

Rebuilding The FS5W71 5-Speed Transmission

The first of a two-part series detailing the disassembly, inspection, and reassembly of the most common L-series 5-speed transmission.

by Derek Garnier

This article will take you step by step through the rebuild procedure for the FS5W71 transmission. We'll cover a few real-world tips not mentioned in the factory service manual. You will also get instructions for building critical service tools as well as information on where to obtain these tools if you do not wish to build your own. Download all diagrams at <http://datsun510.com/downloads/FS5W71.zip>

Before we start, we need to address safety. We'll be working under the car with cumbersome components encrusted with dirt, grease, oil, and other chemicals. It is imperative to follow proper safety guidelines. Most of you will be working on your car in a garage without a lift. Only raise the car on a flat, level surface. If only raising the front end, place wheel chocks behind the rear wheels before raising the front of the car, then support the front of the car on jack stands. If raising both the front and

the rear of the car, chock the rear wheels, elevate and support the front, then elevate and support the rear. Jack stands should only be used on the front crossmember at the front and on the rear crossmember at the rear. Do not use jack stands on the stock body jacking points or any movable suspension component. Make sure the front and rear suspension arms do not interfere with jack stand placement.

Wear eye protection. The debris mentioned above seems to have a knack for finding your nose, mouth, and eyes. If available, use the wrap-around-style eye goggles and not just safety glasses. Debris will come in from the side of glasses that do not have a side shield. Use gloves. The chemicals mentioned above are considered hazardous to handle. Surgical-style gloves are available at all hardware stores. Costco has 150-count boxes for less than \$10. Remember, the only part of your 510 you can't replace

is the driver.

GENERAL INFORMATION

The FS5W71 derives its name from the following naming convention:

(F) - Control type: (F) stands for Floor, referring to the shift lever location

(S) - Style – (S) stands for Special over-drive

(5) - Number of forward gears: (5)

(W) - Synchronizer hub type: (W) stands for Warner synchronizer hubs

(71) - Distance between main and counter shafts (71)mm

(B) - Sequence identification - (A), (B), (C), etc.

The FS5W71 transmission was available in many sequence letters. While we are only interested in the models (B) and (C), the internals are relatively identical throughout the range with exception to the 5th gear synchronizer hub and front and rear cases, based on engine and mounting requirements. Please see the file "Transmission Model Guide.xls" for a listing of transmission types and car models.

TRANSMISSION REMOVAL

There are a few items that can be addressed before the car is ever raised. First and foremost, disconnect the battery. Place the shift lever in neutral and remove the shift lever from inside the car by removing the E-ring and control lever pin that holds the shift lever in place. Close the doors. You don't want to open the doors while the car is raised as any twisting to the car will cause stress on the doors and the doors will become a structural member. Now safely raise the car and place on jack stands.

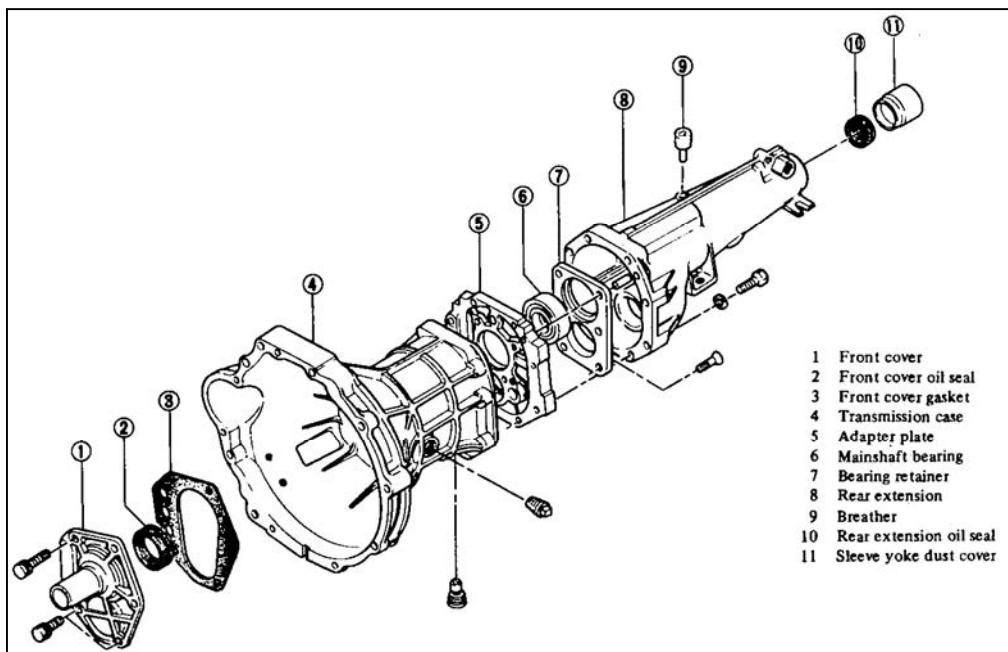


Figure 1—Exploded view of the main components of the FS5W71.

Some of the intermediate steps may be different depending on your engine setup. Dual SU carbureted cars may require the removal of the rear SU for clearance. Dual Weber or Mikuni carbureted cars may require the same. Lever actuated carburetor linkage may need to be removed. I've also found it easier to drain the radiator and loosen the top radiator hose. This alleviates the stress to the radiator and hose as the engine tilts backward. Remove the front left (driver's side) wheel for better access under the car and to provide clearance for sliding out the transmission.

Under the car: Drain the oil from the transmission. Use a 1/2" breaker bar to loosen the plug on the bottom of the transmission. Remove the exhaust tube from the manifold. Spray the bolts with a good dousing of penetrating oil if they are stuck. You do not want to crack or strip a stud. If you have a rear slip joint through the crossmember, this will need to be loosened along with the mounting clamp. The exhaust tube will require a couple inches of rear travel in order for the front flange to clear the exhaust manifold studs. If your exhaust is tucked tight to the transmission tunnel or to the crossmember, you will need to completely remove the forward pipe. Mark and disconnect any wires to the transmission switches. The red/black wires are for the reverse lamps, but you may have other wires if your emission control system is still in place. Disconnect the speedometer cable. If the knurled nut is too tight, it should accept an open-ended 19mm wrench across its flats. Remove the clutch slave cylinder. This should be held on by two 14mm-headed bolts. Make sure the clutch slave does not come apart or the piston may fall out, releasing all the clutch fluid onto the ground (or onto you). Rather than allowing the slave cylinder to hang freely, I place mine on the steering center link to support the weight and to keep it out of the way. Remove the parking brake adjustment connection at the rear crossmember as it interferes with pulling the driveshaft out. Remove the driveshaft-to-differential flange bolts. Drop the rear of the driveshaft down and pull toward the rear of the car to remove the front of the driveshaft from the transmission splines. A small amount of oil will start to drip from the tail of the transmission, so place a catch vessel under it. Remove the cables from the starter and remove the starter. Remove the lower dust shield bolts at the front, bottom of the transmission. Place a jack under the center of

