

Introduction

This guide will assist the installer in adapting the GM TH700R4 & Early 4L60E automatic transmission to the Jeep Borg Warner 1305/1339 transfer case as found in 1973-1979 Jeeps.

Note to the Installer

This document and the use of any Novak products assumes safe and adequate working knowledge of the automotive systems involved. Vehicular repair, upgrade and conversion work can be among the most difficult of automotive mechanical and electrical tasks and it is upon the customer to ascertain whether they are working within their expertise or whether they should acquire assistance. Because Novak has no control over the customer's project procedures, Novak instructions and recommendations do not constitute a warranty of fitness, applicability or compatibility with the customer's particular project. Novak cannot determine the skill level of the customer and/or the installer of Novak products, nor can Novak publish all of the information on fundamentals that an installer should know before attempting these advanced procedures. While every attempt at informational accuracy has been made, these instructions and any recommendations therein are for guidance only. This guide is not intended to replace the service manual specific to your vehicle. It is not possible to document the wiring, routing and specific system details of every vehicle and the installer should obtain and use both their vehicle's manual and the engine or transmission donor vehicle's manual in conjunction with these instructions.

Your Legal Requirements

Novak products and procedures are intended and recommended for off-road use only and installation on a vehicle for use on public roads could violate laws within your jurisdiction. Additionally, installation of Novak products may adversely affect the warranty coverage on your vehicle.

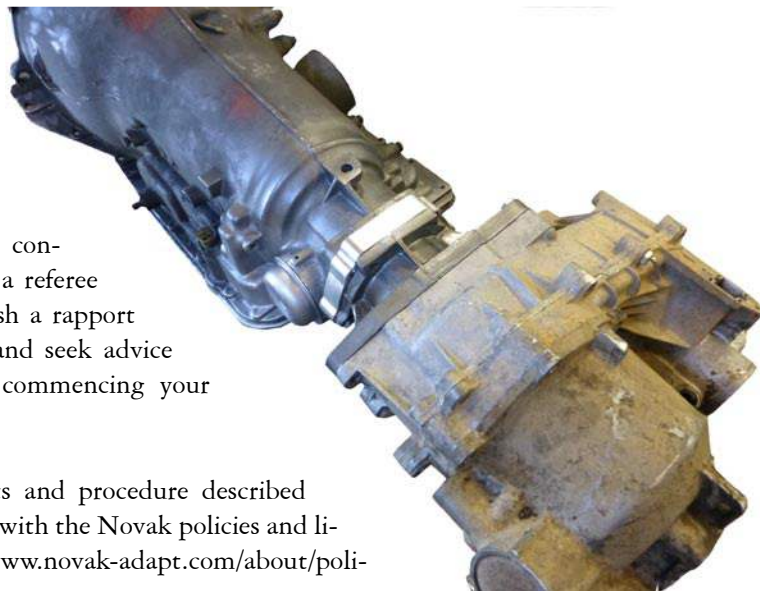


This guide is not meant to explain, interpret nor notify the installer any laws concerning vehicle changes, engine conversions and the emissions systems surrounding them. It is the installer's responsibility to know and understand their local, state and national legal requirements and regulations and to make their installation conform to emission and vehicle safety demands of the jurisdictions in which the vehicle may operate. Novak does not recommend nor condone the

disabling or modification of the vehicle or any system within it that could render it out of conformance with any laws in which the vehicle may be licensed or operate. Neither Novak Conversions nor its directors, principles nor employees are responsible for any changes made to your vehicle.

If you are performing a powertrain conversion and if your vehicle requires a referee inspection, you may wish to establish a rapport with them and discuss your plans and seek advice and approval from them prior to commencing your modifications.

These instructions and the products and procedure described herein are offered only in accordance with the Novak policies and liability limitations found at: <http://www.novak-adapt.com/about/poli->



cies.htm, which may supersede and prevail over these policies.

About the TH700R4 & Early 4L60E

The TH700R4 is an automatic shift, four-speed overdrive, longitudinally positioned transmission. It is now considered to be one of the finest overdrive automatic transmissions ever produced.

The Turbo 700 was introduced in 1982 as a response to fuel economy pressures, and to be phased in as the replacement for the TH350. The transmission was available for both car (RWD) and truck platforms. The transmission's principal new feature was its 30% overdrive. It also sported a lower-than-usual 3.06:1 first gear, popular for off-the-line acceleration as well as off-road torque.

