

## INSTALLATION GUIDELINES

The following is a slightly modified version of the guidelines that are used in our shop. Bow Tie Overdrives uses these guidelines in general and custom installations specifically. The main purpose of these guidelines is to remind ourselves of all the steps necessary to install a modern General Motors automatic overdrive transmission into a vehicle that was built for a different transmission. It is not our intent to supply our customers with complete step by step instructions. We are not qualified to write such a document, besides; it would need to be so voluminous that most of our customers wouldn't take the time to read it anyways. This document is intended to give our customers a quick overview of the various steps which need to be addressed during the installation process. It is the installer's responsibility to acquire the necessary skills and specific knowledge required to do the installation correctly. My sincere recommendation is; be willing to spend the time to gain the specific knowledge needed to do this installation correctly, or hire someone that is qualified, then hold them responsible, and make sure the installation is done properly, and according to our Installation Guideline standards. If you choose to hire a third party to do the installation, your installer is your responsibility. Bow Tie Overdrives will not take any responsibility for or authority to, third party installers. However, we do present a cooperative attitude towards all installers. The installers must maintain a cooperative attitude and be willing to follow our instructions through the installation process. Prior to hiring an installer, we highly recommend that you inform them of the procedures that we will require, so they can incorporate them into the cost of the installation. Upon your request, we will supply an additional set of our Installation Guidelines for your installer. It is recommended that you keep a copy of these Installation Guidelines so you can monitor your installer's progress during the installation, and for any future adjustments that may need to be made. If all of the procedures are not followed according to our instructions, there will not be a warranty offered on your transmission.

I would like to give you a couple of examples where you need to "fill in the blanks" sort of speak. First, when you install the pan you need to take the time to torque the pan bolts according to the factory's recommended rating. (Yes we do torque the pan bolts by using a torque wrench!) The torque specification section we have included will give you the correct torque for these pan bolts. This information is also available from any General Motors manual. While we took the time to supply you with General Motors torque figure, we will not take the time to explain the difference between an inch, pound, or foot pound rating. Furthermore, we will not tell you the proper technique when using the torque wrench, how you adjust it or where to get one. Do you get the idea here? Just because we are willing to give you the technical information, doesn't mean you will understand it, or apply this information correctly. Comprehending this information, acquiring the necessary tools, and subsequently applying the correct application technique, are entirely the installer's responsibility. Bow Tie Overdrives recommends that you use a thread fastener on certain fasteners in these guidelines. We state the need to do this important step; however, we intentionally withhold supplying the installer with a brand name or type of product to use. It is the installer's responsibility to do the necessary product research to determine which product is needed to do your job correctly. You must take full responsibility for determining the appropriate product to use and the correct method of applying this product. If you are not willing to accept full responsibility in these matters, please don't use our guidelines.

Compared to the traditional Power-Glide, Th-350 and Th-400 transmission we're all familiar with, the Th-700R4 and Th-2004R transmissions have installation requirements that are very unique and diverse. For the last seven years, BowTie Overdrives have had hundreds of vehicles brought to us with various kinds of "problems". The least serious of these "problems" would simply be a transmission that doesn't "behave" like it should. The most serious of these "problems" would be a newly "built" transmission that has failed catastrophically and now needs to be "rebuilt". By simply following a few rigid guidelines, it could have prevented most of these "problems" from occurring.

The **special** installation and set up requirements of Th-200R4 and Th-7004R transmissions fall into two major categories:

- First; The TV cable system.
- Second; would be to provide an adequate cooling system for your vehicle. This would include a correctly functioning torque converter lock up clutch.

**Just because your cooling system prevented your old Power-Glide, Th-350, or Th-400 from burning up, does not mean it will be adequate for your new overdrive transmission! In certain driving situations, overdrive transmissions, will generate heat far more rapidly than a one to one high geared transmission. Ignoring this fact has caused most failures.**

Bow Tie Overdrives wants to make it absolutely clear that we **will not warranty** one of our custom built overdrive transmissions unless the installer is willing to clearly demonstrate to our company that the necessary control, and support systems required by these unique automatics, has been adequately supplied, and is set up correctly. While building one of these wonderful overdrives, there is nothing we can do to prevent failure from overheating, or lack of a proper pressure signal from the TV system. With a little effort and some inexpensive monitoring equipment (especially when compared to the cost of fixing one of these units), it is easy to clearly demonstrate that the necessary support systems are set up and functioning correctly. Just because something is critical in nature doesn't mean it's difficult to do. For instance; filling the transmission up with transmission fluid is not difficult to do, but if someone decides not to do it, this would have the same ugly result as they would if you had an incorrectly set up pressure control system (TV), or an inadequate cooling system.

The system requirements fall into two major categories. The transmissions Throttle Valve (TV) cable system and the transmissions fluid temperature control system. The following three areas directly affect these systems.

1. The TV system controls the internal hydraulic pump which provides friction clamping pressure, hydraulic fluid to control the shift timing and feel, lubrication, and transmission temperature control. Knowing this, the need for this system to be adequate under all operating conditions should be obvious. The clamping pressure applied to a friction pack must be greater than the torque force being applied or it will just slip. This must be true in all driving conditions from light throttle cruising to heavy towing. The most expensive friction materials available will quickly fail without adequate clamping pressure. That being said, just because the TV cable systems operation is critical to longevity and proper operation, doesn't mean that its difficult to set up correctly. **It is our strong opinion that the TV cable system cannot be set up correctly without a pressure gauge!**
2. The fluid temperature control system is designed to properly manage the transmissions operating temperature. Most people don't realize that routing the lines from the transmission through the radiator is designed to bring the transmission up to its proper operating temperature and **then maintain it at that temperature.** This is the reason that the factory's transmission hard lines always run to a heat exchanger located in the vehicles thermostatically controlled radiator system. We have yet to see an "auxiliary" type cooler mounted anywhere that was capable of doing this job properly. Contrary to popular belief, a good transmission temperature control system ran through a heat exchanger located in the exit tank of the vehicles radiator, will normally hold the transmissions fluid temperature 30 to 50 degrees F lower than the engines indicated operating temperature. The transmission temperature will be very stable with a system like this unless; the radiator is bad, or the transmissions heat exchanger located in the radiator is ineffective. The transmission fluid flow rate through the heat exchanger should be checked. We use a simple procedure to determine if a system has any flow restrictions. Restricted flow has the same result as inadequate cooling or inadequate lubrication to the transmissions hard parts. **It is our strong opinion that the effectiveness of the transmission fluid temperature control system cannot be determined without the use of a temperature gauge!**
3. The other part of the transmission fluid temperature control system that needs to be understood, set up and made to work correctly, is the torque converter lock up clutch. This system is very easy to install, understand and use. **With proper management of this system, overheating of the transmission fluid can be prevented in all driving situations as long as the cooling system is in good condition.** Please read our web site section about this system.  
<http://www.700r4.com/Tech/TCC/introindex.htm>

We require installing an inline filter somewhere in the return line back to the transmission from the radiator or auxiliary cooler. We are not advocating the permanent use of an inline filter, but we require the use of one on a new start up. The higher operating pressures and fresh load of very high detergent transmission fluid will likely dislodge debris from inside the heat exchanger. While this dislodged debris rarely causes serious mechanical damage, you will not like having to pull the governor or valve body to clean up a stuck valve. We will require you install one of these aftermarket filters for the first 100 miles and no more than 500 miles for the warranty on our transmission upon initial start up. After this period, remove the filter from the system. The main filter located inside the pan, should be more than adequate from then on.

