



The Great TV Mystery

- *A typical 700R4/2004R installation costs between \$1000 to \$2500, requires many hours of labor, skinned knuckles and no small amount of thought, ingenuity and fabrication skills. We find a very large percentage of people who have installed these overdrives have no idea how they should behave or what they're actually capable of doing. With that thought in mind, let us offer you the following:*

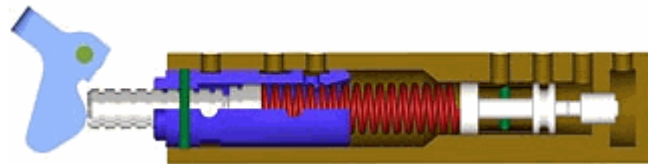
-
- Up shift at the appropriate time when using light throttle.
 - Shift with a moderate firmness at light throttle.
 - Shift firmness and delay should increase proportionally to the amount of throttle applied.
 - Under specific conditions, all Th-700R4 and Th-2004R transmissions should perform the following downshifts:
 - Fourth gear to third gear
 - Fourth gear to second gear
 - Fourth gear to first gear
 - Third gear to second gear
 - Third gear to first gear
 - They shouldn't shuttle back and forth from 4th (overdrive to third) while just trying to maintain the appropriate highway speed.
 - Wide open Throttle upshift points should feel firm and occur at the correct RPM.

Most Hot Rodders have read a number of articles emphasizing how "critical" the set up of the TV cable system is to these nifty overdrive transmissions. The same articles offer little in the way of a reasonable solution concerning how to set up the TV system between a performance aftermarket carburetor and the transmission. These articles usually offer impossible to understand diagrams of how the TV system cable needs to be pulled or a procedure to try. However when they try the procedure the transmission doesn't behave the way they know it should. The results is most of these folks become so intimidated by this "mystery" system that they readily accept terrible transmission behavior because they fear ruining their new transmission by not getting it right! We at Bow Tie Overdrives have always felt these wonderful overdrive automatic transmissions should be the very centerpiece a high performance vehicle and not have their potential performance compromised in any way!

This whole section of your web site is devoted to helping folks get these wonderful transmissions operating properly so they can enjoy their new overdrive transmission to its fullest! The subsequent sections will offer a comprehensive explanation of this complex system, simple tools and how to use them so you can maximize the performance of your Th-700R4 or Th-2004R with absolute confidence you will not do something to damage it in the process.

There is an **EZ** Solution!

[Click here...](#)



If you are in the need for a solution to your behavior problems, check out our precisely engineered systems that we have available for most of the popular carurators / fuel injection setups.

If you would like more information on the TV system it's self, check out our article entitled, "[TV System 101](#)". This is a 3 part series covering many topics.

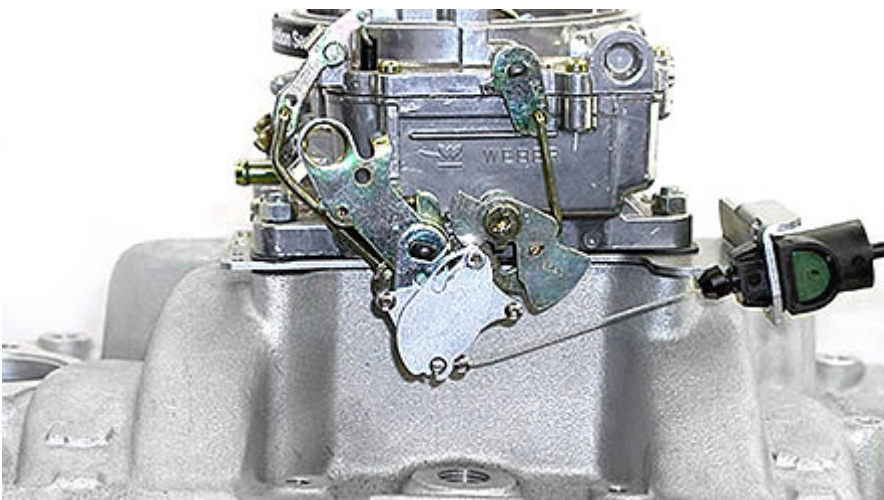


The EZ Solution!

Our U.S. Patented and Patent pending TV Made EZ systems are the worlds only complete bolt on TV systems that provide owner / installer a quick, simple and very easy way to establish a proper communications link between popular aftermarket carburetors and fuel injection systems and Th-700R4 and Th-2004R transmissions. Our TV Made EZ systems have been precisely engineered to work on each individual carburetor or fuel injection system linkage. We supply everything required for a quick installation at a very reasonable price. As an added bonus, these systems can be installed using simple hand tools. Each kit is engineered to allow its installation without making permanent alterations to the parent carburetor or fuel injection systems linkage.

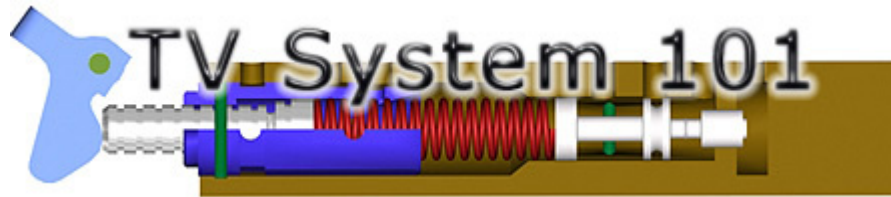
EZ Installation *EZ* Adjustment \$ Low Cost \ Everything Included

Once installed, our unique cable pulling cam also provides the owner / installer a means of adjusting the shift timing and feel of these transmissions during light and medium throttle driving.



For a small investment of time, money and effort, you will be able to gain control of your transmissions "Personality" while absolutely being sure you are signaling for instant pressure rise to protect the transmissions frictions.

Patent Pending Precision engineering Kits Available *for most setups!*



1. STOCK TV CABLE SYSTEM

2. TV FEED FLUID

3. ILLNESSES

Throttle Valve Cable system 101

PART ONE - EXPLANATION OF STOCK TV CABLE SYSTEM

What follows is our understanding of how the TV control system communicates to the Th-700R4 and Th-2004R transmissions. **Part Two** will explain where the TV feed fluid goes once the TV cable system tells it to go there. **Part Three** will discuss TV cable system "illnesses".

Introduced in the early eighties, the General Motors Throttle Valve cable management system has caused more than its share of confusion, misunderstandings and subsequent headaches. The following is an overview of this system as we understand it.

This system was developed as a communication and management link from the engines carburetor / fuel injection linkage to the transmissions valve body for many General Motors automatic transmissions. During this article we will only be describing its use in two of the many transmissions it was used in, the Th-2004R and the Th-700R4. The most important thing to understand about this TV cable system is that it's the **ONLY LINK** these transmissions have to the outside world. TV cable controlled transmissions cannot operate properly unless the information they need is input correctly through the throttle valve cable system.