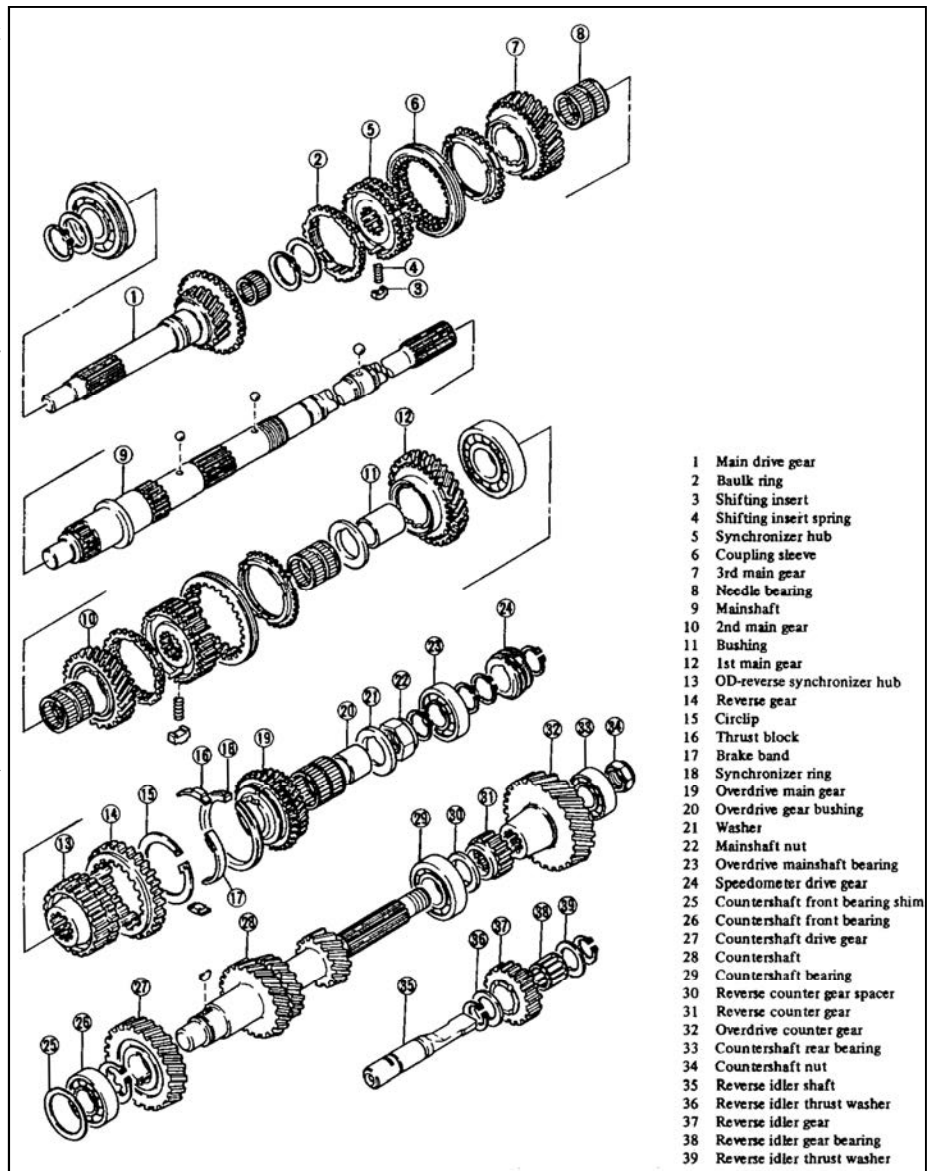


Figure 2—Exploded view of the FS5W71 main and countershafts, including gears, synchronizers, and bearings.

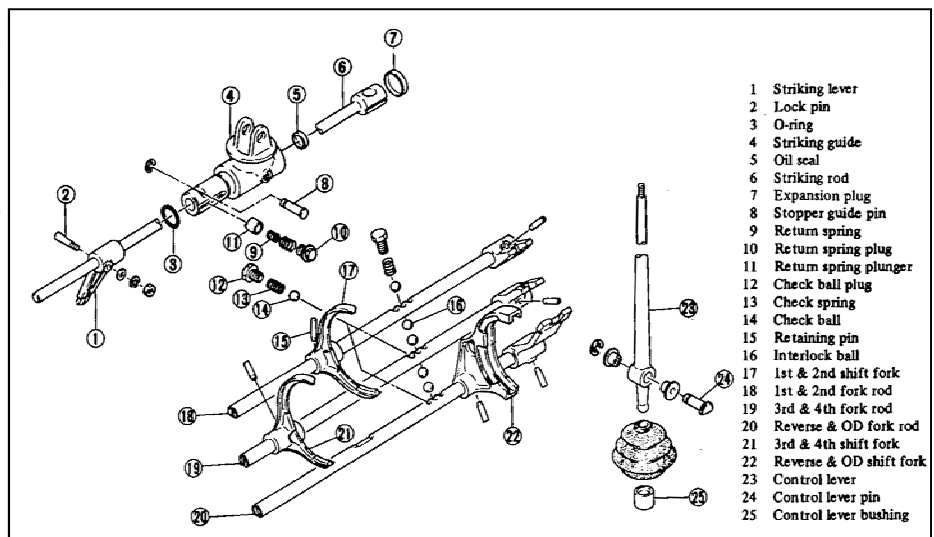


Figure 3—Exploded view of the shifter and gear selector forks.

the transmission. This is where most of the weight is carried. If you have two jacks, place a jack under the rear of the engine oil pan to support the engine. Remove the transmission crossmember bolts from the transmission mount by unscrewing the two 12mm-headed bolts. Now remove the bolts on each side of the transmission crossmember securing it to the car body. When you lower the rear of the transmission, more oil is going to come out. Slowly lower the jack under the transmission. If you placed a second jack under the engine, you will have to coordinate lowering both. When all the oil has been drained from the rear of the transmission, wrap a plastic bag over the end to keep oil drips from getting all over your work space. Now remove the four bolts holding the transmission to the engine. I find it easiest to get the top bolts using two 12" extensions and a swivel joint. You can also reach your hands up around the transmission, but the extensions make the ratchet movement easier. At this point, the transmission is ready to pull, but you will probably need to use a bit of muscle to move it toward the rear of the car. Once the input shaft clears the pressure plate, lower the jack under the transmission. If you have the room, you can now move the jack and transmission out from

under the car. I never have that much room, so I place the front of the transmission on the floor and lift the tail away from the jack, then slide the unit out with the bellhousing coming out by the wheel well (Photo 1). Now, completely clean your work area. Most likely you have spilled some fluid and have tools scattered about. A clean work area will make it easier to find those tiny transmission internal components if you drop any.

CASE DISASSEMBLY

Refer to Figures 1, 2, and 3 for all detail during disassembly and reassembly.

Place the transmission onto your work surface. Remember, lift with your legs, not with your back. Wipe off any dirt, oil, and grime. Look at the inside of the bellhousing and input shaft. Is there fluid inside the bellhousing? If so, you need to identify the fluid before proceeding. Gear oil is the sign of a bad gasket or seal. Antifreeze is the sign a bad rear freeze plug. Engine oil is the sign of either a bad rear crankshaft seal or a leak elsewhere finding its way into the bellhousing. Water may just be condensation or picked up from the road. If you have another problem with your car, now is the time to fix it.

Remove the front dust cover where the throw out bearing fork sticks through the bellhousing. If you are missing one, add it to your list of parts to buy. Reach inside the bellhousing and pull the throw out bearing and fork toward the front to release both (Photo 2). There is a small spring clip on the fork that holds it to the ball pivot on the front bearing plate. Make sure this spring clip is not broken. Check the condition of the throw out bearing and decide if it needs replacement. It should be firm, but turn without grinding or notching. At this point I place the transmission face down on a pair of 2 x 4 pieces of wood. This raises the transmission so it does not rest on the input shaft (Photo 3). Remove all electrical switches. It's a good idea to make notes or take pictures of the switches and their locations. Place marked tape around the switches when removed with position numbers. Our transmission has four electrical switches and knowing which ones connect to which wires and where they are placed is important. If the gear moved away from neutral, shift the transmission back to neutral by placing the shift lever and pin back in place. Remove the speedometer drive hold-down tab and the speedometer. If the speedometer is stuck, using a wide flathead screwdriver,



Photo 2—Bellhousing of the FS5W71, including the input shaft, throw out bearing, and clutch fork.



Photo 4—Tailshaft case section removed, exposing some of the internal transmission gears.

gently insert the tip into the hold-down slot and pry against the tail housing for leverage. Remove the striking rod E-ring and stopper guide pin (Figure 3, Part 8) from the rear end of the tail housing. This is the pin at the top of the tail housing directly in front of the striking guide (Figure 3, Part 4). Remove the return spring plug, return spring, reverse check spring, and plunger (Figure 3, Parts 9, 10, & 11) from rear extension. There may only be a single spring, depending on your transmission. Remove the eight (8) bolts securing the rear extension housing (Figure 1, Part 8) and turn the striking guide (Figure 3, Part 4) toward the left (as viewed from the rear of the transmission). Drive the rear extension housing backward by tapping with a soft-face mallet. Any sealant will be holding the housing tight to the adapter plate (Figure 1, Part 5). Use the mallet against the transmission mount casting for leverage. Photo 4 shows the transmission internals with the rear extension housing removed.