**A quick review of the things we require for our warranty to apply:**

- A TV system set up correctly so it manages the transmissions shift characteristics to your satisfaction.
- A pressure check performed using a pressure gauge attached to the transmission during start up and test-driving.
- A cooling system that proves to be adequate during actual driving conditions. This will require the use of a temperature gauge with the sender located in the transmissions pan. This is the only method we know of to prove that the system is cooling. The number one failure of automatic transmissions is overheating. A gauge will demonstrate whether the heat exchanger system is adequate or not. All our transmission pans have a 1/8" NPT drain plug provided to make normal service more convenient. Most modern electric temperature gauge sender units are 1/8" NPT so installing the sender in the pan (where it should be) is simple and easy to do.
- A simple flow check must be performed to ensure no restrictions exist in the cooling system. Returning fluid from the transmission temperature control system is the forced lubrication circuit for this transmission. All internal hard parts are lubricated by this fluid flow. Restricted flow through the system caused dual problems. It would have *inadequate cooling ability* and *an inadequate lubrication circuit*. We have seen brand new expensive radiators that had built in restrictions bad enough to cause lubrication failure problems. All lines *and fittings* must have an inside diameter opening of no less than 1/4" for proper flow.
- The torque converter lock up system will need to be working correctly with a safety disconnect circuit activated by the vehicles brake light system. A simple test will be performed during the test drive, and should be performed periodically while driving, to determine if the torque converter lock up system continues to function correctly. Certain driving conditions dictate the use of the manual lock up system so too must be operational and the owner must indicated he understands how to use it properly.

The installation you are about to perform is not difficult, but it must be done correctly. If you fail to do it correctly, you will be extremely unhappy when you have to take it back out and ship it back to us at your own expense? Anytime during the installation process, we encourage you to call us for technical assistance as needed. If you are confused or don't understand something in these guidelines, please feel free to call for clarification.

Since legal ownership changed from our company to you the moment the transmission left our shipping dock, we have no control over how it gets installed. However, we do have the right to require certain installation disciplines that will need to be followed for our warranty to apply. If you don't agree with these requirements, you have every right to install it anyway you choose, however, we will not register it for warranty unless our guidelines are followed and you as the owner are willing to demonstrate to our satisfaction that the above requirements have been met. In seven years, we have **never** refused our warranty to anyone who has worked with us. You can close the box back up and ship it back to us for a complete parts refund. If this sounds harsh, it is not intended to be, just practical and common sense. We want people to enjoy these transmissions and will do whatever we reasonably can do to help our customers get it installed properly and adjusted correctly. Experience has taught us, if these tests are not performed properly, the chance of success is strictly a roll of the dice! Sometimes you'll get lucky, sometimes you won't. Most of these items are basic test procedures listed in any General Motors manual for correctly evaluating the performance of these transmissions. Our own shop personnel perform these same tests on every installation! We really do practice what we preach because we believe these tests will prevent almost all future problems. If you perform these simple tests, your chances of being thrilled with your new transmission are very great indeed.

If the above sounds preachy, please accept our sincere apology. Try to understand this paper was written after many years of trying to communicate with people over the phone and at car shows concerning the proper installation of these transmissions. The one thing we have learned from this experience is: **once we started placing full responsibility for a correct installation on the installer where it belonged, the failure and return rate of these transmissions fell to almost zero.**

### Uncrate and inspect the products

Remove the lid from the crate and remove the packet that contains these guidelines and other useful documents. If you gave us an e-mail or fax number, we would have sent a duplicate set of these documents. Inspect the contents of the crate for damage to the transmission or any of the accessories that were shipped with it. If you find any damage, make a proper damage claim with the delivery service as quickly as possible. If everything is ok in the crate, remove the contents, and please take the time to compare the items in the box to the actual invoice. This step will insure that you've received everything you paid for. We will not accept claims of shortage more than 10 days after the shipment has been received, so please perform this inventory check off immediately after you receive the shipment. Things can be left out or lost in transit. The trucking companies will only honor freight shortage claims if they are filed within a very short period of time from the actual delivery date.

### Remove all the shipping plugs

Find and remove all the shipping plugs from the following locations:

1. Input and output shafts
2. TV cable hole
3. Dipstick hole
4. Transmissions cooling line fittings

In addition to the shipping plugs you should find sleeve type seals in the TV cable attachment hole and the dipstick hole. If you purchased a new TV cable or dip stick from us, it will come with a sleeve type seal already installed. Remove the one from the new TV cable or dip stick to prevent you from trying to install two sleeve seals into the same hole. This happens more frequently than you can imagine because people wait till the transmission is in place, Then try to install the TV cable or dip stick. Now they can't see the extra seal because the transmission tunnel blocks their view.

### Prepare the mating surface on the back of the engine block

1. Remove all old paint from the mating surface on the back of the engine. (you may have noticed that we cleaned the matching surface of the transmission)
2. Check the mating surface for burrs, cracks or anything else that may interfere with the transmission seating squarely against the back of the engines' bell housing.
3. Make sure the locating dowel pins are not missing or damaged or located too far in to give full engagement into the corresponding locating holes in the transmission bell housing. The transmission will not position correctly to the engine without these dowels. These dowels are not that difficult to drive out a little to offer more engagement surface. We have seen serious damage done to the flex plate, converter and transmission because this important item was overlooked.
4. Check all threaded holes and repair if necessary.

### Inspect the condition of the flex plate for:

1. Broken or chipped teeth
2. Warped? (quite common) Check it visually while the engine is running, if you can see visible for and aft movement, you should check run out with a dial indicator. Factory tolerance is .030" total run out.
3. Cracks in the flex plate right around the crankshaft bolt circle are very common. Flex-plates are very cheap compared to the time, effort and money required repairing the potential damage that will occur later if the flex-plate should fail or ruin the transmissions front seal and bushing.
4. If you are replacing a TH-400, make sure you have a dual bolt pattern flex-plate.
5. Inspect the converter snout pocket in the end of the crankshaft. When breaking in any motor, bolt up the converter and put all 11.5 quarts of transmission fluid in the transmission and leave in "PARK", then break in the motor.
6. Now is the ideal time to check for leaking freeze plugs or rear main seal. It is quite simple to fix while the transmission is removed.
7. Make sure the flex plate isn't "dished" by placing a straight edge on the ring gear checking for uniformity of gap to the disc. This is a very common problem and can cause serious damage to the transmissions pump if the flex plate is dished forward enough to cause the converter hub (drive snout) to disengage from the hydraulic pump rotor. Make sure you check the gap

### Cooling lines need to be inspected for the following:

1. Inspect all lines for good flares and fittings.
2. Inspect for flattened areas on the lines that can restrict fluid flow.
3. Run at least one can of cooler line flush or until the cleaner comes out clear.
4. Observe the flow for any indication of flow restriction in the cooling system. (At start up we recommend you also perform a simple flow volume check)
5. Blow out with compressed air after cleaning.

