

1984-94 AUTOMATIC TRANSMISSIONS**ZF 4HP 22-EH & ZF 4HP 24-E Overhaul****APPLICATION****TRANSMISSION APPLICATION**

Application	Transmission Model
1984	
325e	ZF 4HP 22-EH/TY
528e	ZF 4HP 22-EH/UP
533i	ZF 4HP 22-EH/UE
633CSi	ZF 4HP 22-EH/UF
733i	ZF 4HP 22-EH/TT
1985-86	
325e	ZF 4HP 22-EH/TY
528e	ZF 4HP 22-EH/UP
533i	ZF 4HP 22-EH/UE
633CSi	ZF 4HP 22-EH/UF
735i	ZF 4HP 22-EH/TT
1987-89	
All Models	ZF 4HP 22-EH
1990	
All Except 7 Series	ZF 4HP 22-EH
7 Series	ZF 4HP 22-E9
1991	
325i, 325is	ZF 4HP 22-XX
325iC	ZF 4HP 22-AC
525i	ZF 4HP 22-HR
535i	ZF 4HP 22-HR
735i, 735iL	ZF 4HP 22-HS
1992	
325i, 325is	ZF 4HP 22-XX
325iC	ZF 4HP 22-AC
525i	ZF 4HP 22-HR
535i	ZF 4HP 22-HR
735i, 735iL	ZF 4HP 22-HS
1993	
535i	ZF 4HP 24-E9
750iL	ZF 4HP 24-E9
850Ci	ZF 4HP 24-E9
1993-94	

750iL	ZF 4HP 24-E9
850Ci	ZF 4HP 24-E9

IDENTIFICATION

Transmission identification plate is attached on driver's side of transmission case. Lower left series of numbers on identification plate indicate number of gears 4, type of controls "H" (Hydraulic), type of gears "P" (Planetary) and a torque capacity rating of 24. The "E" or "EH" as applicable at end of series of numbers indicates an electronic or Electronic-Hydraulic type transmission.

DESCRIPTION & OPERATION

Automatic transmission is electronically controlled and has 4 forward speeds and one reverse speed.

Transmission consists of clutches, brakes, one-way clutches and a lock-up torque converter. See **Fig. 1**.

Transmission shifting is controlled by operation of shift solenoids on the valve body. The Electronic Control Unit (ECU) or Transmission Control Unit (TCU) controls shift solenoid operation by information supplied by various inputs. Transmissions are equipped with various shift modes. See **SHIFT MODES**.

SHIFT MODES

1. Transmission is equipped with 2 different shift modes, Manual ("M") mode and Economy ("A") mode. Economy ("A") mode may be used to provide maximum fuel efficiency. When in Economy mode, torque converter lock-up will exist in 3rd and 4th gears.
2. Manual ("M") mode is for single gear driving. When in Manual mode, transmission will remain in the selected gear. For example, if shift lever is in "D" range, transmission will remain in 3rd gear. Manual or Economy mode may be selected by using shift mode switch, located near shift lever on console.

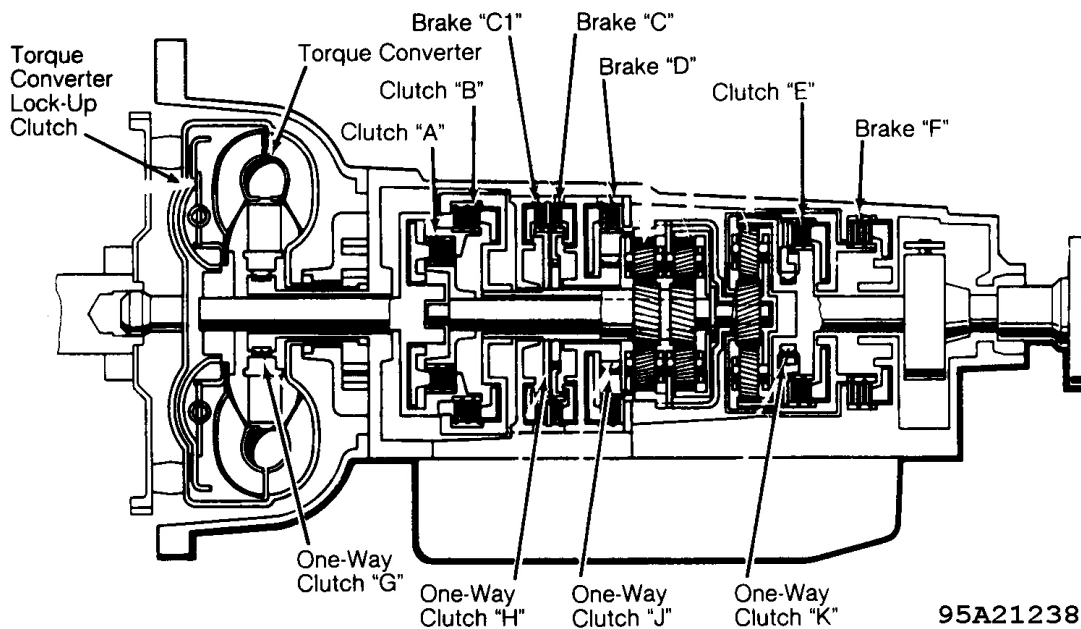


Fig. 1: Identifying Transmission Components
 Courtesy of BMW OF NORTH AMERICA, INC.

LUBRICATION & ADJUSTMENTS

See appropriate SERVICING article.

TROUBLE SHOOTING

PRELIMINARY INSPECTION

Transmission malfunctions may be caused by poor engine performance, improper adjustments, or failure of hydraulic or mechanical components. Always begin by checking fluid level, fluid condition, linkage and cable adjustments. Perform road test to determine if problem has been corrected. If problem still exists, several tests must be performed on transmission. See **TESTING**.

SHIFT LEVER IN POSITION "P"

Park Will Not Engage Or Does Not Hold

Selector linkage between selector lever and transmission improperly adjusted. Excessive friction in parking lock mechanism. Defective parking pawl mechanism.

Engine Cannot Be Started In "P"

Transmission switch faulty.

SHIFT LEVER IN POSITION "R"**No Reverse Gear**

Selector linkage between selector lever and transmission improperly adjusted. Oil filter screen dirty. Defective clutch "B" defective; also no 3rd gear. Brake "D" defective; also no engine braking in 1st gear. Defective clutch "E"; no engine braking in 2nd and 3rd gears and in 1st gear.

Slipping Or Shaking When Starting Off

Defective Clutch "B", "E" or brake "D".

Hard Engaging Jolt "P"-"R" Or "N"-"R" Or Definite Double Knock For "P"-"R" Or "N"-"R" Shift (Engine Speeds At 1500 RPM Or Less)

Damper "B" faulty and 2-3 shift is incorrect.

Back-Up Lights Do Not Come On (Electrical System Okay)

Transmission switch faulty.

SHIFT LEVER IN POSITION "N"**Car Moves Or Creeps**

Selector linkage between selector lever and transmission improperly adjusted. Defective clutch "A"

Engine Cannot Be Started In "N" Or "P"

Transmission switch faulty.

SHIFT LEVER IN POSITION "D"**No Forward Gear Engagement**

Oil filter screen dirty. Defective clutch "A". 1st gear one-way clutch slipping. Selector linkage between selector lever and transmission improperly adjusted. Main pressure valve seized.

Slipping Or Shaking When Moving Off

Defective clutch "A".

Hard Engaging Jolt "N"-"D" (Engine Speeds At 1500 RPM Or Less)

Defective clutch "A". Damper "A" faulty.

No 1-2 Or 2-1 Shift (Warm Or Cold)

Kickdown switch faulty (kickdown shifts). Transmission electronics faulty. Defective solenoid valve No. 1. Control valve 1-2 or 3-4 seized. Shift valve 1-2 seized. Defective brake "C1" and/or "C". Defective clutch "C" faulty.

No 2-3 Or 3-2 Shift (Warm Or Cold)

Defective solenoid valve No. 2. Defective solenoid valve 2-3 seized. Defective clutch "B".

No 3-4 Or 4-3 Shift (Warm Or Cold)

Defective solenoid valve No 1. Control valve 1-2 or 3-4 seized. Shift valve 3-4 seized.

No 3-4 Shift (Warm Or Cold)

Defective brake "F". Program switch faulty.

Car Starts Off In 2nd Gear

Transmission electronics faulty. Defective solenoid valve No. 1. Shift valve 1-2 seized.

Car Starts Off In 3rd Gear

Transmission electronics faulty. Defective solenoid valve No. 1 or 2. Shift valves 1-2 and 2-3 seized.

Car Shifts 1-3

Shift valve 2-3 seized. Transmission electronics faulty. Defective solenoid valve No. 2.

SHIFT POINTS**No Load Shift Incorrect**

Defective ECU or TCU.

Full Load Shift Points Incorrect

Full load signal missing. Improperly adjusted throttle cable. Defective ECU or TCU.

No Upshifts Or Downshifts

Defective speed sensor or wiring circuit.

No Kickdown Shift

Defective kickdown switch faulty. Improperly adjusted throttle cable.

1-2, 2-3 Or 3-4 Upshifts Too Long In "D"

Defective pressure regulator. Defective pressure regulator solenoid valve or wiring circuit. Defective damper, modulation valve, or pressure regulator/reducing valves No. 1 or 2.

SHIFT TRANSITIONS

No Load Shifts Too Hard

Defective ECU or TCU. Modulation pressure too high. Defective clutch plates.

Full Load & Kickdown Shifts Too Long

Defective ECU or TCU. Modulation pressure too low. Defective clutch plates.

Full Load & Kickdown Shifts Too Hard

Defective ECU or TCU. Incorrect modulation pressure. Defective damper.

No Transmission Shifts

Valve body failure. Transmission electronics faulty. Defective solenoid valves.

SHIFT LEVER IN POSITION "3"

No Engine Braking

Defective clutch "E".

SHIFT LEVER IN POSITION "2"

Manual Downshift 3-2 Malfunction

Sticking locking valve. Transmission electronics faulty. Defective solenoid valve No. 2.

No Engine Braking

Defective brake "C1" or clutch "E"

SHIFT LEVER IN POSITION "1"

Manual Downshift 2-1 Malfunction

Locking valve No. 1 sticks. Transmission electronics faulty. Defective solenoid valve No. 1 faulty.

No Engine Braking

Defective brake "D" or clutch "E".

TORQUE CONVERTER CLUTCH OPERATION

Torque Converter Engagement Not To Specification

Defective ECU or TCU.

Loud Noise When Torque Converter Lock-Up Clutch Applies-

Defective torque converter.

Torque Converter Lock-Up Clutch Stays Engaged & Engine Will Not Idle With Transmission In "D"

Defective solenoid valve No. 3. Defective ECU or TCU. Defective torque converter.

Torque Converter Lock-Up Clutch Engagement Too Hard

Defective torque converter.

No Torque Converter Lock-Up Clutch Engagement

Defective ECU or TCU. Defective torque converter or solenoid valve No. 3.

NOISE FROM TRANSMISSION**Loud Oil Pump Intake Noise**

Oil level too low. Valve body leaks.

Noisy & No Gear Engagement After Long Trip

Oil filter screen dirty.

TESTING**ROAD TEST**

1. Before performing road test, warm engine to normal operating temperature. Ensure fluid level is correct and in good condition. Ensure shift linkage and throttle cable are properly adjusted.
2. Road test vehicle and check for abnormal noise, vibration and clutch slippage. Specified clutch and brake are applied in designated gear. See appropriate CLUTCH & BRAKE APPLICATION table. Drive vehicle with shift lever in "D" position.
3. Ensure upshift and downshift speeds are correct in relation engine RPM. See **SHIFT SPEED SPECIFICATIONS** table.
4. Slipping or excessive engine speed during shifts usually indicates clutch or brake slipping problems. Unless an obvious condition exists, transmission should never be disassembled until hydraulic pressure tests have been performed.

CLUTCH & BRAKE APPLICATION ("H" SERIES)

Lever							
-------	--	--	--	--	--	--	--

1990 BMW 325i

1984-94 AUTOMATIC TRANSMISSIONS ZF 4HP 22-EH & ZF 4HP 24-E Overhaul

Position	C1	C2	C3	Brake Appl.	Free-Wheel	Engine Brake	Park Pawl
P	...	...	X	...	...	...	X
R	...	X	X	B3	...	...	...
N	...	...	X	...	...	...	...
D							
1st	X	...	X	...	X	...	...
2nd	X	...	X	B1, B2	X	X	...
3rd	X	X	X	B2	X	X	...
4th	X	X	...	B2, B4	...	X	...
3							
1st	X	X	...	...	X	...	...
2nd	X	...	X	B3	X	X	...
3rd	X	X	X	B3	X	X	...
2							
1st	X	...	X	...	X	...	...
2nd	X	...	X	B1, B2	X	X	...
1							
1st	X	...	X	B3	X	X	...

CLUTCH & BRAKE APPLICATION ("EH" SERIES)

Gear	Clutch	One-Way Clutch	Brake
1st ⁽¹⁾	A, E	⁽²⁾ G, J, K	D
2nd ⁽³⁾	A, E	⁽²⁾ G, H, K	C, C1
3rd ⁽⁴⁾	A, B, E	⁽²⁾ G, K	C
4th ⁽⁵⁾	A, B	⁽²⁾ G	C, F
Reverse ⁽⁶⁾	B, E	⁽²⁾ G	D

(1) Solenoid valve No. 1 and 2 are activated.

(2) One-way clutch "G" may be applied, depending on operating conditions.

(3) Solenoid valve No. 2 is activated.

(4) Torque converter lock-up may be applied, depending on operating conditions. Solenoid valves No. 1 and No. 2 are not activated.

(5) Torque converter lock-up clutch may be applied, depending on operating conditions. Solenoid valve No. 1 is activated.

(6) Solenoid valve No. 1 and 2 are activated.

SHIFT SPEED SPECIFICATIONS

Application ⁽¹⁾	Engine RPM
Light Throttle Upshift	
1-2	1900-2100

1990 BMW 325i

1984-94 AUTOMATIC TRANSMISSIONS ZF 4HP 22-EH & ZF 4HP 24-E Overhaul

2-3	2000-2100
3-4	2000-2200
CL Closed (4th Gear)	2200-2300
CL Open (4th Gear)	1700-1900
CL Closed (3rd Gear)	4100-4300
CL Open (3rd Gear)	3800-4000
Full Throttle Upshift	
1-2	5100-5600
2-3	4800-5100
3-4	(2) 4700-4900
Full Throttle Downshift	
4-3	(2) 2800-3000
3-2	2600-2800
2-1	2300-2500
Kickdown Upshift	
1-2	5400-5900
2-3	5600-5900
3-4	(2) 5900-6100
Kickdown Downshift	
4-3	(2) 4200-4300
3-2	3400-3600
2-1	N/A
Manual Downshift	
4-3	(2) 4200-4300
3-2	3200-3400
2-1	2200-2500
(1) With shift lever in "D" position and shift mode switch in Economy ("A") mode.	
(2) CL closed prior to shift.	

TORQUE CONVERTER STALL TEST

CAUTION: DO NOT perform torque converter stall speed test for more than 5 seconds or transmission may be damaged.

1. Apply parking brake. Block all wheels. Connect tachometer and start engine. Ensure A/C is off. Warm engine to normal operating temperature. Place shift lever in "D" position.
2. Fully depress brake pedal. Fully depress accelerator for 2-4 seconds and note maximum engine speed. This is the torque converter stall speed. Allow transmission to cool for 2 minutes before repeating torque converter stall speed test.
3. Ensure torque converter stall speed is within specification. See **TORQUE CONVERTER STALL**

SPEED SPECIFICATIONS table. If torque converter stall speed is not within specification, refer to **TORQUE CONVERTER CLUTCH OPERATION** under TROUBLE SHOOTING for possible causes.

TORQUE CONVERTER STALL SPEED SPECIFICATIONS

Application	Stall RPM
1984-90	
325e & 528e	1900-2050
524td	2280-2490
533i, 633CSi, 733i & 735i	
H Series	1970-2120
EH Series	1980-2120
1991-94	2100-2300

- If torque converter stall speed is less than specified, check for low engine output or defective torque converter one-way clutch. If torque converter stall speed is greater than specified, check for slipping clutch.

HYDRAULIC PRESSURE TEST

- Pump pressure and torque converter pressure may be checked. Remove pressure tap plugs from pump pressure tap and torque converter pressure tap on transmission case. See **Fig. 2** . Connect pressure gauge to pump pressure tap and torque converter pressure tap.
- Start engine. Check hydraulic pressures in relation to shift lever position, gear and engine RPM. See **HYDRAULIC PRESSURE TEST SPECIFICATIONS** table. Ensure pressures are within specification. See **HYDRAULIC PRESSURE TEST SPECIFICATIONS** table.
- Shut engine off. Remove pressure gauge. Reinstall plugs in pressure taps.

HYDRAULIC PRESSURE TEST SPECIFICATIONS

Pressure & Test Conditions	Pressure: psi (kPa)
Pump Pressure	
"D" Position	
1st Gear @ 700-1000	85-107 (586-738)
2nd 3rd & 4th Gear @ 4000	65-82 (448-565)
"R" Position @ 700-1000 RPM	157-185 (1082-1275)
Torque Converter Pressure	
"D" Position In 4th Gear	10 (69) Max.