Set the transmission back down on your work surface. Remove the front cover securing bolts and remove the front cover (Figure 1, Part 1). You'll find this easier said than done. Any sealant will be holding the front cover to transmission case (Figure 1, Part 4). I used a brass drift through the throw out bearing fork cutout with a mallet to break the

seal. Use caution as you do not want to strike the front cover any more than necessary to break the seal. You can damage the transmission case or input shaft if you strike it too firmly. When you remove the front cover, the countershaft front bearing shim (Figure 2, Part 25) will either come with it or drop out. Do not lose it. I safety wire these parts together and set aside (Photo 5). Remove the main drive bearing ring from the input shaft bearing using bladed snap ring pliers or an expander. In a pinch, you can expand the ring using external snap ring pliers, but beware there are no holes in this ring for the snap ring pliers pins to engage. Separate the transmission case from the adapter plate using a soft mallet. You should be able to strike the bellhousing in a forward motion. Now place the adapter plate in a suitable holding fixture and place both in your vise, with the countershaft (Figure 2, Part 28) on top and facing away from you. No holding fixture? No problem. See the file "Custom Tools.pdf" for instructions and pictures on how to make a simple holding fixture.

GEAR DISASSEMBLY

Using a pin punch, drive out the roll pins (Figure 3, Part 15) holding the shift rod forks (Figure 3, Parts 17, 21, & 22 – Photo 6). Do not remove the roll pins holding the shift gates to the end of the

shift rods (Figure 3, Parts 18, 19, & 20). Remove the check ball plugs, springs, and check balls (Figure 3, Parts 12, 13, & 14). From the left side, your adapter plate will have access to the plugs for the 3rd / 4th gear shift rod and for the 5th / Reverse shift rod, but the 1st / 2nd shift rod will be accessed from the bottom, next to your vise jaws. The plugs are soft, so use a socket on each. When you remove the 1st / 2nd gear plug and spring, the check ball will drop out. Be prepared to catch it or be prepared to crawl around your floor looking for it. Drive out the shift rods by tapping with a soft mallet. All of the check balls will now be loose and ready to drop out. Your best defense is a good offense. Using a piece of wire, force each ball into the shift rod bore and remove (Photo 7). There are a total of three check balls and four interlock balls (Figure 3, Part 16). Set the plugs, springs, and balls aside in a sealed bag or container.

The gears should be in a neutral position (Photo 8). This means the 1st / 2nd and 3rd / 4th synchronizer hub coupling sleeve (Figure 2, Part 6) will be disengaged. Double engage the gears by moving the 1st / 2nd coupling sleeve and the 3rd / 4th coupling sleeve forward or rearward to engage each gear. You will feel the coupling sleeve snap into place. With both coupling sleeves engaged, the input shaft, main shaft, and countershaft can-



Photo 8—Gearset shown here in neutral.

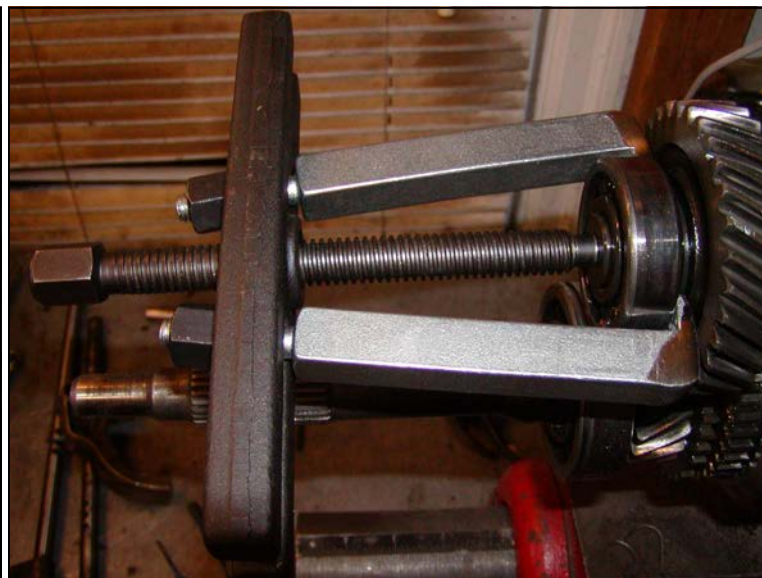


Photo 9—Showing the positioning of the gear puller, beginning with the countershaft front bearing.

not rotate. Engagement of 5th /Reverse is not necessary. Spin the vise around so the input shaft now faces you. Using a gear puller, remove the countershaft front bearing (Figure 2, Part 26 - Photo 9). Remove the counter drive gear snap ring. Position a puller onto the counter drive gear (Figure 2, Part 27 - Photo 10). Heat the counter drive gear hub with a torch and slowly crank the puller to remove the counter gear (Photo 11). If you compare Photo 10 to Photo 11, you will notice the puller has changed. I did not use heat with the first puller and cracked the puller. This gear is on solid. As you remove the counter gear, the main drive gear (input shaft - Figure 2, Part 1) will also come off. Be sure you are able to keep it from dropping. Also beware the needle bearings will most likely come off with it. Remove the two opposing woodruff keys supporting the counter gear (Photo 12). Photo 13 shows the shafts with counter drive gear and main drive gear removed.

Spin the vise around again so the tail of the mainshaft is facing you. Remove snap ring from the tail of the mainshaft next to the speedometer gear. Remove the speedometer gear (Figure 2, Part 24). Be prepared to catch the check ball below the speedometer gear. Remove the second snap ring after the speedometer

gear. Remove the snap ring, overdrive mainshaft bearing (Figure 2, Part 23), and second snapping. Gently pry up the staking on the main shaft nut (Figure 2, Part 22) so any bent part of the staking is above the level of the threads on the mainshaft. Make sure you do not destroy the staking or the nut as they are getting very hard to find and you may end up having to use it again. Loosen the mainshaft nut. The mainshaft nut is right-hand thread for transmissions 3/79 and earlier. The mainshaft nut is left-hand thread for transmissions 4/79 and later. Use the factory plate tool, a pipe wrench, or make the 19" deep 1-1/2" socket we use by following the instructions in the file "Custom Tools.pdf" in the Zip file. Most likely, if your transmission is right-hand thread, the nut will have worked itself loose and will be finger tight. This is common and the reason Nissan switched to left-hand thread. Pry up the staking on the countershaft nut (Figure 2, Part 34). I found this incredibly difficult and instead used a die grinder to carefully grind away the staking, while taking care not to damage the slot in the shaft or the threads (Photo 14). You can use a hand file and file the staking to a very thin point, and then pry up the staking without fear of damaging the countershaft. Once staking is pried

or removed, loosen and remove the countershaft nut. Using a gear puller, remove the overdrive counter gear (Figure 2, Part 32) and countershaft rear bearing (Figure 2, Part 33). The reverse counter gear (Figure 2, Part 31) will most likely come off with the overdrive counter gear (Photo 15). Remove the reverse counter gear spacer (Figure 2, Part 30).

Spin the vise around again so the tail of the mainshaft is away from you. Disengage the synchronizer hub coupling sleeves by moving them back to their neutral position. Remove the snap ring and thrust washer from the front of the mainshaft. Now remove the 3rd /4th gear synchronizer hub assembly (Figure 2, Parts 2 - 8) as an assembly and set aside. Spin the vise around again so the tail of the mainshaft is facing you. Tap out the countershaft (Figure 2, Part 28) using a soft mallet and set aside. Using the strongest pair of snap ring pliers, remove the reverse idler snap ring from the reverse idler shaft (Figure 2, Part 35). This is the thickest, most difficult snap ring I've encountered, second only to turbochargers, so take care to use the correct tool to remove. Remove the spacers, reverse idler gear, and needle bearings (Figure 2, Parts 36 - 39). You do not need to remove the second thick snap

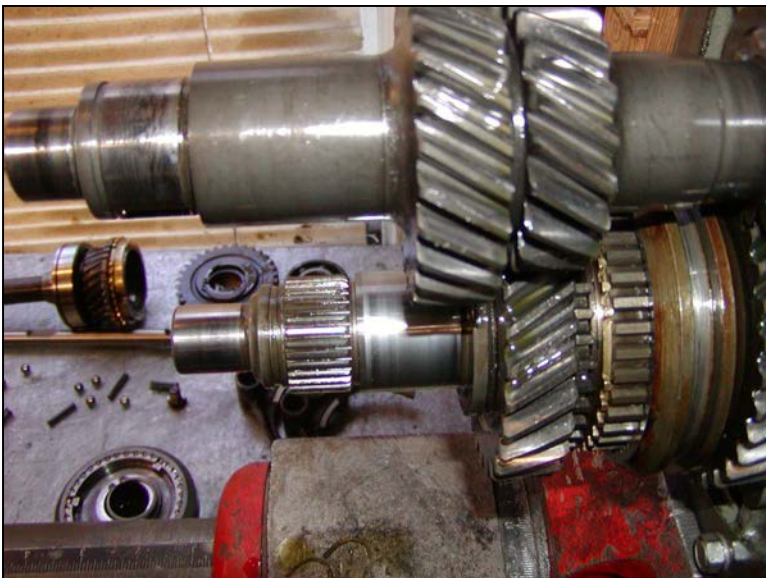


Photo 13—Transmission shafts shown here with counter drive gear and main drive gear removed.



