Introduction

We hope that the installation of your new Novak adapter assembly goes smoothly and that you acheive the improved results with your Jeep® that you intend. This kit is for adapting the GM Muncie SM465 transmission to the Jeep® Dana Spicer Models 18 & 20 transfer cases as found in 1941-1979 Jeep vehicles.

NOVAK CONVERSIONS
JEEP® POWERTRAIN SUPERIORITY

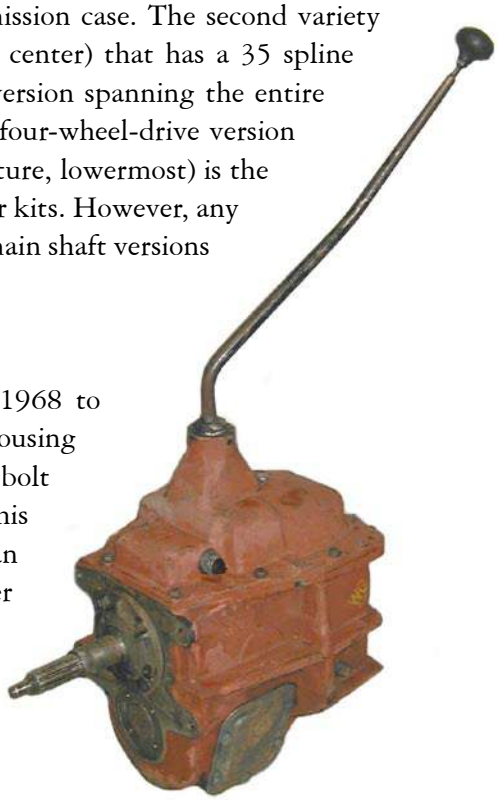
Despite whatever your experience with this type of work may be, we strongly advise you to read these instructions well and save them for future reference and parts numbers. Contained in these instructions are the requirements, tips, hints and tricks of years of performing these conversions, both in our own facility and information we've gained from discussing this swap with our customers. Put this information to good use.

About the SM465 Transmission

The Muncie SM465 is a heavy-duty, compound low transmission used in 1968 to 1991 GM trucks. It is a very strong transmission with all gears synchronized except first and reverse. Its great durability, gearing and ready compatibility with GM bellhousings - and modifiable compatibility to some AMC bellhousings - make it a prime Jeep conversion transmission.

Identification

The SM465 has a case length of 12". It is also identifiable by its large, 5-1/8" diameter input bearing retainer. The case itself is generously ribbed both vertically and horizontally. There are three different versions of this transmission - the differences lying mainly in the output end of the main shaft. The early four-wheel-drive version (picture, uppermost), from 1968 to 1978, has a 10 spline involute output shaft that sticks out 2-5/8" from the rear face of the transmission case. The second variety is the two-wheel-drive style (picture, center) that has a 35 spline output shaft with a threaded end, this version spanning the entire production period of the SM465. The later four-wheel-drive version was produced from 1979-on. Its main shaft (picture, lowermost) is the longest, has 32 splines and is not compatible with our kits. However, any SM465 can be made to be compatible by the use of the main shaft versions of our kits.



Compatibility

The 465 is compatible primarily with GM bellhousings from 1968 to 1989 trucks. The key dimension is the locating bore of the bellhousing which is 5-1/8". Apart from this, the bellhousing has the same bolt pattern as other GM standard shift versions. If you need to join this transmission to a GM bellhousing with the 4-11/16" bore, it can be done. The bore must be opened up to 5.000" and the retainer turned down to 4.995" as precision slip fit. We can perform this service with a very quick turnaround, or you may have it done by a good machine shop local to you.

The 465 may also be made to be compatible with AMC bell-

housings. This modification has primarily been developed for conversions replacing the SR4, T4 and T5 Jeep® transmission as used in 1980-86 CJ vehicles. 1972-79 AMC 6 and V8 engines can also be used with this transmission but must be equipped with a bellhousing, release arm, release bearing, and clutch disc from a 1980-1986 6-cylinder CJ. Our Kit #465-AMC can be purchased to simplify this process.

The Muncie 465 can be used with any GM engine having a 5-1/8 inch bellhousing bore and the "regular" GM transmission bolt pattern. GM bellhousings with the car and early truck 4-11/16" bore may be opened up to 5.000" inches and then turning down the SM465 retainer to 4.995" to accommodate this transmission. The 465 transmission can also be used with many AMC engines without adapter by following the procedures in our extended instructions, if applicable.

There are three versions of the Muncie 465. This kit designed to work with all of these versions, as we have provided a new transmission mainshaft that will connect directly into the Jeep transfer case's input gear.

Adapting the SM465 to AMC Bellhousings

You can save some parts chasing and cost of machine work by using our #465-AMC kit as it has a modified 465 retainer, special pilot bushing and socket-head bolts. If your machinist does do the work, the following section will offer him a guide. If you are using our #465-AMC kit, skip the information about modifying the retainer and pilot bushing that follows.

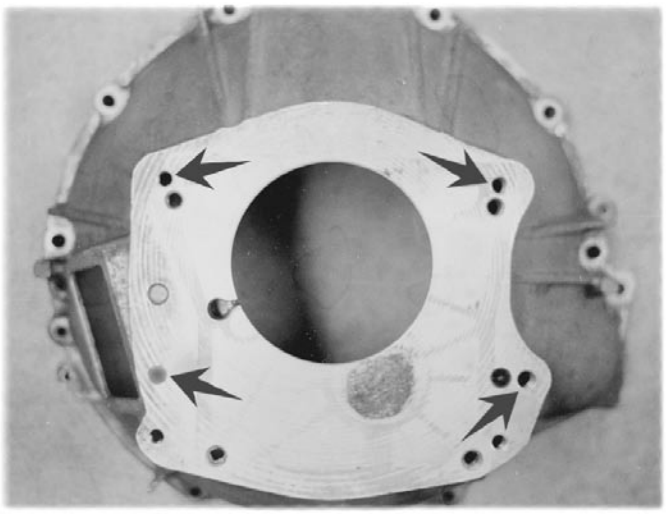
Novak kit #465-AMC, consisting of a new turned and sleeved retainer, seal, pilot bushing and bolts.

