MANUAL TRANS OVERHAUL - BORG-WARNER - T56 6-SPEED

1998 MANUAL TRANSMISSIONS Borg-Warner T56 (MM6) 6-Speed

IDENTIFICATION

Transmission has 2 identification labels, located on lower left side of case. One label contains a VIN derivative. Other label is transmission identification information, giving model type and date of manufacturer.

DESCRIPTION

Borg-Warner T56 transmission is a fully synchronized 6-speed. Manufacturer also identifies it as 85-mm 6-speed (RPO MM6). Transmission is used in vehicles equipped with a 5.7L engine. Transmission has an aluminum case with internal shift rail mechanism. Manufacturer recommends Dexron IIE or III automatic transmission fluid to protect synchronizer friction material. Transmission is equipped with a solenoid which operates a reverse lock-out assembly. Solenoid prevents operator from shifting transmission into Reverse when vehicle is moving forward. To enhance fuel economy, transmission also is equipped with a gear select solenoid, which inhibits 2nd and 3rd gears when shifting from 1st gear. Solenoid is activated when engine coolant temperature is greater than 162°F (77°C), vehicle speed is between 15-21 MPH and throttle is opened 35 percent or less.

LUBRICATION & ADJUSTMENTS

See TRANSMISSION SERVICING - M/T article in MANUAL TRANS SERVICE section

TROUBLE SHOOTING

TROUBLE SHOOTING - BASIC PROCEDURES article in GENERAL TROUBLE SHOOTING section.

ON-VEHICLE SERVICE

EXTENSION HOUSING OIL SEAL

Removal & Installation

Raise and support vehicle. Remove drive shaft. Using appropriate seal remover, remove seal. Lubricate inside lip of NEW oil seal prior to installation. Using appropriate seal installer, install seal. Install drive shaft and tighten bolts to specification. See **TORQUE SPECIFICATIONS** . Check fluid level.

REVERSE LOCK-OUT SOLENOID

Removal & Installation

Raise and support vehicle. Remove harness connector. Remove reverse lock-out solenoid from reverse lock-out assembly, located on left side of transmission. To install, reverse removal procedure. Install NEW "O" ring.

Tighten solenoid to specification. See **TORQUE SPECIFICATIONS** .

VEHICLE SPEED SENSOR

Removal & Installation

Raise and support vehicle. Remove harness connector and retainer bolt. Remove vehicle speed sensor. Remove "O" ring from sensor. To install, reverse removal procedure. Install NEW "O" ring. Tighten sensor retainer bolt to specification. See **TORQUE SPECIFICATIONS** .

REMOVAL & INSTALLATION

See TRANSMISSION REMOVAL & INSTALLATION - M/T article in MANUAL TRANS SERVICE section.

TRANSMISSION DISASSEMBLY

1. Ensure exterior of transmission is free of dirt and grease prior to disassembly. Remove vent tube, clutch housing, clutch fork and clutch fork pivot "T" handle. Mount support fixture to transmission and install on bench mounted holding fixture. See **Fig. 1** . Rotate transmission to horizontal position with shifter up. Drain transmission fluid.

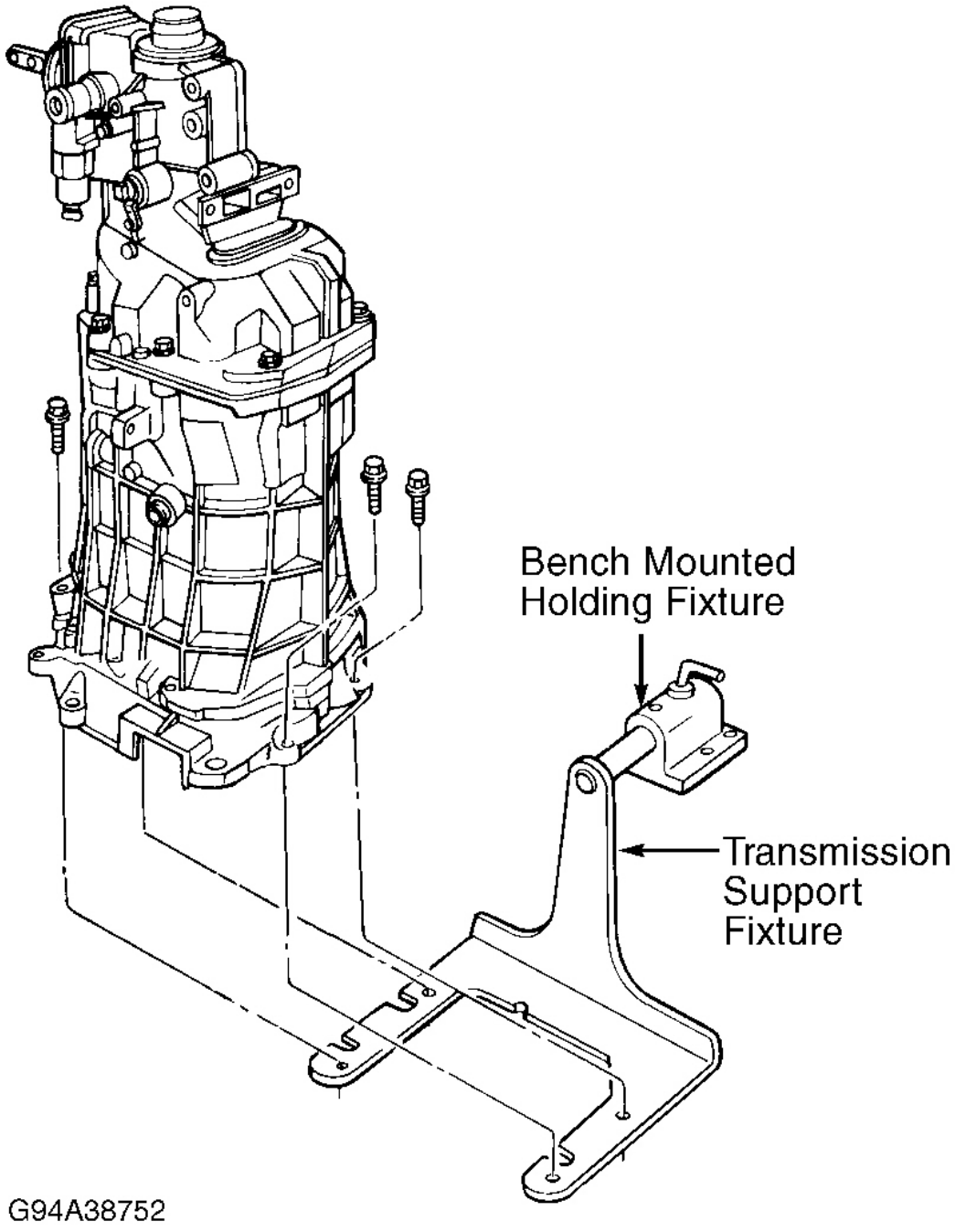

Fig. 1: Installing Transmission Support Fixture
Courtesy of GENERAL MOTORS CORP.

2. Shift transmission into 3rd gear, 4th gear, then Neutral position. Remove shifter assembly. Inspect

isolator cup and offset shift lever for wear. If isolator cup is loose, or if offset shift lever has excessive wear, replace components as necessary. Remove offset shift lever roll pin.

NOTE: If isolator cup is not fully retained in rear offset lever with adhesive, replace rear offset lever assembly.

3. Remove rear offset lever and isolator cup assembly. Remove extension housing bolts. With transmission in horizontal position, slide extension housing off shift rails.
4. Rotate transmission to vertical position. Remove sealing ring and snap ring. Using gear remover and puller, remove speedometer gear. Remove snap ring. Remove roller bearing snap ring, spacer, roller bearing, spacer, snap ring and thrust washer. Remove reverse gear, needle bearing, wave washer and synchronizer ring.See **Fig. 2** and **Fig. 3** .
5. Remove reverse synchronizer snap ring. Remove and discard reverse shift fork snap ring. Remove reverse shift fork synchronizer and thrust washer. Using gear remover and puller, remove 5th-6th driven gear. Remove 5th-6th shift fork snap ring.
6. Rotate transmission to horizontal position with guide plate up. Remove countershaft extension assembly with 5th-6th shift fork. Remove gear select solenoid. Remove cover plate bolts and cover plate. Remove shift detent assembly, front offset lever roll pin and shift guide plate bolts. See **Fig. 2** and **Fig. 3** .
7. Remove guide plate and front offset lever. Hold guide plate and front offset lever together while sliding off shift rail to prevent spring release of detent ball and spring. Remove solenoid lever. Rotate front offset lever to clear case during removal.
8. Remove front offset lever, roll pin, shift detent spring, detent ball and shift guide plate. Remove 8 of 10 adapter plate-to-transmission bolts. Rotate transmission to vertical position. Remove 2 remaining adapter plate bolts. Remove shift lever guide bolts. See **Fig. 2** and **Fig. 3** . Remove case magnet. Slide transmission case up off of gear clusters and shift rail components. Remove transmission case.
9. Remove 5th-6th and reverse shift rail levers from shift interlock plate. Remove 5th-6th and reverse shift rail assembly. Lift up mainshaft enough to remove countershaft. Remove mainshaft and shift rail assembly as complete assemblies. See **Fig. 4** . Remove shift rail assembly from mainshaft. Remove 4th gear synchronizer ring. Remove input shaft.