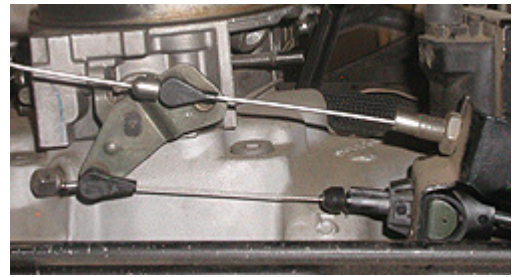
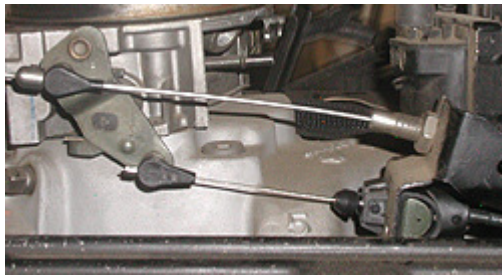
The following is a direct quote out of a General Motors service manual for a 1991 C/K truck equipped with a 4L60 (AKA THM-700-R4) transmission

"The TV cable used with the 4L60 transmission should not be thought of an automatic downshift cable. The TV cable used on the 4L60 controls line pressure, shift points, shift feel, part throttle downshifts and the detent downshifts. The function of the cable is similar to the combined functions of a vacuum modulator and a detent cable."

To help you understand this system we will first demonstrate how this system operates in a typical stock factory application. The TV cable management process starts at the vehicles accelerator pedal. As the accelerator pedal is depressed, a mechanical connection (Typically a cable) is connected to the engines carburetor or fuel injection systems throttle linkage. Further references to this linkage will be called the "carburetor linkage". This connection causes the "carburetor linkage" to rotate from its idle position to its wide open throttle position as the accelerator pedal is moved to its fully depressed position.

In Part Two and Part Three we will look at what the "internal" TV **system** components do and why "setting up" the correct starting and ending relationship of the three TV system components is so critical to these transmissions. Before we do so, one extremely important point needs to be made. You may notice that throughout this article, the term "adjusting" the TV cable will carefully avoided. We will do this for a very specific reason. We have read lots of General Motors manuals explaining how to "adjust" the factory TV cable. While most GM publications used the term "adjust", when you actually followed their procedure, what you actually accomplished was to "set" the system to its correct W.O.T. position which will in turn automatically "set" the correct starting position. This Part One will explain this in specific detail. We are not aware of a single GM publication that advocates "adjusting" the TV cable once it has been properly "set". We are not being "anal" about semantics here but commenting on the wide spread belief that the TV cable system can be "adjusted" to make the transmission "act" better. As far as we know, this system was never designed nor intended to be a transmission behavior adjuster. We further feel this is a very dangerous practice being performed by many "professional" transmission shops and mechanics. Once have read the remainder of Part One, Part Two and Part Three, we believe you will agree with us that once a correct TV relationship is "set", you cannot re-adjust it without creating a problem of some type. Some of these problems are minor but some can shorten the life of the transmission dramatically! Know what the difference is we will explain in Part Three "illnesses".

The TV cable attaches to the "carburetor linkage" in such a way as to cause the TV cable assembly's inner wire cable to be pulled as the "carburetor linkage" is rotated by the action of the accelerator pedal while it moves from idle to its fully depressed position. The cable assembly synchronizes engine throttle movement with TV plunger movement. (Shown Below)



The transmission end of the TV cable assembly is attached to the transmissions case. (Picture #1)

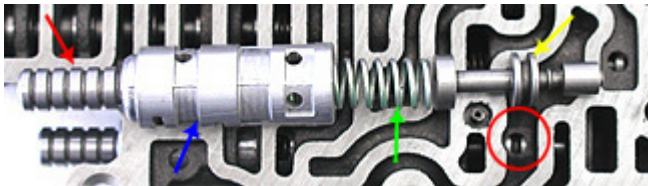


The inner wire of the TV cable assembly is connected to a rigid wire link, which in turn is connected to a throttle lever / bracket assembly that's bolted to the transmissions valve body assembly. (Picture #2)

As the cable is pulled, the throttle lever rotates, pushing in on the TV plunger located in the transmissions valve body.



Pulling and releasing of the TV cable during normal driving, reciprocates the TV plunger back and forth inside the TV bushing. (Shown at left in the fully extended and fully depressed positions)



Whenever the TV plunger (Red arrow) is moved inward inside the TV bushing (Blue arrow), it pushes on the TV spring (Green arrow) which in turn pushes on the TV valve (Yellow arrow). The sole purpose of the TV valve is to direct TV Feed fluid into the orifice shown with the red circle. The volume and pressure of this TV Feed fluid, being directed into this passage, will progressively increase, as the accelerator pedal is being depressed. This increasing TV feed volume and pressure entering into this feed passage is directed to all of the transmissions pressure regulating and shift control circuits. This increase in volume and pressure is not designed to increase in a progressive straight line; it's heavily biased towards increasing pressure and volume more rapidly during the initial movement of the Throttle valve and to have delivered its full influence by slightly over half throttle opening.

This feature works hand and glove with the transmissions pressure boost system (controlled by the line bias valve) to more closely match increases in engine torque.

"Engine torque increases more rapidly with early acceleration and increases slower as engine speed increases!"
(This is a direct quote from a GM technicians guide)

To clarify this long winded description, I refer back to another direct quote from the GM service manual mentioned earlier.

"The TV cable used on the 4L60 (AKA THM700R4) controls line pressure, shift points, shift feel, part throttle downshifts and the detent downshifts."

Everything is controlled by the TV feed fluid flowing into the single orifice shown above which is in turn controlled by the positioning of the TV valve! It would be a gross understatement to say that the TV valve and the fluid feed hole it manages are critically important to the Th-700R4 and Th-2004R!

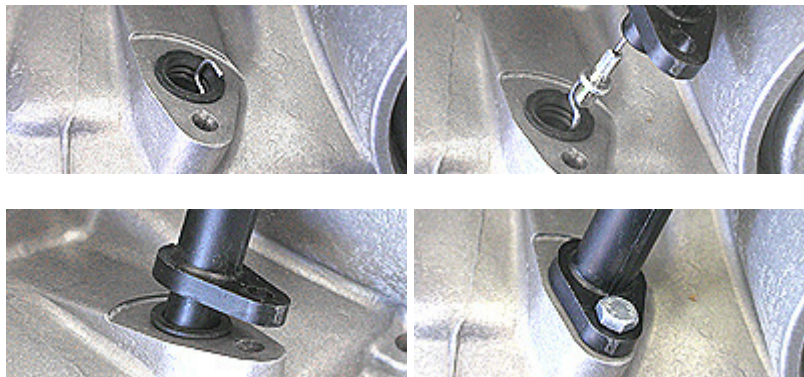
Let's get into the details!

The following is a physical description of a typical factory TV cable, plus an explanation describing how to "set" it properly using the factory procedure, followed by an illustration of what actually happens to the TV plunger / TV bushing relationship when the TV cable is adjusted using this stock factory procedure?

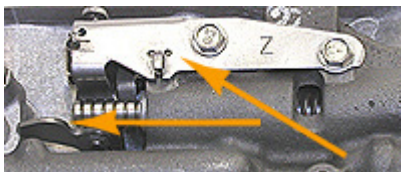
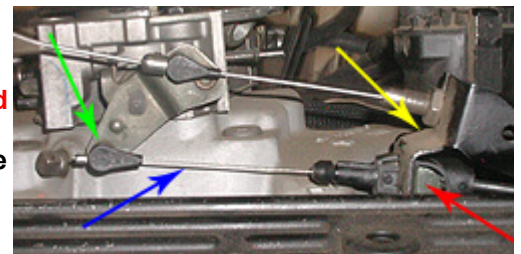
TV Cable



The transmission end TV cable assembly mounts to the transmission case by a single 6MM bolt. A rubber sleeve type seal placed between the TV cable housing and the case hole prevents fluid from leaking out of the transmission.