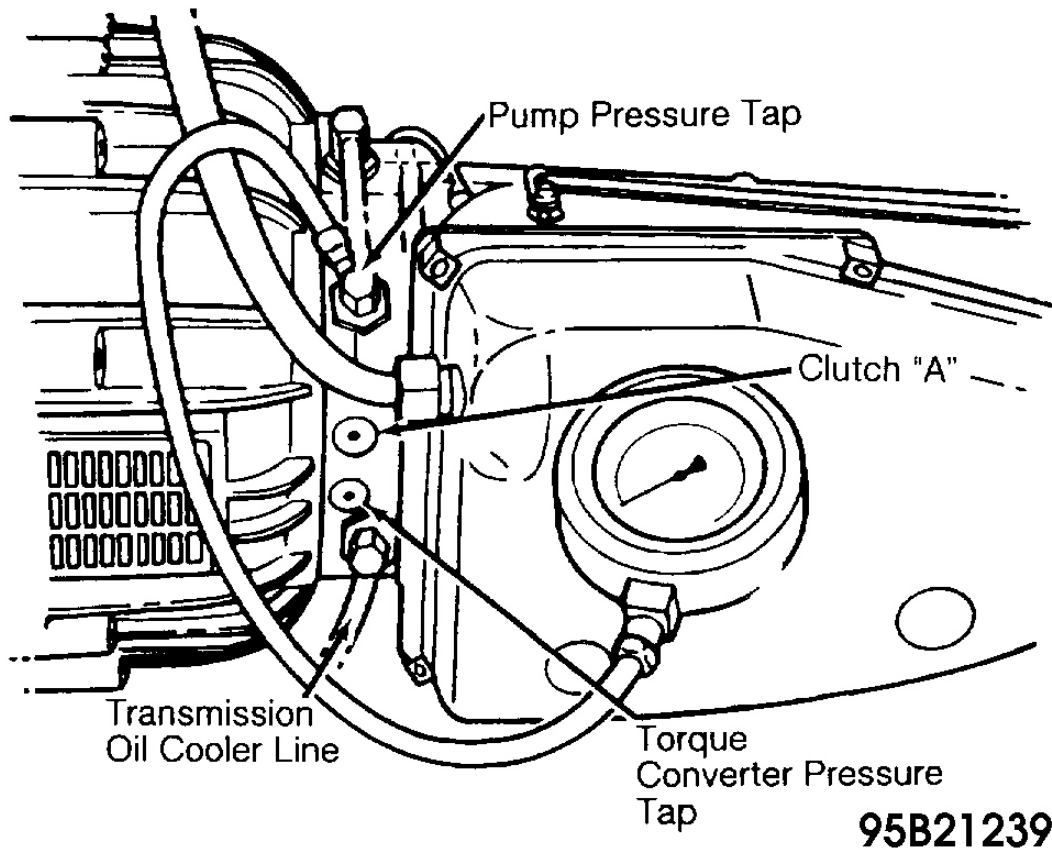


Fig. 2: Identifying Pressure Tap Locations
 Courtesy of BMW OF NORTH AMERICA, INC.

ELECTRONIC TESTING

CAUTION: DO NOT disconnect Electronic Control Unit (ECU) with ignition on.

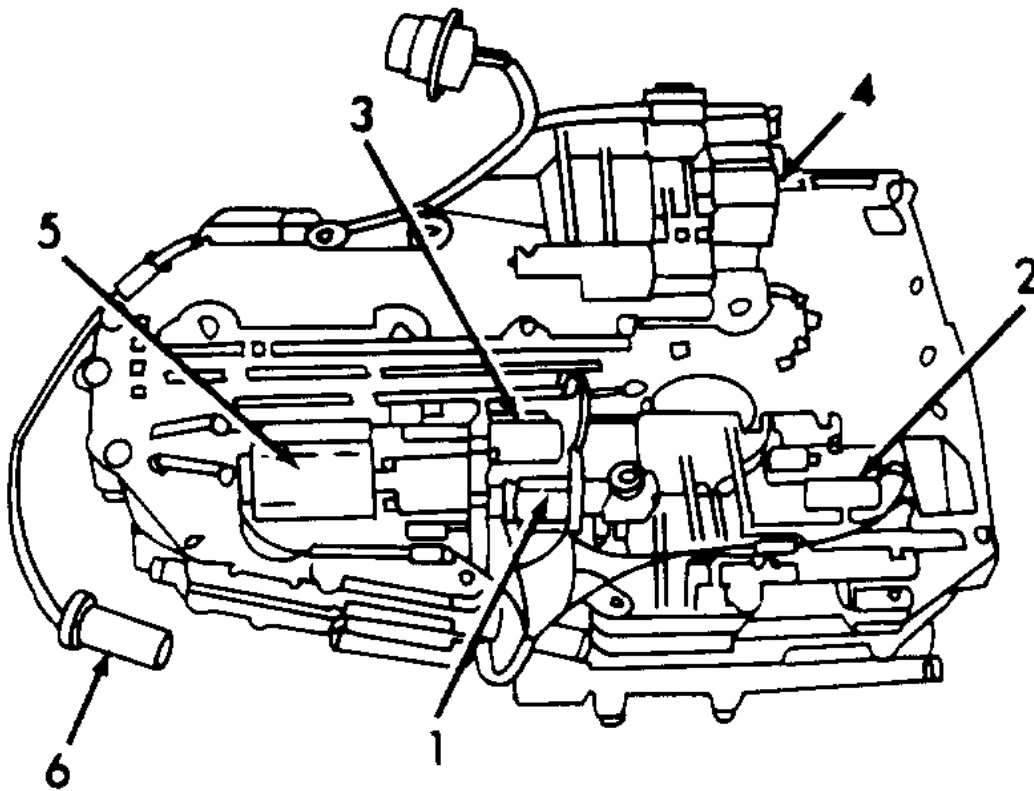
Electronic Control Unit (ECU) is located behind passenger's side kick panel. Connect Adapter (HWB81129425091) in conjunction with Connecting Lead (HWB81129425092) for electronic testing. Use only Bosch (AEGS) service tester to perform following tests.

Test No. 1 (Warning Light)

1. If warning light on instrument panel does not come on when ignition is turned on, check voltage between wires 5/19 and 33 with ignition on. Voltage should be at least 10 volts minimum. Check warning light bulb. Check for open circuit in wiring from instrument panel to warning light. Repair or replace components as necessary. If no defect is found, replace printed circuit board for shift mode indicator.
2. If warning light does not flash and remains on after engine is started, check for open circuit in ground

wire 5/19. Check voltage between wires 5/19 and 24 with ignition on. Voltage should be at least 5 volts. If voltage is not as specified, repair defective wiring. If voltage is correct, replace transmission ECU.

3. If warning light comes on while driving vehicle, check voltage between wires 5/19 and 35. Voltage should be at least 10 volts. If voltage is not as specified, repair wiring. If voltage is as specified, check wiring to valve body shift solenoid valves and go to Test No. 2. Different solenoids are mounted on the valve body. See **Fig. 3**.
4. If no TD signal is produced, check wiring connections and power supply to ECU. If there is no TI signal, check wiring connections and power supply to ECU and go to Test No. 2.



1. 1st/2nd & 3rd/4th Gear (Gray/Violet) Solenoid
2. 2nd/3rd Gear (Green/Violet) Solenoid
3. Converter Lock-Up Clutch (Red/Violet) Solenoid
4. Reverse Gear Lock (Orange/Violet) Solenoid
5. Pressure Regulator (Blue/Violet)
6. Pulse Sender (Brown/Brown)

93I25336

Fig. 3: Identifying Valve Body Solenoid Valves
 Courtesy of BMW OF NORTH AMERICA, INC.

Test No. 2 (Solenoid Valves)

1. For 1st-2nd and 3rd-4th solenoid valves, check resistance between wires No. 1 and 16. Resistance should be 25-46 ohms. If resistance exceeds specification, check wire to solenoid valve for damage or ground. If resistance is okay specification, replace solenoid valve.
2. For 2nd-3rd gear solenoid valves, check resistance between wires No. 1 and 25. Resistance should be 25-46 ohms. If resistance exceeds specification, check wire to solenoid valve for damage or ground. If resistance is okay, replace solenoid valve.

NOTE: Specified resistance values for solenoid valves and pressure regulator should be measured with transmission fluid temperature greater than 68°F (20°C).

3. For reverse gear lock solenoid valve, disconnect ECU electrical connector. Check resistance between wires No. 1 and 20. Resistance should be 25-46 ohms. If resistance exceeds specification, check wire to solenoid valve for damage or ground. If resistance is okay, replace solenoid valve.
4. For torque converter lock-up clutch solenoid valve, check resistance between wires No. 5/19 and 1/25. Resistance should be 25-46 ohms. If resistance is high, check wire to solenoid valve for damage or ground. If resistance is okay, replace solenoid valve.

Test No. 3

For pressure regulator solenoid valve, check resistance between wires No. 1 and 22. Resistance should be 1.8-4.6 ohms. If resistance exceeds specification, check wire to pressure regulator for damage or ground. If resistance is okay, replace pressure regulator solenoid valve.

Test No. 4 (Mode Position Switch)

1. Switch mode switch to S2. A magnetic switch will return program switch to position "E" for each testing procedure. Check resistance between wires No. 6 and 14. Resistance value should be infinity for switch positions "S", "3", "2" and "1". There should be zero ohms resistance for switch position "E". If values are not as specified, check for damaged wiring. If wiring is okay, replace switch.
2. Measure voltage between Black and Brown wires while starting vehicle. Voltage should be at least 8 volts. If voltage is not within specification, check for damaged wiring. Repair wiring as necessary.

Test No. 5 (Kickdown Switch)

1. With accelerator pedal in idle position, check resistance between wires No. 19 and 2. Resistance should be infinite. With accelerator pedal at full throttle, resistance should be zero.
2. If resistance is as specified, check for damaged wiring to kickdown switch. If wiring is okay, replace kickdown switch.

Test No. 6 (Mode Position Switch)

With ignition on, place shift mode position switch to S1. Measure voltage between following wires:

- Wires No. 19 and 18 (mode switch in position "1")

- Wires No. 19 and 28 (mode switch to position "2")
- Wires No. 19 and 29 (mode switch to position "3")
- Wires No. 19 and 30 (mode switch to position "D")
- Wires No. 19 and 4 (mode switch to position "D")

Voltage should be at least 10 volts on all circuits. If voltage is less than specified, check for damage wiring or short circuit. Check for defective mode position switch. Display unit is defective if battery voltage is too low. Repair or replace components as necessary.

Test No. 7 (Pulse Transmitter)

Check resistance between wires No. 8 and 27. Resistance should be 800-1600 ohms. If resistance is not within specification, check wire to pulse transmitter for damage or short. Repair wiring as necessary. If resistance is okay, replace pulse transmitter.

Test No. 8 (Dynamic Scope Test)

Connect test lead between wires No. 8 and 27. Lift vehicle on hoist. Rear wheels should turn easily. Start engine. Select position "D" on selector lever. Accelerate engine to about 25 MPH. All sine curves on scope pattern should be larger than 0-10. If not, check wire to pulse transmitter. If nominal value is okay, replace pulse transmitter.

REMOVAL & INSTALLATION

TRANSMISSION

See appropriate REMOVAL & INSTALLATION article.

TORQUE CONVERTER

Torque converter consists of pump, turbine and stator assembled as a unit. Torque converter cannot be serviced and must be replaced if defective.

NOTE: For torque converter stall speed test, refer to the **TORQUE CONVERTER STALL TEST** under TESTING.

TRANSMISSION DISASSEMBLY

VALVE BODY & INTERNAL COMPONENTS

1. Remove torque converter. Remove bolts, oil pan and gasket. Disconnect electrical connectors at solenoid valves on valve body. Remove bolts and valve body.
2. Remove retaining clips from oil supply bores in transmission case and remove compression springs. Remove 2 retaining clips and 2 compression springs from cylinder "F" at output shaft end of transmission. Using puller threaded into sealing sleeves, remove sealing sleeves from oil bores. Remove 2

sealing sleeves at cylinder "F" output shaft side.

NOTE: To improve lubricating oil supply to cylinder "F" gear set, retaining clip, compression spring and sealing sleeve must be removed from bore. Sealing sleeve must be removed from bore using a M6 x 65 bolt. See Fig. 4.

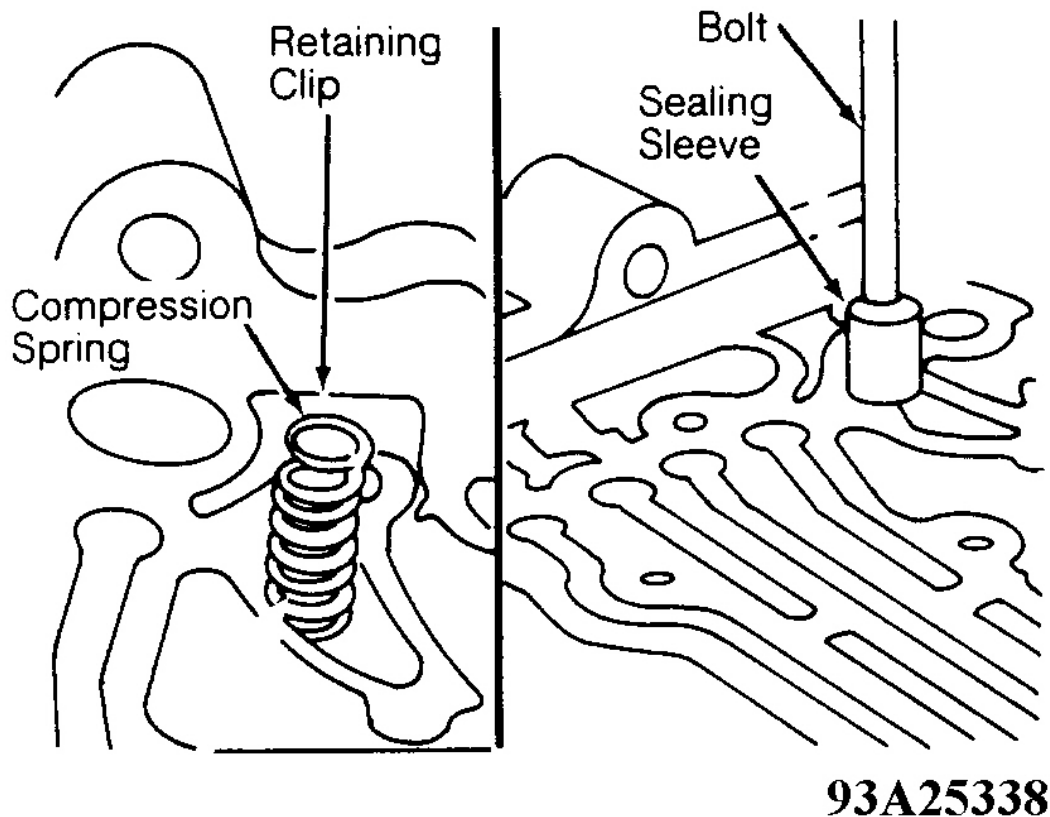


Fig. 4: Removing Sealing Sleeve

Courtesy of BMW OF NORTH AMERICA, INC.

3. Hold output flange. Remove collar nut and output flange. Remove bolts, extension housing and gasket. Remove parking lock gear from output shaft. See Fig. 5. Remove parking pawl, spring and shaft.
4. Place Sleeve (241010) on output shaft and secure with lock nut. Remove 4th gear clutch set-to-transmission case Torx bolts from rear of transmission case.