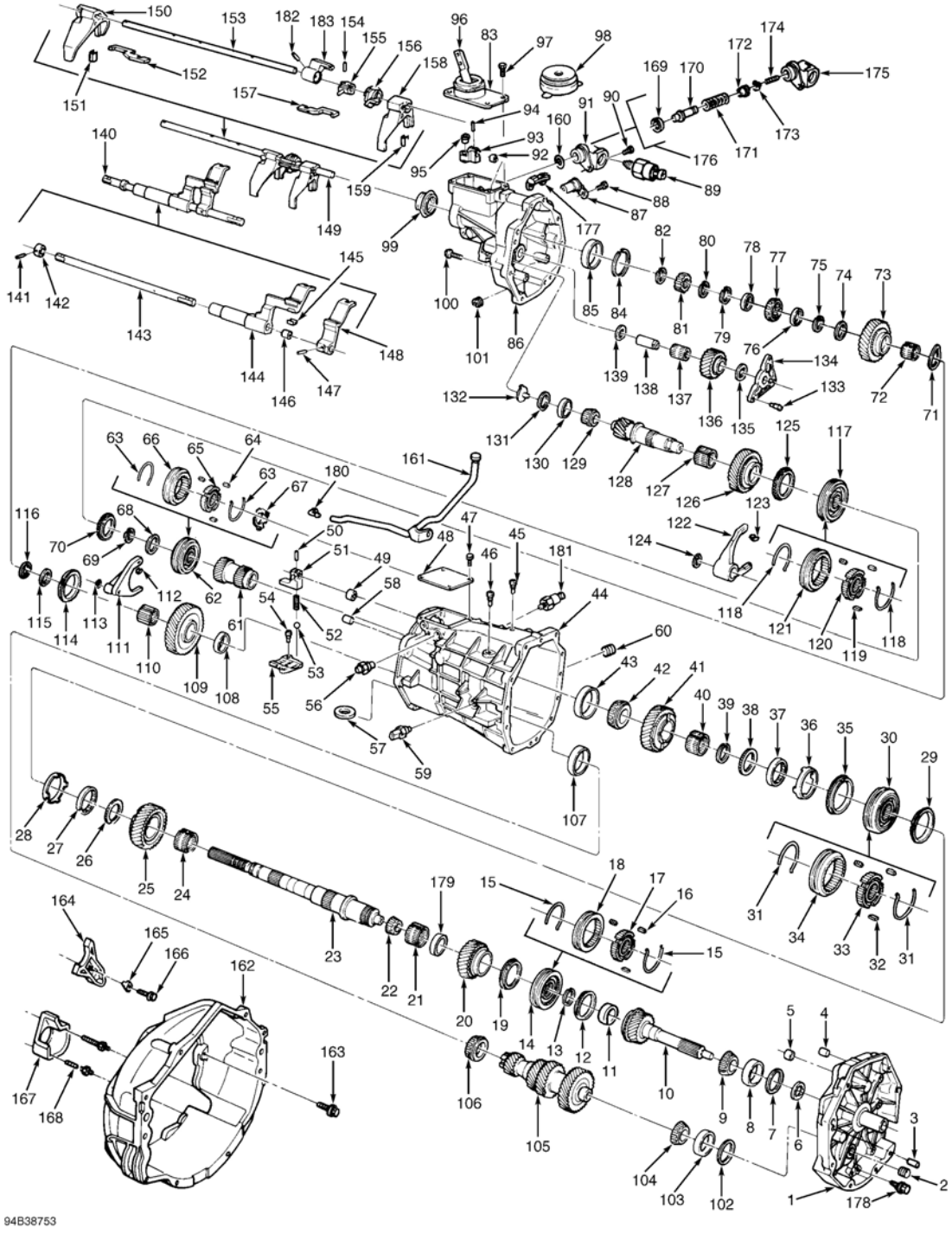

Fig. 2: Exploded View Of T56 Transmission Components
Courtesy of GENERAL MOTORS CORP.

1. Transmission Adapter Plate
2. Plug
3. Dowel Pin
4. Dowel Pin
5. Shift Rail Bushing
6. Input Shaft Seal
7. Input Shaft Shim
8. Input Shaft Bearing Race
9. Input Shaft Bearing
10. Input Shaft
11. Input Shaft Bearing Race
12. 4th Gear Synchronizer Ring
13. Snap Ring
14. 3rd-4th Synchronizer Assembly
15. 3rd-4th Synchronizer Spring
16. 3rd-4th Synchronizer Key
17. 3rd-4th Synchronizer Hub
18. 3rd-4th Synchronizer Sleeve
19. 3rd Gear Synchronizer Ring
20. 3rd Gear
21. 3rd Gear Needle Bearing
22. Mainshaft Small Bearing
23. Mainshaft
24. 2nd Gear Needle Bearing
25. 2nd Gear
26. Thrust Washer
27. Inner Cone
28. Friction Cone
29. 2nd Gear Synchronizer Ring
30. 1st-2nd Synchronizer Assembly
31. 1st-2nd Synchronizer Spring
32. 1st-2nd Synchronizer Key
33. 1st-2nd Synchronizer Hub
34. 1st-2nd Synchronizer Sleeve
35. 1st Gear Synchronizer Ring
36. Friction Cone
37. Inner Cone
38. Thrust Washer
39. Snap Ring
40. 1st Gear Needle Bearing
41. 1st Gear
42. Mainshaft Large Bearing
43. Mainshaft Bearing Race
44. Transmission Case
45. Shift Lever Guide Bolt
46. Shift Lever Guide Bolt
47. Shift Detent Cover Bolt
48. Shift Detent Cover
49. Shift Rail Bushing
50. Front Offset Lever Roll Pin
51. Front Offset Lever
52. Shift Detent Spring
53. Shift Detent Ball
54. Shift Guide Plate Bolt
55. Shift Guide Plate
56. Shift Detent Assembly
57. Magnet
58. Dowel Pin
59. Back-Up Light Switch
60. Fill Plug
61. 5th-6th Gear
62. Reverse Synchronizer Assembly
63. Reverse Synchronizer Spring
64. Reverse Synchronizer Key
65. Reverse Synchronizer Hub
66. Reverse Synchronizer Sleeve
67. Reverse Synchronizer Key Retainer
68. Thrust Washer
69. Snap Ring
70. Reverse Gear Synchronizer Ring
71. Wave Washer
72. Reverse Gear Needle Bearing
73. Reverse Gear
74. Thrust Washer
75. Snap Ring
76. Spacer
77. Mainshaft Rear Bearing
78. Spacer
79. Snap Ring
80. Snap Ring
81. Speedometer Gear (Electronic)
82. Snap Ring
83. Shifter Assembly
84. Snap Ring
85. Mainshaft Bearing Race
86. Transmission Extension Housing
87. Electronic Speed Sensor
88. Speed Sensor Bolt
89. Reverse Lock-Out Solenoid
90. Reverse Lock-Out Assembly Bolt
91. Reverse Lock-Out Assembly
92. Shift Rail Bushing
93. Rear Offset Shift Lever
94. Rear Offset Shift Lever Roll Pin
95. Isolator Cup
96. Shifter Lever
97. Shifter Assembly Bolt
98. Shifter Boot
99. Rear Output Seal & Boot
100. Transmission Extension Housing Bolt
101. Drain Plug
102. Countershaft Shim
103. Countershaft Bearing Race
104. Countershaft Bearing
105. Countershaft
106. Countershaft Bearing
107. Countershaft Bearing Race
108. Thrust Washer
109. 6th Gear
110. 6th Gear Needle Bearing
111. Reverse Shift Fork
112. Reverse Shift Fork Pad
113. Snap Ring
114. 6th Gear Synchronizer Ring
115. Spacer
116. Snap Ring
117. 5th-6th Synchronizer Assembly
118. 5th-6th Synchronizer Spring
119. 5th-6th Synchronizer Key
120. 5th-6th Synchronizer Hub
121. 5th-6th Synchronizer Sleeve
122. 5th-6th Shift Fork
123. 5th-6th Shift Fork Pad
124. Snap Ring
125. 5th Gear Synchronizer Ring
126. 5th Gear
127. 5th Gear Needle Bearing
128. Countershaft Extension
129. Countershaft Extension Bearing
130. Countershaft Bearing Race
131. Countershaft Extension Shim
132. Oil Funnel
133. Reverse Idler Shaft Bracket Bolt
134. Reverse Idler Shaft Bracket
135. Reverse Idler Gear Thrust Washer
136. Reverse Idler Gear
137. Reverse Idler Gear Roller Bearing
138. Reverse Idler Gear Shaft
139. Reverse Idler Gear Thrust Washer
140. 5th-6th Shift Rail Assembly
141. Reverse Shift Collar Roll Pin
142. Collar
143. 5th-6th & Reverse Shift Rail
144. 5th-6th Shift Rail Lever
145. 5th-6th Shift Rail Lever Pad
146. 5th-6th Shift Rail Lever Bushing
147. Reverse Shift Lever Pin
148. Reverse Shift Rail Lever
149. 1st-2nd & 3rd-4th Shift Rail Assembly
150. 1st-2nd Shift Fork
151. 1st-2nd Shift Fork Pad
152. Shift Interlock Plate
153. 1st-2nd & 3rd-4th Shift Rail
154. Roll Pin
155. Control Select Arm
156. Gear Select Interlock Plate
157. Shift Interlock Plate
158. 3rd-4th Shift Fork
159. 3rd-4th Shift Fork Pad
160. Reverse Lock-Out Assembly "O" Ring
161. Vent Tube
162. Clutch Adapter Housing
163. Clutch Adapter Housing Bolt
164. Clutch Fork
165. Clutch Fork Pivot "T" Handle
166. Clutch Fork Pivot Bolt
167. Clutch Actuator Adapter Housing
168. Clutch Actuator Adapter Housing Bolt
169. Snap Ring
170. Reverse Lock-Out Plunger
171. Reverse Lock-Out Outer Spring
172. Reverse Lock-Out Collar
173. Snap Ring
174. Reverse Lock-Out Inner Spring
175. Reverse Lock-Out Body
176. Reverse Lock-Out Assembly
177. Transmission Bumper
178. Transmission Adapter Plate Bolt
179. Spacer
180. Vent Tube Fitting
181. Gear Select Solenoid
182. Roll Pin
183. Gear Select Solenoid Lever

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Fig. 3: Legend For Exploded View Of T56 Transmission Components
Courtesy of GENERAL MOTORS CORP.

