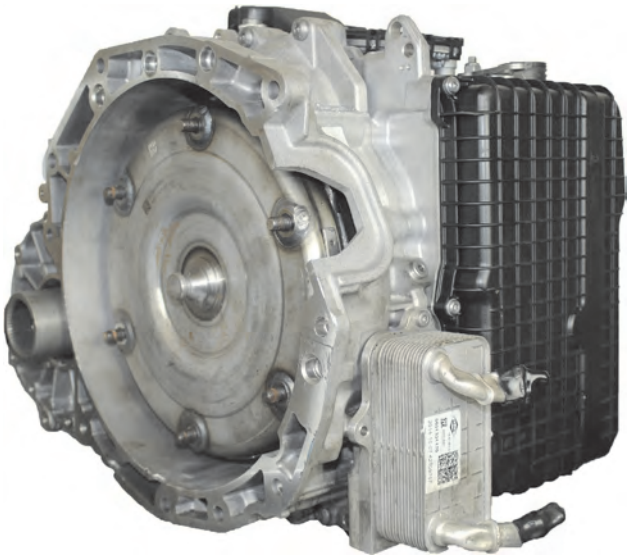
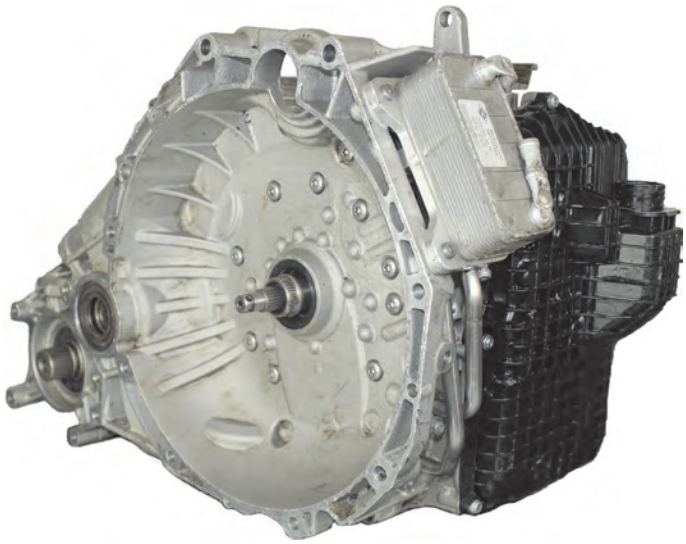
ZF9HP48 - 948TE

PRELIMINARY INFORMATION



ZF9HP48



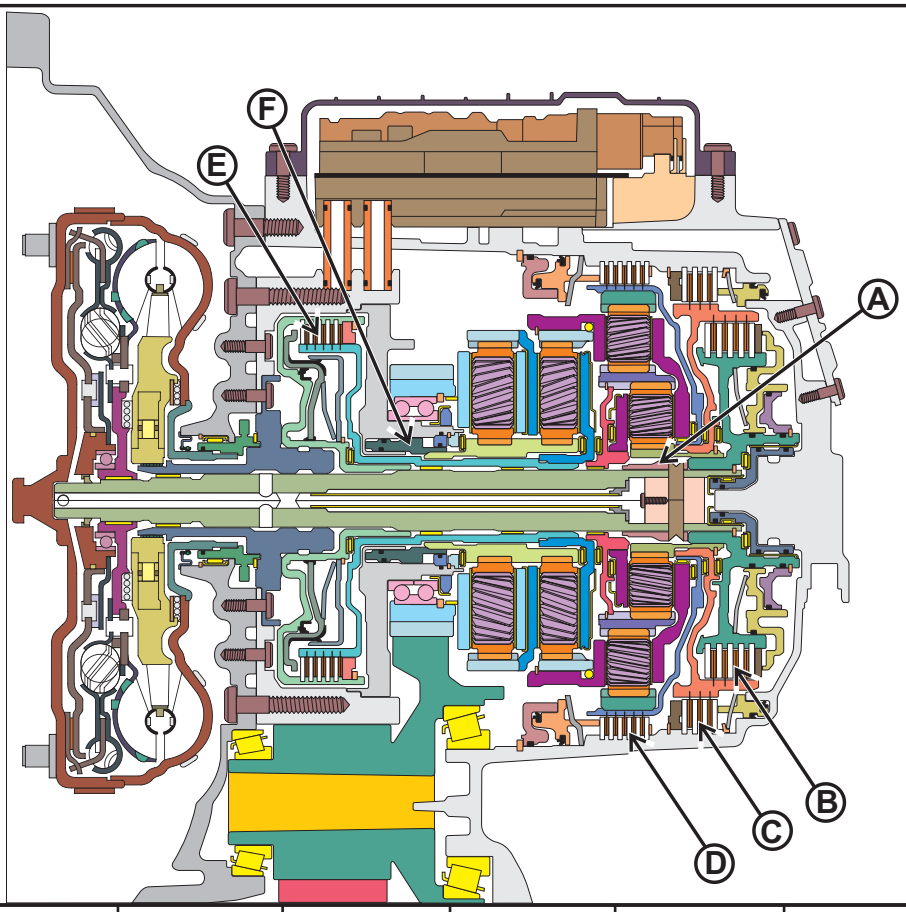
948TE

The ZF9HP48 - 948TE automatic transmission is a 9 speed, electronically controlled unit manufactured by ZF. The transmission represents the latest in automatic transmission technology for a transverse, AWD (all-wheel drive) unit. ZF describes the ZF 9HP48 transmission as having the following features:

· Designed to be maintenance free
· Transmission fluid is fill for life
· The TCC strategy has a controlled slip feature with electronically regulated lock-up control on gears 1 to 9
· Planetary gearset with 9 speeds, 4 planetary geartrains, and 6 shift elements
· Wide transmission ratio spread with small ratio steps
· The first-ever use of interlocking dog clutches in a passenger car automatic transmission
· Shift programs controlled by the TCM (transmission control module)
· TCM (transmission control module) has an adaptive capability to ensure efficient gear shift quality throughout the service life of the transmission
· Diagnostics available from the TCM (transmission control module) via the high speed CAN (controller area network) Powertrain systems bus.

This transmission will be found in the following Global applications:
Acura TLX and MDX, Chrysler 200, Fiat Doblò, Fiat 500X, Honda CR-V, Jeep Cherokee (KL), Jeep Renegade, Ram ProMaster City, Range Rover Evoque, Land Rover Discovery Sport.

COMPONENT APPLICATION CHART

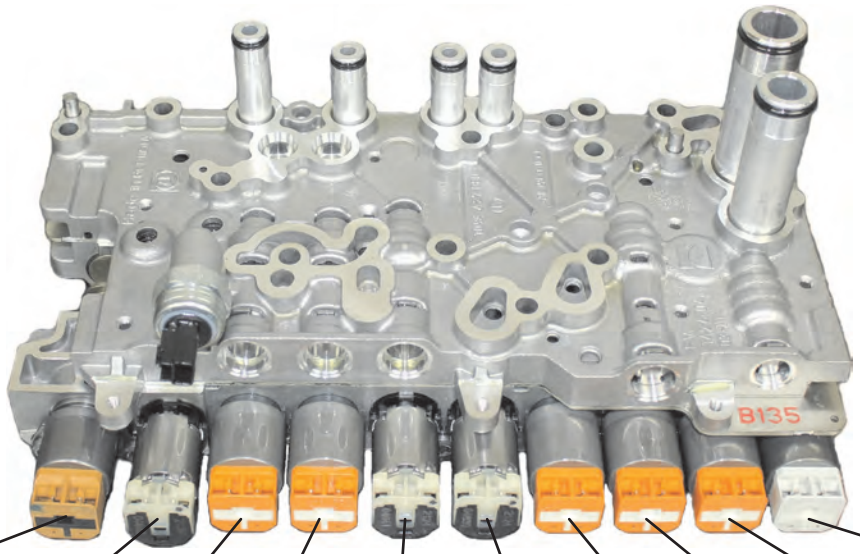


	A Clutch (Dog)***	B Clutch	C Brake	D Brake	E Clutch	F Clutch (Dog)***	Ratio
P/N	Open			ON		Closed	
Reverse	Open	ON		ON		Closed	**3.830**
1st Gear	Closed			ON		Closed	**4.713**
2nd Gear	Closed		ON			Closed	**2.842**
3rd Gear*	Closed	ON				Closed	**1.909**
4th Gear**	Closed				ON	Closed	**1.382**
5th Gear	Closed	ON			ON	Open	**1.000**
6th Gear	Closed		ON		ON	Open	**0.808**
7th Gear	Closed			ON	ON	Open	**0.699**
8th Gear	Open		ON	ON	ON	Open	**0.580**
9th Gear	Open	ON		ON	ON	Open	**0.479**

** - Failsafe Gear according to Land Rover*
*** - Default Gear according to Dodge*
**** - Dog Clutch shift transitions dependent upon proper engine and shaft speed*

Figure 1

SOLENOID IDENTIFICATION AND APPLICATION CHART

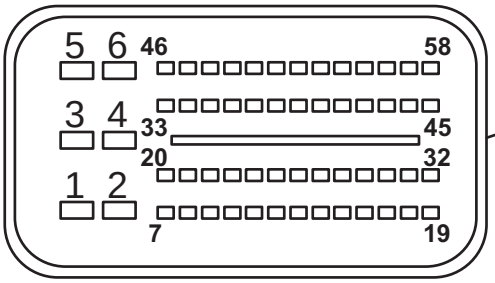


Magnetic Control Solenoid (Park-Lock Actuator)
Park Lock Solenoid
C Brake Solenoid
D Brake Solenoid
F Dog Clutch Solenoid
A Dog Clutch Solenoid
E Clutch Solenoid
B Clutch Solenoid
TCC Solenoid
System Pressure Solenoid

	A Sol.	B Sol.	C Sol.	D Sol.	E Sol.	F Sol.	TCC Sol.	Press. Sol.	Pk/Lk Act.	Pk/Lk Sol.
Park								Mod.		
Reverse		X		X		X		Mod.	X	X
Neutral						X		Mod.	X	X
1st Gear	X			X		X	Mod.	Mod.	X	X
2nd Gear	X		X			X	Mod.	Mod.	X	X
3rd Gear	X	X				X	Mod.	Mod.	X	X
4th Gear	X				X	X	Mod.	Mod.	X	X
5th Gear	X	X			X		Mod.	Mod.	X	X
6th Gear	X		X		X		Mod.	Mod.	X	X
7th Gear	X			X	X		Mod.	Mod.	X	X
8th Gear			X	X	X		Mod.	Mod.	X	X
9th Gear		X		X	X		Mod.	Mod.	X	X

Figure 2

TCM PIN IDENTIFICATION



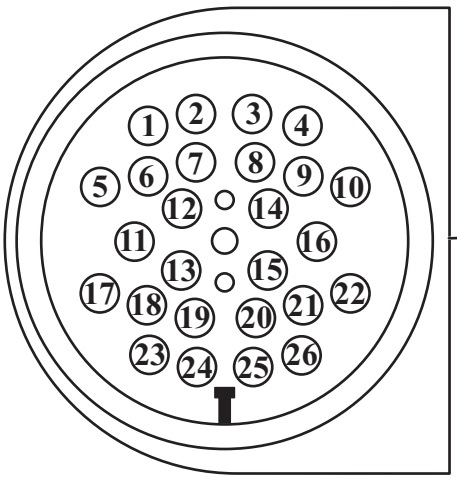
948TE

Transmission Control Module Pin Assignments

PIN #	NAME	SIGNAL DESCRIPTION
1 & 2	Z904 & Z909	Control module ground
3	T78	System voltage supply to all pressure regulating solenoids
5	A190	Control module supply voltage (Fused +)
6	T118	System voltage supply to all ON/OFF solenoids
8	T917	PRNDL Switch return (ground)
9	F1	Ignition OFF/RUN/START control output
10	T376	5 V Supply to the Oil Pressure Sensor (A & F Dog Clutch Release Pressure)
11	T41	TRS T41 Signal
12	T69	9 Volts supply for the Park Pawl Sensor and Input and Output speed sensors
13	T3	TRS T43 Signal
14	T42	TRS T42 Signal
15	T1	TRS T1 Signal
17	T54	ATF temperature sensor signal
19	T377	Oil Pressure Sensor Signal (A & F Dog Clutch Release Pressure)
30	T820	ATF temperature sensor ground
31	T52	Input Speed Signal
34	D29	CAN C +
35	T803	Hydraulic Park Lock Solenoid
36	T802	Dog Clutch "F" Solenoid
38	T801	Dog Clutch "A" Solenoid
39	T792	Pressure Control Solenoid - TCC
40	T818	Pressure Control Solenoid D
43	T14	Output Speed Signal
47	D30	CAN C -
51	T800	Mechanical Park Lock Solenoid
52	T812	Pressure Control Solenoid - Line Pressure
53	T790	Pressure Control Solenoid E
54	T814	Pressure Control Solenoid B
55	T816	Pressure Control Solenoid C