### Install the TV cable and the dipstick

1. Lubricate (with a little transmission fluid) the end of the TV cable housing where it will slide into the sleeve seal. It's very difficult to slide it in when the seal is dry.
2. Hook the link into the end of the TV cable and pull up into the TV cable housing. Once it's up inside the TV cable housing it won't come unhooked.
3. Slide the TV cable housing into the seal in the transmission.
4. Install and tighten the retainer bolt. (see torque specs)
5. Lubricate the end of the dipstick tube where it slides into the sleeve seal.
6. Slip the dipstick into the seal. There are times when you will have to install the dipstick after the transmission is in place but it normally is easier to do it before the transmission is installed.

### Torque converter preparation

1. Check the end of the snout (This is the bushing surface that slides into the seal and front bushing and engages into the pump rotor of the transmission) for any sharp edges that may have been overlooked when they built the converter. Pay particular attention to the slots that were machined into this bushing that engage with the hydraulic pump rotor. Sharp edges on this bushing will cut the transmissions front seal and score the front bushing if they're not removed. Sharp edges here are not uncommon so make sure you clean them off before you insert the converter into the transmission. Caution; be sure to stuff a shop rag into the front snout to keep filings or chips from entering the converter while you perform this precautionary step.
2. Place one quart of Dextron III into the converter. (1/2 quart if it's a small 2.8 v-6 or 4 cylinder converter)
3. Wipe a light coating of transmission fluid on the snout where it's going to slide into the transmissions front bushing and seal.

Place the converter on the input shaft and engage it with the hydraulic pump rotor

**You can easily damage things during this procedure.** The following is a list of potential items that can be damaged during the installation of the converter onto the input shaft and getting it engaged with the front pumps rotor:

1. The “O” ring seal on the end of the input shaft. If this “O” ring seal is damaged during installation the converter will not lock up properly, which will result in continuous fluid overheating inside the converter. You need to put some transmission gel or petroleum jelly on this “O” ring before you attempt to install the converter.
2. The front pump seal can be easily damaged if there is a sharp edge on the converter snout or you cock the converter while installing it. We have seen people push the front seal tensioning spring out of the front seal and jam it into the pump with disastrous results. This damage has ranged from gouging the front pump housing to actually breaking the rotor itself.
3. The front bushing can be gouged and subsequently ruined if the converter isn’t lined up correctly before it is inserted into the front pump.
4. A lot of people have ruined their converter or pump rotor, pump housing, have bent flex-plates or literally broken the bell housing by trying to pull the transmission up to the engine using the bell housing bolts.

**All this because the torque converter wasn’t indexed all the way into the pump rotor. More serious damage has accidentally occurred during this operation than all the other mistakes combined.**

Take the time to understand what needs to happen during the insertion of the converter and how it is supposed to index into the pump rotor. Take a flashlight and look into the front seal. Notice how the pump rotor tangs must engage with the slots in the converter snout. My advice for someone that’s not used to doing this is to: place the transmission up on a sturdy workbench or transmission jack. This will place it at a height where it’s easier to control the converter during this procedure. The torque converters are heavy and not easy to handle because of their shape. Get as comfortable as you can before you start. Washing your hands prior to starting this step wouldn’t hurt. You should also wipe any oil off the outside of the converter before you start handling it. Again torque converters are heavy and cumbersome to handle!

Hold the converter “square” to the transmission as you place it onto the input shaft. Gently guide the converter into the front seal/bushing until you feel the input shaft splines come up against the turbine splines inside the converter. Start turning the converter as you gently begin to apply inward pressure to the converter. You will “feel” the splines engage and the converter will slide in. Continue to apply slight pressure to the converter as you continue to rotate it. The converter will slide in a little further when the converter snout slots engage the pump rotor. Check that the converter turns freely.

The best way to be absolutely certain that the converter is fully indexed into the front pump is to place the transmission/converter assembly up against the back of the engine. The bolt lugs on the converter should not be touching the flex plate. There should be a gap between the flex plate and the converter bolt lugs. With the transmission bolted to the engine, this gap should be approximately 3/16” but no more than ¼”. (If the gap is larger than ¼”, **precision** shims must be installed to obtain the proper gap before the converter bolts are installed.). Before installing the bolts into the converter lugs you will need to slide the converter forward to the flex plate. If a gap doesn’t exist, the converter isn’t indexed into the pump properly. To get it to index into the pump, you need to continue turning the converter, at the same time, applying slightly inward pressure until it fully engages. Another easy way to check when using a full size converter is to try and slide your fingers between the converter and the pump housing. If you can, the converter isn’t fully engaged. This test doesn’t apply to the smaller v-6 or small diameter high stall converters.

### Place the transmission up to the engine

1. When you place the transmission up to the engine, it should position itself over the dowel pins and then set flush up against the back of the engine. If it doesn't set flush, STOP and determine why! See the information above for clarity.
2. When you are certain the transmission is positioned correctly, the converter is indexed all the way into the pump and the gap is correct, install the bell housing bolts using an approved thread-locking compound. Remember to place the upper passenger side bell housing bolt through the dip-sticks mounting tab. Use the proper grade of bolt and torque them to the proper specification. (see torque spec sheet)
3. The torque converter should spin freely and not be touching the flex-plate.
4. Install the converter bolts using an approved thread-locking compound. Torque these bolts to their proper specification. We supply special metric bolts with all of our converters because serious damage will result to the converter if these bolts are too long. They will go through the converter attachment lugs and come into contact with the shell of the converter. The area that these bolts contact on the **outside** of the converter shell is the same surface that the converter clutch rides on the **inside** of the converter shell. If the bolts touch this area and are then tightened up, they will place a dent in this area. A dent on the outside of the converter shell results in a dimple on the inside of the converter shell right where the converter clutch rides. Consequently the converter clutch will not engage fully and will slip, chatter and fail very quickly.
5. If your particular application wouldn't allow you to put the dipstick in before you raised the transmission up into place, now is the time to install it. Installing the dipstick later is usually very difficult.
6. Now is a good time to install the inspection cover.
7. Raise the rear of the transmission up to its proper position and install the transmissions cooling lines.  
Note: The top line on a 4L80E and TH-2004R is pressure out and the bottom line on the TH-700R4 (4L60E) is the pressure out.