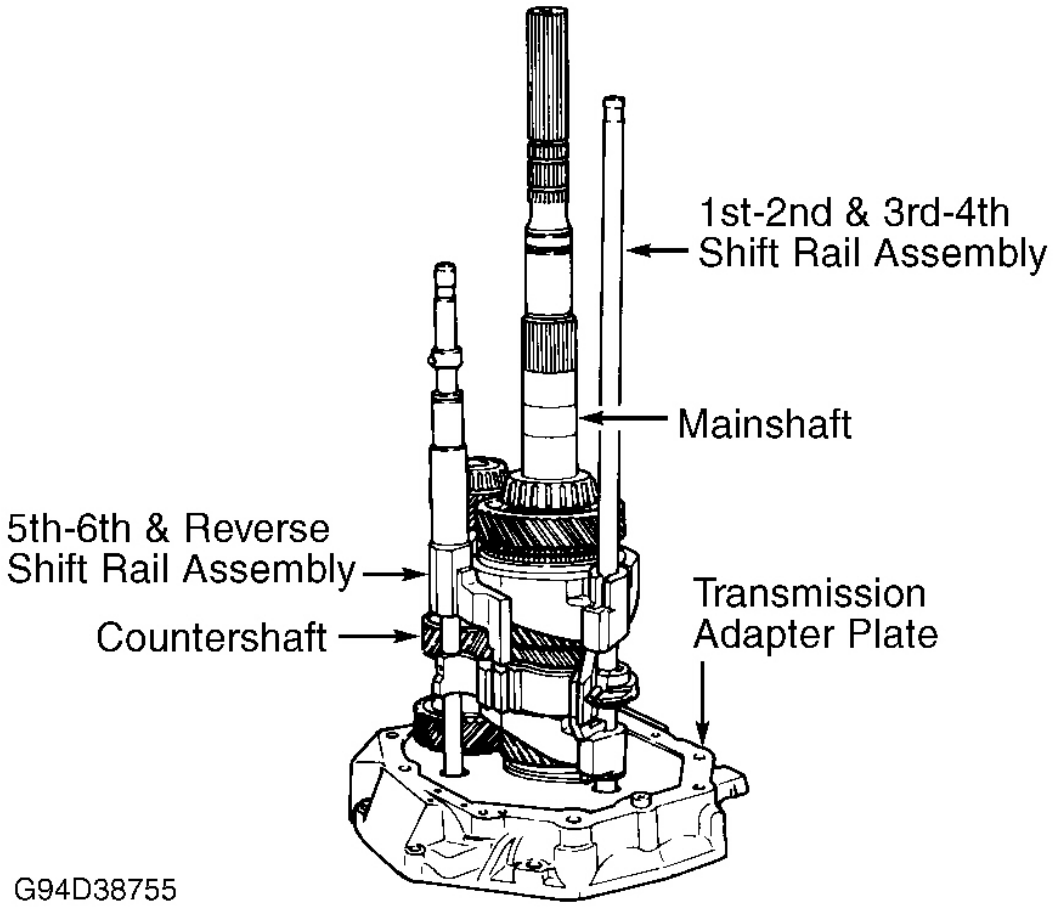


Fig. 4: Identifying Shift Rail Assemblies
Courtesy of GENERAL MOTORS CORP.

COMPONENT DISASSEMBLY & REASSEMBLY

INPUT SHAFT

NOTE: DO NOT remove input shaft bearing unless inspection indicates bearing damage. Replace bearing and race as an assembly if necessary.

Disassembly

Using split plate and hydraulic press, remove input shaft bearing from input shaft. Using race remover and slide hammer, remove input bearing race.

Cleaning & Inspection

1. Clean components with solvent and dry with compressed air. DO NOT spin dry bearings. Inspect input shaft and spline for excessive wear or cracks. Inspect gear teeth for excessive wear, pitting, scoring, spalling or breaks.
2. Inspect bearing for rough rotation, burred or pitted condition. If scuffed, nicked, burred or scored condition cannot be repaired with a soft stone or crocus cloth, replace components as necessary.

Reassembly

Using race installer and hydraulic press, install bearing race. Using press tube and hydraulic press, install input shaft bearing. Ensure bearing rotates smoothly after installation.

MAINSHAFT ASSEMBLY

NOTE: Identify synchronizer rings to gears prior to disassembly. DO NOT mix synchronizer rings. DO NOT remove mainshaft bearings unless inspection indicates bearing damage.

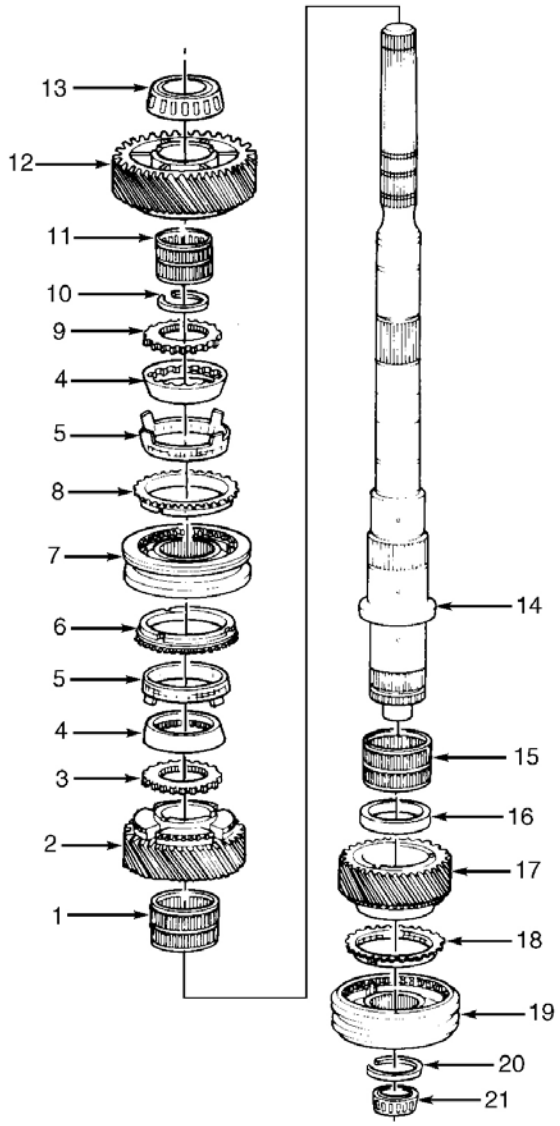
Disassembly

1. Remove large mainshaft bearing and "O" ring. Remove 1st gear and 1st gear needle bearing. Remove snap ring, thrust washer, inner cone, friction cone and synchronizer ring. Using split plate and hydraulic press, remove 1st-2nd synchronizer assembly, 2nd gear synchronizer ring, friction cone, 2nd gear inner cone, thrust washer and 2nd gear. See **Fig. 5** .
2. Remove 2nd gear needle bearing. Remove 3rd-4th gear synchronizer snap ring. Using split plate, "V" blocks and hydraulic press, remove 3rd gear synchronizer assembly, 3rd gear synchronizer ring and 3rd gear. Remove spacer and 3rd gear needle bearing. Using press adapter, split plate and hydraulic press, remove and discard small mainshaft bearing (if necessary).

Cleaning & Inspection

Clean components with solvent and dry with compressed air. Inspect mainshaft and spline for excessive wear or cracks. Inspect gear teeth for excessive wear, pitting, scoring, spalling or breaks. Inspect bearings for rough rotation, burred or pitted conditions. If scratches, grooves or nicks cannot be removed using a soft stone or crocus cloth, replace component as necessary.

NOTE: For synchronizer disassembly and reassembly, see SYNCHRONIZERS under COMPONENT DISASSEMBLY & REASSEMBLY.



1. 2nd Gear Needle Bearing
2. 2nd Gear
3. Thrust Washer
4. Inner Cone
5. Friction Cone
6. 2nd Gear Synchronizer Ring
7. 1st-2nd Synchronizer Assembly
8. 1st Gear Synchronizer Ring
9. Thrust Washer
10. Snap Ring
11. 1st Gear Needle Bearing
12. 1st Gear
13. Mainshaft Large Bearing
14. Mainshaft
15. 3rd Gear Needle Bearing
16. Spacer
17. 3rd Gear
18. 3rd Gear Synchronizer Ring
19. 3rd-4th Synchronizer Assembly
20. Snap Ring
21. Mainshaft Small Bearing

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Fig. 5: Exploded View Of Mainshaft Assembly
Courtesy of GENERAL MOTORS CORP.

