Drivetrain Diagnostics



Figure 1

For many automotive professionals, drivetrain diagnosis and troubleshooting are often viewed as intimidating exercises. This largely stems from a lack of understanding drivetrain systems and their operation. As a result, a common mindset when it comes to drivetrain concerns is, “If it’s a transmission problem, replace it.”

However, replacing transfer-cases, transmissions, and differentials is an expensive service, especially when the real problem could be low in complexity and inexpensive. The objective of this chapter is to emphasize the wisdom of using a proven diagnostic approach by sharing some case studies of real transmission failures in order to help the reader better understand drivetrain concerns.

Diagnostic Approach

Over the years, car manufacturers have spent a lot of time and effort developing diagnostic processes for their service technicians. By observing their most successful technicians in order to see how they diagnose vehicle service issues, manufacturers are able to form and implement specific diagnostic routines. These routines allow service departments at new car dealerships to operate more efficiently. Their ultimate goal is to save the dealer and the manufacturer millions of dollars by following proven diagnostic practices.

We as an automotive program have developed our own diagnostic approach. It is patterned after the routine that various automotive manufacturers have developed and implemented. In this class, we will use our program’s approach with a few minor adaptations in order to make it more applicable to automatic transmission repair, since this is the area where most service professionals seek guidance.

Examine the Automotive Program's Diagnostic Approach below, noting the few extra items that make it more applicable to automatic and CVT transmission diagnosis:

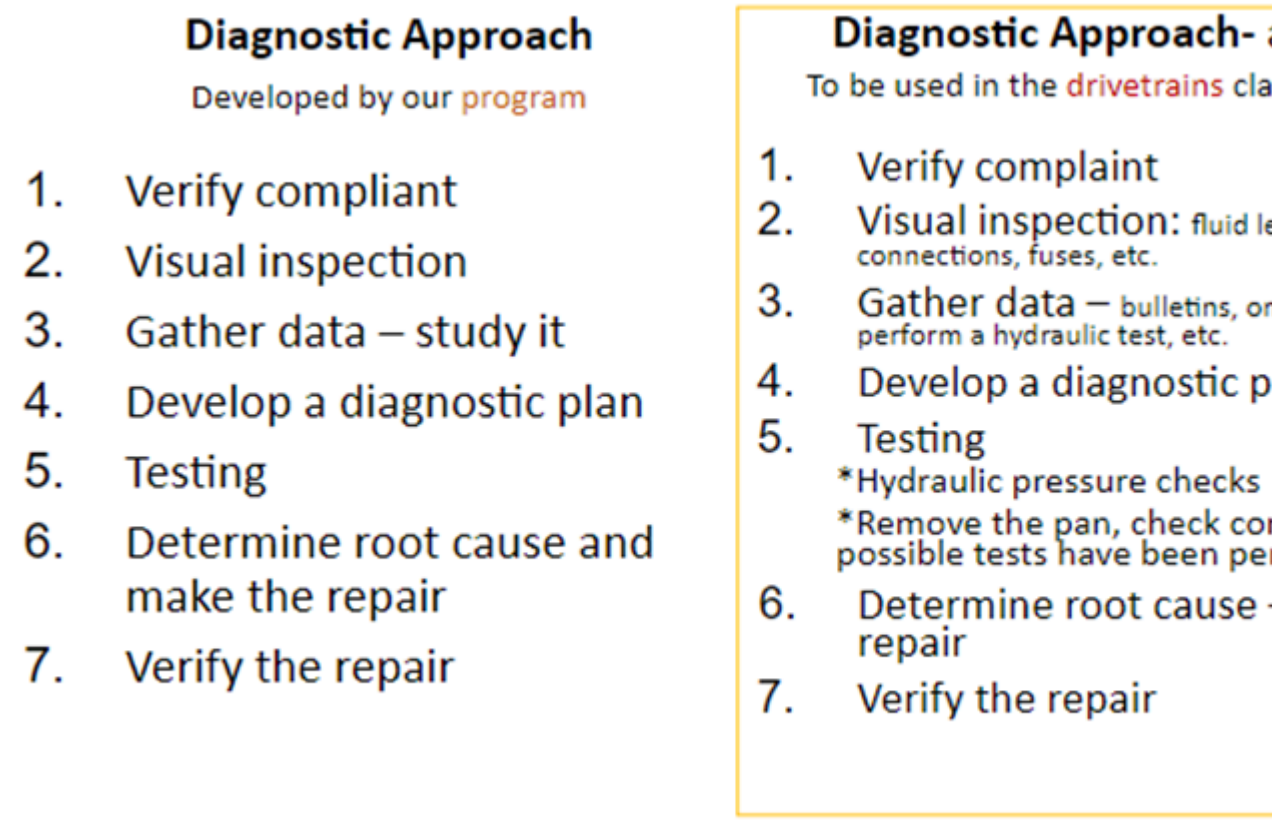


Figure 2

As with any diagnostic approach, regardless of the industry, the first step is to **verify the complaint**. A technician needs to duplicate the problem in order to understand the nature of the problem.

Step two is to perform a **visual inspection**.

1. Examine the transmission fluid level's color and condition—is there debris in the fluid, or is it contaminated with engine coolant?
2. Electrical connections need to be inspected—wiggled, taken apart and examined, etc.
3. Inspect any and all hoses, wiring near exhaust pipes, shifting linkages, fuses, etc.
4. Use a scan tool to (1) view monitor status and (2) gather diagnostic trouble codes.

Case Studies

Case study 1: Whenever engine coolant has mixed with the transmission's fluid (evidenced as pink transmission fluid—see Figure 3 and Figure 4 below), the transmission and the radiator will need to be replaced. What occurs in these instances, the cooler tank inside the radiator cracks somehow which allows transmission fluid to mix with coolant and coolant to mix with the transmission's fluid. The real concern is, water erodes and peels off clutch lining material from the multi-disc clutches inside the transmission. There is no reversing this kind of wear and contamination. This has been a common problem for many years, and the root cause is a cracked transmission cooler tank inside the radiator.