Figure 3

948TE



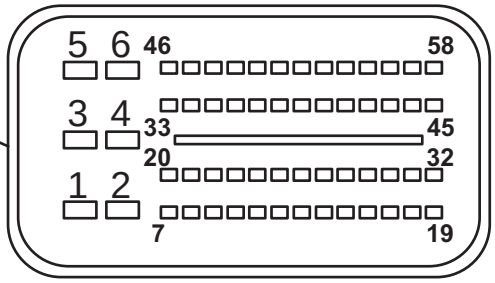
Transmission Pin Assignments

PIN #	NAME	SIGNAL DESCRIPTION
1	T78	System voltage supply to all pressure regulating solenoids
2	T801	Dog Clutch "A" Solenoid
3	T814	Pressure Control Solenoid "B" - B Clutch Control
4	T118	System voltage supply to all ON/OFF solenoids
5	T816	Pressure Control Solenoid "C" - C Brake Clutch Control
6	T818	Pressure Control Solenoid "D" - D Brake Clutch Control
7	T790	Pressure Control Solenoid "E" - E Clutch Control
8	T802	Dog Clutch "F" Solenoid
9	T812	Pressure Control Solenoid - Line Pressure
10	T792	Pressure Control Solenoid - TCC
11	T803	Hydraulic Park Lock Solenoid
12	T800	Mechanical Park Lock Solenoid
15	T376	5 V Supply to the Oil Pressure Sensor (A & F Dog Clutch Release Pressure)
16	T377	Oil Pressure Sensor Signal (A & F Dog Clutch Release Pressure)
17	T917	PRNDL Switch return (ground)
18	T1	TRS T1 Signal
19	T3	TRS T3 Signal
20	T42	TRS T42 Signal
21	T41	TRS T41 Signal
22	T14	Output Speed Signal
23	T52	Input Speed Signal
24	T69	9 Volts supply for the Park Pawl Sensor and Input and Output speed sensors
25	T820	ATF temperature sensor ground
26	T54	ATF temperature sensor signal

Figure 4

ZF9HP48

TCM PIN IDENTIFICATION

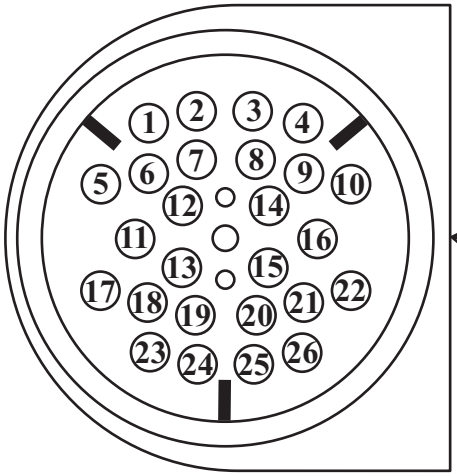


Transmission Control Module Pin Assignments

PIN #	NAME	SIGNAL DESCRIPTION
1	Ground	Control module ground
3	UDRMV1	Common voltage feed to electronic pressure regulating solenoids
5	Battery (KL30)	Control module supply voltage
6	UDRMV2	Common voltage feed to solenoid valves
8	Sensor GND	Sensor electrical ground
9	IG (KL15)	Ignition status
10	VS_5V	Sensor supply voltage (5 Volts)
12	VS_9V	Sensor supply voltage (9 Volts)
13	L3	Park position sensor (In)
15	L4	Park position sensor (Out)
17	T_Oil+	ATF temperature sensor + connection
19	Vout_Pr	Pressure sensor output voltage
30	T_Oul-	ATF temperature sensor - connection
31	N_T	Input shaft speed sensor
34	CAN0-high	High side connection for high speed controller area network powertrain bus
35	Out8	Park solenoid valve - controls parl lock pawl position hydraulically
36	Out7	Solenoid valve "F" controls dog clutch "F"
38	Out6	Solenoid valve "A" controls dog clutch "A"
39	Out4	Electronic pressure regulating solenoid - torque converter clutch
40	Out2	Electronic pressure regulating solenoid "D" - control brake "D"
43	N_OUT	Output shaft speed sensor
47	CAN0-low	Low side connection for high speed controller area network powertrain bus
48	P-Signal (HSS)	Park confirmed signal
51	Out9	Park solenoid magnet - controls parl lock pawl position mechanically
52	Out5	Electronic pressure regulating solenoid - system pressure
53	Out3	Electronic pressure regulating solenoid "E" - control clutch "E"
54	Out0	Electronic pressure regulating solenoid "B" - control clutch "B"
55	Out1	Electronic pressure regulating solenoid "C" - control brake "C"

Figure 5

ZF9HP48



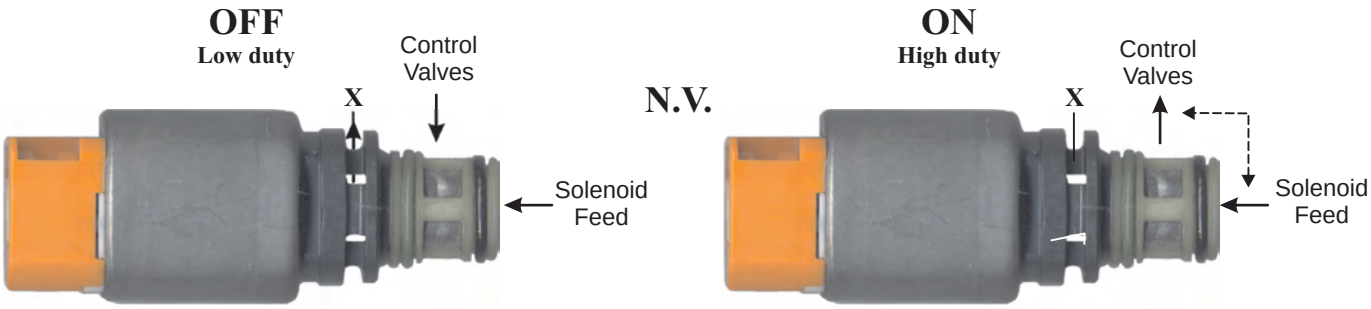
Transmission Pin Assignments

PIN #	NAME	SIGNAL DESCRIPTION
1	UDRMV1	Common voltage feed to electronic pressure regulating solenoids
2	Out6	Solenoid valve "A" controls dog clutch "A"
3	Out0	Electronic pressure regulating solenoid "B" controls clutch "B"
4	UDRMV2	Common voltage feed to solenoid valves
5	Out1	Electronic pressure regulating solenoid "C" controls brake "C"
6	Out2	Electronic pressure regulating solenoid "D" controls brake "D"
7	Out3	Electronic pressure regulating solenoid "E" controls clutch "E"
8	Out7	Solenoid valve "F" controls dog clutch "F"
9	Out5	Electronic pressure system solenoid - system pressure
10	Out4	Electronic pressure system solenoid - torque converter clutch
11	Out8	Park solenoid valve - controls park lock pawl position hydraulically
12	Out9	Park solenoid magnet - controls park lock pawl position mechanically
15	VS_5V	Sensor supply voltage (5 volts)
16	Vout_Pr	Pressure sensor output voltage
17	Sensor GND	Sensor electrical ground
18	L4	Park position sensor (Out)
19	L3	Park position sensor (In)
22	N_OUT	Output shaft speed sensor
23	N_T	Turbine speed sensor (input shaft speed)
24	VS_9V	Sensor supply voltage (9 Volts)
25	T_Oil-	ATF temperature sensor - connection
26	T_Oil+	ATF temperature sensor + connection

Figure 6

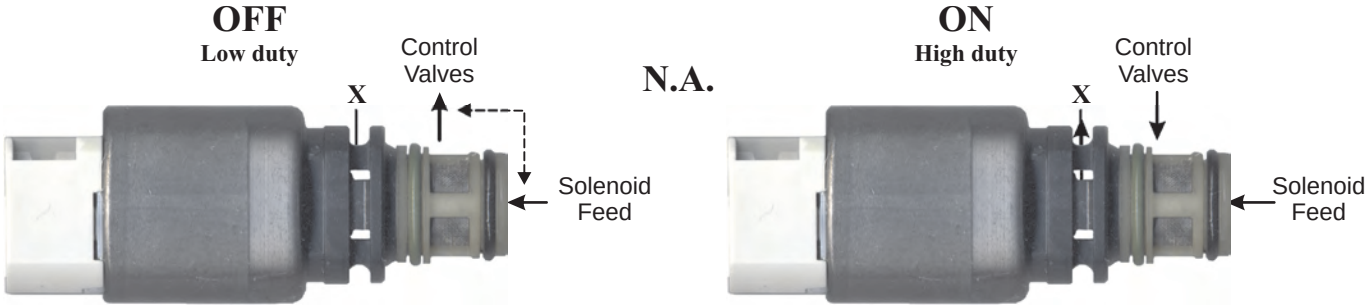
ZF9HP48 - 948TE SHIFT SOLENOID CHECKS

B, C, D, E & TC CLUTCH PRESSURE CONTROL SOLENOIDS



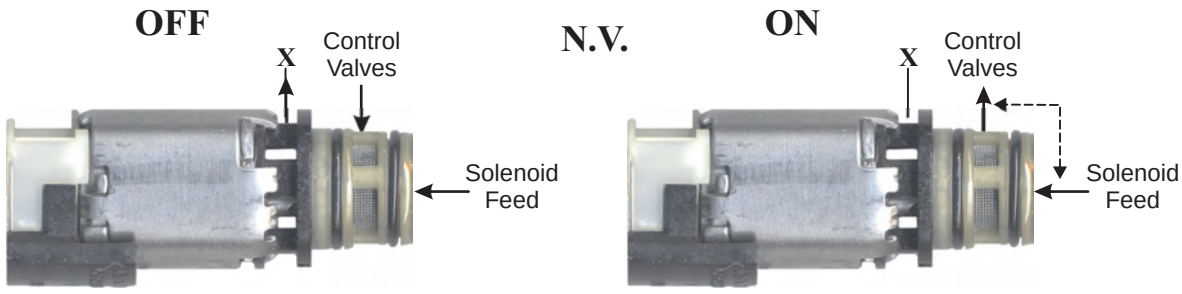
B, C, D, E and TC Clutch solenoids are Normally Vented variable Pressure Control Solenoids. When the solenoids are OFF, or at Low Duty cycle, pressure from the valves they are in control of is connected to the exhaust. When the Solenoids are ON, or at High Duty cycle, Solenoid Feed is connected thru the Solenoid to the valves they are in control of.

SYSTEM PRESSURE CONTROL SOLENOID



The System Pressure Control (LP) is a Normally Applied variable Pressure Control Solenoid. When the Solenoid is OFF, or at Low Duty cycle, Solenoid Feed is connected thru the Solenoid to the valves it is in control of. When the solenoid is ON, or at High Duty cycle, pressure from the valves it is in control of is connected to the exhaust.

DOG CLUTCH A, F & PARK LOCK ON/OFF SOLENOID



Dog clutch A, F and Park Lock Solenoids are a Normally Vented On/Off type solenoid. When the Solenoid is OFF, pressure from the valves it is in control of is connected to the exhaust. When the solenoid turns ON, Solenoid Feed is connected thru the Solenoid to the valves they are in control of.