Reassembly

1. Using bearing installer, "V" blocks and hydraulic press, install NEW mainshaft small bearing (if removed). Install 3rd gear needle bearing, spacer and 3rd gear. Install 3rd gear synchronizer ring. Using press tube, press tube adapter and hydraulic press, press 3rd-4th gear synchronizer assembly onto mainshaft.
2. Install 3rd-4th gear synchronizer assembly with inside diameter groove on sleeve facing 3rd gear. Start hydraulic press operation but stop before synchronizer keys engage synchronizer ring slots. Lift and rotate 3rd gear to engage keys of synchronizer ring. Continue to press until fully seated.
3. Install 3rd-4th synchronizer snap ring. Install 2nd gear needle bearing, 2nd gear and thrust washer. Install 2nd gear inner cone, friction cone and 2nd gear synchronizer ring. Using split plate and hydraulic press, press 1st-2nd gear synchronizer assembly onto mainshaft.
4. Install 1st-2nd gear synchronizer assembly with inside diameter groove on sleeve facing 1st gear. Start hydraulic press operation but stop before synchronizer keys engage synchronizer ring slots. Lift and rotate 2nd gear to engage keys of synchronizer ring. Continue to press until fully seated.
5. Install 1st gear synchronizer ring, friction cone, inner cone and thrust washer. Install snap ring and 1st gear needle bearing. Install 1st gear, mainshaft large bearing and "O" ring.

COUNTERSHAFT ASSEMBLY

NOTE: DO NOT remove countershaft bearings unless inspection indicates bearing damage. Replace bearing and race as an assembly if necessary.

Disassembly

Using split plate and hydraulic press, remove small countershaft bearing from countershaft (if necessary). Using split plate, press adapter and hydraulic press, remove large countershaft bearing from countershaft (if necessary). See **Fig. 2** .

Cleaning & Inspection

1. Clean components with solvent and dry with compressed air. DO NOT spin dry bearings. Inspect countershaft for excessive wear or cracks. Inspect gear teeth for excessive wear, pitting, scoring, spalling or breaks.
2. Inspect bearings for rough rotation or burred or pitted condition. If scuffed, nicked, burred or scored condition cannot be repaired with a soft stone or crocus cloth, replace components as necessary.

Reassembly

Using bearing installer and hydraulic press, install bearings. Ensure bearings rotate smoothly after installation.

COUNTERSHAFT EXTENSION ASSEMBLY

NOTE: DO NOT remove countershaft extension bearing unless inspection indicates bearing damage. Replace bearing and race as an assembly if necessary.

Disassembly

1. Remove 5th-6th shift fork, thrust washer and 6th gear. Remove needle bearing and spacer. Remove 6th gear synchronizer ring. Remove 5th-6th synchronizer snap ring and discard.
2. Using split plate and hydraulic press, remove 5th gear, 5th-6th synchronizer assembly and 5th gear synchronizer ring. Remove 5th gear needle bearing. Using split plate, press adapter and hydraulic plate, remove bearing. See **Fig. 2** and **Fig. 3** .

Cleaning & Inspection

1. Clean countershaft extension components with solvent and dry with compressed air. DO NOT spin dry bearing. Inspect countershaft and spline for excessive wear or cracks. Inspect gear teeth for excessive wear, pitting, scoring, spalling or breaks.
2. Inspect bearing for rough rotation or burred or pitted condition. If scuffed, nicked, burred or scored condition cannot be repaired with a soft stone or crocus cloth, replace components as necessary.

NOTE: For synchronizer disassembly and reassembly, see SYNCHRONIZERS under COMPONENT DISASSEMBLY & REASSEMBLY.

Reassembly

1. Using bearing installer, "V" blocks and hydraulic press, install countershaft extension bearing. Install 5th gear needle bearing, 5th gear and 5th gear synchronizer ring. Using press tube and hydraulic press, press 5th-6th synchronizer assembly onto countershaft extension.
2. Install synchronizer assembly with inside diameter grove on sleeve facing 5th gear. Start hydraulic press operation but stop before synchronizer keys engage synchronizer ring slots. Lift and rotate 5th gear to engage keys of synchronizer ring. Continue to press until fully seated.
3. Install NEW 5th-6th synchronizer snap ring. Install 6th gear synchronizer ring and spacer. Install 6th gear needle bearing, 6th gear, thrust washer and 5th-6th shift fork.

SYNCHRONIZERS

NOTE: Synchronizer components are not interchangeable. Keep synchronizer components separate. Hubs and sleeve are a matched set and should be kept together as originally assembled.

Disassembly

Using small screwdriver, remove synchronizer springs. Remove keys and synchronizer sleeve from hub. On reverse synchronizer, remove key retainer and discard. See **Fig. 6** .

Cleaning & Inspection

1. Clean components with solvent and dry with compressed air. Inspect synchronizer teeth for wear, nicked, burred or broken teeth. Replace hub and sleeve if excessive wear exists. Inspect keys and springs for wear, cracks or distortion. If scuffed, nicked or burred conditions cannot be repaired with a soft stone or crocus cloth, replace components as necessary.

2. Inspect synchronizer rings for excessive wear. Using a feeler gauge, measure clearance between each synchronizer ring and gear. Ensure rings and gears are matched correctly and rings are fully seated on gear. If clearance for all rings except reverse is less than .025" (.64 mm), replace appropriate synchronizer ring.
3. If clearance for reverse synchronizer ring is less than .030" (.75 mm) when measured without wave washer between gear and ring, replace reverse synchronizer ring.

Reassembly

1. Install synchronizer sleeve to hub. Align key openings in hub with cuts in synchronizer sleeve. Install keys with slots facing hub. Install one synchronizer spring, locating spring tang to one key slot.
2. Turn synchronizer assembly over. Install other synchronizer spring, locating spring tang on same key but wind in opposite direction. Install NEW synchronizer key retainer on reverse synchronizer with retainer tangs over synchronizer keys. See **Fig. 6** .

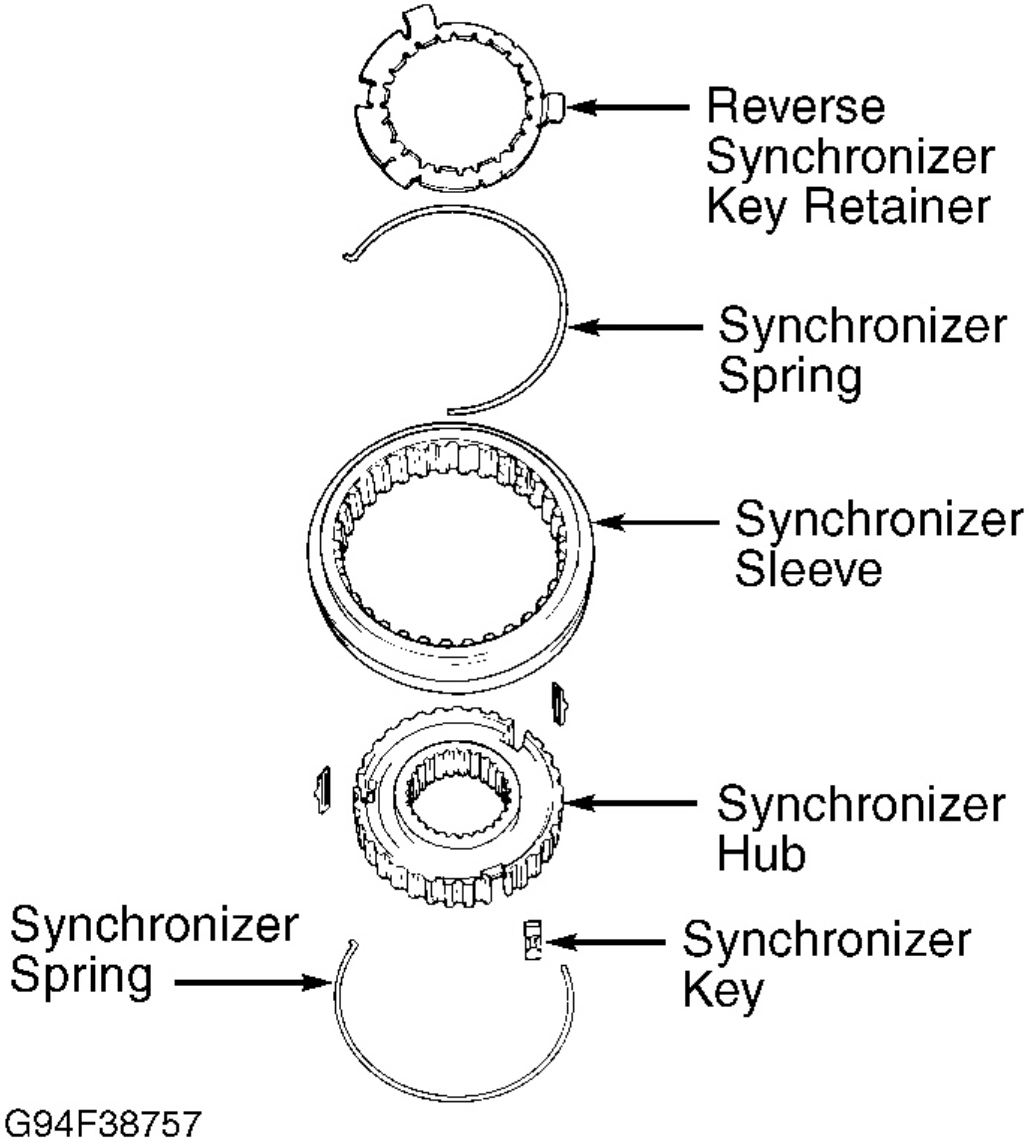


Fig. 6: Exploded View Of Reverse Synchronizer Assembly (Others Are Similar)
Courtesy of GENERAL MOTORS CORP.

SHIFT RAIL ASSEMBLIES

Disassembly (1st-2nd & 3rd-4th Shift Rail)

Rotate selector pin until it is opposite shift links. Remove 1st-2nd and 3rd-4th shift forks with shift links from rail. Remove roll pins and gear select solenoid lever. Remove interlock plate from rail. Remove selector pin roll

pin. Remove selector pin. See **Fig. 7** .

