

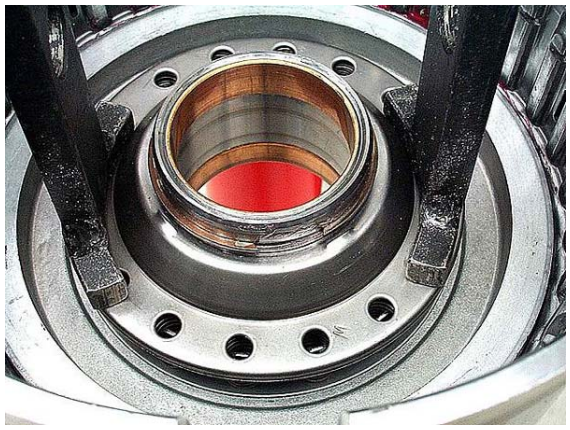
Place the appropriate thrust washer on the stator support, and set the reverse input drum on the support. Check the top drum bushing for clearance. There must be no more than 0.003" clearance between the bushing and the journal. Check the drum for any side-to-side or rocking motion. If there is any motion, replace the drum bushings. Be sure to chamfer the edge of the larger bushing after installation to help the drum go over the seal rings during unit assembly.

If the drum appears okay but the band surface is glazed mirror smooth, you may resurface the band apply area on the drum, but don't use anything coarser than #400 grit emery cloth or ScotchBrite™. You do NOT want a rough surface on this drum.

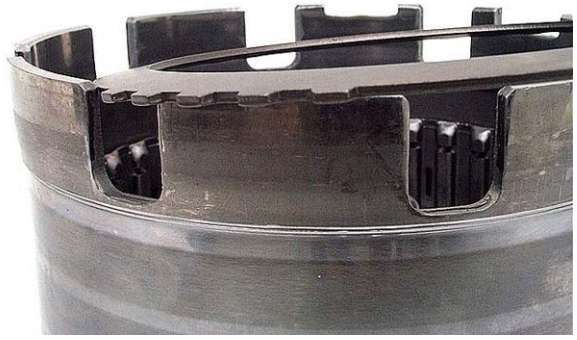
Step 6: Apply assembly lube into the drum seal surfaces.

Step 7: Install new lip seals on the reverse input piston, then install the piston into the drum. Use a feeler blade or other suitable tool to guide the seal lips into the bores. Be very careful not to cut the seals.

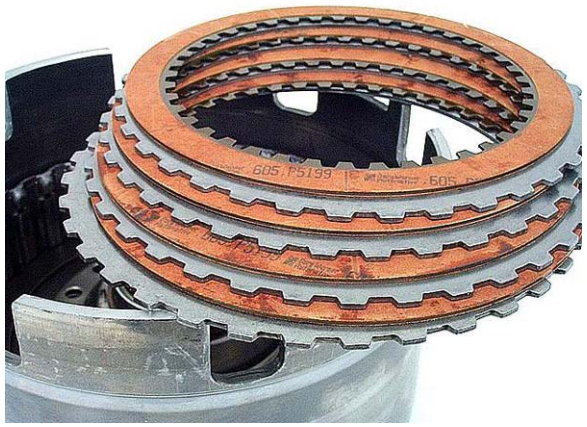
Step 8: Install the return spring assembly into the drum, then place the drum into a suitable press to compress the return spring assembly. Compress the return springs, then install the snap ring. Remove the drum from the press fixture.



Step 9: Place the cushion plate onto the piston, dished side down.



Step 10: Load the clutch plates into the drum, starting with a steel plate, ending with a friction plate.



Step 11: Install the selective pressure plate and snap ring into the drum.

Step 12: Measure the clutch clearance between the pressure plate and the snap ring. This clearance must be between 0.040" and 0.076" (1.02mm-1.94mm). If your clearance is not within these specifications, adjust the clearance by installing the correct pressure plate. The available pressure plate thicknesses are**:**

0.228"-0.234" (5.787mm-5.947mm)

0.257"-0.263" (6.519mm-6.678mm)

0.285"-0.292" (7.249mm-7.409mm)

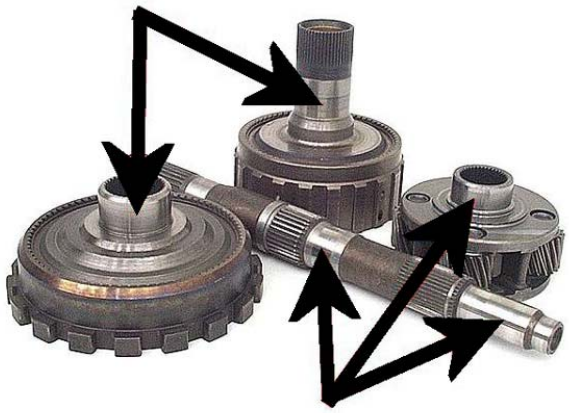
The reverse input drum is now ready for final unit assembly.

Gear Train

The gear train section covers the major internal metal components not covered in another section of this program. These components are primarily the planetary gear assemblies, roller clutches, sprags and shafts.

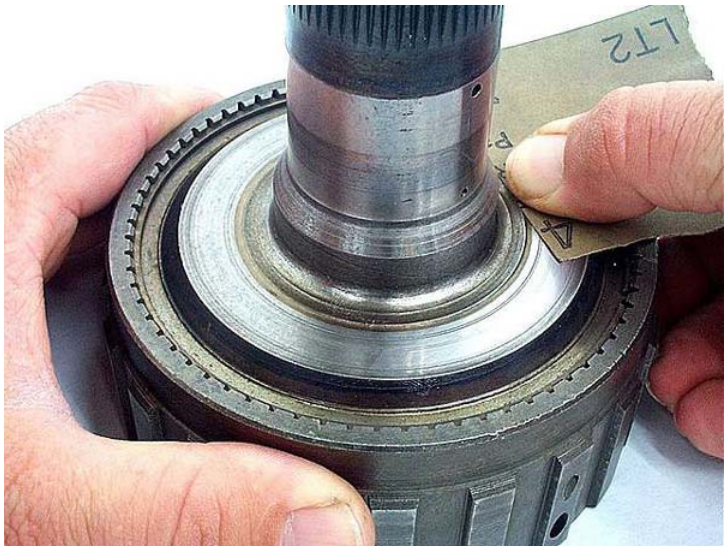
Step 1: After the unit is disassembled, begin your geartrain inspection by looking at the helical gear teeth on all planetary gear assembly components. If there is any visible tooth damage, the component must be replaced, along with the two other parts that mesh with the damaged part. In other words, if you find bad planet carrier teeth, the planet assembly, sun gear and ring gear of that set should all be replaced. If you find bad sun gear teeth, the planet and ring gear must also go.

Step 2: Inspect all bushing journals for wear or scoring. Journal discoloring is usually normal, and is not cause for replacement of the part. However, if you can feel the wear, there's too much there. If there is very light marking to a journal but no noticeable wear, you can recondition the surface of the bushing journal with ScotchBrite™ or #400 grit emery cloth. Pay particularly close attention to the shaft portion of the front ring gear hub, which is the upper or rear-most part in this photo. It’s a real common excessive wear area.



Step 3: Although all bushings and bushing journals must be checked for wear and clearance, there is only one geartrain bushing that should be replaced during any internal service, the rear sun gear internal bushing. This is a critical alignment bushing and is also under substantial load. This bushing also bears most of the load caused by any imbalance of the front planet and input sprag assemblies.

Step 4: Inspect all thrust surfaces for wear or scoring. Thrust surface discoloring is usually normal, and is not cause for replacement of the part. However, just like the bushing journals, if you can feel the wear there's too much there. These surfaces can also be reconditioned using ScotchBrite™ or #400 grit emery cloth.



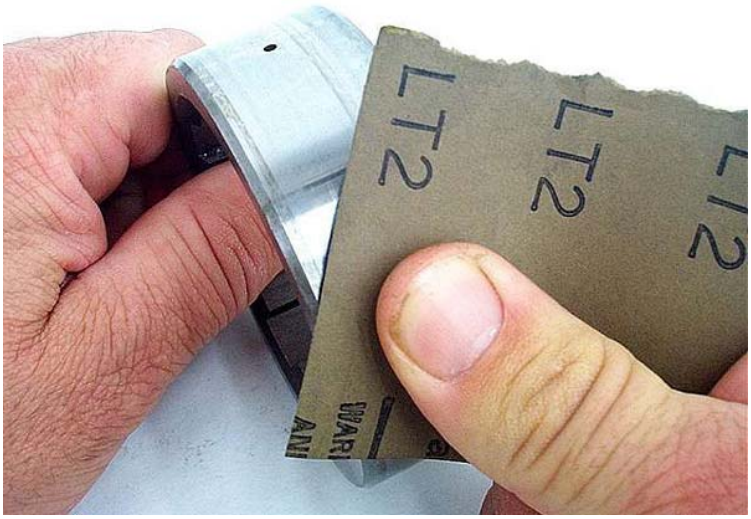
Step 5: Inspect thrust bearings and washers for any discoloration due to heat. If any unusual black or purple markings show on the bearings or washers, they must be replaced. It is a crying shame when a $1000+ job takes a dive due to a bad $3 bearing not being replaced. All thrust bearings must smoothly rotate when spun by hand. Since the front planet bearing is trapped within the assembly and you can't directly inspect it, place the output shaft seal sleeve on the bearing. Press down on the sleeve while rotating it. It should spin perfectly smoothly. Any grating feeling or sound means that the planetary assembly must be replaced.

NOTE: Thrust bearings should not be run through a cleaning machine unless they are trapped within an assembly. Cleaning machine deposits can remain in the bearings, causing rapid wear and failure.

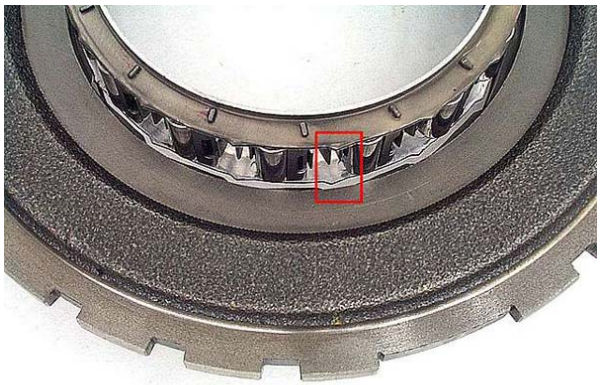
Step 6: Inspect planetary gear needle bearing and thrust condition by seeing if the gears will rock on their shafts and spinning the gears by hand. If you feel any rocking motion or roughness in any of the gears, replace the assembly. Measure planetary pinion gear end play. Planetary pinion gear end play must not exceed 0.024".

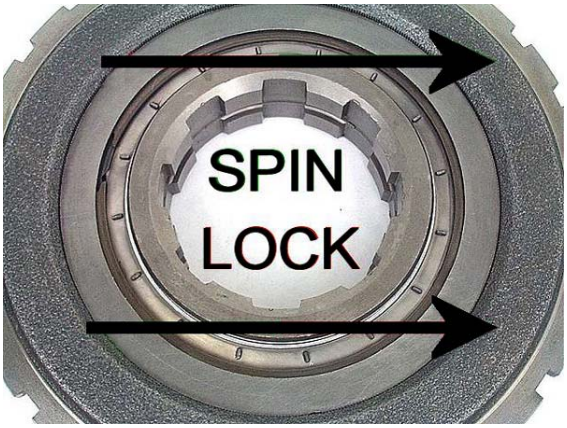
WARNING- INJURY THREAT: Under *no circumstances* should planetary gears be spun up to high speed using a compressed air nozzle. These gears are made of extremely hard, therefore **brittle** steel. Although it sounds really cool, when spun up like this these gears and needle bearings have been known to seize up and viciously **explode** after a cleaning machine removes the lube from the needle bearings. The resulting shrapnel blasting across the rebuild area, your hands and your face is certain to really thrash your day. When blow drying the planetary gears, hold the gears with your thumb and fingers to keep the gears from spinning.

Step 7: Remove the low roller clutch inner race from the roller clutch assembly and inspect the race for wear or excessive scoring. If the race appears smooth, recondition the outer surface of the race with ScotchBrite™ or #400 grit emery cloth.



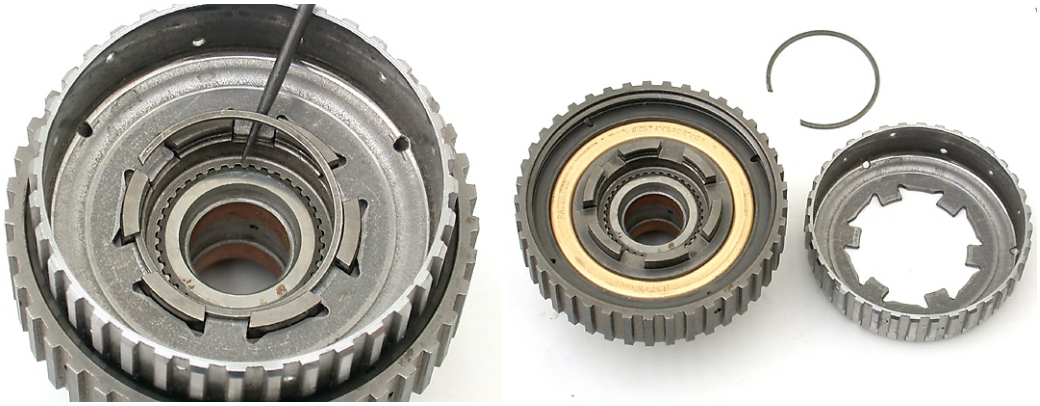
Step 8: While the inner race is removed from the low roller clutch assembly, gently shake the outer race. If any rollers or springs fall out, the roller clutch spring and roller assembly must be replaced. If the roller clutch spring and roller assembly must be replaced, be sure to properly index the assembly cage teeth to the outer race properly to make sure that the roller clutch locks and spins in the proper directions. If all parts remain where they should, reinstall the inner race into the roller clutch assembly by rotating it clockwise into place. Make sure that the inner race locks counter-clockwise and rotates clockwise when viewed as shown.





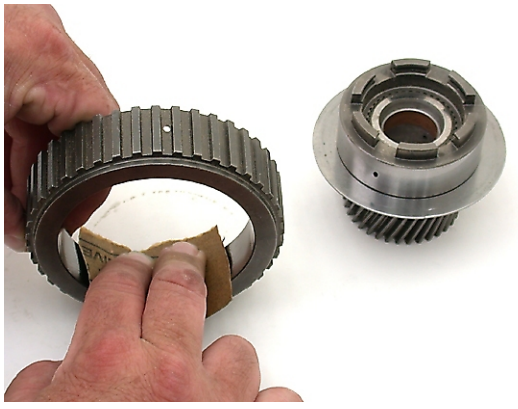
Input Sprag-Single Cage Element
(Double Cage Element section immediately follows **Step 15** of this section)

Step 9: Disassemble the input sprag assembly by removing the snap ring from inside the overrun clutch hub. Lift the hub from the assembly.

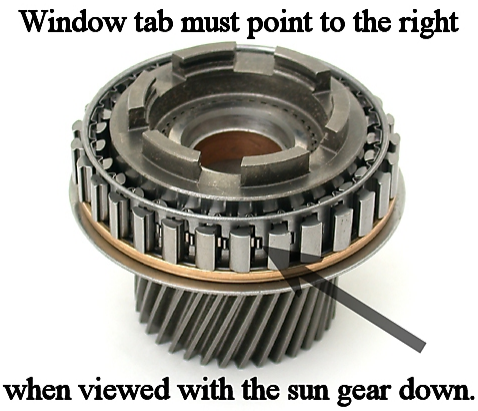


Step 10: Lift the sprag outer race from the assembly. Separate the sprag element and end plates from the inner race. Inspect both sprag races for wear or scoring. Inspect clutch hub teeth for wear.

Step 11: Use #240 grit emery cloth to break through the glaze on both inner and outer sprag races. Finish both surfaces with #320 grit emery cloth. Thoroughly clean all sprag components.



Step 12: Place and end plate on the inner sprag race, then slide the sprag element into position as shown.



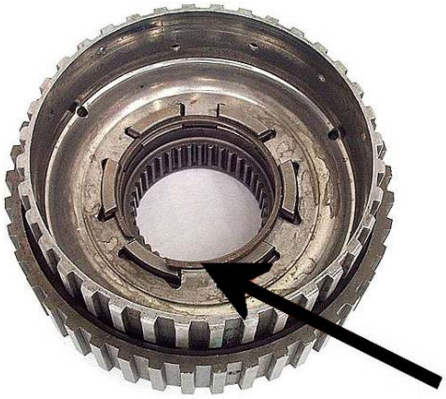
Step 13: Start the sprag outer race over the sprag element at an angle, rotating the outer race counter-clockwise when viewed with outer race on top. You'll need to push the last few teeth into the outer race with your finger as you rotate the outer race.

Step 14: Place the second sprag end bearing onto the sprag element.

Step 15: Place the overrun clutch hub into position on the sprag assembly as shown and lock it into place with the snap ring. Make sure the snap ring ends are on either side of a gap in the race lugs as shown.

Input Sprag-Double Cage Element

Step 16: Disassemble the input sprag assembly by removing the snap ring from inside the overrun clutch hub. Lift the hub from the assembly.



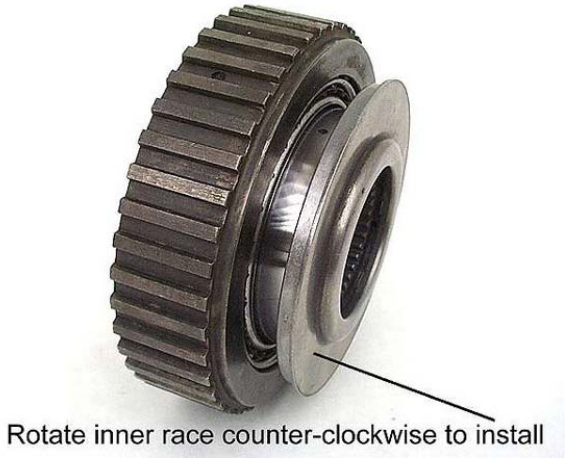
Step 17: Remove the sprag inner race from the assembly. Separate the sprag element and end plates from the components. Inspect both sprag races for wear or scoring. Inspect clutch hub teeth for wear.

Step 18: Use #240 grit emery cloth to break through the glaze on both inner and outer sprag races. Finish both surfaces with #320 grit emery cloth. Thoroughly clean all sprag components.

Step 19: Place the sprag element into the outer sprag race at an angle as shown, with the wide edges of the sprag element cages facing the top of the race. Once the element is inside the race, rotate the element to the level position inside the race.

Step 20: Place an end bearing on the inner sprag race as shown.

Step 21: Install the inner race into the sprag as shown by rotating the inner race counter-clockwise.



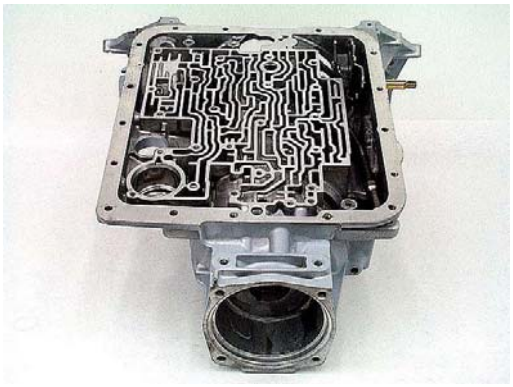
Step 22: Flip the sprag assembly over. Place the second sprag end bearing onto the sprag element.

Step 23: Place the overrun clutch hub into position on the sprag assembly as shown and lock it into place with the snap ring.

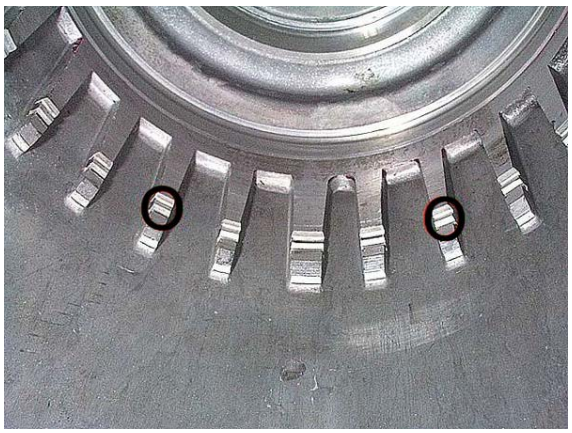
Important- BOTH STYLE SPRAGS:
Step 24: Verify correct sprag rotation direction. While holding the overrun clutch hub stationary with the overrun clutch hub aimed down, the sprag outer race must rotate clockwise and lock counter-clockwise.

Case Assembly Preparation

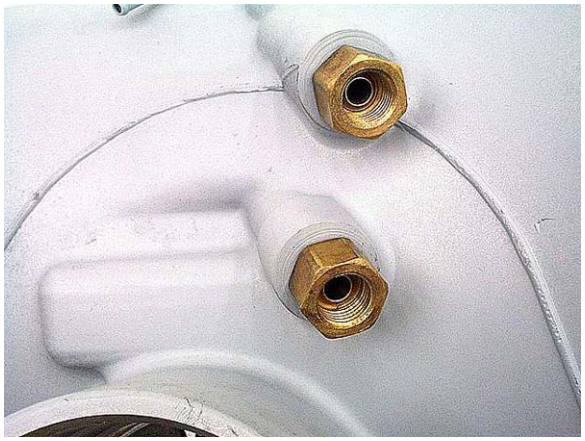
Step 1: Inspect all bolt holes for stripped or pulled threads. Repair or replace as necessary. Keep in mind that certain cases may be rare or hard to find, so be sure that a replacement is available before discarding a case with damaged bolt holes.



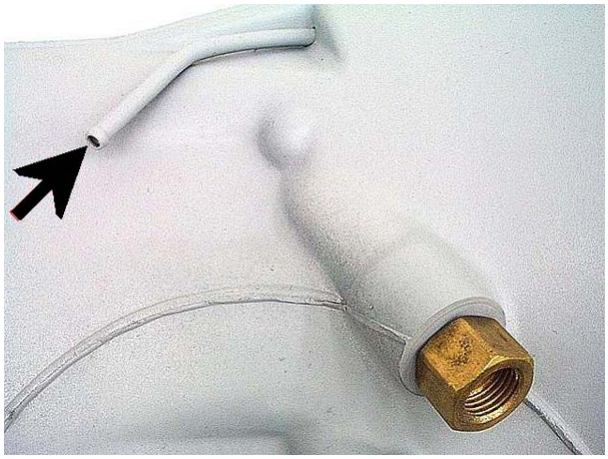
Step 2: Inspect the internal case lugs for wear or damage where the low roller clutch assembly contacts the lugs. If there is more than 1/16" lug wear, the case should be replaced. Although there are repair devices made to correct this wear problem on the THM350, don't use them on the 4L60E. The 4L60E has a much lower first gear, and under high load could break the repair devices and the case.