Figure 7

ZF9HP48 - 948TE SHIFT SOLENOID CHECKS

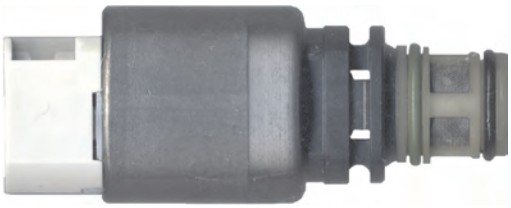
B, C, D, E & TC CLUTCH PRESSURE CONTROL SOLENOIDS

Resistance
Value 5-6 Ohms
20°C (68°F)

Solenoid Output
Pressure Specs.
Off- 0psi/bar
On- 68.17psi
4.7 bars

SYSTEM PRESSURE CONTROL SOLENOID

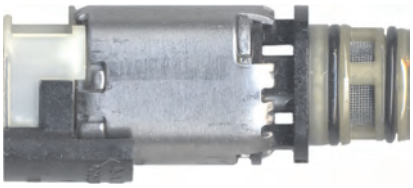
Resistance
Value 5-6 Ohms
20°C (68°F)



Solenoid Output
Pressure Specs.
Off- 68.17psi
4.7 bars
On- 0psi/bar

DOG CLUTCH A, F & PARK RELEASE ON/OFF SOLENOID

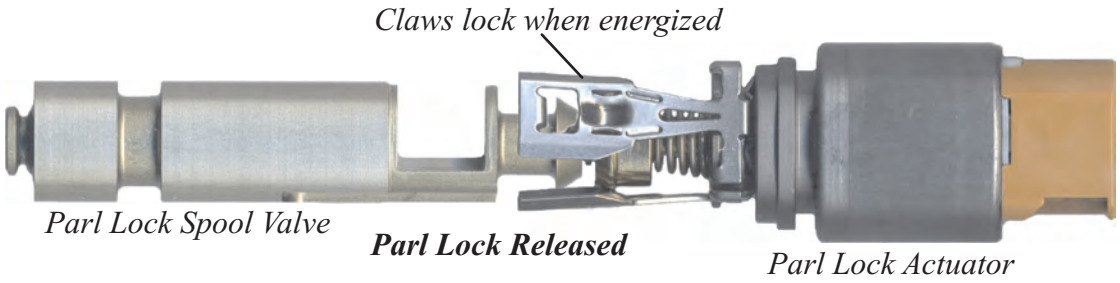
Resistance
Value 10-12 Ohms
20°C (68°F)



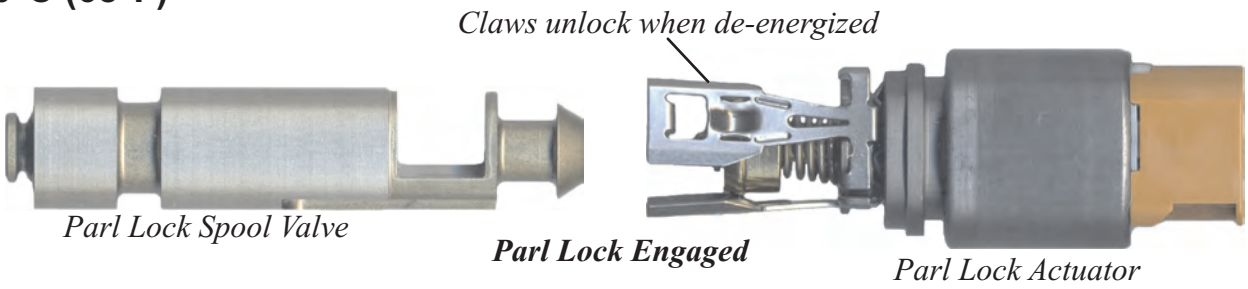
ON/OFF
Type
Solenoid

Figure 8

ZF9HP48 - 948TE SHIFT SOLENOID CHECKS



Resistance Value 25 Ohms 20°C (68°F)



A control solenoid called the Park Lock Actuator is located in the valve block. The solenoid is controlled by the TCM (transmission control module) and converts electrical signals into hydraulic control signals to control the electronic park lock function.

The control solenoid is an on/off solenoid which is controlled by the TCM (transmission control module) by switching the solenoid to earth.

When the Park lock is to be released, the park lock solenoid valve sends ATF (automatic transmission fluid) pressure to the spool valve and moves it into contact with the claws of the solenoid. Movement of the spool valve moves the park rod and releases the park pawl from the park interlock gear. The control solenoid is energized by the TCM (transmission control module) and the claws close to retain the spool valve in the unlocked position. A shuttle valve retains ATF (automatic transmission fluid) pressure on the spool to prevent inadvertent park lock operation in the event of an electrical failure until the engine is stopped.

When the Park lock is to be engaged, ATF (automatic transmission fluid) pressure is released from the spool valve and the TCM (transmission control module) de-energises the control solenoid. The claws are released, the spool valve returns under spring pressure to the park lock position and the park lock is engaged. A Service Park Release (SPR) procedure must be performed to release the parking lock manually if an electrical failure occurs or the engine is not running.

To allow the vehicle to roll through a car wash, the control solenoid remains energized if the engine is stopped with the TCS (transmission control switch) in neutral. This holds the transmission out of park without hydraulic pressure for 10 minutes. After this time the control solenoid is de-energised, releasing the claws and allowing the spool valve to return to the park position.

The resistance of the solenoid coil winding is 25 Ohms at 20 °C (68 °F).

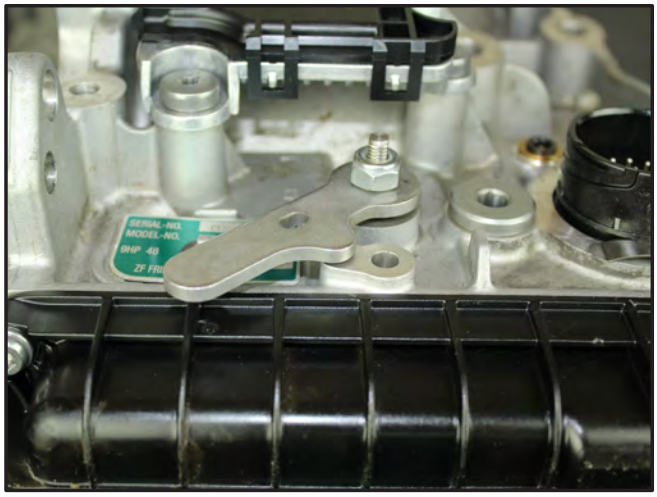
Figure 9

SERVICE PARK RELEASE

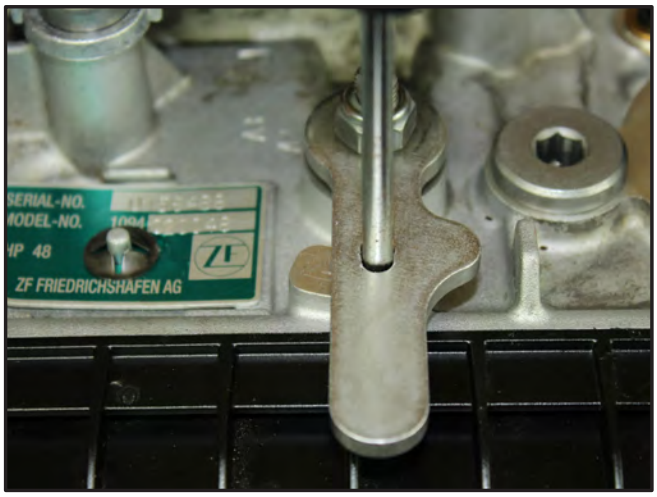
Service Park Applied

Service Park Released

948TE



Service Park Applied



Service Park Released

ZF8HP48

948TE (MPR) - *Park by wire applications*

Dodge/Chrysler vehicles utilize an emergency Manual Park Release Lever to disengage Park should power be lost. On the bench, the lever can be flipped and bolted down to service the valve body assembly.

ZF8HP48 Land Rover Service Park Release (SPR) - *Park by wire applications*

The SPR is a mechanical procedure which requires removal of the air filter housing for access. The procedure is required when there has been a loss of vehicle electrical power or a failure to the automatic transmission preventing release of the park lock. The following procedure must be used to release the park lock before moving the vehicle. The vehicle must be held by either the electric park brake or wheel chocks to prevent it unintentionally moving when the park lock is released.

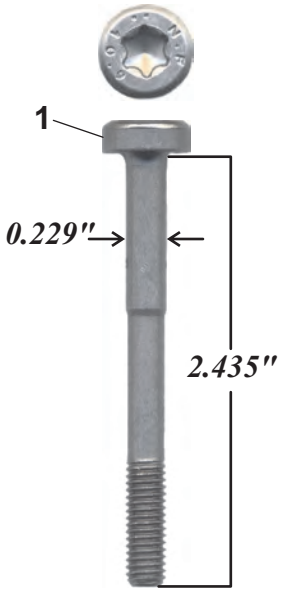
1. Make sure that the ignition is off.
2. Remove the air filter assembly to get access to the SPR lever on the automatic transmission
3. ZF8HP48 - Rotate the SPR lever in a counter clockwise direction until the slot in the SPR lever aligns with a corresponding hole in the transmission's casing. Hold the SPR lever in this position and insert a suitable 5mm diameter locking pin through the slot in the SPR lever and into the hole in the transmission's casing. The vehicle can now be moved.