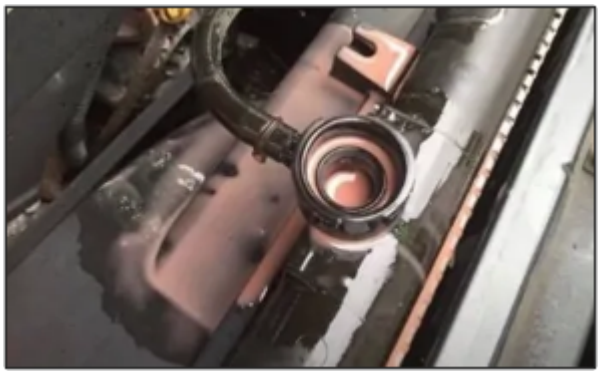


Figure 3



Figure 4

Case study 2: The point of this example is, when a transmission doesn't work it doesn't always mean that it has failed and needs to be rebuilt or replaced. The issue may be as simple as the transmission is low on fluid.

A **2001 Chevrolet Malibu** was towed to the lab because the vehicle would not move whenever the transmission was placed in Reverse or Drive.

Unfortunately, the student technician put the car in gear, when attempting to verify the complaint, and revved the engine up to 3,500 rpm while in Drive. Under these conditions the car *did* start to move but could only so marginally/slightly.

The car was placed onto a lift, and the transmission's fluid level was found to be quite low. The pan was removed in order to see if a serious amount of transmission clutch material or metal shards were present. In this case there was very little debris present, the fluid was rather clean and in good condition, so a new gasket was ordered and the pan was bolted back into place. It was determined that the transmission fluid level was three quarts low. The 2001 Chevrolet Malibu has a **GM Turbo-Hydramatic 4T40E** transmission, which does not have a dipstick; instead, it has a level plug. Watch this video to learn how to check a 4T40E transmission's fluid level.

To add fluid, remove the fill cap located on top of the transmission. It is a black cap located on top of the bell housing area. (see Figure 5).

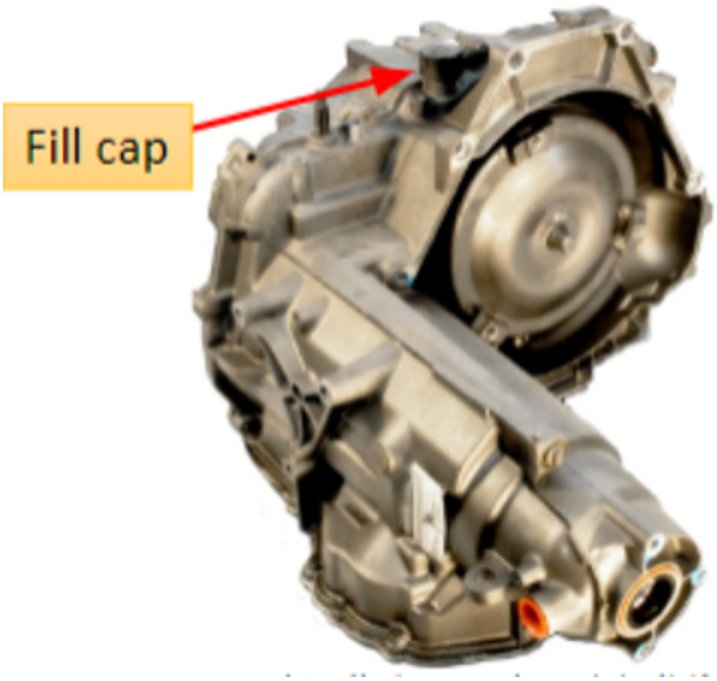


Figure 5: https://go4trans.com/transmission/4t40e/

Whenever a transmission is low on fluid, there is always a reason! On this particular vehicle, a CV shaft axle seal was found to be leaking. This allowed fluid to leak out over time. Automatic and CVT transmissions operate hydraulically and require adequate fluid levels in order to function. This transmission was low enough on fluid that the vehicle couldn't move.

Once the leak was fixed and the transmission fluid level restored, the car was test-driven. All four gears were present, and Reverse worked as well. The car was returned to the customer, who was glad that his car had an inexpensive problem.

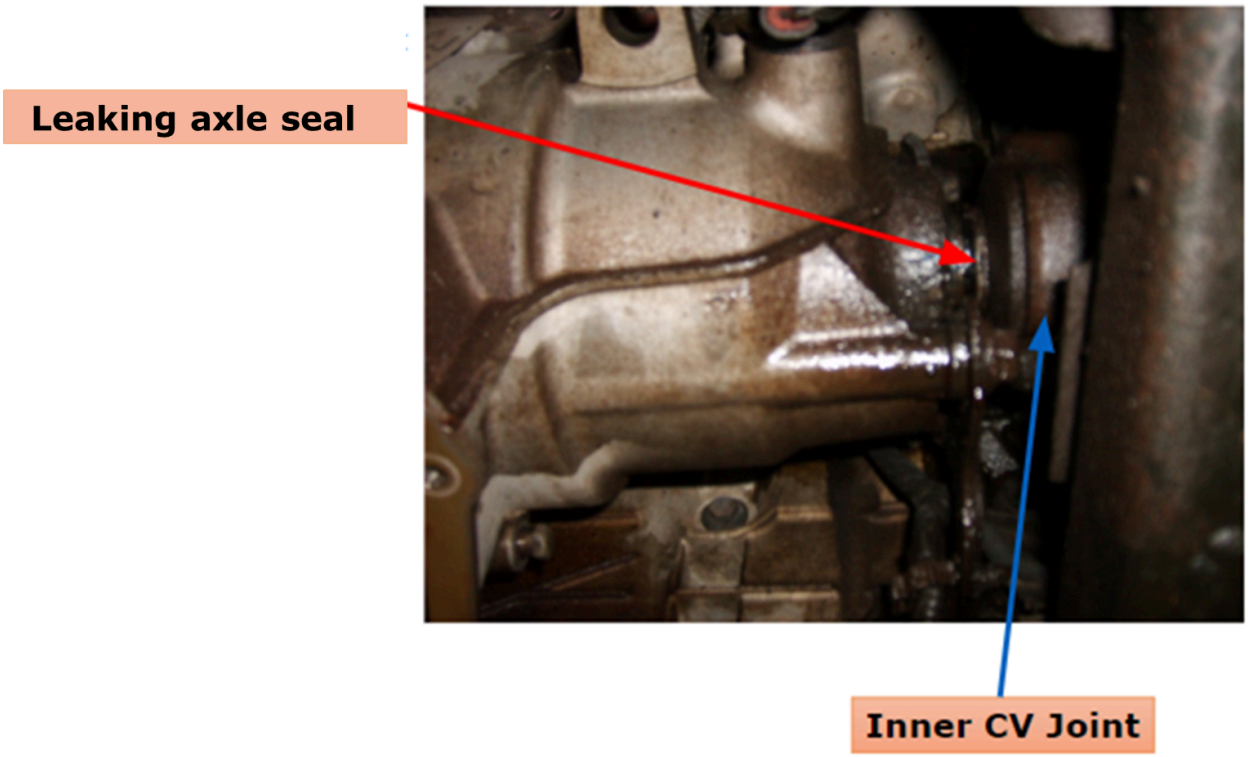


Figure 6

Case study 3: Another simple repair occurred when a **2004 Chevy Malibu Maxx LT** had what seemed to be a low engine power problem. The car was drivable, but the complaint was that the engine had a power issue when starting out from a stop.