Cleaning & Inspection

Clean components with solvent and dry with compressed air. Inspect shift rail for excessive wear or burrs. Inspect shift forks and shift links for excessive wear, breaks or distortion. Inspect shift fork nylon inserts for excessive wear. Replace components as necessary.

Reassembly

Install selector pin, roll pin and interlock plate to shift rail. Install 1st-2nd and 3rd-4th shift fork with shift link to rail. Install gear elect solenoid lever and roll pins. Align selector pin with slots in shift links.

Disassembly (5th-6th & Reverse Shift Rail)

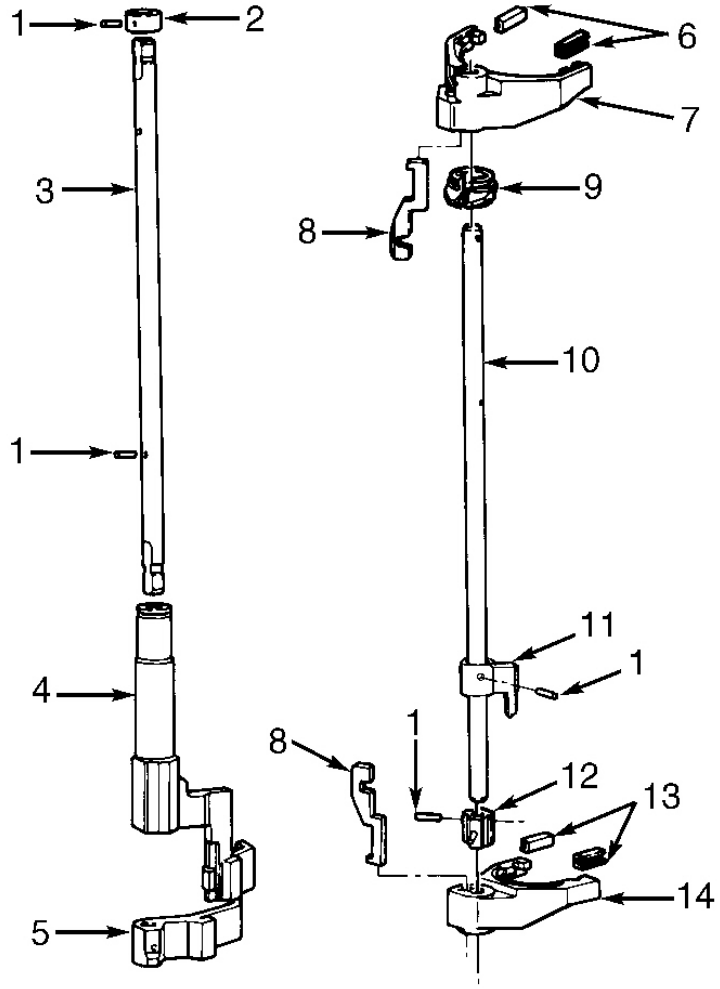
Remove collar roll pin and collar. Remove 5th-6th shift rail lever from rail. Using slide hammer and bushing remover, remove shift rail lever bushings. DO NOT remove bushings unless inspection indicates bushing damage. Remove reverse shift rail lever roll pin and shift rail lever from shift rail. See **Fig. 7** .

Cleaning & Inspection

Clean components with solvent and dry with compressed air. Inspect shift rail for excessive wear or burrs. Inspect shift fork nylon insert for excessive wear. Inspect shift rail levers for excessive wear, fracture or distortion. Inspect shift rail lever bushings for excessive wear. Replace components as necessary.

Reassembly

Install reverse shift rail lever to rail. Locate reverse shift rail lever to roll pin hole at opposite end of rail from snap ring groove. Notched edge of reverse shift rail lever should face toward other roll pin hole. Install reverse shift rail lever roll pin. Install 5th-6th shift rail lever bushings. Install 5th-6th shift rail lever to shift rail. Install collar and collar roll pin.



1. Roll Pin
2. Collar
3. 5th-6th & Reverse Shift Rail
4. 5th-6th & Reverse Shift Rail Lever
5. Reverse Shift Rail Lever
6. 1st-2nd Shift Fork Pad
7. 1st-2nd Shift Fork
8. Shift Link
9. Interlock Plate
10. 1st-2nd & 3rd-4th Shift Rail
11. Gear Select Solenoid Lever
12. Selector Pin
13. 3rd-4th Shift Fork Pad
14. 3rd-4th Shift Fork

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Fig. 7: Exploded View Of Shift Rail Assemblies
Courtesy of GENERAL MOTORS CORP.

TRANSMISSION ADAPTER PLATE

Disassembly

Remove input shaft and counter shaft bearing races and shims. Remove adapter plate plug and input shaft seal. Using bushing remover and slide hammer, remove 1st-2nd and 3rd-4th shift rail bushings. DO NOT remove bushings unless inspection indicates bushing damage. Remove dowel pins. See **Fig. 2** and **Fig. 3** .

Cleaning & Inspection

Clean components with solvent and dry with compressed air. Inspect bearing races and bores for wear, scratches or grooves. Inspect bushings for excessive wear or burrs. Inspect case for cracks and replace if necessary. Inspect sealing surfaces for nicks, burrs or scratches. If scratches, grooves or nicks cannot be removed using a soft stone or crocus cloth, replace component as necessary.

Reassembly

1. Install dowel pins. Using bushing installer, install 1st-2nd and 3rd-4th shift rail bushings. Using seal installer, install input shaft seal. If end play measurement procedure has been performed, install selected shims in appropriate positions.
2. If end play procedure has not been performed, see INPUT SHAFT, MAINSHAFT & COUNTERSHAFT SELECTIVE SHIM PROCEDURE and COUNTERSHAFT EXTENSION SELECTIVE SHIM PROCEDURE under **REASSEMBLY ADJUSTMENTS** . Install countershaft and input shaft bearing races.

TRANSMISSION CASE

Disassembly

Remove fill plug. Remove back-up light switch and dowel pins. Using race remover, removing countershaft and mainshaft bearing races. DO NOT remove bearing races unless inspection indicates bearing race damage. Using bushing remover and drive handle, remove 1st-2nd and 3rd-4th shift rail bushing. See **Fig. 2** and **Fig. 3** .

Cleaning & Inspection

Clean components with solvent and dry with compressed air. Inspect bearing races and bores for wear, scratches or grooves. Inspect bushing for excessive wear. Inspect transmission case for cracks and replace if necessary. Inspect for damaged threads, sealing surfaces for nicks, burrs or scratches. If scratches, grooves or nicks cannot be removed using a soft stone or crocus cloth, replace component as necessary.

Reassembly

Using bushing installer, install 1st-2nd and 3rd-4th shift rail bushing. Install mainshaft and countershaft bearing races. Install dowel pins. Install back-up light switch and fill plug and tighten to specification. See **TORQUE SPECIFICATIONS** .

EXTENSION HOUSING

Disassembly

1. Remove reverse idler shaft bracket bolts and bracket. Remove reverse idler gear thrust washer, idler gear and roller bearing. Remove thrust washer and reverse idler shaft. Remove countershaft extension bearing race and shim. Remove funnel, plug and reverse lockout assembly bolt. See **Fig. 2** and **Fig. 3** .

CAUTION: Reverse lockout assembly is under spring pressure. Exercise caution when removing snap ring to prevent injury.

2. Remove reverse lockout solenoid from reverse lockout body. Remove "O" ring and snap ring from lockout body. Remove reverse lockout inner spring. Compress reverse lockout plunger and collar in vise and remove snap ring. Remove reverse lockout plunger, outer spring and collar. Remove vehicle speed sensor bolt and sensor. Remove "O" ring from sensor. Remove rear seal and boot.
3. Remove mainshaft bearing race snap ring. Using bearing race remover and drive handle, remove mainshaft bearing race. DO NOT remove bearing race unless inspection indicates bearing race damage. Using bushing remover and drive handle, remove shift rail bushing. DO NOT remove bushing unless inspection indicates bushing damage.

Cleaning & Inspection

Clean components with solvent and dry with compressed air. Inspect bearing races and bores for wear, scratches or grooves. Inspect bushing for excessive wear or burrs. Inspect housing for cracks and sealing surfaces for nicks, burrs or scratches. If scratches, grooves or nicks cannot be removed using a soft stone or crocus cloth, replace component as necessary.

Reassembly

1. Using bushing installer and drive handle, install shift rail bushing (if necessary). Using bearing race installer and drive handle, install mainshaft bearing race (if necessary). Install mainshaft bearing race snap ring. Install rear seal and boot with drain hole down. Install NEW "O" ring on speed sensor and install speed sensor. Tighten bolt to specification. See **TORQUE SPECIFICATIONS** .
2. Install reverse lockout plunger, outer spring and collar to reverse lockout body assembly. Compress reverse lockout plunger collar and outer spring in vise and install snap ring. Install reverse lockout inner spring. Install reverse lockout components into reverse lockout body and install snap ring.
3. Install reverse lockout solenoid to reverse lockout body assembly. Tighten solenoid to specification. Install NEW "O" ring to body assembly and install reverse lockout assembly to extension housing. Tighten lockout assembly bolt to specifications. See **TORQUE SPECIFICATIONS** . Install sealant to plug threads and install plug. Tighten plug to specification.
4. If end play measurement procedure has been performed, install selected shim in appropriate locations. If end play procedure has not been performed, see INPUT SHAFT, MAINSHAFT & COUNTERSHAFT SELECTIVE SHIM PROCEDURE and **COUNTERSHAFT EXTENSION SELECTIVE SHIM PROCEDURE** under REASSEMBLY ADJUSTMENTS.