Photo 14—Countershaft nut staking removed, here using a die grinder. Ensure no damage to the shaft or

ring from the reverse idler shaft. Remove mainshaft nut thrust washer, mainshaft reverse gear OD synchronizer, and overdrive gear (Figure 2, Parts 13 – 21 including unnumbered parts). Be prepared to catch the locating ball under the mainshaft nut thrust washer. Remove the mainshaft by tapping with a soft mallet while holding the front mainshaft gear assembly. Note, there is another locating ball under the thrust washer directly in front of the main bearing assembly. Be prepared to catch the locating ball. Remove the hub and gear assembly (Figure 2, Parts 10 – 21 including unnumbered parts) from the mainshaft by sliding the assembly toward the rear of the mainshaft. Your adapter plate will now be almost bare (Photo 16). Using a Torx T40 socket, remove the six (6) screws holding the bearing retainer (Figure 1, Part 7) to the adapter plate. Now remove the reverse idler shaft, noting the notch in the shaft and how it engaged the bearing retainer. Remove the mainshaft bearing (Figure 1, Part 6) and the countershaft bearing by tapping with a soft mallet.

We will not be disassembling the tail housing section, other than removing the old oil seal and installing a new one.

COMPONENT DISASSEMBLY

The 3rd/4th gear and 1st/2nd gear synchronizer hub assembly are almost identical

except the 3rd/4th gear synchronizer hub (Figure 2, Part 5) has a thicker center section on one side. Therefore, it is recommended not to mix up the hub assembly components. Disassembly of these two synchronizer hub assemblies is the same. Place your thumbs on the synchronizer hub (Figure 2, Part 5) and use your fingers to slowly pull the coupling sleeve (Figure 2, Part 6) toward you. Do this over your clean work surface as the shifting inserts (Figure 2, Part 3) and shifting insert springs (Figure 2, Part 4) will fall out.

The OD/Reverse synchronizer hub assembly (Figure 2, Parts 13 – 19) is unique. The FS5W71B and FS5W71C transmissions use a crush-style black fiber ring (Figure 2, Part 18 - synchronizer ring) instead of the traditional shifting inserts and springs. Disassembly of the unit is not necessary for cleaning. If you would like to disassemble the unit for any reason, simply remove the large snap ring to pull the unit apart. If the synchronizer ring is severely damaged, disassembly will be necessary to replace the ring. While reverse functions similar to 1st, 2nd, 3rd, and 4th where the synchronizer hub coupling sleeve slides to engage the baulk ring (Figure 2, Part 2), the 5th gear synchronizer ring works by sliding the reverse gear (Figure 2, Part 14) over the thrust block (Figure 2, Part

16) and brake band (Figure 2, Part 17), thereby directly applying pressure to the synchronizer ring which friction couples to the overdrive main gear (Figure 2, Part 19). The brake band and synchronizer ring take the wear from this friction coupling.

The input shaft assembly can be disassembled by removing the snap ring and washer from the main drive gear (input shaft) and pressing off the bearing (Photo 17). This is our last part for disassembly as we will not be disassembling the tail housing.

Clean the tail housing, adapter plate, and case (bellhousing) spotless with a degreaser. Do not sand or media blast the adapter plate as it will destroy the machined surfaces. Make sure you remove all sealant from each part. Use a razor blade, but do not use a wire brush or sand paper. Clean parts in clusters in order to keep components together, and then set aside in labeled bags or containers.

PART I WRAP UP

At this point the transmission has been completely disassembled. The second part of this series will detail inspecting the parts, ordering new parts, and the reassembly procedure.

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Photo 16—Transmission adapter plate shown mostly disassembled. Remove the bearing retainer plate next.



Photo 17—Positioning shown for pressing off the input shaft bearing.

Rebuilding The FS5W71 5-Speed Transmission

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INSPECTION

General inspection is straightforward. We are looking for score marks on rotating surfaces, chipped or worn teeth on gears, loose or missing needles on needle bearings, and broken springs on the synchronizer hubs.

Photo 18 shows the reverse idler assembly cleaned and laid out for inspection. Notice the shaft still has the inside snap ring in place as there is no reason to remove it. Check the shaft for score marks where the needle bearings are located. The left set of needle bearings came with the rebuild kit. Verify the new needle bearings are well seated in the cage assembly. The loose snap ring should be fine, but verify it has not stretched out of round during disassembly. Check both washers for excessive wear or scoring on the faces which are in direct contact with the reverse idler gear. Now check the reverse idler gear for scoring in the bore

or on either thrust surface. Finally, check the teeth of the reverse idler gear. The teeth should be sharp and not excessively worn. Photo 19 shows a closeup of our reverse idler gear teeth, which are completely knackered. This would explain the grinding into reverse. This gear should be replaced.

Photo 20 shows the 1st/2nd gear synchronizer hub components along with the 1st and 2nd main gears. Verify the needle bearings are well seated in the cage assembly and are not worn or missing. New needle bearings are not included in the rebuild kit, so if these are bad, they must be ordered from Nissan. Check the sleeve for wear on all surfaces. The sleeve rides directly on the mainshaft, separated only by a thin layer of oil. If starved for oil, there may be burn marks or scoring on the inner surface, which would also be evident on the mainshaft. If both are scored, the transmission is probably junk and not worth the cost of

replacement parts. Check the ends of the sleeve and the face of the thrust washer for wear as they are in direct contact. Check the surface of the synchronizer hub for wear where it is also in contact with the sleeve. All parts should show minimal wear and no scoring or gouging. The shifting inserts and shifting insert springs should not be worn or broken. Broken springs can allow the synchronizer hub coupling sleeve to overshift, causing the transmission to stick in gear. Weak or broken springs should be replaced with new springs from Nissan. Check the teeth of the synchronizer hub coupling sleeve on the ends, where they engage the baulk rings. The teeth should have minimal wear. If the teeth are flat on the ends, the coupling sleeve should be replaced. Lastly, check both gears for chipped teeth or flattened areas where the baulk ring aligns the coupling sleeve (arrow points). All should show minimal wear and not be worn flat. Check all surfaces for scoring. Take a small gauge wire and clean out the oil holes leading from the inside of the gear to the teeth. Photo 21 shows 2nd gear, with sharp teeth, minor wear on baulk ring alignment tabs, and no scoring on baulk ring, thrust, or bearing surfaces.

Photo 22 shows the 3rd/4th gear synchronizer hub components along with the 3rd main gear. Also shown are the new brass baulk rings from the transmission kit. Inspect these parts exactly as you inspected the 1st/2nd gear synchronizer hub components. Any worn parts will require replacement from Nissan.

Photo 23 shows the OD/Reverse synchronizer hub components. Parts inspection is the same as above except for the 5th gear synchronizer ring (Figure 2, Part

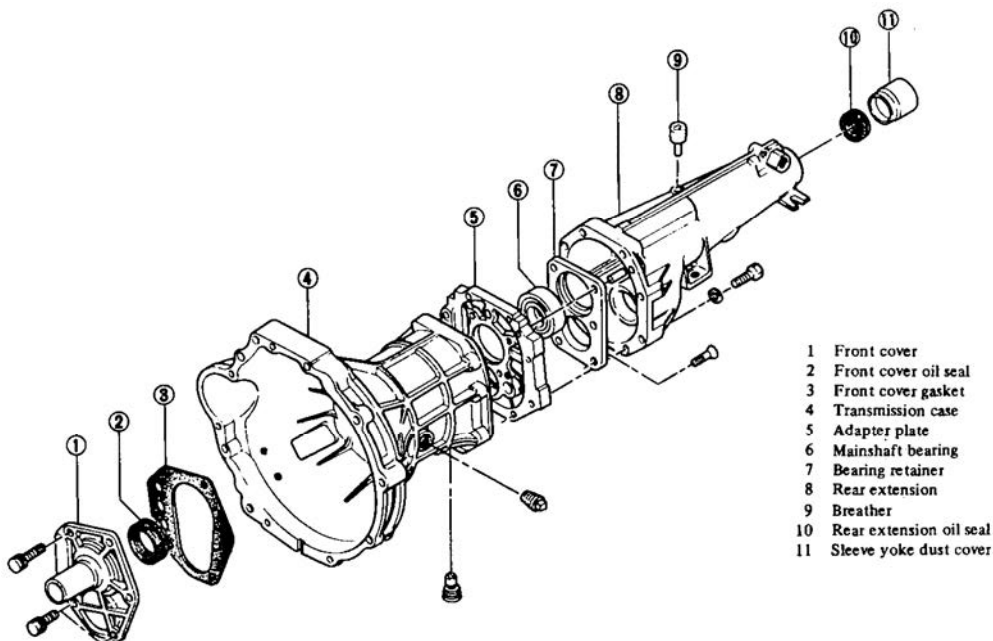


Figure 1—Exploded view of the main components of the FS5W71.