Modifying the Retainer

The 465 front bearing retainer will be modified by machining the large diameter of the retainer in a lathe. This will be reduced in size from 5.125" to 4.995". Machine a steel bushing in a lathe to be a light press fit on the Muncie front bearing retainer. If using a new retainer, the dimensions of this bushing will be 1.371" inside diameter, 1.430" outside diameter, and 2.625" long. If the retainer is used, then inside dimension must be compensated for wear on the retainer when figuring the size for the press fit.

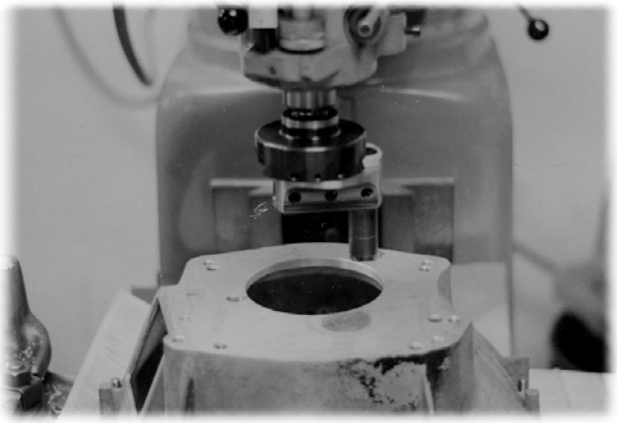
Pilot Bushing

A special pilot bushing is required and can be made as follows: Machine a piece of aluminum or steel to 1.816" outside diameter, 1.093" inside diameter and .500" long. Press a standard Chevy pilot bushing (Dorman #690-014) into this adapter and press the adapter/pilot bushing into the AMC crankshaft torque converter bore. Or, contact us here at Novak and we can have one on your doorstep in little time at all.



Bellhousing Modification

Install the modified retainer on the GM transmission using 5/16-18 x 7/8 socket head (Allen) bolts. The transmission locating bore on the rear face of the bellhousing must be bored out to 5.000" diameter. This procedure will require a vertical milling machine or a large lathe. With this type of equipment the bellhousing modification is quick and easy and should be able



to be done at a local machine shop. If you cannot get this done locally, we can provide this service, as well as drilling and tapping of the bellhousing. Place the bellhousing on the floor, engine side down (you may have to put a couple of 2x4's or similar under it) and stand the transmission on its face on the bellhousing. In other words, just like it would be in use, only now it's standing vertically. Align the cover gasket surface of the transmission with the dowel pin holes in the bellhousing. Transfer the mounting bolt hole pattern of the transmission to the bellhousing. Drill the two upper holes with a letter "U" or 23/64" size drill and tap these two holes 7/16"-14.

If the SM465 has lower holes that are not threaded, proceed as follows: Drill the lower drivers side hole of the 465 through with a 1/2" drill. Drill the lower passenger side hole with a 27/64" drill and tap this hole 1/2"-13 thread. On the lower drivers side hole, install a 7/16" bolt with the head inside the bellhousing and a nut and lockwasher at the ear of the transmission. Use a 1/2"-13 bolt in the passenger side lower hole. If the 465 has lower holes that are threaded proceed as follows: Drill the lower drivers side hole through the bellhousing with a 15/32" drill. This bolt will be 7/16"-14 with the head inside the housing. Drill the lower passenger side bolt with a letter U or 23/64" size drill and tap this hole 7/16"-14. A 7/16"-14 bolt should just pass through the lower ears on threaded type 465 transmission. If not, a few strokes with a round file will provide clearance.

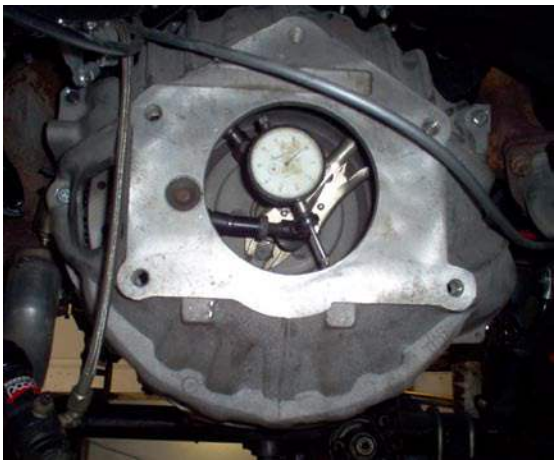
While these written instructions may sound complicated, the actual procedure is really quite simple and the end result is most worthwhile.

Clutch System

The clutch is not so much dependant on the transmission being used as is the engine, but a general guideline is to use the flywheel and pressure plate as prescribed for your year and model of engine. The clutch disc must have a 1-1/8" x 10 spline hub to match the GM input shaft. Since the 1980-1986 Jeep CJ's used a clutch disc with just such a spline configuration on the T4, T5 and T176 transmissions, this is easily provisioned.

You can use a conventional linkage or hydraulic clutch release system, depending on your Jeep's setup and your preferences. When used with AMC engines (as discussed above) you can use a factory release system since the modified SM465 retainer has the same diameter of throwout bearing as 1976-1986 Jeeps. In terms of hydraulic release, many factory AMC bellhousings have a flat at the 8 o'clock position tapped to 5/16"-18. These accept an OEM slave cylinder. A more in-depth discussion can be had at the Novak Knowledge Base, www.novak-adapt.com, or with a tech at Novak who may also be able to configure a clutch system that is most appropriate for your combination.

Bellhousing Alignment



On any engine using a standard shift transmission, with or without an adapter, it is important to check the bellhousing locating bore location relative to the crankshaft. The potential for transmission failure or premature wear is so great, due to misalignment at this point, that no engine should be assembled without being checked. The checking procedure is quite simple. Correcting misalignment is not so simple but must be done to insure normal service from the transmission. A dial indicator is required, as well as a suitable means to mount this instrument on the engine crankshaft.

A dial indicator (right) is a device that has an arm or contact point,

About Your Novak Adapter

The Novak #462R adapter kit is built to high standards of design, materials and build. The adapter housing is cast and machined from 356-T6 aluminum. Our adapter shaft is machined of a triple-alloy gear steel, specially hardened and precision ground for strength and longevity.

The design of this adapter is such that it precludes the need to buy a special transfer case front output yoke.

Novak warranties your adapter and shaft against defects of workmanship and materials for the life of the vehicle. This warranty is non-transferable and requires a copy of your invoice as documentation. These components are not warrantied against damage or defects resulting from improper installation, including misalignment, improper assembly, improper mounting, or incorrect driveshaft lengths, and miscalculated driveshaft geometry on shackle reversal setups. Because we have no control over how the parts are handled or installed, we are not liable for any problems or failures of this product unless it is a defect of design, materials or workmanship. Determination of this warranty is at the fair discretion of Novak, Inc.