Figure 10

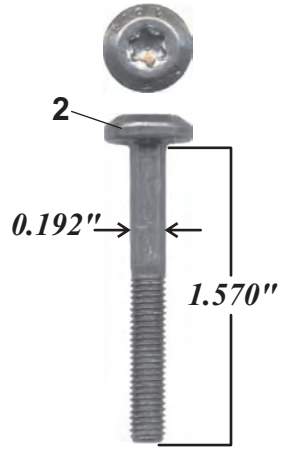
VALVE BODY CIRCUIT IDENTIFICATION

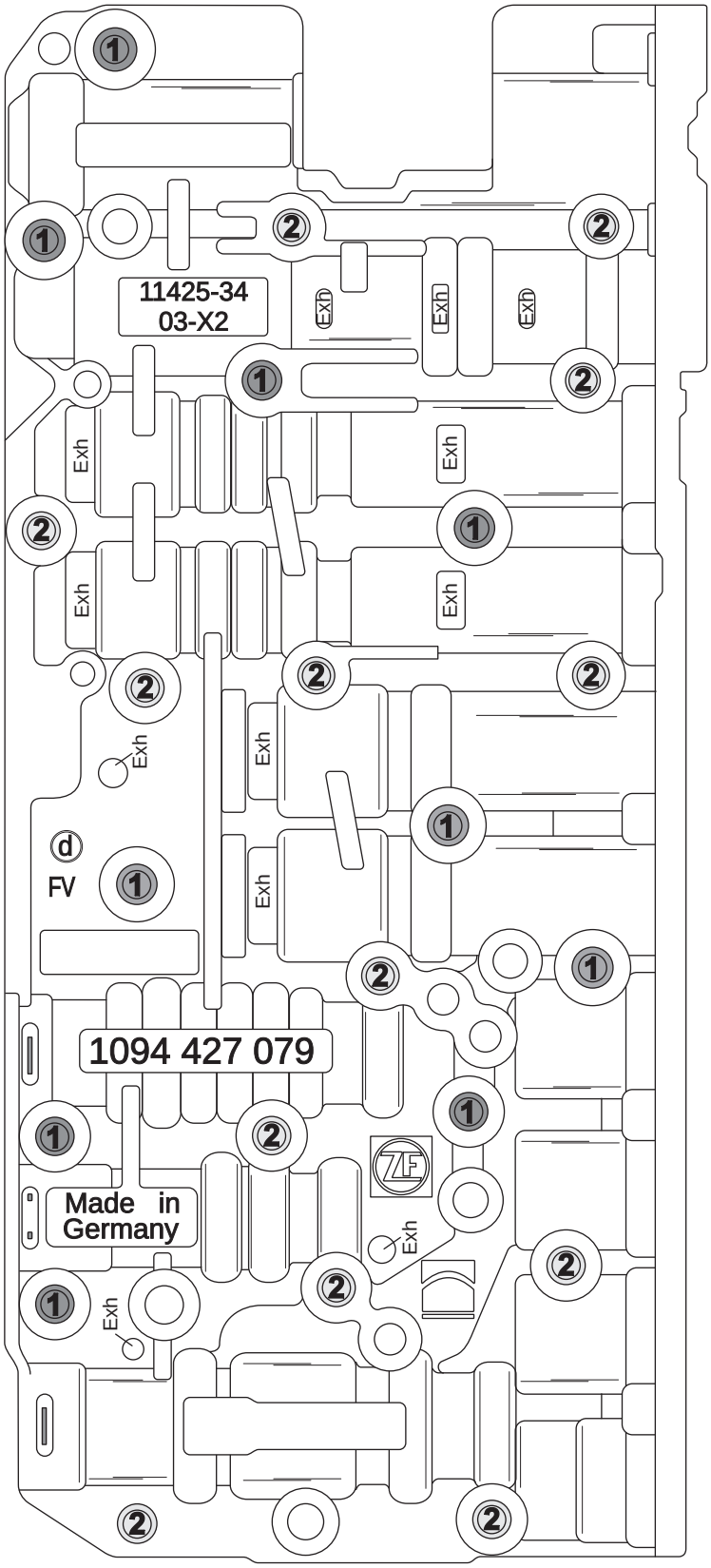
Outer Valve Body Housing Upper Side

#40 Torx



#27 Torx



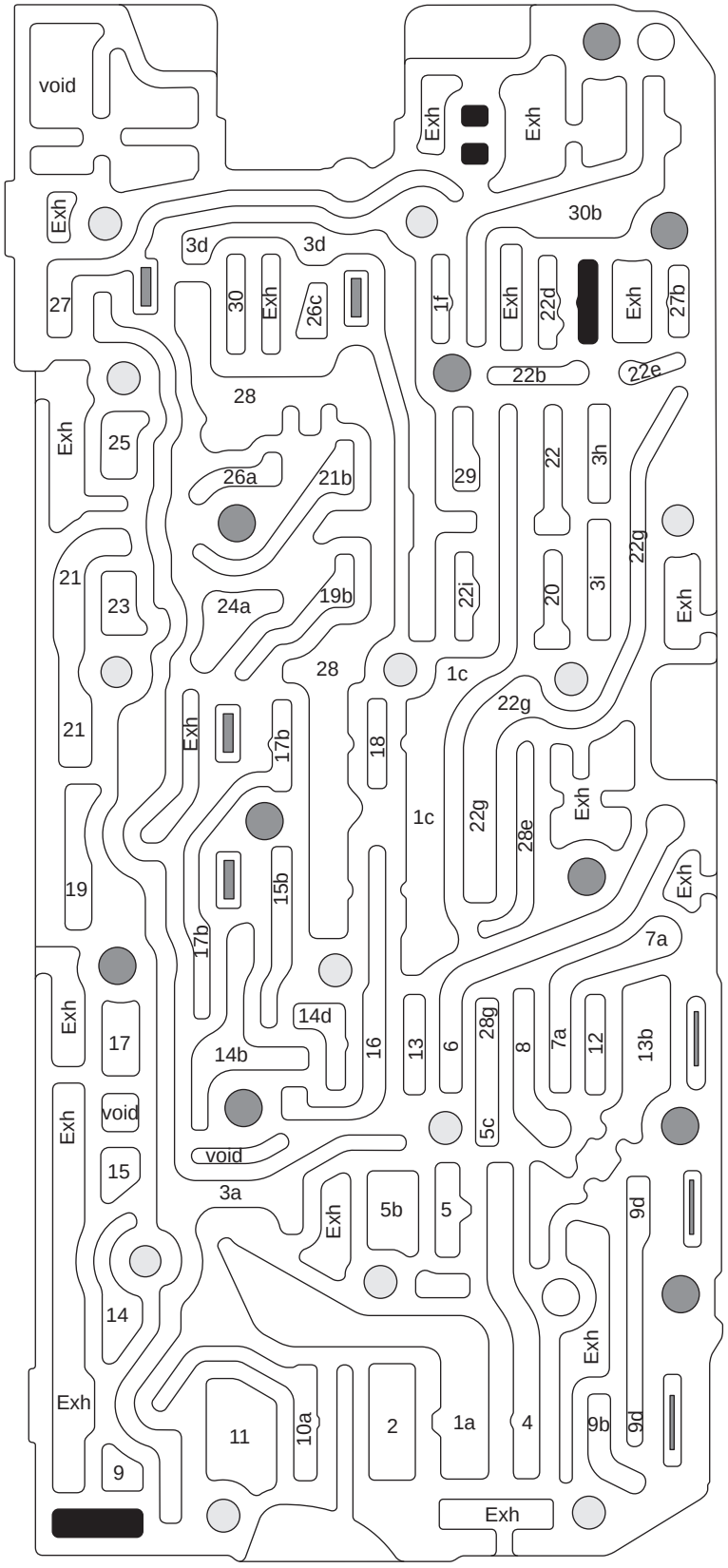


1 Valve Body to Case Bolt - M6x62 [8Nm/71in.Lb.] (10)
2 Outer to Inner Valve Body Bolt - M5x40 [6Nm/53in.Lb.] (13)

Figure 11

VALVE BODY CIRCUIT IDENTIFICATION

Outer Valve Body Housing Inner Side



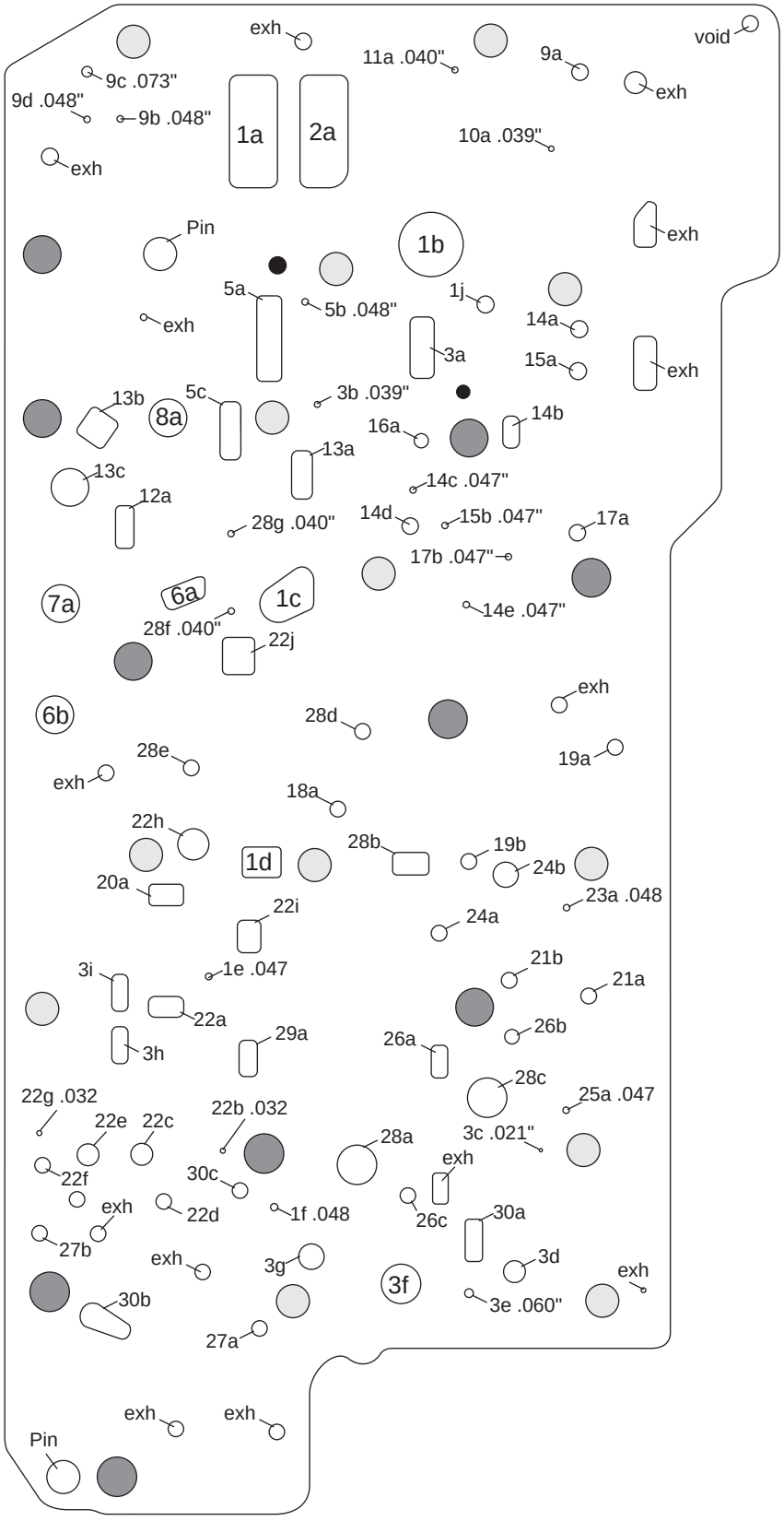
Hydraulic Circuit Legend

1 System Pressure Circuit
2 Pump Return Circuit
3 Solenoid Feed Pressure Circuit
4 Lubrication Valve Feed Circuit
5 Pre-fill/Converter Circuit
6 TCC Release Pressure Circuit
7 TCC Apply Pressure Circuit
8 To Heat Exchanger Circuit
9 Pressure System Solenoid Circuit (EPC)
10 Shift Valve-System Pressure Circuit (SV-SP)
11 System Pressure Valve Exhaust Circuit
12 TCC Circuit
13 TCC Exhaust Circuit
14 TCC Solenoid Circuit
15 B Clutch Solenoid Circuit
16 B Clutch Apply Circuit
17 E Clutch Solenoid Circuit
18 E Clutch Apply Circuit
19 A (Dog) Clutch Solenoid Circuit
20 A (Dog) Clutch Release Circuit
21 F (Dog) Clutch Solenoid Circuit
22 F (Dog) Clutch Release/
A (Dog) Clutch Apply Circuit
23 D Brake Solenoid Circuit
24 D Brake Apply Circuit
25 C Brake Solenoid Circuit
26 C Brake Apply Circuit
27 Park Control Solenoid Circuit
28 Pre-fill Pressure Circuit (B, C, D & E)
29 F (Dog) Clutch Apply Circuit
30 Park Cylinder Circuit (PCYL)