18). This is a fiber ring with a wear surface. If it is severely pitted or if it is missing any part of the fiber, it must be replaced with a new ring from Nissan. Notice also the thrust blocks (Figure 2, Part 16) are stamped with a Mitsubishi logo. Not important, just interesting to note how many manufacturers submitted components. On this synchronizer assembly, 5th gear is also the coupling sleeve that slides between reverse, neutral, and 5th gear when shifting. Photo 24 shows my completely knackered 5th gear. The gear teeth are forced into mesh with the reverse idler gear when shifting into reverse. There is no synchronization of gears utilizing a baulk ring as in the other gears. When your engine is running and you press in the clutch, you must wait a moment before shifting into reverse to allow the shafts to stop spinning or this is what happens. 5th gear on this transmission should also be replaced along with the reverse idler gear.

Photos 25, 26, and 27 are the critical sections of the mainshaft. Photo 25 shows the splines of the tail end of the mainshaft, where the driveline yoke is installed. Use a paper towel and your thumbnail and clean out every single spline. Now inspect the splines to make sure they are sharp and completely straight. Remember all those high-revving clutch sidesteps you do? These splines take part of the abuse and while not prone to twisting or flexing, they still can become malformed. Photo 26 shows the threads for the main nut, journal area, and splines for the OD/Reverse synchronizer hub (Figure 2, Part 13). The threads are rolled and hardened. If they are damaged, you may be out of luck. If they do have damaged areas, do not try to find a die to fix the threads. First off, you won't find one. Second, a die cuts and will damage all the threads. Instead, find a thread repair bar for metric 1.0 pitch threads. Running the bar over damaged threads may straighten them without cutting new threads. The journal areas should be free of any scoring. Bad scoring on the journal may be able to be ground below grade if the scoring is not significant and is localized. The splines should be cleaned and should be straight and sharp. Damaged splines cannot effectively be repaired. Photo 27 shows more journals and splines on the front of the mainshaft. Check as before.

Photo 28 shows the main drive gear (input shaft) and associated components. The new bearing and brass baulk ring are included in the rebuild kit. The spacer and snap ring should not show any

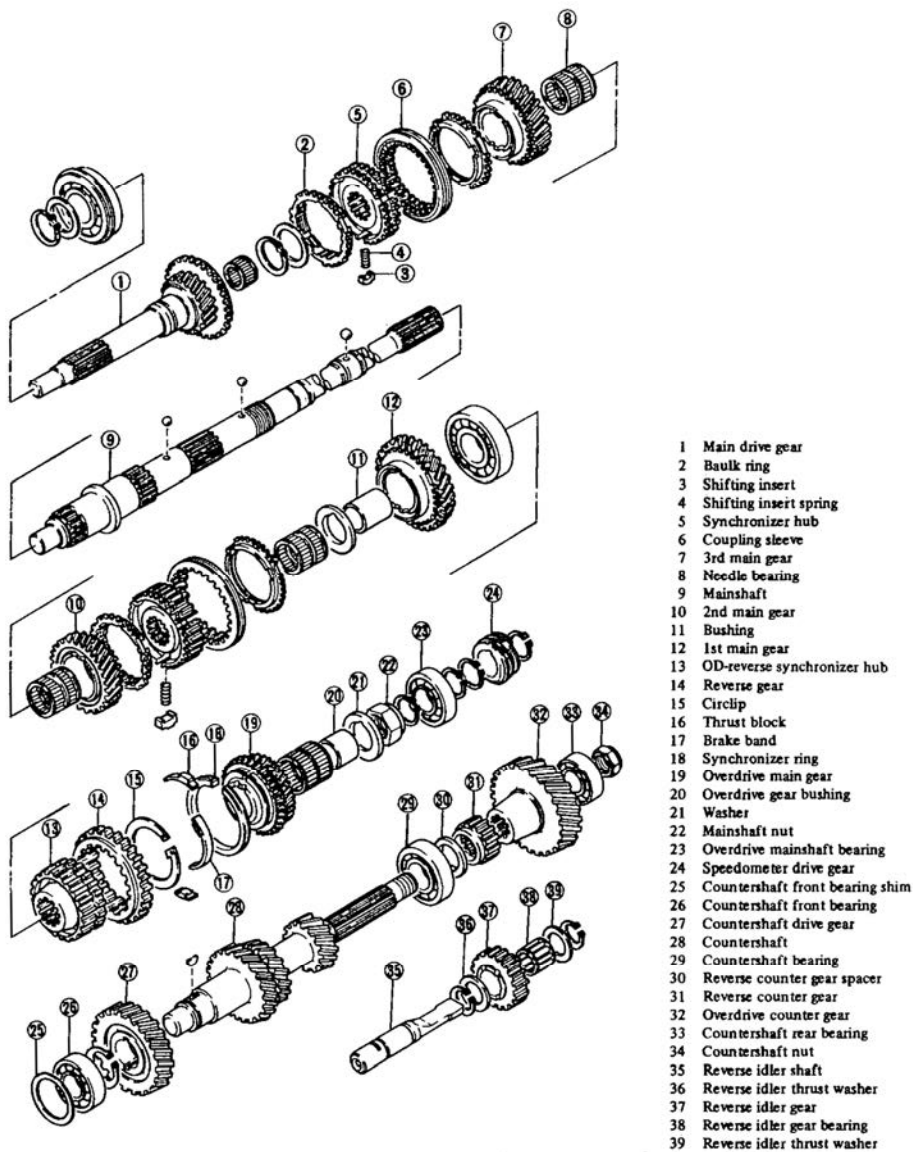


Figure 2—Exploded view of the FS5W71 main and countershafts, including gears, synchronizers, and bearings.

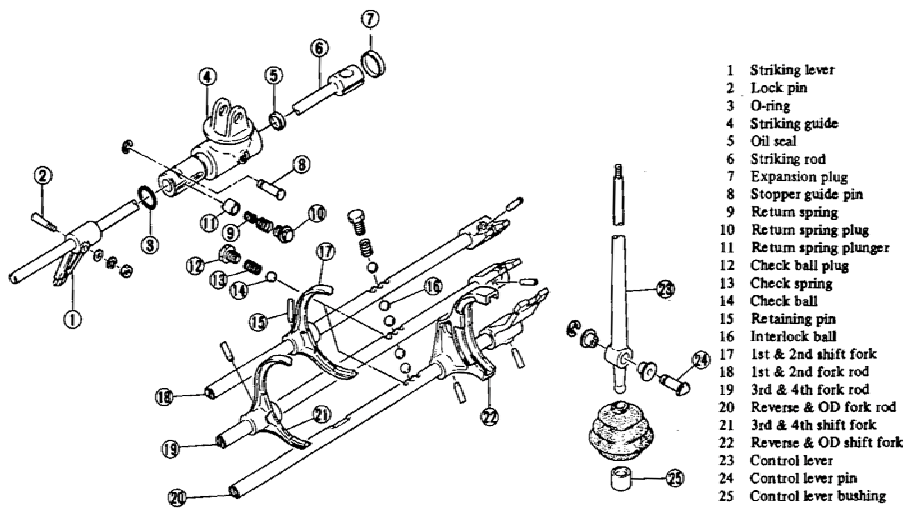


Figure 3—Exploded view of the shifter and gear selector forks.

signs of bending or distortion. Clean the splines of the input shaft thoroughly. Check the splines for any twisting or wear. The input shaft splines are in direct contact with the clutch disk hub. The hub is spring loaded and should buffer the splines from the force of hard launches. Check the tip of the input shaft for excessive wear. This portion rides inside the flywheel bushing. All wear should occur to the bushing inside the flywheel and not to the shaft, but check for scoring or burrs. Check the gear for chipped teeth or flattened areas where the baulk ring aligns with the coupling sleeve (arrow points).