Step 3: Check the cooler line fittings for stripped threads and rounded corners. Replace if necessary.

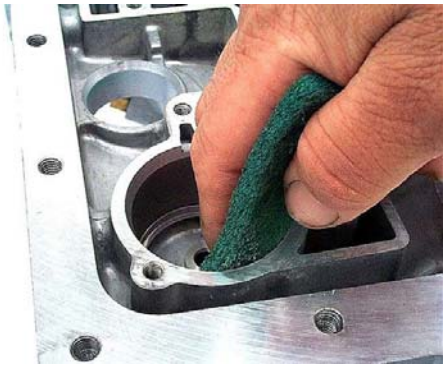


Step 4: Make sure that the vent tube is in place and not restricted.



Step 5: Check the servo and accumulator bores for damage caused by broken parts.

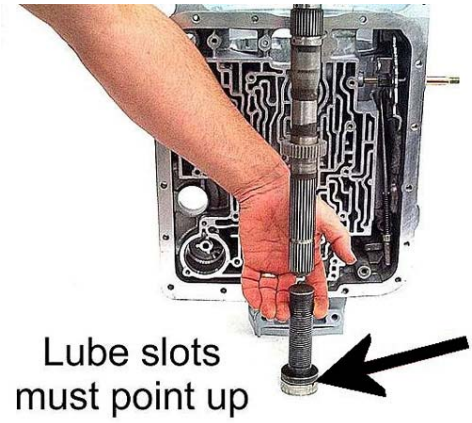
Step 6: If the previous steps do not reveal any damage, then the case should be okay to rebuild. Scuff up the accumulator bore with ScotchBrite™.



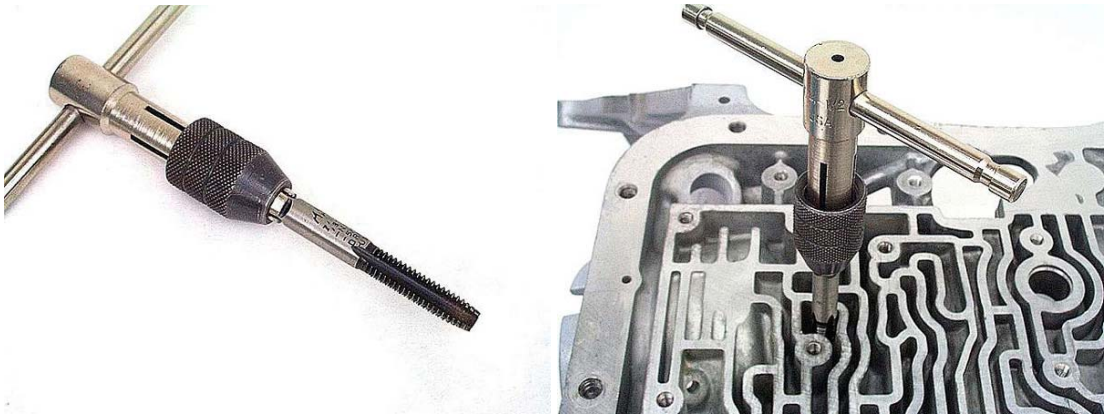
Step 12: Flat sand the valve body surface of the case, and remove any pump gasket material from the pump surface of the case.

Step 13: Thoroughly clean the case. Blow any standing water or cleaning solution out of the case passages rather than let it drip dry. This keeps any cleaning machine deposits from contaminating the new ATF or causing valves to stick after the unit goes back into the vehicle.

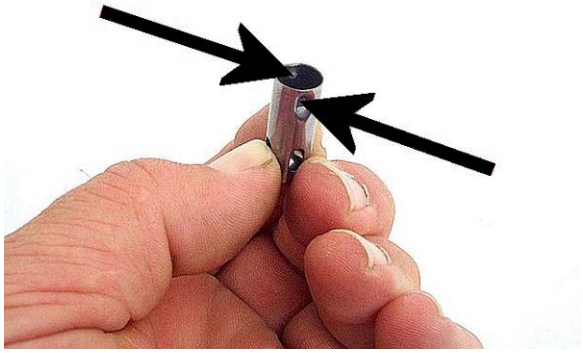
Step 7: To replace the rear case bushing, position the case with the bell housing aimed down. Use a cutting chisel to remove the old bushing. Flip the case over, bell housing up. Place a new bushing on a suitable driver, with the bushing lube notches pointing up. It can be quite awkward to drive the bushing inside the case, due to the confined area you're working in. One way around this is to hold the bushing and driver over the case bore, then use the output shaft as a hammer, tapping the bushing into position with the rear end of the shaft (please don't tell anyone that we told you to use a perfectly good transmission part as a hammer). Be sure that the top of the bushing is installed approximately 1/8" below flush with the top of the bushing bore in the case.



Step 8: If the 2-4 band or 3-4 clutch was damaged, and you don't see an obvious cause for this such as a damaged seal or bushing, it may have been caused by a leaking 3rd accumulator checkball capsule inside the servo bore. Don't take any chances; replace the capsule. To do this, remove the old capsule by inserting a 3/8" coarse thread tap into the capsule and rotating it clockwise. Eventually, the capsule should rotate with the tap. Keep rotating it while pulling on the tap, and the capsule will come out.



NOTE: The tap may bottom out on the ball before getting a good grip on the inside of the capsule. If so, drive a 5/16" punch or bolt into the capsule. This should flatten the capsule bumps that retain the ball, allowing you to pull the ball out with a magnet. The tap should now properly grip the capsule.



Step 9: blow any metal chips out of the capsule hole. Place a new checkball capsule into the hole, ***open end up***. Use a 3/8" driver or a long 3/8" bolt with the threads cut off to drive the capsule into position.

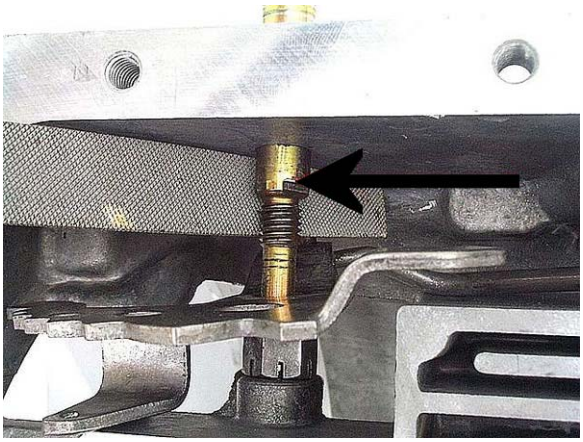
CAUTION: The capsule must be driven into the hole to the proper depth. If this is not done properly, serious unit malfunction will occur. Using the driver mentioned above, gently tap the capsule into the bore while watching through the servo bore until the entire capsule window is visible through the servo bore.

Step 10: To change the manual shaft seal, the manual shaft must be removed from the case.

- Remove the manual shaft nut from the manual shaft.

- Pry the manual lever toward the center of the case to provide access to the manual shaft clip, then pry the manual shaft clip off of the manual shaft.

- Use a file on the area of the manual shaft as shown to remove any ridge from the shoulder of the shaft.



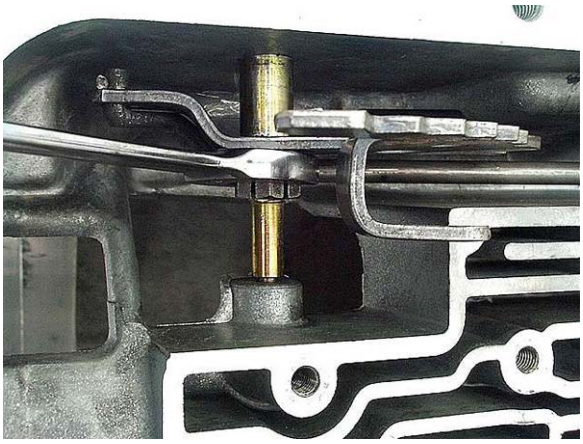
- Remove the manual shaft from the case and smooth the area of the shaft where the seal rides with some ScotchBrite™ or #400 grit emery cloth.

- Pry the manual shaft seal from the case bore.

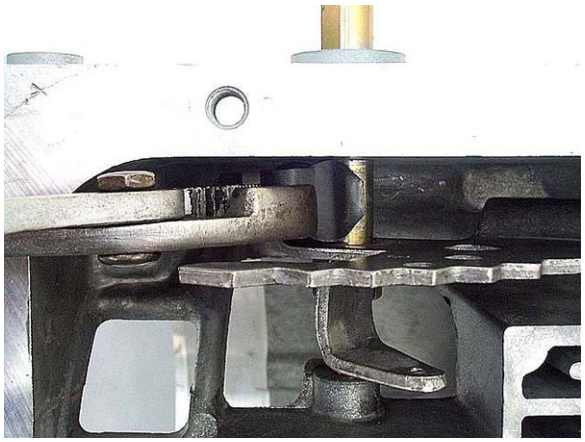
- Install the new seal with the proper installer tool or a 9/16" deep socket. Don't hit the seal hard enough to deform it, but be certain that the seal is bottomed out in its bore.

- Coat the manual shaft with assembly lube, then slide it partway into the case bore. Position the manual lever as shown, and start the manual shaft through it.

- Place the manual lever retaining nut over the end of the shaft, then slide the shaft the rest of the way into the case. Tighten the manual lever nut firmly.



- Using a pair of pliers, push the manual shaft clip into place on the manual shaft.



Step 11: Check all pressure taps to be sure that they're tight, in case anyone left one loose after doing a pressure test before the unit was removed from the vehicle.

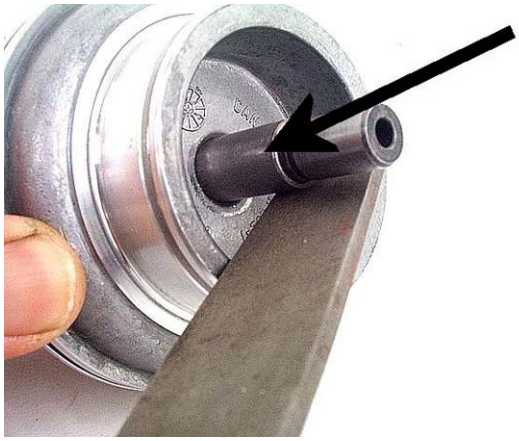
Servo

Step 14: Remove the servo cover and 4th gear piston from the servo assembly. Remove the 4th gear piston from the servo cover and remove the seal ring from the piston. If there is still an o-ring on the servo cover, remove it.

Step 15: Remove the guide ring from the servo. Remove the rubber o-ring from the guide ring.

Step 16: Remove the seal rings from the 2nd gear piston. Remove the e-clip from the servo pin, then slide the washer and spring off of the pin.

Step 17: Use a file to remove any ridge from the servo pin area shown. This will keep from scratching up the inside of the piston pin bore, causing apply circuit leaks. Slide the servo pin out of the piston.



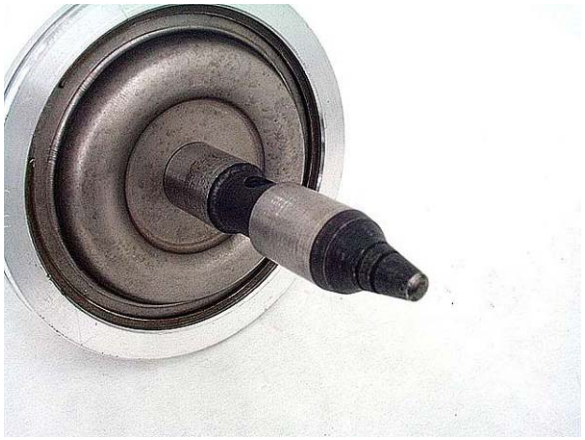
Step 18: Use a small screwdriver to pry one end of the snap ring out of the 2nd gear servo piston. Press down on the spring retainer plate and remove the snap ring. Remove the cushion spring retainer and spring.

Step 19: Thoroughly clean all servo parts.

Step 20: Place the cushion spring inside the 2nd gear piston as shown, then place the retainer plate on top of the spring.

Step 21: Press down on the retainer plate, then install the snap ring to hold the plate into the piston.

Step 22: Slide the servo pin into the 2nd gear piston. Place the spring and washer over the flat end of the servo pin. Install the clip into the servo pin groove to retain the spring and washer.



Step 23: Coat the 2nd piston seal ring grooves with assembly lube. Pre-twist the larger teflon seal ring so that it tends to be smaller in diameter than the large piston groove. This, plus the grease, will keep the ring from sticking out of the groove. Install the seal rings into the grooves, firmly pressing them to the bottom of each groove.

Step 24: Place a new rubber o-ring (the smaller of the two servo o-rings) onto the piston guide ring, then slide the guide ring over the small 2nd piston seal ring with the flat side of the guide ring facing toward the large 2nd piston seal ring. Be careful to guide the smaller 2nd piston seal ring into the guide ring without cutting the seal ring.

Step 25: Coat the 4th piston seal ring groove with assembly lube, then install the seal ring into the groove. Place the 4th piston over the flat end of the servo pin as shown, with the larger-bump side of the 4th piston facing away from the 2nd piston.

Step 26: Place a new rubber 0-ring (the larger of the two servo o-rings) into the servo cover groove. Place the servo cover over the 4th piston, being careful to guide the seal ring into the cover without cutting the ring. Slide the servo return spring over the pointed end of the servo pin.

Extension Housing

Step 27: Use the appropriate sized driver to remove the extension housing bushing. Thoroughly clean the housing.

Step 28: Install a new bushing into the extension housing, being careful not to drive the bushing in at an angle. An arbor press is best to assure good alignment. You can use an old driveshaft yoke to check for proper bushing clearance.

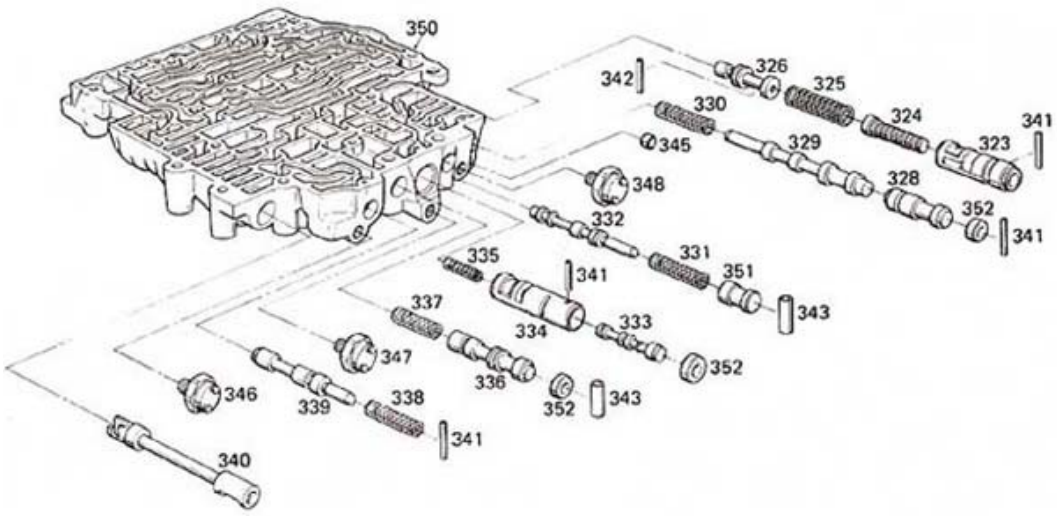
Step 29: Coat the outside diameter of a new rear seal and drive it into the housing.

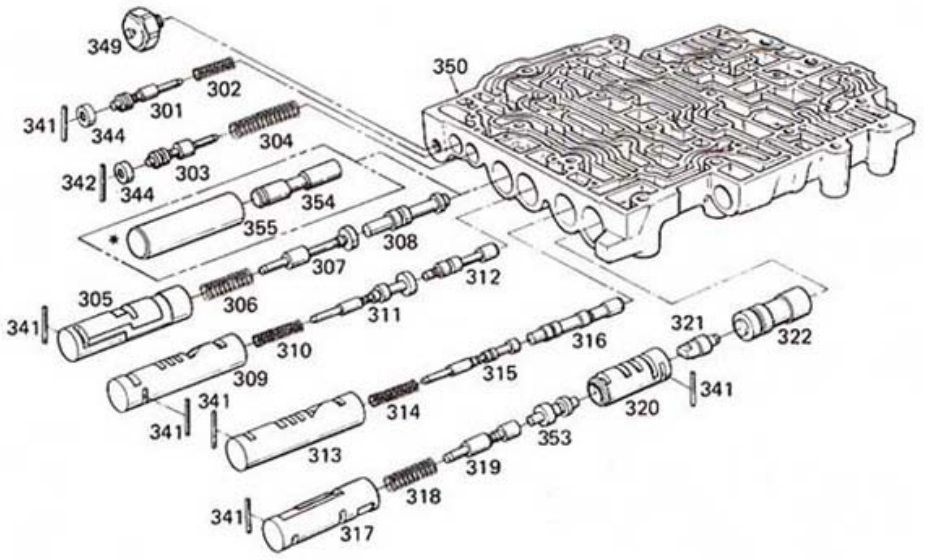
Step 30: Place a new lathe cut o-ring into place on the front of the extension housing.

Valve Body/Accumulators/Governor

Valve Body

Step 1: The valve body must be completely disassembled and cleaned. Use the accompanying illustrations to identify the locations and names of the components as necessary.

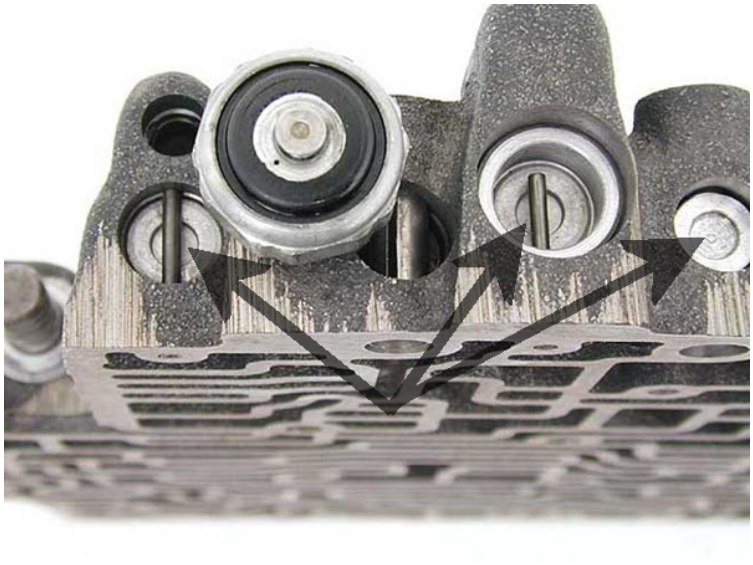




301 VALVE, T.V. MODULATOR DOWNSHIFT
302 SPRING, T.V. MODULATOR DOWNSHIFT VALVE
303 VALVE, T.V. MODULATOR UPSHIFT
304 SPRING, T.V. MODULATOR UPSHIFT VALVE
305 SLEEVE, CONVERTER CLUTCH THROTTLE
306 SPRING, CONVERTER CLUTCH THROTTLE
307 VALVE, CONVERTER CLUTCH THROTTLE
308 VALVE, CONVERTER CLUTCH SHIFT
309 SLEEVE, 3-4 THROTTLE VALVE
310 SPRING, 3-4 THROTTLE VALVE
311 VALVE, 3-4 THROTTLE
312 VALVE, 3-4 SHIFT
313 SLEEVE, 2-3 THROTTLE VALVE
314 SPRING, 2-3 THROTTLE VALVE
315 VALVE, 2-3 THROTTLE
316 VALVE, 2-3 SHIFT
317 SLEEVE, 1-2 THROTTLE VALVE
318 SPRING, 1-2 THROTTLE VALVE
319 VALVE, 1-2 THROTTLE
320 SLEEVE, LO RANGE CONTROL
321 VALVE, 1-2 LO RANGE DOWNSHIFT
322 VALVE, 1-2 SHIFT
323 SLEEVE, THROTTLE VALVE PLUNGER
324 PLUNGER, THROTTLE VALVE
325 SPRING, THROTTLE VALVE
326 VALVE, THROTTLE

328 VALVE, 3-4 RELAY
329 VALVE, 4-3 SEQUENCE
330 SPRING, 4-3 SEQUENCE VALVE
331 SPRING, T.V. LIMIT VALVE
332 VALVE, T.V. LIMIT
333 VALVE, 1-2 ACCUMULATOR
334 SLEEVE, 1-2 ACCUMULATOR VALVE
335 SPRING, 1-2 ACCUMULATOR VALVE
336 VALVE, LINE BIAS
337 SPRING, LINE BIAS VALVE
338 SPRING, 3-2 CONTROL
339 VALVE, 3-2 CONTROL
340 VALVE, MANUAL
341 PIN, COILED SPRING
342 PIN, COILED SPRING
343 RETAINER, SPRING (SLEEVE)
344 PLUG, VALVE BORE
345 PLUG, CUP (.33 DIA.)
346 SWITCH ASM., PRESSURE (3RD CLUTCH)
347 SWITCH ASM., PRESSURE (4-3 PULSE)
348 SWITCH ASM., PRESSURE (4TH CLUTCH)
349 SWITCH ASM., PRESSURE (T.C.C. SIGNAL)
350 BODY, CONTROL VALVE
351 PLUG, T.V. LIMIT
352 PLUG, VALVE BORE (12.5 - O.D.)
353 VALVE, 1-2 LO RANGE UPSHIFT
354 PLUG, CONVERTER CLUTCH SHIFT VALVE BORE (ECM CONTROLLED VEHICLES)
355 PLUG, CONVERTER CLUTCH T.V. BUSHING BORE (ECM CONTROLLED VEHICLES)

TIP: Most disk-shaped bore plugs have an indentation on one side. This indentation always points toward the outside of the valve body.



Step 2: The throttle valve is prone to sticking, causing late or no upshifts. Therefore, we recommend that you install an anti-stick spring over the inner end of the throttle valve, available through most transmission parts suppliers. Make sure that the small end goes over the valve, with the large end pointing toward the bottom of the valve bore.