Figure 12

VALVE BODY CIRCUIT IDENTIFICATION

Spacer Plate



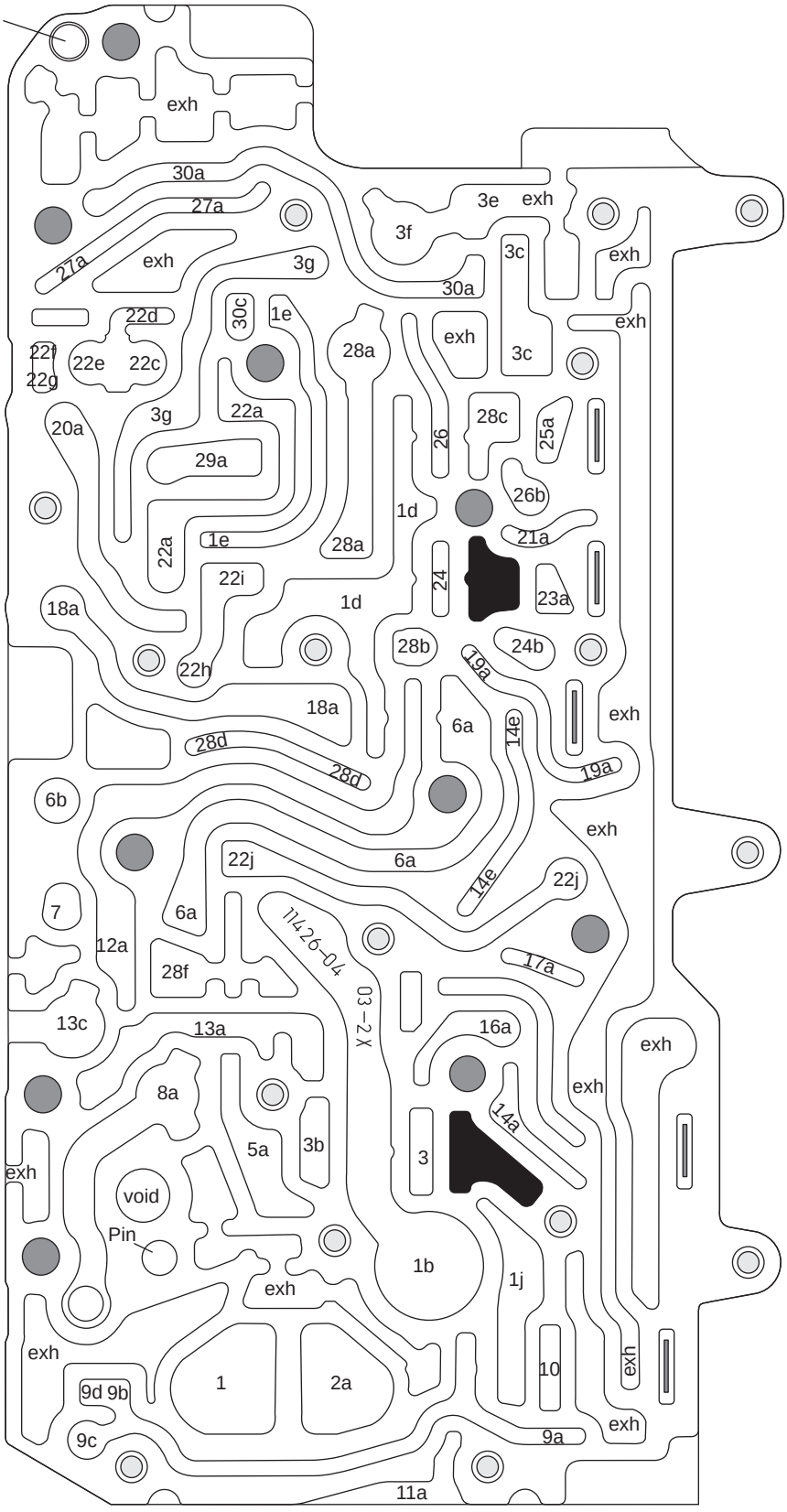
Hydraulic Circuit Legend

1 System Pressure Circuit
2 Pump Return Circuit
3 Solenoid Feed Pressure Circuit
4 Lubrication Valve Feed Circuit
5 Pre-fill/Converter Circuit
6 TCC Release Pressure Circuit
7 TCC Apply Pressure Circuit
8 To Heat Exchanger Circuit
9 Pressure System Solenoid Circuit (EPC)
10 Shift Valve-System Pressure Circuit (SV-SP)
11 System Pressure Valve Exhaust Circuit
12 TCC Circuit
13 TCC Exhaust Circuit
14 TCC Solenoid Circuit
15 B Clutch Solenoid Circuit
16 B Clutch Apply Circuit
17 E Clutch Solenoid Circuit
18 E Clutch Apply Circuit
19 A (Dog) Clutch Solenoid Circuit
20 A (Dog) Clutch Apply Circuit
21 F (Dog) Clutch Solenoid Circuit
22 F (Dog) Clutch Release/
A (Dog) Clutch Apply Circuit
23 D Brake Solenoid Circuit
24 D Brake Apply Circuit
25 C Brake Solenoid Circuit
26 C Brake Apply Circuit
27 Park Control Solenoid Circuit
28 Pre-fill Pressure Circuit (B, C, D & E)
29 F (Dog) Clutch Apply Circuit
30 Park Cylinder Circuit (PCYL)

Figure 13

VALVE BODY CIRCUIT IDENTIFICATION

Inner Valve Body Housing Upper Side



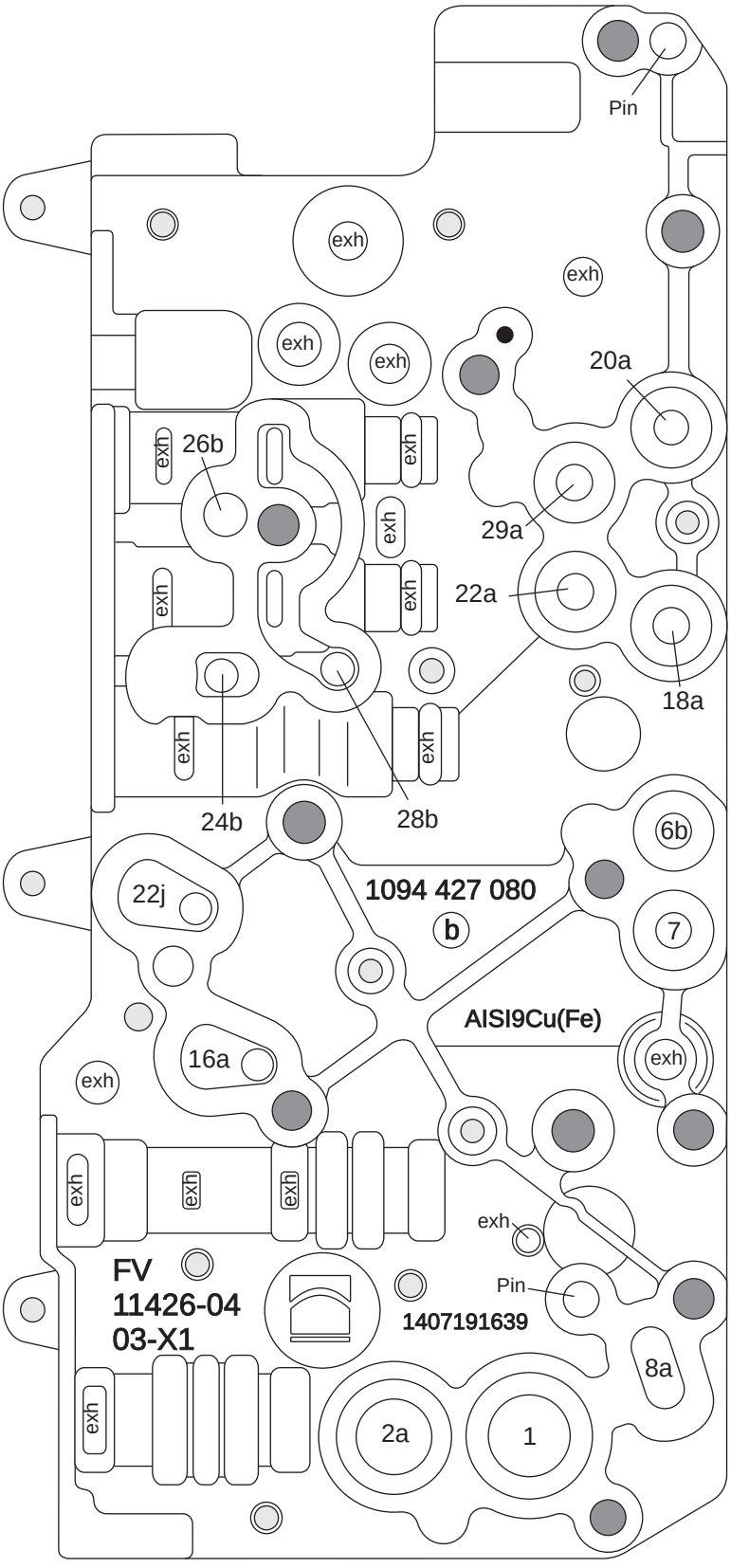
Hydraulic Circuit Legend

1 System Pressure Circuit
2 Pump Return Circuit
3 Solenoid Feed Pressure Circuit
4 Lubrication Valve Feed Circuit
5 Pre-fill/Converter Circuit
6 TCC Release Pressure Circuit
7 TCC Apply Pressure Circuit
8 To Heat Exchanger Circuit
9 Pressure System Solenoid Circuit (EPC)
10 Shift Valve-System Pressure Circuit (SV-SP)
11 System Pressure Valve Exhaust Circuit
12 TCC Circuit
13 TCC Exhaust Circuit
14 TCC Solenoid Circuit
15 B Clutch Solenoid Circuit
16 B Clutch Apply Circuit
17 E Clutch Solenoid Circuit
18 E Clutch Apply Circuit
19 A (Dog) Clutch Solenoid Circuit
20 A (Dog) Clutch Apply Circuit
21 F (Dog) Clutch Solenoid Circuit
22 F (Dog) Clutch Release/
A (Dog) Clutch Apply Circuit
23 D Brake Solenoid Circuit
24 D Brake Apply Circuit
25 C Brake Solenoid Circuit
26 C Brake Apply Circuit
27 Park Control Solenoid Circuit
28 Pre-fill Pressure Circuit (B, C, D & E)
29 F (Dog) Clutch Apply Circuit
30 Park Cylinder Circuit (PCYL)