**(Note: You will be asked to describe how your lines are routed)**

### Install the cross-member and transmission mount.

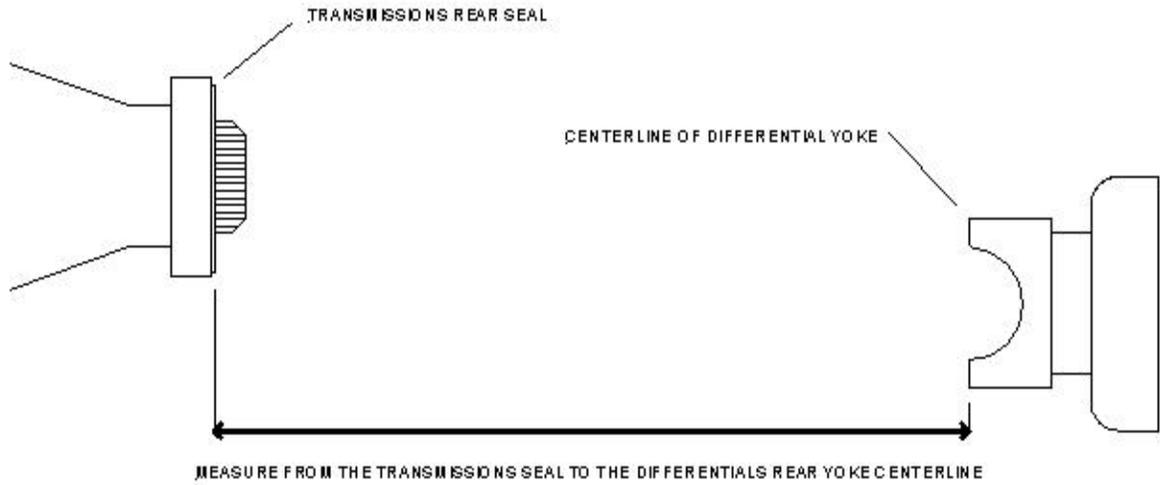
Just a note: If you are doing a custom installation, making or modifying a cross member, you need to position the transmission correctly in the cars chassis. One trick that is helpful: The bottom-machined surface should run parallel to the bottom of the body (pinch weld) in most vehicle applications. This simple method will usually position the engine and transmission in proper relationship to the chassis. Jacking the rear of the transmission up or down will pivot the engine/transmission assembly around the front mounts. Once you have the bottom machined surface of the transmission running parallel to the bottom of the body/frame, just modify the cross-member to keep it in this position.

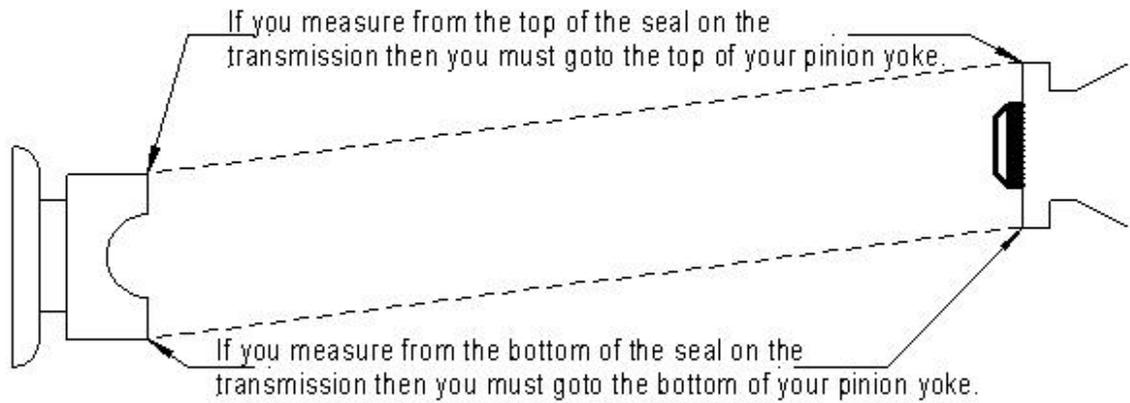
### Measure for the Driveshaft.

**(Note: you should check with your local drive-shaft company for their procedure)**

1. Our local drive-shaft company has us use this method: Measure from the transmissions rear seal to the center split line of the yoke where the u-joint attaches, while the vehicle is on the ground. We have included a simple diagram to help clarify this for you. Take this measurement along with your driveshaft down to your local driveshaft company to be altered. In most conversions this will mean having the driveshaft shortened and balanced.
2. If you are converting from a TH-400, heavy duty manual 4-speed or the early cast iron Powerglide, you may have to change to a 27-spline yoke for the front end of the driveshaft. We normally request our drive shaft service to install a yoke for a TH-350 as they are not as bulky as some used with late model Th-700R4 applications. They are also normally less expensive than those specifically made for the TH-700R4. Consult with your driveshaft company for their advice before making your final choices. **(Note: Make sure your yoke does not have a breather hole, if it does it will need to be welded closed. If this hole is left open it will result in a transmission leak especially when parked on an incline.)**
3. When you install the driveshaft after it has been modified, make sure that it's the correct length. With the car sitting on the ground with the driveshaft installed, there should be approximately 3/4" of smooth machined surface of the yoke visible. If the driveshaft is too long or too short, it may produce catastrophic results. Transmissions have been completely destroyed by this simple mistake. Again consult with your driveshaft company. **(Note: You will be asked how much of the smooth machined surface of the yoke is showing on your application.)**

## HOW TO MEASURE FOR A DRIVESHAFT





## Set up the TV system

Before you start please read the TV set up instructions completely a couple of times.

If you get impatient with this part of the installation, you will more than likely end up very unhappy with your experience with these wonderful transmissions. We can set up this system correctly to most carburetors in less than an hour. This TV system is a relationship that must be **established** by you. (See the instructions included with your TV system)

It may be necessary to completely reset this TV cable relationship a few times during this driving phase. This is when we make the proper set up for shift timing and feel, you will be able to establish infinite shift timing and feel combinations.

While the shift timing and feel can be adjusted to give you many different transmission personalities, the hydraulic pressure management part of this TV system must always perform a very specific function. This can only be confirmed with a pressure gauge attached to the hydraulic pump port on the transmission.

Here is another way to state this. You can alter the shift timing and feel of the transmission and it will rarely cause damage to the transmission. This is not true for the pressure control side of the TV cable's duties. If you get the transmissions hydraulic volume and pressure control system out of a specific operating range, **it can be fatal to this transmission**. This is the reason **we never use shift timing and feel as a method of determining if the transmission is working correctly**. As you experiment with these various shift timing and feel settings you must **always maintain sufficient hydraulic operating pressures**.

Since this subject is so poorly understood, we are going to state this still another way. You can vary the TV cables "pull" characteristics and the results will produce dramatically different shift timing and feel characteristics. At the same time, this must be accomplished while maintaining adequate internal operating pressures. The difference between these various correct set ups is how it shifts and feels with different throttle settings. In other words it is the major "tuning" tool that you will use to get the transmission to shift like you want it to shift. You can consider yourself forewarned, it is easy to get this transmission to feel correct and be fatally inadequate in the hydraulic pressure production department. This is the reason we emphasize the pressure gauge while doing this set up. Poor shifting characteristics may annoy you but they will rarely hurt anything.

Bottom line is this. The following statement must be true after you get the combination of shift timing and feel you want. Pressure regulation should track correspondingly to throttle position. When pulling the TV cable without moving the throttle linkage your hydraulic pressures should rise instantaneously. Our heart felt advice is to take your time and be certain you understand the TV instructions. Budget as much time as required to set up the correct shift timing and feel for your application. Relax and enjoy the journey, the results will be worth it! We don't want you to think that this is difficult, it's really not, it's just very important! If you get confused, please call us, we wish to help!