At the "carburetor linkage" end of the TV cable there's a special plastic housing molded onto the end of the TV cable assembly indicated by the **red arrow** in the picture a right. This "housing" snaps into a metal mounting bracket shown by the yellow arrow. This bracket is typically mounted to the engines intake manifold.



The inner wire cable (indicated by the **blue arrow** above) located inside the TV cable assembly typically has a tear drop shaped plastic connector at one end and a metal connector at the other. The "tear drop" connector (**Green arrow** above) snaps onto the "carburetor linkage". The metal connector at the transmission end is connected to a rigid wire link (shown in picture # 2 earlier) which is in turn connected to a rotateable throttle lever and bracket assembly (orange arrows at left). A fully extended TV plunger is not able to touch the activating cam surface of this lever when the cable is in its non adjusted full "out" position.

Let's run through the stock TV cable set up procedure!

General Motors Corporation is very specific when describing the correct method for "Setting" the TV cable system. The most "common" factory TV cable design has a metal "D" shaped button built into the housing of the cable assembly located where it snaps into the mounting bracket on the intake manifold.

There are other TV cable designs but all of them are designed to establish the **proper starting and ending relationships of the TV system components**. We will explain what the proper starting and ending points are once we've walked through what happens when we execute the factory TV cable "set" procedure.

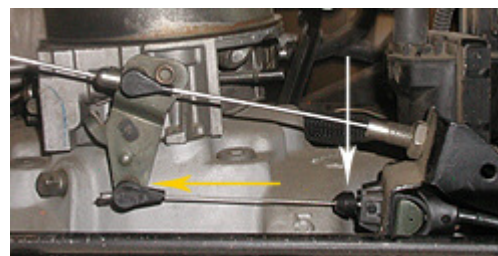
The manual states the TV system is set correctly when the TV lever touches the face of the TV bushing at the same time as the engines "carburetor linkage" is at its wide open throttle position and the accelerator pedal is fully depressed.

Once everything is connected correctly, the first step of the factory TV "set" procedure is accomplished by first pushing in on the TV cable housings "D" shaped cable slider release button, then pushing the cable slider towards the transmission until it stops as far into the cable housing as it will go. Release the "D" button to hold it in this preset position.



By sliding the "cable slider" back into the cable housing like this, you're increasing the actual length of the TV cable's outer sheath that's located between the transmission case and the TV cables mounting bracket located on the intake manifold.

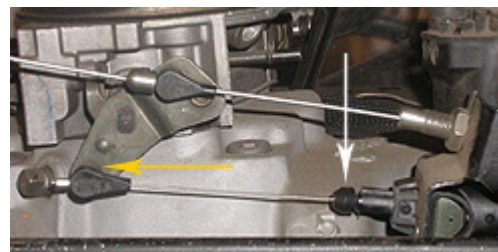
As the cable sheath gets longer between these two connection points, it will preload the TV plunger into the TV bushing as shown in the picture at the left.



The manual states you properly "set" the TV system by manually rotating the "carburetor linkage" to its wide open throttle position. However, as you attempt to rotate the "carburetor linkage" towards its wide open throttle position, the TV lever quickly comes into contact with the outer end of the TV bushing as shown by the **blue arrows** in the picture below.



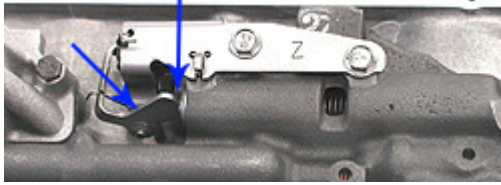
The TV lever stops at the TV bushing well before the throttle reaches its wide open throttle position as shown by the **orange arrow** in the picture above. Notice the TV cable slider position as indicated by the white arrow.



You must "force" the "carburetor linkage" to its full W.O.T. position as shown by the **orange arrow** in the picture to the right. This action has "forced" the TV cable "slider" mechanism to "ratchet" out to its correct "set" position! The white arrow in the picture at right shows the TV "slider" in its new extended position.

We have just established the **correct wide open throttle relationship** between three key TV system components.

- First, the "throttle linkage" is at W.O.T. (**Orange arrow** above picture)
- Second, the TV cable slider mechanism is correctly positioned. (**White arrow** above picture)
- Third, the TV lever is positioned up against the TV bushing as shown by the **blue arrows** in the picture at the left.



As long as the vehicles accelerator pedal will cause the "carburetor linkage" to rotate to its full W.O.T. position; these three components will always be in their correct relative W.O.T. positions whenever the vehicles accelerator pedal is depressed fully!

Experience has taught us to go one step further and check to be certain the vehicles accelerator pedal will rotate the "carburetors linkage" to the wide open throttle position. 60% of the vehicles that come into our shop do not!

When the General Motors procedure is followed, it establishes the correct **wide open throttle position** of the TV plunger when the vehicles accelerator pedal is fully depressed. Nothing else is supposed to be done! This wide open throttle position "set" is designed to calibrate the relationship of the vehicles accelerator pedal mechanism to the TV system. This position will then automatically establish the correct working relationship between the TV system components as the "carburetor linkage" rotates back to its idle position.

What happens when the "carburetor linkage" is permitted to rotate back to the idle position is at the very heart of understanding these transmissions TV cable systems! As the "carburetor linkage" is allowed to rotate back to idle, the distance the inner wire of the TV cable is allowed to travel back out is the **sole determining factor** of where **the "starting position" of TV valve will position in the TV bushing.**

Watch how this happens in the following pictures

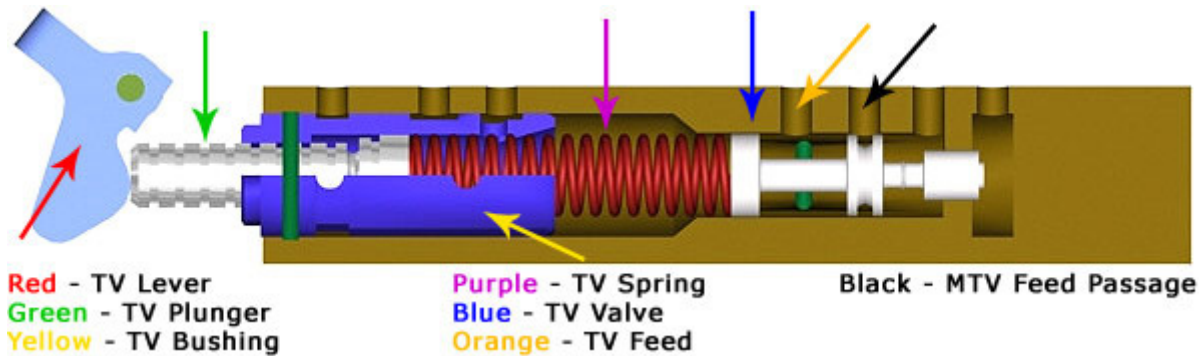
When we left off last in our effort to "set the TV cable up, we were holding the "carburetor linkage" at its wide open throttle position. As you allow the "carburetor linkage" to rotate back to its normal "idle" position, this movement also permits the TV cable's inner wire cable to "follow". This in turn permits the TV lever to rotate away from the face of the TV bushing and the TV plunger to also follow to its **starting position** inside the TV bushing. The TV plunger will end up partially "preloaded" in the TV bushing at an exact point which was "pre-engineered" by General Motors when the system was designed. This starting "point" is determined **entirely by the distance that the wire cable was allow to return!**





The picture at the left and the picture above show this particular factory TV cable adjusted to "its" correct starting point. Pay particular attention to the picture at left which clearly indicates the TV valve is being position to a part way in the available travel inside the TV bushing. It is not longer at the full out position. Once you understand what just happened, you will then understand that the starting position of the TV plunger will always be determined by the amount of **return cable movement** from the **previously set correct W.O.T. position!** "Carburetor linkage" design determines the distance the inner wire cable is allowed to travel on its return to idle.