Figure 7

A test drive confirmed the power issue, but it was noticed that only shift occurred while driving, not three. During visual inspection a P0751 code was found, which is SS1 or shift solenoid 1 (sometimes called Solenoid A) has a problem. According to ProDemand, this indicates that there is a "no 1st and 4th gear" problem. When the TCM sees a problem with this solenoid or its corresponding valve, the transmission will default to starting out in 2nd gear instead of 1st. The transmission's fluid level was good, and the fluid itself was very clean; therefore, it was suspected that the problem would be something simple, perhaps the solenoid.

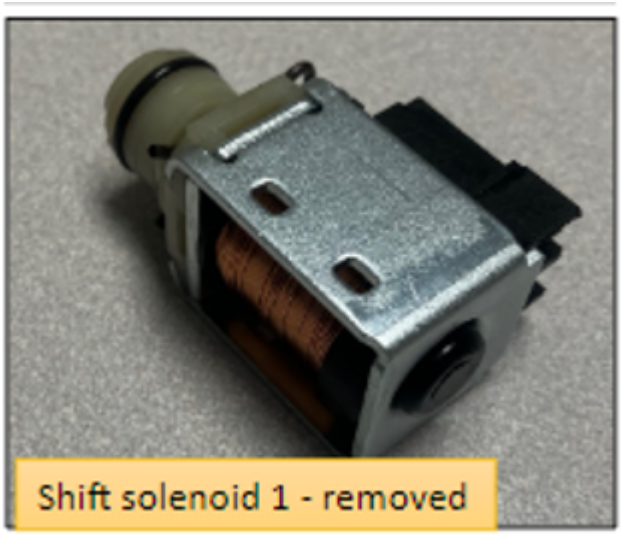


Figure 8

The car was test-driven again—this time, paying better attention to transmission shift points. The power issue when starting out from a stop was quite noticeable, and only one shift occurred while traveling up to cruise speeds. This confirmed that the transmission only operated in 2nd and 3rd gears.

After the test drive, using a scan tool with the engine off, the shift solenoids were bidirectionally operated to see if a 'click' noise could be heard from each solenoid at the transmission. All of the transmission's solenoids 'clicked' except SS1.

This video shows what should be observed while driving a vehicle with a four-speed automatic transmission. Watch both the tachometer and the speed-o-meter. By watching the tachometer you can see when transmission shifts occur.

The repair for this Malibu Maxx was to replace both shift solenoids, (just to be safe) the EPC (electronic pressure control) solenoid, and the TCC (torque converter solenoid), since it would take five hours to make such a repair. They can be replaced without removing the transmission, but it does require a vehicle lift and a sturdy transmission jack.

Replacing all of the solenoids is a good service practice, due to the time it takes to remove the transmission's side cover in order to access them. In the end, the cost was less than $350. After the repair, a 're-learn' was performed with a scan tool, the car was driven, and all gears were present and no DTCs occurred.

In review, this transmission's symptoms were **verified** (poor engine power was due to it starting out in 2nd gear), and it was during the **visual inspection** that the P0751 DTC was found, as well as the discovery that the transmission would only shift once while driving. There was no need to perform a hydraulic pressure check in this situation, since the car had 2nd, 3rd, and Reverse. The bottom pan (these transmission models have two pans) was removed to ensure that there was no evidence of clutch material or metal shavings; the fluid was very clean and there was no evidence of clutch wear. The root cause was found, and the repair was performed.

Below is an image of this transmission's valve body with the solenoids identified (Figure 9).



Figure 9:
https://www.buffaloengine.com/catalog/p

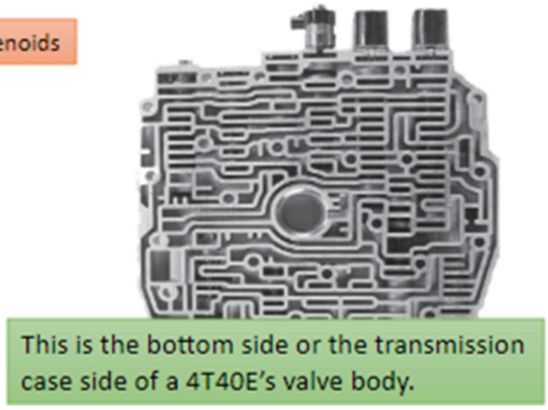


Figure 10

Case study 4: Another story is of a **2003 Saturn SL** that came in for a transmission repair. A student on campus had purchased the car from a seller who informed him that there was a small transmission problem, it didn't shift quite right but it had been this way for some time. The buyer was able to purchase the car at a reduced price. The new owner drove the car for nearly six months with the transmission condition, but fearing that it needed a transmission rebuild, he decided to have our class make the needed repair.



Figure 11

We applied the seven-step diagnostic approach. The problem was easily duplicated; the 1-2 shift was normal, but there was a strange shift sensation during the 3-4 shift. Additionally, we found that the torque converter clutch would not engage. The student technicians decided to perform a thorough step two visual inspection.

It was during their visual inspection that they decided to check all fuses. A blown 5 amp Body Control Module fuse was found. During another test drive, it was discovered that cruise control wasn't working, either.

The fuse was replaced. On a third test drive the transmission "shift problem" disappeared, the torque converter clutch now applied, and the cruise control operated as it should.

Out of curiosity, the student technicians looked up the wiring diagram to see what circuits this fuse impacted. Sure enough, it supplied power to the TCC solenoid and the Cruise Control Module. We will never know why the fuse was blown, but after it was replaced, the student technicians test drove the car six different times over two different labs to ensure that the problem didn't reoccur. The car was returned to a very happy customer.

Diagnosing this car took between four and five hours, but due to patience and checking all the basics, the problem was found. Imagine the frustration and wasted resources if someone had decided to replace or rebuild the transmission to see if it would fix the problem, only to discover that the problem was still there.