Photo 29 shows the countershaft assembly and all components. New bearings are included in the kit. The new nut came from Nissan. Check all gears as before for chipped teeth. Check the countershaft drive gear (Figure 2, Part 27) for any wear in the slots for the woodruff keys. Check the reverse counter gear (Figure 2, Part 31) and reverse counter gear spacer (Figure 2, Part 30) for wear on the faces. Photo 30 shows light scoring. This surface should be cleaned and a thicker spacing washer used, but in a bind will suffice. Check the countershaft surfaces and gears. The threads should be clean, the splines sharp and straight, and all journal sur-

faces smooth. Check gears for chipping (Photo 31).

ORDER PARTS

At a minimum, you will need a bearing, seal, and gasket kit. At less than \$100 this kit is very cheap insurance. Replacement baulk rings are cheap in the aftermarket, but are expensive through Nissan. In the past, Kelvin Dietz has suggested using aftermarket baulk rings for 1st, 3rd, and 4th and using the stronger, better quality baulk ring from Nissan for 2nd. On this transmission I've decided to use the bearing, seal, gasket, and baulk ring kit from an aftermarket supplier. In addition, I will be using a new countershaft nut from Nissan. My mainshaft nut was in good condition, so I will be reusing it. Although both 5th gear and the reverse idler are bad, I will not be replacing either as this is my own transmission and I'd rather just pause before pulling the shifter into neutral than spending \$200 on replacements. See the document "Extra Data.doc" or "Extra Data.mht" in the Zip file for part numbers, prices, and ordering information. Photo 32 shows my initial kit, complete with an extra baulk ring that doesn't belong to my transmission.

ADAPTER PLATE ASSEMBLY

Press a new mainshaft bearing (Figure 1, Part 6) into the adapter plate (Figure 1, Part 5). If using a mallet, make sure you only tap the bearing outer race and not the inner race. Place the adapter plate back in the holding fixture and place in your vise. Insert the reverse idler shaft (Figure 2, Part 35), aligning the slot in the shaft with the indent in the bearing retainer (Figure 1, Part 7). Install the bearing retainer bolts and, using a T40 Torx driver in an alternating pattern, torque each to 14 to 18 ft. lbs. (Photo 33). Now stake the bearing retainer bolts. The easiest way to stake the bolts is to use a center punch and tap the bolt where it just meets the adapter plate. Press countershaft bearing (Figure 2, Part 29) into adapter plate. If using a soft mallet, only tap the outer bearing race and not the bearing inner race (Photo 34).

GEAR ASSEMBLY

We'll be installing the 1st/2nd gear assembly (Photo 35) into the mainshaft. Assemble the 1st/2nd gear synchronizer hub assembly. Assembly of the 1st/2nd gear and 3rd/4th gear synchronizer hubs is the same. Place the coupling sleeve (Figure 2, Part 6) flat on the work surface. Insert the shifting insert springs



Photo 19—Inspection of the reverse idler gear shows extreme wear on the teeth. Replacement is necessary.



Photo 30—Countershaft drive gear face shows light scoring.

(Figure 2, Part 4) into each bore in the synchronizer hub (Figure 2, Part 5). Place the shifting inserts (Figure 2, Part 3) onto the springs and compress with your fingers. Now set the synchronizer hub into the coupling sleeve (Photo 36). Push down gently on the synchronizer hub as you compress each shifting insert. As the synchronizer hub slides into the coupling sleeve, press downward on each shifting insert. The inserts will snap into place inside the coupling sleeve (Photo 37). Take your time and make sure you do not crush a shifting insert spring or press the synchronizer hub in too far before seating the shifting inserts. Apply oil to the journal directly behind the separator cast into the mainshaft (Photo 27). Install the 2nd gear needle bearings onto the journal. Oil the needle bearings and install 2nd gear (Figure 2, Part 10) onto the needle bearings. The surface for the baulk ring faces the rear. Put oil on the baulk ring surface and install the baulk ring. Install the synchronizer hub assembly onto the splines on the mainshaft. Rotate 2nd gear on the mainshaft until the notches in the baulk ring align with the shifting inserts on the synchronizer hub and the synchronizer hub slides down and seats against 2nd gear. Install another baulk ring, engaging the shifting inserts into the slots in the baulk ring. Apply oil to the journal on the mainshaft. Install the bearing

sleeve (Figure 2, Part 11) and apply oil to the outside surface. Install the 1st gear needle bearings and oil them. Install 1st gear (Figure 2, Part 12) over the needle bearings with the front of the gear seated in the baulk ring. The assembly should now look like Photo 38. Locate the ball socket on the mainshaft (Photo 39) and apply a dab of bearing grease. Insert locating ball. Apply oil to the backside of 1st gear and install the thrust washer with the cutout on the inside of the thrust washer over the locating ball. Now we need to install the mainshaft into the adapter plate. Photo 40 shows the first setup I used to install the mainshaft into the adapter plate. While this looks like an OK setup, it actually was not. First, by having the mainshaft above the adapter plate, the entire gear assembly wanted to fall down, possibly dislodging the locating ball. Secondly, I was only supporting the adapter plate, and by extension, only the outer main bearing race, yet the pressure from the press was against the mainshaft, and by extension, to the main bearing inner race. I thought about all this AFTER I had pressed the shaft into place. As a precaution, I disassembled the entire assembly, purchased a new \$16 mainshaft bearing, and started over. Do not use this method as damage to the main bearing can incur. Photo 41 shows the proper setup for installing the mainshaft into the adapter plate. A 24"

piece of 1-1/4" galvanized pipe was purchased from the local hardware store for less than \$10. The pipe was used to apply pressure directly against the mainshaft bearing inner race. By inverting the mainshaft assembly we also avoid the possibility of the gear assembly falling out of place. You can install the mainshaft by using a soft mallet, but I would still suggest to invert the mainshaft assembly and use the mallet against the 1-1/4" piece of galvanized pipe.

Position the rear of the countershaft into the countershaft bearing in the adapter plate. Engage the countershaft gears with the gear cluster on the mainshaft. Press the countershaft into the adapter plate using a 12" piece of 1" galvanized pipe to support the assembly and rest against the countershaft bearing inner race (Photo 42).

Apply oil to the front journal on the mainshaft. Install and oil the 3rd gear needle bearings (Figure 2, Part 8). Install 3rd gear (Figure 2, Part 7) with the baulk ring mating surface facing forward. Apply oil to the baulk ring surface and install the baulk ring. Install the 3rd/4th gear synchronizer hub assembly onto the mainshaft splines, rotating 3rd gear until the shifting inserts engage the slots in the baulk ring. The 3rd/4th gear synchronizer hub assembly is not symmetrical – one side of the hub is thicker than the other. The thicker side of the hub faces



Photo 32—Aftermarket bearing, seal, and gasket kit..

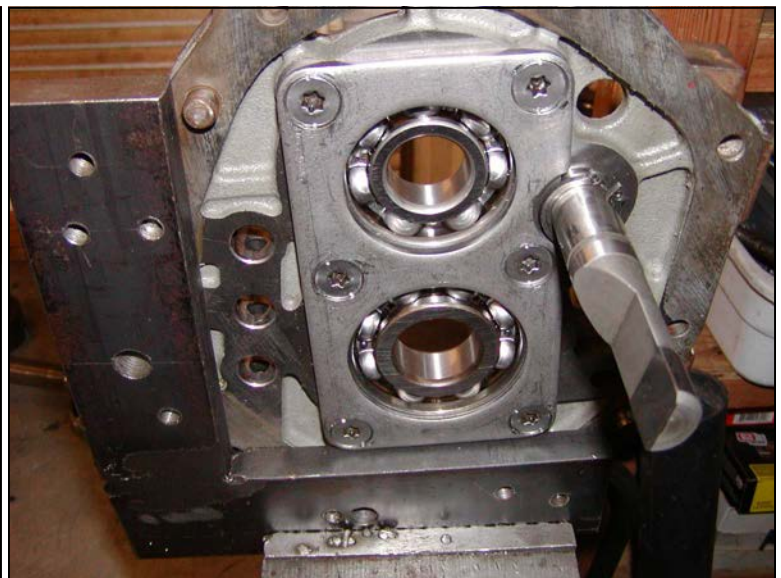


Photo 34—Installation of main and countershaft bearings. Install using pressure on the outer race, not inner.

forward. Next install the thrust washer and snap ring to the front of the assembly. Three thicknesses of snap ring are available. If you have excessive endplay in the 3rd gear assembly, order a snap ring with the amount of end play added to the existing snap ring thickness. Available thicknesses are in the file “Extra Data.doc” or “Extra Data.mht” in the Zip file.