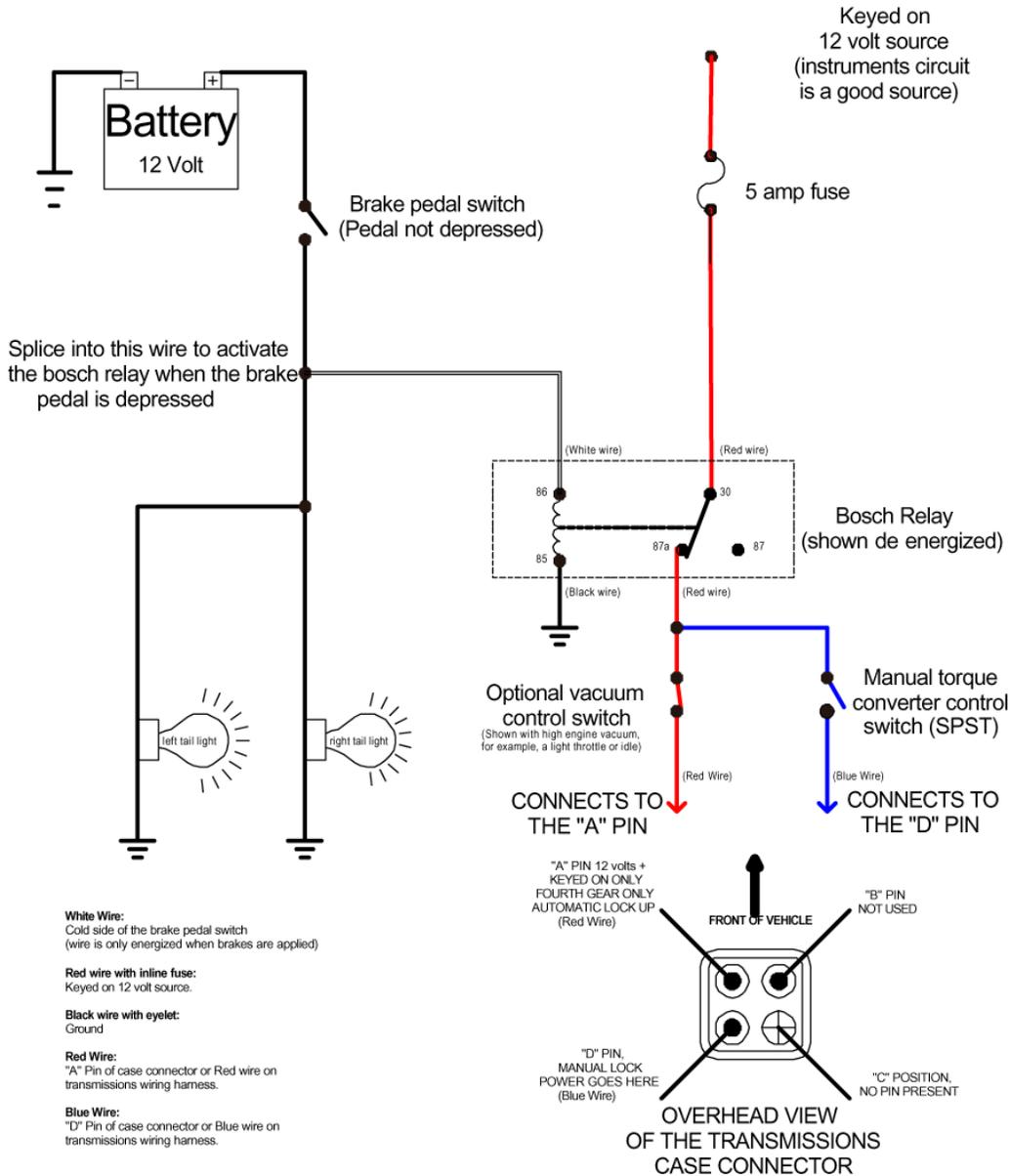
## Install shifter linkage

1. To correctly set up a shifter system the pan must be removed.
2. Fasten shifter assembly to the pan and/or manual shaft of transmission. Insure that it's properly connected to the shifter.
3. If you are connecting to stock linkage, move the shifter through all gear positions to insure all positions are available. If you are installing an after market shifter, follow their installation instructions. If you're installing a console or column shifter conversion kit follow their instructions.
4. The next step is really important, because you can get set ups to feel correct from the shifter but not be correct in the transmission. If your transmission control system is not correctly set up, you can unknowingly "ask" the transmission to be engaged in two different positions at the same time. This can result in hydraulic fluid cross feeding and ultimately damaging the transmission.
5. Have your assistant go under the vehicle and ensure that the manual detent spring inside the transmission is fully engaged in the park detent of the internal detent lever (looks like a rooster head comb). Repeat for the remaining six gear selection positions, insuring the manual detent spring roller seats into the "bottom" of each detent position fully in each selected gear position. **The goal is to have the detent spring fully seat into the internal detent lever in all seven gear positions.**

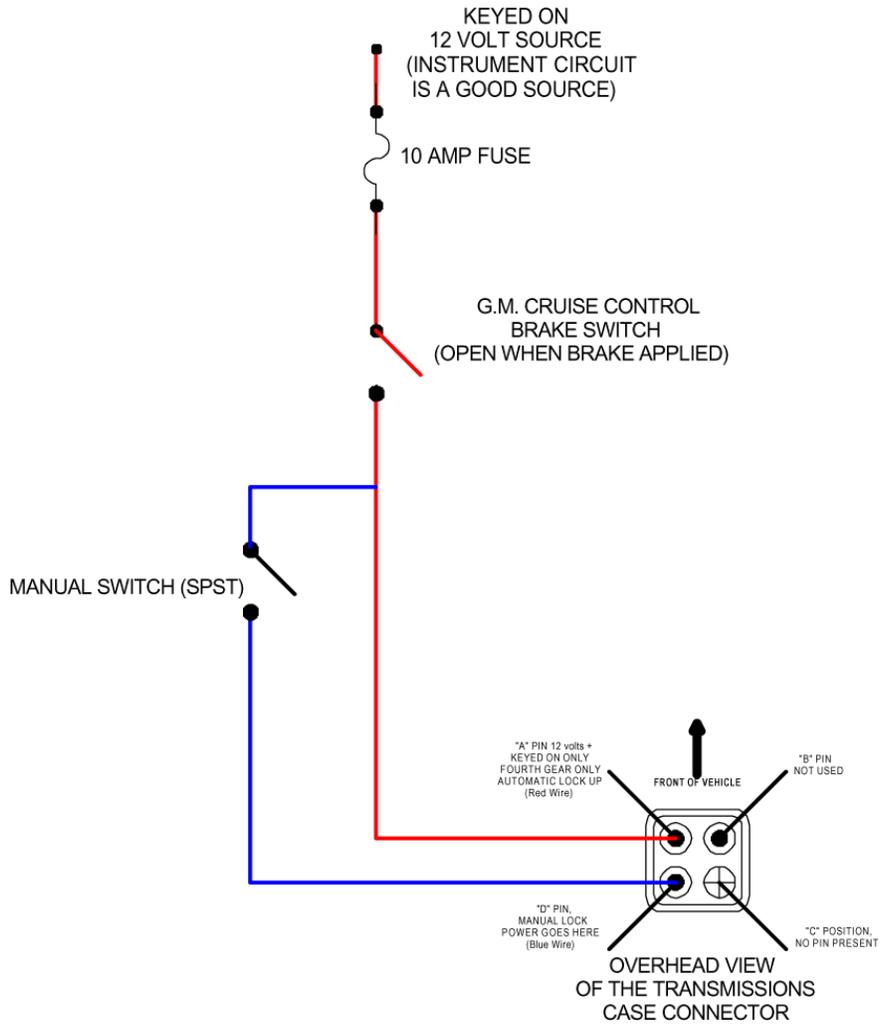
### TCC wiring (Torque converter control) 4<sup>th</sup> gear automatic