Unfortunately, incidents like this occur every day. Individuals who are not aware of the fact that a transmission is an integral component of a vehicle's entire operating system. The transmission is not a stand-alone system and some of the electrical circuits that operate transmission functions also impact the operation of the engine and body some controls. Because of this, having some knowledge of transmission operation led to a correct diagnosis and repair.

Assuming that all transmission problems require a transmission replacement can be a costly decision in both time and money. Not all situations are this fortunate for the customer, but this experience is a reminder of the need to wisely invest time and energy by utilizing a systematic diagnostic approach.



Figure 12

Case study 5: Our fifth case study involves a somewhat rare type of failure that can occur on high-mileage vehicles. A Ford Windstar was towed in due to "no transmission operation." Because the van would not move when placed into Drive or Reverse, the verification process of no vehicle movement was simple. All fluid levels were checked, and it was found that the transmission fluid was only a half quart low—not enough to render the transmission inoperative.

During a visual inspection, we noticed that one CV joint looked quite new, but the boot was severely torn. We decided to put the vehicle on a lift to see if the problem was with the transmission or the CV joint. The video below shows what was found.

This "no transmission operation" is a reminder of how open differentials operate. An open differential sends power to the wheel that has the least resistance, and this is exactly what was occurring in this case.

Case study 6: Story six is of a **2005 Mitsubishi Endeavor** that had a vibration issue, but only at vehicle speeds between 32–39 mph. The problem did not exist at speeds above or below this range. However, when the problem did occur, it was quite noticeable. There were no DTCs, and upon checking all of the vehicle's fluid levels, they appeared clean for the most part, with no metal debris. The transmission fluid was rather dark in color, but it was full. The drive-lines and U-joints were inspected. We could not find anything wrong at this point and we were clueless as to how to proceed next. We searched Indentifix and ATRA (both diagnostic service sites), and they had no such cases listed.



Figure 13

We googled the problem and found that one individual, a Mitsubishi service technician, had posted such a problem. He stated that this symptom is caused by a bad TCC clutch, and that he had seen this happen a number of times. This began to make some sense, because the problem always occurred after a 4th gear shift under light throttle. This is precisely when the TCC or torque converter clutch engages, just after a 4th gear shift under light throttle. Further more, this vibration was felt throughout the vehicle, not in one area like something a bent wheel could cause. The point being made is, this type of vibration is one that occurs at certain speeds, under light engine loads and during initial torque converter engagement. Experienced drivetrain technicians call this type of vibration SHUDDER. Shudder is a vibration described as a short lived or momentary shudder sensation that can be compared to briefly driving over a rumble strip. In short, shudder is a short lived, high frequency vibration that occurs when engine load is light and at vehicle speeds above 30 -35 mph or higher.

Another term used in the industry that some consider as TCC clutch failure is "fish bite." This type of sensation is felt in the vehicle as well. However, fish bite describes an intermitant vibration not a consistant one, as described above. Intermitant or fish bite type vibrations are most often due to a failing ignition coil or spark plug, not a worn converter clutch. The reason fish bite happens is, whenever the TCC applies it is like shifting into direct drive because when a TCC engages the converter it links the egine's crankshaft to the tranmission's input shaft, no more fluid coupling. This is a brief, sudden load put onto the engine, which is the very condition that cancause a failing ignition component be noticed.



Figure 14: https://www.autozone.com/drivetrain/transmission-torque-converter/mitsubishi

Transmission removal on an Endeavor is a bit of a chore but this was the best diagnostic information that we had. We removed the transmission and sent the torque converter to a business that rebuilds torque converters. Our cost was $130. We performed a transmission flush once the converter and transmission were back in place. This was ultimately the solution to this Endeavor’s vibration/TCC lock-up engagement issue.

Case study 7: Story seven is of a **1999 Dodge 1500 pick-up** with a **46RE** transmission. This was a very common transmission for 1995–2003 Dodge pick-ups. This story includes a hydraulic pressure test.



Figure 15

The customer came in fully expecting a rebuild. The complaint was low engine power when starting out from a stop. The customer stated that the transmission would start out in 2nd gear rather than 1st when the range selector was in Drive.

The transmission fluid level was checked, as well as other visuals performed before driving. The test drive confirmed a very low power issue when starting out in Drive. We also discovered that the transmission would start out in 1st, but only when Low was selected. When in 2nd range, it would start out in 2nd. It was discovered that when Drive was selected, the transmission was actually starting out in 3rd gear. This was rather easy to diagnose, because when in Drive, the engine power was worse accelerating from a stop than it was compared to being in 2nd gear.

Additionally, only one shift would occur in Drive, which was a 3-4 shift at approximately 50 mph. It had to be a 3-4 shift, because the engine's rpm read 2,000 once the shift completed while driving at speeds of 60–65 mph.

At this point, we felt that a rebuild may not be necessary since all four ranges could be accounted for: 1st gear was present in Low range, 2nd gear was present in 2nd, etc. Though the shifts didn't happen correctly, all three shifts could be obtained if we manually moved the selector through all of the ranges.

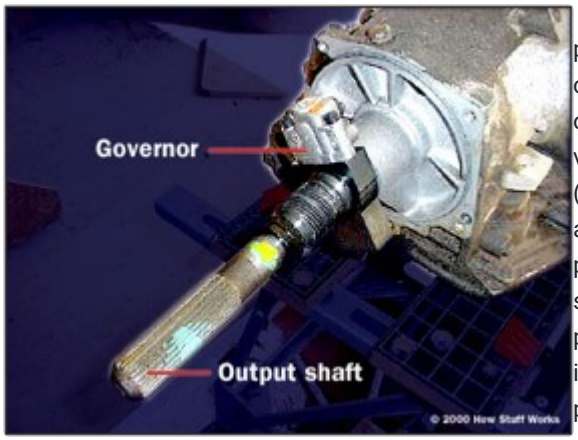
It was now time to gather some data, DTCs, and bulletins. We found three DTCs: P1762, P1763, and P1757. A search for bulletins was completed and one was found on ATRA. We also searched Identifix using two of the DTCs—P1762 and P1763—and we found that other technicians had posted the same issues with these same codes. It is always best to search with one or two DTCs, not three or more when using Identifix.

Code 1762 is "Governor pressure low," and 1763 is "Governor pressure high." Code 1757 is "Governor pressure is above 3 psi at 0 mph." We also noticed that TFT, or transmission fluid temperature, was a bit strange; it read 100°F all the time. The transmission could not have been this warm, since it was a 25°F day. The voltage PID for TFT read 2.63 volts.