Figure 14

VALVE BODY CIRCUIT IDENTIFICATION

Inner Valve Body Housing Case Side



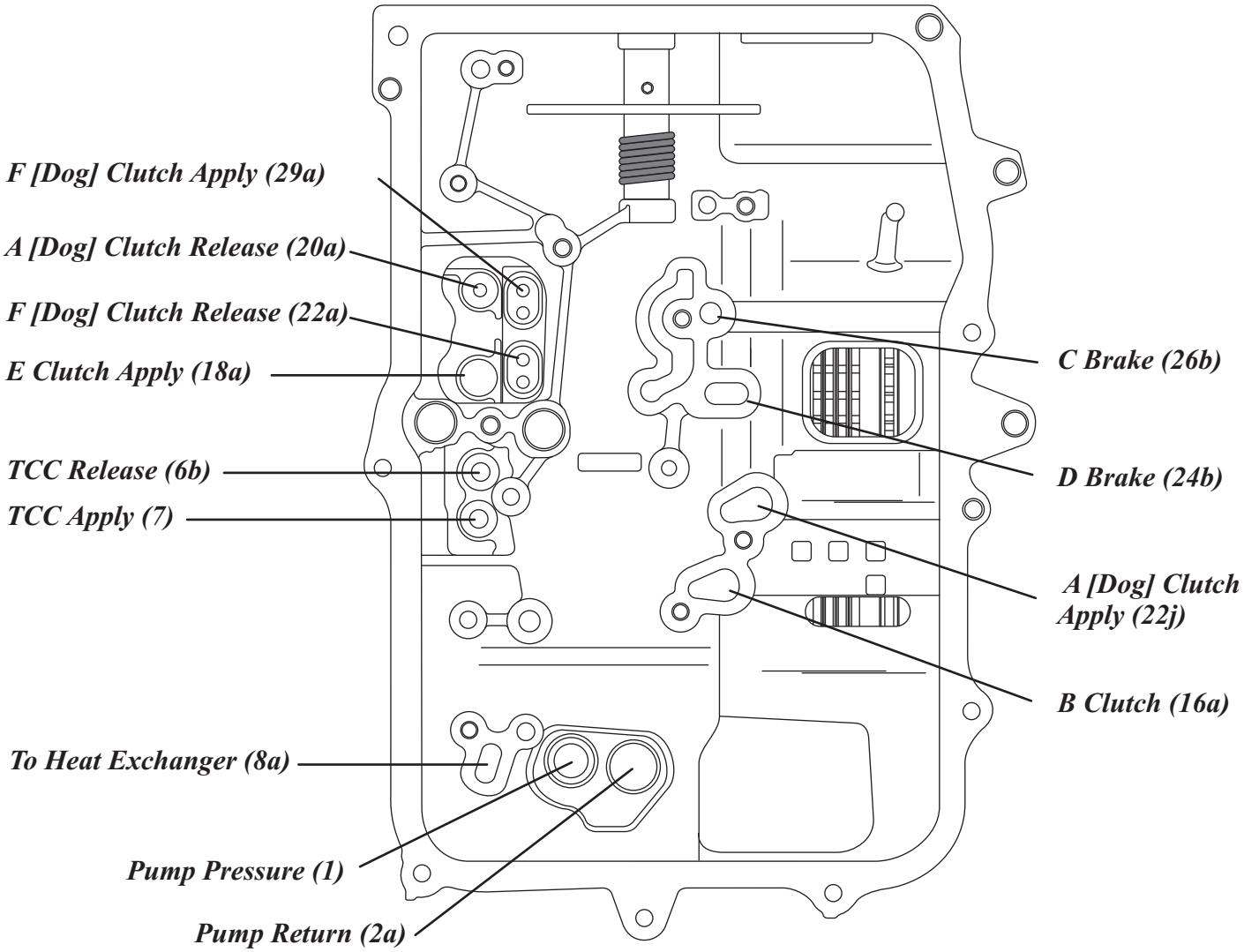
Hydraulic Circuit Legend

1 System Pressure Circuit
2 Pump Return Circuit
3 Solenoid Feed Pressure Circuit
4 Lubrication Valve Feed Circuit
5 Pre-fill/Converter Circuit
6 TCC Release Pressure Circuit
7 TCC Apply Pressure Circuit
8 To Heat Exchanger Circuit
9 Pressure System Solenoid Circuit (EPC)
10 Shift Valve-System Pressure Circuit (SV-SP)
11 System Pressure Valve Exhaust Circuit
12 TCC Circuit
13 TCC Exhaust Circuit
14 TCC Solenoid Circuit
15 B Clutch Solenoid Circuit
16 B Clutch Apply Circuit
17 E Clutch Solenoid Circuit
18 E Clutch Apply Circuit
19 A (Dog) Clutch Solenoid Circuit
20 A (Dog) Clutch Apply Circuit
21 F (Dog) Clutch Solenoid Circuit
22 F (Dog) Clutch Release/
A (Dog) Clutch Apply Circuit
23 D Brake Solenoid Circuit
24 D Brake Apply Circuit
25 C Brake Solenoid Circuit
26 C Brake Apply Circuit
27 Park Control Solenoid Circuit
28 Pre-fill Pressure Circuit (B, C, D & E)
29 F (Dog) Clutch Apply Circuit
30 Park Cylinder Circuit (PCYL)

Figure 15

VALVE BODY CIRCUIT IDENTIFICATION

Case Passage Identification



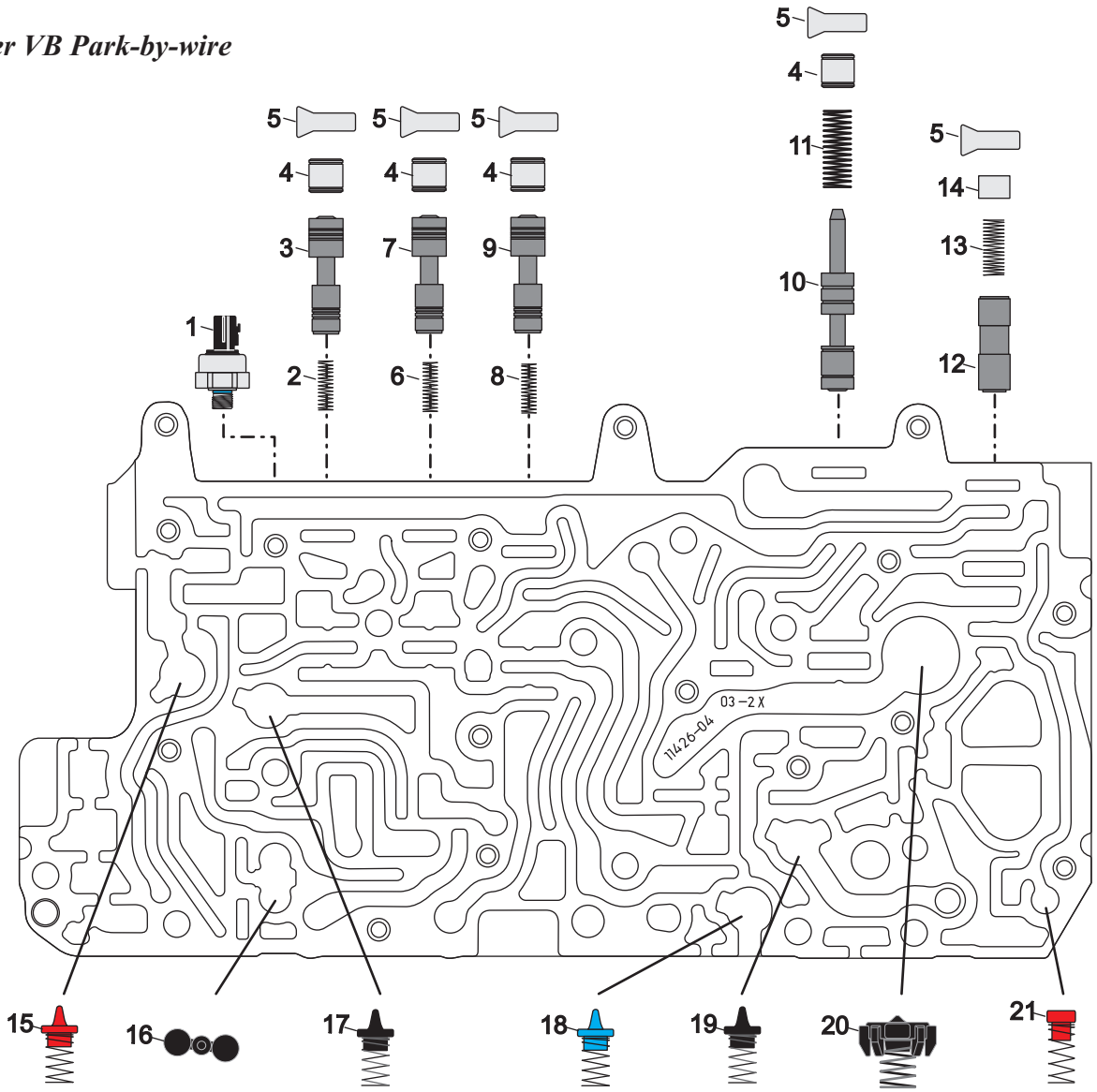
Hydraulic Circuit Legend

1 System Pressure Circuit
2 Pump Return Circuit
3 Solenoid Feed Pressure Circuit
4 Lubrication Valve Feed Circuit
5 Pre-fill/Converter Circuit
6 TCC Release Pressure Circuit
7 TCC Apply Pressure Circuit
8 To Heat Exchanger Circuit
9 Pressure System Solenoid Circuit (EPC)
10 Shift Valve-System Pressure Circuit (SV-SP)
11 System Pressure Valve Exhaust Circuit
12 TCC Circuit
13 TCC Exhaust Circuit
14 TCC Solenoid Circuit
15 B Clutch Solenoid Circuit
16 B Clutch Apply Circuit
17 E Clutch Solenoid Circuit
18 E Clutch Apply Circuit
19 A (Dog) Clutch Solenoid Circuit
20 A (Dog) Clutch Apply Circuit
21 F (Dog) Clutch Solenoid Circuit
22 F (Dog) Clutch Release/
A (Dog) Clutch Apply Circuit
23 D Brake Solenoid Circuit
24 D Brake Apply Circuit
25 C Brake Solenoid Circuit
26 C Brake Apply Circuit
27 Park Control Solenoid Circuit
28 Pre-fill Pressure Circuit (B, C, D & E)
29 F (Dog) Clutch Apply Circuit
30 Park Cylinder Circuit (PCYL)

Figure 16

VALVE BODY

Lower VB Park-by-wire

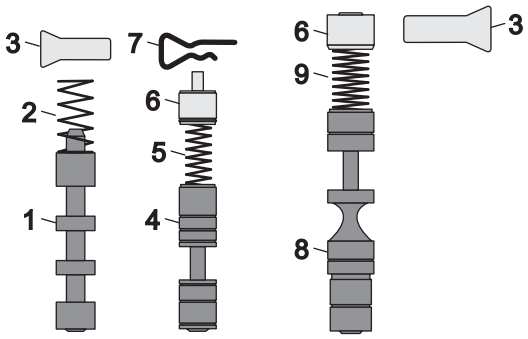


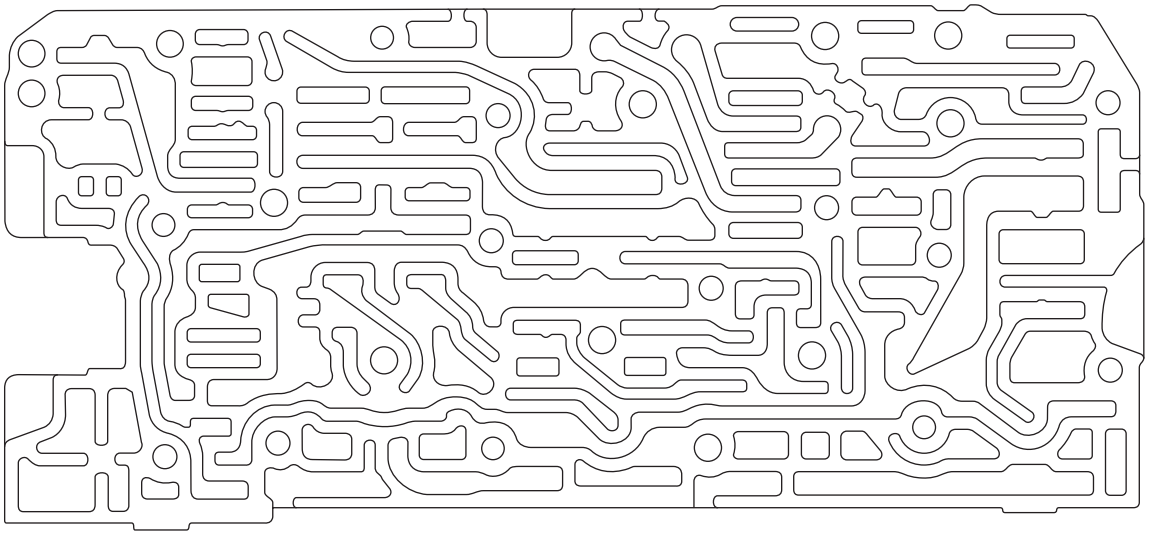
1. Dog Clutch Pre-Fill Exhaust Pressure Sensor
2. C Clutch Valve (CV-C) Spring (0.798" x 0.202" x 0.015")
3. C Clutch Valve (CV-C)
4. Bore Plug
5. Retainer
6. D Clutch Valve (CV-D) Spring (0.798" x 0.202" x 0.015")
7. D Clutch Valve (CV-D)
8. Lockup Clutch Valve (LC-V) Spring (0.955" x 0.204" x 0.022")
9. Lockup Clutch Valve (LC-V)
10. Solenoid Pressure Regulator Valve (PR-V)
11. Solenoid Pressure Regulator Valve (PR-V) Spring (1.745" x 0.355" x 0.042")
12. Shift Valve-System Pressure (SV-SP)
13. Shift Valve-System Pressure (SV-SP) Spring (1.352" x 0.258" x 0.034")
14. Shift Valve-System Pressure (SV-SP) Spring Cap
15. Dog Clutch Pre-Fill Check Valve
16. A & F Dog Clutch Rocker Ball
17. Clutch Pre-Fill Pressure Check Valve
18. TCC Release Pressure Exhaust Check Valve
19. Cooler Pressure Check Valve
20. Drain Back Check Valve
21. Line Boost Damper Check Valve