While the pan is off for setting up the TV system and shifter, I recommend that you take a few minutes with the enclosed wiring diagram and the following descriptions and familiarize yourself with all the TCC system components. These electrical circuits are very simple and basic. If the system should stop working correctly it's normally very quick and easy to fix. Proper operation of this system should be checked frequently and quickly fixed if it malfunctions. **Failure of the converter to lock up is a major cause of failure with these transmissions. If you plan to tow or just drive a lot in third gear or lower, please request and study our paper entitled "Understanding torque converter lock up."** This paper covers a lot of information that is too lengthy to be included in this guideline. Understanding proper gear selection and torque converter clutch management is essential. This understanding will give you the ability to prevent overheating the transmission fluid and overloading the rear planetary gear set while driving in hard pull situations. **(Note: You will be asked to describe how your wiring is hooked up)**

## Bosch Relay Kit Wiring Diagram



## Brake Switch Kit Wiring Diagram



### Dip stick correct?

The transmissions fluid will be checked on level ground, fluid up to operating temperature and the engine idling with the gear selector in park. While you have the pan off to set up the TV cable system, it's recommended you check the dipstick for proper registration. When you check the fluid level as described above, the actual fluid level, in relationship to the transmission, will be even with the bottom of the machined surface of the case. The end of the dipsticks' tube will extend below the bottom of the case. This prevents us from visually confirming the calibration of the dipstick indicator at a glance. Scratch a mark on the dipstick tube even with the bottom of the case. While the indicator is in the tube, measure from this mark down to the tip of the indicator. Now remove the indicator. You will need to measure from the tip of the indicator up the measured amount to confirm proper calibration. The full mark should match the measurement. If the indicator is not calibrated correctly, it's a simple matter of filing a notch at the correct level. Now use this file mark as your correct fill point in the future. Incorrect calibration is not uncommon. So perform this simple check **before** you install the pan. **(Note: You will be asked to describe how you calibrated your dipstick)**

### Install the pan

If you have a stock carburetor, fuel injections set up that is exactly like stock or you are using our new U.S. patent Pending TV Made EZ system on your carburetor, you can install all the pan bolts and torque them to the correct specification now.

If you don't have a Stock GM TV system, have a carburetor or fuel injection system which we have not developed our new TV Made EZ system for, you will need to visually establish a correct mechanical relationship for the TV system. The dynamics of the rate of cable pull will effect the shift timing and shift feel so you may have try more than one set up to get the transmission to behave the way you want. Please call us and we will help you through this process. This procedure will require the pan to be removed and reinstalled a few times to visually establish a new **correct** set up that has different pull characteristics. We suggest using the following procedure while working through this process.

- Install the pan using 8 of the 16 pan bolts and lightly torque them. Do not over torque them or you will damage the pan gasket. The fiber gasket supplied can be reused many times unless it is damaged from over tightening the pan bolts. You will more than likely have the pan back off very soon. 8 bolts will be enough to keep it from leaking excessively while you perform your test-drives and adjustments.

Once the correct shift timing and feel has been established, install all the bolts and torque to the correct spec.

### Fill with fluid

A TH-700R4 transmission with a radiator cooler, using a standard size converter will typically hold 11 ½ quarts (23 pints) of fluid. **(Note: You will be asked how many quarts it took to fill your system)** Take the time to check the dipstick calibration, especially if you're not sure how much fluid your application should hold. If you are running additional coolers, adjust the total fluid volume accordingly. We recommend using any good quality brand of Dextron III. Buy it on sale and change it frequently. We have found good regularly scheduled maintenance to be more important than the brand used. Buy cheap and change often!

**CAUTION: IF YOU ARE RUNNING A SPECIAL SMALL DIAMETER HIGH STALL CONVERTER CALL US FOR THE CORRECT FILL PROCEDURE. IT IS BETTER TO OVERFILL A LITTLE THAN UNDERFILL. WE INSTALL A DRAIN PLUG IN EVERY PAN SO IT'S EASY TO ADJUST THE LEVEL AFTER YOU ARE UP AND RUNNING.**

1. Pour in five quarts.
2. Open six more, start the engine, install the six quarts.
3. Engage all selector positions.
4. Allow the fluid to warm up and then check the level with your calibrated dipstick. Add fluid as required.

## Pressure Check

A pressure gauge must be connected to the pump during the start up **and subsequent drive testing** in order to qualify for a warranty from our company. We find seven feet of hose and 0 to 300 psi gauge allows us to monitor the pressures at start up and during the test drive. The seven feet of hose will allow you to have the gauge right at the carburetor (or F.I. throttle body) end of the TV cable for easy viewing while the TV cable is being set. Seven feet of hose also allows you to bring the gauge inside the drivers' window so you can observe the pressure response while doing your test drive. Connect the close 90 degree NPT fitting to the pump outlet on the driver's side of the case just above the manual shaft. As you tighten this fitting, point it to the rear of the transmission so the hose will clear the shift linkage without interference. If you have difficulty finding this tool, we can sell you a complete gauge, seven feet of hose and close 90 degree 1/8" NPT fitting combination for \$29.00. This is the only way you can be certain that the pressure regulation is working properly. Before we shipped this transmission to you, we actually installed your transmission into a test vehicle, ran the same complete pressure profile you are about to perform. We also did the complete drive test you are about to perform and checked for proper operation during all operational modes of your transmission. The following efforts will be to confirm nothing has changed since we removed the transmission, shipped it to you and your subsequent installation. We will compare your readings to the readings when we tested it and determine if something has changed. If something has changed, correct it before you attempt to drive the vehicle. Transmissions are difficult to damage unless you're driving them. Correct set up is critical to the very survival of TH-700R4s and TH-2004Rs. It will save lots of potential grief later if you take the time to get this system installed and set up correctly before you attempt to drive the vehicle.

After you have the pan on, gauge installed and the fluid in. You may perform the pressure check. You will need a helper to complete this test. This person doesn't have to be knowledgeable about what is going on. They'll just be pulling the TV cable when asked to do so. Have a set of needle nose pliers handy for them to use. Please have your helper available to help if necessary when you call in the pressure readings. Attempting to perform the following pressure test, without the engine running correctly will be a waste of your time and ours. After you do this pressure test you will next be performing the test drive. Short periods of wide-open throttle operation are necessary during this test drive. If the engine is new or not correctly broke in, we recommend you do this now. **Do not disconnect the converter and pull it back.** Leave everything connected and leave the transmission in Park for break in. After you get the engine operating correctly then continue your installation. The shifter must get all positions and hold the transmission in park safely. Please don't call us until the torque converter control circuit wiring has been correctly installed. We must check this system during the test drive.