Should you have any questions concerning this conversion or these components, we welcome you to contact us.

suitably connected to a pointer, that moves in front of a dial with markings on its face. These markings usually represent .001" each. The purpose of a dial indicator is to measure in thousandths of an inch that can be read directly on the dial of the indicator.

Above: Tools common to a gearbox rebuild. Bearing and gear pullers will vary.
Below: A set of large, bevel tipped, external snap ring pliers is indespensable for removing the large Eaton type retaining rings you'll encounter. These shown are under the Blue Point brand.

To check a bellhousing, mount it on the engine it's going to be used with, make sure there are no burrs or dirt on the block or bellhousing. All bellhousing to block bolts should be in and tight. Mount the dial indicator on the crankshaft of the engine using a suitable magnetic base attachment or mechanical clamping means. The contact point of the indicator should be touching the bore of the bellhousing. The indicator must be mounted rigidly enough so it does not move on its mounting to prevent false readings. Rotate the engine by hand with the spark plugs removed and observe the reading on the dial. Keep adjusting the dial assembly until the needle moves the least amount per rotation. When you have acheived the least amount of needle movement throught he 360 degree sweep of the indicator, this is your runout. You can then determine the direction it is offset by the movement of the needle.

The total number of thousandths misalignment of the bore relative to the crankshaft is read directly on the dial. Total runout should not exceed .007", with .010" being maximum. The greater the misalignment, the sooner transmission problems and failure will occur. A symptom of misalignment is unusual wear of the pilot bushing. We have checked stock Chevy bellhousings on engines that were out more than 1/32" (.032"). Some Ford one are reportedly worse. Anything over .010" runout must be corrected before the engine and bellhousing are put in service or you can count on pilot bushing, transmission, and clutch problems, followed by transmission failure. The simplest way to correct misalignment is to try another bellhousing or bellhousings. Machining the bellhousing is the best cure but offset dowel pins are simpler. Shims between the block and bellhousing will also work if you have the patience to use this method. Offset dowel pins are available from speed shops locally or online.

This style of snap ring plier is more universal, with a dimpled and knurled flats. They are great for smaller snap rings.

Transfer Case Adaptation Procedure

Transmission Disassembly

Begin by draining the transmission of its fluid. You may wish to inspect the gear oil for water, metallic particles and odor to ascertain as much of the transmission's history and condition as possible.

Shift Cover Removal

Remove the transmission shifter stick by pressing downward and rotating counter-clockwise the domed retainer. The hold-down will release and allow the shifter to be removed. Now, through the shifter port, move the reverse shifter fork (the one on the left) so the rear edge of its slot is aligned with the front edges of the slots in the 1st-2nd and 3rd-4th shifter forks. This partially engages the reverse idler to facilitate the cover removal. Now remove the ten top cover bolts and remove the top cover assembly. It may require a few firms blows with a soft-faced mallet to break the gasket's hold. If you must pry with a screwdriver, keep it out towards the edge so as not to mar the gasket sealing surfaces. If the top does not readily come off, rotate the input shaft while lifting the top cover. First gear has roll pins in it that can get in the way of the top removal. Rotating the shaft moves them out of the way.

OEM Tailhousing Removal

Once the cover is off, slide the shifter sliders so as to lock the transmission mainshaft in two gears (i.e., 3rd & 1st).

Remove the transmission tailhousing or adapter housing by removing the eight bolts. 2wd versions will require removal of the output yoke, first. On 2wd models, you may now remove the rear parking brake (if equipped), the rear tailhousing and speedometer drive gear. This is best done with a large socket driver and a very large adjustable wrench (pipe or crescent). A socket impact wrench may be helpful here.

Earlier 4wd versions (ten-spline output) require removal of the mainshaft nut and lockwasher. Later 4wd versions (32 spline ouput) require removal of the snap ring. Remove the rear adapter housing and coupler sleeve, if present.

Clean off all residual gasket material from the rear face of the transmission with a razor scraper. Avoid marring the sealing surface.

Lowering the Countershaft

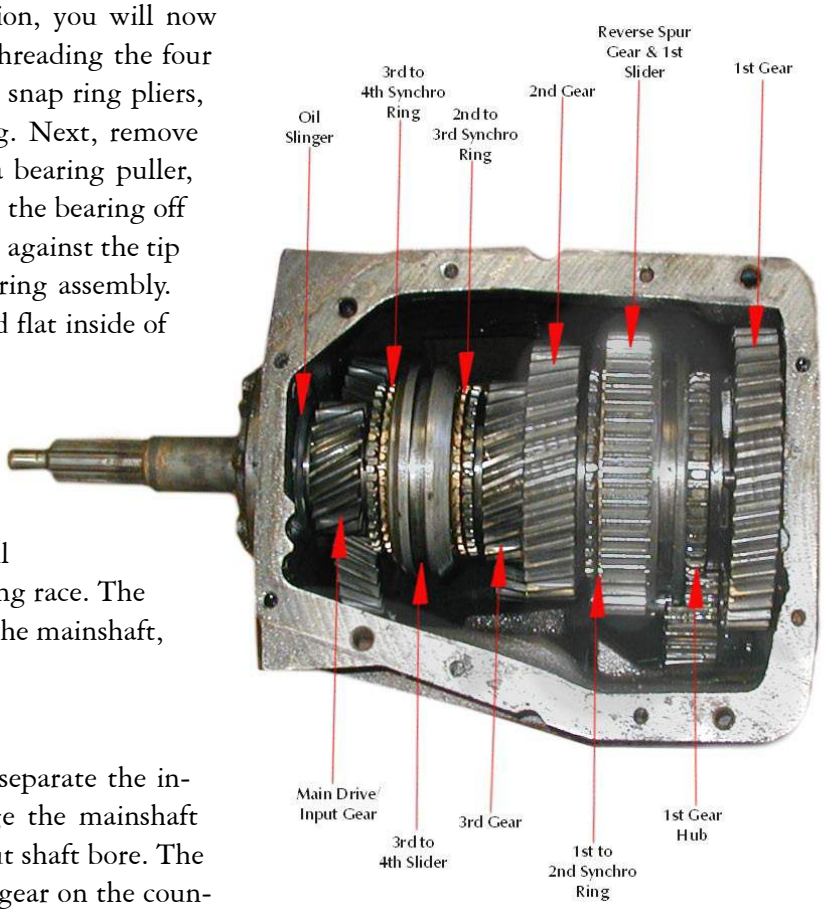
Ideally, you will remove the countershaft rear main bearing in order to lower it down to later facilitate removal of the upper geartrain. However, this step is not fully necessary if you are only doing an upper end rebuild or mainshaft replacement only. It does make main shaft and input shaft removal a lot easier and the instructions will follow from that perspective.