REASSEMBLY ADJUSTMENTS

INPUT SHAFT, MAINSHAFT & COUNTERSHAFT SELECTIVE SHIM

PROCEDURE

1. Position transmission in vertical position. Install input shaft to adapter plate. Install mainshaft to input shaft. Lift mainshaft enough to install countershaft and install countershaft. Install transmission case to adapter plate and install bolts. Tighten bolts to 26 ft. lbs. (35 N.m).
2. Place tip of dial indicator on end of mainshaft. See **Fig. 8** . Measure input shaft/mainshaft end play by moving input shaft up and down. End play should be 0-.002" (0-.05 mm). Select appropriate shim to obtain specification. Remove dial indicator and place tip of dial indicator on end of countershaft.
3. Install Countershaft End Play Measuring Tool (J-39444-1) through adapter plate plug hole. See **Fig. 9** . Measure countershaft end play by moving countershaft up and down. End play should be 0-.002" (0-.05 mm). Select appropriate shim to obtain specification.
4. Remove adapter plate-to-transmission case bolts. Remove transmission case and countershaft. Remove mainshaft from input shaft. Remove input shaft from adapter plate. Remove input shaft and countershaft bearing race. Install selective shim.

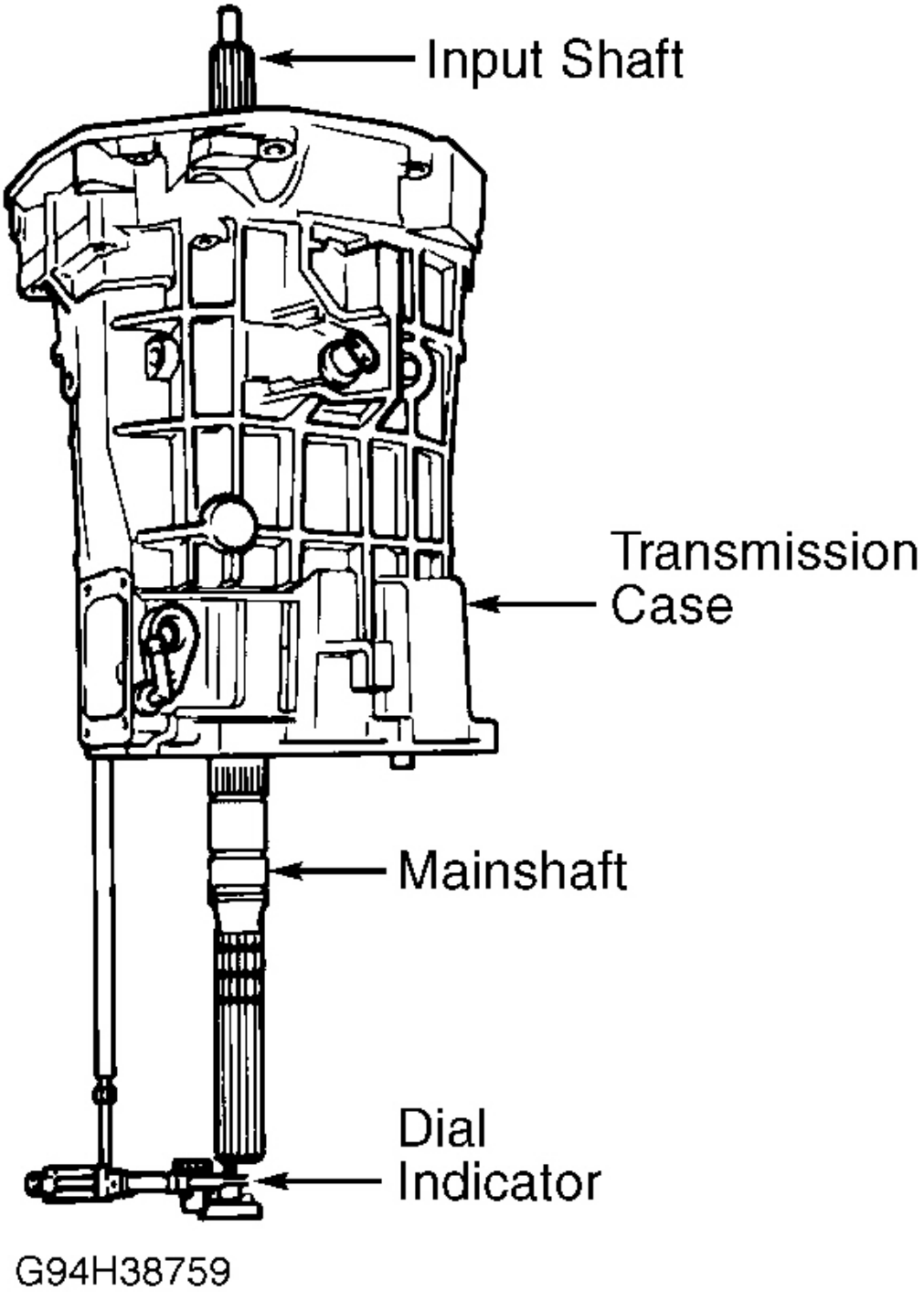

Fig. 8: Measuring Input Shaft & Mainshaft End Play

Courtesy of GENERAL MOTORS CORP.

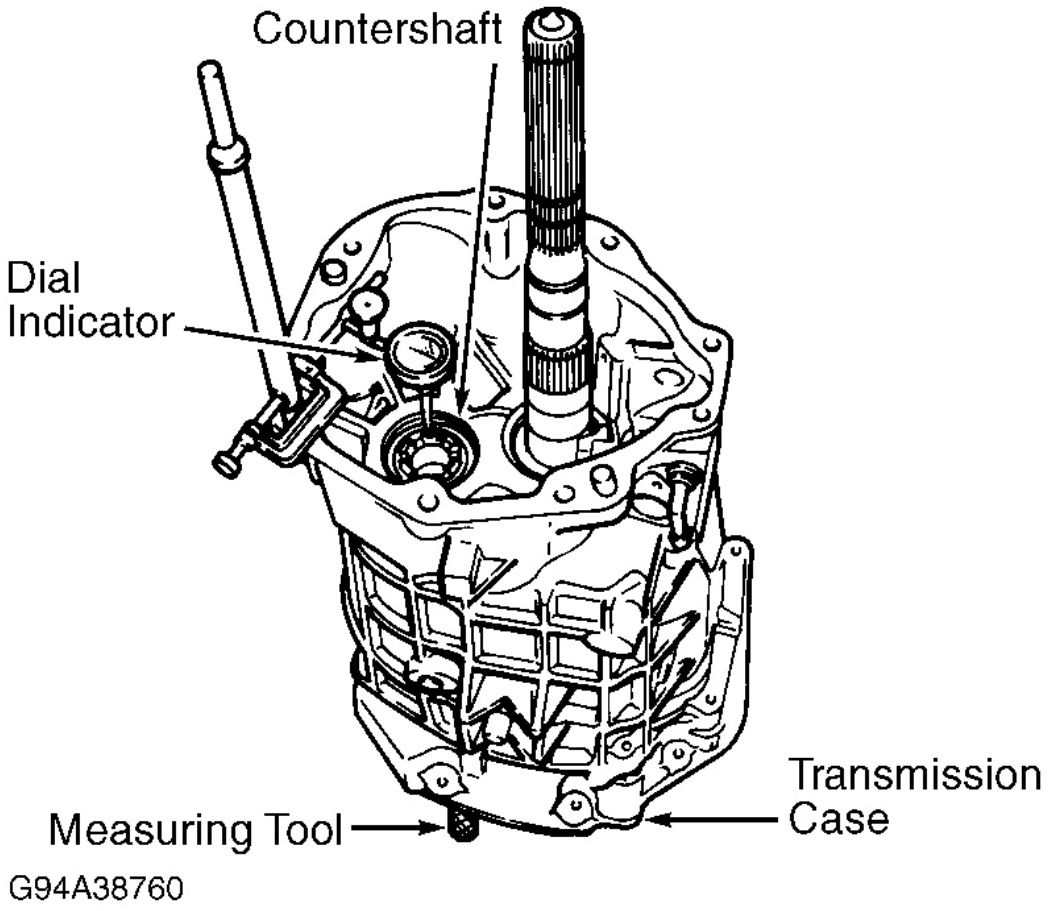

Fig. 9: Measuring Countershaft End Play
Courtesy of GENERAL MOTORS CORP.

COUNTERSHAFT EXTENSION SELECTIVE SHIM PROCEDURE

NOTE: This procedure cannot be performed accurately until countershaft selective shim procedure has been performed, and transmission has been assembled to point of installing countershaft extension.

1. Position transmission in horizontal position. Install countershaft extension to countershaft, ensuring splines fully engage. Install extension housing and bolts. Tighten bolts to 26 ft. lbs. (35 N.m). Install Countershaft Extension End Play Measuring Rod (J-39444-2) through adapter plate plug hole, and screw rod into countershaft extension. See **Fig. 10** .
2. Install dial indicator with tip on end of measuring rod. Position transmission in a vertical position.

Measure countershaft end play using rod to move countershaft extension up and down. End play should be .002-.005" (.05-.13 mm). Select appropriate shim to obtain specification.

3. Remove dial indicator and measuring rod. Apply sealant to plug threads and install adapter plate plug. Tighten plug to specification. See **TORQUE SPECIFICATIONS** . Remove extension housing bolts and extension housing. Remove countershaft extension and countershaft extension bear race. Install selective shim.