Once the TV cable is "set", the **TV plunger start position** also positions the **TV spring** which in turn positions the **TV valve**.



Now would be a good time to explain that when the transmission is operating, there's a certain amount of hydraulic pressure preloading on the three components, TV plunger, TV spring and TV valve. This does effect their relative starting positions so our pictures and illustrations are positioned as they would be in the valve body when it's operating. We will not spend time in this article discussing hydraulic pre load because it will just confuse the issue. This article was written to help people understand how the manipulation of the TV plunger, TV spring and TV valve by the TV cable system, controls all of the vital functions of these transmissions. However, we will explain latter in this article how to use a pressure gauge to guarantee that the TV valve is positioned correctly at its starting idle position and offer solutions how to fix it if it's not.

Everything written in Part One is written for the purpose of making the following point: The actual starting position of the TV valve in the valve body is determined by two variable factors, only one of which can be controlled by the builder of the transmission, no matter who the builder is! The actual position of the TV valve at idle is determined by the length of the TV spring and the distance the TV cable travels as the "carburetor linkage" is rotated from its correct W.O.T. position back to the idle position.

A TV spring with a specific length will be installed when the transmission is remanufactured. The distance the TV cable is allowed to travel while going back to idle is determined by the "carburetor linkage" in the specific vehicle the transmission gets installed into. For any TV system to be "correct" there must be a very specific relationship created between these to elements.

Only the installer can determine whether the system is calibrated correctly. This can only be done after the transmission gets installed into the vehicle and only the installer can adjust this relationship if it's not correct!

Question: *So what is the correct starting position of the TV valve?*

Answer: We've never seen anything specifically published about this critical relationship but years of working with this system has convinced us that the TV valve needs to be positioned right at the edge of the TV feed orifice when transmission and the linkage is at idle. This is our opinion, but logic and years of experience keep confirming this starting position to be ideal *for most vehicles.*

Summary of Part one

"The TV cable used on the 4L60 (transmission AKA THM-700-R4) controls line pressure, shift points, shift feel, part throttle downshifts and the detent downshifts."

Everything up to this point in the article boils down to one specific point: The TV valve and one orifice feed passage control everything about operating pressures and transmission behavior!

The position of the TV valve is controlled by the length of the TV spring and the distance the TV cable is allowed to return while the "carburetor linkage" returns from the correct W.O.T. setting to the idle position.

Once the factory "set" procedure has been followed, the installer can easily determine whether the TV cable system is set up and responding correctly using the following methods and tools.

- Have a helper depress the accelerator pedal all the way and hold it there. You should attempt to rotate the "carburetor linkage" further by hand. If it rotates further, your accelerator pedal cannot activate the TV system to its wide open throttle position and needs to be fixed.
-
- Manually hold the "throttle linkage" to the wide open throttle position and confirm that the TV cable cannot be pulled further. This confirms the TV plunger is fully buried.
-
- Temporarily connect a 0-300 PSI pressure gauge to the transmissions pump diagnostic port located above the manual shifter shaft. (Insert a picture) We have found seven feet of hydraulic hose should allow the installer to have the pressure gauge in his hand while working at the carburetor or fuel injection location. Make sure the engine is warmed up and off the fast idle cam or circuit. With the engine at normal idle, the pressure should be at minimum regulated pressure or slightly higher. You can determine whether the TV valve is positioned correctly or not with the next two tests. Write down the minimum observed pressure at idle, disconnect the TV cable. If the pressure drops, if is normally safe to drive the vehicle. If drops a lot (over 3-4 lb.), something is not correct in your system. This condition is normally safe to drive but the transmission may perform unsatisfactorily. We call this condition, Long Spring Syndrome (LSS); its cause will be discussed in depth in Part three "illnesses". If pressure didn't drop when you disconnected the TV cable, reconnect the cable; **gently** pull the inner wire cable without moving the throttle linkage. If you can **gently** pull the cable any distance without instant pressure rise, something is seriously wrong and you should identify the source of this condition which we call Short Spring Syndrome (SSS). This is potentially a very dangerous condition that can lead to rapid clutch failure. The causes of this condition will be discussed in detail in Part Three - "illnesses"

Installers responsibilities

- The TV system controls line pressure, shift points, shift feel, part throttle downshifts and the detent downshifts through one orifice

- Everything the transmission needs to know is transmitted through the TV cable to a single orifice which is controlled by the TV valve. Determining whether this is correct can only be done by the installer!
- The factory "set" procedure establishes the **correct wide open throttle** position relationship between the **"carburetor linkage"**, the **"slider"** position on the TV cable and the **TV lever** positioned against the face of the TV bushing. **This can easily be determined by the installer, just hold the linkage in its W.O.T. position while pulling on the TV cable, if the TV will not pull further, it's correctly set at W.O.T. position.**
- What the factory "set" procedure (Manually rotating the 'carburetor linkage by hand) doesn't confirm is whether depressing the accelerator pedal fully also causes the "carburetor linkage" to rotate to its W.O.T. position. Rotating the "throttle Linkage by hand is **not** the same as causing W.O.T. to occur by depressing the accelerator pedal fully. If the **accelerator pedal** doesn't cause the **"carburetor linkage"** to fully rotate to its W.O.T. position, the **TV Lever** will not fully bury the **TV plunger**, even if the factory "set" procedure was absolutely performed correctly. Proving this relationship is correct **can only be done by the installer.** This "check" normally requires two people, one to depress the accelerator pedal, the other to check if the "carburetor linkage" is completely rotated to W.O.T
- The **distance** the TV cable travels as the "carburetor linkage" is allowed to rotate back to idle, determines the **"starting" position** of the TV valve.
- There are to "illnesses" that the TV system can have which will have a direct affect on these transmissions. Whether one of these "illnesses" is present or not can only be determined by the **installer after** the "set" procedure has been performed and can only be determined by the use of a **pressure gauge** screwed into the pumps diagnostic port. **The builder of the transmission has nothing to do with determining whether one of these "illnesses" are present. This can only be determined by the installer.**

Our company highly recommends that our customers allow us to stay closely involved all the way through the installation, set up test driving and warranty authorization. We do this so our customers can feel very comfortable with getting this transmissions installed correctly. With Th-700R4 and Th-2004R transmissions, the **installer** is every bit as responsible for the successful operation of these wonderful overdrive transmissions as the **builder** of the transmission! No amount of finger pointing, screaming denials, claims of ignorance or quoting of other sources, (like well meaning brother in laws or your favorite mechanic at Bubba's transmission shop) by the **installer** will change this fact! In all stock applications, especially in custom applications, these transmissions are **not** Plug and Play! These transmissions require the **installer** to set, check and correct the TV cable system (if needed)!

If your transmission behaves inappropriately, exhibits delayed pressure response or has elevated idle pressures, only you the installer, can fix these issues!

Your transmission builder has nothing to do with the distance the TV cable travels as it returns from wide open throttle to the idle position! For this relationship to be correct the TV cable travel distance must be matched to the length of the TV spring by the installer!

Part Two will explain where the TV fluid goes once the TV valve directs it into the TV feed passage!