We purposefully left out a description of this pressure check procedure because this is one area that is too important to leave open to interpretation. Your transmission was installed in one of our test vehicles and ran through a complete series of operational tests. A full spectrum pressure check out is part of this procedure. As you perform this pressure check you will confirm that nothing has changed from when it left our shop. You must call in your pressures and other misc. information that you were asked to get throughout these guidelines before you can proceed to the test drive. The next section of this guideline is a description of the test drive procedure you will run through **after** this pressure test has been completed. The test drive is comprehensive so we included the driving test description as something to refer to after each step. However, this test drive information was not included to encourage a test drive of the vehicle before you have completed this critical pressure check out.

**If the vehicle is driven before you perform this pressure check, a warranty will not be offered, even if the transmission appears to perform correctly. Low pressures can and will cause damage to occur very quickly if you attempt to drive the car. A damaged part may not fail immediately, but it will still be damaged and can shorten the life of the transmission. We do not make exceptions here.**

## Pressure Test

You will need to install a 0-300psi pressure gauge in order to perform this test. The pressure gauge must be attached to the direct pump pressure port on the driver's side of the transmission, it is above the manual shifter shaft approximately three and a half inches. These readings should be taken right after the initial startup of the transmission, the vehicle shouldn't be driven until you verify these pressures with our facility. If the vehicle is driven prior to our approval it may void your warranty.

Please read the following three tests very carefully, these are very critical.

Once you have set up the T.V. cable correctly according to the instructions for your specific T.V. system, do not bring the engine up to operating temperature as it is hard to set the pressures due to the volume. Now perform the following three tests as follows:

### **Pressure @ Idle T.V. connected**

With the vehicle running at an idle, make sure that the T.V. cable connected to the carburetor/fuel injection linkage, and adjusted to the appropriate settings. With the gear selector in park record the reading off of the pressure gauge. Next pull the gear selector down into reverse and take that reading, then continue to shift the shifter down through the rest of the gears one by one taking a reading in each gear.

### **Pressure @ Idle T.V. Disconnected**

Once again with the vehicle running at a idle, disconnect the T.V. cable from the carburetor/fuel injection linkage, and simply record the pressure readings again in each gear.

### **Pressure @ High Idle Full T.V.**

You will need a helper to help you perform this last test.

This test is a little bit more complex and will require the use of an assistant.

On this test we will once again start off in park, bring the vehicle up to approximately 1500 rpm's and have your assistant pull the T.V. cable all of the way out until he can feel it stop, it will stop when it buries the plunger in the transmission, now take a pressure reading, release the T.V. cable and let the engine rpm back down to a idle. Now we need to perform this same test in the remaining six gears, upon doing this in the other gears the car is going to try to move as if we were power braking it, so we highly recommend that you set the emergency brake and keep your foot planted firmly in the brake pedal

Gear Selector Position	Pressure @ Idle T.V. Connected	Pressure @ Idle T.V. Disconnected	Pressure @ High Idle Full T.V.
Park			
Reverse			
Neutral			
Overdrive			
Third			
Second			
First			

## Test drive

CAUTION MUST BE EXERCISED DURING THE INITIAL TEST DRIVE. IF YOU FEEL SOMETHING IS NOT CORRECT, STOP AND CALL US. WE CAN CORRECT WHATEVER THE PROBLEM IS BEFORE ANY DAMAGE IS DONE.

DURING ALL THE YEARS OF TEST- DRIVING VEHICLES WE HAVE NEVER DAMAGED A TRANSMISSION DURING THIS PROCESS. IF SOMETHING DOESN'T FEEL RIGHT, STOP THE TEST AND CALL US TO HELP YOU DETERMINE WHAT IS WRONG.

It has been our experience the first hour after start up of a newly built automatic transmission is critical. Realize what we are doing is very similar to starting a new engine. Get through this phase and you are well on your way to a long happy life with your new transmission.

1. When you are ready to test drive place the selector in the overdrive position. Softly run the transmission through all the forward gears. Come back to a stop and do the same thing at least two more times. This will bring the transmission up to operating temperature. Bring the vehicle back to a full stop.
2. Keep the selector in the overdrive position and perform a minimum throttle first to second shift. This will be the slowest vehicle speed you can get the vehicle to ease into second gear. When the transmission shifts to second you need to aggressively floor the accelerator to make the transmission perform a second gear to first gear downshift. If the transmission fails to downshift. Terminate the test drive. Carefully return to your shop and call us.
3. Next you perform a minimum throttle (Minimum vehicle speed) third gear into fourth gear. If you have a tachometer this is easy to see when this occurs. Without a tachometer you might have to play with the gear selector to determine when you are in fourth gear at minimum vehicle speed. When you are certain that you have the vehicle into fourth gear at the slowest vehicle speed, aggressively floor the throttle to force the transmission to downshift to second, bypassing third in the process. If the transmission fails to perform this test, terminate the test drive and call us.
4. Let the transmission go back into fourth and check for converter lock up. Put your vehicle in light acceleration with your throttle pedal. Hold that position with your right foot while you gently apply the brake pedal with your left foot. Not enough to apply the brakes but just enough to turn on the brake lights. If your brake pedal disconnect circuit is working; you will feel the engine rpm jump up as the torque converter disengages. Continue to hold the throttle position with your right foot. When you release the brake pedal with your left foot, the engines' rpm should drop right back down as the converter re-engages. You must have some acceleration going on while you perform this test or you probably won't feel the engagement and disengagement when it occurs. Now bring the vehicle back to a complete stop.
5. Select manual first gear. Accelerate to 3000 rpm and hold that setting for five seconds. When you are sure the transmission will not go into second gear on its own, release the throttle pedal back to idle. You should feel a strong compression braking action happening. Accelerate back to 3000 rpm.
6. Select second gear with the selector. You should get a clean crisp shift into second gear. Accelerate up to 3000 rpm and hold that rpm setting for five seconds. When you are sure the transmission won't shift on its own into third gear, release the throttle pedal back to the idle position and check for engine compression braking once again. Accelerate back up to 3000 rpm.
7. Select manual third gear with the selector. The transmission should cleanly and quickly shift into third gear. Take the engine rpm up to 3000, hold it there for five seconds, release the throttle pedal and confirm that you have the correct engine compression braking. Bring the vehicle back to a complete stop.
8. Perform a minimum throttle first to second gear up shift, then aggressively floor the accelerator pedal to perform a second gear to first gear downshift. This time hold the throttle pedal to the floor and record the rpm that the transmission automatically up shifts to second gear and then to third gear. If you don't have a tachometer, the shift points should feel reasonably close to appropriate for passing situations.