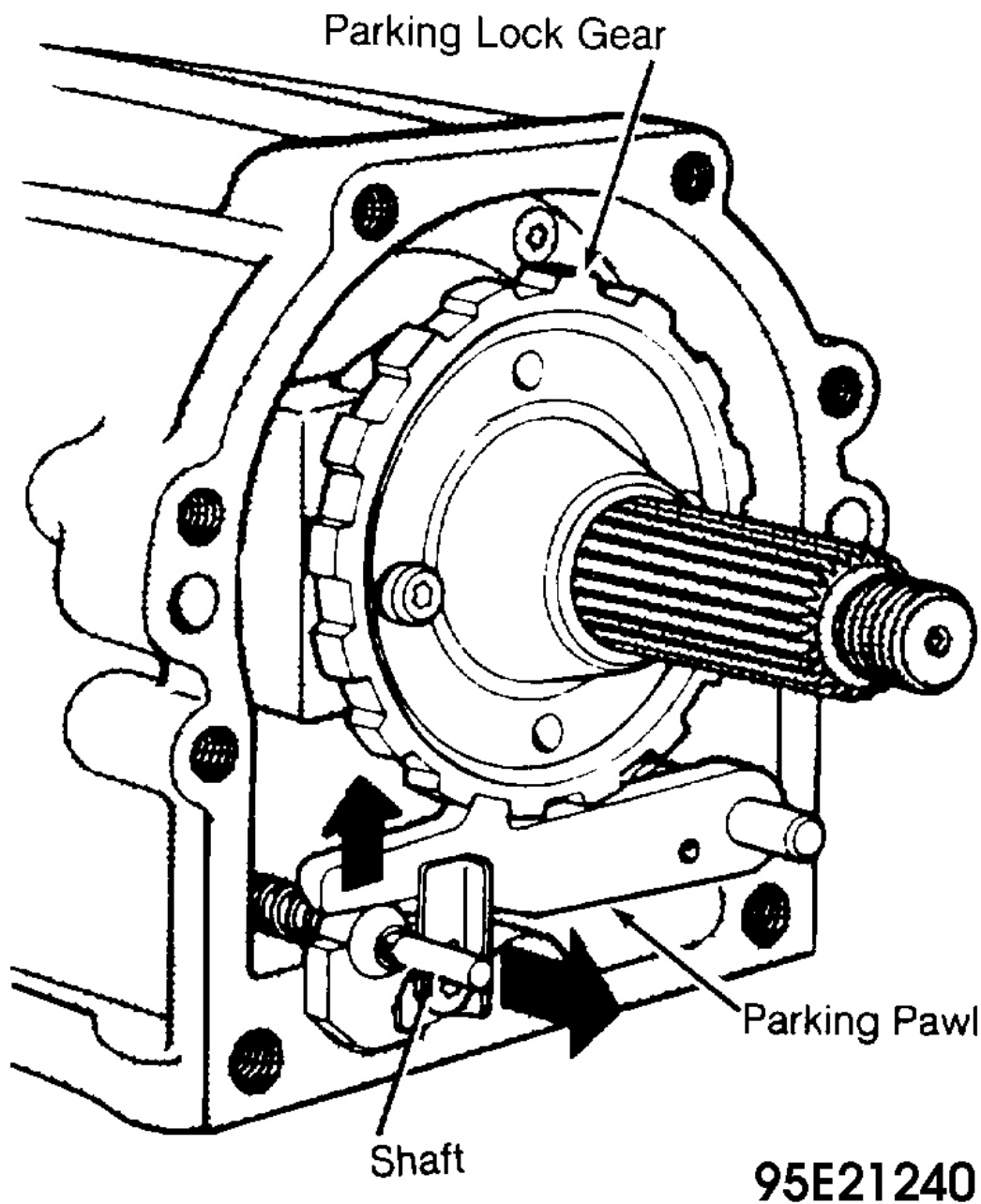


Fig. 5: Identifying Parking Lock Gear, Parking Pawl & Components
Courtesy of BMW OF NORTH AMERICA, INC.

5. Position transmission with oil pump facing upward. Remove bolts and torque converter bellhousing and transfer plate. Remove angled washer, axial bearing and thrust washer from input shaft. Remove input shaft and clutch "A". See **Fig. 6**.

6. Remove clutch "A" carrier plate, angled thrust, thrust bearing and metal thrust washer. Remove clutch "B" retaining snap ring. Using 2 lifting hooks, remove clutch "B" and support ring and seal. See **Fig. 6** .
7. Remove large snap ring from inside of transmission case. Place Protector (24 0 040) on intermediate shaft and lift planetary gear set with intermediate shaft from transmission case. See **Fig. 7** .
8. Remove angled washer, axial bearing, thrust washer and 4th gear clutch set as a complete unit. See **Fig. 8** .

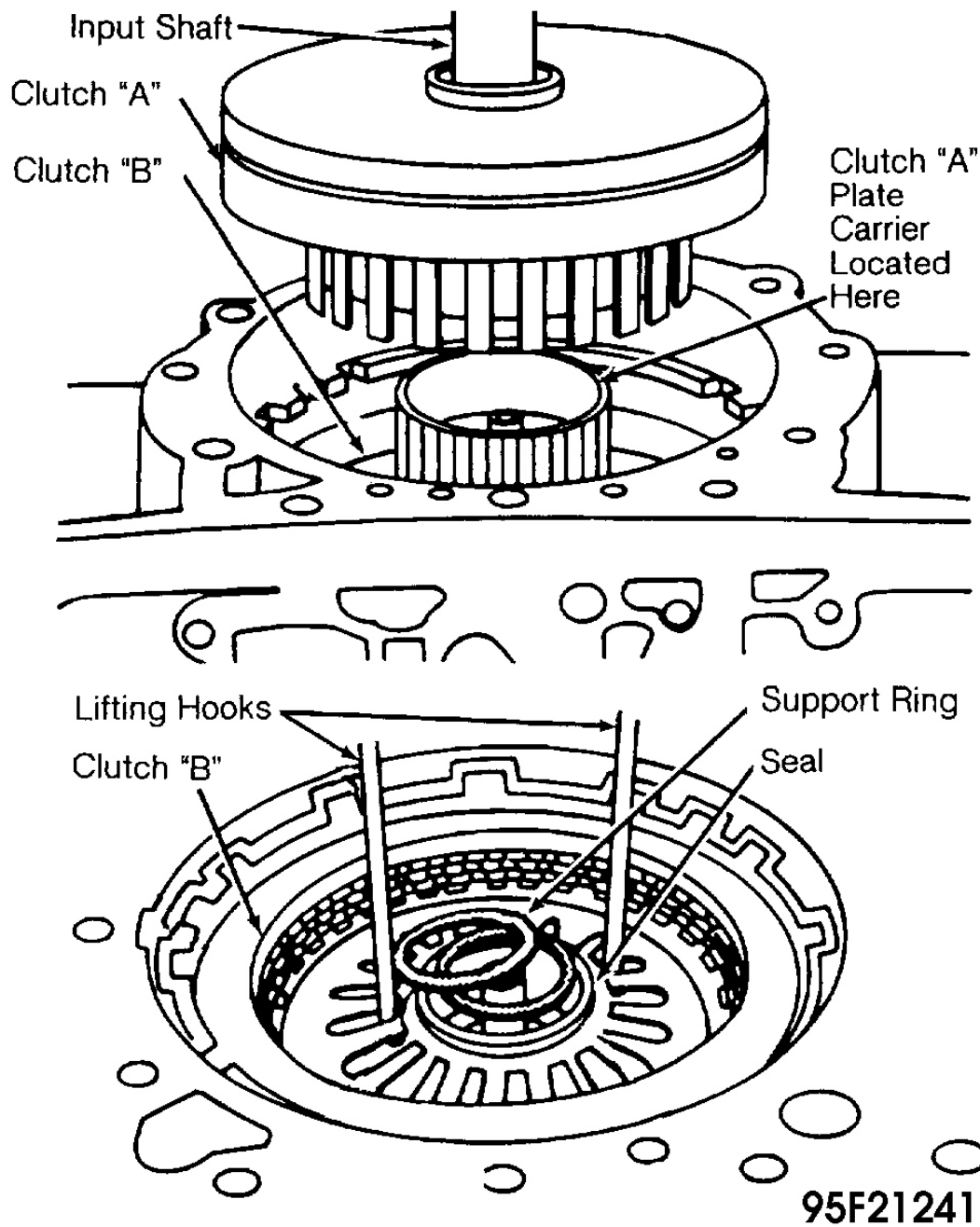


Fig. 6: Removing & Installing Clutches "A" & "B"
 Courtesy of BMW OF NORTH AMERICA, INC.

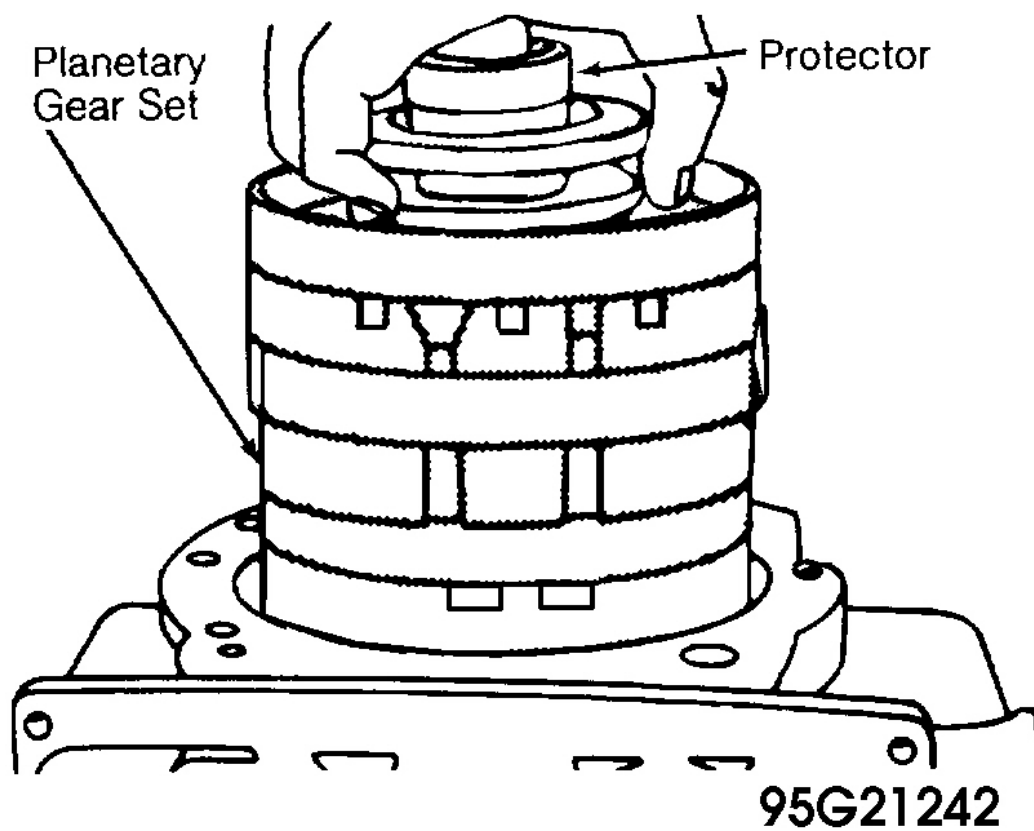


Fig. 7: Removing & Installing Planetary Gear Set
Courtesy of BMW OF NORTH AMERICA, INC.

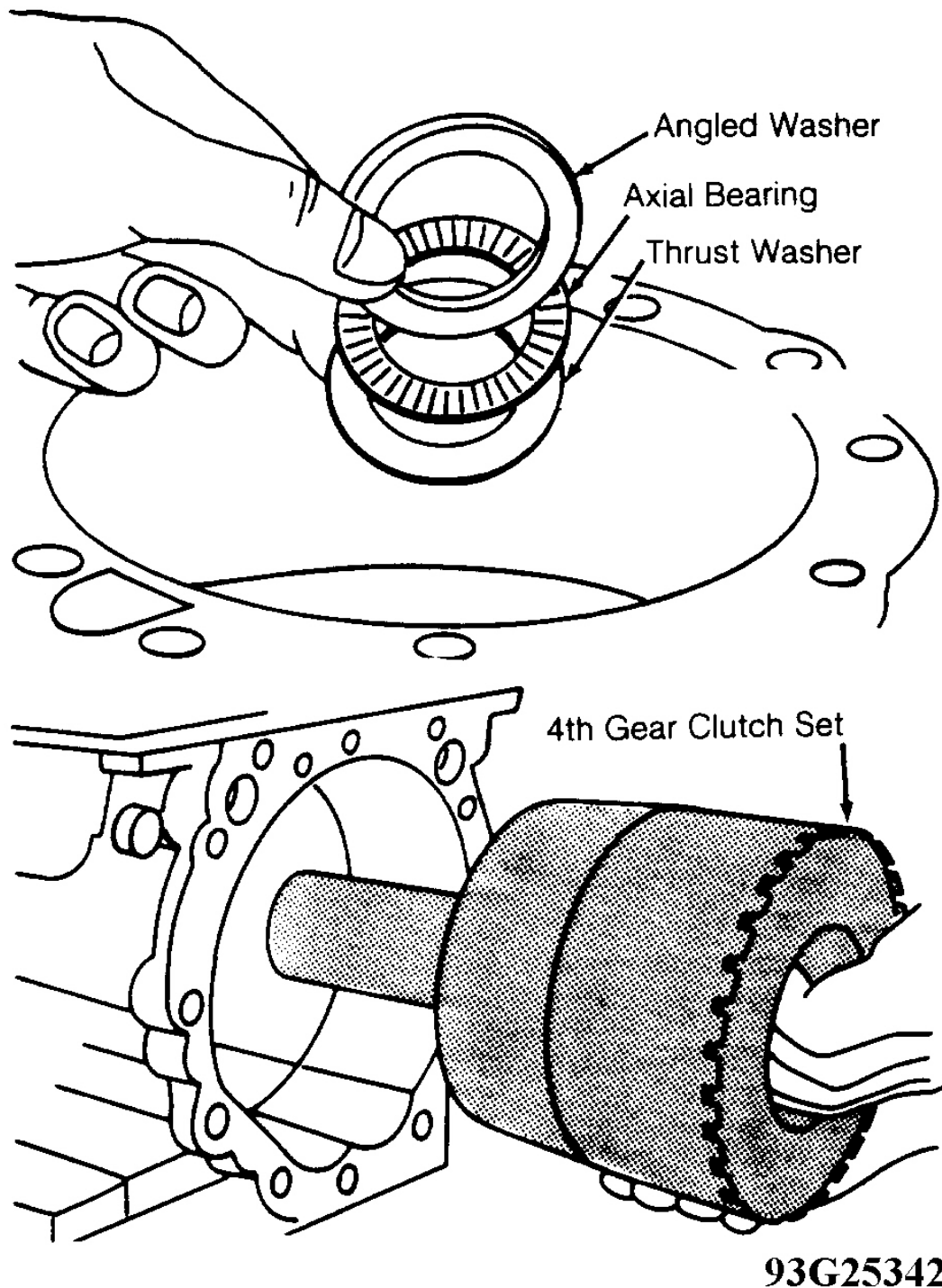


Fig. 8: Removing Angled Washer, Axial Bearing, Thrust Washer & 4th Gear Clutch Set
Courtesy of BMW OF NORTH AMERICA, INC.

COMPONENT DISASSEMBLY & REASSEMBLY

PRIMARY (OIL) PUMP

Disassembly

Alternately loosen primary pump bolts from torque converter housing. Separate primary pump from torque converter housing by lightly tapping bolts. Remove bolts and primary pump.

Inspection

1. Clean all parts and check for signs of damage or scoring. Check clearance between pump driven gear and pump body. Pump driven gear-to-pump body clearance should be .003-.006" (.07-.15 mm).
2. Check pump body-to-pump driven gear radial play while rotating pump driven gear 360 degrees. Pump body-to-pump driven gear radial play should be .0008-.0016" (.020-.040 mm). Check clearance of primary pump with Engaging Bushing (243140).
3. Using depth micrometer, measure gear axial clearance from surface of pump body to surface on pump gear on both pump drive and driven gears. Gear axial clearance should be .008-.016" (.20-.40 mm). If any component is defective or measurement is not within specification, replace oil pump assembly.

Reassembly

Install pump drive and driven gears with reference marks (punch marks) facing upward, toward top of pump body. Install NEW "O" ring on primary pump. Install primary pump in torque converter bellhousing. Ensure centering pin on primary pump engages with hole in torque converter bellhousing.

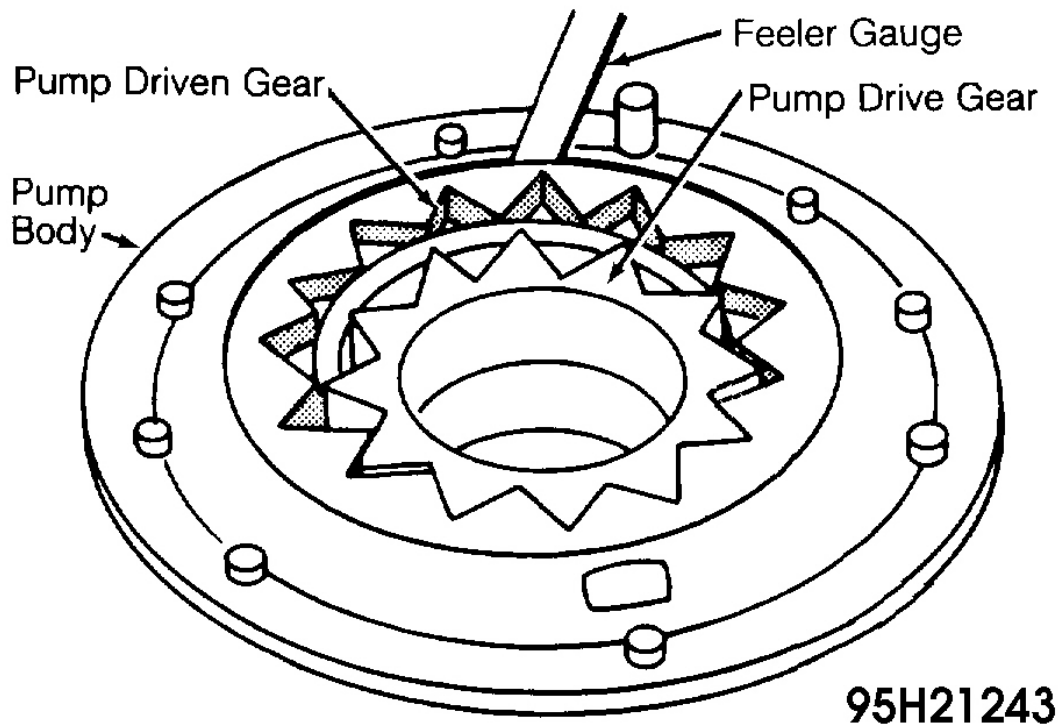


Fig. 9: Checking Pump Body-To-Pump Driven Gear Radial Play
 Courtesy of BMW OF NORTH AMERICA, INC.