To lower the counter shaft down into the case, remove the rear bearing from its shaft and case bore by removing the outer snap ring with proper snap ring pliers, and then follow with a bearing puller, securing the jaws into the now-exposed snap ring groove. Use the shaft's centerdrill as the central push-point on your puller.

Once the rear lower bearing is removed, you can pull the countershaft rearward, causing the countershaft first gear to protrude through the rear of the case. This will allow the front of the counter shaft to drop out of its needle roller bearings and then give you more clearance to remove the upper end components.

Mainshaft Bearing Removal

Moving on to the front of the transmission, you will now remove the input bearing retainer by unthreading the four 5/16" bolts. Then, using a pair of suitable snap ring pliers, remove the input bearing outer snap ring. Next, remove the shaft journal snap ring. Now, using a bearing puller, lock into the groove in the outer race. Pull the bearing off the input shaft by applying the couterforce against the tip of the input shaft and pulling on the bearing assembly. Rotate the input shaft so that its machined flat inside of the transmission faces downward.



Now, the transmission mainshaft rear bearing should be removed by removing the outer snap ring. You will again require a bearing puller, which you will lock into the snap ring groove of the bearing race. The threaded rod will push against the end of the mainshaft, in like manner to the input shaft.

Upper Geartrain Removal

Once both bearings have been removed, separate the input and main shafts enough to disengage the mainshaft pilot tip from the needle rollers in the input shaft bore. The input gear's flat will just clear the countergear on the countershaft. This will probably require tilting the input shaft some, combined with rotating the flat side of the synchro bull ring down, and pull the input shaft out the front, snaking it out of the bore. Be wary of the input shaft to mainshaft pilot needle bearings. Try to keep them from falling into the case, but don't feel too bad when they do. Just keep a magnet handy.

Once this is done you will pull the mainshaft/gears assembly further inward into the case and tilt it upward and remove it through the top of the transmission case. You would be wise to keep a close tab on all of your fingers through these steps; leather gloves can be a great asset here. The gears are heavy and sharp, and you will be more effective at the remainder of the project if your fingers are intact to do it.

When to replace synchronizer blocker rings

No one likes wasting money unneccesarily replacing good parts. However, too many installers just assume the synchros are well enough. Some judge that if the clutch teeth of the ring (those that are cut like, and mesh to the clutch "bull" teeth of the mating gear) look good, the synchro must be good.

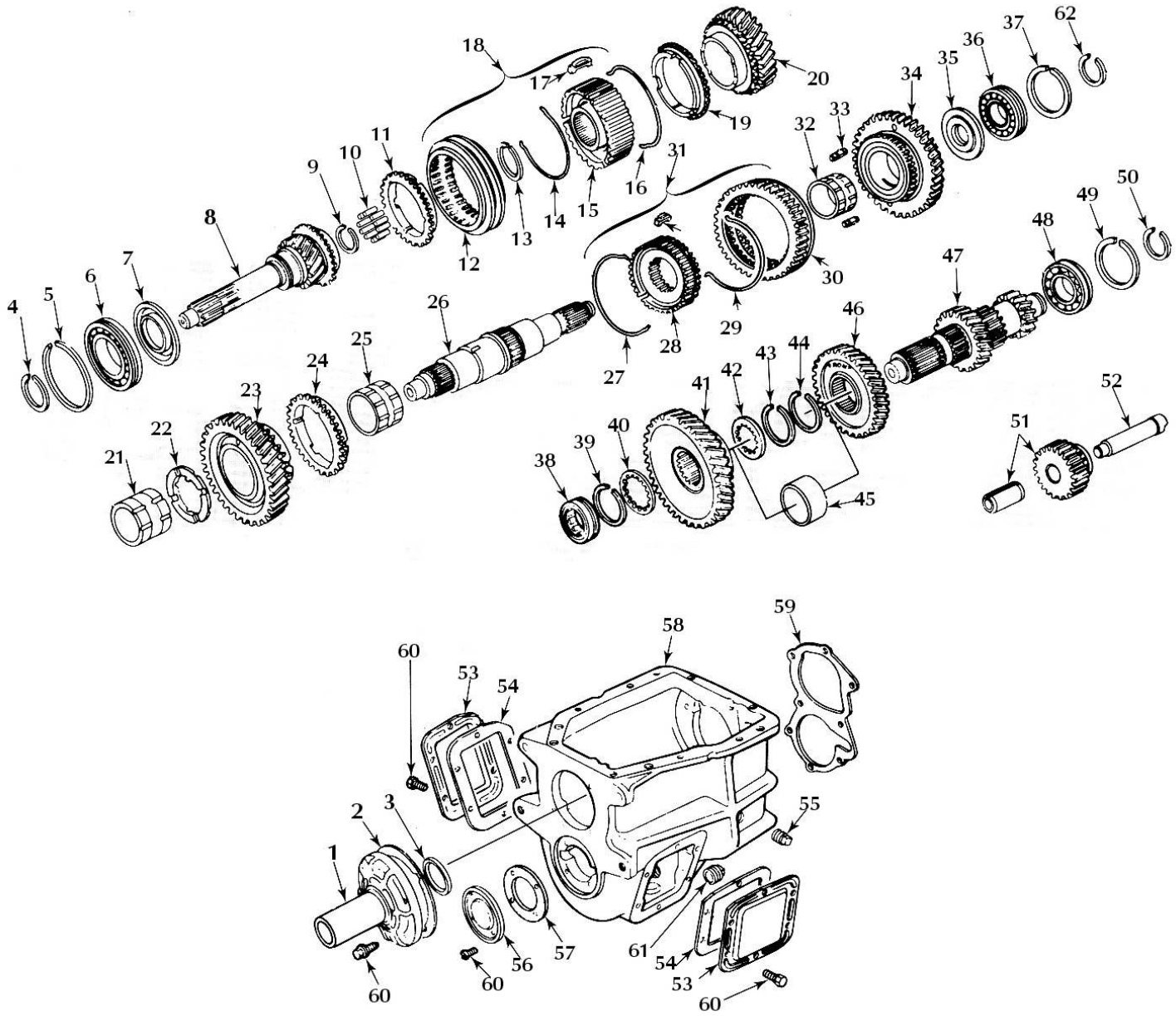
A synchro's wear is, in fact, best judged by the condition of the internal threads in the ring's cone. It is their ability to hold oil, yet grip during the gear change that defines whether they are good or not. It takes a pretty experienced eye to judge these.

