THERE'S A NEW 9 SPEED ON THE BLOCK



by Bill Brayton
members.atra.com



In this edition of *Fun with Transmissions* we're going to check out the new 9T50 from General Motors (figure 1). We'll take a look at some interesting features like the hydraulically actuated sprag and many other points that make this a unique unit.

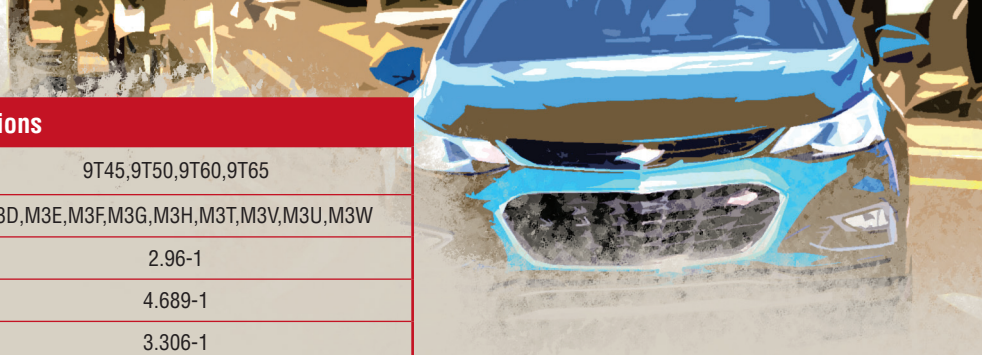
As with several other transmissions, GM and Ford have collaborated on the development of a series of 8 and 9 speed front wheel drive transmissions. Introduced in 2017 there several versions available, 9T45, 9T50, 9T60, and the 9T65. The GM units require the use of Dexron® 6 fluid. Ford has a similar version called the 8F35, 8F40 and 8F57 and uses Mercon® ULV. We'll cover those units another time.

The 9T series has a 4.689:1 ratio in 1st gear for light foot launch and two overdrive ratios in 8th and 9th gear. Like other multi-gear transmissions it can start in 1st or 2nd gear depending on the drivers need (Figure 2a and 2b).

Figure 1

Model	Year	Engine	Transmission
Traverse	2018	3.6L V6	9T65
Traverse	2018	2.0L Turbo I4 Ecotec	9T65
Enclave	2018	3.6L V6	9T65
LaCrosse	2018	3.6L V6	9T65
Malibu	2017	Turbo	9T50
Cruze	2017	1.6L Turbo Diesel	9T50
Equinox	2018	2.0T	9T50

Figure 2a



Specifications	
9T45,9T50,9T60,9T65	9T45,9T50,9T60,9T65
RPO Codes	M3D,M3E,M3F,M3G,M3H,M3T,M3V,M3U,M3W
Reverse Gear Ratio	2.96-1
1st Gear Ratio	4.689-1
2nd Gear Ratio	3.306-1
3rd Gear Ratio	3.012-1
4th Gear Ratio	2.446-1
5th Gear Ratio	1.923-1
6th Gear Ratio	1.446-1
7th Gear Ratio	1.000-1
8th Gear Ratio	0.747-1
9th Gear Ratio	0.617-1
Effective Final Drive Gear Ratios Available	2.89/3.17/3.32/3.47/3.63/3.80
Torque Converter Size	228 mm
Pressure Taps	Line
Transmission Fluid Type, Capacity	DEXRON VI®,8.82L, 9 QTS, Site plug to check
Transmission Net Weight	95.9 kg (211 lbs)
Maximum Trailer Towing Capacity	9T45 – 1743 kg (3842 lbs)
	9T50 – 2598 kg (5727 lbs) 9T60 – 3080 kg (6790 lbs) 9T65 – 2473 kg (5452 lbs)
Maximum Gross Vehicle Weight (GVW)	9T45 – 2400 kg (5291 lbs) 9T50 – 2730 kg (6019 lbs) 9T60 – 2730 kg (6019 lbs) 9T65 – 2930 kg (6460 lbs)

Figure 2b

Both the GM and Ford versions share components with their 6-speed brothers, the 6T40 and 6F35.