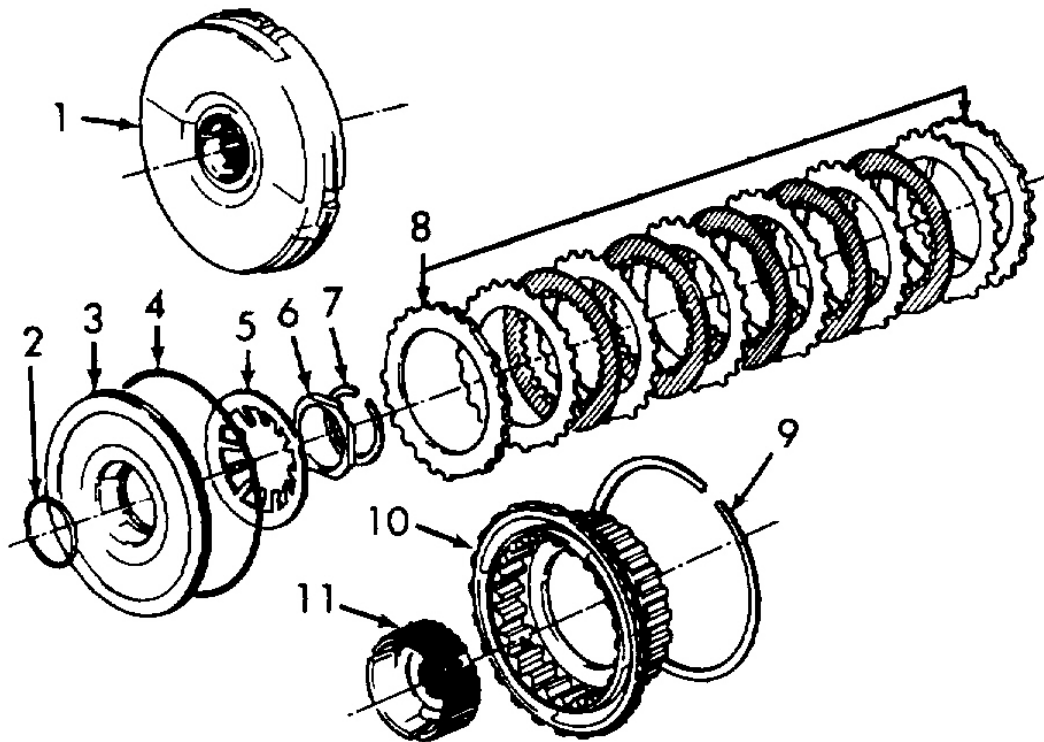
CLUTCH "A"

Disassembly

1. Press input shaft from clutch "A" assembly. Using press, slightly compress clutch plate carrier. remove snap ring that retains plate carrier. See **Fig. 10** . Release press.
2. Remove plate carrier, discs and plates from clutch drum. Note number and arrangement of plates and discs. Compress spring and remove snap ring and lock plate. Remove piston from clutch drum by applying compressed air to oil passage on inside of splined area on clutch drum. Remove "O" rings.

Reassembly

To reassemble, reverse disassembly procedure using NEW "O" rings. Coat all components with ATF. Ensure spring is installed in clutch drum with curved surface facing downward toward clutch drum. Ensure discs and plates are installed in correct sequence. See **Fig. 10** . Install input shaft. Install NEW "O" ring on end of input shaft.



- | | |
|----------------|-------------------|
| 1. Clutch Drum | |
| 2. "O" Ring | 7. Snap Ring |
| 3. Piston | 8. Discs & Plates |
| 4. "O" Ring | 9. Snap Ring |
| 5. Spring | 10. Plate Carrier |
| 6. Lock Plate | 11. Disc Carrier |

95121244

Fig. 10: Exploded View Of Clutch "A"

Courtesy of BMW OF NORTH AMERICA, INC.

CLUTCH "B"**Disassembly**

1. Remove snap ring, discs and plates from plate carrier. Note number and arrangement of discs and plates for reassembly reference. See **Fig. 11**.
2. Bend open tabs on lock plate. Using press and spring compressor, compress spring. Remove snap ring from center of plate carrier. Release press. Remove lock plate and spring.
3. Apply light air pressure on oil passage in splined area on plate carrier to remove piston from plate carrier. Remove "O" rings from piston.

Reassembly

1. To reassemble, reverse disassembly procedure using NEW "O" rings and NEW lock plate. Coat all components with ATF. Ensure tabs on lock plate are fully bent over. Ensure spring is installed with raised area facing upward, away from plate carrier.
2. Ensure original number of discs and plates are installed and in correct sequence. See **Fig. 11**

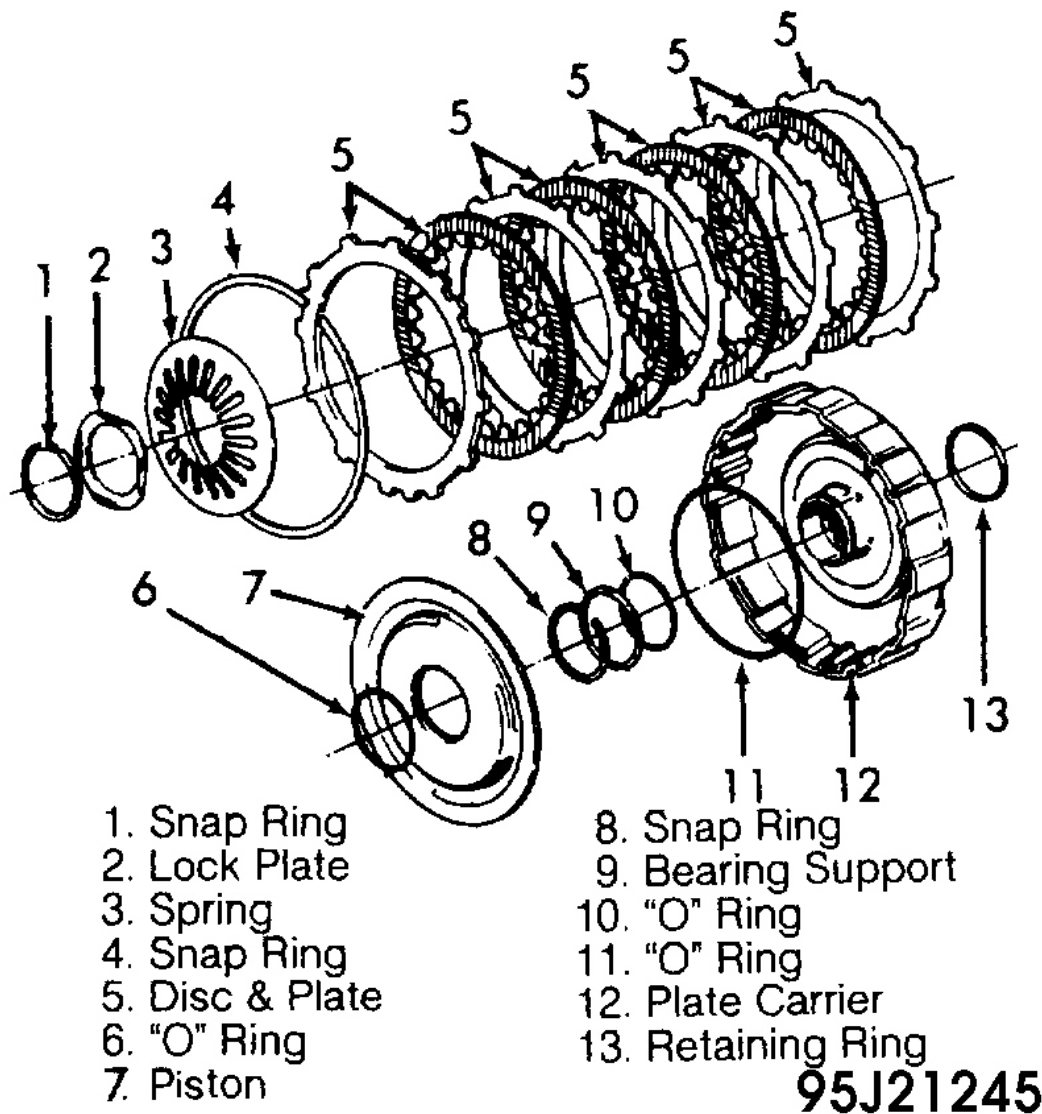


Fig. 11: Exploded View Of Clutch "B"

Courtesy of BMW OF NORTH AMERICA, INC.

CLUTCH "C" & "C1"

CAUTION: Note thickness of plates in each clutch for reassembly reference, as different thickness plates may be used.

Disassembly

1. Place clutch assembly onto a pipe with an outside diameter of 1.142" (29.00 mm) and clamp assembly in a vise. Remove centering plate. Remove discs and plates for clutch "C" from plate carrier, noting number and arrangement for reassembly reference. See **Fig. 12** .
2. Using press and spring compressor, compress spring. Remove snap ring from center of plate carrier. Apply air pressure to oil passage on plate carrier to remove piston.
3. Turn assembly over and remove discs and plates for clutch "C1" from plate carrier, noting number and arrangement for reassembly reference. Using press and spring compressor, compress spring on centering plate. Remove snap ring from center of centering plate.
4. Apply air pressure to oil passage on centering plate to remove piston from centering plate. Remove "O" rings.

Reassembly

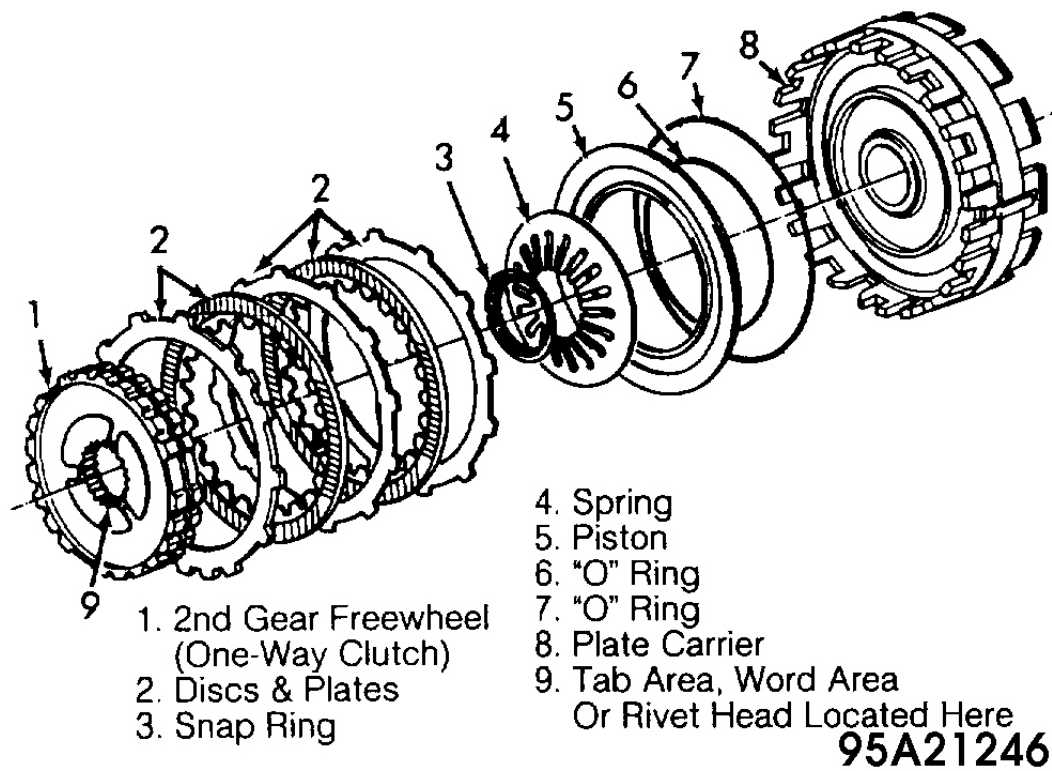
1. Coat all components with ATF. Install NEW "O" rings on pistons. Install piston for clutch "C" in plate carrier. Install spring on piston. Ensure raised area on spring is facing upward, away from plate carrier.

CAUTION: When installing one-way clutch, ensure tab area or word "oben" (top) or rivet heads are facing upward.

2. Compress spring and install snap ring. Install one-way clutch on plate carrier. Ensure tab area or word "oben" (top) or rivet heads are facing upward. See **Fig. 12** .

CAUTION: When installing discs and plates for clutch "C", ensure thinnest plate is installed against piston. Install original thickness plates and original number of discs and plates. Plates and discs must be installed in correct sequence. See Fig. 12 .

3. Install thinnest plate for clutch "C" on the piston. Install original number of discs and plates in correct sequence. See **Fig. 12** . Install piston in centering plate. Install spring on piston. Ensure raised area on spring is facing upward, away from centering plate.
4. Compress spring and install snap ring. Install original number of discs and plates for "C1" clutch in correct sequence on plate carrier. See **Fig. 12** . Install centering plate on plate carrier.

**Fig. 12: Exploded View Of Clutch "C"**

Courtesy of BMW OF NORTH AMERICA, INC.

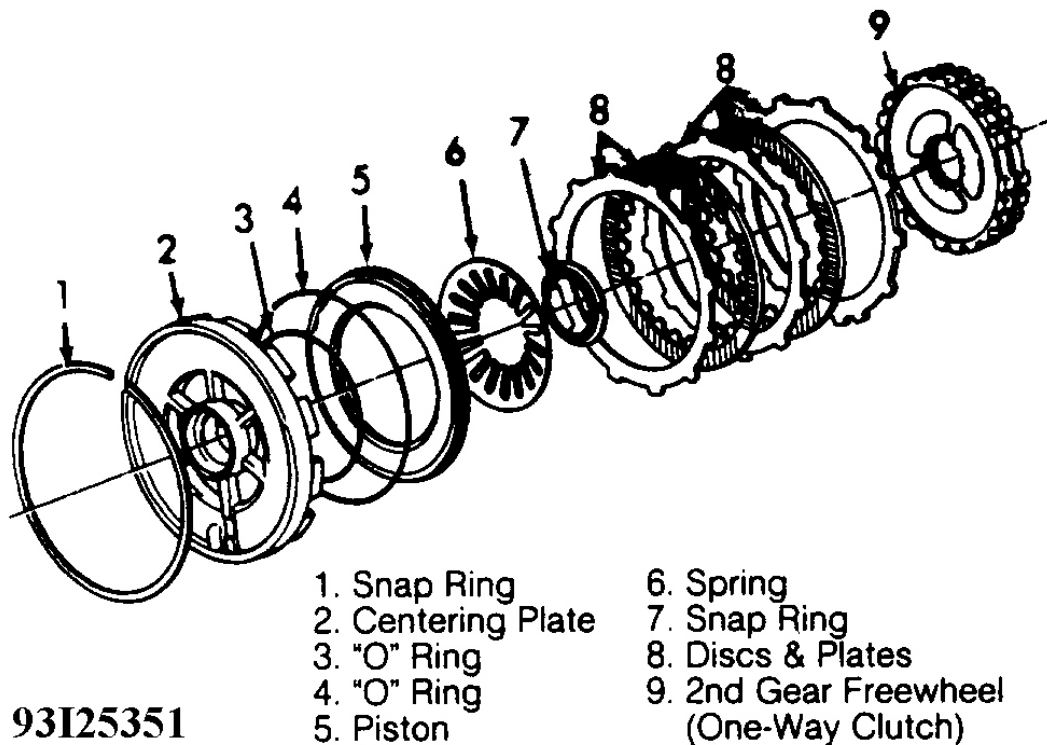


Fig. 13: Exploded View Of Clutch "C1"
 Courtesy of BMW OF NORTH AMERICA, INC.

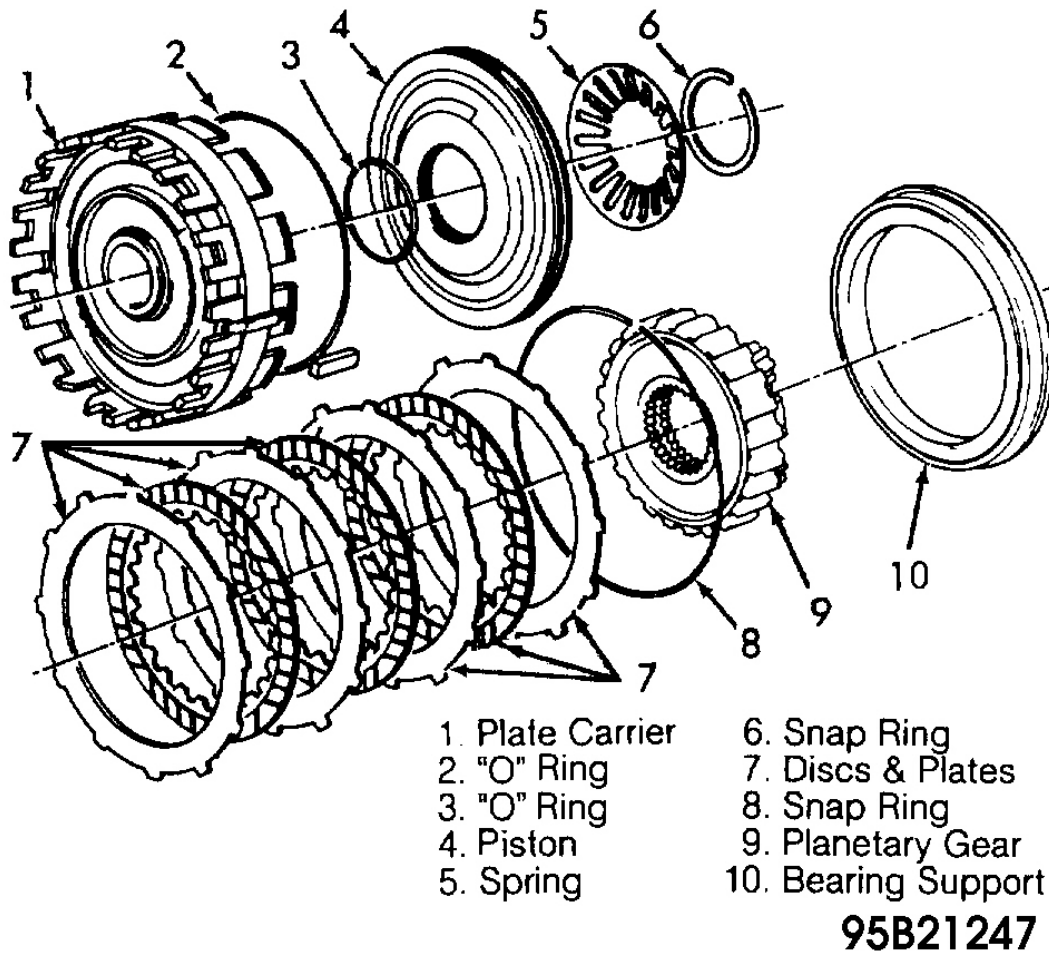
CLUTCH "D"

Disassembly

1. With clutch "C" and "C1" removed, lift clutch "D" from planetary gear set. Remove snap ring, discs and plates. See **Fig. 14** . Note number and arrangement of discs and plates for reassembly reference.
2. Using press and spring compressor, compress spring. Remove snap ring. Release press. Apply air pressure to oil passage on plate carrier to remove piston from plate carrier. Remove "O" rings.