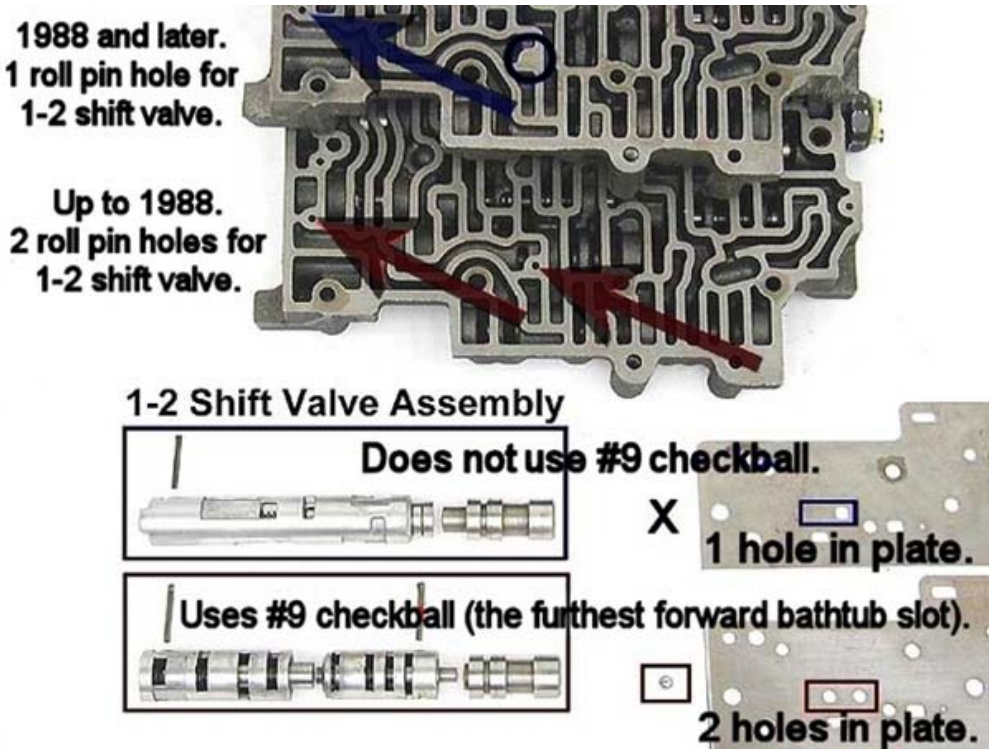
Interchanging Valve Bodies

Step 3: If the valve body needs to be replaced for any reason, there are a few areas you need to match up to assure correct operation.

- The 1-2 shift valve assembly, separator plate and case checkball pattern must be matched up. ATRA Technical Bulletin #118 shows you the areas to check, but the illustration accompanying this step may be a bit clearer. Just remember:

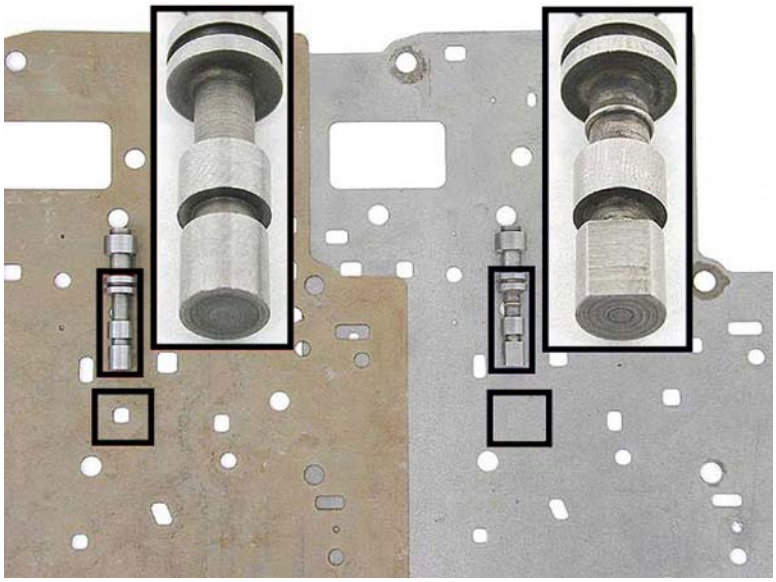
  1 roll pin for the 1-2 shift valve sleeve = 1 hole in the separator plate = no #9 checkball (shown as item 55D in ATRA Technical Bulletin #118).

  2 roll pins for the 1-2 shift valve sleeve = 2 holes in the separator plate = #9 checkball is used in the case.



- The line bias valve may have a flat place ground on the end land. This must match the separator plate hole pattern.

  The line bias valve *without* the flat land must have the hole shown in the separator plate.
  The line bias valve *with* the flat land must not have this hole in the separator plate.



- 1989 and later 4L60 models had the TCC shift valve bore cast closed, with a slot added to the casting to replace the function of the valve bore. Prior to this, the valve body came with either a TCC shift valve assembly or a pair of bore plugs. If your original valve body has the complete TCC shift valve assembly, then your vehicle relies on this valve to help establish minimum lock-up speed, as well as part-throttle lock-up release control. Make sure that the replacement valve body has a fully functional TCC shift valve assembly.

TCC Lock-up Controls

If you feel the TCC engages too early or releases too easily with increased throttle, these characteristics can be altered by modifying the TCC shift valve assembly. However, there are different procedures for different engine sizes and TCC shift valve assembly configurations. These procedures may include:

- Increasing the TCC shift TV valve spring tension by replacing the TCC shift TV valve spring with a slightly stiffer spring.

- Replacing bore plugs with the TCC shift valve assembly from an earlier valve body.

- Replacing a stock TCC shift TV valve, spring and sleeve with a repair kit assembly.

- Replacing bore plugs with both a stock TCC shift valve *and* installing a TCC shift TV valve update kit.

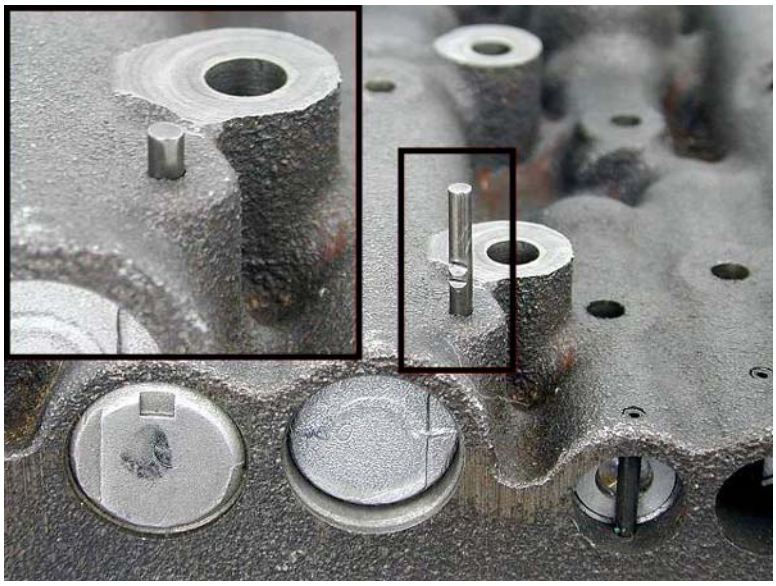
- Replacing the valve body.

IMPORTANT: There may also be other steps that need to be performed on a particular configuration! We'll try to make this easy for you by listing the different configurations you may encounter, and the complete modification steps for each:

V6 Engine: You may want to raise the minimum TCC engagement speed, since the original engagement speed seems a bit early. However, the original TCC part throttle release (PTR) calibration is typically quite acceptable, so you *don't* want to affect PTR. Use the description of your TCC shift valve style to determine how to raise the minimum TCC engagement speed.

- Complete TCC shift valve assembly, typically 1982-1984: Install a slightly stiffer TCC shift TV valve spring. Do not replace or modify anything else in the TCC shift valve assembly.
- TCC shift valve bore plugs, typically 1985-1988: Replace both bore plugs with a complete TCC shift valve assembly from a 1982-1984 V6 valve body, replacing the spring that came with the replacement shift valve assembly with a slightly stiffer one.
- Cast-closed TCC shift valve bore, typically 1989 and later: To raise minimum TCC engagement speed, this valve body must be replaced with a 1988 V6 valve body that has a TCC shift valve bore. Other earlier replacement valve bodies may allow you to raise minimum TCC engagement speed, but risk other equipment mismatches. Always match up the 1-2 shift valve and line bias valve when changing valve bodies. Use the modifications described in the previous paragraph.

TIP: When experimenting around with valve body springs, you can change valve springs much easier the *second time* by using a solid THM350 valve body pin pushed in from the bottom side of the valve body, rather than the standard roll pin. Just bang on the pin with a chisel a few times to make a wide spot on the pin so it will stay in the valve body. Now all you need to do to change the spring is remove the pan and pull the pin out of the valve body.



V8 Gas Engine: You may want to raise the minimum TCC engagement speed, since the original engagement speed seems a bit early. The original TCC part throttle release (PTR) calibration *may or may not* be too sensitive, depending on your road test results. Use the description of your TCC shift valve assembly style to determine how to perform the modifications you need.

- Complete shift valve assembly, typically 1982-1984: To raise the minimum TCC engagement speed only, install a slightly stiffer TCC shift TV valve spring. Do not replace or modify anything else in the TCC shift valve assembly. To raise the minimum TCC engagement speed *and* make TCC PTR *less sensitive*, replace the TCC shift TV valve, spring and sleeve with GM repair kit #8642970*.
- TCC shift valve bore plugs, typically 1985-1988: To raise the minimum TCC engagement speed only, replace both bore plugs with a complete TCC shift valve assembly from a 1982-1984 V8 Gas valve body, replacing the spring that came with the replacement shift valve assembly with a slightly stiffer one. To raise the minimum TCC engagement speed *and* make TCC PTR *less sensitive*, replace the bore plugs with *just the TCC shift valve* (the valve in the bottom of the TCC shift valve bore) from any 1982-1984 valve body, then install GM repair kit #8642970*.

- Cast-closed TCC shift valve bore, typically 1989 and later: To make any changes to minimum TCC engagement speed or TCC PTR sensitivity, this valve body must be replaced with a 1988 V8 Gas valve body that has a TCC shift valve bore. Other earlier replacement valve bodies may allow you to raise minimum TCC engagement speed, but risk other equipment mismatches. Always match up the 1-2 shift valve and line bias valve when changing valve bodies. Use the modifications described in the previous paragraph to make any changes.

  ***NOTE:** When using GM repair kit #8642970 on a V8 Gas unit, you must remove 1-1/2 to 2 coils from the spring that comes with the kit for an acceptable minimum lock-up speed. Always aim the cut spring end *away* from the valve.

When using this kit, you may find the minimum 2-3 shift time now *seems* just a bit too late. This is because engine RPM is higher at this speed because TCC has not engaged. Remedy this by cutting 1 to 1-1/2 coils from the 2-3 shift valve spring. Always aim the cut spring end *away* from the valve.

TIP (repeated from V6 section)**:** When experimenting around with valve body springs, you can change valve springs much easier the *second time* by using a solid THM350 valve body pin pushed in from the bottom side of the valve body, rather than the standard roll pin. Just bang on the pin with a chisel a few times to make a wide spot on the pin so it will stay in the valve body. Now all you need to do to change the spring is remove the pan and pull the pin out of the valve body.

Diesel Engine- You will probably want to both raise the minimum TCC engagement speed, since the original engagement speed seems a bit early *and* make the TCC part throttle release (PTR) less sensitive. Replace the TCC shift TV valve, spring and sleeve with GM kit #8642970.

IMPORTANT: If you have a diesel engine and are going to use GM repair kit #8642970, **do not** modify the spring that comes in the kit!

When using this kit, you may find the minimum 2-3 shift time now *seems* just a bit too late. This is because engine RPM is higher at this speed because TCC has not yet engaged. Remedy this by cutting 1 to 1-1/2 coils from the 2-3 shift valve spring. Always aim the cut spring end *away* from the valve.

Accumulators

Auxiliary Valve Body

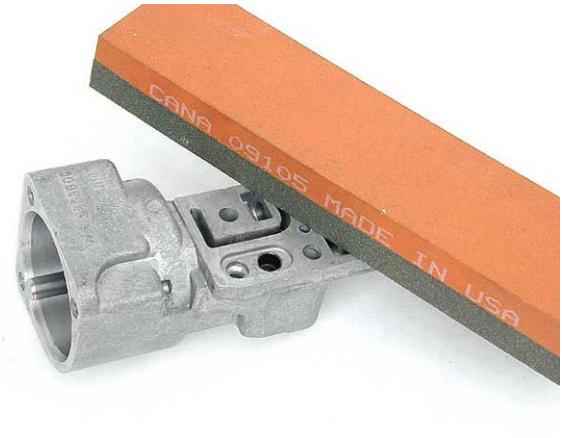
Step 4: Remove the auxiliary valve body cover (if equipped). Remove the accumulator spring and piston. Remove the seal from the piston.

Step 5: Inspect the press fit of the piston pin to the bottom of the accumulator housing bore. There must be no gaps or looseness.

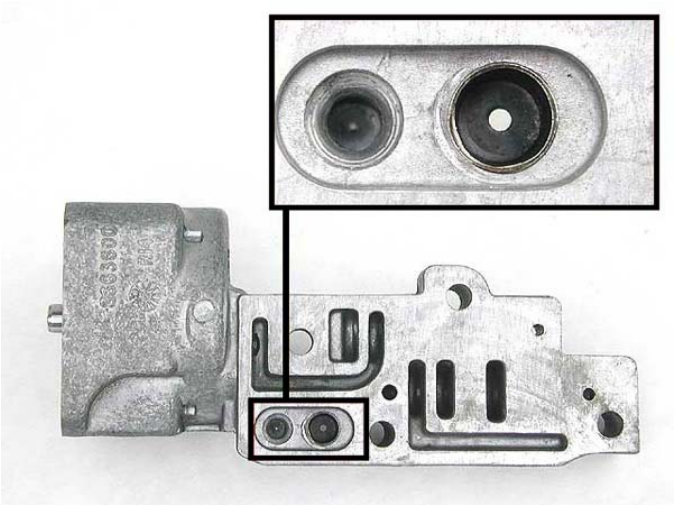
Step 6: Inspect the accumulator piston edge for any signs of scoring or wear. If wear is found, replace the piston.

Step 7: Resurface the piston bore and pin with ScotchBrite ™. Make sure that there is no wear on the pin.

Step 8: Remove both valve bore assemblies from the housing and flat sand the mounting surface of the housing.



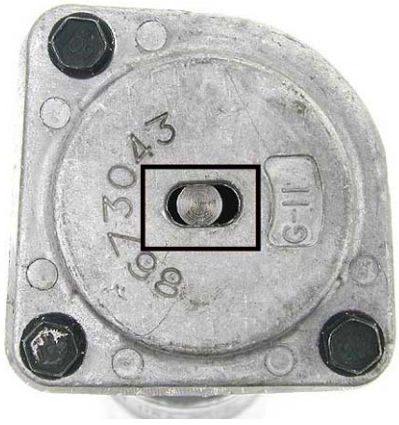
Step 9: Thoroughly clean all parts. Be sure that the forward clutch apply orifice is not restricted.



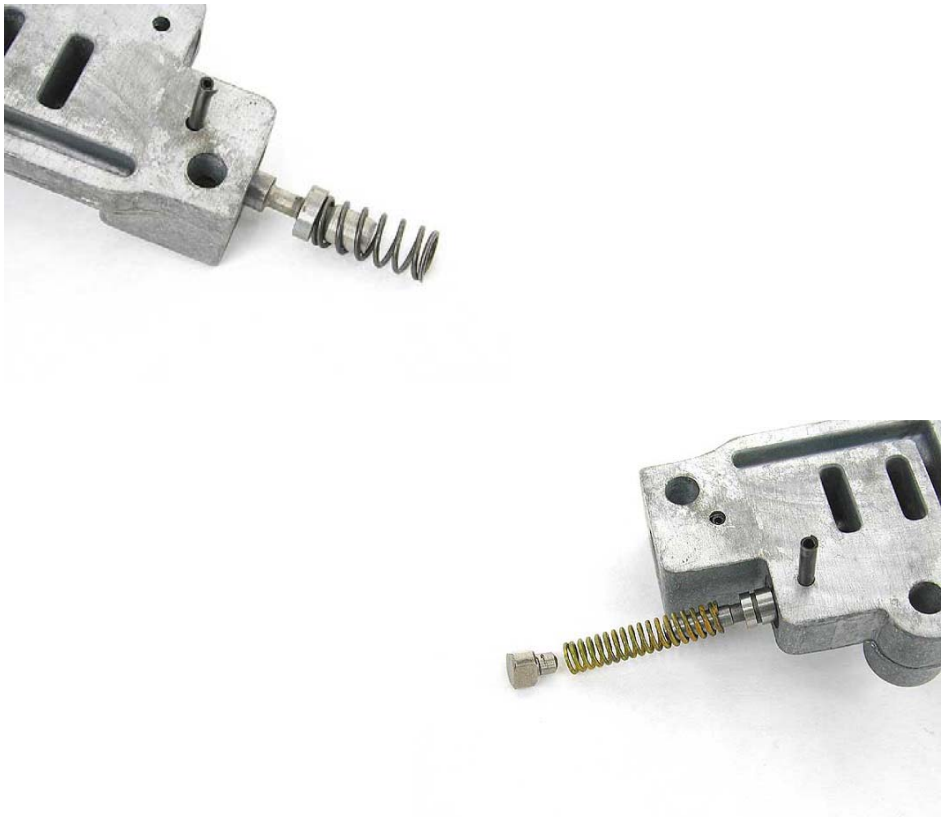
Step 10: Install a new seal on the accumulator piston. Coat the housing bore and pin with assembly lube, then install the piston into the bore.

Step 11: Install spring onto the piston, then install the cover and hand-tighten the bolts snugly.

IMPORTANT: The cover must have an oblong hole over the pin that the pin must *not* be able to fit through. If you have an earlier cover with a round hole, it *must* be replaced.

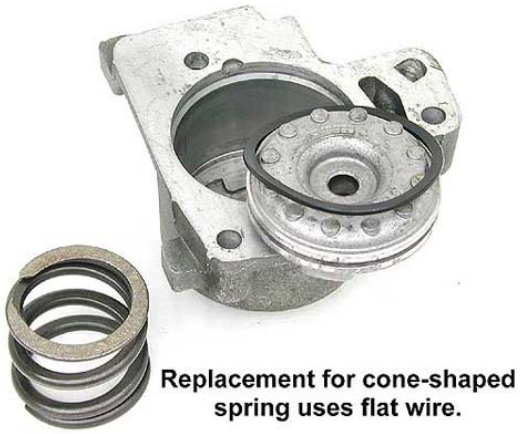


Step 12: Install the two valve assemblies into the housing.



1-2 Accumulator

Step 13: Remove the spring and piston from the housing. Note the sequence in which they came out. Remove the seal from the piston.



NOTE: If the 1-2 accumulator uses a cone-shaped spring, it must be replaced with the new style spring available from your parts supplier.

Step 14: Inspect the accumulator piston edge for any signs of scoring or wear. If wear is found, replace the piston.

Step 15: Make sure that there is no wear on the pin. If wear is found, the housing must be replaced. Resurface the piston bore and pin with ScotchBrite ™, then flat sand the mounting surface of the housing. Thoroughly clean the housing and piston.

Step 16: Place a new seal on the piston. Coat the housing and pin with assembly lube. Install the piston and spring into the housing.

NOTE: The spring and piston position may be reversed on your model. Install the parts in the same direction they came out.

Governor

Step 17: Inspect the governor gear and shaft for wear. The shaft should show no signs of scoring, have no 'steps' on the shiny areas, and measure 0.800" in diameter. The gear must have no noticeable tooth wear. If the shaft and gear check out okay, thoroughly clean the governor and it will be ready to install. If the shaft shows wear, the governor must be replaced. If the gear shows wear, the gear must be replaced. The following steps show how to replace the governor gear.

Step 18: Make a wood block to support the governor while changing the gear (thanks for the tip Randall!). There will be some fairly vigorous hammering, so the governor must *not* be supported by the gear, which would break off.

Step 19: Remove the roll pin holding the gear to the shaft.

Step 20: Pull the gear out of the shaft. Use a small screwdriver to also pry the valve out of the governor shaft. Thoroughly clean the governor parts.

Step 21: Place the governor valve back into the shaft, shorter end first. Make sure that the valve moves freely inside the shaft.

Step 22: Tap a new governor gear all the way into the shaft, making sure not to crack the new gear. Do not place the weight end of the governor against the bench while hammering on the gear. One suggestion is to hold the governor against your belt while tapping on the gear to absorb the shock.

Step 23: Using a 1/8" drill, drill *only halfway* through the governor gear. Once this is done, insert the drill into the other side of the governor and drill through the gear. This way the hole in the gear is properly aligned with the hole in the shaft.

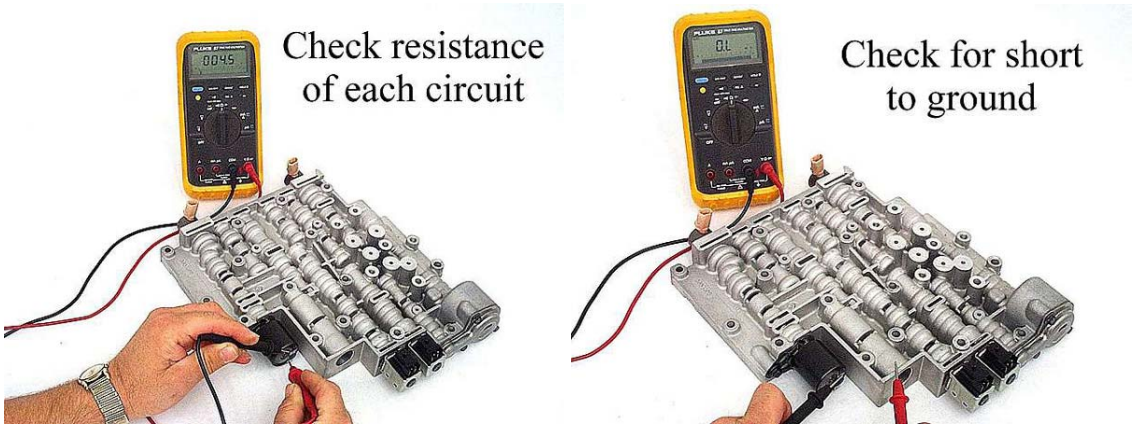
Step 24: Using your wood block for support, tap a new roll pin into the governor gear, making sure that both ends are below flush with the governor shaft.

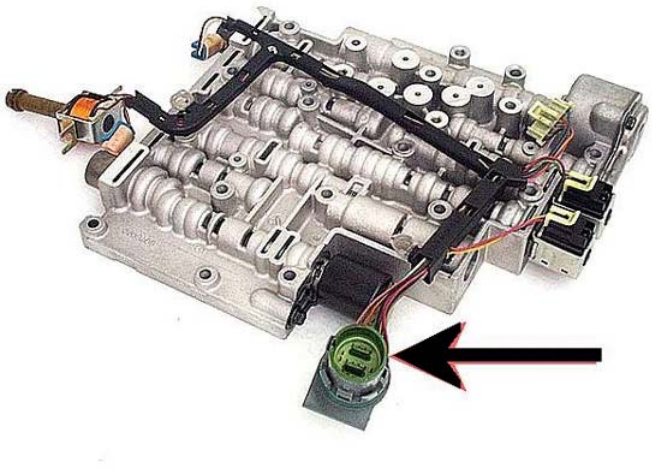
Step 25: Use a chisel to stake the roll pin holes so that the pin can't work its way out of the shaft.