**(Note: You will be asked what your transmission and engine temperatures were at this point)**

9. Stop the vehicle and open the hood. Feel the return line from your cooling system. Please use some common sense here. Use extreme caution around any moving or hot engine components. Please don't call us complaining of burnt fingers or shredded clothes. When you touch the return line, do so with caution, use a quick, light tap to determine if the line is scolding hot. You should be able to touch this line without burning your hands. Even the outgoing line shouldn't be hot enough to burn you if you touch it momentarily. If you feel very high temperatures on the return line you should add a cooler. A transmission temperature gauge will help determine what is occurring. If you error on this topic, please do with too much cooling. The temperature gauge is recommended even if you don't plan to tow. 150 degrees F or less should be indicated with a temperature probe (sender) positioned in the pan. The fluid can be seriously overheated if pan temperatures exceed 150 degrees F. This happens because overheating is occurring in the converter, not the pan. What they don't realize is the temperature that we are observing is the fluid temperature **after** it has returned from the cooling system! People are confused about this because they know that Dextron III can withstand higher operating temperatures than 150 degrees F. What they are failing to realize is the gauge is reading the fluid after it has gone through the cooling system. While it is impractical to probe the inside of the torque converter when it is operating, it's known to be the hottest component in the system. The converter is **the** heat source and the main reason a cooling system is essential to automatic transmissions. So we have learned though years of observation this transmission is doing fine at 150 degrees F and overheating when over that if you are sensing the fluid temperature in the pan. Call with your observations concerning this drive test. Install the remaining pan bolts. (See torque specification sheet) Check for any leaks. These transmissions normally are not "Leakers", but the cooling lines can sometimes be pesky especially at the transmission end. The lines can be difficult to get a wrench on correctly. Recheck the fluid level.

### Miscellaneous Specifications

Location of the fasteners	Fastener description	Recommended Torque	Number of fasteners
Pan to case bolts	8mm x 1.5	97 inch pounds	16
Cooling line fitting to case	¼ N.P.T. x 18	28 foot pounds	2
Converter to flex-plate	10mm x 1.5	46 foot pounds	3
Bell-housing to engine block	3/8" x 16	23 foot pounds	6
Shift lever to manual shaft	10mm x 1.5	22 foot pounds	1
Pressure switches	1/8 NPT x 27	8 foot pounds	N/A
Pressure passage plugs	1/8 NPT x 27	8 foot pounds	N/A
Inspection cover to transmission case	# 14 sheet metal screws	60 inch pounds	4
Speedometer gear sleeve to tail-housing	6mm x 1.0	8 foot pounds	1
Rear transmission mount to case	10mm x 1.5	32 foot pounds	2
Cross member to rear transmission mount	7/16" x 14	32 foot pounds	1 or 2
Drive shaft bolts	Normally 5/16" x24	15 foot pounds	2
4x4 aluminum inspection cover	10mm x 1.5	32 foot pounds	6
Tail-housing to case	10mm x 1.5	25 foot pounds	4
Flexplate to Crank	7/16" x 20 x 5/8"	55 foot pounds	6

- ❖ Fluid capacity for a full sized converter and complete stock transmission fill up is 23 pints. (11 ½ quarts)
- ❖ Use any GM approved grade of Dextron III. My best advice is to buy whatever is on sale and change it often.
- ❖ Change all the fluid at least once a year. This will require a minimum of 11 ½ quarts of fluid, a new filter and a pan gasket.
- ❖ With a balanced cooling system and a temperature sensor located in the pan you should indicate a normal operating temperature of less than 150 F. Most installations don't even require additional coolers if the radiator system is well designed. When you plan to tow, you should try to over kill this requirement. If you must error while designing a cooling system for your transmission, please do so on the safe side of the equation, on the side of supplying a little more cooling than is needed, rather than not quite enough. If your system runs higher hotter than 150 degrees F you can bet the cooling

system isn't adequate or the torque converter is not locking up! Continuous operation at 150 degrees or less will insure the fluid lasts the full year between complete fluid flushes.

- ❖ The number one cause of failure with these transmissions is continuously running the transmission fluid hotter than it is designed to tolerate or frying the fluid during a single catastrophic incident. Considering the cost of a high performance motors and these automatic overdrives, we have never been able to understand why the Hot Rod community in general has such a cavalier attitude about the cooling requirements of these two costly items. We have had professional custom car builders tell us they don't have room for a cooler in the radiator! We've had them tell us their customers don't want ugly hard lines going to the radiator. Just because you don't have room for a heat exchanger in the radiator or don't like the looks of the cooling lines won't stop their fluid from burning up!
- ❖ Run a temperature gauge to indicate what is happening. **Always run the transmission fluid through a transmission heat exchanger built into your radiator.** Fluid can be degraded very quickly if it is operated at elevated temperatures continuously. The figures I have seen from manufacturers of Dextron III say the ideal operating temperature is approximately 160 degrees F. It is very easy to get the fluid hotter than 160 degrees F in the converter and it happens with astonishing speed. Our experience indicates the temperature of the fluid in the torque converter can and does fluctuate very rapidly. The converter holds two thirds of the systems fluid at any given moment. Using infra red scan instruments to monitor the temperature of the converter shell while running the transmission on our test stand, we can increase the temperature on the converter shell 100 degrees in only a couple minutes. This is while a temperature gauge sensing the temperature in the pan continues to show normal 150 to 165 normal temperatures. This is sometimes confusing for lay people to comprehend this phenomenon so we highly recommend you read our paper on controlling heat with converter lock up
- ❖ If you are going to tow, install a temperature gauge and an extra capacity **auxiliary** cooler. (This is in addition to the radiator cooler) We also recommend you request and study our paper "Understanding torque converter lock up" which is a comprehensive paper on this subject. What follows in this guideline is information concerning this matter but it's very limited in scope. After reading this guideline I'm sure you get the idea we are very concerned with the transmissions fluid temperature because we certainly are, however, we also know it is very easy to control if you understand the system.
- ❖ Use the largest flat tube cross-flow style cooler you can afford. Install this cooler in front of the car's radiator. Force air to be drawn through this cooler by mounting it as close to the radiator as you possibly can. These types of coolers are only effective when air is actively flowing across the fins and tubes. Make sure your cars cooling system has a fan shroud and the fan is positioned correctly in relationship to the shroud. The size and quality of the cooler is meaningless if air is not forced to remove the heat by flowing over the fins and tubes! If you live in a very cold winter location you will need to install a proper bypass system to control the direction of fluid flow through this cooler in the wintertime. You can avoid over cooling the fluid this way. These bypass systems avoid over cooling by changing which cooling device the fluid flows through last. In the summer time you want all the cooling you can get, so you want the auxiliary cooler last in the system. In cold winter climates you want the radiator water to maintain proper transmission fluid temperature so the fluid needs to flow through the radiator cooler last. Some areas get very cold and stay that way through the entire winter. In these areas you should completely bypass the auxiliary cooler from the system during the winter season.

## Summary

While this paper is quite lengthy, I think a quick summary will help to focus on the really important areas.

- ❖ Installing the Torque converter is an area that needs to be done with caution.
- ❖ The TV system is the communication link to this transmission and while it is quite simple to set up it is critical to get it correct.
- ❖ After installation we must confirm that the hydraulic pump is working correctly using a pressure gauge.
- ❖ The cooling system must run through an effective heat exchanger located in the tank of the radiator. This is a minimum system and more should be added to this if you have any questions as to the effectiveness of the cooler. Burnt fluid is the number one killer of automatic transmissions and especially the TH-2004R and the TH-700R4.
- ❖ The torque converter lock up system is a major player in controlling overheating the transmissions fluid. The fluid will burn up without this system working correctly.
- ❖ Complete filter, gasket and full system fluid need to be changed every 15,000 miles or annually whichever comes first.

700R4 Drive Gear Installation