Press a new bearing onto the mainshaft (input shaft). Use the 12” long 1” galvanized pipe to assert pressure only on the bearing inner race. Also make sure the groove in the outside of the outer race is toward the front. Install the main bearing spacer and snap ring. Six thicknesses of snap ring are available. If there is any end play, order a snap ring with the amount of end play added to the existing snap ring thickness. Available thicknesses are in the file “Extra Data.doc” or “Extra Data.mht” in the Zip file.

Apply oil to the front of the mainshaft and install the mainshaft pilot bearing. Apply oil to the baulk ring mating surface on the main drive gear (input shaft) and install baulk ring. Assemble main drive gear assembly onto the front end of the mainshaft. Install the woodruff keys into the slots on the front of the countershaft. Install the countershaft

drive gear (Figure 2, Part 27) onto the front of the countershaft, over the woodruff keys. The countershaft drive gear has a thicker middle section that faces the rear of the transmission. Most likely you will need to move the main drive gear bearing (Photo 43). Press the countershaft drive gear onto the countershaft using the 12” long 1” galvanized pipe to support the adapter plate assembly and apply pressure against the countershaft bearing in the adapter plate. Use a piece of 2” pipe against the countershaft drive gear (Photo 44). Install snap ring to the front of the countershaft. If there is any end play between the countershaft drive gear and the snap ring, order a snap ring with the amount of end play added to the existing snap ring thickness. Available thicknesses are in the file “Extra Data.doc” or “Extra Data.mht” in the Zip file. Press the countershaft front bearing (Figure 2, Part 26) onto the front of the countershaft.

At the rear of the adapter plate, install the reverse idler thrust washer (Figure 2, Part 36) onto the reverse idler shaft. Apply oil to the idler shaft and install the reverse idler gear bearing (Figure 2, Part 38). Apply oil to the bearing and install

the reverse idler gear (Figure 2, Part 37) with knackered teeth facing the rear of the transmission. Install the other thrust washer (Figure 2, Part 39) and excessively thick snap ring.

Install the reverse counter gear spacer (Figure 2, Part 30) onto the countershaft. Install the reverse counter gear (Figure 2, Part 31) onto the countershaft with the longer hub section facing forward.

Install the OD/Reverse synchronizer hub (Figure 2, Part 13) onto the mainshaft with the longer hub section facing forward (Photo 45). Assemble the OD/Reverse synchronizer assembly. The anchor block and thrust block (Figure 2, Part 16) are 180 degrees apart with the brake bands (Figure 2, Part 17) between them. The black fiber synchronizer ring (Figure 2, Part 18) fits over this assembly with the ends of the synchronizer ring meeting the top of the thrust block. The circlip (Figure 2, Part 15) holds the entire assembly together. Install the reverse gear (Figure 2, Part 14) over the end of the OD/Reverse synchronizer hub, knackered teeth facing forward. Oil the mainshaft journal and install the overdrive gear bushing (Figure 2, Part 20). Oil the bushing and install the needle bearings. Oil the needle bearings and install the overdrive main gear (Figure 2,



Photo 38—Assembly of the 1st/2nd gear synchronizer hub assembly.

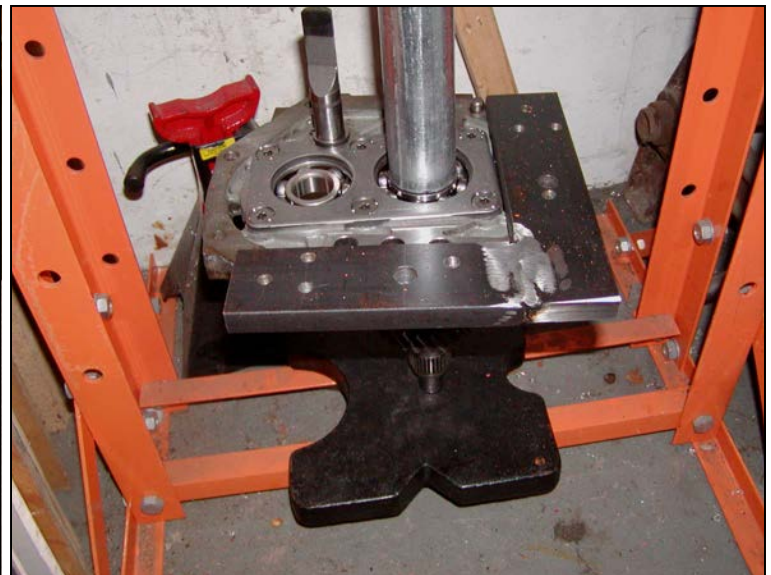


Photo 41—Showing the proper setup for installing the mainshaft into the adapter plate.

Part 19) complete with OD/Reverse synchronizer assembly facing forward. Install the overdrive counter gear (Figure 2, Part 32). Tap on the countershaft rear bearing (Figure 2, Part 33) using a small piece of pipe against the inner bearing race. Install and hand tighten the countershaft nut (Figure 2, Part 34) (Photo 46). On the mainshaft, install the locating ball with a dab of grease and then the washer (Figure 2, Part 21). Install and hand tighten the mainshaft nut (Figure 2, Part 22). Double engage the gears by moving the 1st /2nd coupling sleeve and the 3rd /4th coupling sleeve forward or rearward to engage each gear (Photo 47). Using a 27mm socket, tighten the countershaft nut to 80 ft. lbs. and stake. Using either the factory tool or our 19" deep 1-1/2" socket, tighten the mainshaft nut to 101-103 ft. lbs and stake (Photo 48). As has been pointed out to me by Kelvin Dietz, he usually ends up with the nut 90 degrees past the original point. As you can see from the photo, we've also got the original staking just about 90 degrees past the staking point. I would imagine loss for wear is making the difference. All that is left on the mainshaft is to install the snap ring, overdrive mainshaft bearing (Figure 2, Part 23), snap ring, speedometer drive gear (Figure 2, Part 24), and final snap ring. Disengage the synchronizer hub coupling sleeves by moving

them back to their neutral position.

SHIFT FORK ASSEMBLY

When installing the shift forks and shift fork rods, we have to remember the transmission is upside down. Refer to Figure 3 for a full layout of the shift forks, shift fork rods, and check balls, but remember, the transmission is upside down compared to the drawing. We have to do a choreographed "dance" when installing the forks, rods, and balls as you cannot install all of one, then move onto the next. This means we will be installing forks when there are no rods to secure them and installing check balls before installing each rod. Start by applying oil to the Reverse & OD shift fork (Figure 3, Part 22) and install over Reverse gear (Figure 2, Part 14). Apply oil to the 1st & 2nd fork rod (Figure 3, Part 18). This shows as the top rod in the drawing, but as our transmission is upside down, will become the bottom rod in the adapter plate. Slide the 1st & 2nd fork rod through the lowest of the three shift fork rod holes in the adapter plate and let the Reverse & OD shift fork rest on top of the rod (Photo 49). Apply oil to the 1st & 2nd shift fork (Figure 3, Part 17) and place in the groove on the 1st/2nd gear synchronizer hub coupling sleeve with the long part of the shift fork boss facing rearward. Slide the 1st & 2nd fork rod through the 1st & 2nd shift fork. Ap-

ply oil to the 3rd & 4th shift fork (Figure 3, Part 21) and place in the groove on the 3rd/4th gear synchronizer hub coupling sleeve with the long part of the shift fork boss facing forward. Slide the 1st & 2nd fork rod forward and allow the 3rd & 4th shift fork to rest on the top of the rod (Photo 50). The striking lever (Figure 3, Part 1) gate of the shift fork rod should be facing the 4 o'clock position when viewed from the rear (Photo 51). Apply oil to the interlock ball bore between the bottom and middle shift fork rod bores. Insert two (2) interlock balls (Figure 3, Part 16) into the bore. Apply oil to the 3rd & 4th fork rod (Figure 3, Part 19) and insert through the hole in the Reverse & OD shift fork (Figure 3, Part 22) and then through the fork rod bore in the adapter plate and then through the bore in the 3rd & 4th shift fork (Figure 3, Part 21). The striking lever (Figure 3, Part 1) gate of the shift fork rod should be facing the 4 o'clock position when viewed from the rear (Photo 51). Apply oil to the interlock ball bore between the middle and top shift fork rod bores. Insert two (2) interlock balls (Figure 3, Part 16) into the bore. Apply oil to the Reverse & OD fork rod (Figure 3, Part 20) and insert into the Reverse & OD shift fork (Figure 3, Part 22) and then through the fork rod bore in the adapter plate. The striking lever (Figure 3, Part 1) gate of the shift fork rod should be facing the



Photo 47—Gears shown here are double-engaged to enable tightening of the mainshaft nut.