There were some initial bugs in the earlier versions. A feather in GM / Hydramatic's cap was the fact that they stuck with the 700R and followed through with improvements and upgrades. 1987 and newer transmissions are considered

to be refined and very reliable, as indicated by their OEM installations against performance 350 V8s in sports cars and trucks. Earlier transmissions are affordably given all these upgrades to put them at the same high level of durable service and performance. Aftermarket building techniques and parts upgrades make this transmission very capable of Big Block power in race, street and off-road applications.

In 1990, the 700R4 was redesignated as the 4L60 (4-speeds, Longitudinally positioned, 6000 lbs. GVW). This was a change in name only with no significant mechanical changes associated.

In 1993, an important change did occur and that was the conversion of the hydraulic logic shifting system over to an electronic one. Mechanically, the transmission's power transmitting core remained the same, but the valve body and actuation system for the clutches, bands, etc. became controlled by electronic actuators and solenoids. A Vehicle Speed Sensor (VSS) was used as the primary feedback sensor, which fed the PCM or ECM (vehicle powertrain computer) the data to make shift decisions. The engineering of this system is not regarded as a complication, but an elegant simplification and further improvement to this transmission. This version is called the 4L60-E (or Early 4L60-E for our purposes).

In 1997, the 4L60-E began to be released having received a redesigned case. This is the Later 4L60-E, and it is not compatible with this conversion.



Summary

GM's commitment to the 700R4 is apparent in its strength, quality and broad usability. It is hands-down one of the most respectable transmissions of our era, and a very compelling Jeep conversion transmission. The 700R is a very attractive swap option for all Jeeps, with the exception of the CJ5 and other short wheelbased Jeeps - due to powertrain length and driveshaft angle issues. Adaptability to nearly all Jeeps is exceptional.

About This Conversion

Our TH700R-4 to QuadraTrac conversion makes for a very strong, and capable assembly both on-road and off-road. This kit was developed due to frequent customer requests.

The Adapter

The Novak TH700R-4 / 4L60 to Jeep QuadraTrac transfer case adapter is very compact at only 1" long. The adapter itself machined from a billet of high-grade aluminum alloy featuring a heavy cross-section and precision locating.

2wd versions of the Turbo 700R-4 / 4L60 and early 4L60-E are all ready to bolt up to our adapter kit as the required style of output shaft is already installed.

4wd transmission versions work equally well, but you will need to install a 2wd style transmission output shaft (image, below). We carry good, used GM shafts for this purpose and its installation and this requires disassembly of the transmission, and we recommend the services of a transmission professional. The basic installation is 2-3 hour bench job and may include simple gasket and seal replacements. Some choose this as the time for a more thorough master rebuild and update.

This assembly retains the use of the installer's existing factory TH400 to QT adapter to make a combined transmission and adapter length of 26-7/8". When used with Novak's popular, 1/2" thick #437AMC kit (adapting AMC engines to GM auto transmissions), this combination is essentially the same as the length of the TH400 and its factory transfer case adapter at 27-1/8"

700R-4 Versions

These kits are for the square, four-bolt tailhousing 700R-4 / 4L60 or 4L60-E, typically made through 1995. Some 1996 and later versions have a hex, six-bolt pattern tailhousing and removable bellhousing, and are not compatible with this conversion.

We offer two adapter kits:

Option I is for the 700R4 (aka, 4L60), which is the conventional, hydraulically controlled transmission; kit #1379.

Option II is for the 4L60-E, which is the electronically controlled version of the 4L60; kit #1379-E, shown below, right. This version permits you to use the electronically controlled 4L60-E (four-bolt version) with your 1305 / 1339 transfer case. Note that you will need to mildly modify the 4L60-E tailhousing (specific instructions, below) to install the included vehicle speed sensor (VSS). Also, make sure to plan on connecting your transmission to the GM ECM (if doing a GM engine swap) or get a standalone electronic transmission controller, available from GM, TCI, Jet, B&M and others.

Any version and year of the TH700R-4 can be adapted to the 300 transfer case, including "90 degree" (Gen. I, II, III V6 & V8 Small Block or Big Block engines) and "60 degree (early S10 Blazer 2.8L engine style)" versions of the 700, as determined by your choice of engine.

