10885 May Chapel Rd. Lawrenceville, IL 62439
618-943-4856 www.bowlertransmissions.com

New Transmission Installation Guide

Congratulations on the purchase of a new overdrive transmission! This is an exciting time and I'm sure you're anxious to get the transmission installed so you can start grabbing gears and chirping tires. We are just as excited for you and want to make sure you have the best experience possible, so we've put together this installation guide for you. Grab a drink, relax, and enjoy the read, it will be well worth the time to save you the aggravation later. There are certain inspections and steps you want to take before installing a new or different transmission in your car or truck that will assure a "one-time" installation. Doing these steps only take a few minutes and will save you headaches and head scratchin' down the road. We recommend performing each check before trying to assemble-as-you-go, following the steps below. In most cases your entire package was hand selected by Bowler Performance to ensure that you do not run into any issues, but we still recommend following through these procedures to ensure there aren't any unforeseen issues that may have been overlooked.

1) Pilot Bushing or Pilot Bearing - Both accomplishes the same goal to support the pilot tip of the transmission input shaft. Not all engines can accept a bearing due to limited space available in the crankshaft and in some applications a bearing may stick out and cause interference with either the clutch disk or the splines on the input shaft. Your retailer may not have this information so some homework may be required on your part to make sure you'll have enough room if you're trying to run a bearing.

There are two common things to make sure of when it comes to pilot support... one is did you put one in? We've seen transmissions get destroyed and clutches not release properly because someone forgot to install a pilot bushing/bearing. Oops! Secondly is the right size pilot bushing or bearing. Too big you get premature bearing/gear wear and clutch chatter, too small and you get an energized input shaft, which we'll talk about later. So, verify this: the pilot tip and the bearing or bushing should have about .0005 to .003 clearance. Not to be confused with an interference fit which is a no go. This check can be preliminarily checked with the bearing or bushing not installed in the crank but MUST be verified after it is installed in the crank because the inside diameter will shrink. **LS engine owners please see page xx**

2) Flywheel Balance - Depending on the engine, it could be externally balanced or internally balanced. You will want to make sure the crank, flywheel AND harmonic balancer all have the same Zero Balance or Imbalance, as it's called. Ask your engine builder if you're not sure. Aftermarket engine stroker kits typically follow existing motor balancing, but not always. The stroker kit manufacturer will have this information for you. Yeah, I know - more than just the flywheel info here but it all plays together on the engine. Later in the guide we will cover checking the flywheel runout as well.

3) Bell Housing - Multiple checks to do here. You'll want to check four things before assembling all your components: Bell housing fit to engine and transmission, perpendicular alignment, and bell housing run-out. All of these checks will require a dial indicator and a magnetic base. There is a special section of this guide that covers the entire procedure.

4) Clutch Pressure Plate - Does it fit the flywheel you have? Some flywheels have multiple clutch patterns on them to accommodate various equidistant, LONG (aka Borg & Beck pattern) or custom patterns. Make sure you can install the pressure plate properly. Never modify the mounting holes in the flywheel, never drill new mounting holes in the pressure plate or flywheel, and ALWAYS use the correct fasteners. There will either be locating pins and non-stepped bolts OR step-bolts and no locating pins. If you install a pressure plate that does not use pins and install non-stepped

bolts you will get a vibration. Also, clutch pressure plates are balanced independently of any other assembly. Never balance an engine with the pressure plate installed. You can check the balance with the pressure plate installed but do not re-balance the pressure plate. If your engine builder finds a problem with the balance of the pressure plate... replace it or rebalance it. And never check this with the disk installed since the disk cannot be perfectly centered.

5) Clutch Disk - the life decision maker of the whole manual transmission set-up. Install it correctly. The top-hat side of the disk goes towards the transmission. There may also be a sticker on the clutch disk indicating which side goes which way. Verify the spline of the disk matches the spline of the input shaft of the transmission. Verify the clutch disk fits within the pressure plate opening and the edge of the disk comes to or very near the outside edge of the pressure plate surface. Too small of a disk will not be as effective. Additionally, set the disk in the opening of the flywheel and check for the same clearances. Make sure the disk does not come in contact with the flywheel bolts. The flywheel must be installed on the engine to do this check.