1. STOCK TV CABLE SYSTEM

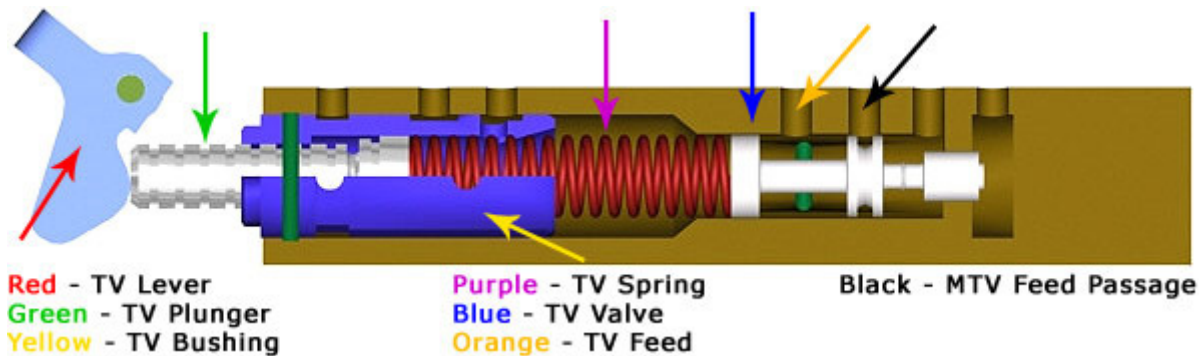
2. TV FEED FLUID

3. ILLNESSES

Part Two: TV feed fluid

The purpose of Part two is explain where the TV feed fluid is directed to once it enters the TV feed passage. Once explained, it will become clear that these transmissions need a TV system that buries the TV plunger inside the TV bushing at W.O.T. and positions the TV valve at the correct position inside the TV bushing at idle!

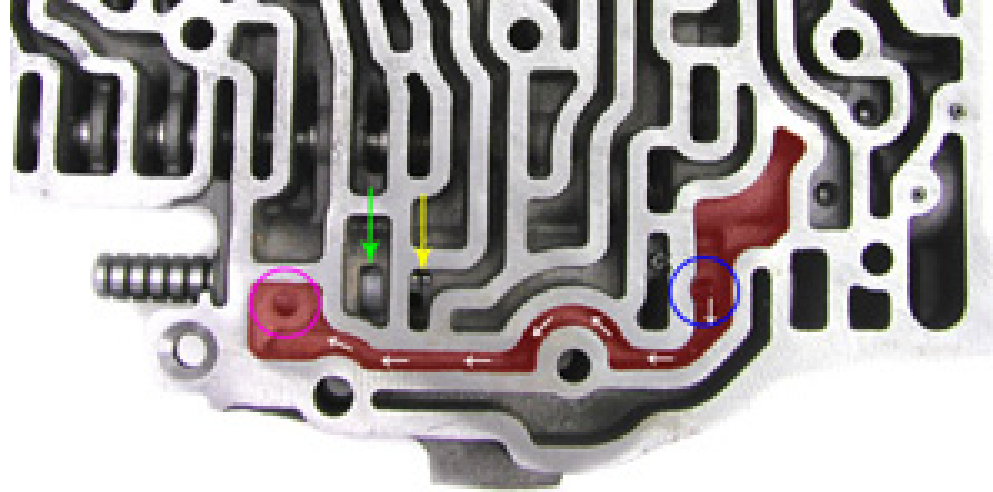
This graphic is a reasonably accurate representation of a Th-700R4 Throttle Valve (TV) system in the correctly set factory position for a Chevrolet C/K pick up with a 350 CI engine with TBI



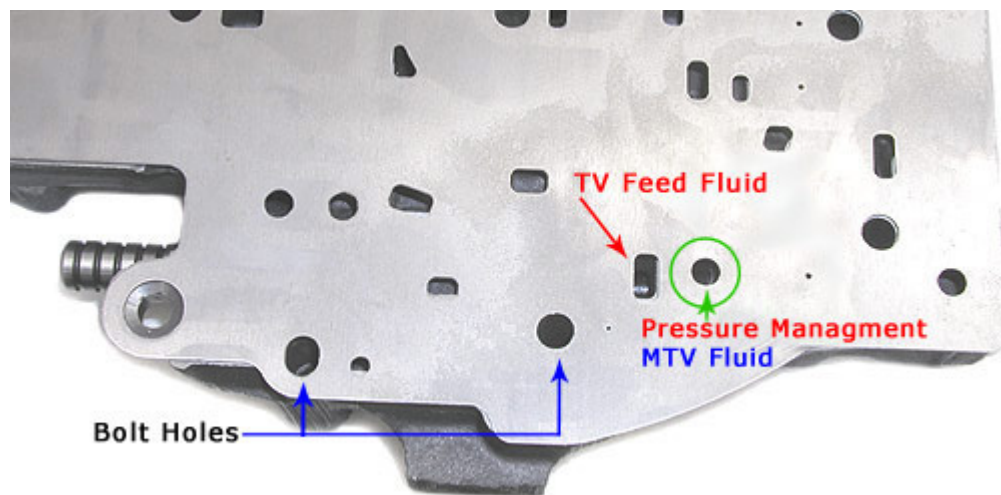
Quoting GM again, not to be redundant, but to again focus our attention on the functions controlled by the TV cable system!

"The TV cable used with the 4L60 transmission should not be thought of an automatic downshift cable. The TV cable used on the 4L60 controls line pressure, shift points, shift feel, part throttle downshifts and the detent downshifts. The function of the (TV) cable is similar to the combined functions of a vacuum modulator and a detent cable."

The five activities listed above are influenced by the TV valve movement. As the TV Valve starts feeding TV fluid into the feed orifice (blue circle), it's directed to three places as it enters the passage shown below (area shown in transparent red). TV fluid passes through the spacer plate (green circle in bottom picture) into the transmissions pressure boost circuit where it instantly boosts line pressure. This fluid also feeds to the circuits that control up shift timing and feel called MTV. The transparent red fluid also feeds the port shown (purple circle in top picture) directing TV fluid back into the TV bushing and TV plunger (See heavy throttle upshift and downshift control section below) to assist plunger movement so the pedal pressure isn't excessive. This fluid also feeds the part throttle (Green arrow) and detent (Yellow arrow) ports in the TV bushing.



The picture below has a hole (Green circle with explanation in the spacer plate TV fluid flows through after entering the passage in the valve body indicated with the transparent red color in the picture above. This fluid



There are plenty of "cross over" effects between these three circuits which we will not even attempt to explain since this article is only meant to provide an overview of the **TV System** and its effect on these transmissions. When you read the following few paragraphs, it should become clear that **all** activities of these transmissions are effected by the TV valve system. The following information is offered to help the owner / installer understand why the **TV valve** must have a **correct starting (idle) position** and a **correct wide throttle position, not just one or the other**. By the end of Part Two it should be obvious that some aspect of the transmission management will not be correct unless the TV system is managed correctly through its full spectrum of movement!

The TV feed fluid is directed into three control circuits which subsequently control or effect the following:

LINE PRESSURE MANAGEMENT



Line pressure management and upshift and downshift timing and feel are fed directly as fluid enters the feed orifice above.