We - almost categorically - recommend that you replace your blocker rings. You are into the transmission, they are typically inexpensive, and new harware is quite affordable.

As stated above, it is sometimes easier to remove the counter shaft rear bearing and drop the counter gear before attempting to remove the input shaft. This step is preferable if you are doing a complete rebuild of the upper and lower ends of the transmission.

Countershaft / Cluster Gear Removal

The countershaft front bearing is accessed by removing the stamped cover. You will expose the Torrington caged needle bearing. It can be pulled out with a crooked puller through the slots. Even easier at this point, you can also remove it from inside the case after the cluster gear is removed. Now, move the countershaft rearward. The gear will stick through the case. You can then tilt the front of the assembly upward and pull it out of the top of the case. The reverse slider will try to tangle with it - just slide it rearward.



1. Input bearing retainer
2. Bearing retainer gasket
3. Input oil seal
4. Input shaft snap ring
5. Input bearing snap ring
6. Input bearing
7. Oil slinger
8. Input shaft, a.k.a. clutch shaft
9. Snap ring
10. Bearings, needle rollers
11. Third-to-fourth synchro blocker ring
12. Third-to-fourth slider
13. Snap ring
14. Synchronizer hub spring
15. Synchronizer hub
16. Synchronizer hub spring
17. Synchro dog, key or pawls
18. Synchronizer hub assembly
19. Third synchro blocker ring
20. Third gear
21. Third gear bushing
22. Thrust washer
23. Second gear
24. Second synchro blocker ring
25. Second gear bushing
26. Mainshaft
27. Synchronizer hub spring
28. Synchronizer hub
29. Synchronizer hub spring
30. Reverse gear & slider
31. Synchronizer assembly
32. First gear bushing
33. Synchro dog, key or pawls
34. First gear
35. Thrust washer
36. Rear bearing
37. Rear bearing snap ring
38. Countershaft front bearing
39. Snap ring
40. Thrust washer
41. Input or clutch countergear
42. Thrust washer
43. Snap ring
44. Snap ring
45. Spacer bushing
46. Third gear countergear
47. Countershaft
48. Countershaft rear bearing
49. Bearing snap ring
50. Countershaft snap ring
51. Reverse idler gear & bushing
52. Reverse countershaft
53. PTO Cover
54. PTO Cover gasket
55. Oil fill plug
56. Countershaft front cover
57. Cover gasket
58. Case
59. Rear gasket
60. Screws
61. Oil drain plug
62. Snap ring (Novak shafts only)

Transmission Mainshaft Disassembly

Once the mainshaft assembly is out and on the bench, remove first gear by sliding it rearward. At this time, we will recommend that you place all the mainshaft components onto a clean surface in the order and orientation as they are found on the shaft. This is very helpful to first-time transmission rebuilders during reassembly. Continue by removing reverse gear/first gear slider just by sliding it rearward. This is the selctor gear with the "spur" or straight-cut teeth. The synchro hub is now exposed and the keys should be taken out and set aside.

Move to the front of the mainshaft assembly now and slide off the third-to-fourth gear slider, frontwards. Set its synchro blocker rings aside along with the hub keys. You will now use a press to press behind second gear to remove it. Point the tail of the main shaft downward and support the second gear on your press's plates. Press on the nose of the mainshaft. Doing this will press off second gear, the third-to-fourth synchro assembly, third gear and the third gear bushing. It often takes a good amount of force to accomplish this. Sometimes coaxing it with a mallet and in rare cases, some heat, is required. Remove the second gear synchro ring.

Transmission Assembly Lube

Very simply, do not use wheel bearing grease or any other heavy lube that will not dissolve in the transmission fluid.

Use an assembly lubricant such as RedLine, or others. Vaseline is actually quite good, especially the thick variety - for setting loose needle rollers into their bores.

If you use any kind of grease that will not dissolve, you will plug off spline and oil passages, and shaft journal failures are nearly iminent. We build our shafts to outstanding specifications, however, Novak cannot warranty any shaft or mating gear that fails due to oil starvation.

You will next press off the first gear bushing and second gear synchro hub by attaching a bearing puller between the front edge of the first gear bushing and the splined section of the mainshaft. If you are replacing the transmission shaft with the new Novak #46xR shaft, removal of the remaining second gear bushing from the old shaft is optional. If you do, it may be removed with a chisel or a press and bearing puller.

At this point you should inspect the transmission components, including gear teeth, sloppy fitting gears, synchronizers and idler shafts and bearings. It is recommended to replace the bearings, small parts and synchro blocker rings, bushings and seals. We keep several SM465 rebuild components on hand in addition to our all-inclusive master rebuild kit, and all are quite affordable.

Reverse Idler Shaft

Replacement of the reverse idler or its bushing is rare. This gear usually sees few miles, and it is constantly bathed in oil. As such, the bushing is not supplied in industry standard master rebuild kits. If replacement is, however, necessary, rhe reverse idler should be driven rearward by inserting a long arbor or drift tool through the PTO cover. This is tricky, but the shaft is usually not too tight in the case bore. Inspect the reverse idler and its bushing. This constitutes the end of the main disassembly process.

A Beautiful Transmission Case

This is where a rebuild can reveal just how obsessive someone can be. With the transmission case empty, you can spray the case with solvent, soak it in soap, pressure wash it and if you are really fastidious - sand-blast it! You can then follow up with an industrial primer and enamel. You can even go so far as to use a heat-baked enamel. We at Novak recommend that you follow the directions on your particular enamel, and that your spouse be out of town if you bake your transmission case in (presumably) her oven.

Mainshaft Assembly

First, use an assembly oil or grease to lubricate the journals on the mainshaft on which the new bushings will be installed. Press the second gear bushing on first. Do this gently as they are made of sintered iron and are not resilient to improper installation methods. Hint: Use a hot light bulb to warm the bushing (about 30 min. each) and freeze the shaft before assembly. This will make them come together much easier. If they do not come together easily enough, you may need to evenly heat the bushing with a torch. The second gear bushing is always the tightest.