6) Clutch Installation - When installing your clutch assembly on the flywheel make sure all the above was addressed. Check the alignment tool. Verify it is the same spline count and pilot tip diameter as the bearing/bushing and the transmission tip. The wrong size tool may not center your disk correctly making transmission installation difficult. Tighten down the pressure plate bolts evenly. Not doing this could temporarily warp the pressure plate and bind the alignment tool throwing off the disk center as you finish tightening down the bolts. The alignment tool should slide in and out easily if the alignment of the disk is correct.

7) Throw Out Bearing Installation - Whether it's a mechanical bearing or a CSC (Concentric Slave Cylinder - hydraulic bearing) it must be installed correctly before installing the trans. Mechanical bearings get installed on forks (levers) and CSC's get set-up with the required .125" clearance. Individual instructions vary by manufacturer or type. Refer to those instructions for proper set-up.

8) Clutch Fork and Clutch Lever- A Clutch Fork rocks on a fulcrum on the driver ' s side of the bell housing and a Clutch Lever attaches to a pivot stud on the passenger side of the bell. The ideal geometry for both of these is the throw-out bearing, pivot/fulcrum, and actuation attach point (Z- bar linkage, cable or external hydraulics) are all parallel with the flywheel when the pressure plate fingers are depressed ¼". Having this correct geometry will provide you with the most consistent feel of the pedal and least amount of travel requiring the clutch disk to release. There are some standard dimensions for various applications and using matching parts with non-adjustable pivots/fulcrums should give you this favorable condition.

9) Transmission Installation - DO NOT DRAW IN THE TRANS or BELLHOUSING WITH THE BOLTS! When installing the transmission, it should go in as smoothly as the fitment you did on each of the components individually and the transmission should slide all the way in and make contact with the bellhousing. Make sure the bearing retainer guide tube does not hang-up on a mechanical t/o bearing. We've seen engine blocks, bellhousings, and transmission cases damaged from trying to use the bolts to draw the parts together.

10) Grease & Sealant - Always seal the flywheel bolts on a crank with open holes when final installing them. Whether it's a thread locking compound or Teflon sealant. Not sealing the threads will result in oil getting on the disk surface. Always grease the pocket on a mechanical bearing - this is the surface that rides on the guide tube of the input shaft. DO NOT grease the splines of the input shaft or the splines of the disk - this must be dry for the same reason. Lightly grease a pilot bearing, DO NOT grease a pilot bushing.

11) Energized Input Shaft - An energized input shaft is a term used to describe constant turning of the transmission gears, with the clutch pedal pushed in and in neutral, and it's hard to shift in or out of gear, while the engine is running. There are a few reasons this can happen and each of those things were discussed in the individual sections. Bottom line is you have a misalignment, interference, or clutch release issue.

- Things that can cause an energized input shaft are:
- Defective or missing pilot bearing/bushing, discussed above.

- Not enough clutch release.
- Too much Marcel in the clutch disk - this is the springiness of a clutch disk. You will be able to squeeze the disk with your fingers to flatten it out. Too much of this spring can cause drag when clutch is released, tasking the synchronizers in the transmission to work extra hard and cause premature wear. The Marcel is what allows the disk to align itself between the flywheel and pressure plate and eliminate that chatter during a slow clutch release. On the flip side, not having any Marcel will cause jerking and chatter. It's such a small thing that plays a huge role in how a vehicle performs.
- Misalignment of the input shaft to the crank, also discussed above.

Alignment Procedures for Your Manual Transmission Installation

Before installing your new transmission, it is very important to make sure that your bellhousing is properly aligned with the centerline of the crankshaft. You will also want to take the time to ensure the flywheel is flat against the crankshaft as well. In this guide, we will cover the processes of aligning all the components to ensure a great experience once all the new parts are installed. The last thing anyone wants is to spend a few thousand on a transmission package only to have problems a few hundred miles down the road.

A bellhousing that is not concentric or parallel with the crankshaft centerline will have a poor shift quality. You may also experience accelerated clutch wear, engagement problems, accelerated input shaft bearing wear, pilot bushing noise/excessive wear, and an overall dissatisfying experience with the performance of your new transmission. Even if you do a dry fit and everything “slides right together” doesn’t ensure a proper alignment. The only way to know for sure is to take the time to do these measurements.