Valve Body

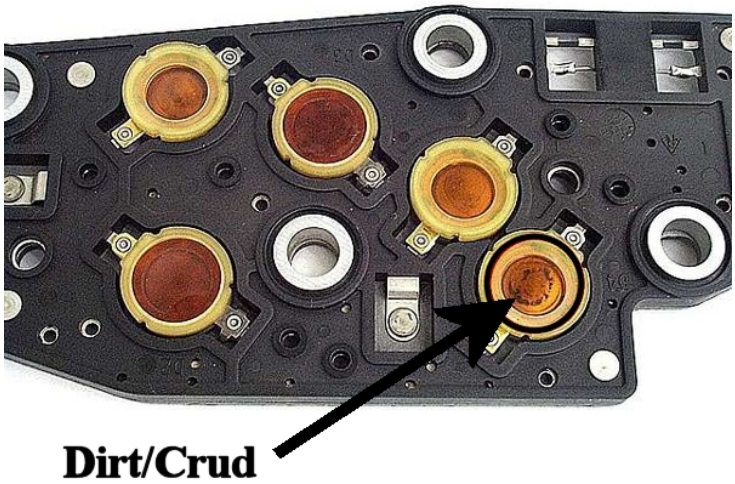
The 4L60E valve body is a very straightforward assembly, and it is rather easy to work on. The retainer clips are easier to work with than most roll pin retainers. The valves are made of steel rather than a softer material, so this valve body is quite cooperative when freeing up sticky valves.

Step 1: There are quite a few electrical components on this valve body. Before dismantling the valve body, check each component for the resistance through each part, as well as making sure that there is no connection between the component terminals and the valve body itself. If you are considering re-using the wiring harness that came with the unit, you may want to consider connecting the harness to the valve body components to check the electrical resistance through the entire transmission internal circuitry. ATRA Technical Bulletin #269 shows all of the electrical testing values and hook-ups you need, and I've included this bulletin at the end of this section.

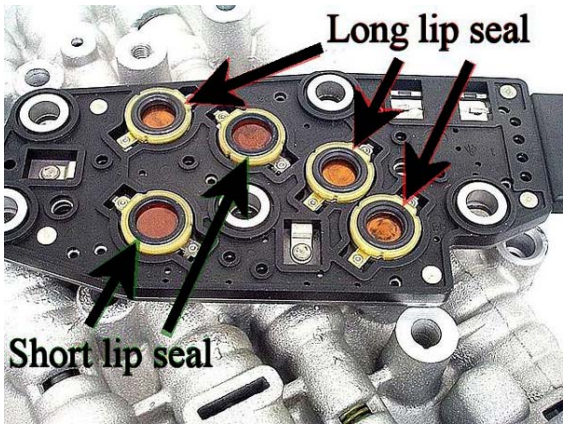


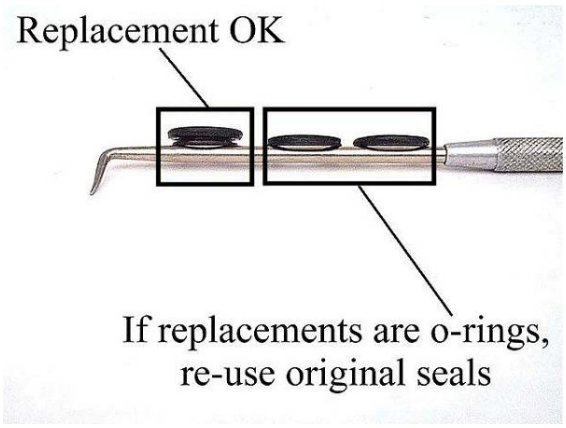


NOTE: If your unit has over 75,000 miles on it, or has been subjected to excessive heat or particle contamination due to an internal failure, it is a good idea to replace the valve body electrical components. They may be damaged or restricted in a way that won't show up during your testing. Also, the pressure switch assembly has rubber sealing components in it. Even though they can be individually replaced, excessive heat may have also damaged unserviceable parts inside the switch assembly. These switch assemblies can also hold debris from a transmission failure inside the switches, which can affect their ability to operate. If you see any dirt in the pressure switch assembly, replace it.

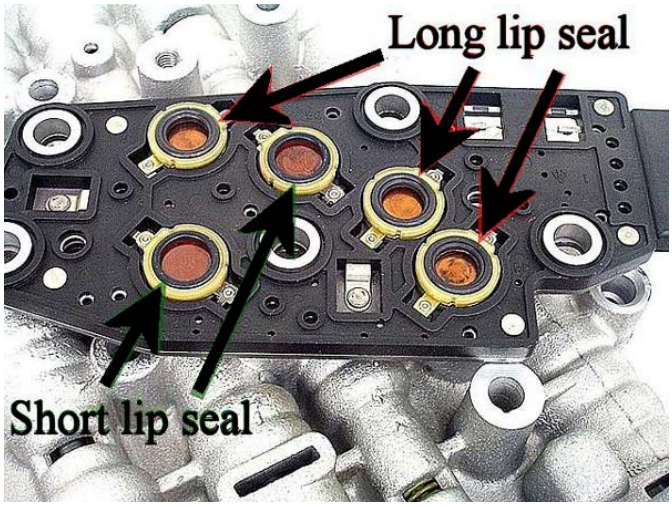


Step 2: If you are going to re-use the Pressure Switch Assembly, the assembly has five rubber switch diaphragm seals that need to be serviced. However, there's a problem with doing this. The assembly has two types of switch seal, a large lip seal and a small lip seal. Most rebuild kits come with the proper large lip seals, but o-rings are provided to replace the small lip seals, and these o-rings are not acceptable. They do not properly grip the diaphragm pocket, which allows them to slip out of position when installing the switch assembly onto the valve body, and assembly lube won't hold them in place. Until proper replacement seals are available, it is advisable to re-use the small lip seals in the pressure switch assembly.



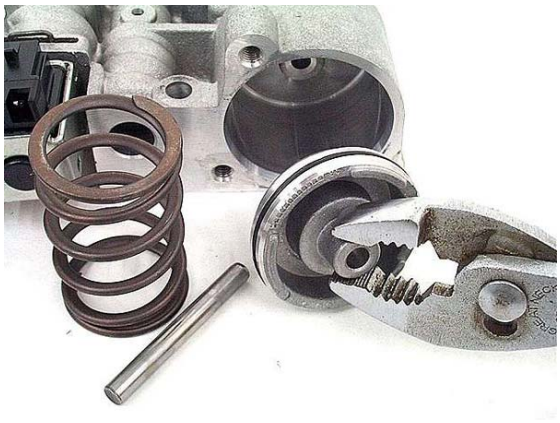


When installing the large lip seals, make sure that the entire lip is under the diaphragm pocket's plastic inner ledge. You can help by pushing on the ID of the seal with the corner of your pick. The small lip seals go in with the sharper edge first, against the diaphragm.

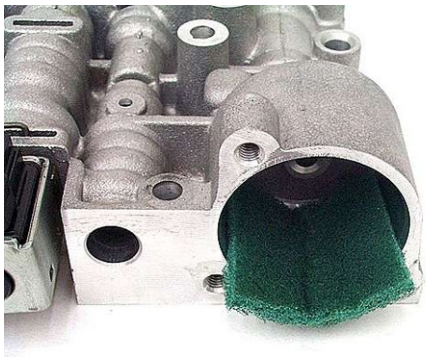


Step 3: Remove the forward accumulator piston cover. This cover also retains the low overrun valve and spring, so retrieve them and set them aside.

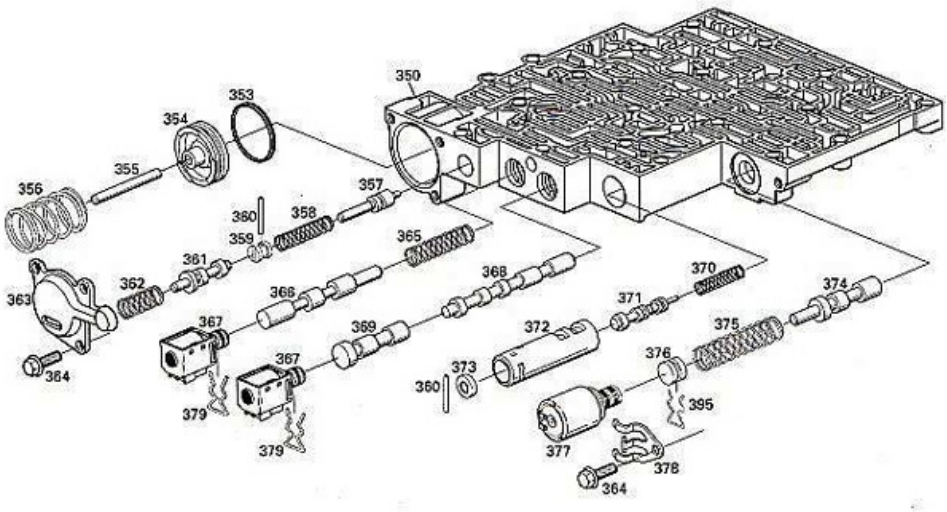
Step 4: Remove the accumulator spring, piston pin and piston. Remove the seal from the piston.

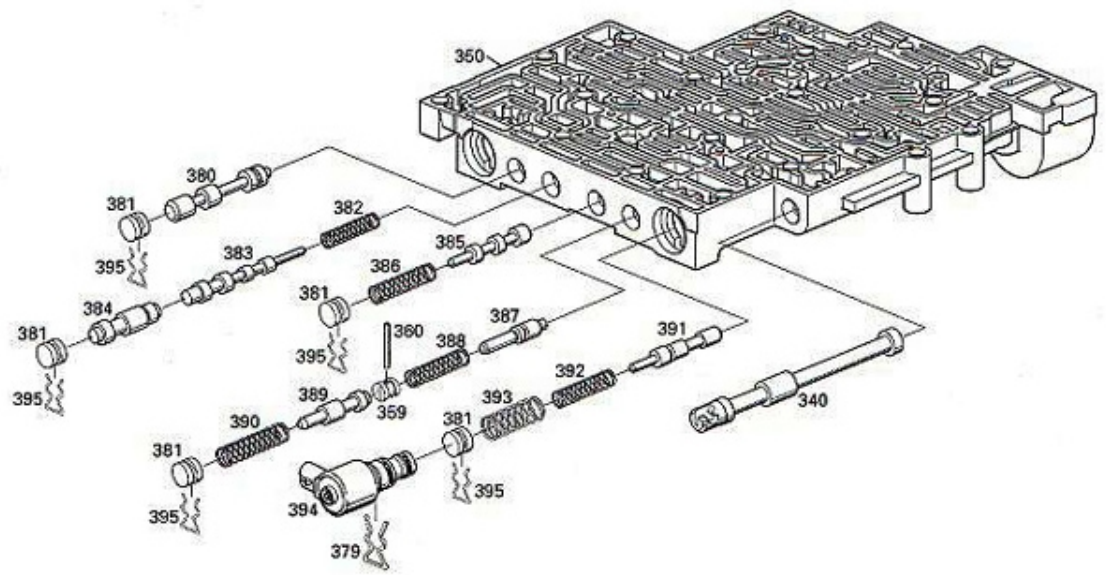


Step 5: Resurface the accumulator bore with ScotchBrite™.



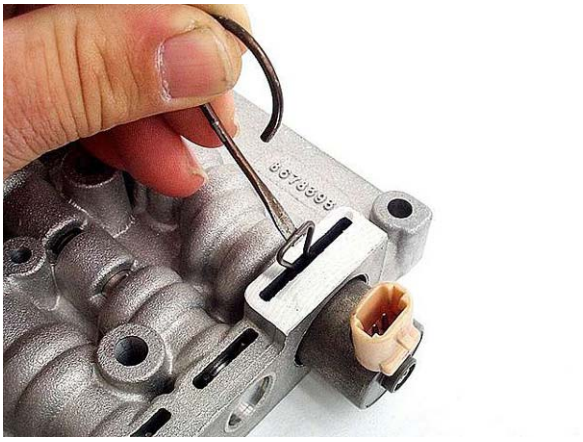
Step 6: Use the following illustrations as a guide for completely disassembling the valve body. You may want to print out these exploded views so you can have them handy as you work.



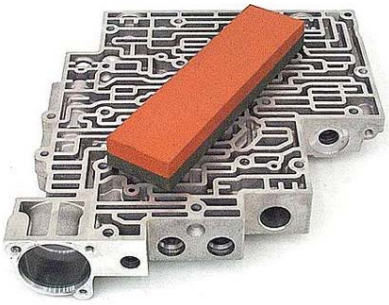


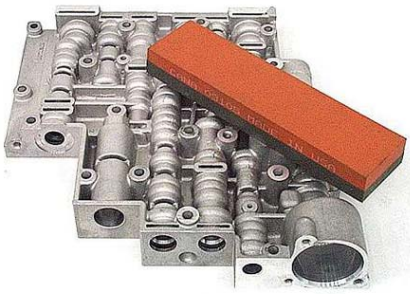
340 VALVE, MANUAL
350 VALVE ASSEMBLY, CONTROL BODY
353 SEAL, FORWARD ACCUMULATOR OIL
354 PISTON, FORWARD ACCUMULATOR
355 PIN, FORWARD ACCUMULATOR
356 SPRING, FORWARD ACCUMULATOR
357 VALVE, FORWARD ABUSE
358 SPRING, FORWARD ABUSE VALVE
359 PLUG, BORE
360 PIN, COILED SPRING
361 VALVE, LOW OVERRUN
362 SPRING, LOW OVERRUN VALVE
363 COVER, FORWARD ACCUMULATOR
364 BOLT, FORWARD ACCUMULATOR COVER
365 SPRING, 1-2 SHIFT VALVE
366 VALVE, 1-2 SHIFT
367A SHIFT SOLENOID A (1-2/3-4)
367B SHIFT SOLENOID B (2-3)
368 VALVE, 2-3 SHIFT
369 VALVE, 2-3 SHUTTLE
370 SPRING, ACCUMULATOR VALVE
371 VALVE, ACCUMULATOR
372 SLEEVE, ACCUMULATOR VALVE
373 PLUG, BORE
374 VALVE, ACTUATOR FEED LIMIT
375 SPRING, ACTUATOR FEED LIMIT VALVE
376 PLUG, BORE
377 PRESSURE CONTROL SOLENOID
378 RETAINER, PRESSURE CONTROL SOLENOID
379 RETAINER, SOLENOID
380 VALVE, CONVERTER CLUTCH SIGNAL
381 PLUG, BORE
382 SPRING, 4-3 SEQUENCE VALVE
383 VALVE, 4-3 SEQUENCE
384 VALVE, 3-4 RELAY
385 VALVE, 3-4 SHIFT
386 SPRING, 3-4 SHIFT VALVE
387 VALVE, REVERSE ABUSE
388 SPRING, REVERSE ABUSE VALVE
389 VALVE, 3-2 DOWNSHIFT
390 SPRING, 3-2 DOWNSHIFT VALVE
391 VALVE, 3-2 CONTROL
392 SPRING, 3-2 CONTROL VALVE
393 SPRING, BORE PLUG
394 3-2 CONTROL SOLENOID
395 RETAINER, BORE PLUG

TIP: One of the cooler things you can do as a rebuilder is to make special little tools to do a special job, particularly if it helps keep you out of the tool truck. One such tool would be something to pull these valve body retainers with. They are inside narrow slots in the valve body, sometimes rather deep. You can make this tool out of either an old screwdriver, or even a piece of coat hanger as shown, using a hammer, pliers and grinder to shape it to suit your needs. The price is certainly right.

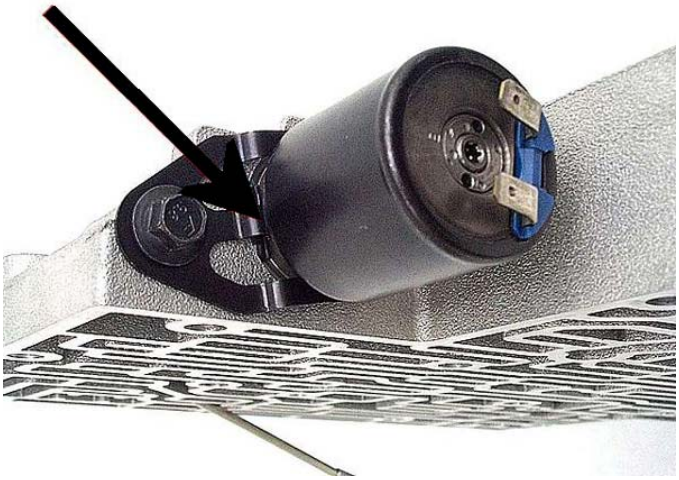


Step 7: Flat sand the main passage side and pressure switch assembly sealing area of the valve body casting enough to remove any high spots near edges, corners and bolt holes.

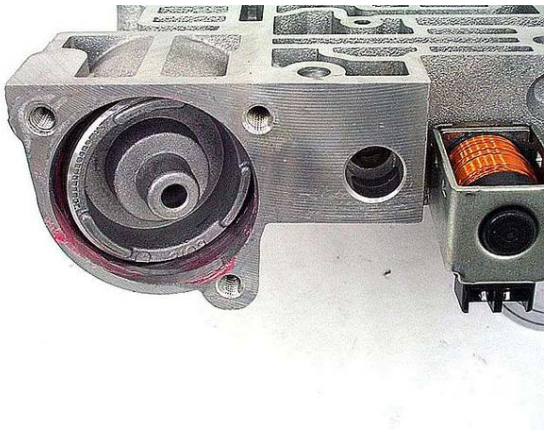


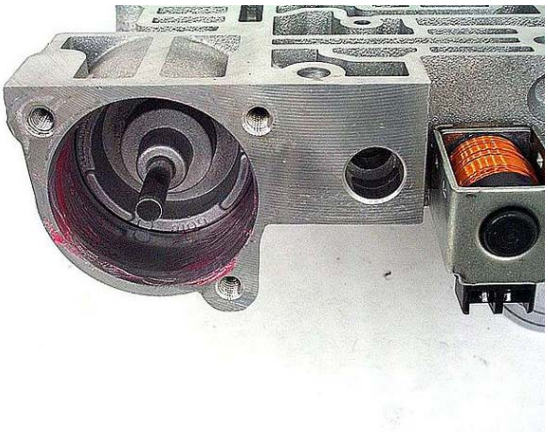


Step 8: Thoroughly clean and blow off all parts. Reassemble all valve trains and electrical components back into the valve body, making sure to install new o-rings on the electrical parts. When installing the force motor, be sure to line up the square tang on the retaining bracket with the flat spot on the snout of the solenoid. This makes sure that the solenoid terminals are aimed in the correct direction, avoiding short circuits against valve body parts.

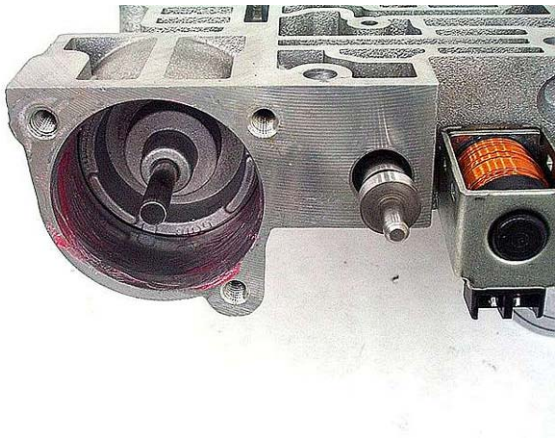


Step 9: Coat the forward accumulator bore with assembly lube. Install a new rubber seal on the accumulator piston. Install the accumulator piston into the valve body at a slight angle to make it easier to push down the bore, then straighten the piston in the bottom of the bore. Install the piston pin into the bore through the piston.

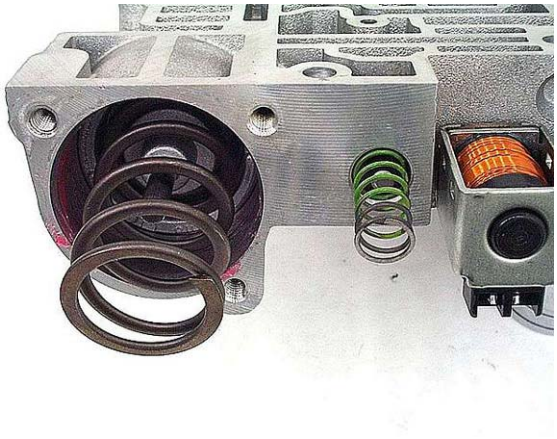




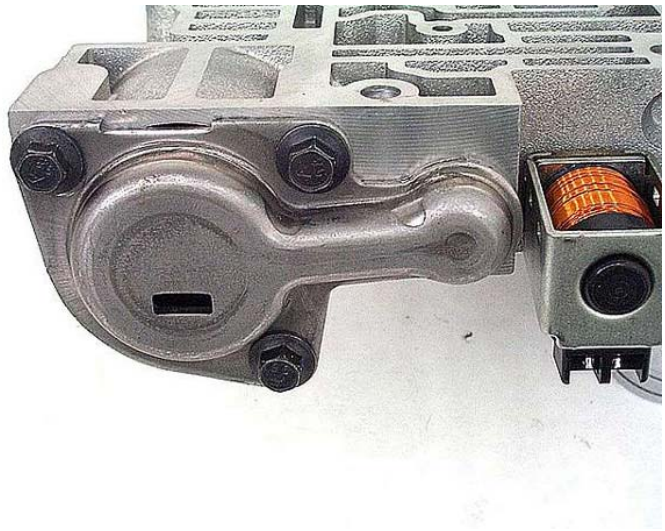
Step 10: Install the low overrun valve into its bore.



Step 11: Install the accumulator spring and the low overrun valve spring.

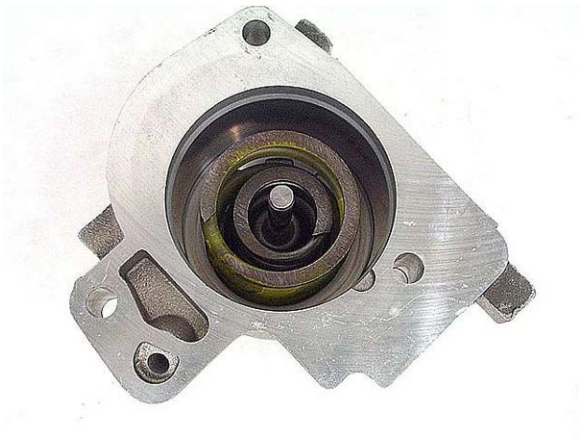


Step 12: Install the accumulator cover, hand-tightening the bolts.