Now press the first-to-second gear synchro assemblies onto the mainshaft. Install the synchro springs and keys. Press the first

gear bushing onto the shaft against the hub. Now install the synchro ring and second gear, aligning the synchro ring slots with the keys (also called "dogs" or "pawls") followed by the third gear thrust washer. This is the one with the single inner tang that will align with the slot we've cut into the mainshaft. Press on the third gear journal bushing onto the shaft. Now, the third-to-fourth synchro hub assembly (with its keys, springs, slider and rearmost synchro blocker ring installed) should be pressed on and then secured by the snap ring. You will leave off the third-to-fourth blocker ring at this time.

Install reverse gear. Its shifter groove orients rearward.

Warning! A broken journal bushing, on top of a press, admonishing care of the user to wear safetly glasses, as things can break under pressure.

It is an option to press on these bushings, but application of enough heat to almost turn them pink will enlarge the bushing enough to allow it to drop into place. Move fast and be careful to keep it going on straight, and to avoid burns in the process.

Install first gear followed by its thrust washer. Note that in 1978, GM slightly modified the first gear bushing. The shafts remain identical to either design - only the first gear bushing and its corresponding washer are a bit different. The difference is made up by the thickness of the thrust washer used. If your first gear bushing is identical to the second gear bushing, you have the earlier bushing. It is the height of the first gear bushing and its mating washer that determines the the amount of endplay that first gear will have. Here's how it works: The first generation first and second gear (1968-1977) bushing is 1.840" long. If you have this bushing, use the step-style thrust washer supplied with your small parts kit, measuring .193" in thickness at the inner, ground portion. If you have the second generation first gear bushing, it will measure 1.860" long. This style uses a flat thrust washer that measures .183" thick. All of our rebuild kits include the step washer and the first gear bushings we supply in our kit will always be of the first generation design. Thus, use the parts we supply you. If you mix and match, you should make sure you understand this difference. Failure to do so will result in first gear not having the proper end play. This end play should be between .020" and .025" when assembled.

Pressing the 1st-2nd syncrhonizer hub onto its splines.

Pressing on the second gear bushing. Our experience shows that this particular bushing is best heated with a torch, and installed onto a very cold mainshaft. The other bushings install easier and usually without heat.

Novak mainshafts and the GM 4wd mainshaft from 1978-1991 use a rear snap ring instead of a threaded lock nut and washer (1968-1977 4wd mainshafts) or a yoke and nut (1969-1991 2wd mainshafts). The latter two styles use the compression of the nuts to secure the mainshaft to the inner race of the rear main bearing. The Novak and later GM 4wd shafts use the snap ring to secure the mainshaft to the inner main bearing. It is important to understand this for the following:

Note that all of our adapter kits include a .010" shim. We include this shim because you cannot adjust the thrust on a snap ring like you can for the threaded SM465 versions. So, in the event that you do not have the thicker (later

generation) first gear thrust washer, you might need to place this shim just behind the rear main bearing inner race, and just in front of the snap ring. Here are three example scenarios:

1. Earlier Generation Assembly, snap ring secured
   Novak mainshaft
   Novak supplied bushings (first generation with 1.840" first gear bushing)
   Novak supplied small parts kit containing first generation thrust washer (.193, step style)
   Novak supplied snap ring
   Novak supplied .010" shim (uncommon this is required, but possible)

2. Earlier Generation Assembly, thrust nut (4wd) or yoke (2wd) secured
   GM mainshaft
   Novak supplied bushings (first generation with 1.840" first gear bushing)
   Novak supplied small parts kit containing first generation thrust washer (.193, step style)
   GM style thrust nut or yoke - do not use .010" shim

3. Later Generation Assembly, snap ring secured (4wd) or thrust nut secured (2wd)
   GM mainshaft
   Novak or other supplied bushings (second generation with 1.860" first gear bushing)
   GM style later thrust washer (.183", flat style)
   GM yoke and thrust nut **OR** GM snap ring - do not use .010" shim

The aftermarket stepped and ground rear thrust washer supplied in the Novak small parts kit is slightly offset and very helpful in that the installer can turn it in either orientation to adjust for the best first gear endplay. First gear should have .020" of end play when this is done. This is as complicated as it gets. If you make it through this (and you will) the rest is usually smooth sailing.

Transmission Reassembly

Reverse Idler

Note the orientation of the reverse idler shaft. The flat should face level and downward, as indicated by the cast relief in your Novak adapter or the factory tailhousing. Follow by replacement of the countershaft bearings and reassembly in the same fashion it was removed.

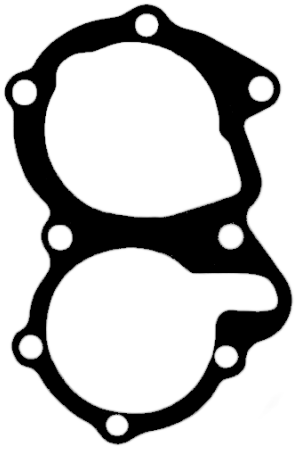
Countershaft Placement

Installation of the countershaft is essentially done in the reverse sequence as it was removed. Lower the rear of the countershaft into the case, guiding the small gear through the rear bearing bore in the case. You will then allow the shaft to sit in the bottom of the case until you have installed the upper end components.

Upper Geartrain Installation

Place the case on its back in your arbor press, having set up your table and plates such that will allow for the tail of the mainshaft to poke through. Install the mainshaft and gears assembly - tail end first - into the transmission case, holding onto first gear. Place the rear bearing and its outer snap ring onto the shaft from the backside of the case and center it both on the shaft and in the case bore. It will be a slip-fit into the transmission case and a light press fit onto the shaft. Use the arbor of the press or another appropriate spacer and press against the pilot tip of the mainshaft, making sure your press plates are support-

ing the rear bearing inner race. Seat the bearing against the shaft journal.



The SM465 rear gasket. Mainshaft endplay is calculated on both OEM and Novak adapters with the gasket thickness considered. Relying on RTV silicone only will likely result in too little endplay.

Install the gasket and rear housing first temporarily and without RTV as you are checking endplay. Once satisfied, remove them, spread a thin skin of RTV on each gasket face and install and tighten the bolts just hand-tight. Allow a couple of hours for the silicone to stiffen and then tighten all bolts to torque.