Checking the bellhousing alignment can be a tedious task, especially if the engine is still in the car, but it is essential for proper operation. If anything, do the alignment to ensure that if you should have a warranty claim that it will not be immediately dismissed due to improper alignment. (Trust us, it is immediately evident when a transmission wasn’t aligned properly, this will almost always void any warranty claims)

Measurement Quick Reference

Standard Automotive Bellhousing Alignment Specifications:
Concentric: +/-.005” or .010” TIR Parallel: +/-.001” or .002” TIR

Hi-Performance 7,500+ RPM Bellhousing Alignment Specifications:
Concentric: +/-.0025” or .005” TIR Parallel: +/-.0005” or .001” TIR

Flywheel runout .001” to .005” Max (less is always better)
Before you get started it is always helpful to go ahead and ensure a smooth, clean mating surface for all the components. This means metal to metal contact may be the only way to get the measurements you need. Normally you will be able to get by with making sure the block surface and crank flange is rust/paint free and the dowel pins are clean of any debris. There shouldn’t be any nicks or burrs either. In some rare cases, it may be necessary to clear the paint from the bellhousing if there is significant build up. A bellhousing that is quite a bit out of parallel will need to be shimmed regardless.

Flywheel Runout

The first part of a successful install will be to ensure that your flywheel is parallel with the crank shaft flange. This will give you a good foundation to work from when checking the bell housing alignment.

1. First be sure the crank flange is clean/rust free. Bolt up the flywheel and torque the bolts to spec.
2. Set up your dial indicator perpendicular to the flywheel clutch surface. This can be done by attaching the magnetic base to the oil pan or engine block.
3. Be sure to zero out your indicator and mark your starting point. Then slowly crank the engine by hand for one full revolution (360*) to be sure you come back to a zero reading at your starting point. Do this one more revolution to ensure repeatability and that your dial indicator is mounted securely.
4. Once you have your starting point established make another rotation and note for any low (negative) readings. If you have any negative readings, mark that spot and that will be your new zero starting point. If you have no negative readings move on to the next step.
5. Now that you have verified your zero-starting point make a couple revolutions and note any high spots. You should end up with no more than .005" TIR. As always, the lower number the better.
6. If you end up with more than .005" TIR there is a possibility that your flywheel is warped, damaged, or needs to be resurfaced. At this point it may also be necessary to check the crank flange for run out as well to be sure it does not have any damage.
7. Once you have your flywheel runout within spec you are ready to move onto checking the bell housing alignment.

** NOTE: If you are working with an aluminum flywheel you may need to remove it for the bellhousing alignment. This will allow you to mount the magnetic dial indicator base to the crankshaft flange for a more solid connection.

Checking Bellhousing Concentric Alignment

There are different procedures to follow depending on your transmission. The TKO 5-speed and Magnum 6-speed utilize two different styles of bellhousing. The TKO 5-speed can be dial indicated on the bellhousing opening, whereas, currently, to do a proper alignment for the Magnum 6-speed, the front cover of the transmission will have to be removed and bolted to the bellhousing so that the input shaft bearing race can be utilized for measuring. From there the measuring procedures are the same.

***TKO 5-speed owners*: There is one more item to be checked before you get started: the front bearing retainer on the transmission. It is the outer diameter of this retainer that determines the concentric placement of the transmission on the bellhousing, not the transmission bolts. Therefore, it is important that the bearing retainer be the right one to work with the bellhousing being used. The retainer should be a snug fit in to the opening in the bellhousing. If it is not, another retainer of the proper diameter must be found (most manufacturers have produced bearing retainers in a number of different diameters). Another alternative is to use a spacer bushing in the bellhousing opening.**

1. After ensuring you have a clean/rust free mating surface. Secure the bellhousing to the engine block and torque all bellhousing to engine bolts to specification. If using a scattershield, make sure the block plate is installed***. Magnum 6-speed owners will also bolt on your front cover at this point, but be sure to attach your magnetic dial indicator base to the flywheel before the front cover goes on.***

Note: The stock dowel pins must protrude out past the block plate/scattershield and locate on the cylindrical part of the dowel pins, not the tapered end. If the scattershield is resting on the tapered end, it will cause an inaccurate alignment reading. If necessary, tap the stock dowel pins rearward, just enough for the tapered end to protrude through the scattershield

2. With the engine on TDC (Top Dead Center), install the dial indicator base on the flywheel. Adjusting the plunger to contact the inside edge of the bellhousing transmission register hole at 12:00, or if aligning for a Magnum 6-speed, you will use the input shaft bearing race to measure from. If needed, removing two flywheel bolts 180* apart for the dialindicator to sit flush on the flywheel is OK.