The nine forward speeds are achieved by using just two driving clutches and four brake clutches (figure 3). The brake clutches are splined to the case and hold a component from rotating.

One of the many things about this transmission that makes it interesting is the "selective one-way clutch" or SOWC. The advantages of a SOWC include increased fuel economy, lower emissions and lower production costs all while offering a more compact design. This ultimately allows the transmission to fit into tighter spaces.

The SOWC is a hydraulically-controlled diode clutch that can operate in two different modes: First, it operates like any other mechanical diode; it freewheels in one direction and locks in the other. It can also switch so that it's locked in both directions.

Hydraulic actuation is achieved using a servo piston mounted to a

9T50 Clutch Apply Chart								
Range	**Gear**	**1-2-3-4-5-6 Clutch**	**2-9 clutch**	**3-8 Clutch**	**4th Clutch**	**5-7-Rev Clutch**	**6-7-8-9 Clutch**	**Selectable One Way Clutch**
Park	P	-	-	-	-		-	-
Reverse	R	-	-	-	-	G	-	Holding
Neutral	N	-	-	-	-	-	-	O
Drive	1st	G	-	-	-	-	-	Holding
	2nd	Applied	Applied	-	-	-	-	-
	3rd	Applied	-	Applied	-	-	-	-
	4th	Applied	-	-	Applied	-	-	-
	5th	Applied	-	-	-	Applied	-	-
	6th	Applied	-	-	-	-	Applied	-
	7th	-	-	-	-	Applied	Applied	-
	8th	-	-	Applied	-	-	Applied	-
	9th	-	Applied		-	-	Applied	-

"O = On but not carrying a load
G = Garage shift element, on and carrying a load"

Figure 3

lever of the CMD (Controlled Mechanical Diode) and is controlled through the valve body with a solenoid and clutch-select valve. The servo piston then positions the CMD actuator lever into the desired position. In 1st gear the diode functions as a standard one-way clutch. In reverse, the diode is locked; preventing it from rotating in either direction (figure 4).

Now, let's take a look at the fluid pump. The chain-driven vane-style pump is used to save space and to improve fuel efficiency. The pump assembly also houses the pressure regulator, TCC control and TCC regulator apply valves.

The pump is mounted to the torque converter housing. The bolts that come in from the bell housing side are a torque-to-yield design which means you can only use them once; replace them on every rebuild (figure 5).