Step 13: Remove the 1-2 accumulator piston and spring from the accumulator housing, taking notice of which order they came out of the housing in. Remove the seal from the piston. Clean all accumulator parts.

Step 14: Recondition the accumulator bore surface with ScotchBrite™. Place a new rubber seal on the accumulator piston. Coat the bore with assembly lube and reinstall the piston and springs into the accumulator housing in their original order.



The valve body is now ready for unit assembly.

BULLETIN Technical

1995
Technical Bulletin #269
- Transmission: 4L60-E
- Subject: Solenoid/ Switch Resistances
- Application: GM

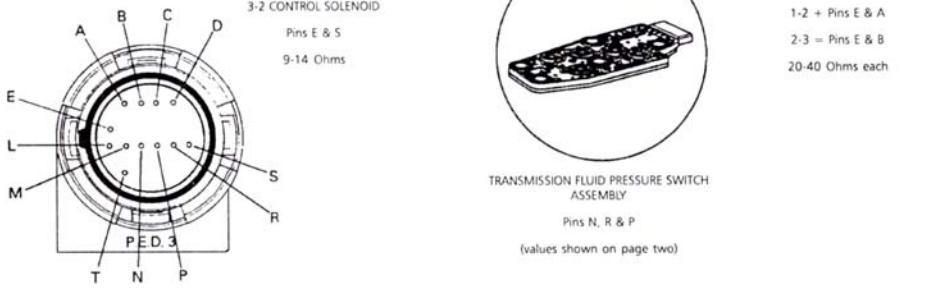
GM 4L60-E
Solenoid/Switch Resistances

Part of the 4L60E electrical diagnosis should include checking the electrical resistance of solenoids and other devices inside and around the unit. The following is a chart showing a typical case connector and pins, the devices they go to, and the resistance or voltage values of the circuits involved.

Transmission Fluid Temperature Sensor
(located in PSA)

Pins L&M

°C	°F	RESISTANCE
-40	-40	100544
-28	-21	52426
-16	10	18580
-4	23	12300
0	32	9379
7	40	7270
19	68	3520
31	86	2232
43	110	1200
55	131	858
67	145	675
79	176	333
91	194	241
103	213	154
115	239	115
127	260	79
139	284	60
151	302	47



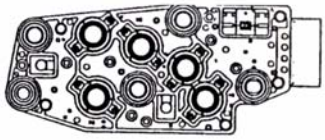
In order to properly test the Transmission Fluid Pressure Switch Assembly, the engine must be running and under full computer control (all wiring connected). Since the computer is sending 12 volts to each of these switches, the resistance of the switches can not be checked with an ohmmeter. Use a voltmeter and check for the proper voltage on the appropriate harness wires in each of the shift lever positions (the wires will need to be pierced).

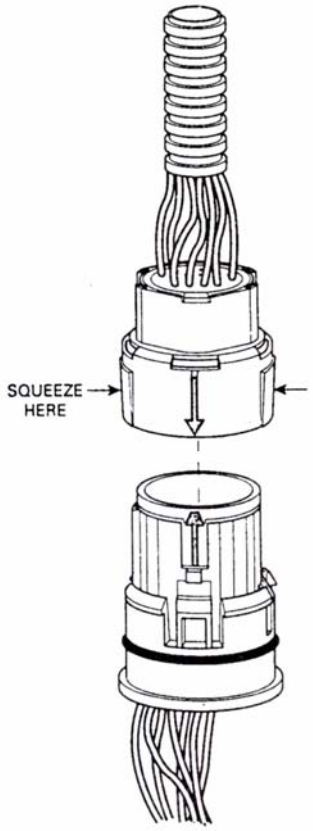
The chart below shows the correct voltage values for each of the shift lever positions.

Harness Pin	N	R	P
PARK	12	0	12
REVERSE	0	0	12
NEUTRAL	12	0	12
D4	12	0	0
D3	12	12	0
D2	12	12	12
D1	0	12	12
ILLEGAL	0	12	0
ILLEGAL	0	0	0

EXPECTED VOLTAGE READINGS

Transmission Fluid Pressure Switch Assembly





Points to remember when working with the transmission electrical connector.

— To remove the connector, squeeze the two tabs toward each other and pull straight up (See illustration).

— Limit twisting or wiggling the connector during removal. This can bend the pins.

— DO NOT pry the connector off with a screwdriver or other tool.

— To install the connector, first orient the pins by lining up the arrows on each half of the connector. Push the connector straight down into the transmission without twisting or angling the mating parts.

—The connector should click into place with a positive feel and/or sound.

— Whenever the transmission pass-through connector is disconnected from the vehicle harness and the engine is running, multiple Diagnostic Trouble Codes will set. Be sure to clear these codes after re-connecting the pass-through connector.

DTC's 59, 67 and 82 will set with key on, engine off.

DTC's 59, 66, 67, 73 and 82 will set with key on, engine on.

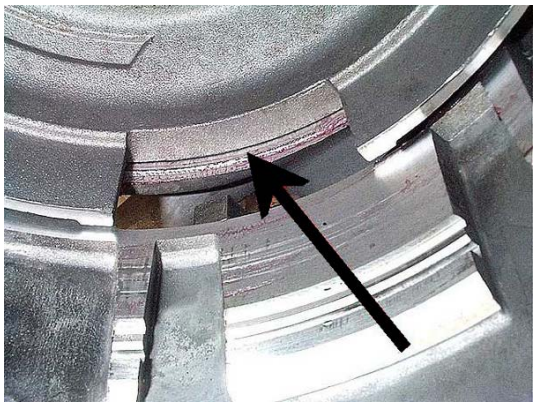
Unit Assembly

The case should be in a holding fixture, bell housing pointing up.

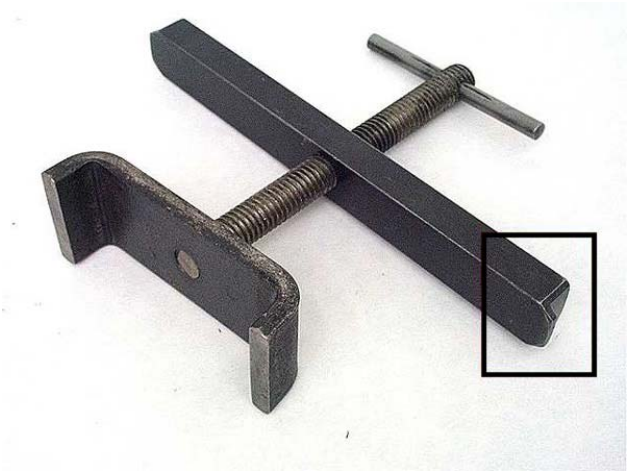
Step 1: Install new rubber seals onto the low-reverse piston.

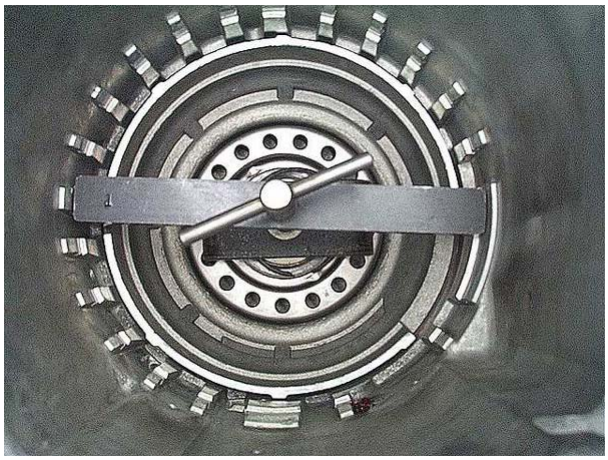
Step 2: Coat the seals and case bores with assembly lube. Line up the piston lug with the proper slot in the case. It might be easier to line up the lug with the slot if you make a mark on top of the piston where the lug is.

Step 3: Using a hammer handle, gently tap the piston into position in the case bore. Be extremely careful, because these seals rip very easily during installation, and ripped low-reverse seals are one of the most common after rebuild complaints for this unit. You will know when the piston is all the way down when you can see the outer seal bore above the edge of the piston near the park pawl.

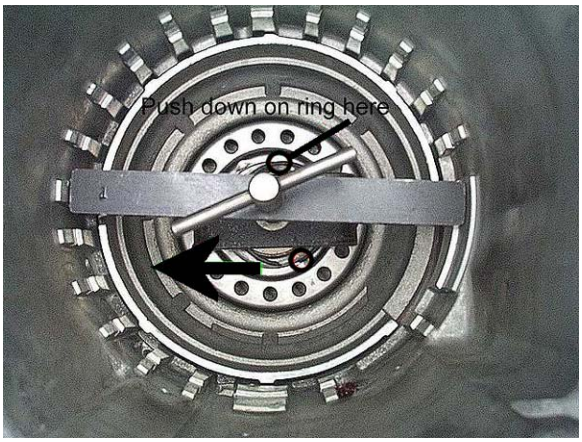


Step 4: Place the low-reverse piston return spring assembly on the piston. Set the proper snap ring on top of the return spring retainer. Install the appropriate spring compressing tool (the tabs on the ends of the cross-bar engage with the low roller clutch race snap ring groove in the case), and compress the return spring assembly.

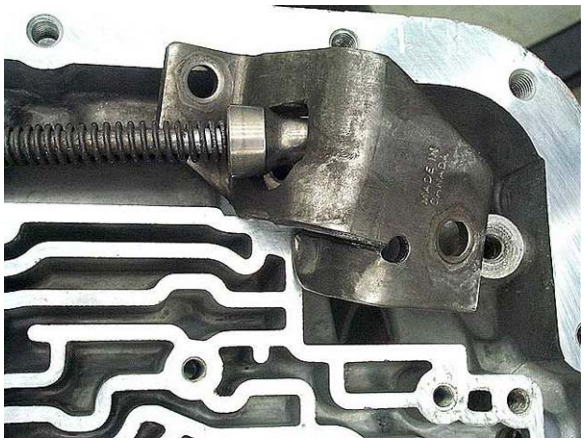


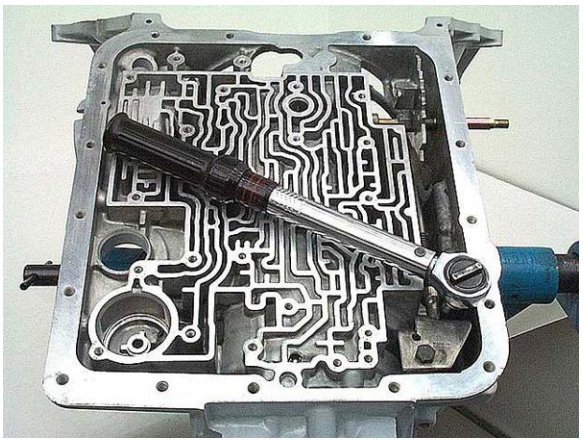


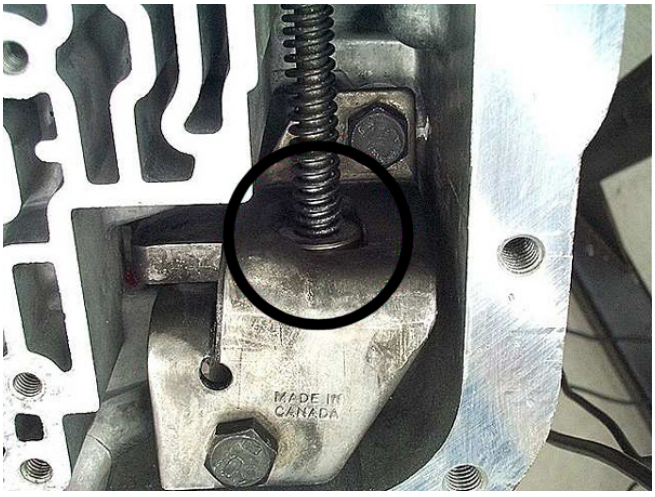
Step 5: Install the snap ring into the groove. One way to do this is to push one end of the ring into the groove with a screwdriver while holding down on the center of the ring. Then use the screwdriver to push the other end of the snap ring away from the first end, which should spread the ring enough to allow you to push it over the case and into the groove. Make absolutely certain that the snap ring is all the way into the case groove, and inside all of the retaining tabs on the return spring assembly. Remove the compressor.



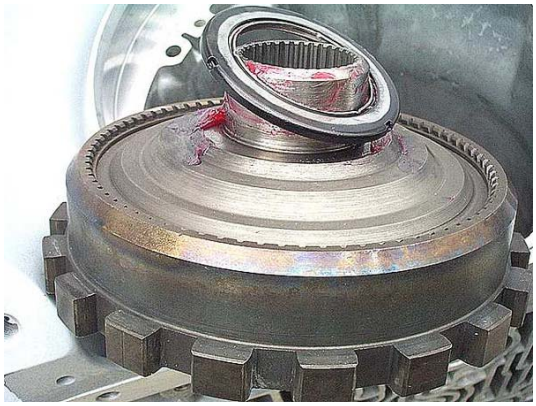
Step 6: With the bottom of the case aimed up, place the park pawl bracket over the pawl and rod. Install the two bolts and tighten them to 23 ft-lbs. Make sure that the rod bullet moves freely in and out of the pawl and bracket, causing the pawl to properly go in and out of the inner case area.





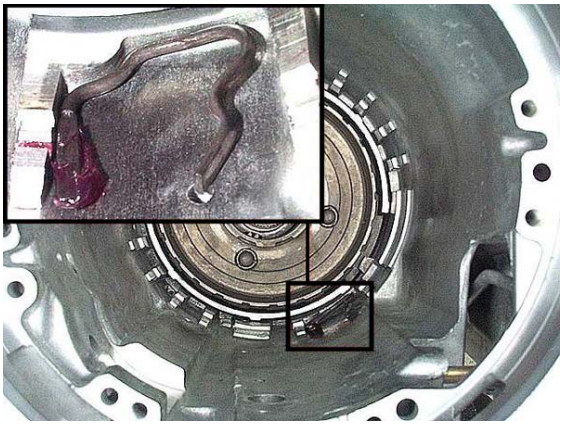


Step 7: Place the rear ring gear rear thrust bearing into position on the back of the rear ring gear as shown, using assembly lube to hold the bearing in place. Lower the ring gear into place inside the case.



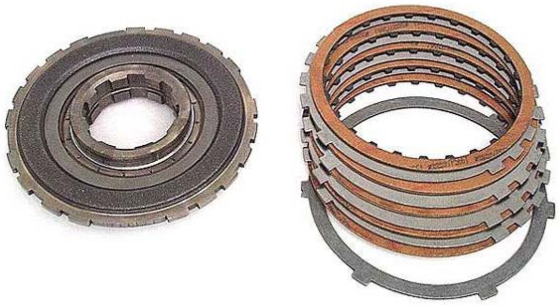

Step 8: Place the rear planetary assembly rear thrust bearing into position on the back of the rear planetary assembly as shown, using assembly lube to hold the bearing in place. Lower the planetary assembly into the rear ring gear, engaging the ring gear teeth.

Step 9: Install the anti-clunk spring into the case, holding it in place with a blob of assembly lube as shown.

Step 10 (1987 and later units with selective L/R spacer plate- Go to **Step 11b** if your unit is earlier)**:** Determine the correct low-reverse spacer plate to use:

- Stack up the low-reverse clutch pack on the bench with only the waved plate, 5 clutch friction plates and 4 clutch steels as shown. Do not include the original thick spacer plate for this measurement. Place the low roller clutch assembly on top of this clutch stack on the bench.



- Measure the height from the bench surface to the top of the low roller clutch assembly as shown. Use the chart below to determine the spacer plate thickness you need for your low-reverse clutch pack.

Selective Low-Reverse Spacer Plate Chart

If your measurement was: ---------- Use selective plate size:

1.061"-1.080" ---------- 0.046"-0.052"
1.081"-1.101" ---------- 0.066"-0.072"
1.102"-1.122" ---------- 0.087"-0.092"

Step 11a: Install the low-reverse clutch pack into the case, starting with the waved plate, followed by the selective spacer plate, then the clutch pack, starting and ending with a friction plate.

Go to **Step 12.**

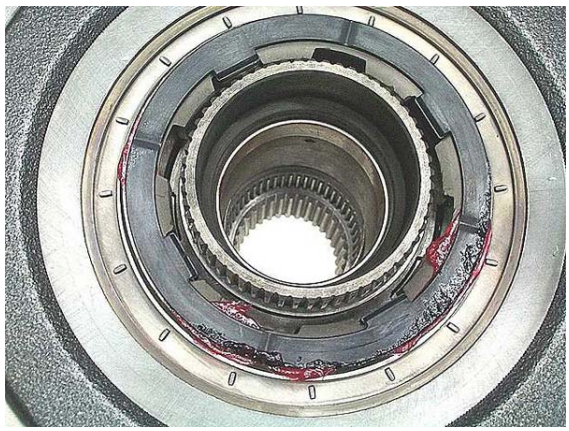
Step 11b (up to 1987 units without low-reverse waved or selective plate)**:** Install the low-reverse clutch pack, starting with a steel plate and ending with a friction plate.

Step 12: Install the low roller clutch assembly into the case, matching up the assembly slot widths with the correct width case lugs. Rotate the roller clutch inner race to allow the inner race lugs to engage the rear planetary carrier lugs. Use a hammer handle to tap the low roller clutch all the way into position. The end of the anti-clunk spring should now be pressing against the side of a roller clutch slot.

Step 13: Install the low roller clutch assembly snap ring, making sure that the anti-clunk spring tip goes between the snap ring ends.

Step 14: Place the plastic thrust washer on the low roller clutch inner race, engaging the washer tabs with the race lugs. Use assembly lube to hold the washer in place.

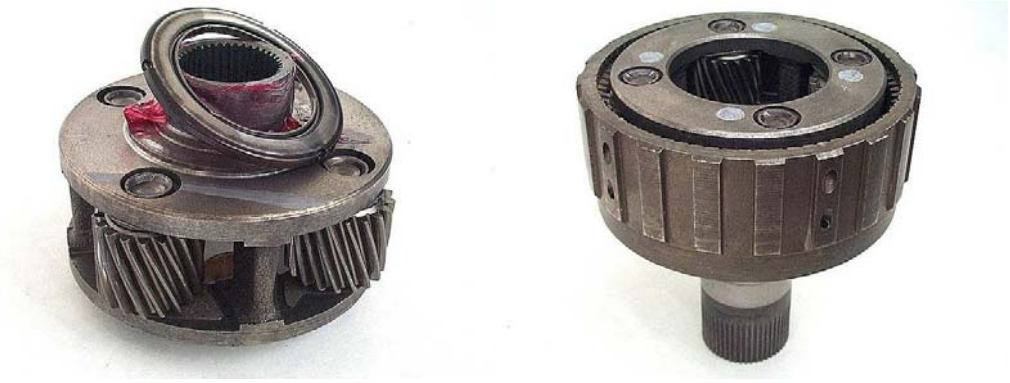
Step 15: Install the rear sun gear into the rear planetary carrier.



Step 16: Place the sun gear shell-to-front ring gear thrust washer in place in the shell, engaging the washer tabs with the holes in the shell. Use assembly lube to hold the washer in place.

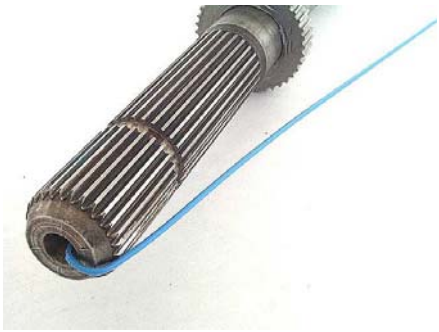
Step 17: Lower the sun gear shell into the case, engaging the shell inner teeth with the top outside teeth of the rear sun gear.

Step 18: Place the front planetary carrier rear thrust bearing in position on the back of the planetary carrier, using assembly lube to hold the bearing in place. Install the planetary carrier into the front ring gear and hub assembly.

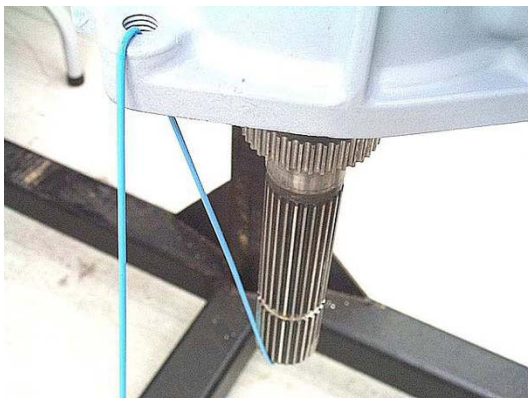


Step 19: Lower the hub and planetary carrier into the case, engaging the hub splines with the rear planetary carrier internal splines. Rotate the hub into position, making sure that the hub is all the way down against the sun gear shell thrust washer.

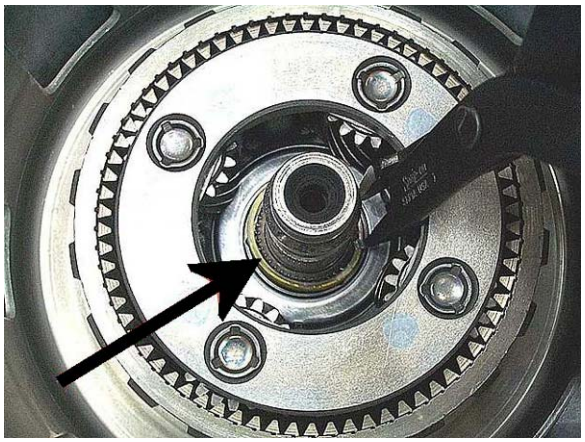
Step 20: Prepare a piece of coat hanger or welding rod (same thing, right?) to use as an output shaft holding tool. You need a straight piece about 1 1/2 feet long. Bend a sharp hook on one end of this piece of coat hanger.



Step 21: Install the output shaft into the unit from the back of the case, rotating it to engage the rear ring gear and front planetary carrier splines along the way. Once the shaft is in position, slide the straight end of coat hanger through one extension housing bolt hole. Slide the wire up until the hook on the end of the wire engages with the hole in the rear end of the output shaft. While holding the shaft in place, bend the wire above the case bolt hole to hold the shaft in position.



Step 22: Install the snap ring into the output shaft groove above the front planetary carrier. You may have to push up on the back end of the output shaft to expose the entire snap ring groove. With the snap ring in place, remove the piece of coat hanger holding the output shaft in place.