   Note: The magnetic based indicator does not need to be on the exact center of the flywheel. TDC/12:00 dial indicator setup will allow better communication with your helper to stop at TDC/12:00 for the repeatability checks. ***Aluminum Flywheel Users:*** you will need to remove your flywheel for the alignment check. The magnetic base indicator will not attach to an aluminum flywheel.

3. With the dial indicator on (0) zero and mounted securely at 12:00, your helper can rotate the crankshaft 360* slowly. Your job is to note the dial indicator reading, you are looking for the most (-) negative number on the dial indicator as it rotates the 360*. When your helper rotating the crankshaft stops on TDC, your dial indicator should read (0) zero at 12:00. If you read (0) zero, then you have verified your dial indicator is mounted securely. Do another crankshaft rotation to double check your dial indicator still reads (0) zero at 12:00.

4. With the dial indicator still secured at 12:00; note the most (-) negative number of the dial indicator during your next 360* rotations. Once you are certain where the most (-) negative number is, mark the bellhousing. This most (-) negative number will be your new dial indicator (0) zero location.

   Note: The most (-) negative number dial indicator reading can be at any location within your 360* rotation.

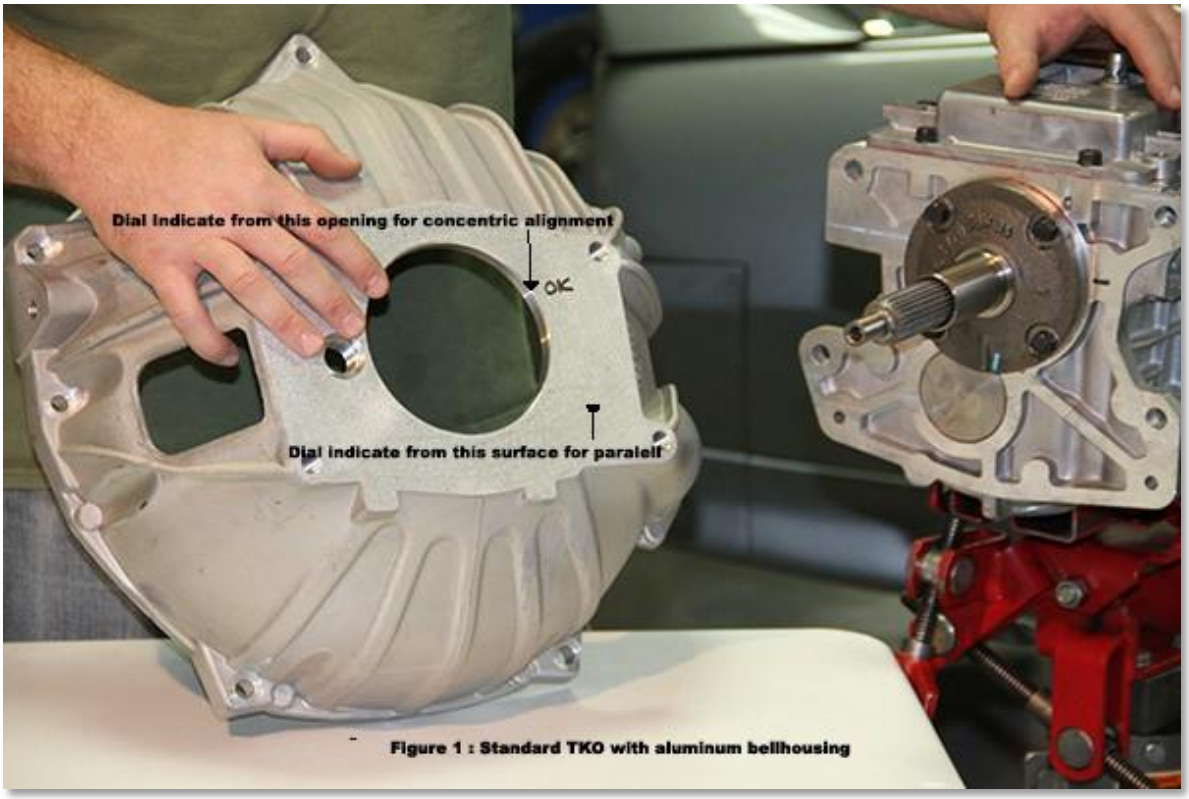


Figure 1 : Standard TKO with aluminum bellhousing

Figure 2: Example of Magnum 6-speed bellhousing

Figure 3: Magnum bellhousing with transmission front cover attached

Bellhousing Mis-Alignment Exercise Example:

5. If you have determined your most (-) negative number is at 8:00; rotate the crankshaft until the dial indicator is at 8:00 and (0) zero the dial indicator. As your helper rotates the crankshaft from the new 8:00 (0) zero location, your most (+) positive number should be roughly at 2:00 or 180* from the new 8:00 (0) zero location. The TIR (Total Indicator Reading) of the dial indicator needle from 8:00 to 2:00 is your bellhousing register hole to crankshaft centerline misalignment. If the TIR was +.028" on the dial indicator, you divide .028" / 2 = .014". and .014" would be the needed offset dowel pin to correct your bellhousing concentric misalignment. The .014" offset dowel pins would also point towards 2:00 to correct the bellhousing mis-alignment.

Checking Bellhousing Parallel Alignment

1. With the engine on TDC and the dial indicator base still mounted on the flywheel, adjust the plunger to contact the front face of the bellhousing at 12:00.

   Note: The bellhousing front face is the contact area your transmission mounts to. You can add a piece of packaging tape to cover the clutch fork pivotball threaded hole. The packaging tape will also allow the plunger to glide over the hole opening.

2. With the dial indicator on (0) zero and mounted securely at 12:00, your helper can rotate the crankshaft 360* slowly. As before, your job is to note the dial indicator reading, you are looking for the most (-) negative number on the dial indicator as it rotates the 360*. When your helper rotating the crankshaft stops on TDC, your dial indicator should read (0) zero at 12:00. If you read (0) zero, then you have verified your dial indicator is mounted securely. Do another crankshaft rotation to double check your dial indicator still reads (0) zero at 12:00.

3. Your most (-) negative number will require shims between the engine block and bellhousing to correct the parallel alignment.

Bellhousing Alignment Helpful Hints

1. Does the concentric bellhousing alignment check but, do not make any offset dowel pin corrections at this time?

2. Do a parallel alignment check and if needed, shim the bellhousing to achieve parallel alignment specs?
   Note: Aligning a bellhousing to within parallel specs will change the bellhousing concentric reading.

3. Do another concentric alignment check and use the correct offset alignment dowel pins to achieve your concentric alignment specifications?

4. TIR = "Total Indicator Reading". The needed "Offset Dowels" to achieve the concentric alignment specs will always be ½ of your TIR. TIR of .028" will use a .014" offset dowel pin to correct the concentric misalignment.

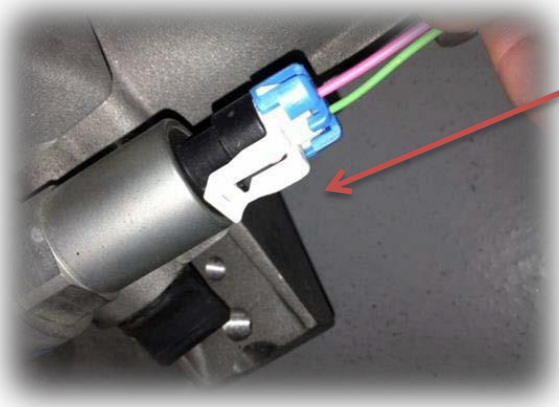
5.

Total Indicator Reading	½ of TIR	Use Offset Dowels
.012" to .020"	.006" to .010"	.007"
.022" to .034"	.011" to .017"	.014"
.036" to .052"	.018" to .026"	.021"

6. The better a bellhousing is indexed and dial indicated to the crankshaft, the smoother performance, higher RPM shifts, and transmission longevity you will experience.

7. If your bellhousing requires offset dowel pins (contact your local speed shop and see if the dowel pins are available in the proper offset for your block). Before installing the offset pins we recommend to drill and tap a small hole into the side of each, dowel pin hole (in the block) so that a small Allen-head set screw can be used to lock the offset pins in the proper orientation after alignment is completed. When installed, the offset dowel pins can be adjusted with a screw-driver to obtain the proper alignment. In some cases, the dowel pins must be polished with a strip of emery cloth to permit them to be rotated in the dowel pin holes with a screw-driver. Adjustment with these offset pins can be tedious and time consuming so be patient. After this is completed, tighten all bellhousing bolts and recheck the alignment one more time. If everything is okay, the bellhousing portion of the job is done.