Reassembly

1. To reassemble, reverse disassembly procedure using NEW "O" rings. Coat all components with ATF. Ensure spring is installed with raised area facing upward, away from plate carrier.
2. Ensure original number of discs and plates are installed and in correct sequence. See **Fig. 14**

**Fig. 14: Exploded View Of Clutch "D"**

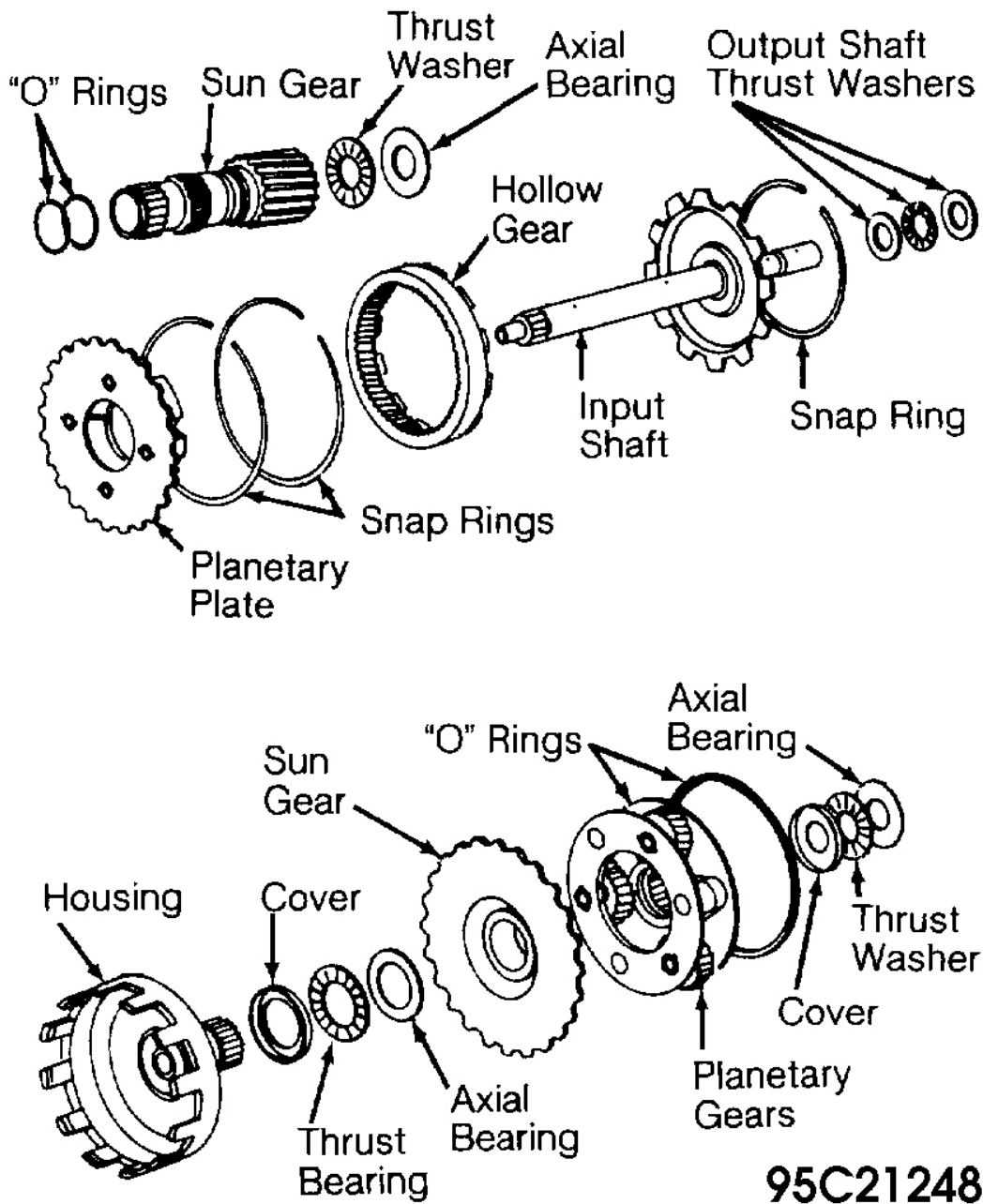
Courtesy of BMW OF NORTH AMERICA, INC.

FRONT PLANETARY GEAR SET**Disassembly**

1. Disassemble 1st planetary gear assembly. Remove support ring for 2nd planetary gear and remove 2nd planetary gear assembly.
2. Remove sun gear shaft. Remove axial bearing and thrust washer. Remove snap ring, hollow gear and planetary plate. See **Fig. 15** . Remove remaining components from housing.

Reassembly

To reassemble, reverse disassembly procedure.



95C21248

Fig. 15: Exploded View Of Front Planetary Gear Set & Components
 Courtesy of BMW OF NORTH AMERICA, INC.

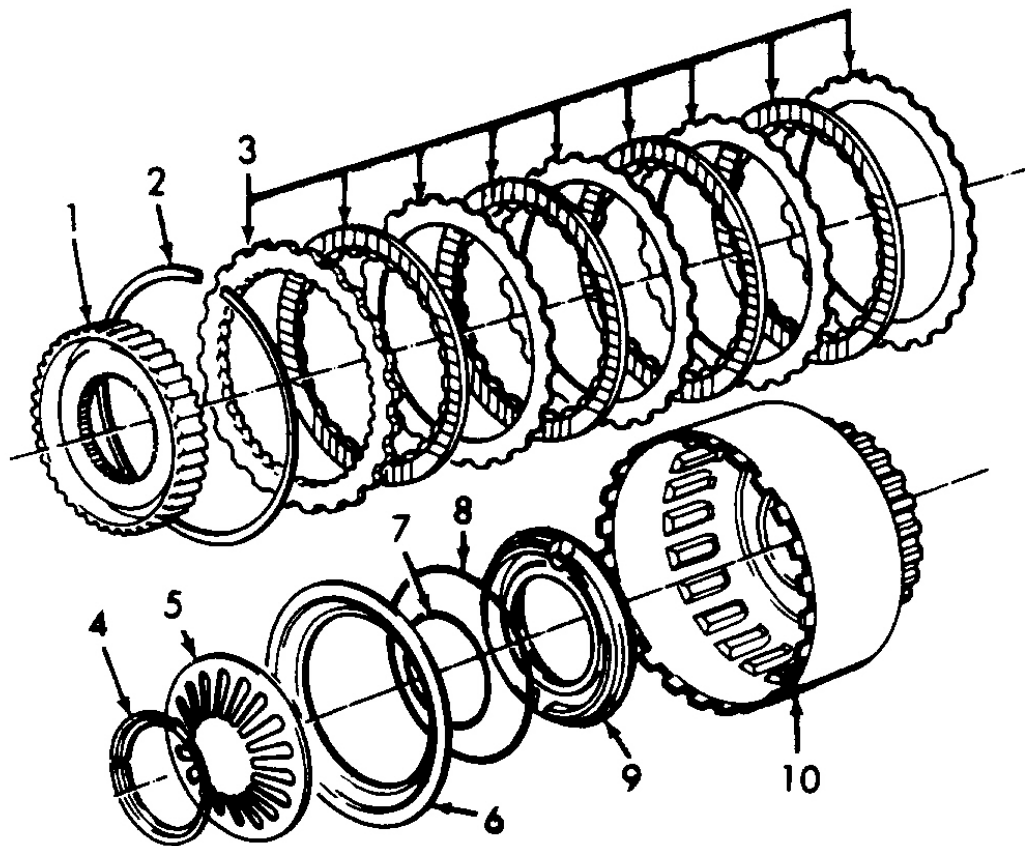
CLUTCH "E" & "F"

Disassembly

1. Remove sun gear and planetary carrier. Remove thrust washers and axial bearing. Remove disassembly sleeve and lift clutch "F" assembly off of clutch "E" assembly. Remove clutch "E" assembly from output shell.
2. Remove thrust washer, axial bearing and steel/copper angled washer, keeping components in order for reassembly. To disassemble appropriate clutch, remove snap ring, discs and plates from cylinder. See **Fig. 16** and **Fig. 17** . Note number and arrangement of discs and plates for reassembly reference.
3. Using press and spring compressor, compress spring. Remove snap ring. Release press. On clutch "E", remove spring, pressure plate and piston from cylinder. See **Fig. 16** . On clutch "F", remove spring and piston from cylinder. See **Fig. 17** . On all applications, remove "O" rings and seal rings.

Reassembly

1. To reassemble, reverse disassembly procedure using NEW "O" rings and seal rings. Coat all components with ATF. Ensure spring is installed with raised area facing upward, away from cylinder.
2. Ensure original number of discs and plates are installed and in correct sequence. See **Fig. 16** and **Fig. 17** .



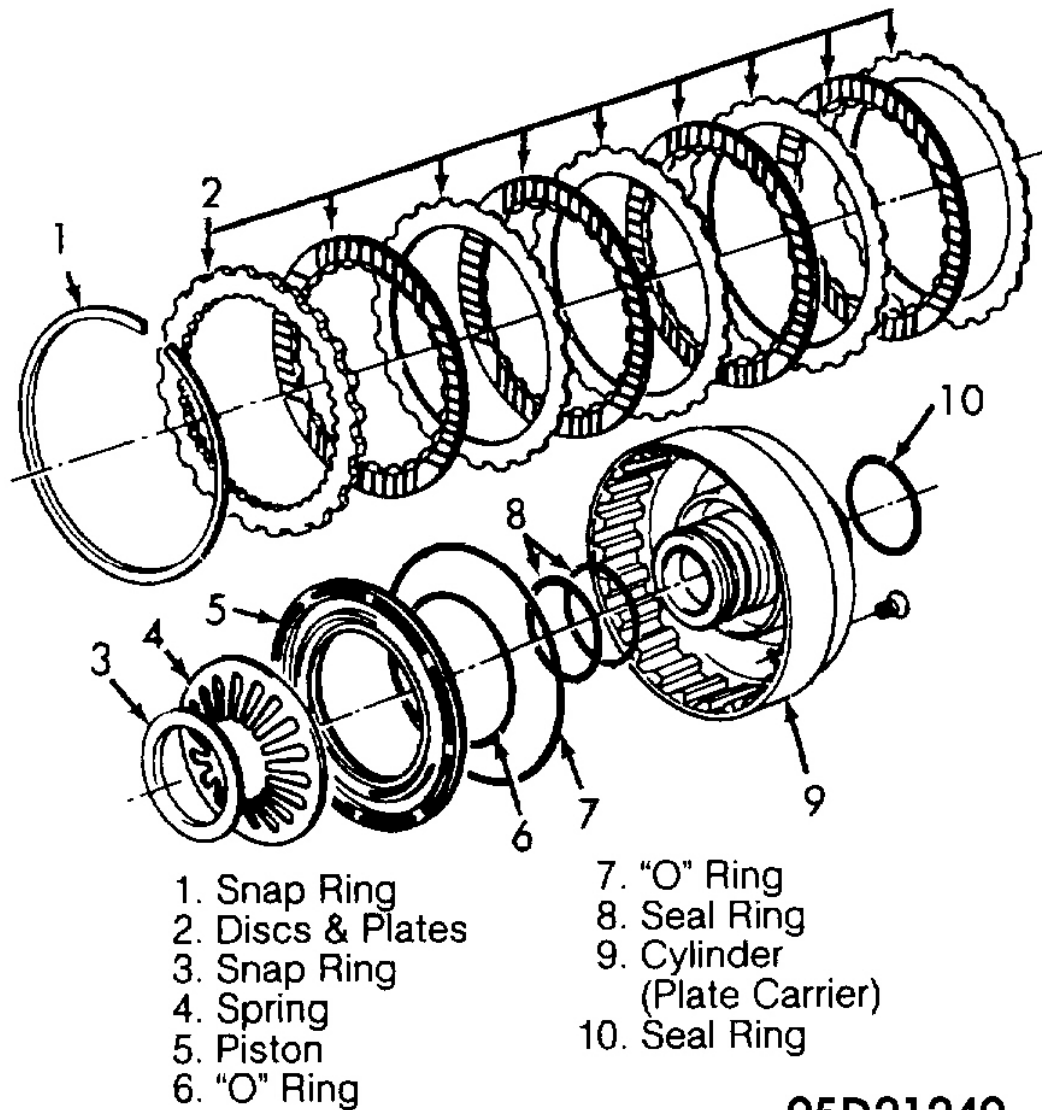
- 1. Disc Carrier
- 2. Snap Ring
- 3. Discs & Plates
- 4. Snap Ring
- 5. Spring

- 6. Pressure Plate
- 7. "O" Ring
- 8. "O" Ring
- 9. Piston
- 10. Cylinder
(Plate Carrier)

93C25355

Fig. 16: Exploded View Of Clutch "E"

Courtesy of BMW OF NORTH AMERICA, INC.



95D21249

Fig. 17: Exploded View Of Clutch "F"

Courtesy of BMW OF NORTH AMERICA, INC.

ONE-WAY CLUTCH**Disassembly**

Remove snap ring. Press output shaft from clutch unit. Remove plate carrier from one-way clutch. Remove snap ring (if used) and carefully press one-way clutch cage out of outer race. Ensure spring pressure does not cause needle bearings to jump out of cage. Refer to **Fig. 18**.

Reassembly

1. Install one-way clutch on outer race and align. Press one-way clutch into outer race against stop. Rotate metal edge on one-way clutch until metal edge engages in holding groove on outer race.
2. Use plate carrier to rotate one-way clutch outer race clockwise and install outer race on the inner race. Using feeler gauge, measure one-way clutch clearance between outer race on inner race. One-way clutch clearance should be at least .004" (.10 mm). See **Fig. 19** .