From our research we learned something about this transmission, it has a governor pressure port on the side of the transmission case. A pressure gauge was connected, and a third test drive was performed. This is when it was determined that the governor pressure readings were far from specification. Governor pressure is supposed to be 0 psi while in Drive at a stop, and then it is supposed to increase approximately 1 psi per 1 mph. For example, governor pressure should be about 10 psi at 10 mph, and about 35 psi and 35 mph, etc. Our pressure readings were 55 psi at a stop, and 80 psi at 15 mph.

So what is governor pressure? It's a term and a component that was used in older transmissions. Before the advent of electronic transmission controls, two components - a **governor** valve and a **throttle** valve - determined shift timing. These were hydraulically operated valves since there were no electronic components on these transmissions before 1994.

Figure 16



Before the advent of electronic control, the governor and throttle valves regulated transmission shifting. The governor was attached to the output shaft and therefore controlled a hydraulic circuit (the governor pressure circuit) based on vehicle speed. The throttle valve was connected to the carburetor's throttle linkage, where the other end of its throttle cable was connected to the transmission's throttle valve. The further an accelerator pedal was pressed down (increasing engine load), the more hydraulic pressure could push against the valve bodies' shift valves. Throttle valves control pressure based on engine load. The diagram below depicts how a shift valve is a "balanced" valve, meaning that when throttle pressure (engine load) is higher than governor pressure, the valve is pushed to the right and shifts will not occur. But when governor pressure increases enough to overcome throttle pressure, it pushes the valve to the left, allowing pump pressure to reach thus applying a band or a clutch, resulting in a transmission range shift.

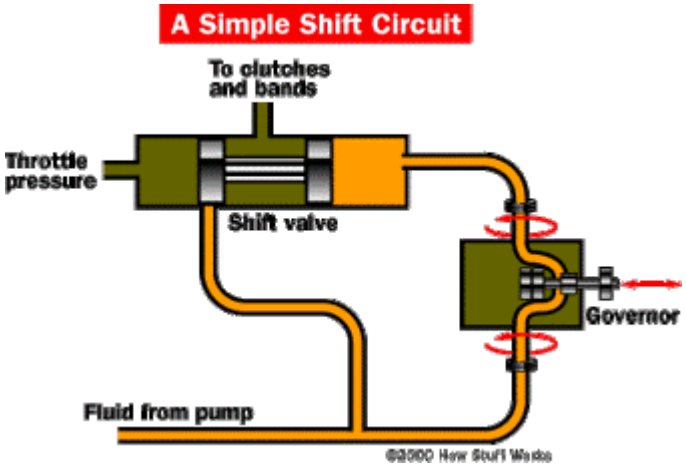


Figure 17

As mentioned, our pick-up's governor pressure measured 55 psi at a stop and 80 psi at 15 mph. The transmission could not down shift due to high governor pressures.

A call was made to our transmission parts supplier. They stated that this is a fairly common problem for this model of transmission, and that the governor solenoid and the pressure sensor are sold as an assembly and are changed as

such.

The cost for the assembly was $80. A transmission fluid flush and filter change were done, due to the fact that the pan had to be removed in order to change this assembly.

Below is the diagram we found on ProDemand of the hydraulic test ports found a 46RE. These ports are located on the side of the transmission, on the driver's side of the vehicle.

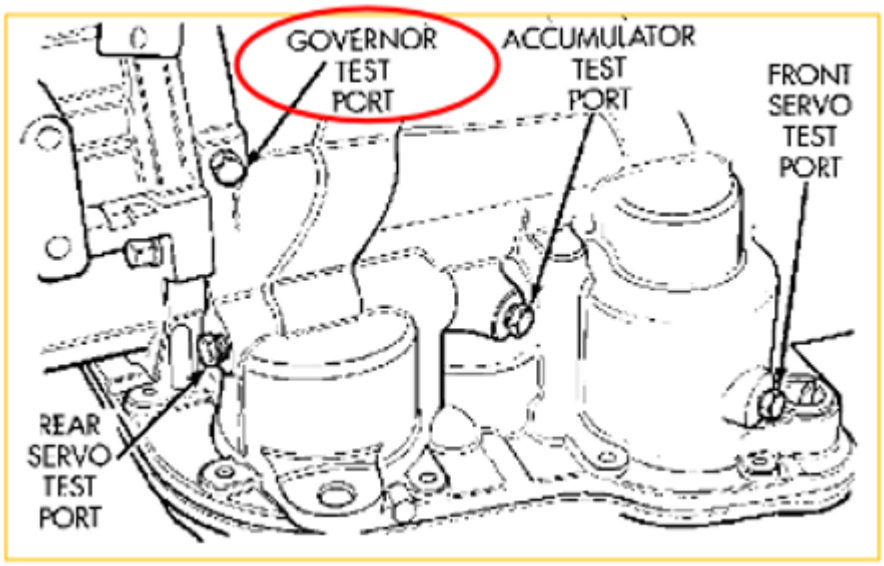


Figure 18

Below (Figure 19) is the governor solenoid (red arrow) and the governor sensor (yellow arrow). These are accessed with the transmission pan removed.

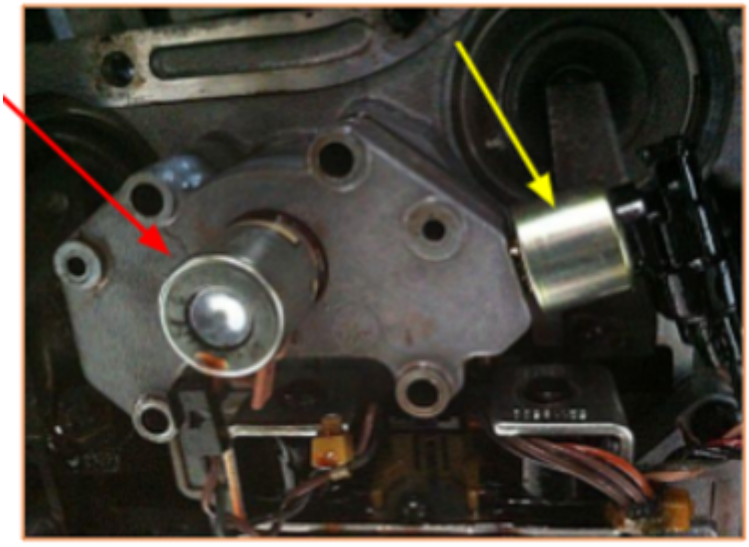


Figure 19: //www.dakota-durango.com/threads/governor-pressure-sensor-and-solenoid-replacement.167370/

After the repair, a test drive was performed. Power was restored since the transmission could now start out from a stop in 1st gear. All transmission ranges were present, with Drive selected, as the transmission shifted 1-2, 2-3, and 3-4 normally when driven from a stop to about 60 mph.