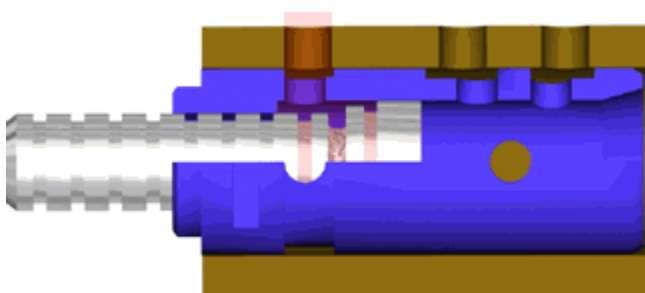
- **Line Pressure:** The TV feed passage (**green circle on spacer plate above**) directs TV fluid to the transmissions pressure boost system, via the line bias valve. The transmissions line pressure will rapidly rise as fluid enters the TV feed passage and will typically have it's **full boost effect by the first 65% of accelerator pedal movement** off the idle position! The need for instant pressure rise to **off set** any increased input of torque into the transmission by the engine is **CRITICAL!**

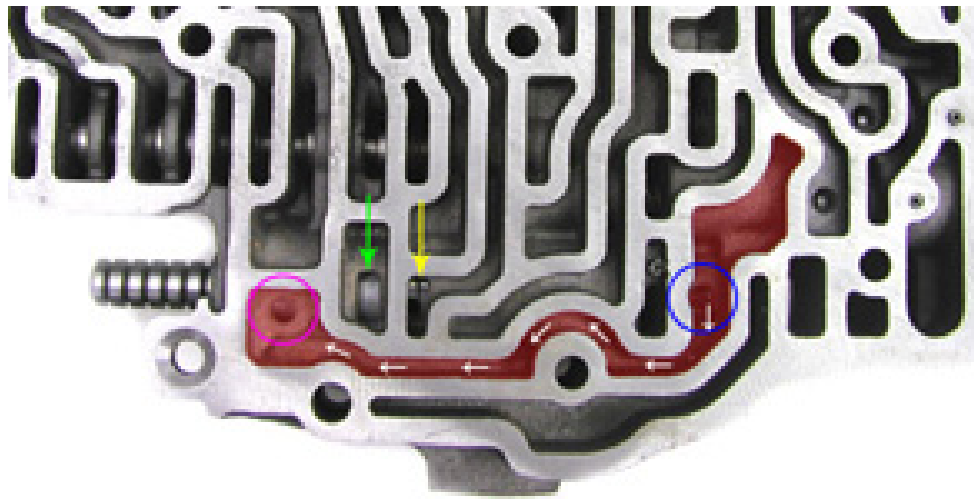
UPSHIFT AND DOWNSHIFT TIMING AND FEEL

- **Upshift and downshift timing and feel:** This fluid circuit is called **modulated TV up**. The **MTV up** control circuit is designed to appropriately delay upshift timing with increases in accelerator pedal application. The further the accelerator pedal is depressed the later and firmer we want the transmission to up shift. This circuit has **its major effects on up shifts timing and feel occur during light and medium accelerator pedal settings** and less "noticeable" effects after the TV system passes 1/2 throttle. **However, this circuit does effect less obvious things all the way from idle to W.O.T.**

The second circuit is the **modulated TV down** circuit, this circuit starts having its affects during **heavy to full throttle settings** and **has little or no effect at light to medium throttle settings**. This circuit works hand in hand with the next topic; **the part throttle and detent ports** located in the TV bushing.

Heavy throttle upshift and downshift control





The fluid entering the TV bushing (left picture above) comes from the TV feed orifice (blue circle-right picture) which is being fed by the movement of the TV valve over the feed orifice. This fluid progressively increases in volume and pressure as the TV valve is activated. We've tried to illustrate these by color and transparency change.

- **Part throttle port and detent port in the TV bushing.** As the TV valve feeds TV fluid into the feed orifice, part of this fluid is fed to the TV plunger through a port in the TV bushing. This fluid increasingly assists in moving the plunger against TV back pressure to prevent the throttle feel from becoming too great. As the TV plunger moves down the bore of the TV bushing it will eventually pass over the part throttle port. The TV plunger must travel 50% to 75% of its full available travel distance inside the TV bushing before it reaches this port. This fluid effects heavy throttle upshifts and under the right circumstances will cause downshifts. These downshifts are normally a single gear.

Detent port fluid feed. The TV plunger must be moved all the way to the end of its available travel to allow TV fluid to enter into the detent port of the TV bushing. Fluid entering this port does a number of things but we feel one of the most important is its effect on two gear down shifts (sometimes three gear)! We are continually amazed at how many people with these transmissions don't realize their transmissions are capable of doing double gear downshifts because theirs never has. TV fluid can only enter this port when the TV plunger is **completely buried at W.O.T.** For the part throttle and detent down shift fluids to have their proper effect on downshifting and upshifting, the TV plunger must move from the systems 50% throttle position to its W.O.T. position!

Line pressure management has its greatest effects during the first 50 to 65% of **TV valve movement**. Light and medium throttle up shift timing and feel is managed during the first 50 to 60% of **TV valve movement**. Wide open throttle upshifts are heavily influenced during the **last 30% of TV valve travel**. Part throttle port in the TV bushing only gets fed **after 50% to 75% TV plunger movement**. The **fun two gear downshifts** are initiated by **TV fluid** directed through the **TV bushings detent port**. This port is only fed when the **TV plunger is completely buried inside the TV bushing at W.O.T.**

Each of the **three TV fluid feeds** described in the preceding paragraphs has **its own specific effect** on these transmissions during a **designed range of movement** as the TV plunger moves from its idle position to wide open throttle position. Line pressure is controlled during the first half of movement, up and down shifting during the full range of movement and the part throttle / detent ports effects only occur after half throttle to W.O.T. Once you understand that **"all positions"** have effects on specific transmission management activities, you will then understand how important it is to establish a correct **full movement TV cable system.**

All the information provided in Part Two is to make one point crystal clear. A **correct starting**

position of the TV system and a **correct ending position** of the TV system must be established for **all** functions to perform correctly! Getting the correct **(W.O.T.) ending position** is **very easy** to do using the factory TV cable adjustment procedure. The **trick** is to get the correct **starting position of this system**. The correct starting position is determined by two factors, **length of the TV spring** and the **distance the TV cable is allowed to return** once the correct TV cable W.O.T. relationship is "set". A method to fix the relationship between these two factors in **stock applications** will be offered at the end of Part Three.

Summary of Part Two

For one of these wonderful overdrive transmissions to operate properly, the **TV system** must start with the **TV Valve positioned** at the edge of the **TV feed orifice** with the **accelerator pedal** in its **idle position** and end up with the **TV plunger** completely buried inside the **TV bushing** when the **accelerator pedal is fully depressed!**

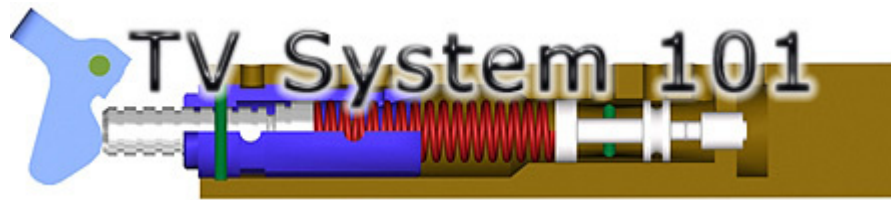
Using the following procedure, the installer can easily check to be sure the TV plunger is positioned correctly relative to the feed orifice, moves instantly with even slight applications of the accelerator pedal and confirm that the TV plunger is mechanically positioned against the face of the TV bushing at W.O.T.