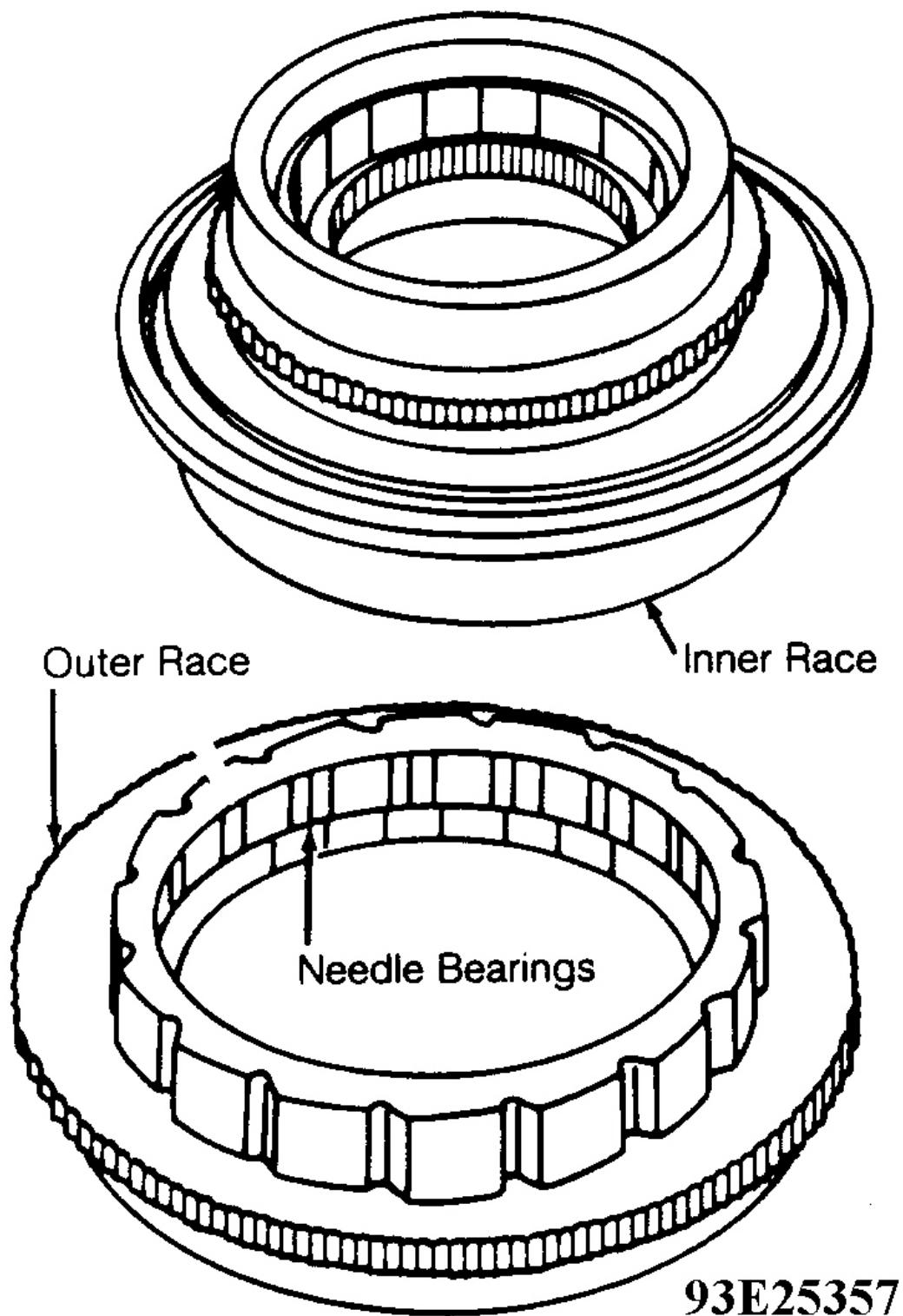


Fig. 18: Identifying One-Way Clutch Components
 Courtesy of BMW OF NORTH AMERICA, INC.

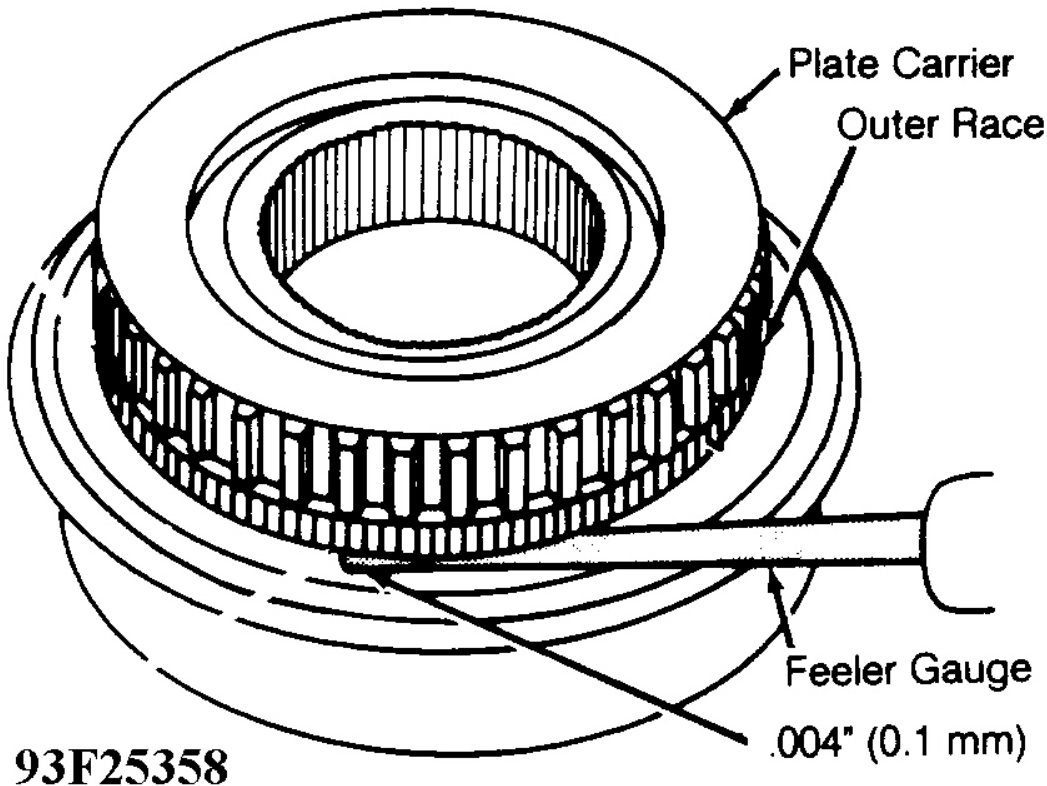


Fig. 19: Checking One-Way Clutch Clearance
 Courtesy of BMW OF NORTH AMERICA, INC.

REAR PLANETARY GEAR

Disassembly

1. Support assembly with output shaft facing downward. Remove one-way clutch and front planetary gear set. Remove sun gear shaft. Remove snap ring and remove hollow gear. Remove rear planetary carrier. See **Fig. 20**.
2. Remove intermediate shaft from shaft and housing. Remove bearing and washer from housing. Remove snap ring holding input hollow gear to intermediate shaft. Remove axial bearing assembly.

Reassembly

To reassemble, reverse disassembly procedure.

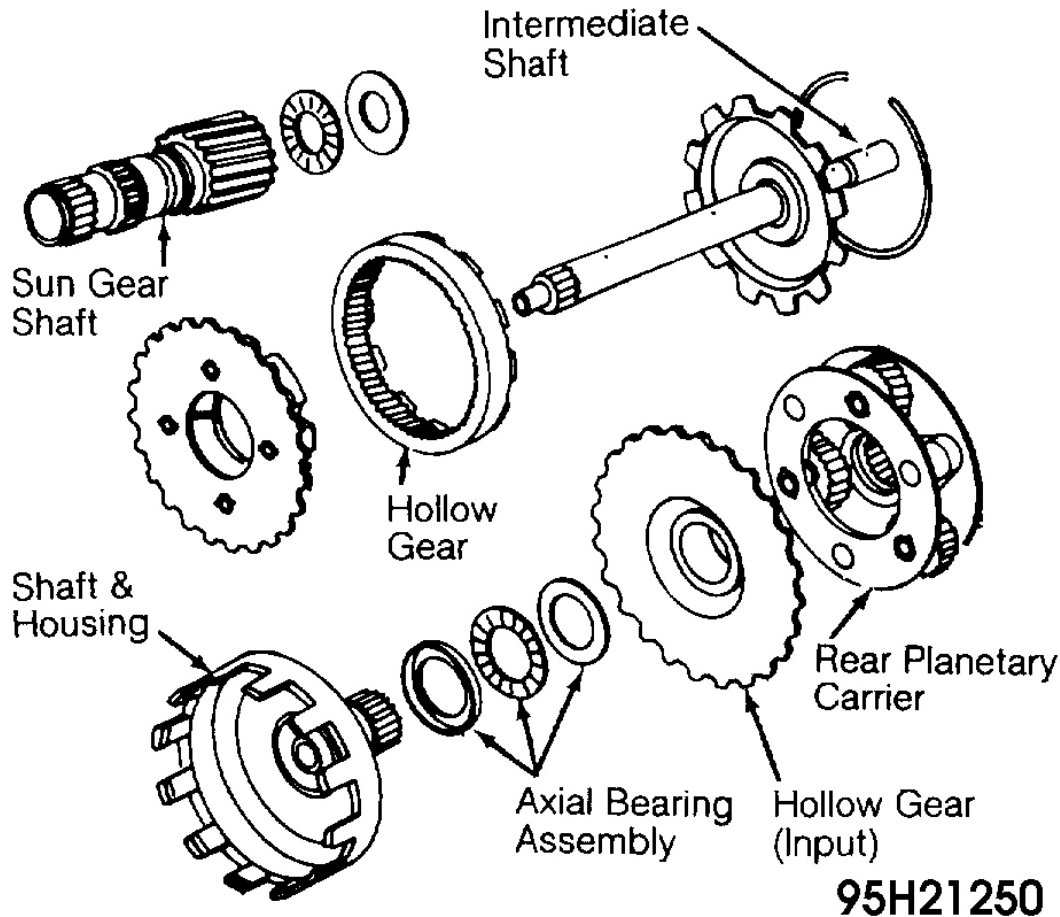


Fig. 20: Exploded View Of Rear Planetary Gear Assembly
 Courtesy of BMW OF NORTH AMERICA, INC.

VALVE BODY

Disassembly Of Upper Valve Body

1. Remove screws and separate upper left valve body (throttle valve) from main valve body assembly. Remove reverse inhibit valve, spring and retaining clip. See **Fig. 21 -Fig. 24**.
2. Remove modulator valve cover plate, modulator valve damper and spring. Note position of and remove modulator valve retaining clip.
3. Remove modulator valve and kickdown valve and spring. Note position of and remove kickdown valve retaining clip. Remove throttle valve and clean upper left valve body.

Cleaning & Inspection

Clean components with solvent and dry with compressed air. Inspect components for signs of wear or damage.

Ensure valves slide freely in bores on valve body.

Reassembly

To reassemble, reverse disassembly procedure. Lubricate all components with ATF. Ensure flat face of throttle valve retaining clip faces away from valve spring and flat side of modulator valve retaining clip faces away from valve spring. When installing modulator valve cover plate, ensure plate lug engages into kickdown valve.

Disassembly Of Upper Right Valve Body

1. Remove screws and separate upper right valve body (thermo valve) from main valve body assembly, ensuring sandwich plate remains with upper right valve body.
2. Remove sandwich plate and ensure nylon ball stays in place. Remove plastic ball and thermo valve assembly.
3. Remove converter clutch damper retaining clip, washer, springs and damper. Remove torque converter valve and spring.
4. Remove torque converter clutch hysteresis valve and spring. Thoroughly clean all valve body components.

Cleaning & Inspection

Clean components with solvent and dry with compressed air. Inspect components for signs of wear or damage. Ensure valves slide freely in bores on valve body.

Reassembly

To reassemble, reverse disassembly procedure. Lubricate all components with ATF. Ensure thermo valve is installed so front face of valve faces thermo switch.

Disassembly Of Rear Valve Body

1. Remove screws and separate rear valve body from main valve body assembly . Hold rear valve body to main valve body and invert assembly.
2. Separate rear valve body from main valve body, ensuring restrictor washers (3) remain in rear valve body. Remove one-way valve and spring from rear valve body. Note position of and size of restrictor washers and remove from rear valve body.
3. Remove check ball, screws and cover plate for clutch "C" and "E" dampers. Remove clutch "C" and "E" dampers and springs.
4. Note position of and remove clutch "F" valve and retaining clip and 1st gear inhibit valve and spring. Remove 3-4 shift valve and spring.
5. Remove clutch "F" damper cover plate. Remove 2nd gear inhibit valve and spring. Remove clutch "F" damper, spring and spring seat washer.
6. Remove 3-4 kickdown valve and spring. Remove remaining 3-4 shift valve.

Cleaning & Inspection

Clean components with solvent and dry with compressed air. Inspect components for signs of wear or damage. Ensure valves slide freely in bores on valve body.

Reassembly

1. To reassemble, reverse disassembly procedure. Lubricate all components with ATF. Ensure clutch "F" valve engages in clutch "F" damper spring seat and flat face of retaining clip faces away from damper.
2. Ensure restrictors are installed in rear valve body and remain in original positions and directions. Ensure when front valve body is inverted, restrictors and ball remain in front valve body.

Disassembly Of Front Valve Body

1. Note size, position and direction of restrictors. Remove restrictors and plastic ball. Remove manual control valve.
2. Remove clutch "C" and "D" cover plate. Remove clutch "C" valve and spring. Remove 2-3 shift valve piston.
3. Note position of clutch "C" valve retaining clip and clutch "C" valve. Remove clutch "C" valve retaining clip and clutch "C" valve. Remove clutch "B" damper springs and spring seat. Remove clutch "B" check ball capsule.
4. Remove 1-2 shift valve piston and clutch "D" damper spring and washer. Note position of, and remove clutch "D" valve retaining clip. Remove clutch "D" valve and collar.
5. Remove primary regulator valve spring and regulator valve. Remove remaining cover plate, torque converter pressure valve and spring.
6. Remove 2-3 shift valve and spring and clutch "C" damper spring and spring seat. Note position of and remove clutch "B" valve retaining clip and valve.
7. Remove 1-2 shift valve and spring. Carefully remove clutch "A" valve spring retaining clip, spring and spring seat. Remove clutch "A" valve and clean all valve body components.

Cleaning & Inspection

Clean components with solvent and dry with compressed air. Inspect components for signs of wear or damage. Ensure valves slide freely in bores on valve body.

Reassembly

1. To reassemble, reverse disassembly procedure. Lubricate all components with ATF. Ensure flat face of clutch "B" valve retaining clip faces away from cover plate.
2. Ensure clutch "D" valve retaining clip flat side faces damper/spring. Ensure clutch "C" valve retaining clip faces cover plate. Install and align plastic ball and restrictors on front valve body. Set valve body aside.

Disassembly & Inspection Of Divider Plate

1. Remove divider plate and ensure restrictors and plastic balls stay in position in divider plate. Remove and discard divider plate gasket, note positions and diameters of plastic balls and remove.
2. Note position and hole size of restrictors and remove them. Clean divider plate, bolts and restrictors and

inspect all components for signs of wear or damage.