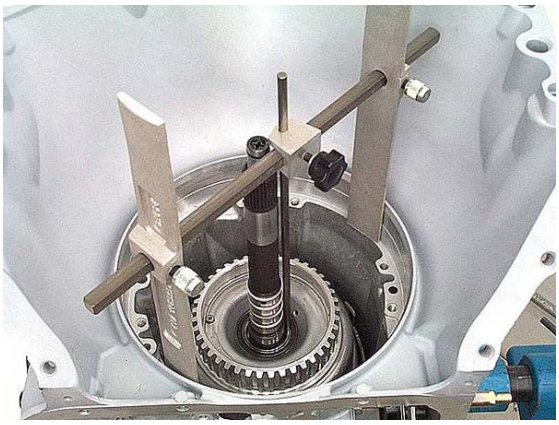


Step 23: Place the front sun gear into the front planetary carrier, shoulder side up, engaging the teeth of the front planetary gears.

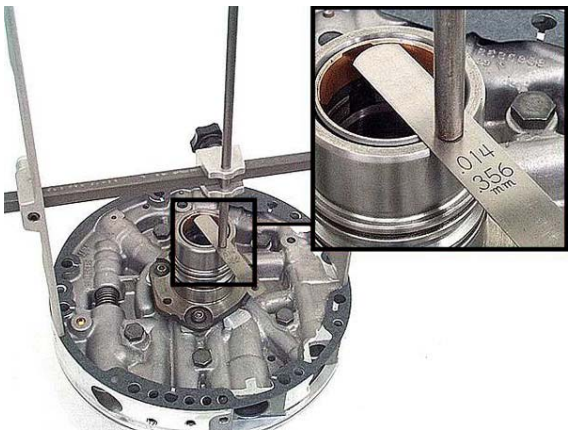
IMPORTANT- The following step concerns main unit endplay, which is arguably the most important adjustment to be made in a 4L60E. If this was checked and adjusted during disassembly, and no parts were changed that might change endplay, skip ahead to **Step #25**. Otherwise, proceed to the next step.

Step 24: Main unit end play must be checked and adjusted before final input drum installation. Here's one quick and easy method:

- Remove the turbine shaft seal ring sizer, then lower the input drum into the case *without the reverse input drum*, engaging the sun gear splines with the forward sprag, and the 3-4 clutches with the front ring gear. When the drum is all the way down, you'll get a nice solid 'clunk' when you move the drum up and down bit. Make sure that the selective endplay washer and thrust bearing are in place on top of the input drum.
- Place an 'H' gauge endplay measuring tool on the pump mounting surface of the case. Set the gauge pin on top of the input drum thrust bearing race and tighten the pin locking screw.



- Place a new pump gasket on the pump, and place the inverted 'H' gauge on the gasket. Use a feeler gauge to measure the clearance between the gauge pin and the thrust journal on the end of the stator support. This clearance, minus two or three thousandths, is your endplay distance.



The factory specification for this clearance is between 0.005" and 0.036". Since you need to allow for gasket crush, keep the minimum clearance above 0.010". To maximize unit life, keep the maximum measured clearance below 0.025".

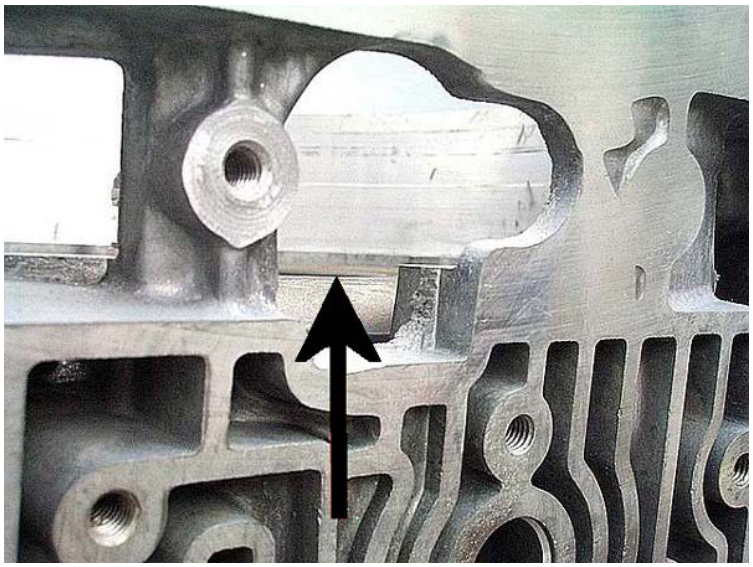
Endplay is adjusted by changing the selective washer under the thrust bearing on top of the input drum. To reduce end play a certain amount, increase the washer thickness by that amount. Use a thinner washer to increase endplay. The available selective washer sizes are:

0.074" - 0.078" (1.87mm - 1.97mm) Identifier mark #67
0.080" - 0.084" (2.04mm - 2.14mm) Identifier mark #68
0.087" - 0.091" (2.21mm - 2.31mm) Identifier mark #69
0.094" - 0.098" (2.38mm - 2.48mm) Identifier mark #70
0.100" - 0.104" (2.55mm - 2.65mm) Identifier mark #71
0.107" - 0.111" (2.72mm - 2.82mm) Identifier mark #72
0.113" - 0.118" (2.89mm - 2.99mm) Identifier mark #73
0.120" - 0.124" (3.06mm - 3.16mm) Identifier mark #74

Once you know the correct selective washer size to use, install the correct selective washer under the thrust bearing on top of the input drum.

Step 25: Place the reverse input drum onto the input drum, rotating the reverse input drum to engage the reverse input clutches with the input drum. Be sure that the reverse drum is all the way down against the input drum thrust bearing. When all the reverse clutches are engaged, the reverse drum will rotate easily on the input drum while being pressed down upon.

Step 26: Lower the drum assembly into the case while rotating the input shaft, engaging the 3-4 clutch teeth with the front ring gear, and the reverse input drum lugs with the sun gear shell lugs. Keeping a slight upward pressure on the shaft while rotating it will make these engagements occur a little easier and quicker. After the reverse drum lugs have engaged the sun gear shell lugs, the drum assembly will be in the proper position when the input shaft moves up and down a little bit *without* the reverse drum moving up and down. The input shaft should be able to turn (although it may be a bit difficult with all the clutch teeth engaged) while pressing down on the input drum, and if you look into the case near where the filter goes, you will see that the reverse input drum is below the pump gasket surface of the case.



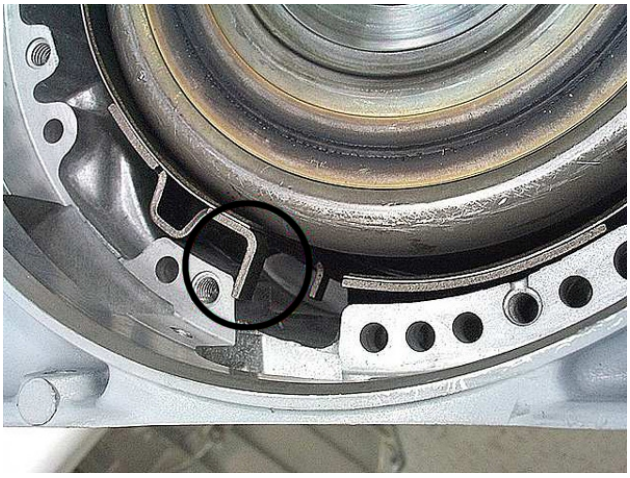
Step 27: To install the 2-4 band:

- Push the input shaft toward the top of the case.

- Align the case anchor end of the band with the anchor hole in the case, then slide that end of the band between the case and the reverse drum until the anchor end of the band is over the anchor hole in the case. You can help position the band by pushing on it through the case passage next to the manual lever.

- Relax pressure on the input shaft and feed the band around the reverse drum.

- Push the input shaft toward the top of the case again, and lift the servo pin end of the band over the case edge, pushing the band end into position between the case and the reverse drum. It's okay to bend the tabs on the end of the band outward a little bit to gain enough clearance to do this.

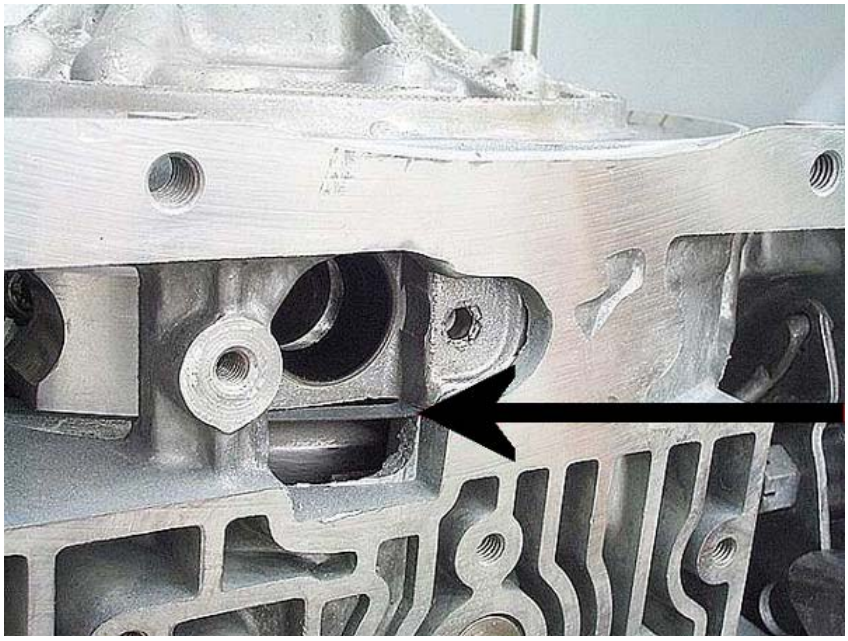


Step 28: Install the band anchor pin into the proper case hole. From this point on, be careful not to handle the case in such a way that would allow the anchor pin to fall out of position. It can sometimes be difficult to get the end of the band re-aligned with the anchor pin once it slips out.

Step 29: Place the pump gasket into position on the case. Thread a pair of pump alignment pins into two pump bolt holes across from each other. You can make alignment pins out of two long 8mm bolts that fit the pump bolt holes in the case that you have cut the heads off of, rounded the cut end, then cut a screwdriver slot into.

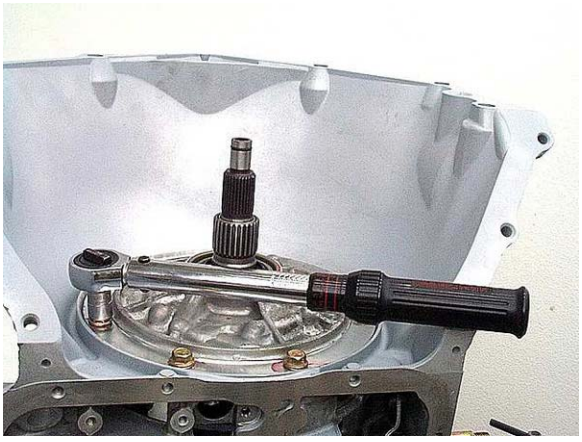
NOTE: It is a good idea to run a thin bead of high quality silicone sealer around the outside of the pump o-ring just before you install the pump into the case.

Step 30: Carefully start the pump into the unit, being very careful to aim the pump straight over the input shaft and into the reverse drum bore. Don't let the pump enter the case at any noticeable angle. If you encounter resistance to lowering the pump before the pump o-ring makes contact with the case, the reverse input drum seal rings may be catching on the drum bushing. Try firmly shaking the bell housing to help wiggle the drum over the rings (grip the housing with rags to avoid cutting your fingers off on the sharp case edges). Once the pump o-ring makes contact with the case bore, you may gently tap on the pump with a hammer handle, working your way evenly around the edge of the pump. Check to see that the pump is fully bottomed against the case and gasket by looking at the gasket area through the filter hole in the case. Remove the two alignment pins.



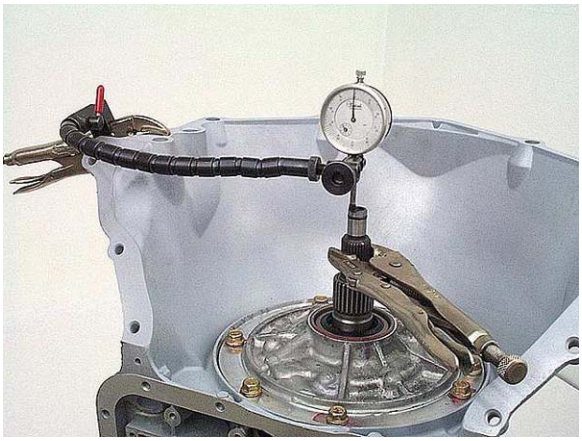
Step 31: Put new o-rings the pump bolts, coat the top of the pump bolt holes with assembly lube, then install the bolts into the case.

Step 32: Torque the pump bolts in a crossover pattern to 18 ft-lbs. Put a new o-ring in the groove on the tip of the turbine shaft.

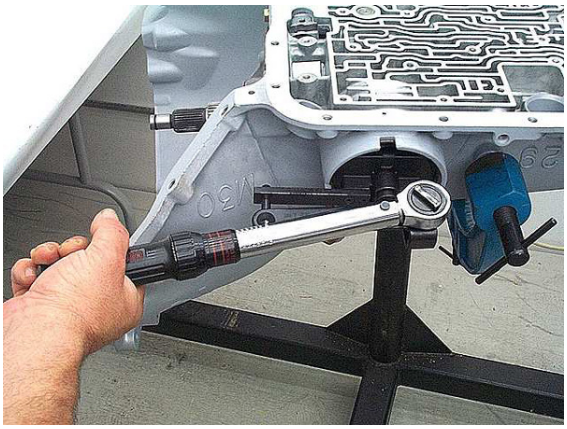


IMPORTANT: If you have not yet verified that your endplay-checking 'H' gauge is accurate, the following step MUST be performed at this time!

Step 33: Mount a dial indicator to the case. Place the indicator peg on the turbine shaft tip and zero it. Gently clamp a pair of vicegrips to the turbine shaft splines and pull it up and down, noting the travel. It should agree with the clearance you set endplay to during **Step #24**. If there is a difference of more than 0.002", you may want to write this on your 'H' gauge and adjust any future endplay measurement results by this amount.



Step 34: Install the 2-4 servo pin measuring tool into the 2-4 servo bore. Keep a set of the three available servo pin sizes to measure the servo pin travel with. Use the pin from this set that matches the length pin the unit originally came with, so that you don't have to take your servo assembly apart for this step if you have already assembled it. Using a torque wrench on the tool, tighten the lever to 8 ft-lbs. If the white line shows up in the window on the tool lever, the pin is correct. If the lever window goes past the white line towards the pan rail, you need a longer pin. If the lever window never reaches the white line, you need a shorter pin. The pins come in three lengths, plus or minus 0.010":

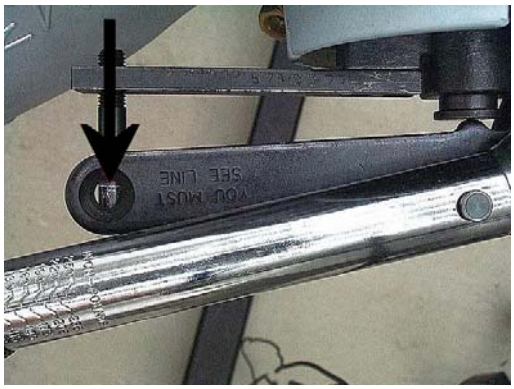


2.600" - ID mark is 1 groove.

2.650 " - ID mark is 2 grooves.

2.700" - ID mark is NO groove.

If it appears that you need a pin that is not within this range, then either the band anchor end has moved out of position on the anchor pin, or you need to try a different band. You can change the pin in the servo measuring tool assembly without having to remove the tool.

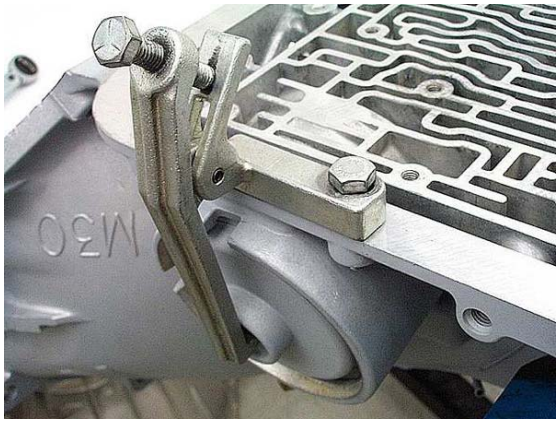


Step 35: Coat the 2-4 servo bore with assembly lube. Make absolutely sure that the large teflon servo seal ring is firmly glued into its groove with assembly lube.

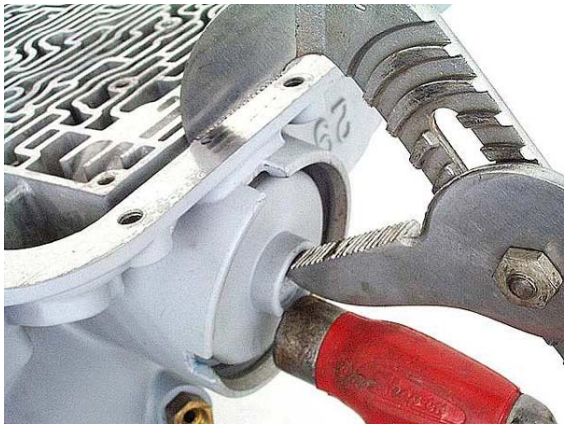
IMPORTANT- If the servo teflon ring sticks too far out of its groove, it's sure to get cut to pieces during servo installation. This is one of the most common rebuild errors made on this unit.

Step 36: Slide the servo assembly into the servo bore until resistance is felt. From this point on, you need to be careful not to let the servo piston back out after it goes any further into the bore. The seals don't like being repeatedly crushed into the bore. There are two ways to install the servo the rest of the way:

- The recommended service tool for this procedure bolts to the pan rail and compresses the servo piston as you tighten the tool bolt.

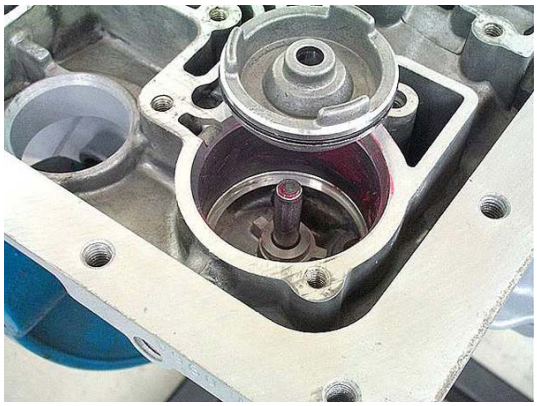


- A large pair of channel-lock pliers placed over the pan rail and against the servo cover will provide constant inward pressure on the cover while you gently tap on the other side of the cover. Be very careful not to damage the pan rail with the pliers.

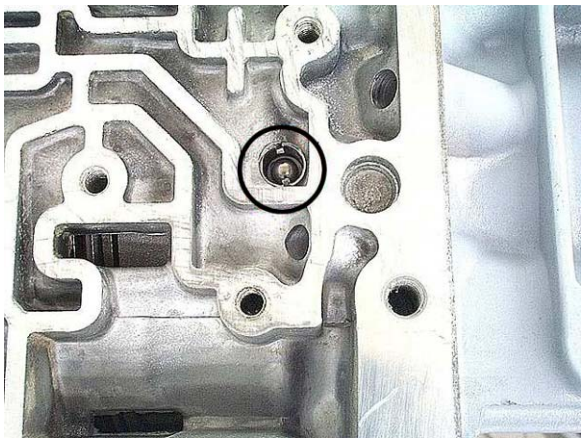


Once the servo bore snap ring groove is exposed, slide the snap ring into the bore groove. Make sure that the snap ring is seated all the way into the groove. Dirt or scale deposits can keep the ring lifted out of the groove a bit, allowing the ring and servo to pop out of the bore in operation.

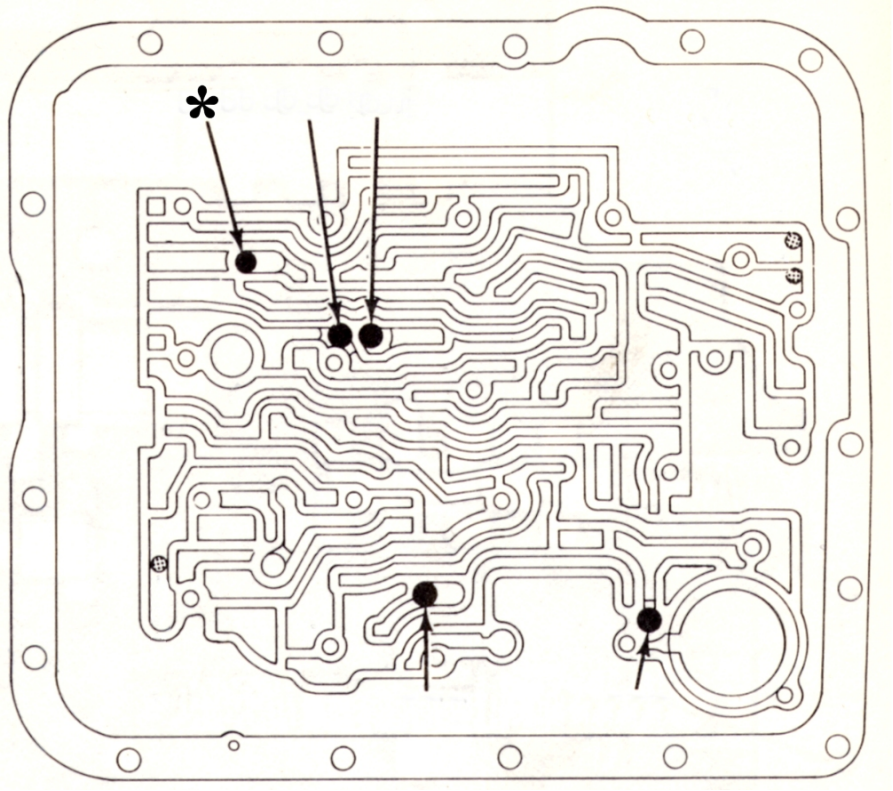
Step 37: Insert the 3-4 accumulator piston pin into the 3-4 accumulator bore in the case. Place a new seal on the 3-4 accumulator piston. Smear some assembly lube inside the 3-4 accumulator bore. Install the 3-4 accumulator piston into the case, open side up. Install the 3-4 accumulator spring into the piston. Place checkball #91 into position in the case pocket next to the 3-4 accumulator as shown.



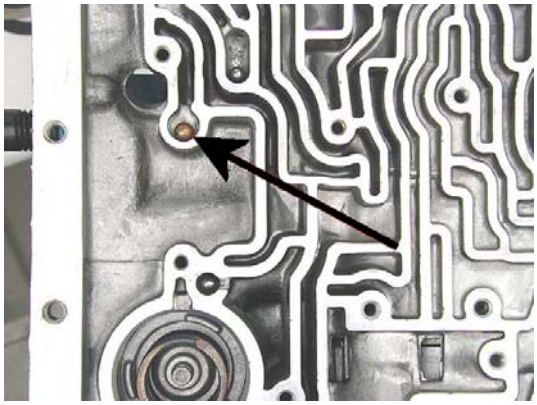
Step 38: On 1987 and later units that use a low-reverse waved cushion plate, there should be a checkball inside a capsule near the low-reverse case apply passage. If the ball is not in the capsule, place a 1/4” checkball in the capsule. The 4L60E has no other loose checkballs in the case.