Everyone, especially the customer, was pleased with the experience. The customer received a working vehicle, and the student technicians involved with this project gained experience with governor pressures and Dodge transmissions.

Case study 8: Story number eight is of a **2004 Toyota Camry**. The complaint was that in the morning the vehicle could be driven for about 4-5 minutes, only then to “neutral out” meaning that while driving the vehicle, engine rpms would rev quite high unless the throttle was released, due to the fact that the transmission would quit propelling the vehicle altogether. Reverse, at this time, was not operational as well.

On the test drive, the student technicians experienced the same symptoms. Due to the fact that the vehicle was being driven up a hill away from the shop, when the car acted up, they were able to get it turned around and were able to coast downhill back to the lab.

The fluid level and condition were checked. The fluid seemed more than just dark in color; it had small, glitter-like metal particles in the fluid. It was decided that the pan needed to be removed in order to investigate further.

This is what they found with the pan removed and the oil drained (Figure 20). These are very large metal pieces from some of the bearings and gears of this Toyota U151E transmission.



Figure 20

With so much apparent damage, a salvage yard unit was used to fix this vehicle. The transmission cooler (radiator) was replaced, and the two cooler lines that connect the transmission to the cooler were flushed with brake cleaning spray and compressed air, several times. With this much debris in the system, we did not want to risk the chance that some of the metal shards would not flush out of the cooler only to end up in the ‘new’ salvage yard transmission. Replacing the cooler seemed like a good precaution in this situation.

So, why would this Camry’s transmission work only after the car had been parked for several hours? While at rest, some of the debris in the transmission’s filter would fall out, allowing some fluid to pass through when it was driven (though it could only be driven a short distance). The debris in bottom of the pan and in the fluid would then be pulled back into the filter and restrict hydraulic fluid flow, to the point that none of the clutches could apply. This is what happens when there is a serious amount of debris in a transmission due to excessive wear and tear of transmission components.

Test your knowledge of this concept by answering the practice question below:

An automatic transaxle slips in and out of gear only while turning corners. Which of the following is the cause of this condition?

☐	Low transmission fluid level
☐	A worn multi-disc clutch assembly
☐	A bad torque converter clutch
☐	Chipped teeth on a planetary gear set

Case study 9: Our ninth example is of a **2002 GMC Yukon** that had no 2nd gear. In actuality, it didn't have 4th gear either since the band that holds a drum (the reverse input drum) in place in order to obtain 2nd gear, known as the 2-4 band, also applies and holds the same drum whenever 4th gear applies. When this band fails, an engine flare issue during second gear is more noticeable, since a vehicle is usually being accelerated more so during a 1st to 2nd shift as compared to a 3rd to 4th shift. During 3rd and especially 4th gear shifts, drivers start letting up on the throttle, since vehicle speed is high enough to be near cruising speed. Therefore, 4th gear doesn't require the same amount of force to hold the reverse input drum from rotating as compared to a 2nd gear shift.

Shown below, Figure 21 is what a worn band and a worn reverse input drum looks like. Figure 22 is a new drum being held next to the worn drum.



Figure 21

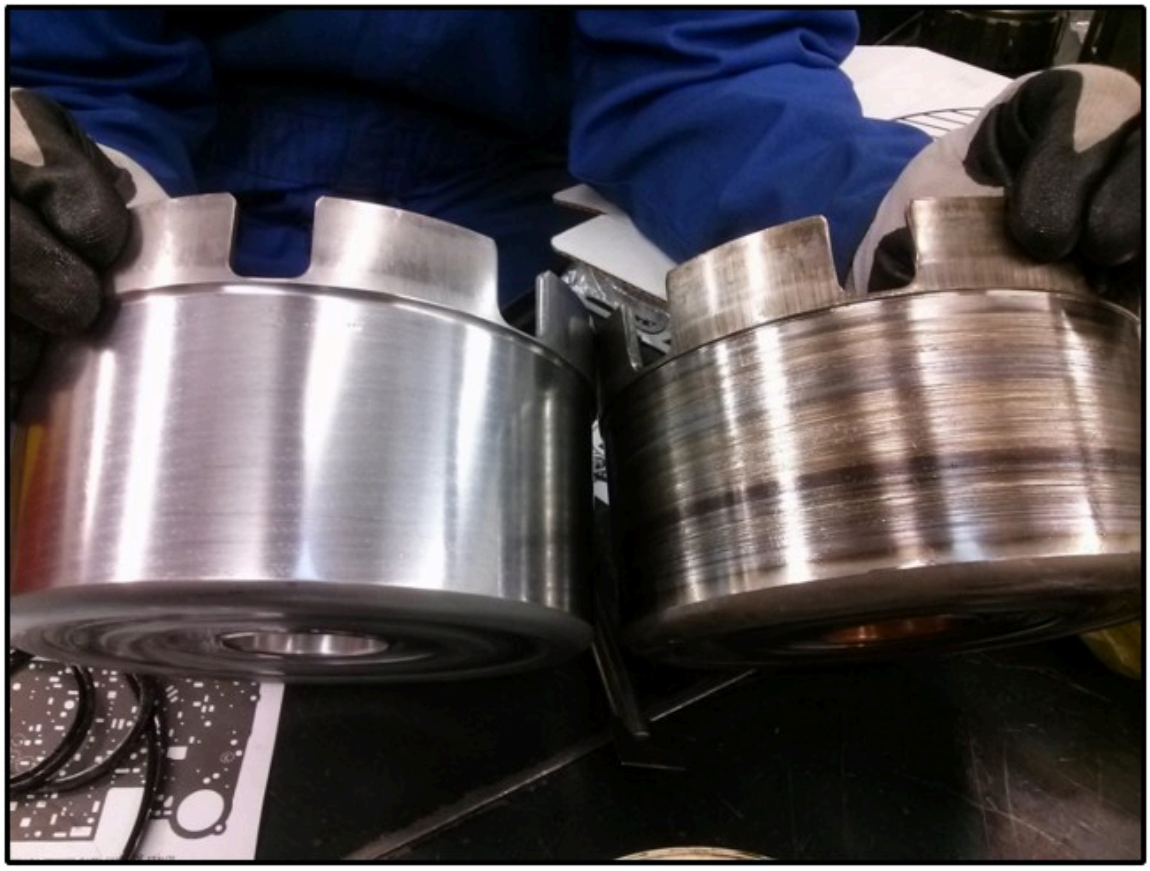


Figure 22

This transmission was completely disassembled, cleaned, and had a full rebuild. Parts for 4L60E's are still available, and there are a lot of aftermarket upgrades and online resources to assist a rebuilder in order to make these models better than original.