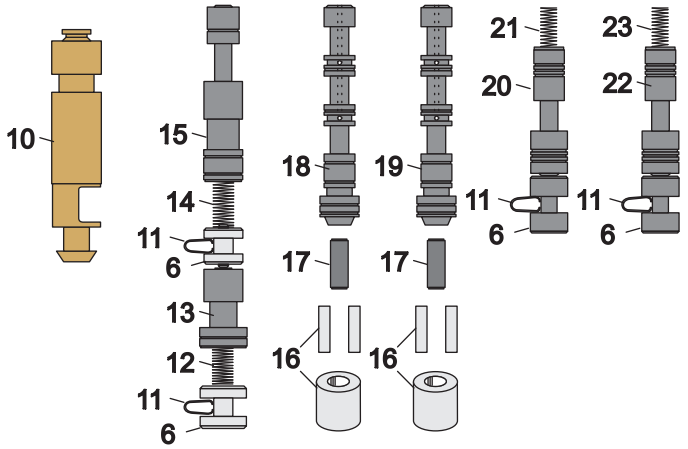
Figure 17

VALVE BODY

Upper VB Park-by-wire







For solenoid identification and location refer to figure 2

1. Converter Switch Valve (SP-V)
2. Converter Switch Valve (SP-V) Spring (0.760" x 0.450" x 0.031")
3. Retainer
4. Lubrication Valve (LU-V)
5. Lubrication Valve (LU-V) Spring (1.310" x 0.316" x 0.031")
6. Bore Plug
7. Wire Retainer
8. System Pressure Valve (SP-V)
9. System Pressure Valve (SP-V) Spring (1.905" x 0.445" x 0.038")
10. Park Cylinder (PCYL)
11. Tension Retainer
12. Park Cylinder Valve (PCV-1) Spring (1.060" x 0.042" x 0.027")
13. Park Cylinder Valve (PCV-1)
14. Park Cylinder Valve (PCV-2) Spring (1.060" x 0.042" x 0.027")
15. Park Cylinder Valve (PCV-2)
16. Valve Pin Sleeve
17. Valve Pin
18. F Clutch Valve (CV-F) - Dog
19. A Clutch Valve (CV-A) - Dog
20. E Clutch Valve (CV-E)
21. E Clutch Valve (CV-E) Spring (0.800" x 0.205" x 0.015")
22. B Clutch Valve (CV-B)
23. B Clutch Valve (CV-B) Spring (0.800" x 0.205" x 0.015")

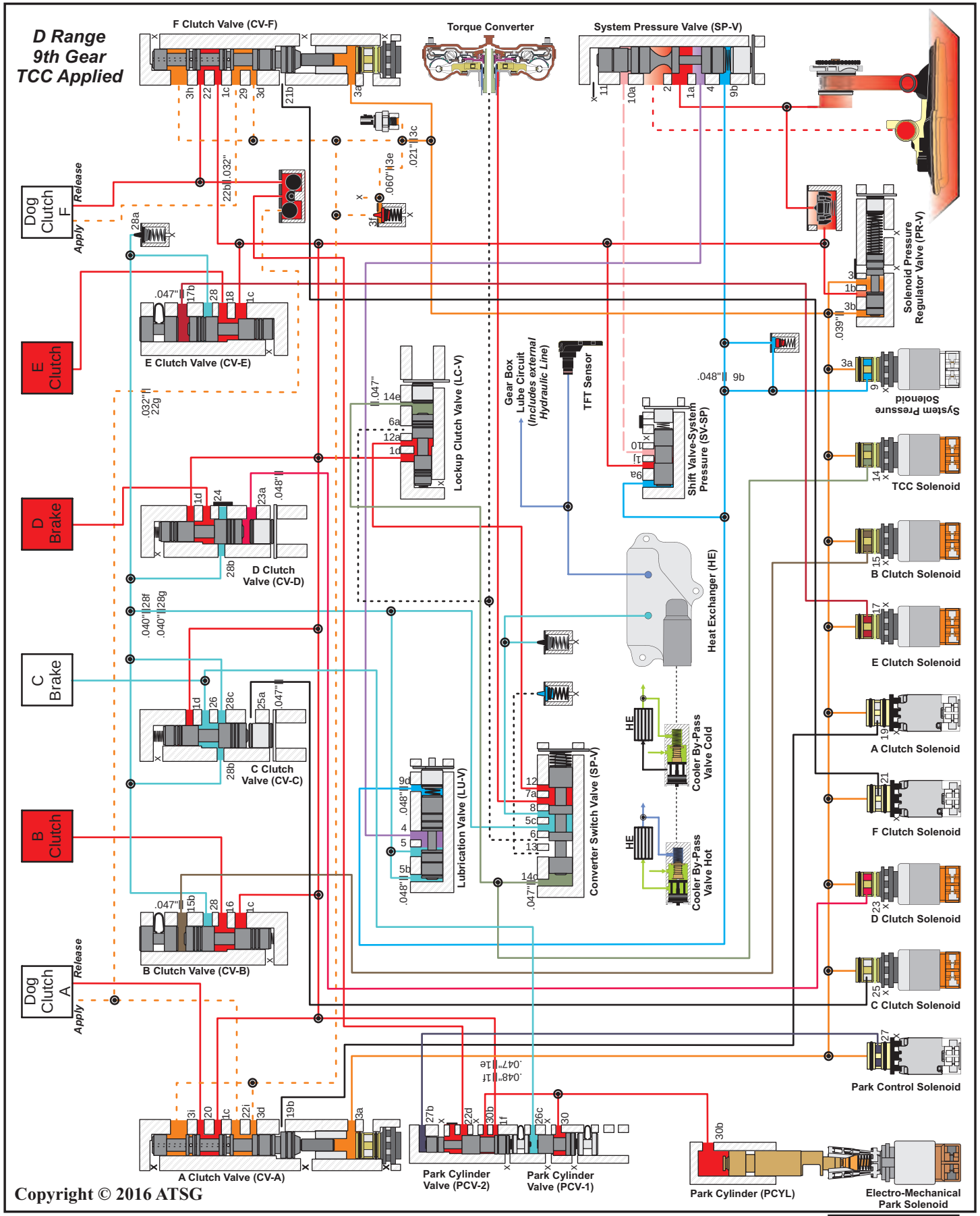
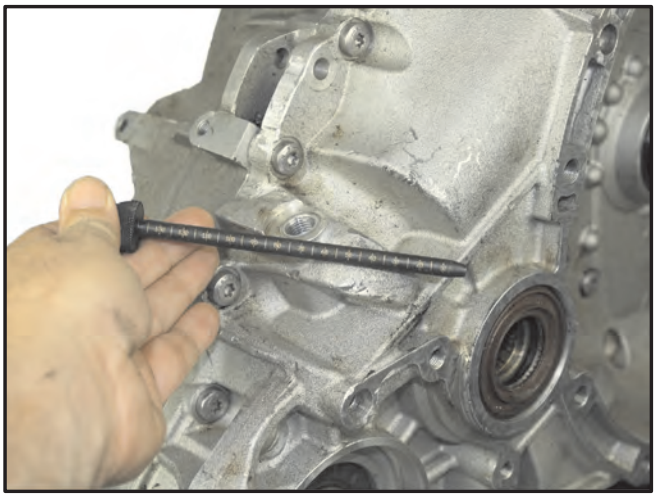
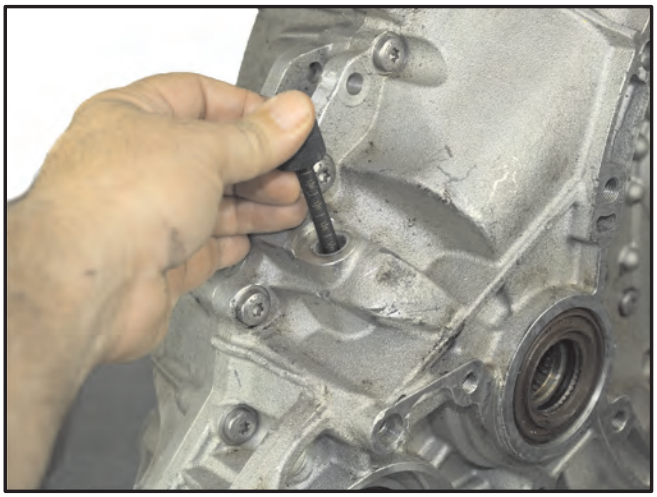


Figure 19

948TE FLUID SPECIFICATIONS





948TE Fluid Specifications

Use MOPAR ZF 8 & 9 Speed ATF part number: 68157995AB

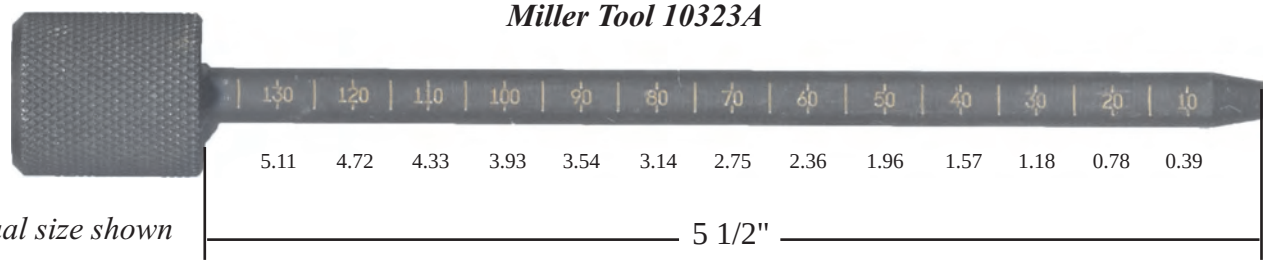
Fluid level can be checked using Miller tool dipstick part number: 10323A - approximate cost is $35.00

Use Fluid Level Table to determine the proper level according to temperature.

Dry fill: 6.5L

TEMP C° (F°)	MIN LEVEL (mm)	NOMINAL LEVEL (mm)	MAX LEVEL (mm)
50 C° (122 F°)	21 mm	26 mm	31.5 mm
55 C° (131 F°)	23 mm	27.5 mm	33 mm
60 C° (140 F°)	25 mm	30 mm	34 mm
65 C° (149 F°)	27 mm	31 mm	35.5 mm
70 C° (158 F°)	28.5 mm	33 mm	36.5 mm
75 C° (167 F°)	30 mm	35 mm	38 mm
80 C° (176 F°)	31.5 mm	36 mm	39 mm
85 C° (185 F°)	32.5 mm	37 mm	40 mm
90 C° (194 F°)	34 mm	38 mm	41.5 mm

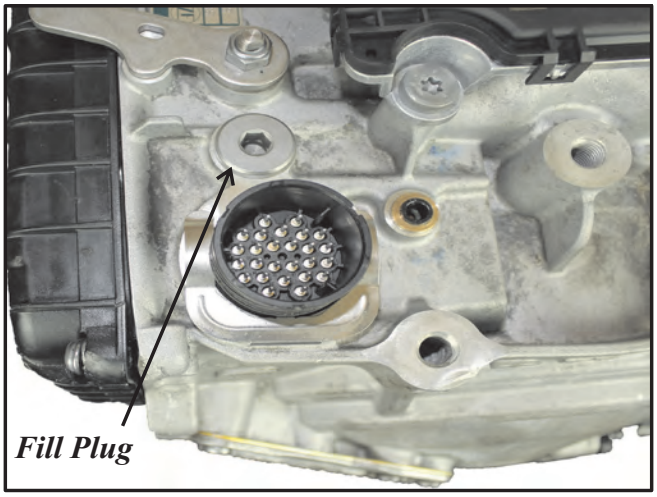
Miller Tool 10323A

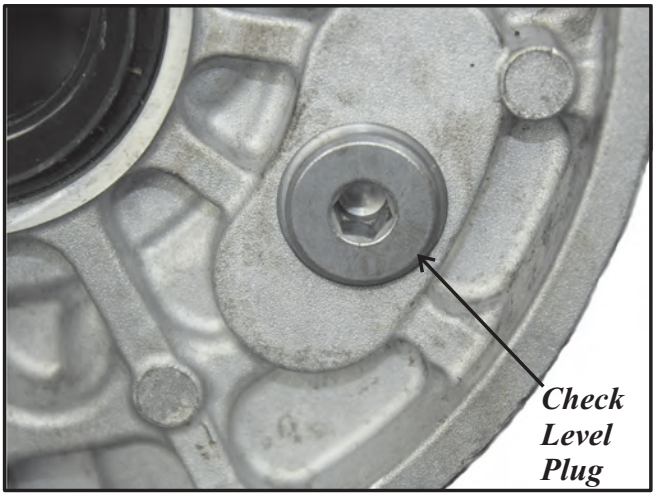


Actual size shown

Figure 20

ZF9HP48 FLUID SPECIFICATIONS





ZF9HP48 Fluid Specifications

Use Shell L12108 (ZF Lifeguard 8) Automatic Transmission Fluid. Dry fill: 6.5L

The transmission fluid must be checked only when temperatures are between 37°C (99°F) and 45°C (113°F) Make sure that all four wheels are off the ground for this step.