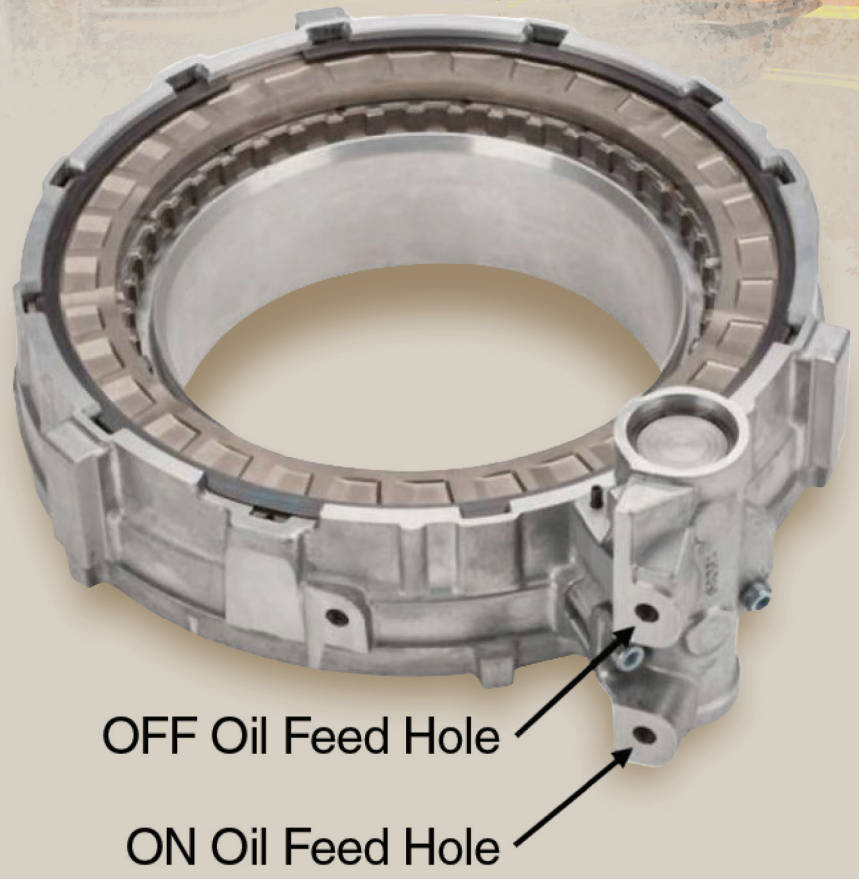


Figure 4

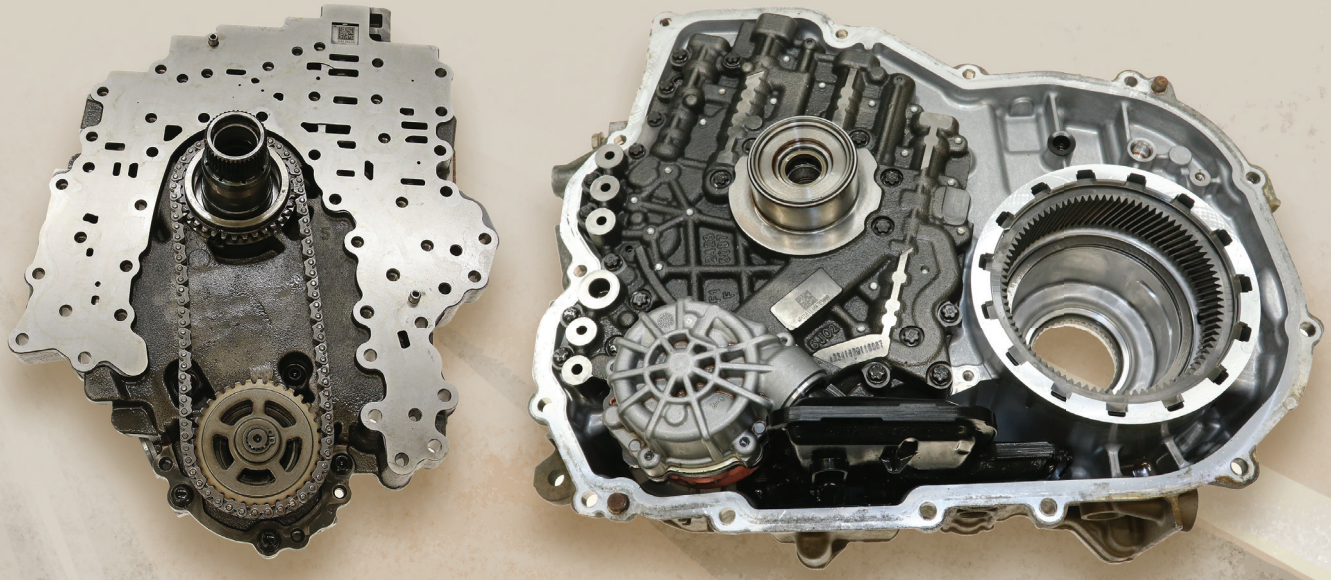


Figure 5

SOLENOIDS

This transmission may have up to twelve individual solenoids (model dependent) installed in various bore locations on the lower control valve body assembly and transmission case (figure 6). Eight of the twelve solenoid valves are used to control pressure regulation and the direction of transmission fluid. The four ON/OFF solenoid valves are only used to direct transmission fluid (figure 7).

The normal operating current range for these solenoid valves is between 0-1.2 amps. If the TCM detects an electrical circuit malfunction or excessive current flow, the TCM will turn OFF the high side driver to that solenoid and set a DTC. The high side driver will reset when the circuit fault is corrected and the ignition switch is cycled.

There are two slightly different designed variations of the pressure regulating solenoid valves used on this transmission. They are the linear variable force solenoid and normally-low variable force solenoid.