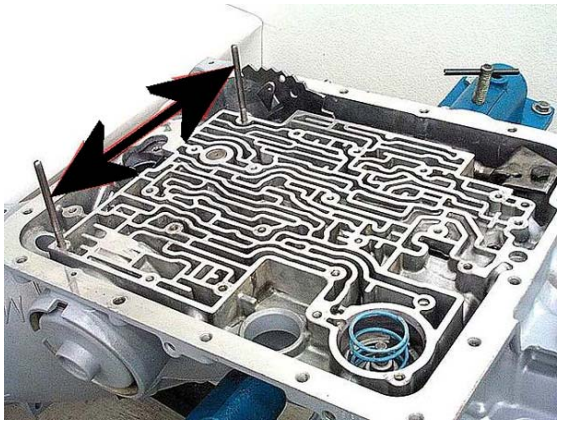
Case Checkballs, 4L60: Place the case checkballs in the locations shown. The checkball marked with a ‘*’ is only used if the separator plate has two holes over the case pocket.



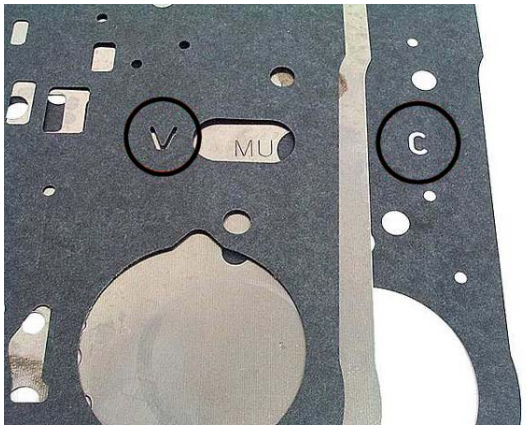
NOTE: 4L60s may come with a larger, copper-colored #10 checkball in the pocket shown. If so, *do not* reinstall this checkball. They cause more problems than they're worth.



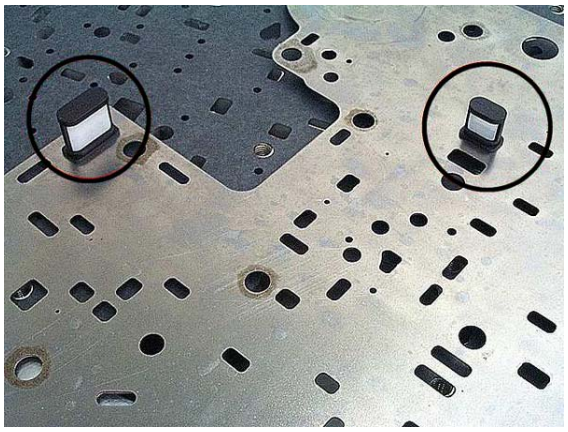
Step 39: Make sure that the band anchor pin is fully seated in the case anchor hole. Install two valve body alignment pins into the holes shown. You can make alignment pins out of two long 6mm bolts that fit the valve body bolt holes in the case that you have cut the heads off of, rounded the cut end, then cut a screwdriver slot into.



Step 40: Place the case gasket (identified by a 'C' cut into the gasket) on the case.



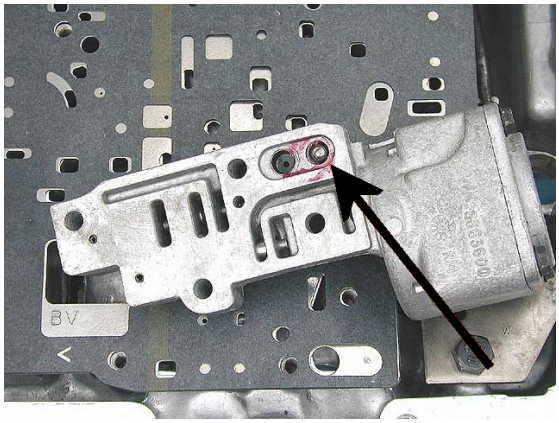
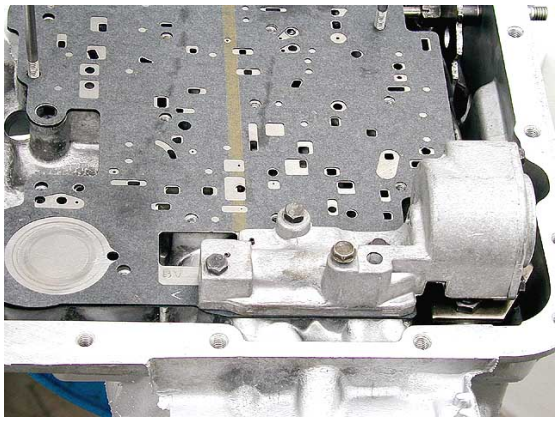
Step 41: Make sure that the separator plate screens are in place (4L60E), then lay the separator plate on top of the case gasket.



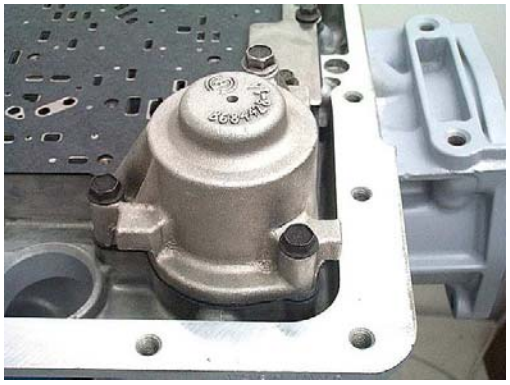
Step 42: Place the valve body gasket (identified by a 'V' cut into the gasket) on top of the separator plate.

Step 43: Early 4L60 & 4L60E- Set the separator stiffener plate into position on the separator plate.

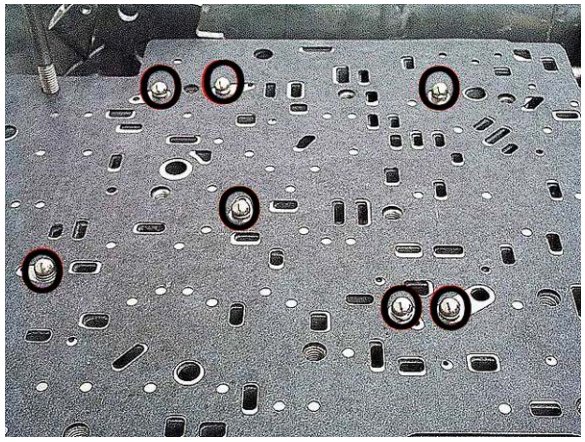
87 & later 4L60- Put the checkball into the auxiliary valve body using assembly lube to hold it in place. Set the separator stiffener plate or auxiliary valve body into position on the separator plate and install the bolts, tightening them to 8 ft-lbs.

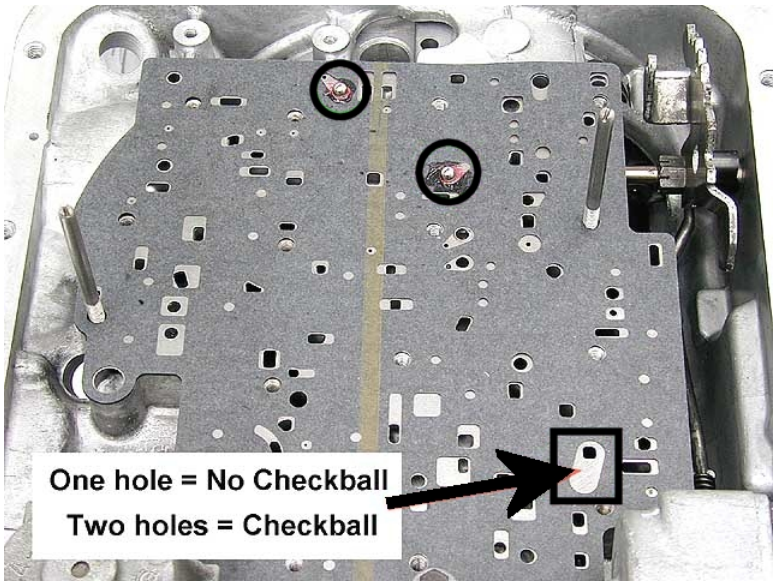
Step 44: Place the 1-2 accumulator housing on the separator plate, install the proper bolts, then tighten bolts to 8 ft-lbs.

Step 45 (4L60E): Place the seven valve body checkballs into the correct positions on the separator plate as shown. A small dab of assembly lube on each of the holes before you put the checkballs on them will help keep the balls in place.



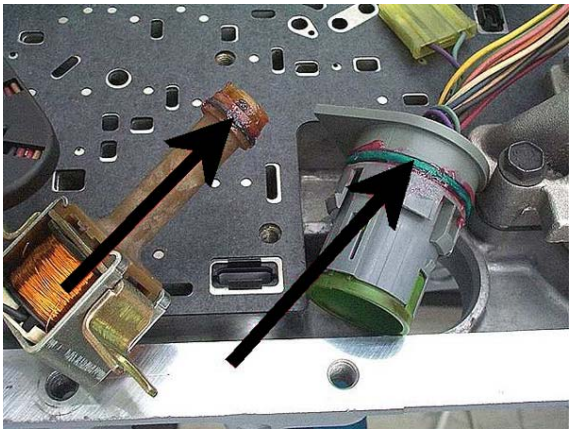
4L60: Place the two or three valve body checkballs, depending on the separator plate as shown, into the correct positions on the separator plate as shown. A small dab of assembly lube on each of the holes before you put the checkballs on them will help keep the balls in place.

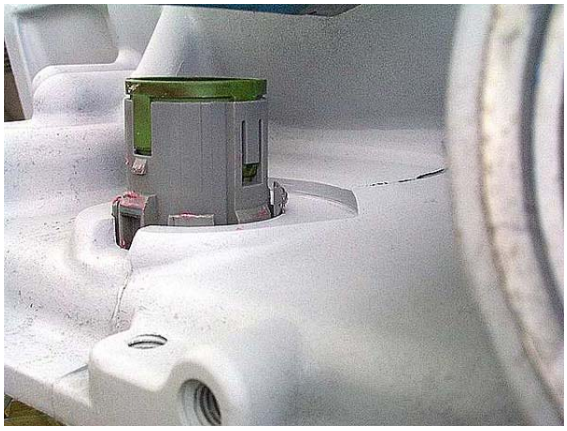
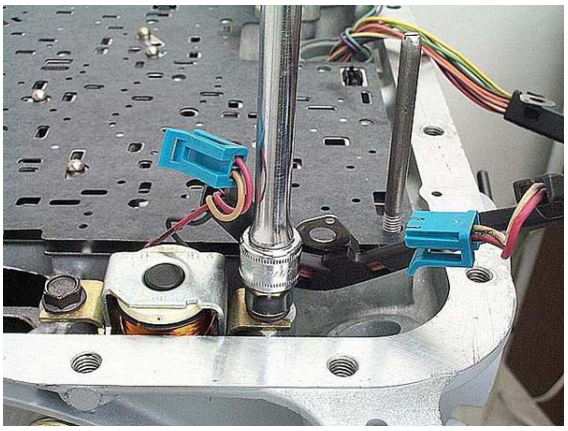


Step 46: Insert the end of the manual valve link with the 'S' shaped bend into the manual lever as shown.

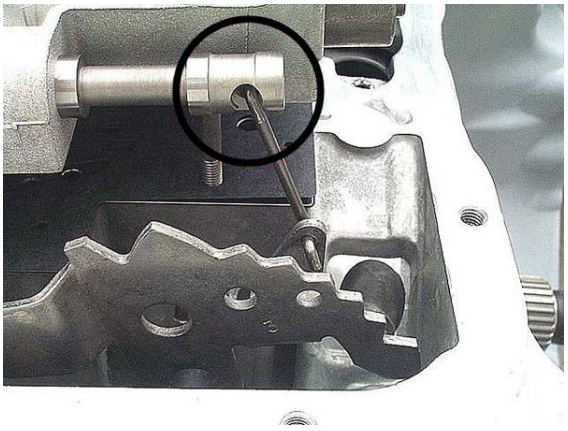
IMPORTANT: 4L60- Skip ahead to Step 54.

Step 47: Place new o-rings on both the solenoid wiring harness case connector and the TCC solenoid. Install the harness into the case. Install the TCC solenoid into the proper position as shown, and bolt it down.

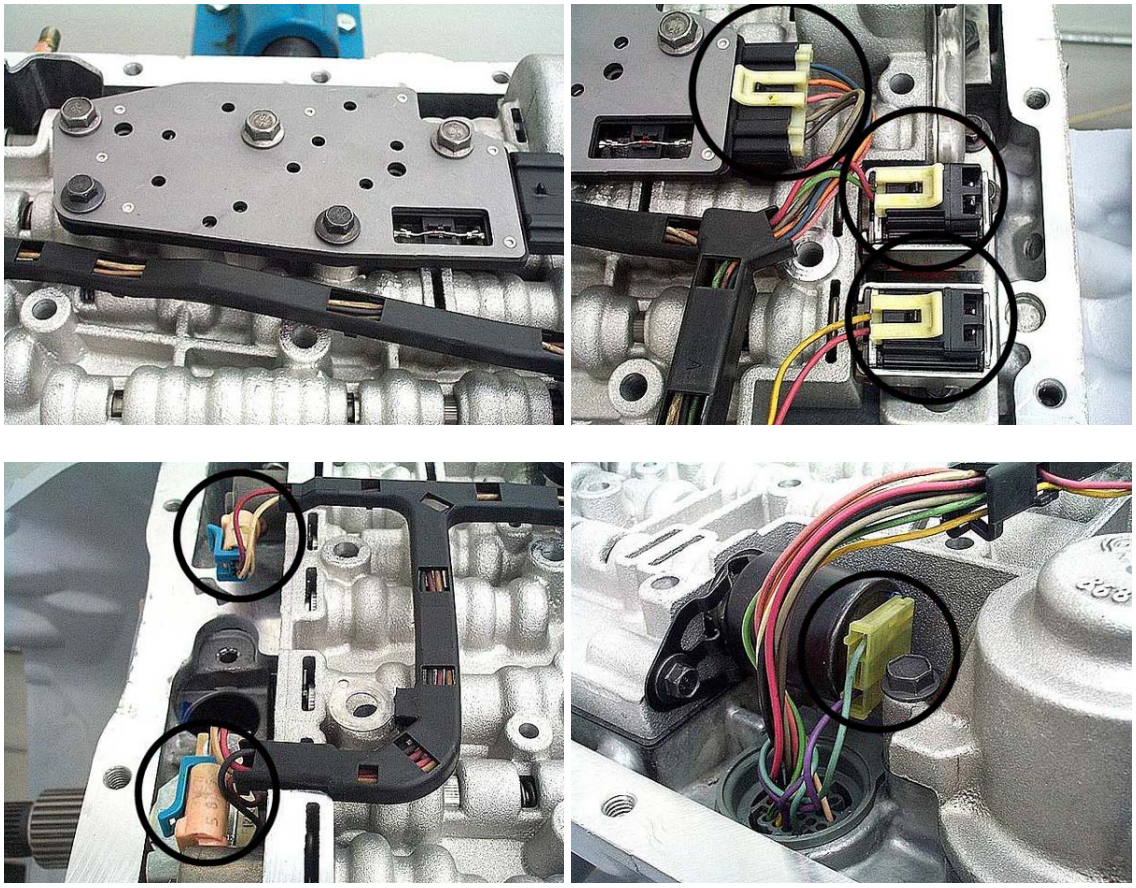


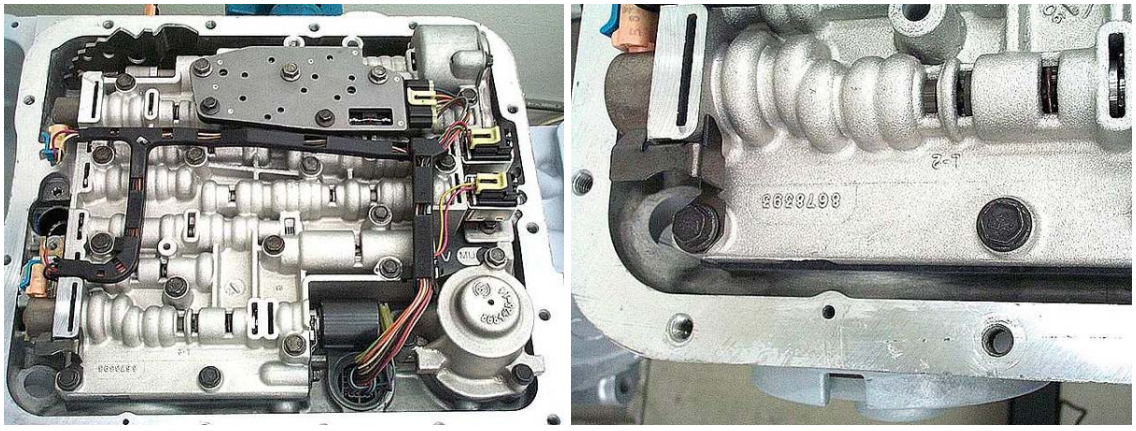
Step 48: Pull the wiring harness away from the valve body gasket, then carefully lower the valve body onto the case. You must guide the free end of the manual valve link into position in the end of the manual valve along the way.

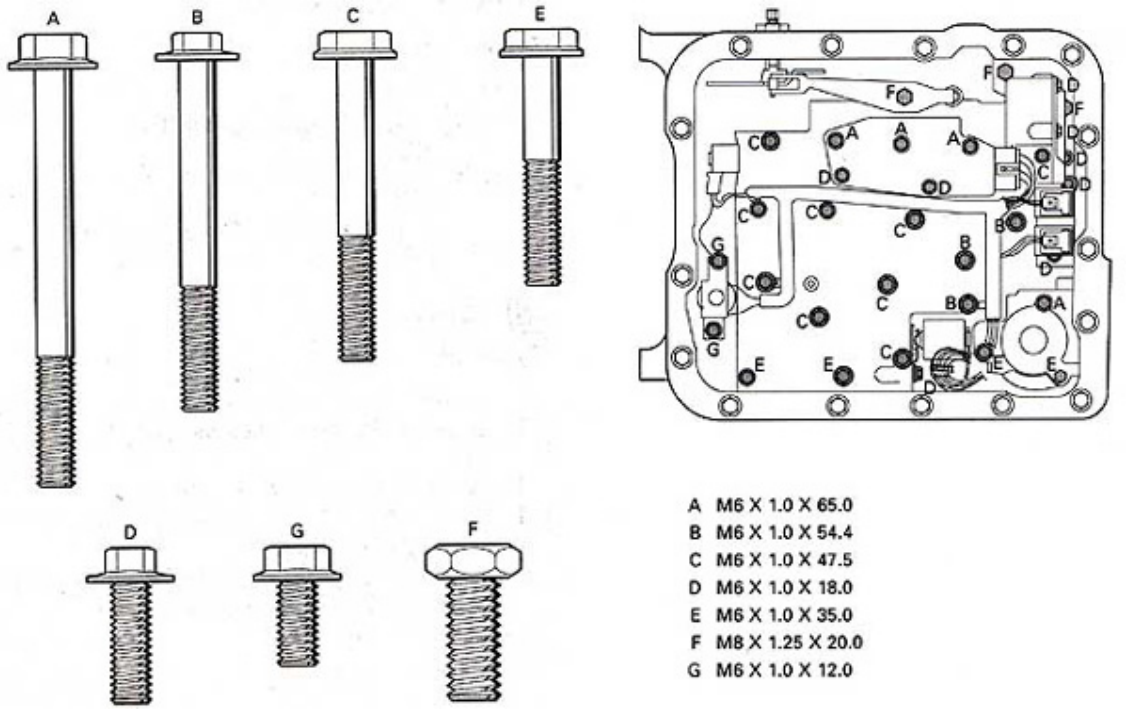
Step 49: Place the pressure switch assembly on top of the valve body and install the correct bolts through it as shown in the Bolt Location and Pattern chart link below, but don't tighten them yet. Lay the wiring harness over the valve body in the correct position. Hook up all solenoid and pressure switch assembly connections, making certain that all connector latches engage like they should.



Step 50: Place the proper bolts through the harness hold-down eyes. Remove the alignment pins, then install the proper bolts into the remaining holes as shown, remembering to install the dipstick stop clip on the front corner of the valve body.

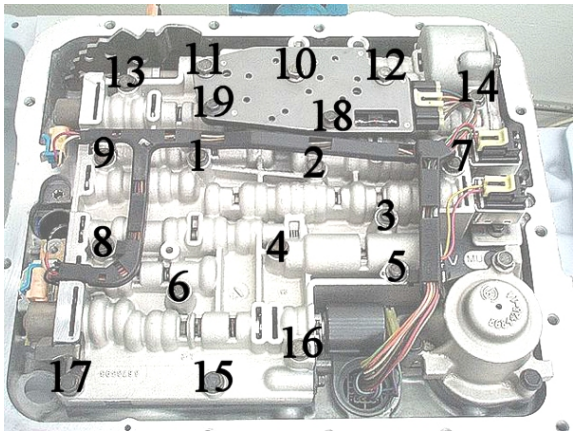


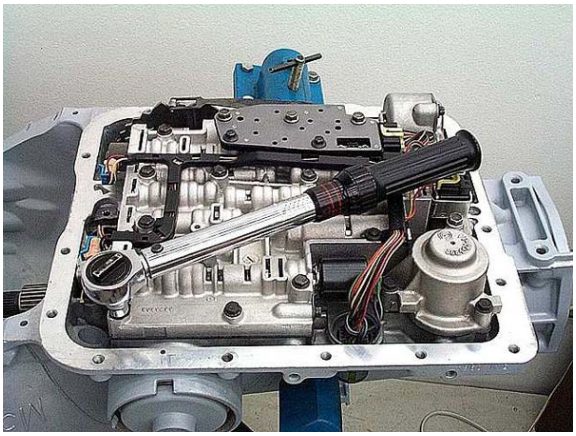
Valve Body Bolt Location and Pattern



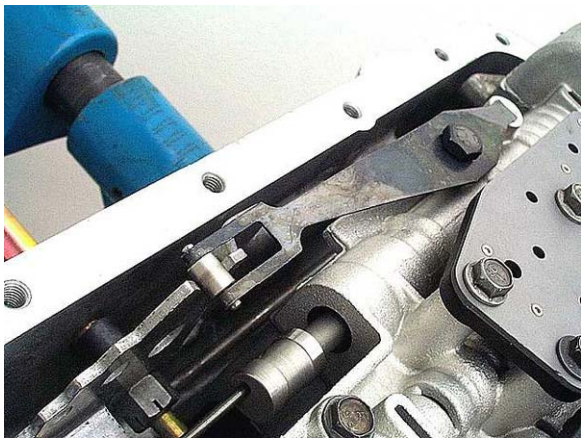
IMPORTANT- Be sure you check bolt lengths! Small length differences are important. The wrong bolt in one of the middle valve body holes can snag the sun gear shell, causing wrong gear starts and bind-ups!