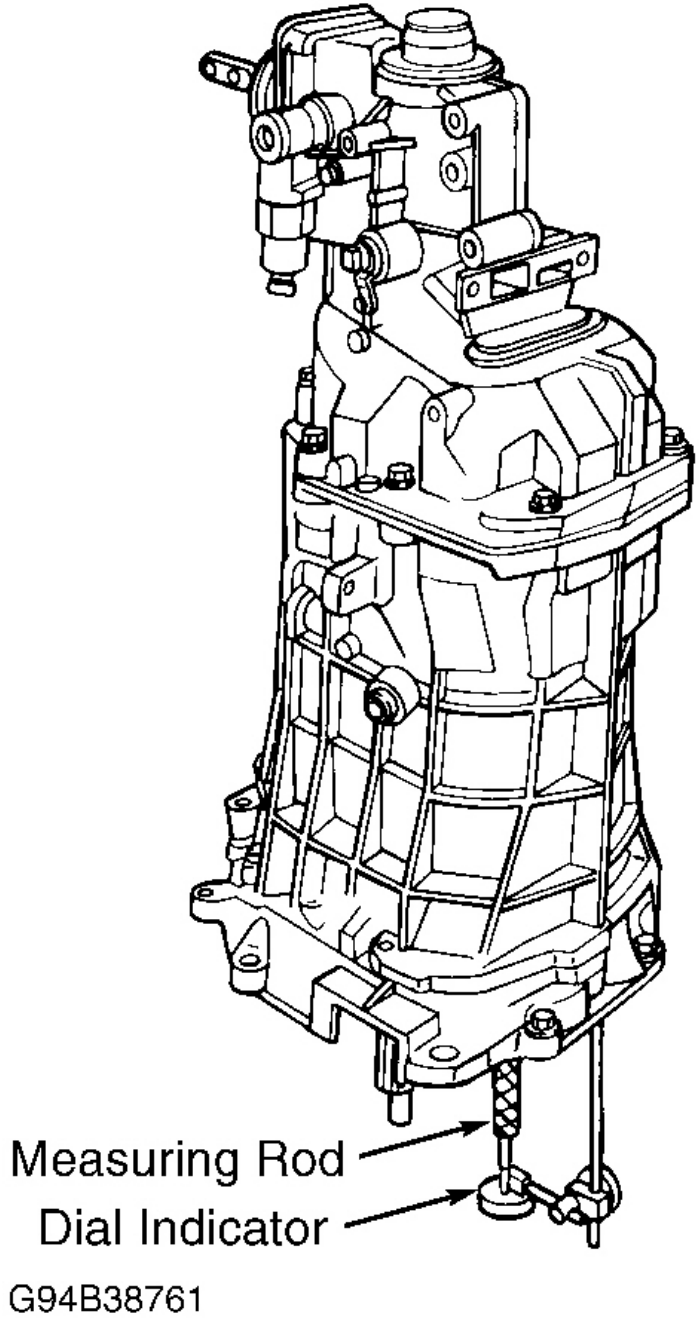

Fig. 10: Measuring Countershaft Extension End Play
Courtesy of GENERAL MOTORS CORP.

TRANSMISSION REASSEMBLY

Reassembly

1. Lubricate all components during reassembly process. Install appropriate selective shims onto adaptive plate. See INPUT SHAFT, MAINSHAFT & COUNTERSHAFT SELECTIVE SHIM PROCEDURE under **REASSEMBLY ADJUSTMENTS** . Install input shaft and countershaft bearing races. Install input shaft and 4th gear synchronizer assembly.
2. Install shift rail assembly to mainshaft assembly. Install mainshaft assembly with shift rail assembly. Lift mainshaft assembly enough to install countershaft assembly. Install countershaft assembly. Lift mainshaft assembly enough to rotate input shaft to engage synchronizer keys with 4th gear synchronizer ring.
3. Install 5th-6th and reverse shift rail. Align slots of shift rail levers with interlock plate. Install sealant at transmission case to adapter plate mating surface. Assemble ball detent in offset lever. Ensure transmission is in Neutral position to keep 3rd-4th shift rail from engaging. Install solenoid lever. See **Fig. 2** and **Fig. 3** . Compress front offset lever together while sliding onto shift rail to prevent spring release of inner components.
4. Slide transmission case onto gear clusters and shift rail components. Apply anaerobic sealer to threads of 2 shift lever guide bolts and install guide bolts. Pull up on 5th-6th and reverse shift rail assembly enough to align slot of shift interlock plate with guide hole. Tighten guide bolts to specification. See **TORQUE SPECIFICATIONS** .
5. Install adapter plate to transmission case bolts and tighten to specification. Install shift detent ball in neutral detent groove of shift guide plate. Install shift detent spring into front offset lever. Install front offset lever and spring to shift guide plate and ball. See **Fig. 2** and **Fig. 3** .
6. Install guide plate and front offset lever together. Lubricate shift rail with assembly lube. Compress guide plate and front offset lever together while sliding onto shift rail to prevent spring release of inner components.
7. Install shift guide plate bolts and tighten to specification. Install front offset lever roll pin and shift detent assembly. Apply anaerobic sealer to threads of shift detent assembly. Tighten shift detent assembly to specification. See **TORQUE SPECIFICATIONS** .
8. Apply sealant to mating surface of cover plate and install cover plate. Install cover plate bolts and tighten bolts to specification. Install gear select solenoid. Install countershaft extension assembly and 5th-6th shift fork with transmission in horizontal position. Ensure splines of countershaft extension engage splines of countershaft. Install 5th-6th shift fork snap ring. See **Fig. 2** and **Fig. 3** .
9. Using gear installer assembly, install 5th-6th gear with smaller outside diameter of gear facing down. Engage splines of 5th-6th gear to shaft splines prior to pressing gear onto shaft. Install reverse shift fork, synchronizer and thrust washer. Install NEW reverse shift fork snap ring. Install reverse synchronizer snap ring.
10. Install reverse gear synchronizer ring. Install wave washer so concave side faces synchronizer ring. Install needle bearing, reverse gear, thrust washer and snap ring. Install spacer, roller bearing, spacer and roller bearing snap ring.
11. Install one speedometer gear snap ring. Install speedometer gear using gear installer assembly. Install other speedometer gear snap ring. Install sealing ring. Install funnel to extension housing.
12. Install appropriate countershaft extension selective shim. See **COUNTERSHAFT EXTENSION SELECTIVE SHIM PROCEDURE** under REASSEMBLY ADJUSTMENTS. Install countershaft extension bearing race. Install reverse idler shaft and thrust washer.
13. Install roller bearing, reverse idler gear and thrust washer. Install reverse idler shaft bracket. Apply

sealant to shift bracket bolt threads and install bolts. Tighten bolts to specification. Apply sealant at extension housing to transmission case mating surface. Align 5th-6th and reverse shift rail with extension housing bore and install extension housing. See **Fig. 2** and **Fig. 3** .

14. Apply sealant to bolt threads retaining transmission bumper. Install extension housing bolts and transmission bumper. Tighten bolts to specification. Install rear offset shift lever and isolator cup. Install rear offset shift lever roll pin.
15. Apply sealant at extension housing to shifter mating surface and install shifter. Tighten bolts to specification. Remove transmission from support fixture and holding fixture. Install clutch fork and "T" handle.
16. Apply sealant to clutch fork bolt threads and install bolt. Install clutch housing and clutch housing bolts. Tighten bolts to specification. Install vent tube.

REVERSE LOCKOUT & GEAR LOCKOUT (SKIP SHIFT) SYSTEM

REVERSE LOCKOUT SYSTEM TEST

NOTE: Reverse lockout system prevents transmission from being shifted into reverse while vehicle is moving. Lockout solenoid is supplied 12-volts with ignition on. Ground circuit is supplied through PCM. Minimal component testing information is available at time of publication.

1. Turn ignition on. Check for battery voltage from fuse at underhood electrical center to reverse lockout and 2nd/3rd gear lockout solenoids (Pink wire). If battery voltage is present, go to next step. If battery voltage is not present, repair circuit as necessary. See **WIRING DIAGRAMS** .
2. Remove solenoid from left side (near top) of gear selector lever tower on transmission. Test by applying 12 volts and ground to solenoid terminals. When activated, solenoid plunger should extend, but can be depressed with thumb pressure.
3. If solenoid operates correctly, Check ground circuit to PCM. If circuit is okay, fault is caused by PCM not completing ground circuit or internal transmission mechanical fault.

GEAR LOCKOUT (SKIP SHIFT) SYSTEM TEST

NOTE: The 2nd/3rd gear lockout solenoid (skip shift solenoid) is located on the left side of the transmission (upper center) below the 4-bolt access cover. Testing information is not available at time of publication.

1. Turn ignition on. Check for battery voltage from fuse at underhood electrical center to reverse lockout and 2nd/3rd gear lockout solenoids (Pink wire). If battery voltage is present, go to next step. If battery voltage is not present, repair circuit as necessary. See **WIRING DIAGRAMS** .
2. Remove solenoid from left side of transmission. Test by applying 12 volts and ground to solenoid terminals.
3. If solenoid operates correctly, Check ground circuit to PCM. If circuit is okay, fault is caused by PCM not completing ground circuit or internal transmission mechanical fault.