T-56 Magnum Wiring



Reverse Lock-Out Solenoid

- One wire to ground
- One wire to either a momentary switch to supply 12 volts + or to the normally closed side of the brake switch. When 12 volts + is applied, the solenoid is energized to allow the shift lever to go to reverse.

Doesn't matter which wire goes where

*** (**Bowler Performance has an All-in-One harness solution which will make it more like OE operation)

Reverse Light Output Switch

- One wire to 12 volts +
- One wire to the reverse lights

Doesn't matter which wire goes where

Vehicle Speed Sensor (VSS)

Used for electronic speedometer output If you are using a mechanical speedometer, this sensor will not be used. But please leave in place. (*If you are using the VSS, please use quality aluminum plug to plug the mechanical speedometer hole. Do not use the rubber shipping plug.*)

Bowler Performance All-in-One harness for the Tremec T56 Magnum

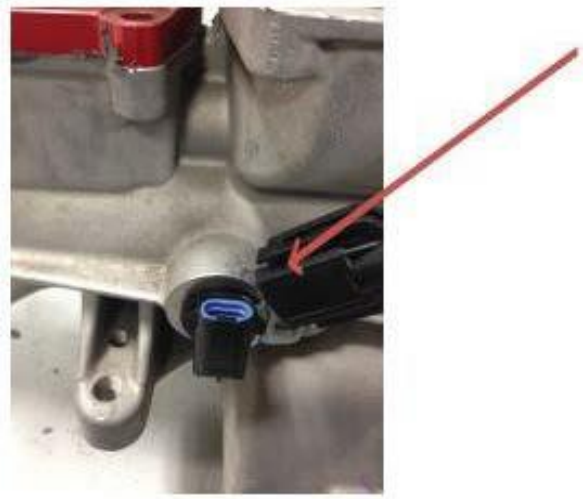
The all in one utilizes a small, built in, epoxy sealed control box that will control each of the 3 functions with power and grounding for each function through 1 switched +12v circuit and 1 wire connected to the negative battery post or engine block. Control of the reverse lockout solenoid is based on a user defined speed setting that is set up through the mobile app. This eliminates the need for a separate lock out control box. The electronic speedometer output connection on the harness is equipped with 2 speed sensor outputs; the speed sensor outputs generate a square wave signal that goes from about -5 to roughly +5 volts, varying in frequency as the speed changes. If your ECM needs a positive only input, the output will automatically shift and give you 0 to +10 volts. The 2 speed sensor outputs are completely independent and can be calibrated separately with any pulse count and ratio you want. These two outputs should be able to drive any common speedometer, cruise control, or ECM. If only one output is needed you can choose either wire and cap the other that will not be used. This will give you much greater flexibility in the components you are able to use and requires less time wiring everything up. The reverse lights are powered by a pair of wires connected to a switched +12 volt source and the positive side of your reverse lights; grounding of those lights should be local to the bulb socket.

TKO WIRING

REVERSE LIGHT HARNESS

- One wire to 12 volts +
- One wire to the reverse lights

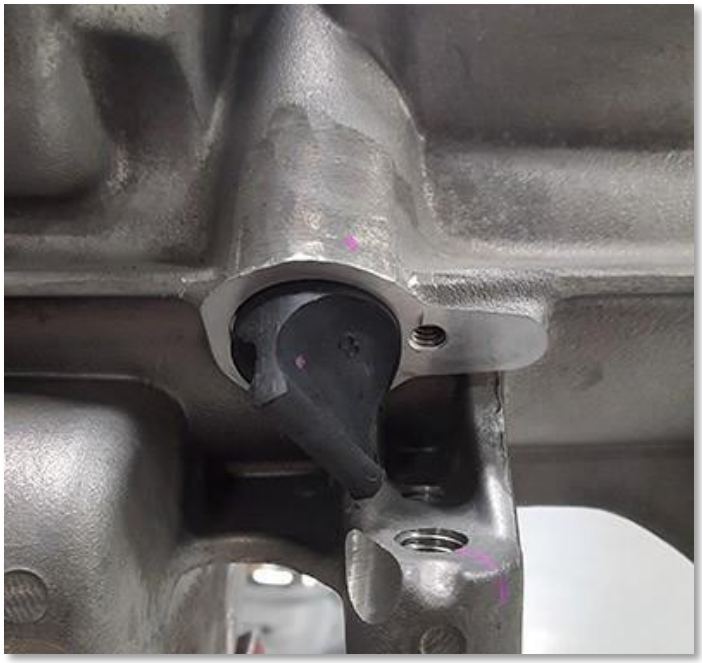
Doesn't matter which wire goes where.