Photo 51—Striking lever gate of the shift fork rod should be facing the 4 o'clock position, as shown here.

5 o'clock position when viewed from the rear (Photo 51). Photos 51, 52, and 53 show the correct alignments of the shift fork rods and shift forks. Photo 51 does not actually show the shift forks. It was taken with the intent of only showing the correct alignment of the striking lever gates. Apply oil and install the check ball, check spring, and check ball plug (Figure 3, Parts 12 – 14) into each check ball bore and tighten each check ball plug to 14-18 ft. lbs. Drive roll pins back into each shift fork.

With everything assembled on the adapter plate, now is the time to check clearances. The factory clearance specifications for gear end play and backlash are given in the document "Extra Data.doc" or "Extra Data.mht" in the Zip file. There are no photos of this procedure as I did not, and do not, perform it. Why? The end play figures will be correct. You will be using a feeler gauge between gears to check clearance. The problem is, if the end play is too much, the manual advises to purchase an entirely new gear cluster. With decent used transmissions available for \$150 available, I'd rather not spend \$200 in gears. Secondly, I do not believe you can accurately measure backlash with the mainshaft and countershaft not supported on all bearing surfaces. Backlash should be

measured with a dial indicator against gear teeth. If only the adapter plate bearings support the mainshaft and countershaft, there will be movement in each shaft that can be magnified the further you measure away from the bearing. I do not view this as an accurate method of measuring backlash. A proper method would be to cut the front off a bell housing and use the surface supporting the input shaft bearing and the countershaft front bearing at their factory set distances from one another. Such a rig would hold the shafts firm at the front as well as at the adapter plate. We will make such a device on our next rebuild, but as I am the client for this transmission, the time is not warranted.

FINAL ASSEMBLY

Place the transmission case (Figure 1, Part 4) face down onto two blocks of wood on your work surface. This is to allow clearance for the main drive gear (input shaft). Clean the mating surface of the transmission case. Apply a thin bead of sealant to the mating surface (Photo 54). I used the RTV red as it is temp, gas, and oil resistant. Remove the adapter plate from the vise and gently lay it on your work surface. Do not allow it to tip forward and apply pressure to the main drive gear (input shaft). Re-

move the holding fixture and clean the front mating surface. Lower the adapter plate into the transmission case, paying attention to align the bearings and shift fork rod ends in their corresponding holes. If you bump one of the shift fork rods, causing it to shift, you can set it back to neutral after you seat the adapter plate. Wipe the rear surface of the adapter plate and apply another thin bead of sealant (Photo 55). Both Photo 54 and 55 show the sealant only on the outside edge of the bolt holes. The sealant was wiped over the entire mating surface prior to assembly. If you only have a bead of sealant on the outside of the bolt holes, transmission fluid can leak from the bolt heads that hold the cases together. Remove the old oil seal from the rear extension housing (figure 1, Part 8). Apply grease to the backside of the new rear extension housing oil seal (Figure 1, Part 10) and press into place. Clean the mating surfaces of the rear extension housing and drop over the adapter plate. Hold the striking guide (Figure 3, Part 4) toward OD/Reverse, but in the neutral position. Once seated, secure the housings through the adapter plate with a bolt in each corner. Now move the striking guide back to center neutral and install the stopper guide pin (Figure 3, Part 8) and control lever as-



Photo 55—Sealant applied to adapter plate, following around the outsides of the bolt holes.



Photo 60—Finished, rebuilt transmission ready to install.

sembly (Figure 3, Parts 23 – 25). Slowly make sure you can shift through the gears (Photo 56). Remember, you do not have the front of the transmission finished, so move gently and slowly, checking to make sure the striking lever is engaging the end of the shift fork rods appropriately. If there is an alignment problem, now is the time to correct it. Once verified, install the remaining bolts to secure the housings and torque all bolts to 12-15 ft. lbs.

Lay the transmission horizontally on your work surface. Install the main bearing snap ring. Remove the old oil seal from the front cover (Figure 1, Part 1) (Photo 57). Thoroughly clean the mating surface of the front cover. Apply grease to the backside of the new oil seal (Figure 1, Part 2) and press into place. Measure the depth of the countershaft front bearing in relation to the case. Use a depth micrometer to make this measurement. This will be the proper thickness of the countershaft-to-bearing shim. Available shims are listed in the document “Extra Data.doc” or “Extra Data.mht” in the Zip file. Apply grease to the countershaft bearing shim and install into the front cover. Clean the mating surface of the transmission case (Photo 58). Apply a thin layer of sealant to the gasket and install the gasket and front cover, with countershaft bearing shim in place, to the front of the trans-

mission case. Install and tighten the five (5) retaining bolts and torque to 12-18 ft. lbs. (Photo 59). If you removed the pivot for the clutch arm, install with locking washer and tighten to 12-15 ft. lbs. Install the speedometer pinion assembly, locating tab, and bolt and tighten the bolt to 3-4 ft. lbs.

Install the backup lamp switch. But wait. What if you forgot where the switch was located? Easy. Using a flashlight, look into each boss where a switch fits in the side of the transmission case and rear extension housing. On our transmission there were four (4) locations for switches. Slowly shift into each gear and note which rods move. The rods will have a flat area that represents no switch engagement and then ramp areas on the front and rear of the flat area. If the flat area becomes a ramp when you engage that gear, then that switch boss holds a switch that is actuated in that gear. Our transmission had a neutral switch, a 3rd gear & 4th gear switch, a 5th gear switch, and a reverse switch. As our car only needs the reverse switch, the others do not need to be wired. If you wish to remove the unused switches, just replace the switch with a 14mm x 1.5 plug and washer. This size plug is a common engine oil drain plug on many Audis, metric Fords, metric GM and other makes. Are all switches the same? The switches I have seen are all normally open (NO)

when disengaged and closed only when engaged. I would not use that as the only possibility. Perhaps Nissan made normally closed (NC) switches that are floating around on rogue transmissions. An easy way to check is to set your voltage-ohm meter (VOM) to measure resistance (or continuity check as some call it). Attach the VOM leads to the leads from the switch. If it reads open or infinite resistance, then the switch is NO. If it reads little or no resistance, then the switch is NC. Now depress the switch plunger and verify the VOM reading is just the opposite of the previous reading. If your switch was NO, showing infinite resistance, and when the plunger is depressed shows little or no resistance, then it is in good working order. This configuration is the switch we want for our backup switch. The circuit is normally open (NO), but when we shift into reverse, the circuit closes and voltage flows to the reverse lamps. If your switch does not change state on the VOM, it is probably bad and should either be discarded or used in a switch boss that is not needed (simply as a plug). I used a red Sharpie and labeled the bosses on this transmission.

Photo 60 shows our finished rebuild ready to be installed back into the car.

DQ

On The Horizon...

- **Fuse Box Building:** Can't find the specific fuse box for your car, or are you planning a restoration and EFI engine installation? Build a new fuse box to interface with the stock 510 harness.
- **Cylinder Head Guide:** L-series cylinder heads are many and varied, and becoming harder to find. Before you shell out cash, know what to look for and what each casting can present you. Bonus coverage of unobtainium L-series heads.
- **Cylinder Head Modification:** Eight basic modifications you can make to improve performance.
- **Transmission Identification:** Comprehensive guide to figuring out which Nissan transmission is which.
- **DIY Sway Bars:** Build your own set of sway bars in your desired size and design for a quarter of the price of an off-the-shelf pair, and build 'em like BRE.