700R4 / 4L60, Non-Electronic Trans Install

Novak's #1379 kit is for the 700R4 aka 4L60 transmission, which is the conventional, hydraulically controlled transmission. No extra preparations are needed at this stage and you may skip the VSS discussion, below.

Early 4L60E VSS Installation Transmission Preparation

The available VSS kit #137VSS-A and #137VSS-B is for the 4L60-E, which is the electronically controlled version of the 4L60. This version permits you to use the electronically controlled 4L60-E (four-bolt version) with your QuadraTrac transfer case. Note that you will need to mildly modify the 4L60-E tailhousing (instructions included) to install the included vehicle speed sensor (VSS). Also, make sure to plan on connecting your transmission to the GM ECM (if doing a GM engine swap) or get a standalone electronic transmission controller, available from GM, PCS, TCI, Jet, B&M and others.

4L60E Speed Sensor Kit Install

Placing the sensor onto the transmission output shaft simplifies the total installation over using a transfer case output shaft sensor and the attendant wiring and PCM complications compensating for low range function, and leaves the Jeep speedometer cable or signal available for its OEM gauges. Most stock GM transfer cases that have the speed sensor in the transfer case have a switch built into the shifter that signals the ECM to remap the functions of the transmission in accordance with being in low range. The original wiring for the VSS will plug into the relocated VSS. This will connect directly to the ECM (or to the DRAC module or its buffer), depending on your type of GM ECM.

In the picture on the right a two-wheel-drive output shaft is shown on top. With 4wd applications, and the Novak conversions, a short output shaft is used.

4L60-E Reluctor Ring Install

You will use the provided reluctor with a 1.30" bore (#137VSS-A) for the smooth journal shaft style that is native to the 4L60E. This assembly must be installed with the clamp ring forward to prevent loosening. Access to the Allen head bolts is through the rear of the transmission case and will have to be tightened more by feel than by sight.

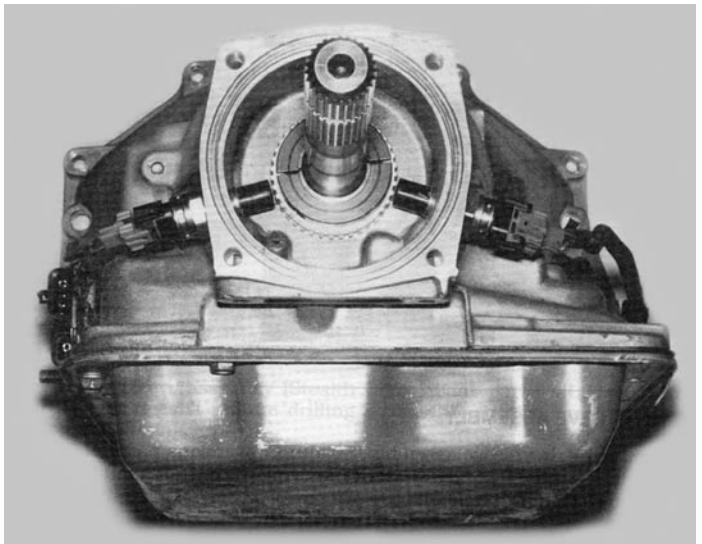


Sensor Installation

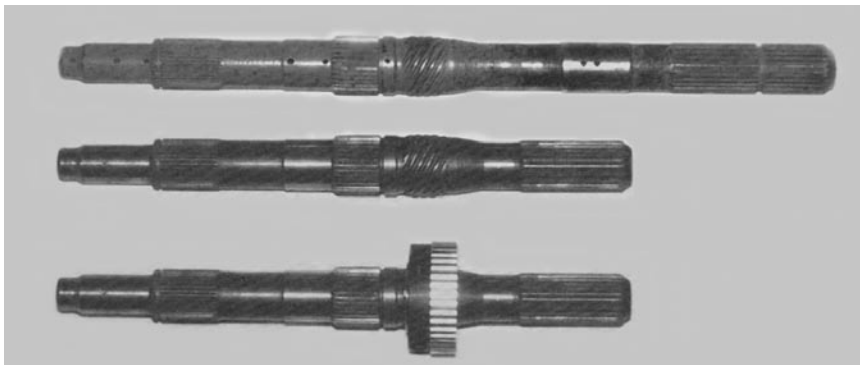
As to radial orientation of the sensor, it can be either on the passenger's or driver's side, depending on the installer's wiring layout and considering the location of the shifter linkages. The sensor will need to be longitudinally positioned to be centered over the reluctor ring journal. Use a small scale or caliper to measure from a datum point such as the transmission case rear face. Using the same measurement, mark the outside of the case for drilling.