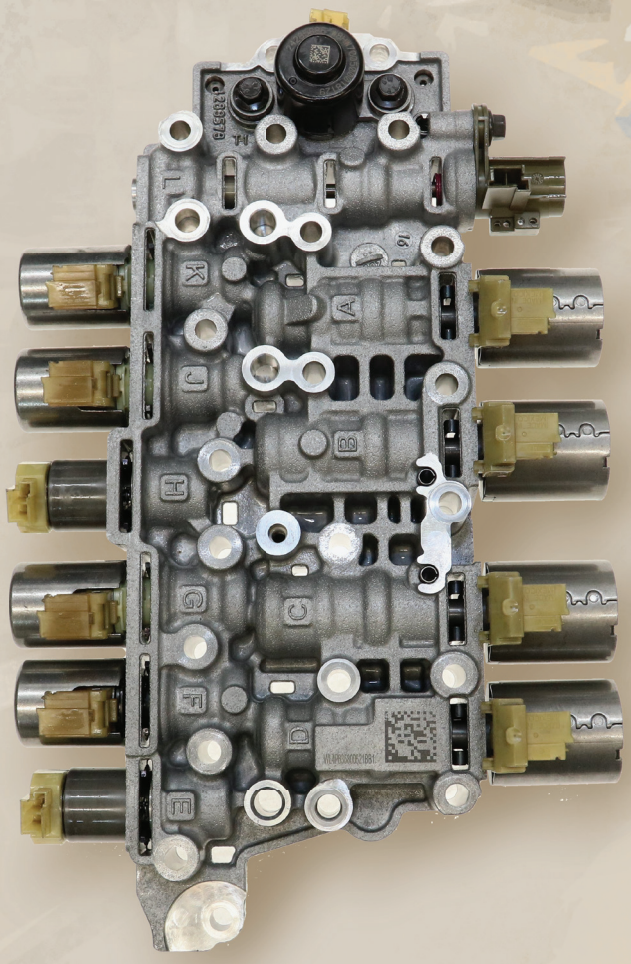


Figure 6

Range	Gear	Solenoids								
		A	B	C	D	E	F	Line	TCC	PISA
Park	Park	Off	Off	Off	Off	Off	On	On	Off	Off
Reverse	Reverse	Off	Off	Off	On	On	Off	On	Off	On
Neutral	Neutral	Off	Off	Off*	Off*	Off	On	On	Off	On
	Neutral Shift	Off	Off	On	On	Off	On	On	Off	On
	Neutral High	Off	Off	Off	On	Off	On	On	Off	On
Drive	1 - Lock - Engine Braking	Off	Off	On	Off	Off	On	On	Off	On
	1 - Freewheel	Off	Off	On	Off	Off	Off	On	Off	On
	2	Off	On	On	Off	Off	On	On	Off	On
	3	Off	Off	On	Off	Off	On	On	Off	On
	4	Off	Off	On	On	Off	On	On	Off	On
	5	Off	Off	On	Off	On	On	On	On	Off
	6	Off	Off	On	Off	Off	Off	On	On	On
	7	On	Off	On	Off	On	Off	On	On	On
	8	On	Off	On	Off	Off	Off	On	On	On
	9	On	On	On	Off	Off	Off	On	On	On

*On/Stroked for ≤ 350 ms in order to apply park servo, releasing the parking pawl when shifting from Park to Netural

Figure 7

NORMALLY LOW - LINEAR SOLENOIDS

On this unit the normally-low linear solenoid valves are solenoids 1, 2, 5 and 6. A normally low linear solenoid actuator is an electro-mechanical device that converts electrical power into a mechanical pushing motion (figure 8).

When the solenoid is energized, the armature applies force to the face of a pressure regulating spool valve. The solenoid actuator applies minimum force with minimum current applied to the solenoid coil and applies maximum force with maximum current applied to the solenoid coil.

NORMALLY LOW - VARIABLE FORCE SOLENOID

The normally low variable force solenoid valves are solenoids 3, 4, and 8. Like any other normally low variable force solenoid, it is an electro-mechanically operated valve. This solenoid is a normally closed solenoid and is controlled by the TECHM (Figure 9).