During the diagnosis process the student technicians used a clutch application chart. A 4L60E has one band, and it only applies during 2nd and 4th gear shifts. This type of chart is available for most every transmission model. (Note the 2-4 Band column on the chart below, Figure 23.)

RANGE	GEAR	SHIFT SOLENOID VALVES		2-4 BAND	REVERSE INPUT CLUTCH	OVERRUN CLUTCH	FORWARD CLUTCH	FORWARD SPRAG CL. ASSEMBLY	3-4 CLUTCH	LO ROLLER CLUTCH	LO/REV. CLUTCH
		1-2	2-3								
PARK		ON*	ON*								APPLIED
REVERSE		ON*	ON*		APPLIED						APPLIED
NEUTRAL		ON*	ON*								
Ⓓ	1st	ON	ON				APPLIED	HOLDING		HOLDING	
	2nd	OFF	ON	APPLIED			APPLIED	HOLDING			
	3rd	OFF	OFF				APPLIED	HOLDING	APPLIED		
	4th	ON	OFF	APPLIED			APPLIED		APPLIED		
3	1st	ON	ON				APPLIED	HOLDING		HOLDING	
	2nd	OFF	ON	APPLIED			APPLIED	HOLDING			
	3rd	OFF	OFF			APPLIED	APPLIED	HOLDING	APPLIED		
2 ***	1st **	ON	ON			APPLIED	APPLIED	HOLDING		HOLDING	
	2nd	OFF	ON	APPLIED		APPLIED	APPLIED	HOLDING			
1 ***	1st	ON	ON			APPLIED	APPLIED	HOLDING		HOLDING	APPLIED
	2nd	OFF	ON	APPLIED		APPLIED	APPLIED	HOLDING			

* 1-2 AND 2-3 SHIFT SOLENOID OPERATION AND THE SHIFT VALVE POSITIONING IN P, R, N RANGES ARE A FUNCTION OF THE INPUT TO THE SOLENOIDS FROM THE VSS. UNDER NORMAL OPERATING CONDITIONS THE SOLENOIDS ARE ON IN P, R, N.

** A MANUAL SECOND - FIRST GEAR CONDITION IS ONLY AVAILABLE ON SOME MODELS. OTHERWISE, THIS CONDITION IS ELECTRONICALLY PREVENTED.

*** IN MANUAL SECOND AND MANUAL FIRST, SOLENOID OPERATION IS A RESULT OF PCM CALIBRATION. SOME CALIBRATIONS WILL ALLOW ALL THREE GEARS UNDER EXTREME CONDITIONS.

Figure 23

Case study 10: Example ten is of a **2002 Chevy Tahoe** that had no reverse. All forward gears worked, but there was no reverse. The two pictures below are of what is known as the Reaction Sun Shell with its teeth stripped or missing (figure 24). The new Sun Shell (figure 25) has teeth in its center hub. This is a very common wear issue for 4L60Es.

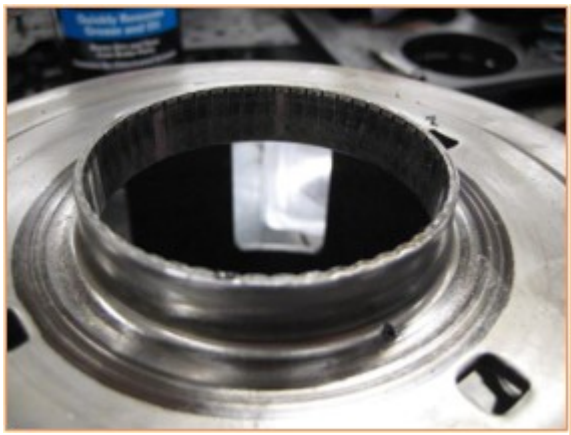


Figure 24



Figure 25

In our search for likely failures, we searched two sources: Prodemand and a Youtube channel called Transmission Bench. ProDemand listed a myriad of reasons for a no-reverse condition, but Transmission Bench got right to the point. Here is the video we used to help us reach the correct conclusion.

This transmission was completely disassembled, cleaned, and had a full rebuild. We replaced the broken Sun Shell with a better-quality unit. The transmission cooler was flushed for 2 hours, just to make certain that no metal shards from the stripped-out teeth could find their way into our rebuilt unit.

Other Diagnostic Checks

Some other types of tests for transmission diagnosis are listed here:

1. A scan tool can at times be used to **bi-directionally shift the shift solenoids**. This allows you to determine whether or not a solenoid can respond, at least electrically.
2. At times it makes sense to **clean the MAF sensor**. A contaminated MAF sensor has an impact on transmission clutch hydraulic pressures. For example, if the PCM can't determine the correct air volume coming into the engine, the TCM will not know to increase hydraulic clutch apply pressures. The end result is unwanted clutch slip or clutch wear. The wear will be gradual thus clutch wear will occur some months later.
3. Whenever a transmission will **not disengage**—meaning, when the transmission is placed in either Park or Neutral and is still engaged in a forward gear—it could be that:

(1) The transmission shift linkage is out adjustment, which can place the valve bodies' manual valve in an incorrect position so that Park or Neutral cannot be achieved.

(2) That there is some serious clutch wear inside the transmission. The way to test for this is to remove the transmission's pan and drain out all of the fluid. Start the engine and test to see if this makes a difference. A transmission shouldn't engage at all without fluid. If it does, you're probably dealing with a set of clutches that became hot enough to weld themselves together, which means that they cannot disengage.

4. At times you may be directed in a diagnostic flow chart in ProDemand to disconnect the transmission's main connector in order to place the transmission in default mode. This forces the transmission to work only in one forward gear (it default gear) with Reverse still operational. This is a test to see if a particular problem is electrical or mechanical in nature.

5. A term and a symptom that you need to be aware of in this industry is something called "**shudder**." This is a problematic or unwanted symptom that occurs while driving. What is felt is a brief chatter or slight vibration sensation for about one or two seconds. What is confusing about shudder is that it can be caused by a number of things, such as a bad torque converter clutch, a motor mount, or an engine misfire issue. The clutches inside a transmission are not usually the cause, because when they slip, they fail. A failed clutch will not cause a vibration. A failed transmission clutch causes engine flare.