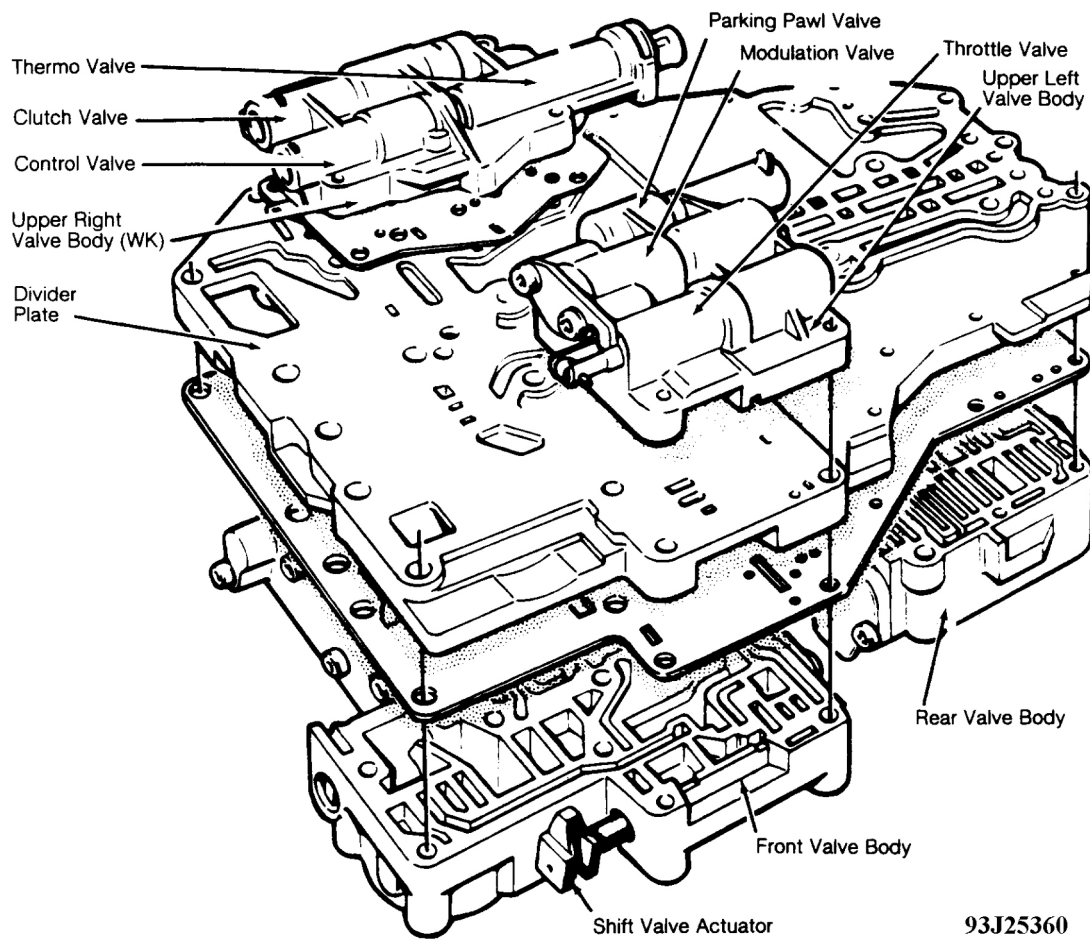


Fig. 21: Exploded View Of Typical Valve Body Assembly

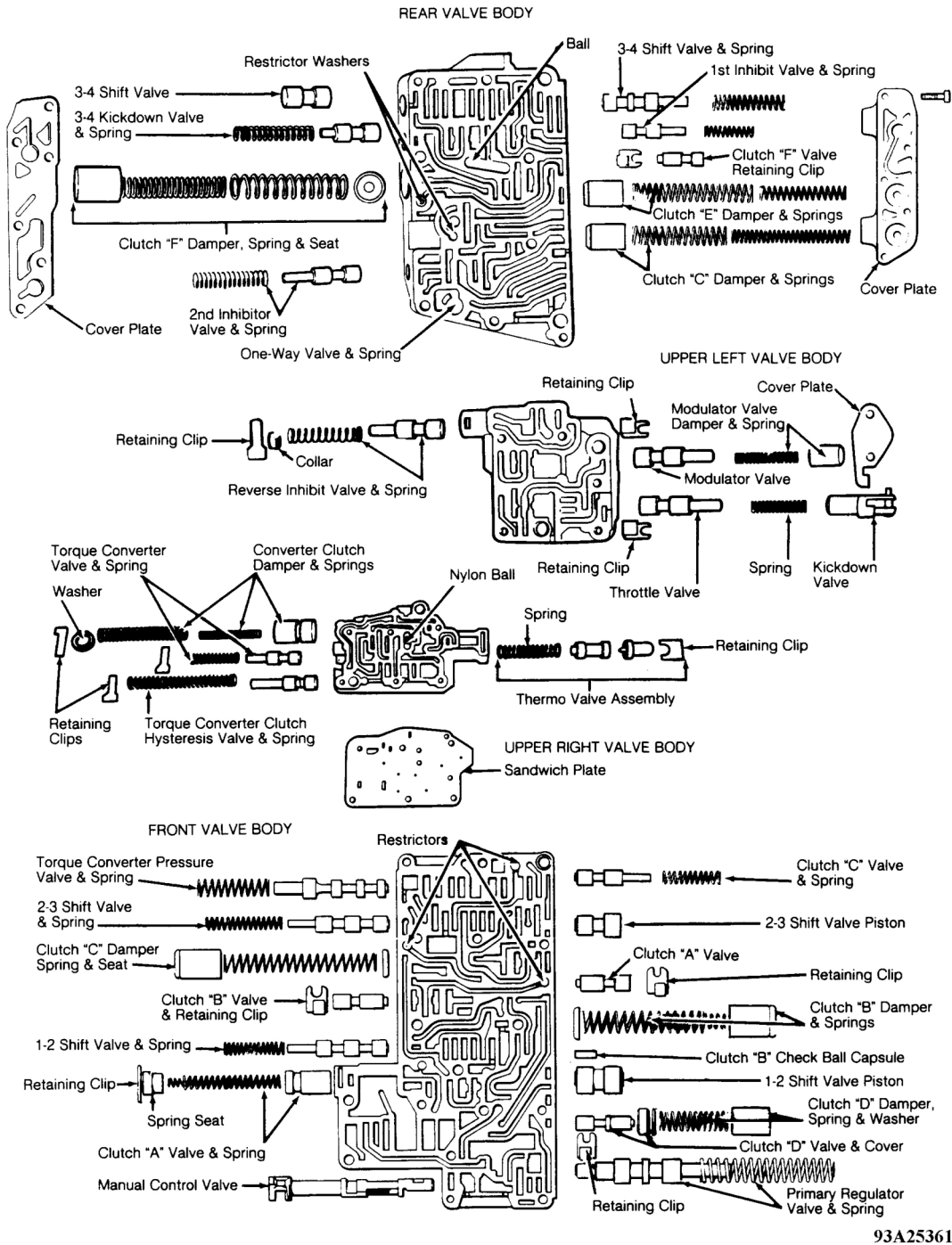


Fig. 22: Identifying Typical Valve Body Components

Valve Body Reassembly

1. To reassemble, reverse disassembly procedure. Install and align divider plate assembly on front valve

body. Ensure manual valve lug engages in divider plate channel.

2. Holding front valve body firmly to divider plate, invert assembly but **DO NOT** tighten securing bolts. Install and seat valve body on divider plate oil feed pipe.
3. Install and align upper left valve body on divider plate. **DO NOT** tighten bolts at this time. Install and align upper right valve body on divider plate. **DO NOT** tighten bolts at this time.
4. Invert main valve body assembly and install rear valve body. Ensure proper length bolts are installed in correct area. See **Fig. 23**.

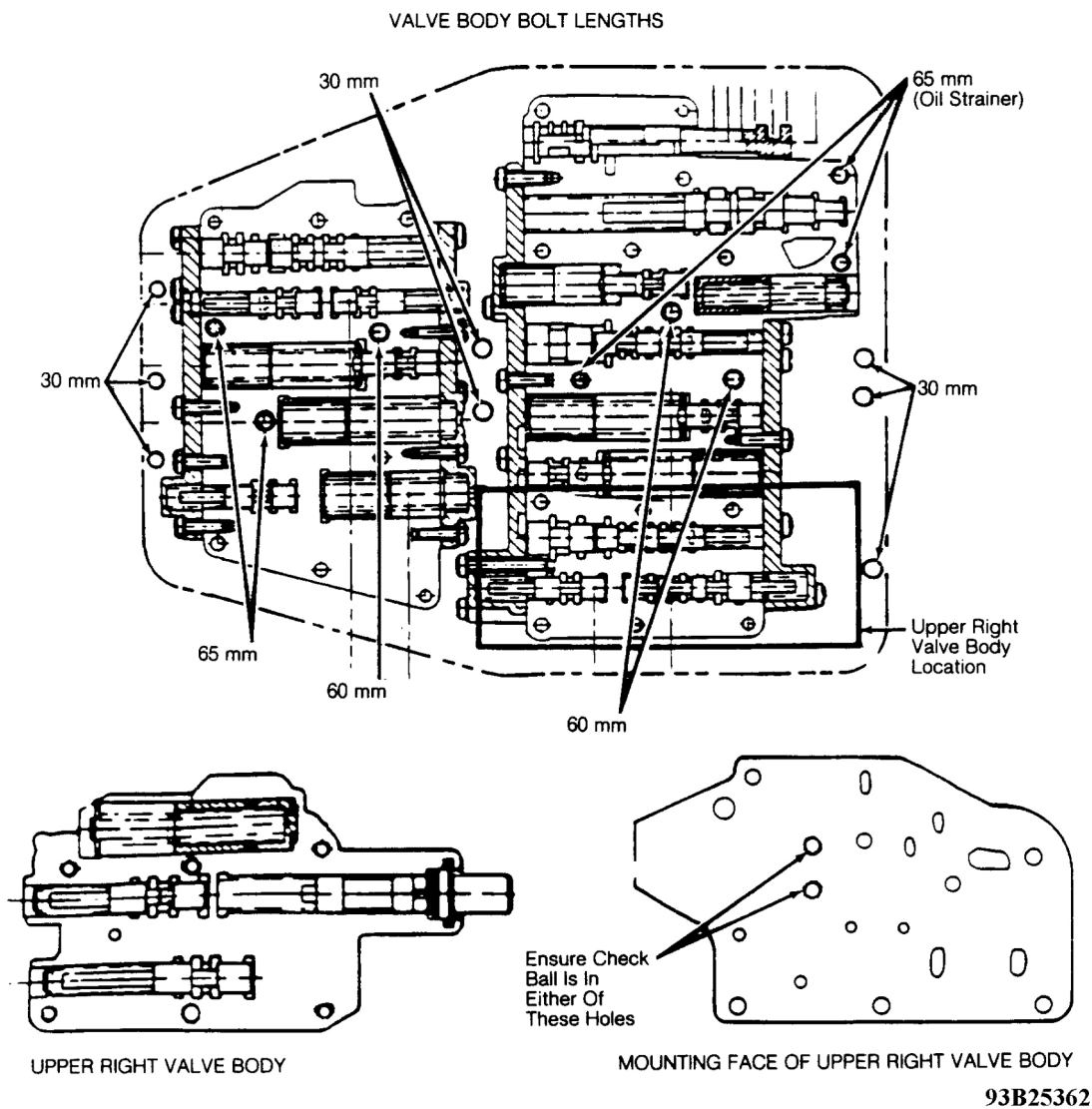


Fig. 23: Locating Valve Body Bolts

TRANSMISSION REASSEMBLY

NOTE: Coat all components with ATF before reassembly.

1. Install 4th gear clutch set into transmission case so 4 oil feed bores are aligned with bores in transmission case. See **Fig. 24** . Install and tighten 4th gear clutch set-to-transmission case Torx bolts from rear of transmission case.
2. Position transmission case with torque converter end facing upward. Install thrust washer, axial bearing and angled washer with collar facing up. See **Fig. 8** . If necessary, use petroleum jelly to hold axial bearing and washers in place.
3. Install planetary gear set with intermediate shaft in transmission case. Align 4 oil feed bores in planetary gear set with bores in transmission case. Ensure springs on planetary gear set remain in the center of cylinder on planetary gear set. Install large snap ring on inside of transmission case.

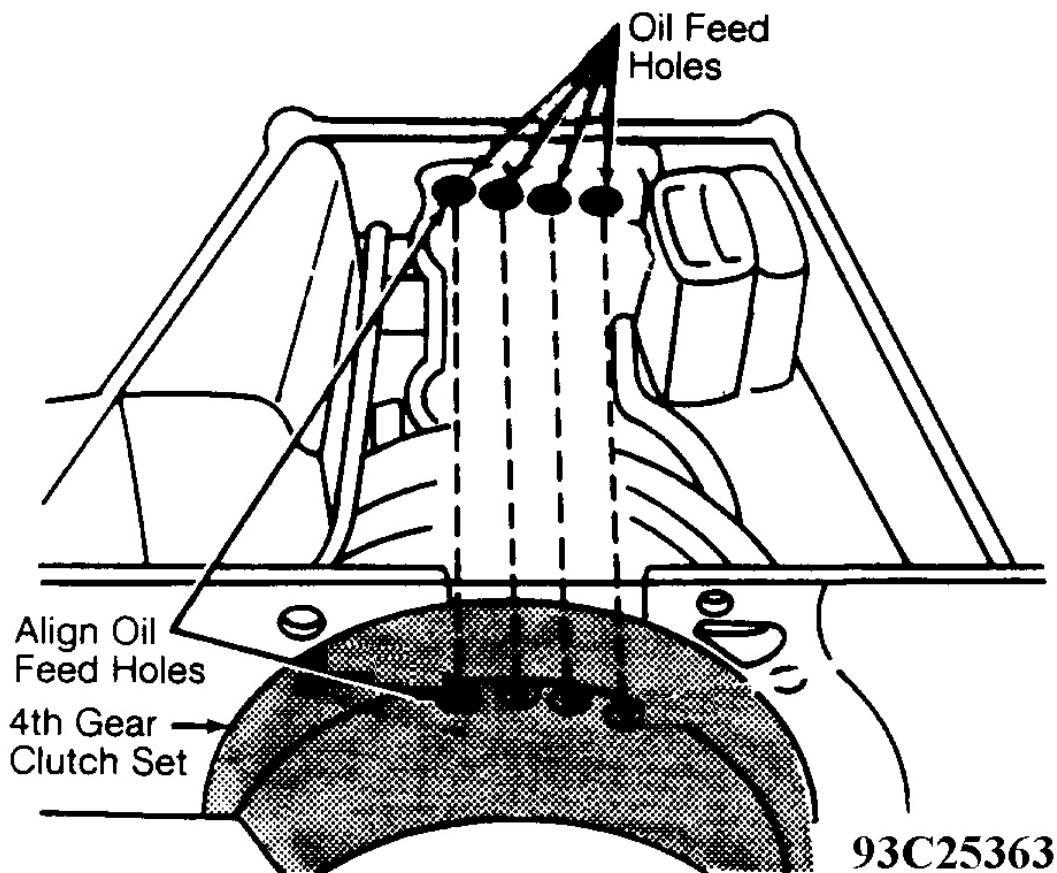


Fig. 24: Aligning Oil Feed Holes

Courtesy of BMW OF NORTH AMERICA, INC.

4. Install clutch "B" and push against stop. Install seal, support ring and clutch "B" retaining snap ring. See **Fig. 6** . Install clutch "A" carrier plate, thrust washer and thrust bearing on clutch "B".
5. Using petroleum jelly, install angled washer on rear of clutch "A". Install clutch "A" on clutch "B". Rotate clutch "A" back and forth until splines on planetary carrier engage with clutch discs. Ensure clutch "A" is fully seated.

6. Install angled washer on clutch "A" with collar facing up. Install axial bearing on angled washer. Use petroleum jelly to hold NEW gasket and thrust washer on rear of torque converter bellhousing. Install torque converter bellhousing. Install and tighten bolts to specification. See **TORQUE SPECIFICATIONS**.
7. Using dial indicator, check input shaft end play. Input shaft end play should be .008-.016" (.20-.40 mm). If input shaft end play is not within specification, install thicker or thinner thrust washer on rear of torque converter bellhousing. Recheck input shaft end play.
8. Remove sleeve from output shaft. Lubricate "O" ring on input shaft with ATF. Install parking pawl, spring and shaft. Ensure spring engages with hole in parking pawl.
9. Install parking lock gear on output shaft. Using NEW gasket, install extension housing on transmission case. Install and tighten bolts to specification.
10. Install output flange and collar nut. Tighten collar nut. Install 3 sealing sleeves into valve body passages on transmission case. Being careful not to damage sealing sleeves, press in sealing sleeves against stop. Install 3 springs and circlips. Press sealing sleeve into valve body bore with tab on sleeve facing bore.
11. Install valve body on transmission case. Ensure selector valve engages in operating finger of pawl. This requires pulling throttle cable slightly, so accelerator cam does not clamp on throttle pressure valve.
12. Install and tighten valve body-to-transmission case bolts finger tight. Align valve body with Aligner (243050). Distance between valve body case and throttle pressure piston must be .453" (11.50 mm). Tighten valve body-to-transmission case bolts to specification. Reconnect electrical connectors at solenoid valves on valve body.
13. Using NEW "O" ring, install wiring harness socket with flat side facing out. Install pulse transmitter on control unit. Using NEW "O" ring, install oil filter. Install and tighten bolt to specification.
14. Place magnets in oil pan. Using NEW gasket, install oil pan. Install and tighten bolts to specification. Install torque converter.

TORQUE SPECIFICATIONS

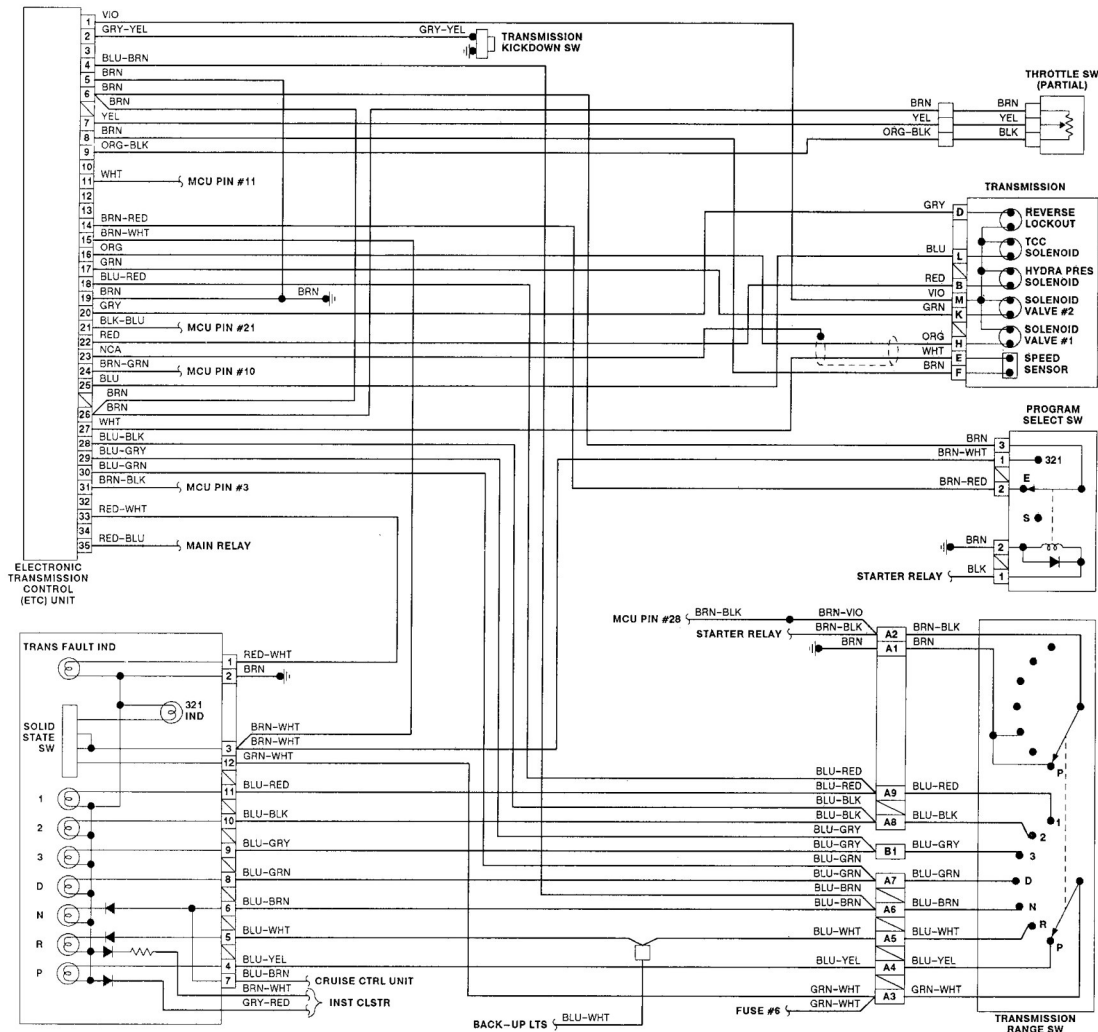
TORQUE SPECIFICATIONS

Application	Ft. Lbs. (N.m)
Collar Nut	74-85 (100-115)
Extension Housing Bolt	17-19 (23-26)
Oil Filler Tube	72 (98)
Torque Converter Bellhousing-To-Transmission Case Bolt	34 (46)
Torque Converter-To-Drive Plate	17-19 (23-26)
Transmission-To-Engine	
8mm Bolts	18-20 (24-27)
10mm Bolts	35-38 (48-51)
12mm Bolts	58-65 (78-88)
	INCH Lbs. (N.m)
Governor Screws	89 (10)
Oil Filter Bolt	62-80 (7.0-9.0)
Oil Pan Bolt	62-80 (7.0-9.0)
Oil Pan Drain Plug	115-150 (13-17)