A few installers worry about drilling and tapping a hole into the transmission case. This is not a problem. The case is aluminum, and it is an easy job to drill and tap. The positioning of the hole is not excessively critical, and the drilling can be done with a hand-held electric drill. Just keep the drill and tap perpendicular to the centerline of the output shaft.

Ultimately you will drill and tap a 5/8"-18 UNF thread hole into the transmission case. Start with a small bit for best control, and work up to a .578" (sie I or 37/64") bit, or follow the tap manufacturer's recommendation. The wall thickness of the case is



5/16" in the areas shown, which gives plenty of thread engagement, given that this part should not be under any significant mechanical forces.



Prevent getting particles into the transmission by inserting a piece of tape over the oil return hole (about 1/2" diameter), and put a piece of tape over the oil spray hole. Use a vacuum adjacent to your drill bit while drilling to further minimize chances of chip contamination, then follow up with gentle compressed air. Wipe the area clean and remove the tape.

Now, verify that the output shaft is centered in the case. You can measure this with calipers or a very precise machinist's ruler using the transmission case rear index ring as a reference point. Next, coat the threads of the VSS with LockTite Blue and tighten it down until it just touches the reluctor ring. Now, back off 1/8 to 1/4 turn, and let the LockTite set-up. The gap is now .012" to .016" which is about ideal. After the LockTite has set-up. Spin the jam nut onto the sensor and snug it against the transmission case.

Now, wire the non-polar wire leads as per your diagram and harness. You should now be ready to continue with the installation of your transfer case adapter.

Note that this speed sensor set-up is smog legal in California and has been issued E.O. #D-371.

Assembly Procedure

Transfer Case Adapter Fasteners And Bearing Removal

If you've not already done so, remove the factory TH400 to QT adapter and its fasteners. Remove your factory adapter bearing.

Clean All Mating Surfaces, Splines & Threads

Clean all adapter mating surfaces on the rear face of the transmission, the original adapter, and the transfer case input, being careful not to contaminate either of their internals with any particles. It may be necessary to razor off old gasket material and sealants. Follow up with a solvent, rag and compressed air as needed.

Clean and inspect all transmission and transfer case face threads. It may be necessary to run a threading tap for clean-up. In the event of severely damaged threads, thread repair inserts might be required. For individuals expecting severe duty from their TH700R4 / QuadraTrac combo, it may be a good idea to use thread inserts in the four bolt holes of the transmission's aluminum flange, as the leverage forces of the transfer case on the transmission could, over time, cause the fasteners to loosen.

Adapter Test Fitment

Omitting, for now, the provided coupler shaft, trial fit the adapter to the rear of the 700R transmission case, leaving the provided o-ring to make certain the adapter mates up easily and squarely. Make sure they fit well together by hand and with minimal resistance. At this test fitting stage or final assembly, never use the adapter bolts and force to bring the assembly together.