Move the transmission control switch (TCS) from D to S then using the steering paddles pause in each gear for a minimum 10 seconds until you reach 4th gear. (max 2000rpm)

Decelerate the wheels until they stop, then turn the (TCS) back into the P position.

Make sure that torque converter is full of oil by raising the engine speed to 2000rpm for 10 seconds, return to idle speed.

Engine must be running to carry out the fluid level check. When transmission fluid temperature reaches 37°C, remove the level plug and wait until oil stops dripping out.

If the transmission fluid does not come out of the transmission fluid level plug hole the transmission fluid level is insufficient. If this is the case add the transmission fluid in 0.5 litre units into the transmission fluid fill plug hole until fluid comes out.

Install plug and torque to: 35 Nm.

Both the 948TE and the ZF9HP48 have a drain plug located at the bottom of the case to be used for partial drains.

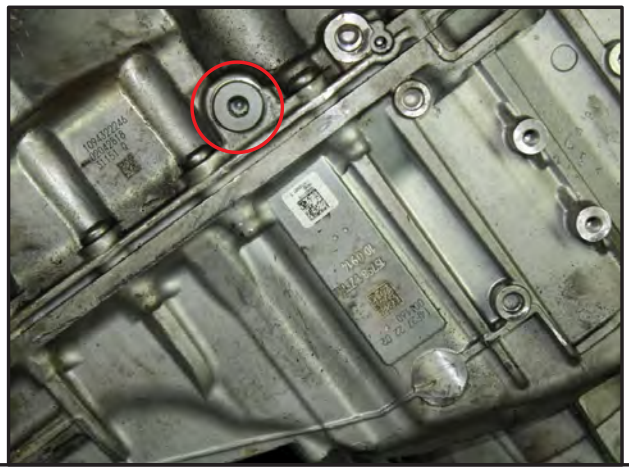


Figure 21

DOG CLUTCH "A" AND "F"

A unique feature to this 9 speed front wheel drive transmission is the use of dog clutches.

Both dog clutches are similar in their operation. Each clutch is operated by fluid pressure acting on a double action piston to move the dog clutch into and out of engagement.

Dog Clutch 'A' (figures 22 and 23) connects the input shaft to the number 2 sun gear which is also the number 1 ring gear (figure 24).

Dog clutch 'F' holds stationary the number 3 and 4 sun gears (which is one long sun gear working to carriers - figure 25) to the centering plate mounted in the transmission casing (figure 26).

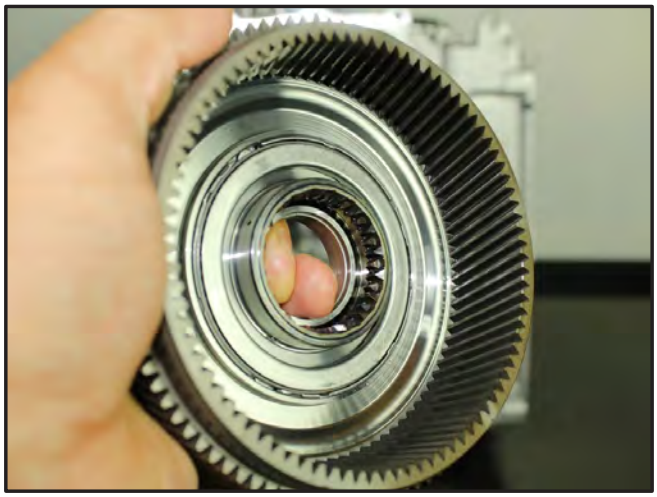


Figure 24

Figure 22

Figure 25

Figure 23

Figure 26

DOG CLUTCH "A" DETAILS"

As seen in figures 22 and 23, Dog clutch 'A' is located at the end of the input shaft and is controlled by a double acting piston located within the input shaft. This piston moves within the shaft when fluid pressure is applied to either side of the piston. The piston is connected to the dog 'A' by a pin which moves in a slot in the input shaft.

Dog 'A' itself is a sleeve with internal and external splines which is permanently engaged with the input shaft via the internal splines. When the piston moves dog 'A' along the input shaft to the 'closed' position, dog 'A' engages with splines on the gearset 1 and 2 planet carrier, transferring drive from the input shaft to the gear set 2. When the dog 'A' is to be disengaged to the 'open' position, fluid pressure is applied to the opposite side of the piston and dog 'A' is moved along the input shaft and is disengaged from the planet carrier. Dog 'A' is in the 'closed' position in gears 1 through 7.

The dog 'A' has two states; open and closed. The piston cannot determine if the dog 'A' has traveled its full distance into or out of engagement with the ring gear carrier or has remained in an intermediate position. The piston is fitted with a sensing piston and the fluid pressure leakage through the sensing piston can be measured by the pressure sensor (transducer) located on the valve body.

The sensing piston is hollow and moves axially within the piston. When fluid pressure is applied to the right side of the piston, the piston and the sensing piston are pushed to the left. During the movement of the piston, a small amount of fluid pressure is passed through the sensing piston. This leakage pressure is measured at the left side of the piston by the pressure sensor (transducer). When the piston has moved fully to the left and reached its end position, the leakage through the sensing piston is blocked. The pressure drop on the left side of the piston is sensed and the transmission control module can determine the dog clutch 'A' is fully disengaged with the ring gear carrier.

If the pressure on the left side of the piston does not drop within a specified shift time, the TCM (transmission control module) can determine that the dog 'A' has stopped in an intermediate position.

The dog clutch 'A' has four possible states of operation as follows:

A. Dog 'A' Open - Fluid pressure is applied to the piston from the left side chamber and the dog clutch 'A' is open. The fluid pressure in the right chamber is almost zero because the sensing piston is pushed to its limit of movement and leakage through the sensing piston is prevented.

B. Dog 'A' Closing - Fluid pressure is applied from the right side chamber which starts the piston moving to the left into engagement with the ring gear carrier. The piston is now in the intermediate position and leakage pressure is passed through the sensing piston into the left side chamber. Pressure in the left side chamber can be measured and will be approximately 2 bar (29 psi).

C. Dog 'A' Closed - Fluid pressure is applied to the piston from the right side chamber, the dog 'A' is closed and fully engaged with the ring gear carrier. The ATF (automatic transmission fluid) pressure in the left chamber is almost zero because the sensing piston is pushed to its limit of movement and leakage through the sensing piston is prevented.

D. Dog 'A' Opening - Fluid pressure is applied to the piston from the left side chamber which starts the piston moving to the right and disengaging from the ring gear carrier. The piston is now in the intermediate position and leakage pressure is passed through the sensing piston into the right side chamber. Pressure in the right side chamber can be measured and will be approximately 2 bar (29 psi).

Dog clutch 'F' is a sleeve with internal and external splines located between the multi-plate clutch 'E' and planetary gear set 4 (Figures 27 and 28). The external splines are engaged to the splines within the bearing support housing, which in turn is fixed stationary to the transmission casing. When dog 'F' is moved to the closed position (Figure 30), the internal splines engage sun gears 3 and 4 holding it stationary in planetary gear set 4 (Figure 31). When dog "F" is moved to the open position (Figure 29), the sun gear is released and freewheels.

The dog 'F' has two states; open and closed. Dog 'F' employs a more simple sensing system than dog 'A'. Dog 'F' is also the piston itself and does not use a sensing piston. The piston of dog 'F' has a leakage sensing hole which is used to detect its current position via pressure sensing.

When fluid pressure is applied to the right side of the piston, the piston is pushed to the left. During the movement of the piston, a small amount of fluid pressure is passed through the leakage sensing hole. This leakage pressure is measured at the left side of the piston by the pressure sensor in the sensor unit. When the piston has moved fully to the left and reached its end position, the leakage through the leakage sensing hole is blocked. The pressure drop on the left side of the piston is sensed and the transmission control module can determine that dog clutch 'F' is fully engaged with sun gears 3 and 4.

If the pressure on the left side of the piston does not drop within a specified shift time, the transmission control module can determine that the dog 'F' has stopped in an intermediate position.

The dog clutch 'F' has four possible states of operation as follows:

A. Dog 'F' Open - Fluid pressure is applied to the piston from the right side chamber and the dog clutch 'F' is open. The fluid pressure in the left chamber is almost zero because the piston is pushed to its limit of movement and leakage through the leakage sensing hole is prevented.

B. Dog 'F' Closing - Fluid pressure is applied from the left side chamber which starts the piston moving to the right into engagement with the sun gears 3 and 4. The piston is now in the intermediate position and leakage pressure is passed through the leakage sensing hole into the right side chamber. Pressure in the right side chamber can be measured and will be approximately 2 bar (29 psi).

C. Dog 'F' Closed - Fluid pressure is applied to the piston from the left side chamber, the dog 'F' is closed and fully engaged with the sun gears 3 and 4. The fluid pressure in the right chamber is almost zero because the piston is pushed to its limit of movement and leakage through the leakage sensing hole is prevented.

D. Dog 'F' Opening - Fluid pressure is applied to the piston from the right side chamber which starts the piston moving to the left and disengaging from the sun gears 3 and 4. The piston is now in the intermediate position and leakage pressure is passed through the leakage sensing hole into the left side chamber. Pressure in the left side chamber can be measured and will be approximately 2 bar (29 psi).

DOG CLUTCH "F"

The "F" dog sleeve is located inside the bearing support bolted to the case (Figure 27).

Figure 28 shows the bearing support removed from the case with the bearing removed to reveal the "F" dog sleeve.

Figure 29 shows the "F" dog in the disengaged position allowing the sun gear to freewheel.

Figure 30 shows the "F" dog clutch in the engaged position which will hold the sun gear stationary,

Figure 31 shows the sun gear (sun gears 3 and 4) inside planetary gear set 4.

Figure 29

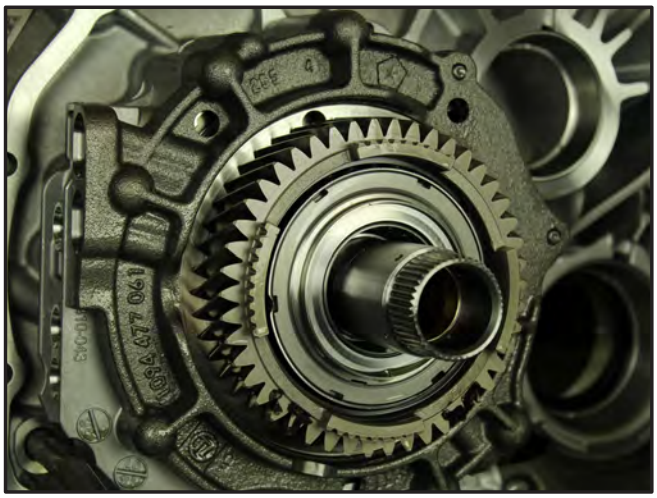


Figure 27

Figure 30

Figure 28

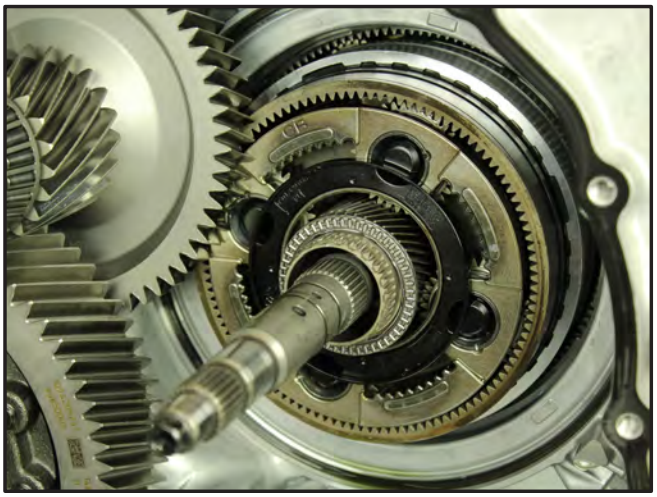


Figure 31