Check Mainshaft Endplay

This is the ideal stage to measure endplay. Temporarily install the supplied rear gasket (no RTV yet) followed by your new adapter, or the factory tailhousing on your 465, making sure it seats the upper bearing and its snap ring. Install and tighten the eight bolts on to 20 ft./lbs., making sure to cross-tighten them to pull the housing up evenly.

Check the shaft for endplay with a magnetic dial gauge, with the needle touching the front or rear tip of the shaft and the magnet solid any any point on the transmission case. Bop the shaft back and forth with a mallet. There should be .001-.003" endplay. This is critical. If you notice that you have .010" over endplay on the output shaft, you may have forgotten to install the supplied (if applicable) shim behind the rear main bearing and in front of the Novak or OEM snap ring.

If you have difficulty, reread the instructions and then call us if you are unable to diagnose the shortfall. If you do not acheive this at first, note that it is tedious to pull the bearings off and try again, but it is far more tedious to have the transmission break down prematurely.

Input / Clutch Shaft Installation

Install the input bearing onto the input shaft. Follow with the shaft snap ring, then the bearing outer snap ring. Then install the input shaft roller bearings with a sticky vaseline and gently insert the assembly through the input bore of the transmission face, aligning the machined flat of the of the synchro cone downward. Now, insert the third-to-fourth synchro blocker ring, making sure to align the keys with the slots. Bring the input and output shafts together. Press or carefully drift the input bearing / shaft assembly into the front bore of the case.

You must make sure all synchros and gears and hubs are all aligned. Follow up by installing the input bearing retainer with its gasket - without using RTV at this time. This nosecone is made of cast iron. It is durable, but not unbreakable, and it should just snap into place. Cross-tighten the bolts to 10 ft. lbs.

If properly pressed together, all internals should move freely.

Check Your Work

Check the shafts for endplay with a magnetic dial gauge. Both transmissions input and output shafts should turn freely and in all gears and there should be .001-.003" endplay in the transmission input or output shaft at any time. This is critical. You should slam both the input and output shafts together with a mallet, then turn them and verify that they are not forcing the synchro ring and both turning together. They should turn independant and without drag on each other. If they do drag each other, you probably have too much endplay in the mainshaft, as disucssed above.

Transmission Lubrication

Fill the transmission with the right gear oil, usually 85W-140 for most climates. Use a GL-4 rated oil, not GL-5, as the latter has an increased amount of sulphur, which is lower in PH and acidic towards the bronze synchronizer rings in your transmission. StaLube and Redline make gear oils that match the GL-4 rating. We like to fill through the top cover, as it's a good opportunity to douse the gears and shafts, not to mention the speed to fill.

Countershaft Bearing Installation

Install the front needle roller assembly into the lower case bore. Note that there are two bearings supplied in our master rebuild kit for earlier (smaller diameter) shaft journals and later (larger diameter) shaft journals. Choose the proper one for your SM465.

Lift the countershaft to level, inserting its front journal into the front roller bearing race. Once started and aligned, tip the transmission flat onto its front face

Shackle Reversal Caveats

If a shackle reversal has been or will be performed on the Jeep, it is crucial that you calculate the suspension geometry's effects on the front driveshaft. Shafts that are too long or do not have enough compression slip will cause the driveshaft to ram your transfer case, causing damage to your axle, driveshaft, transfer case, adapter or transmission.

on a soft but firm surface. Use a brass or aluminum drift to drive the countershaft forward into its bearing. Follow by installing the rear roller bearing and its snap ring. Make sure the counter shaft rolls freely and is seated into its bearings.

Seal it Up

Once satisfied with your transmissions operation, remove the adapter and the front input retainer. Use RTV silicone (we like Permatex® Gray) in thin layers on each side of each of these transmission gaskets. Use a thread locking compound, such as Locktite™ Blue, on the eight 3/8"-16 socket head (Allen) bolts. Cross-tighten them in three steps to a final 35-40 ft./lbs. torque.

Install the front bearing retainer with the same principles in mind. You may use lockwashers or Locktite™ Blue, depending on your configuration.

Install the bolts and torque them lightly until the silicone begins to squeeze out. Return and tighten the bolts to final spec (in an incremental crossing pattern) in an hour after the sealant has solidified.

Top Cover Installation

Put the top cover on, making sure to line up the shifters with their sliders. Test shift through the gears. Some installers like to spin the input shaft pilot tip with a drill (read, Large Chuck) and listen for any noises. Once satisfied with the operation, RTV the shifter gasket like any other. Torqe the top cover bolts to 25 ft. lbs. in a crossing pattern.

Transfer Case Installation

Trial fit the transfer case to the adapter. We have sent your adapter machined and configured for the input bore diameter of your transfer case as requested. Early Model 18's have a 3-5/32" bore and later Model 18's and all Model 20's have a 4" bore. The adapter locator step should be a slip fit into your transfer case bore. In the event they do not match, discontinue installation and contact us. You must never run a powertrain component that is not precisely centered and shouldered. Once satisfied with the fit of the transfer case, apply a thin coat of gasket sealer on the adapter and transfer case faces.

If installing a small bore transfer case, install the case followed by the input gear followed by the supplied washer and NyLock nut. Tighten the nut to 125 ft/lbs. Do not use an impact wrench. To facilitate this, put the transmission in fourth and reverse gears to lock the shaft from turning. Follow up by installing the rear PTO cover.

If you are using a Warn overdrive, just slip it onto the shaft and tighten the special nut with a ½" drive ratchet extension. Carefully install the special snap ring, making sure it seats firmly into its grooves.

If you installing a large bore Model 18 or a Model 20 transfer case, you can install the input gear, washer and NyLock nut before installing the transfer case into place. Torque the mainshaft nut to 125 ft./lbs. for either model transfer case. Do not use an impact wrench. To facilitate this, put the transmission in fourth and reverse gears to lock the shaft from turning. Then install the gasket and transfer case. We have included a stud and nut to use at the (looking frontwards) top, right threaded ear of the adapter, to ease installation. Also, use the provided 3/8"-16 x 1" bolt and lockwasher at the lowermost transfer case flange ear location. Use of a longer bolt will cause mechanical grief when it contacts the countershaft. Use a thread sealant at this location.

Mounting the Drivetrain Assembly

Our adapter is designed and threaded to use the rear mount from a Muncie truck four-speed. The adapter is drilled to accept the regular two-bolt rear mount used on a wide variety of GM and some Jeep applications. This is a a Borg Warner part #31-2268 or Novak #RMU (a stronger urethane design) and will mount on the adapter using bolts, nuts and lockwashers.