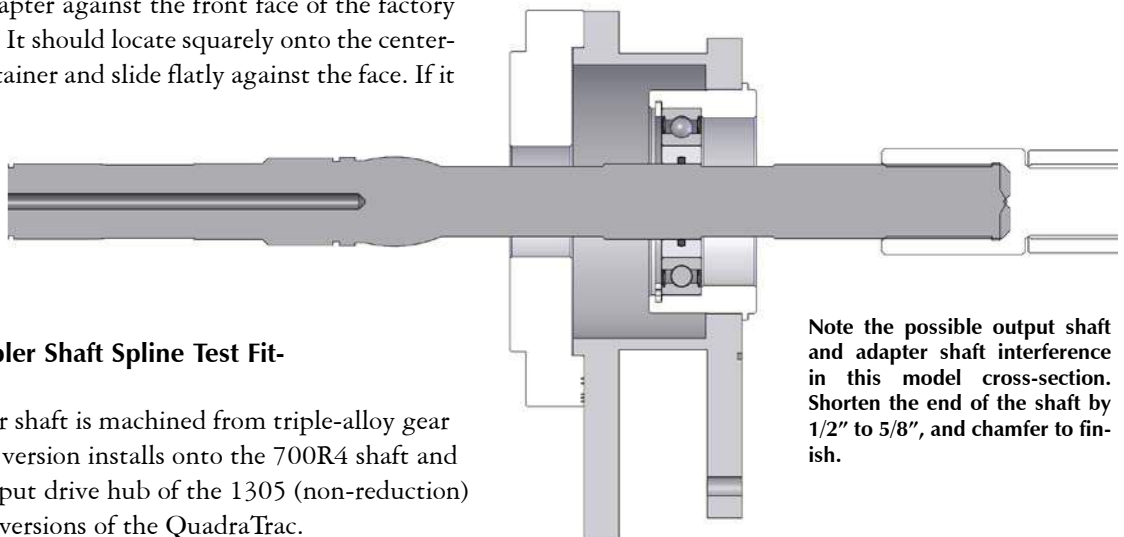
Then, test fit the adapter against the front face of the factory QuadraTrac adapter. It should locate squarely onto the centering input bearing retainer and slide flatly against the face. If it does not, check for any nicks or burrs and rectify as appropriate with a flat file or other means.

Transfer Case Coupler Shaft Spline Test Fitment

The included coupler shaft is machined from triple-alloy gear steel. This 27 spline version installs onto the 700R4 shaft and into the 10 spline input drive hub of the 1305 (non-reduction) or 1339 (reduction) versions of the QuadraTrac.



Two of our preferred gasket sealants include Permatex® The Right Stuff RTV silicone and Permatex® Aviation Form-A-Gasket in the brush-top bottle. Years of experience building many hundreds of gearboxes, leak-down testing them and hard operation prove them to be superior.



Note the possible output shaft and adapter shaft interference in this model cross-section. Shorten the end of the shaft by 1/2" to 5/8", and chamfer to finish.

It is not requisite that you rebuild your QuadraTrac to successfully complete the conversion, but it may be a good time to do so if your transfer case leaks or has many miles of service. .

Before the assembling of either your transmission or transfer case, test fit the transmission output shaft into the Novak coupler shaft to test for proper spline count and fit. Make sure they slide nicely together and by hand. The splines should slide together easily but without a lot of rotational allowance (lash). There is a certain amount of variation in factory shafts due to wear and other factors. We have splined our shaft tight enough to minimize both wear and the risks of breakage.

Note that these are involute splines and are self-centering upon transmission of power.

Then, test fit the adapter shaft to the 10-spline input hub of the QuadraTrac transfer case in like manner as above.

Shorten the Transmission Output Shaft

In order to keep this adapter assembly the same length as the TH400 combo you are replacing, and other factors, it is required to trim shorter the 2wd output shaft of the 700R4 / 4L60 transmission. The recommended



amount of removal is 1/2" to 5/8". This is best done with an electric or pneumatic separating disc / cut-off wheel. It is *critical* to seal off your automatic transmission from cutting debris. This can be done by stuffing the tailhousing with rags and / or using tape to completely seal out the possibility of particle ingress, which could cause transmission malfunction or damage.

Be sure to wear safety goggles and other protective gear and cut the end of the shaft. Once the end of the shaft is cut, chamfer its sharp edge by having an assistant rotate the shaft (locking pliers work well for this, as pictured) while you break the edge and create a chamfer with a grinding disc.