Step 51: After *all* valve body bolts are in place, tighten the bolts to 8 ft-lbs. using the pattern shown, starting in the middle and working your way to the outer edge. Repeat the pattern at least once to assure proper bolt torque.

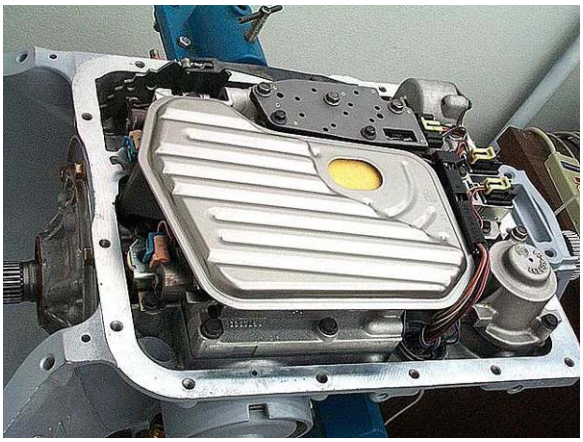




Step 52: Install the manual lever detent spring and bolt.

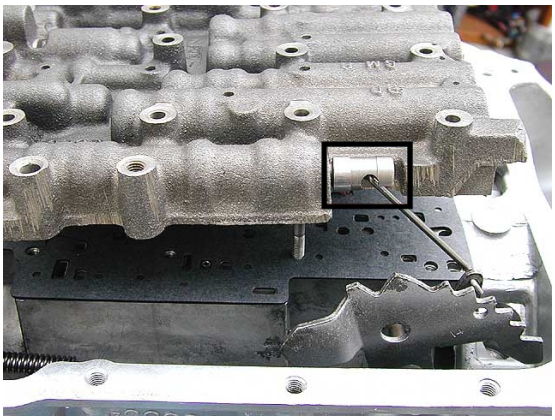


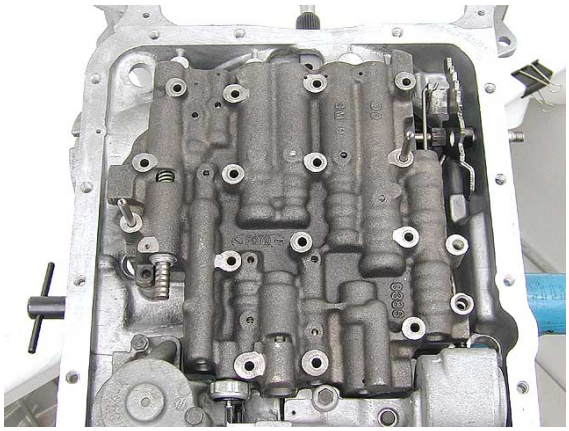
Step 53: Coat the neck of a new filter with assembly lube and install the filter.



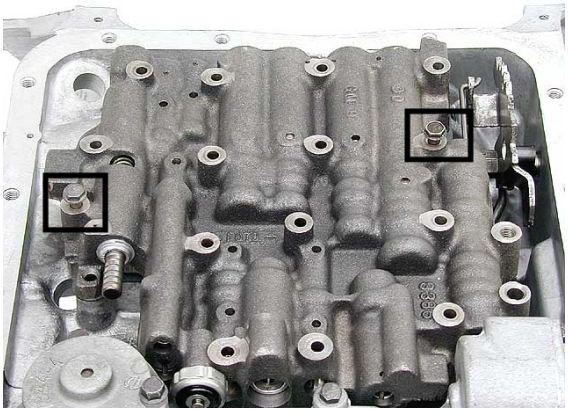
IMPORTANT: 4L60E- Skip ahead to Step 63.

Step 54: Carefully lower the valve body onto the case. You must guide the free end of the manual valve link into position in the end of the manual valve along the way.

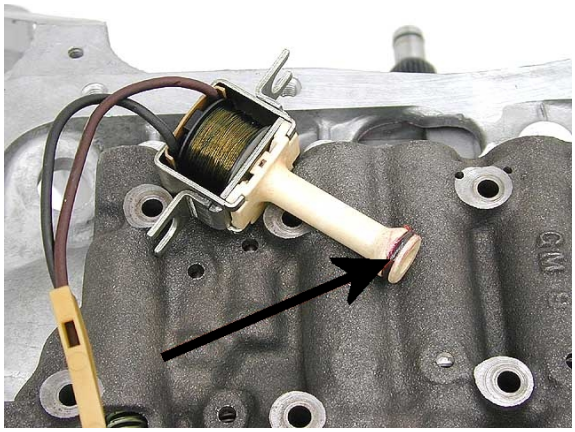


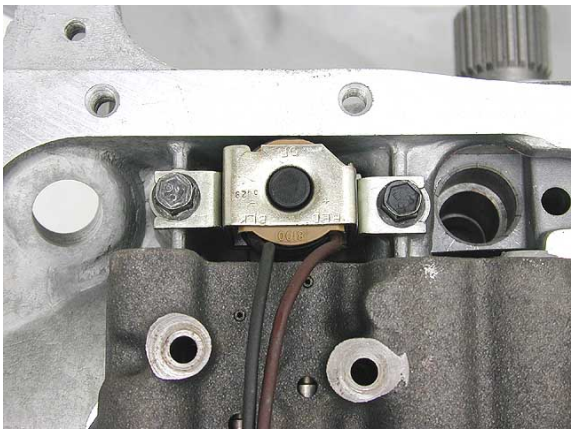


Step 55: Remove the alignment pins, replacing them with regular valve body bolts, but leave the bolts loose for now.



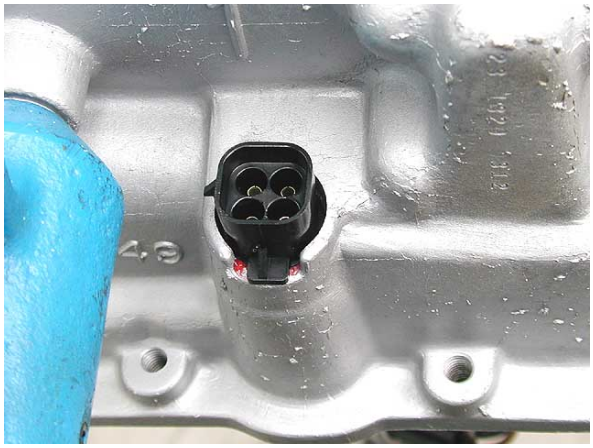
Step 56: Place a new o-ring on the end of the TCC solenoid. Install the solenoid, making sure that the wires aim toward the valve body. Tighten the bolts good and snug.



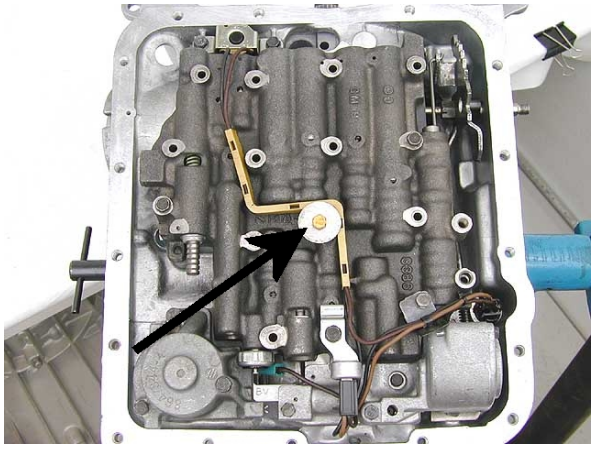


NOTE: Some model valve bodies have a TCC switch that may interfere with tightening the solenoid bolts. Lift the valve body a little bit to gain access to the bolts with a wrench.

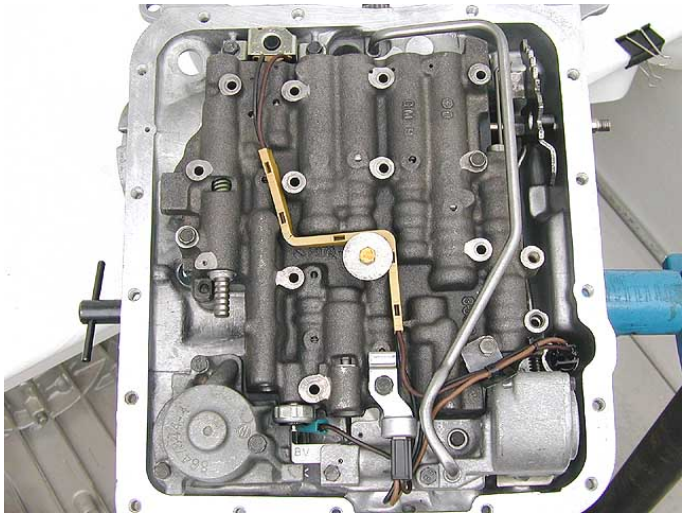
Step 57: Place a new o-ring on the case connector. Place the case connector end of the solenoid wiring harness through the case connector hole to the outside of the case. Connect the harness to the connector, coat the connector o-ring with assembly lube, then press the connector into the case hole, lining up the connector tab with the slot in the case hole.

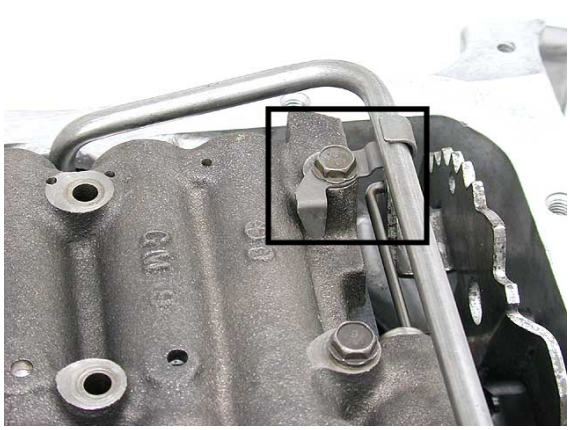


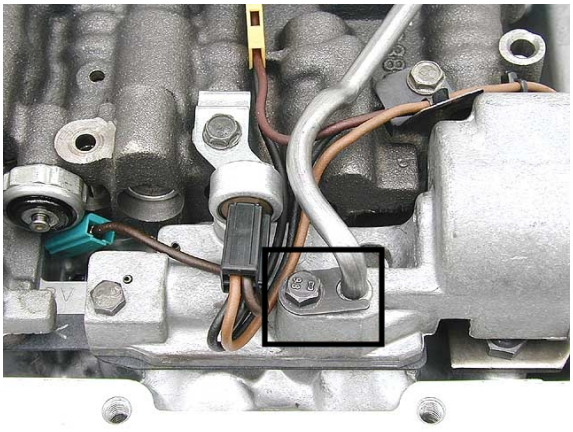
Step 58: Lay out the solenoid wiring harness and switches into the correct position over the valve body, and place valve body bolts through any hold-down brackets. Don't forget the big hold-down washer that goes near the middle of the valve body.



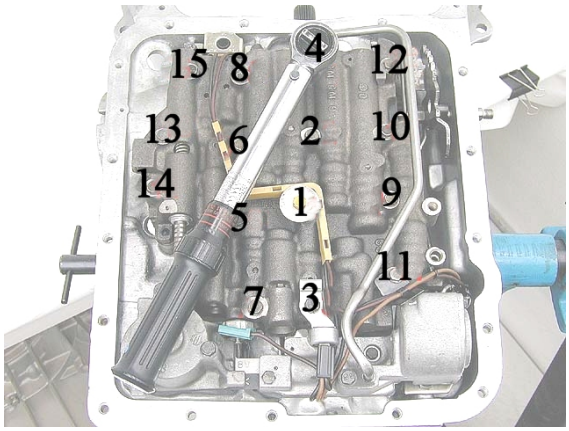
Step 59: Install the auxiliary valve body tube and the two tube hold-down brackets.





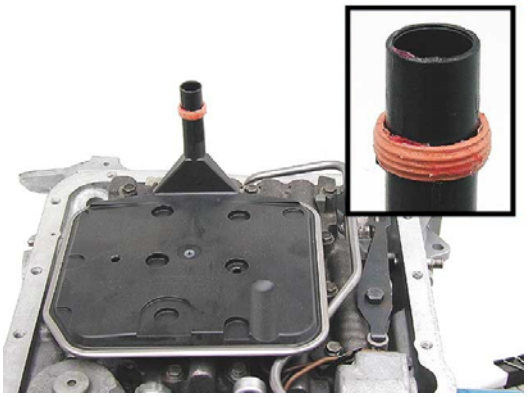


Step 60: Install all remaining valve body bolts. The two bolts that hold the TV lever may not have come to your bench with the unit, since they are usually removed during transmission removal. If this is the case, temporarily use two additional bolts to fill all valve body bolt holes. If the TV lever and bolts came with your unit, install the lever and bolts at this time. Torque all valve body bolts and the loose auxiliary valve body bolt to 8 ft-lbs. in the pattern shown. Repeat the pattern at least once to assure proper gasket crush. If your unit came without the TV lever, remove the two lever bolts.



Step 61: Connect any switches that still need to be hooked up, then install the manual lever detent spring and tighten the bolt good and snug.

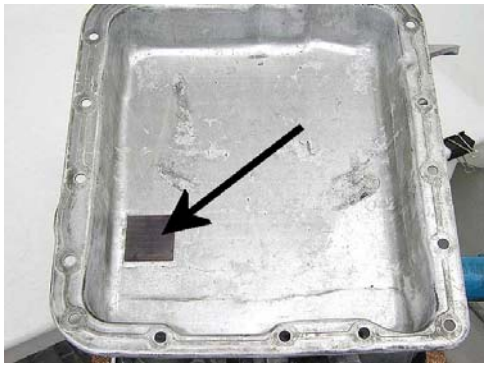
Step 62: Place a new filter ribbed seal on the neck of a new filter. Coat the seal with assembly lube, then install the filter.

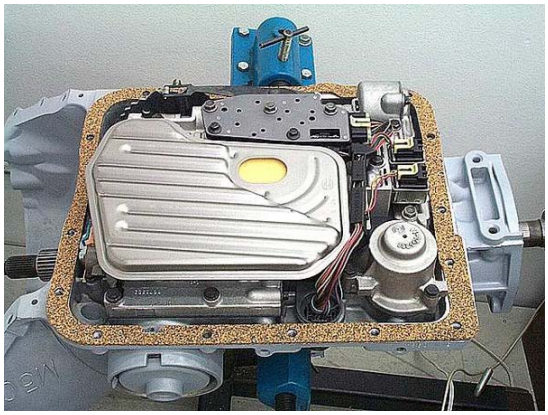


Step 63: Place the magnet in the correct position in the pan. Install a new pan gasket on the case pan rail, then lower the pan onto the pan rail.

4L60E- Start *all* pan bolts into their holes before tightening any of them. Torque the pan bolts to 9 ft-lbs. Repeat the torque pattern at least once to assure proper bolt tightness. The bolts relax after they are all tightened the first time.

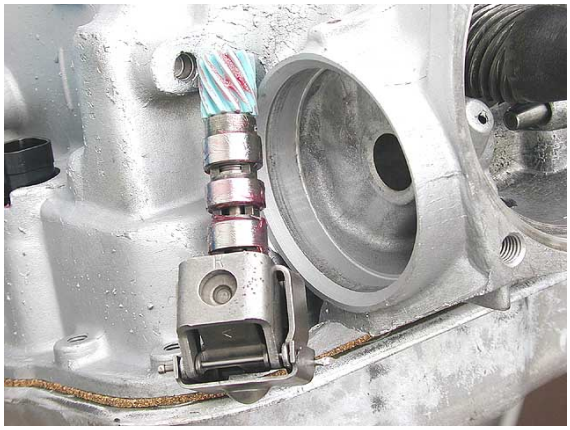
4L60- Install two pan bolts and hand tighten them, since the installer will be removing the pan to hook up the TV cable.



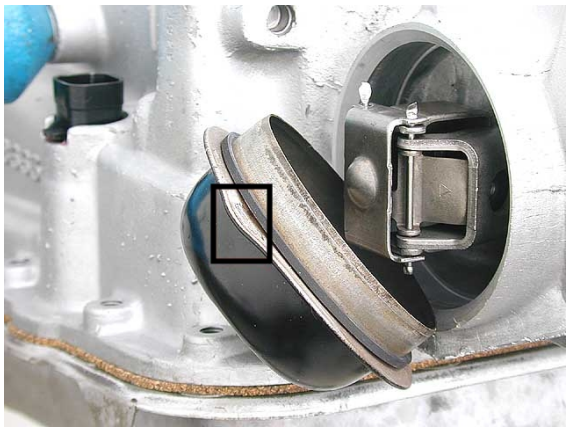


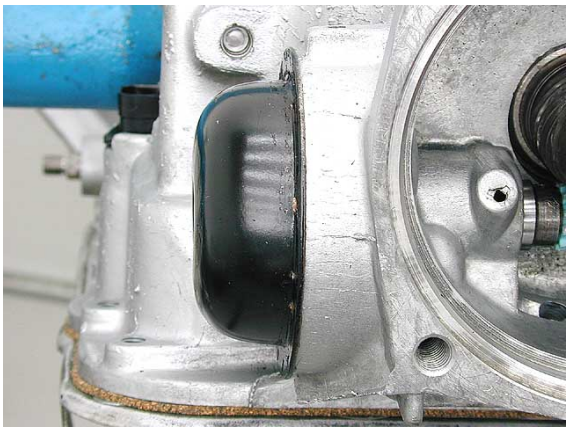
IMPORTANT: 4L60E- Skip ahead to Step 67.

Step 64: Coat the governor shaft with assembly lube and install the governor into the governor bore.

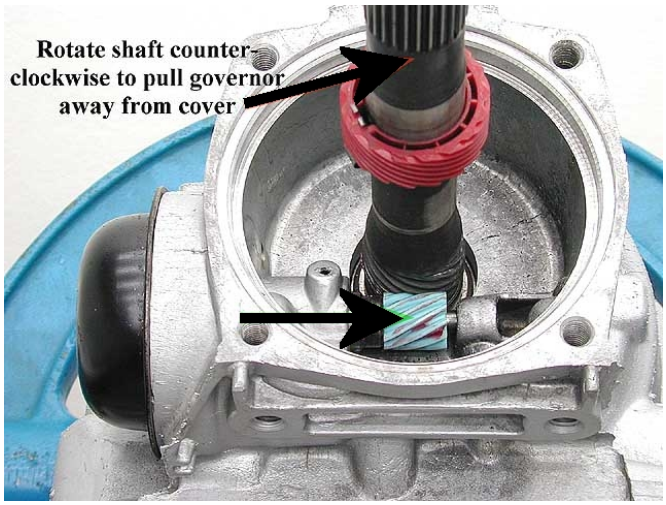


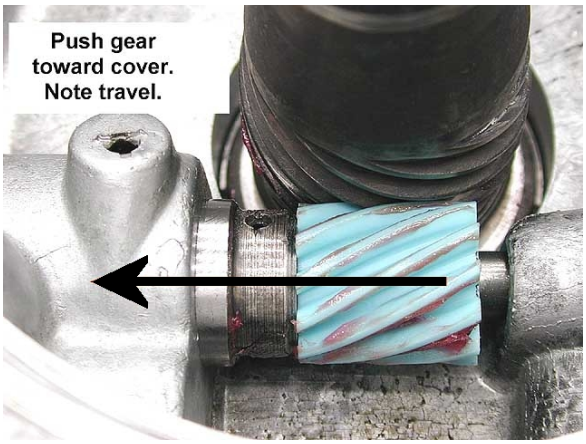
Step 65: Place a new lathe-cut seal on the governor cover. Install the cover onto the case, making sure that any removal dents on the cover flange are aiming toward the rear of the case. Gently tap the cover into position with a hammer until it fully seals against the case. Use a large punch or a socket extension to bang any dents on the flange flat.

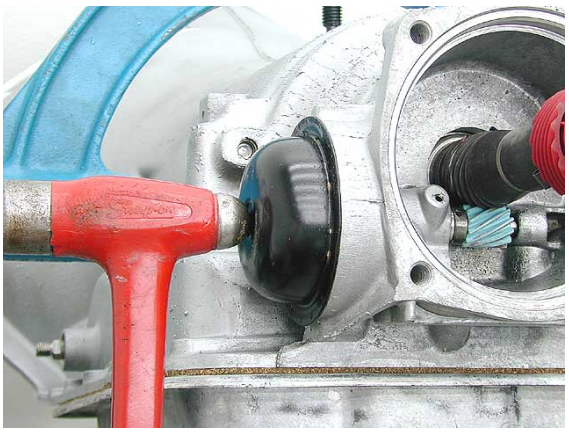




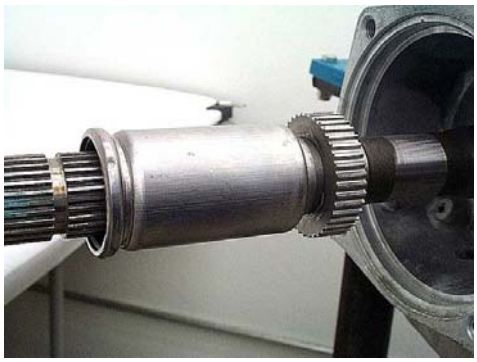
Step 66: To set governor end play, rotate the output shaft counter-clockwise as viewed from the rear of the case. This pulls the governor into the case, away from the cover. Now push the governor gear toward the cover. There should be less than 1/8" governor travel. If there is excessive travel, rotate the output shaft to pull the governor away from the cover again, then tap on the center of the cover to dent it in a bit. Check the travel again, and repeat the adjustment until the proper endplay is observed.







Step 67: If you remove the speedometer drive gear from a 4L60, install lit at this time. Then install a new o-ring into the output shaft sleeve (if equipped). Slide the output shaft sleeve into place on the output shaft.



Step 68: Install a new lathe-cut seal on the extension housing if one hasn't already been installed. Make sure that the extension housing's speed sensor or speedometer cable adapter hole is aimed toward the same side of the case that the manual shaft is on, then tap the extension housing into place on the back of the case. Torque the four housing bolts to 26 ft-lbs.

Step 69: Put a new o-ring on the output speed sensor, then slide the sensor into the extension housing and tighten the sensor bolt to 8 ft-lbs.

If the unit came to you with a range sensor and/or an external shift lever bolted to the manual shaft, install them now. Transmission assembly is now complete.