The solenoid valve varies the control pressure depending on the current applied to the solenoid coil. The solenoid valve control pressure is low with no or minimum current applied to the solenoid coil and increases with increasing current applied to the solenoid coil.

When bench testing the solenoids the resistance of a variable force solenoid is 5.1 Ohms +/- .3 Ohms @ 20°C (68°F). As the temperature of the solenoid windings increase, the resistance will also increase. When the solenoid temperature is at 100°C (212°F), the resistance value will be approximately 6. 7 Ohms +/- .4 Ohms.

NORMALLY HIGH - VARIABLE FORCE SOLENOID

A normally high variable force solenoid is controlled by an electric current through the solenoid coil and is a normally open solenoid (Figure 10).

The solenoid valve varies the control pressure depending on the current applied to the solenoid coil. The solenoid valve control pressure is high with no or minimum current applied to the solenoid coil and decreases with increasing current applied to solenoid coil.

During the bench testing you should see the resistance of a variable force solenoid at 5.1 Ohms+/- .3 Ohms@ 20°C (68°F). As the temperature of the solenoid windings increase, the resistance will also increase. When the solenoid temperature is at 100°C (212°F), the resistance value will be approximately 6. 7 Ohms +/- .4 Ohms.

ON/OFF SOLENOIDS

The ON/OFF solenoid valves are solenoids 9, 10, 11 and 12. The ON/OFF solenoid valve is electronically controlled by the TECHM (figure 11). This solenoid is a normally closed solenoid that is controlled ON (fully open) or OFF (fully closed).

The resistance of an On/Off solenoid is 12.0 Ohms +/- .3 Ohms@ 20°C (68°F). As the temperature of the solenoid windings increase, the resistance will also increase. When the solenoid temperature is at 100°C (212°F), the resistance value will be approximately 15.8 Ohms +/- .4 Ohms.

There are several other parts of this transmission including a unique valve body, a stop/start system and a few pointers when working on this new unit that we will get into in the future. Until then, keep having *Fun with Transmissions*!

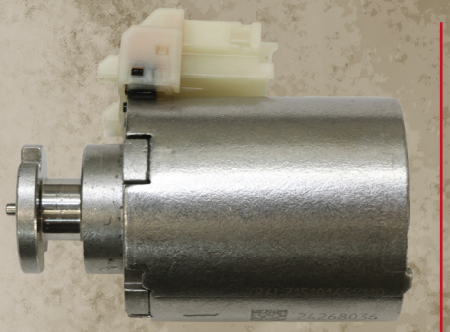


Figure 8

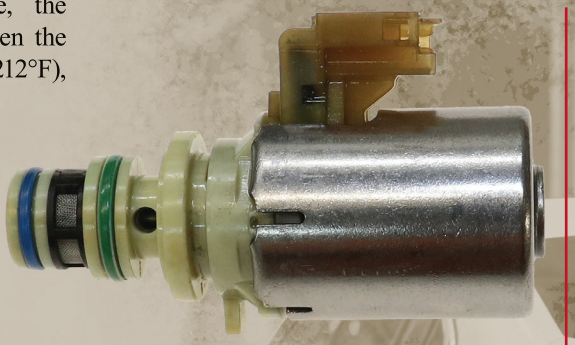


Figure 9

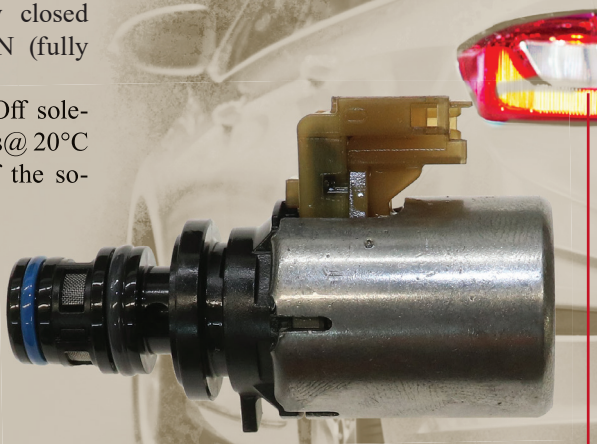


Figure 10



Figure 11