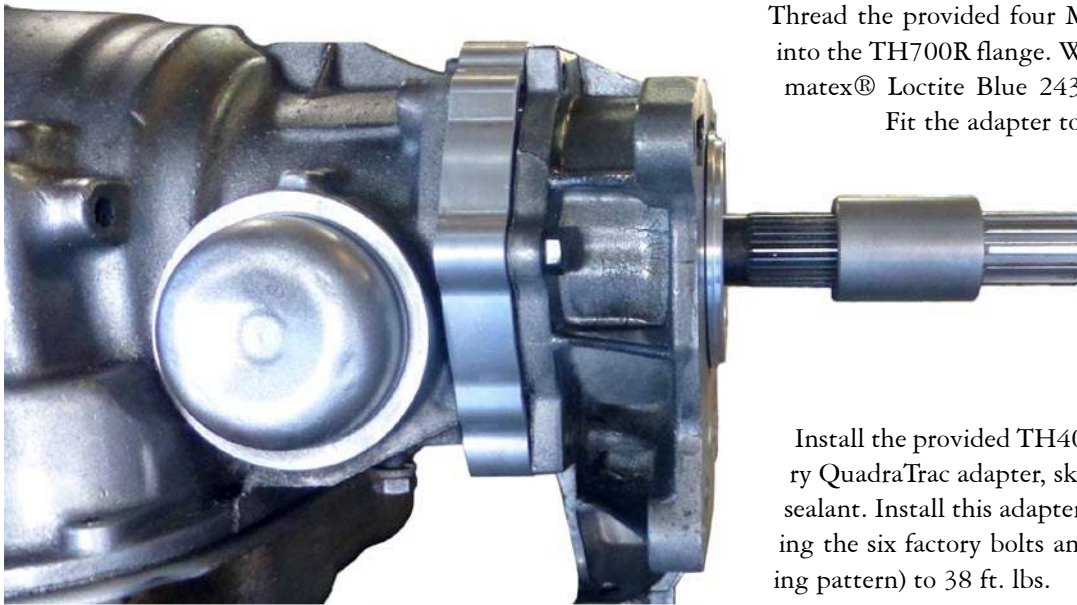
Thoroughly clean your transmission and working area to proceed with the final adapter assembly

Adapter to Transmission Installation

We've included a new TH700R rear o-ring, which you will seat onto the shoulder of the adapter's locator step. Coating the o-ring with a *thin* coat of sealant is acceptable but be careful as excess sealant can escape into the transmission and wreck it in operation by plugging fluid passage.



We've provided a vial of Permatex® Loctite Blue 243 thread locking compound. A drop or two per stud is recommended to prevent them from loosening under strenuous service.



Thread the provided four M10 studs to full hole depth into the TH700R flange. We recommend the use of Permatex® Loctite Blue 243 thread locking compound.

Fit the adapter to the transmission flange and install the lock washers, then nuts, tightening them in a crossing pattern in three successive stages until you've achieved 38 ft. lbs. of torque.

Install the provided TH400 rear gasket onto the factory QuadraTrac adapter, skinning it with your preferred sealant. Install this adapter onto the Novak adapter using the six factory bolts and tightening them (in crossing pattern) to 38 ft. lbs.

Bearing Adapter Assembly

We have provided a pre-assembled bearing adapter, which mimics the shape of the original adapter bearing for the purpose of centering and shouldering your factory adapter to the QuadraTrac input bore. This adapter assembly uses a sealed bearing and grooved bearing sleeve, which has an o-ring, creating an excellent seal between the gearboxes. Apply a skin of RTV sealant behind the lip of this bearing adapter, then insert it into the factory adapter. It may take light taps from a soft mallet to seat it, and the sealant should just squeeze out the perimeter.

Adapter Shaft Splines Lubrication & Installation

The transmission output shaft splines and transfer case input shaft splines should be pre-lubricated prior to assembly for

start-up usage. Use an assembly lubricant only. Do not use grease or any other substance that will not properly dissolve into the transmission fluid. Upon filling and operating the TH700R4, the splines will then be continuously exposed to ATF and well lubricated.

Transfer Case Installation

In like manner as above, place a gasket on the rear face of the adapter, then carefully install your QuadraTrac transfer case to the factory adapter. You may need to twist the transfer case to get the splines of the coupler shaft to line up. Bring them together and make sure there is no space between them. If there is, check for any misalignments or impingements. Also, be sure that you cut an adequate amount off



your trans output shaft. There should be no thrust pressure against the transmission shaft in the assembly.

Use the factory adapter bolts, torquing them to 38 ft. lbs.