Customers often ask if they must use a specially fabricated crossmember to accomodate a conversion. No. The crossmember itself can be the factory unit, or an aftermarket or custom "flat-style" skid plate. By drilling the crossmember for the above mentioned flexible mount, your conversion transmission can be very cleanly mounted. Note that installation to a rigid crossmember risks breakage of the transmission, adapter or transfer case. Your adapter's warranty will be voided in this scenario. Note that spacers can be used under the rear mount to acheive the proper transmission height.

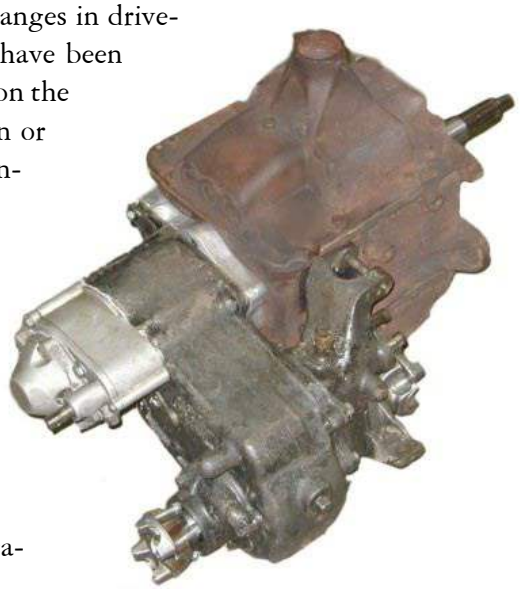
Driveshafts

Most factory transmission and adapter combinations to the Dana 18's & 20's vary. As such, it is often that driveshaft lengths will need to be changed to accomodate the swap. Also, consider that there multiple ways to install a conversion engine (often used with this transmission) and the following will be of note:

Novak #RMU

It is seldom a good idea to allow the driveshafts to make the decisions as to where the powertrain will be placed. Some of our customers, fearful at the perceived expense of new or modified driveshafts, attempt to let the existing driveshafts dictate engine, transmission and transfer case location, sometimes to the detriment of the project. Driveshaft modifications are usually inexpensive when performed by driveline, RV or tractor implement specialists. New driveshafts are an option but seldom a requirement in regards to the actual successful conversion. Jeeps that require extensive travel or specialty-built driveshafts have this option available through several fabricators across the nation.

Finish mounting the transmission and engine and have the weight of the Jeep on the wheels when measuring the length to modify the driveshafts. Any changes in driveshaft length must be determined after the engine and transmission have been mounted. The Jeep must be sitting on the ground with its full weight on the wheels to make the best determination. If a shackle reversal has been or will be performed on the Jeep, it is crucial that you calculate the suspension geometry's effects on the front driveshaft. Shafts that are too long or do not have enough compression slip will cause the driveshaft to ram your transfer case, causing damage to your axle, driveshaft, transfer case, adapter or transmission. Our experience has shown that some stock Jeep drive shafts are not quite the correct length from the factory to begin with. This can be corrected if the driveshafts are modified.



Transmission Shifter

The OEM SM465 shifter will come up through the floor in varying loca-

tions based on installation. You may need to bend the shifter cane to fit your application. This is easily done by removing the shifter from the top cover, locking it in a vice and using a torch to heat the areas at which the bends will occur.

Novak offers a new straight shifter for the SM465 that can be bent to your Jeep. It also eliminates the two-piece pinned finger design that is responsable for a sloppy shifter feel in some transmissions.

Transfer Case Shift Linkages

Early Model 18 twin-stick shifters are easily and cleanly retained. The cast shifter bracket tucks in between the SM465 gussets and top cover, though a minimal amount of grinding may be necessary to clear up variations in castings. Some IH Scout Model 20 shifters are equally simple.

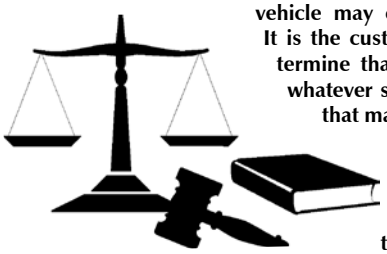
Single shifter Model 18 & 20's will require a new shift lever mounting anchor. We have had good luck with using a shoulder bolt (1/2" dia.) in the side bosses (image, left) of the SM465, with side tension set by using springs and washers as necessary. A simple "L" bracket fastened to two of the top cover bolts works well. Again, a shoulder bolt and nut makes a clean pivot for the factory single shifter lever. Follow up with threaded rod and bearing ends and/or clevises to complete the linkage.

Remote shifted Dana 20's vary between models and years. Some are very problematic independant of a conversion and may be replaced as a matter of course. Clearance is the only other driving consideration. If you do not find an apparent solution, contact us here at Novak as we may have some ideas.

Some Conclusions

While reading through these instructions, and especially while performing the transmission swap, it is often recognized that it is not the swap itself that provides the greatest difficulty, but in the ancillary things like linkages, mounts, clearances, and the like. Any good installation should consider all the points in this article and also allow for time, energy and funds for the dozens of variations in drivetrain conversions that cannot be anticipated.

We strongly suggest that you keep these instructions for future reference. For questions concerning your conversion, contact us and we'll be pleased to answer your questions. There is no final word to our instruction packages. We update them often and invite our customers to offer any suggestions, images or questions they may have that can make the process easier for any to follow. Note our contact information below.



Air pollution laws vary from state to state. Changing an engine or transmission in your vehicle may change its pollution status. It is the customer's responsibility to determine that their vehicle conforms to whatever state and Federal regulations that may apply to their vehicle. Neither Novak, Inc. nor its directors are responsible for any changes made to your vehicle, nor the injury to the individual, or damage to property. Always exercise care and good judgement when installing this, or any other component on your vehicle.

Novak Kit #462R includes:

- **Transmission mainshaft**
- **Adapter plate**
- **Snap ring, rear**
- **Bolts (8), socket head, 3/8″-16 x 1″**
- **Seals (2), output**
- **Bolt, 3/8″-16 x 1″**
- **Washers, lock, 3/8″**
- **Nut, Nylock, input gear**
- **Washer, input gear**
- **Stud, 3/8″-16 x 1-1/2″**
- **Shim, rear bearing, .010″**
- **Instructions**

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