WIRING DIAGRAMS



Fig. 25: Wiring Diagram (1986-87 BMW Models)



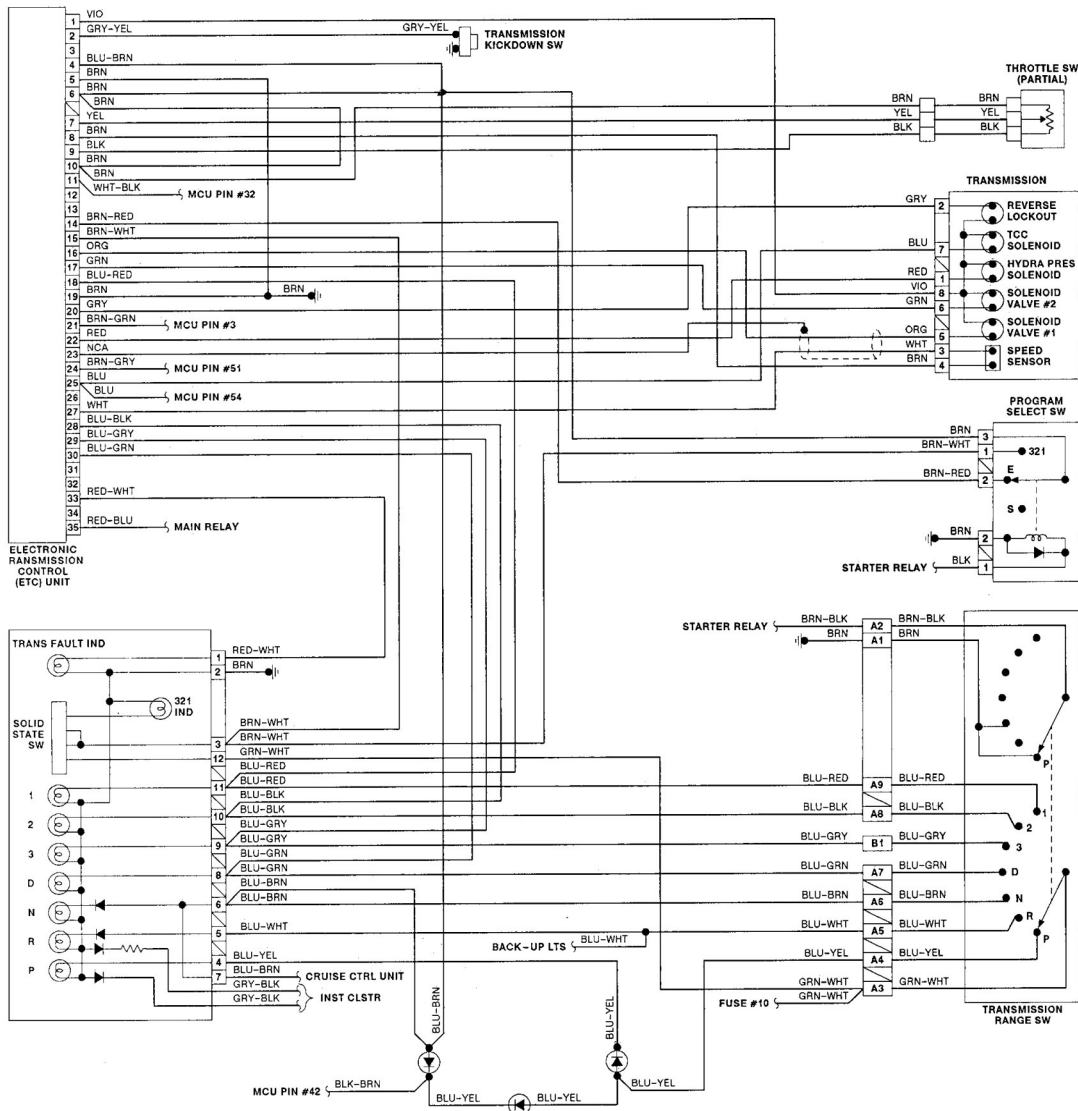
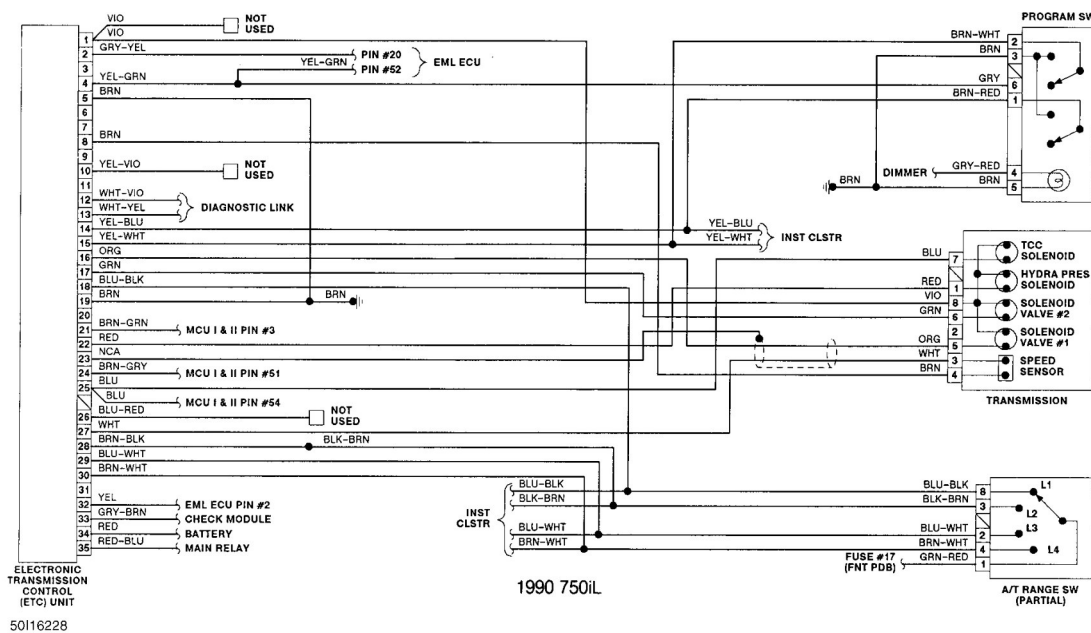
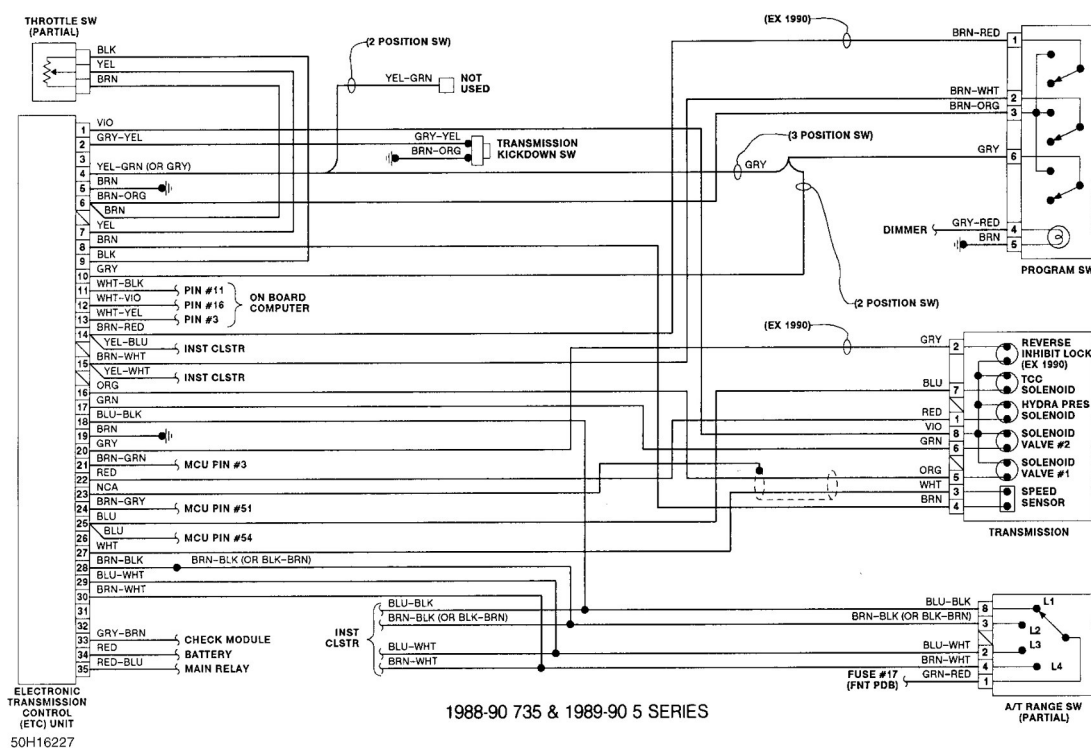


Fig. 27: Wiring Diagram (1988-89 BMW 635CSi)

1984-94 AUTOMATIC TRANSMISSIONS ZF 4HP 22-EH & ZF 4HP 24-E Overhaul



1990 BMW 325i

1984-94 AUTOMATIC TRANSMISSIONS ZF 4HP 22-EH & ZF 4HP 24-E Overhaul

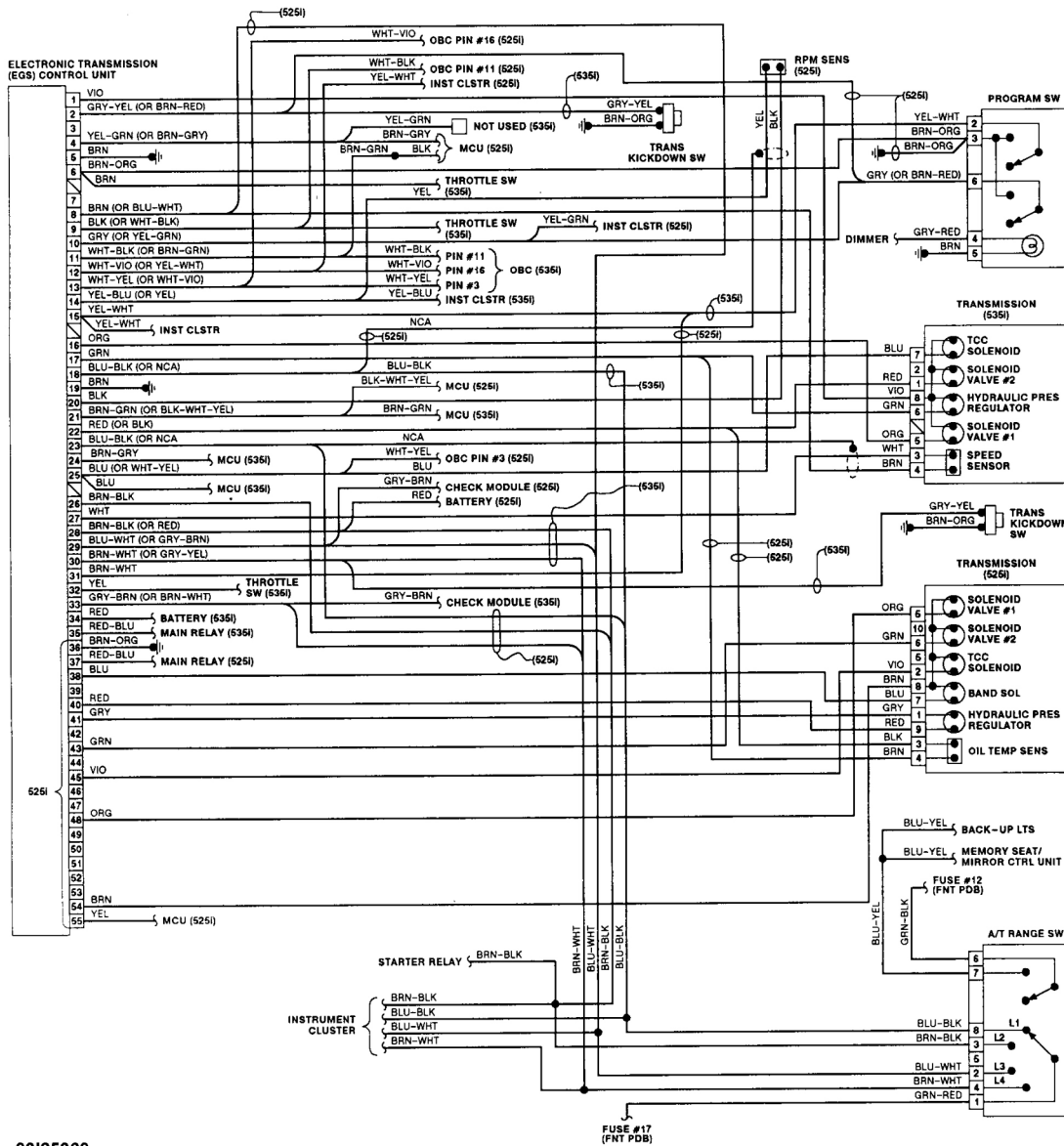
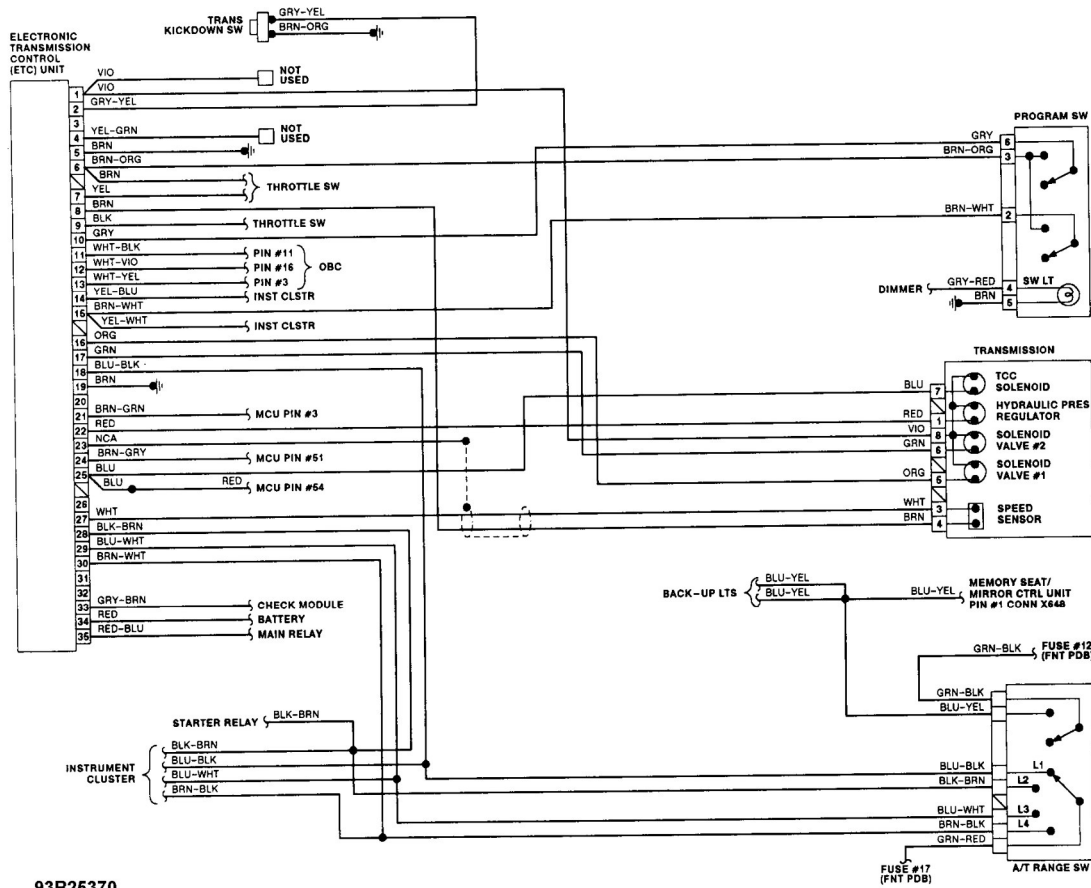


Fig. 30: Wiring Diagram (1991-92 BMW 525i & 535i)

1990 BMW 325i

1984-94 AUTOMATIC TRANSMISSIONS ZF 4HP 22-EH & ZF 4HP 24-E Overhaul



93B25370

Fig. 31: Wiring Diagram (1991-92 BMW 735i & 735iL)

1990 BMW 325i

1984-94 AUTOMATIC TRANSMISSIONS ZF 4HP 22-EH & ZF 4HP 24-E Overhaul



Fig. 32: Wiring Diagram (1993 BMW 535i)