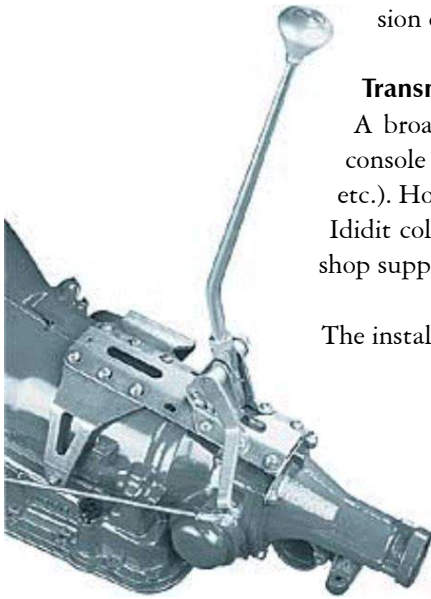
Transfer Case Shifter

Since the length of this transmission is the same as the original TH400 combo, this transmission conversion will allow for the retention of the factory shifters.

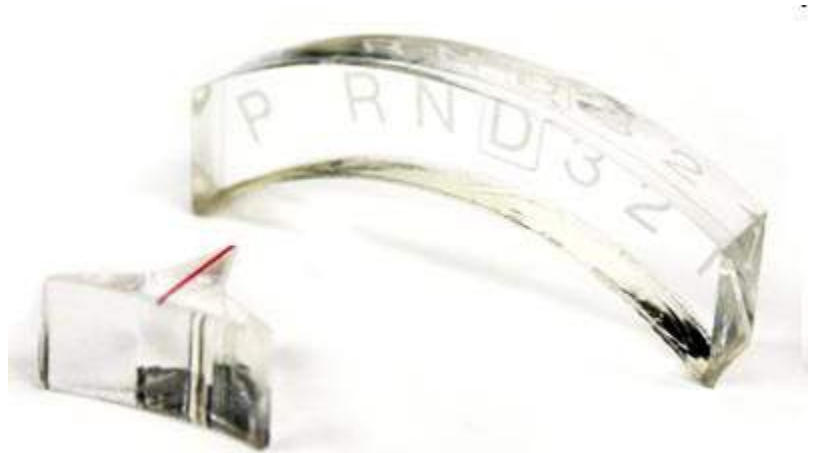
Transmission Shifter

A broad variety of transmission shifters are compatible with this conversion, ranging from console shifters (i.e.; Art Carr, B&M, etc.), to direct-mount stick shifters (i.e.; Gennie, Lokar, etc.). However, most installers are likely to retain their factory column linkage, in which case the Ididit column indicator kit for overdrive automatics is useful. Look for it at your favorite speed shop supplier.

The installer will also need to reattach the factory column shifter bellcrank, or change to an after-



market cable shifter kit, available from Lokar, Ididit and perhaps others. Use of Lokar's adjustable shift sector arm #ACA1802 (image, adjacent) for the transmission is also recommended.



Driveshafts

Because this assembly (when used with the Novak kit #374 engine adapter) is the same length as the TH400 its replacing, the rear drive-shaft does not need to be replaced for the purpose of this conversion.

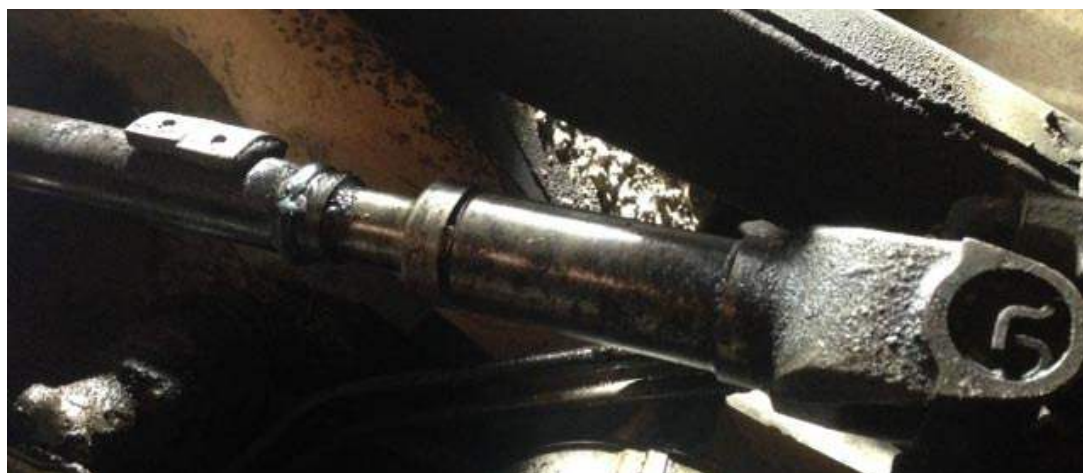
The factory 1-1/4" diameter front driveshaft can be used, but it will have to be turned around so that the narrow portion of the shaft can get past the transmission pan, placing the CV portion of the shaft (if so equipped) at the axle

A non-factory style driveshaft (shown) may not clear the transmission pan. Use the factory or after-market 1-1/4" diameter driveshaft.