When dealing with shudder, follow the **seven-step approach**:

1. **Verify** that it is happening. Ignition misfire issues and worn driveline U-joints can cause symptoms much like TCC shudder. Late-model V-8 engines with cylinder deactivation can also cause shudder.
2. **Visually** inspect, just as with any drivability issue: fuses, connections, fluid levels, fluid condition, drive-line condition, scan for DTCs, etc.
3. When **gathering data**, a good place to start with a shudder issue is a search for TSBs of the particular vehicle. Also, view scan tool data as to when TCC lock-up occurs, and how much TCC slip occurs when it engages while driving. Slip rpm should be less than 50–60 rpm. If the shudder occurs during TCC lock-up, then you are likely dealing with a worn converter clutch.
4. If it doesn't appear to be a TCC clutch problem, then **further diagnosis** needs to be performed in order to determine if an ignition system misfires, a faulty TPS, VSS, or some other sensor is the cause. If there are no misfire DTCs, don't forget to look at Mode $06 data, which can be of help when dealing with misfires.

Steps 5 – 7: At this point you will have created a diagnostic plan, only to make a repair and then verify that the repair was successful.

Additionally, don't rule out the option for performing a transmission fluid flush, since oil additives break down and deteriorate. Apparently, there is a bulletin that states that with some GM 6L80s, one shudder fix is to drain out the

Dexron VI fluid and to use Ford's Mercon LV fluid instead (https://static.nhtsa.gov/odi/tsbs/2019/MC-10163890-9999.pdf). This sounds a bit strange but apparently some service professionals have had success with this.

Common causes of shudder are a bad TCC, bad motor mount, the TCM needs a re-flash or probably the most common is an ignition misfire issue. On V-8 engines that have a cylinder deactivation system, (GM's Active Fuel Management or their newer Dynamic Fuel Management system) it can be "shut down" with a simple program device that is plugged into the OBD II connector. This device forces all of the engine's cylinders to 'fire' all the time, which will simplify the diagnostic process.

ETE Reman, the United States' second largest transmission remanufacturer, has a 5-Step Approach for diagnosing transmission shudder. Here are their steps:

1. Check for **trouble codes** and repair all non-transmission codes before condemning the converter or transmission.
2. With a scan tool, **monitor TCC slip** while the shudder occurs during a test drive. If slip does not change, the problem is likely an engine performance issue.
3. If slip increases during TCC lock-up, then the problem is likely the converter or the TCC solenoid. However, check for bulletins by the manufacturer. This could point you towards the real problem. For example, GM recently issued a **TSB** for its **6T70/75** unit, explaining that the shudder is often caused by poorly connected ignition coil grounds.
4. Shudder is often caused by a loss of proper transmission fluid pressure. Adjusting or replacing the EPC solenoid (electronic pressure control) may solve the problem. A fluid flush may fix the problem as well. Fluids can deteriorate, and service shops have been known to install the wrong type of transmission fluid.
5. Try an additive. There are plenty of transmission shudder fluid additives on the market. If an additive fixes the problem, keep in mind that this is only a temporary fix. A flush or a new converter may be in order to fix the real shudder issue.

Terminology

The transmission world seems to have its own diagnostic terminology. Here is a list of common terms that are used in transmission technical articles and service bulletins.

Engine Flare: A brief but rapid rise in engine rpm and a loss of torque delivery to the drive train in between a transmission shift. This occurs due to one clutch failing to engage. This can occur because of clutch wear or low hydraulic pressure.

Engine Braking: This is downshifting to a lower gear to reduce vehicle speed by using engine compression to slow down the vehicle.

Light Throttle: To slowly apply load on the engine by accelerating in a mild fashion.

Full throttle detent: A quick and full/hard acceleration that causes transmission downshift.

WOT: Wide Open Throttle, full travel of accelerator pedal.

Chuggle: An older term for shudder. Described as a brief vibration that is felt during TCC engagement. Some refer to this as a 'fish bite' sensation.

Delay: Transmission engagement is delayed; no vehicle movement after the transmission has been shifted into gear until after some time has elapsed, more than a few seconds.

Garage shift: Engagement of the transmission from park into Drive or Reverse.

Hunting: Frequent transmission shifts of adjacent gears. This often occurs during certain steady cruising speeds near 50 mph; a shift pattern is 3-4, 4-3, 3-4, etc. This condition may require a re-flash, which is an updated transmission shifting schedule.

Shudder: True shudder is when the torque converter clutch engages abnormally due to converter clutch wear or their is a transmission fluid issue. It is a subtle vibration felt while driving and lasts only for a moment.

Tie-up: A condition where two clutch applications overlap, when one clutch releases too late or a clutch comes on too early. This causes the engine to labor or “drag” down briefly and can cause driveline vibration. A re-flash is often the fix for this condition.

Conclusion

Diagnosing drivetrain issues, especially transmissions, can be something of a challenge. The trick is to treat diagnosis as a *challenge*, not as a *chore*. Following a proven diagnostic approach will always be the best way to invest your time and efforts.

Society is full of people who give up. Many successful business owners have stated that about 80% of the people they have ever hired don’t have the desire to apply themselves to their full potential. They had the potential and had they applied themselves, they would have moved up in the company and compensated accordingly.

Most people have great capabilities but seem to lack the determination to conquer a challenge. This is where individuals separate themselves. Who will “dig in” and rise up to give their very best, and who will look for a way out of an uncomfortable situation?

In light of these sentiments, consider these two quotes and good luck with the challenges you come across in life, because in actuality, they are learning opportunities.

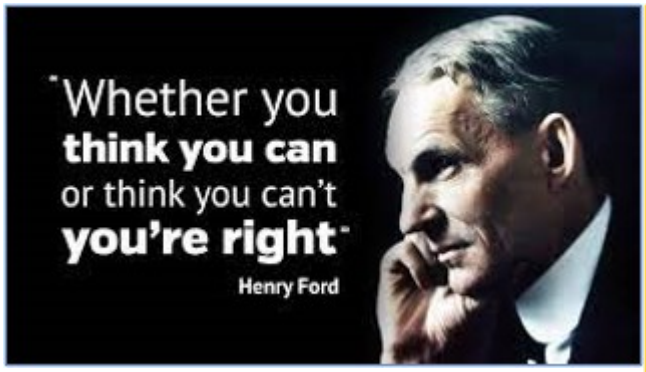


Figure 26



Figure 27

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