This procedure will require the use of a second person. Connect a 0-300 PSI pressure gauge to the transmissions pump diagnostic port on the drivers side of the bell housing. Perform the TV "set" procedure, start the engine and check for the following:

[Click here for an explanation of how to hook up a 0-300 PSI gauge](#)

- First; your pressure gauge should read the same with the TV cable connected or disconnected. A slight pre-load of 2 to 4 lbs at idle will not normally produce any adverse effects.
- Second; when the TV cable is connected and adjusted correctly, even slight movements of the TV cable where it exits the cable housing should produce **instant** pressure rise.
- Finally; have your assistant depress the accelerator pedal fully and hold it there. Using a set of pliers, try to pull the TV cable further out. If you can not, then this demonstrates the TV Lever is firmly against the face of TV bushing at this W.O.T. position.
- If your system doesn't pass these tests, they can be fixed! The fix process may require the removal and reinstallation of the transmissions pan a few times but it is not that difficult to do. **Delayed pressure response can be very serious and needs to be addressed A.S.A.P.**

Part Three will explain how to determine which "Illness" your transmission has and how to cure the problem.



1. STOCK TV CABLE SYSTEM

2. TV FEED FLUID

3. ILLNESSES

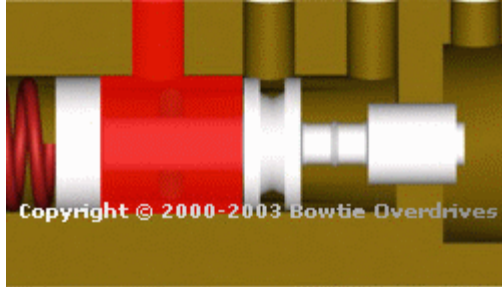
Part Three: "Illnesses"

In [part one](#) we described the **TV cable** and how to **set it to factory specification** at wide open throttle. We learned the idle **starting point** of the **TV valve** was determined by the **distance the TV cable travels out** as the **"carburetors linkage"** is rotated back to its **idle position**. This happens because idle position of the **TV cable** determines the **TV plungers starting position** relative to the **TV bushing**. Subsequently this **TV plunger position** determines the **TV springs position** which in turn determines the **TV valves starting position in the valve body**. We also learned that **everything** this transmission needs to know must be communicated by **TV feed fluid movement into the TV feed orifice**. **The Pressure and volume of the TV feed fluid into the feed orifice is 100% controlled by the TV valve as it moves to subsequently expose more and more of the TV feed orifice as the vehicles accelerator pedal is depressed**. This requires a very precise relationship be established by the coordinated effects between two components! **The distance the TV cable is allowed by the "carburetors linkage" to move outward as the linkage rotates back to idle from W.O.T. and the length of the TV spring**.

In [Part Two](#) we described where the **TV fluid is directed** once it's allowed to enter the **TV feed passage**. We learned that **TV feed fluid immediately** effects **line pressure, up shift timing and light to medium throttle down shift timing** whereas **heavy throttle downshifting** events are more controlled by **TV fluid** being directed back to the **TV plunger and TV bushing**. Heavy throttle up shifts and Down shifts are controlled by the **TV plunger's physical position** inside the **TV bushing** relative to the **part throttle and forced detent downshift ports**. **Part throttle downshifts** are governed by **TV fluid** allowed to enter the **part throttle downshift port** at around **60% to 75% throttle position**. **Forced or detent down shifts** are controlled by **TV fluid** allowed to enter the **detent control circuits** when the plunger is **100% buried inside the TV bushing**. This **physical positioning** of the **TV plunger in the bushing** is what allows **TV fluid** to enter into the **detent port!**

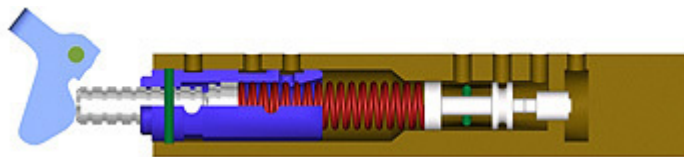
Most important thing to be learned from Part Two is that proper control of these wonderful overdrive transmissions requires full movement of the TV system including a **correct starting position** where the TV valve is positioned right at the edge of the TV feed fluid orifice at idle and a **TV plunger that gets completely buried** then the accelerator pedal is depressed fully! The **fully depressed TV plunger position** is very **easy to achieve** at wide open throttle, also very **simple to verify**. The **correct starting position** can be **somewhat complex** to set up but is also **very easy to verify**.

Part Three will describe incorrectly established relationships between the "carburetors linkage" return of the TV cable and the length of the TV spring. We call these **incorrect relationships "illnesses"** since they will have detrimental effects on the proper operation of these transmissions. Certain **"illnesses"** can cause **rapid failure** while others will just **prove aggravating, irritating and frustrating**. We will explain how to diagnose an **"illness"** and offer ways to correct (cure) these afflictions.



NORMAL TV VALVE MOVEMENT

Here we have a TV valve moving over the TV feed fluid passage regulating the volume and pressure of the fluid entering the TV fluid orifice as the TV spring forces the TV valve to move as the TV plunger is moved by the TV cable. We show what we believe to be a movement which is very close to perfect for most applications. We will describe some exceptions in Part four "Behavior"



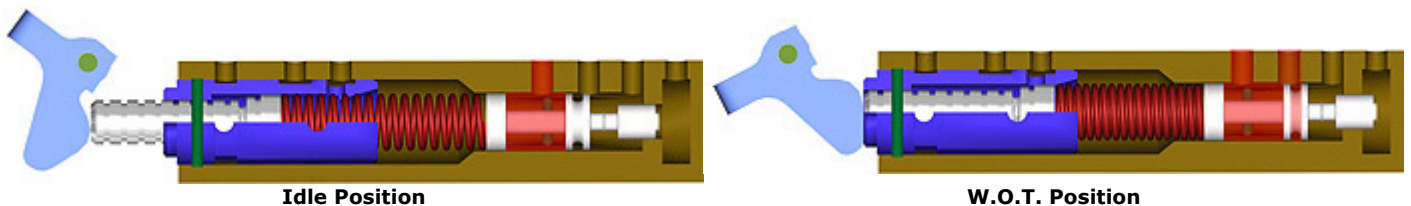
Pictured here is a properly adjusted TV system setting at its idle position. Note the the TV plunger is positioned somewhere between its fully out position and its fully depressed position. Please note that the TV plunger is held in this starting "position" by the TV lever. This is also true for the TV valve. The TV valve is "positioned" in the location above by the TV plungers position in the TV bushing and the length of the TV spring.

It is important to understand that the TV valve would no longer be positioned as shown in the picture if the TV spring was either longer or shorter than the one in the picture.

It would also not be in the position shown if the "carburetor linkage" had allowed the TV cable to travel a further distance out as the carburetor linkage rotated back to its idle position. Same is true if the travel distance would have been shorter.

Whenever the TV valve is not positioned correctly we like to think of its incorrect position as an "illness" which needs to be diagnosed and corrected. We call the "illness" where the TV valve is positioned short of the TV feed orifice, short spring syndrome or SSS for short. The second illness where the TV valve is positioned beyond the edge of the TV feed orifices edge is called long spring syndrome of LSS for short.