Your factory shaft may also have large weights (see picture) on it, evidence of high-production, roughly assembled driveshafts. You may need to upgrade to an aftermarket shaft whose small weights will clear the transmission.



yoke.



Transmission Rear Mount

The installer will use the factory style rear mount installed onto the factory adapter, as it will land in close proximity to the original crossmember holes. Alternatively, Novak offers an upgraded, interlocking urethane rear mount as an upgrade to the factory rubber mount.

A Warning on Hard Mounting

Under no circumstance should you "hard-mount" any part of your powertrain and doing so will void any warranty offered on this kit. Hard-mounting involves mounting the engine or transmission solidly to the frame horns, or to the crossmember / skidplate. This rigidity may be permissible in a race car that only sees smooth track, but is in no way appropriate for a regular street vehicle, let alone a 4wd vehicle. The powertrain requires the give, flex and shock-absorption afforded it by urethane, rubber or similar



isolators.

As concerns the rear mount: even if you install a crossmember that is itself mounted to the frame on flexible isolators (also not a good idea as the crossmember is intended to be a structural and solid component of the frame), this is not enough since the amount of moment force required to flex that kind of crossmember is significantly higher and will unnecessarily strain the transmission case, rear mount base and the adapter. This can cause cracked cases, chronically loosening bolts, excessive driveline shock, broken parts, etc.

Transmission Cooling

For every 10 degrees cooler you can keep the transmission, you can add 25,000 miles to its service life. Therefore, use of a transmission oil cooler is advisable for this automatic transmission. Use of a transmission temperature gauge is also a good idea. These are widely available and generally inexpensive.

With the increase in popularity of the newer, hotter burning, fuel-injected engines, it is increasingly recommended to run a stand-alone, dedicated transmission fluid cooler and in front of the engine radiator wherever possible, in lieu of one integrated into a radiator.

Engines & Engine Mounting

A 700R4 installation is often done in conjunction with an engine conversion into the Jeep. These engines include the Chevrolet Small Block V6 & V8, from Generations I, II, & III, 1955-2012+.

Novak's MM Series engine mounts, featuring excellent vibration dampening, superior strength and impressive adjustability - adjustable even after the engine is installed. The design and strength and affordability of our mounts are second to none.

In any scenario, it is critical that the engine be installed (as the Jeep engines usually are) with an offset of 1" to 1-1/2" to the driver's side. Other engine mounts on the market - especially the bolt-in versions - do not take this into account and make other placement decisions for the installer that do not take the full powertrain into account. Novak offers what we have found to be the most intelligent engine mounting system for Jeeps available, allowing the installer to make an easy and satisfying decision as to powertrain placement with the 700R and the Dana 300 both considered.



This Jeep featured a hard-mounted adapter, though with isolators at each end of the transmission support crossmember, which offers inferior powertrain flex and unacceptable frame flex. To counteract the latter, the installer welded a tubular crossmember behind the transfer case, which makes future servicing highly problematic.

Best stick with a more conventional skidpan and rear mount isolator, which offers better characteristics, geartrain shielding and frame strength.



Axles

Use of factory axles is completely acceptable with this conversion. Axle upgrades are not necessary to the conversion itself, but they may be chosen for reasons external to this transmission upgrade.

Speedometer

Because you're retaining the factory Jeep transfer case, you'll use its speedometer output to the factory (or aftermarket) gauges just as original. If you are running a cable driven gauge and a computer controlled engine that requires a VSS, you may need to run a signal generator with both cable and electrical outputs and as appropriate for your particular engine's PCM.

Conclusion

We suggest that you keep these instructions for future reference. For questions concerning your conversion, contact us. We'll be pleased to answer your questions.

There is no final word to our instruction packages. If you have a question you feel this information should have covered and didn't, please let us know about it. You are also welcome to submit your suggestions, ideas and images that you think we should include here which may help future conversion installers. Note our contact information below.