VEHICLE SPEED SENSOR (VSS)

- Used for electronic speedometer output.
- If you are using a mechanical speedometer, this sensor will not be sued. But please leave in place. (*If you are using the VSS, please use quality aluminum plug to plug the mechanical speedometer hole. Do not use the rubber shipping plug.*)

TKO Neutral Safety Switch- Optional to use. There is currently no pigtail adapter available. If you choose to use it, just clip the attached connector off and hard wire it into your starter solenoid power wire.



Factory installed rubber plug. This is where the mechanical speedometer pick up is located. You will need to replace this rubber plug with either our billet speedo plug or a mechanical cable adapter. Both are listed below should you still need one or the other please give us a call. 618-943-4856

If you will be utilizing a mechanical speedometer we can equip your Tremec with one of our cable adapters. We will just need to get your rear gear ratio and rear tire size to set the adapter up with the proper gear. If you will be using an electronic speedometer or not using the mechanical speedometer, then you will need to replace the rubber plug with our billet speedo plug. This will ensure you do not experience any fluid leaks from the rubber plug coming loose or falling out completely.

GM "LS" Engine Pilot Bearing Instructions
There is THREE GM pilot bearings with different OUTSIDE DIAMETERS. It is IMPERATIVE that you followthese instructionsandinstallthecorrectpilotbearingforyourapplication.

Pilot bearing for crankshaft position "A" is a SMALL outside diameter (1.094") GM pilot bearing that fits into the inner most pocket of the crankshaft range. This bearing is typically (but, NOT ALWAYS) used with Transmission/Bell housings on GM; LS1 powered vehicles from 1998 to 2002. (NOTE: if using the small GM pilot bearing, the internal O-ring seal faces the transmission when installed properly).

Pilot bearing for crankshaft position "B" is a MEDIUM outside diameter (1.652") GM pilot bearing that fits into the outer pocket of the crankshaft range. This bearing is typically (but, NOT ALWAYS) used with Transmission/Bell housings on GM; LS3, LSA, LSX and LS9 powered vehicles from 2003 to 2012. (NOTE: This is a double sealed bearing and it may be installed either direction into the crankshaft).

Oversize Pilot bearing for crankshaft position "B" is a LARGER outside diameter (1.705") GM pilot bearing that fits into the outer pocket of the crankshaft range. This bearing can be used with SOME aftermarket crankshafts and/or GM CRATE engines where the crankshaft pilot bearing bore is oversized AND you are using a Transmission/Bell housing combination from a 2003 to 2012 GM vehicle. (NOTE: This is a double sealed bearing and it may be installed either direction into the crankshaft).

In most cases, you can dimensionally match the old pilot bearing to one of the new enclosed pilot bearings. (IMPORTANT NOTE: many GM LS engines use a press-in oil plug deep inside the crankshaft range, DO NOT move or disturb this plug when removing or installing a pilot bearing. Your old pilot bearing must be removed by means of a mechanical pilot bearing puller – DO NOT attempt to use a "hydraulic" method to push-out or remove your old pilot bearing!).

The best method to determine the correct pilot bearing and pilot bearing position for your application is by using a straight edge or yard stick across the front of your transmission Bell housing and measure the distance that your transmission input shaft protrudes past the front of the Bell housing.

If your transmission input shaft dimension is between 3/4 to 1 inch (19mm to 25.4mm) use the SMALL diameter pilot bearing in crankshaft position (A) and disregard the remaining pilot bearings.

If your transmission input shaft dimension is between 1/4 to 3/8-inch (6.3mm to 9.5mm) test if the MEDIUM outside diameter pilot bearing into crankshaft position (B). The pilot bearing should be a slight press it into the crankshaft. If the MEDIUM diameter bearing is a loose fit, please use the LARGE outside diameter bearing for a slight press it into the crankshaft.

Be sure to install your pilot bearing into the crankshaft by driving or pressing on the outer most part of the bearing ONLY. The pilot bearing must be straight and fully seated into the crankshaft… DO NOT FORCE the installation. Once installed, the inner portion of the bearing must spin free and smoothly.