Short Spring Syndrome - SSS

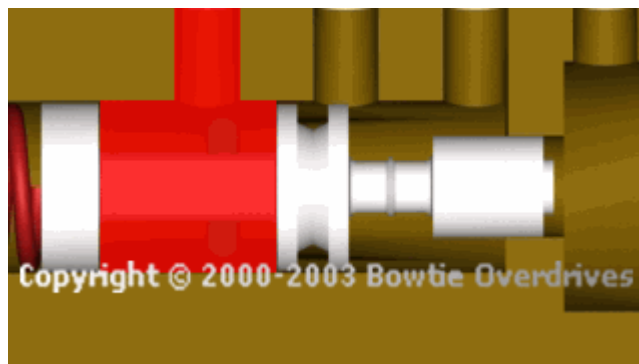


Idle Position

W.O.T. Position

Three conditions will cause **SSS**. The first occurs when some well meaning person "**adjusts**" the TV cable again after performing a correct factory "set" procedure. This typically happens when some knuckle head tells him that readjusting the TV cable is a great way to "**adjust**" the transmissions behavior. The second is a **TV spring** that is **too short** to properly position the TV valve right at the edge of the **TV feed orifice** after the cable has been "set" to factory specification. The last cause of the **TV valve** being positioned "short" of the **TV feed orifice** is when the **TV cable** was allowed to **travel too long a distance** outward when the "carburetor linkage" rotated back to idle from the correct Wide Open Throttle position

Regardless of the cause, the result is still the same. The TV valve is **positioned short of the leading edge of the TV feed orifice at idle**. **SSS** can simply be defined as a condition where the **TV valve must be moved some distance before it reaches the edge of the TV feed orifice where it can begin its management influences**. **The distance the TV valve must travel before it can begin to "manage" will determine how serious the condition is.**



SSS CONDITION

SSS is potentially a very dangerous condition since the vehicles accelerator pedal will be signaling the vehicle's engine to make increasing amounts of torque **before** the TV valve **even starts** to signal the transmissions pressure boost system **to raise line pressure to off set this increasing twisting force**. **Severe SSS** will lead to very **rapid transmission clutch / friction failure** since **clutch clamping pressure** will be **lagging behind engine torque input!** Mild SSS afflicts a large percentage of Th-700R4 and Th-2004R transmissions because of the natural "**shortening**" of the TV spring that occurs during the millions of cycles this spring is put through during its normal lifetime. If the TV spring is not "**re-calibrated**" during the **rebuild and installation** process, this "**illness**" will still be present when its installed back into the vehicle. This condition will lead to a **much shorter service life** than it gave the first time around. We believe that "**mild**" **SSS** is the root cause of almost all friction failures in these transmissions especially high gear friction failure. Food for thought; if a transmission is capable of providing 300,000 miles of normal service but "fails" at 125,000 miles instead, is that acceptable?

The other leading cause of failure is overheating which is also easy to prevent!

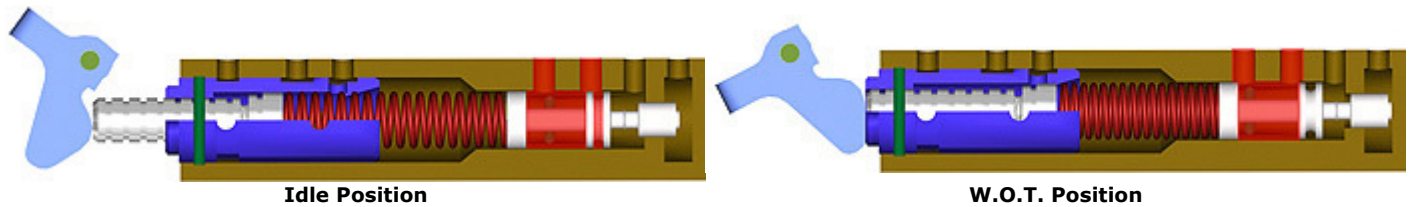
SSS also delays the signal to delay the up shift timing, consequently the transmission will "**usually**" short shift (commonly called stack shifting) as it sequences up through the gears. Stack shifts are shifts that occur earlier than is appropriate for the specific throttle setting at the time. While this condition can be quite irritating, it normally doesn't hurt anything. Low pressures, on the other hand, are very serious and can easily go unnoticed until it's too late since a little bit of slippage can be very hard to detect. **Whether you know about it or not, it will still accelerate friction wear.**

Another affect from the condition of **SSS** is its affect on downshifting. Downshifting will be delayed relative to accelerator pedal position or be non-existent altogether. This is especially noticeable while trying to get a forced or detent downshift which relies on the TV plunger being totally depressed into the TV bushing at W.O.T. If your transmission is **late to downshift or doesn't two gear (detent) downshift**, I would be very suspicious of an **SSS** condition.

This condition is very easy to identify using a 0-300 PSI gauge to confirm instant pressure response with even the slightest movement of the TV cable. (Insert link) [The installer can easily remedy this condition.](#)

Our advise is never drive a vehicle that has an SSS condition until is fixed!

Long Spring Syndrome - LSS



The other **incorrect TV set up condition** is what we call **Long Spring Syndrome (LSS)**. This condition exists when the **TV valve** is positioned in such a way as to cause **TV feed fluid** to be **prematurely feeding into the TV feed orifice**. This condition will be **influencing the transmissions control circuits** even though the **accelerator pedal is still in its idle position**. We know of four things that will normally cause the **LSS "illness"**. First is when the vehicles accelerator pedal will not rotate the "carburetor linkage" to its full **W.O.T. position** and the accelerator pedal is then used during a factory "set" procedure to "set" the W.O.T. position. Second cause would be a "carburetor linkage" which causes the TV cable to return a distance shorter than required to position the TV valve at its correct starting position. Third is a TV spring that's too long which subsequently will not allow the TV valve to position correctly at the edge of the TV feed orifice. This **LSS** condition rarely causes damage but can result in some **very frustrating behavior**. **LSS** causes the TV valve to be positioned in such a way as to allow TV feed fluid pressure and volume to feed into the TV feed passage before the accelerator pedal is depressed at all! This condition **signals** for **higher line pressures** and instructs the up shift control circuits to start **delaying the up shift timing** before the accelerator pedal is even depressed at all! Common symptoms of LSS are late hard up shifts compared to the accelerator pedal position during light to medium throttle driving situations. Late hard shifts during light throttle driving situations gets very old in a hurry. Downshifting may occur too early and can sometimes causes "shuttling" between overdrive (4th) and 3rd gears. The transmission may produce double down shifts at inappropriate times, of example, it shifts from overdrive (4th) down to second gear (2nd) gear when a shift into third (3rd) would have been far more appropriate.



LSS CONDITION

This condition is also very easy to diagnose using a 0-300 PSI pressure gauge attached to the transmission pump diagnostic port on the drivers side of the transmission. When you're certain your **TV cable system** is achieving the correct W.O.T. relationship between all of its components; the **accelerator pedal completely depressed**, the "carburetor linkage" rotated to its mechanical W.O.T. stop and the TV plunger totally buried into the TV bushing. Perform the following test; first start the engine and let it idle. Record the reading on the pressure gauge. Disconnect the TV cable and "gently" start allowing the cable to return into the cable housing. If at any point the pressure reading drops lower then the pressure you originally wrote down, you have an **LSS** condition! How much the pressure drops will determine the severity of your transmission **LSS "illness"**.

If your transmission has an **LSS** condition but passes the following drive test (click on the link below) *and you are happy with its overall behavior*, you should probably leave it alone!

[Click here for our 'Test driving procedures'](#)

If you now are certain your TV cable is set up correctly with no signs of **SSS** or **LSS** but it still doesn't behave the way you would like, you should now proceed to Part Four "**Behavior**"

[1. STOCK TV CABLE SYSTEM](#)

[2. TV FEED FLUID](#)

[3. ILLNESSES](#)

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