TORQUE SPECIFICATIONS

TORQUE SPECIFICATIONS

Application	**Ft. Lbs. (N.m)**
Adapter Plate Plug	20 (27)
Adapter Plate-To-Trans. Bolt	26 (35)
Back-Up Light Switch	20 (27)
Clutch Fork Bolt	18 (24)
Clutch Housing-To-Adapter Plate Bolt	26 (35)
Cover Plate Bolt	15 (20)
Drive Shaft Bolt	16 (22)
Extension Housing Plug	20 (27)
Extension Housing-To-Trans. Bolt	26 (35)
Gear Select Solenoid Lever	15 (20)
Reverse Idler Shaft Bracket Bolt	18 (24)
Reverse Lockout Assembly Bolt	13 (18)
Reverse Lockout Solenoid	30 (41)
Shift Detent Assembly	30 (41)
Shift Guide Plate Bolt	16 (22)
Shift Lever Guide Bolt	20 (27)
Shifter Bolt	15 (20)
Transmission Case Fill Plug	13 (18)
	INCH Lbs. (N.m)
Speed Sensor Retainer Bolt	89 (10)

WIRING DIAGRAMS

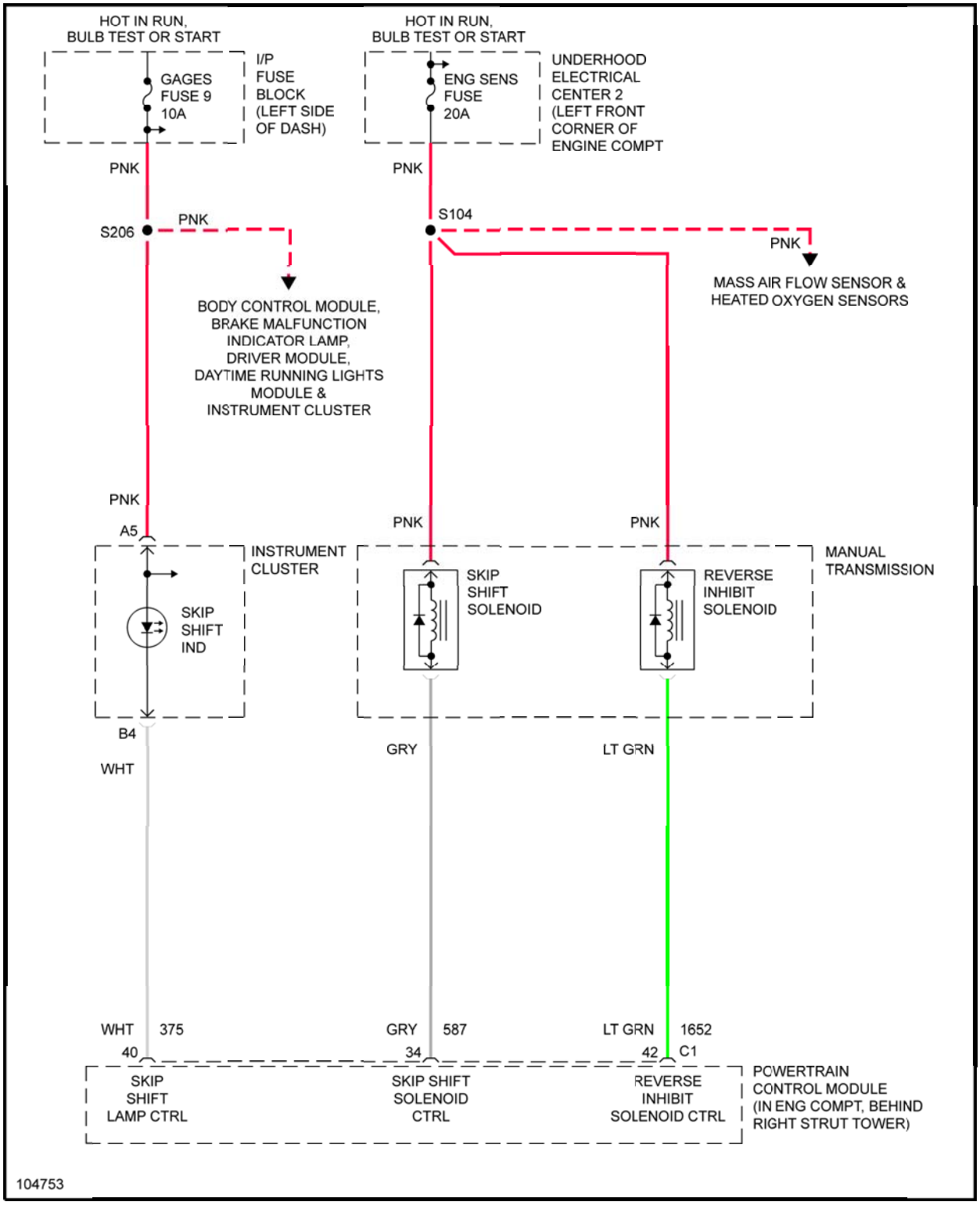
HOT IN RUN, BULB TEST OR START
GAGES FUSE 9 10A
I/P FUSE BLOCK (LEFT SIDE OF DASH)
HOT IN RUN, BULB TEST OR START
ENG SENS FUSE 20A
UNDERHOOD ELECTRICAL CENTER 2 (LEFT FRONT CORNER OF ENGINE COMPT
PNK
PNK
S206
PNK
S104
PNK
BODY CONTROL MODULE, BRAKE MALFUNCTION INDICATOR LAMP, DRIVER MODULE, DAYTIME RUNNING LIGHTS MODULE & INSTRUMENT CLUSTER
MASS AIR FLOW SENSOR & HEATED OXYGEN SENSORS
PNK
A5
PNK
PNK
INSTRUMENT CLUSTER
SKIP SHIFT IND
SKIP SHIFT SOLENOID
REVERSE INHIBIT SOLENOID
MANUAL TRANSMISSION
B4
WHT
GRY
LT GRN
WHT 375
40
GRY 587
34
LT GRN 1652
42 C1
SKIP SHIFT LAMP CTRL
SKIP SHIFT SOLENOID CTRL
REVERSE INHIBIT SOLENOID CTRL
POWERTRAIN CONTROL MODULE (IN ENG COMPT, BEHIND RIGHT STRUT TOWER)
104753

Fig. 11: Camaro & Firebird (5.7L VIN "G") Manual Transmission Solenoids Wiring Diagram

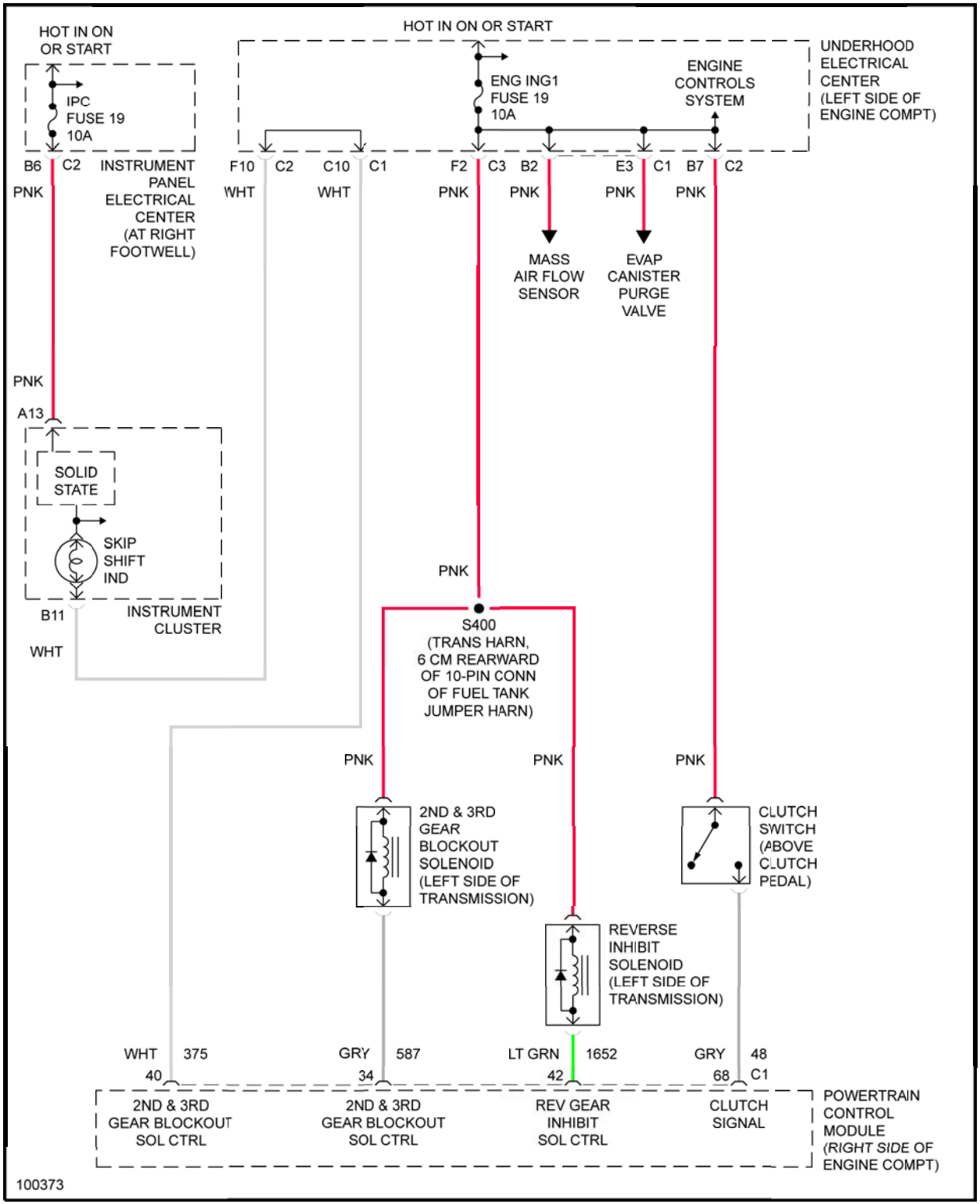
HOT IN ON OR START
IPC FUSE 19 10A
B6 C2
PNK
INSTRUMENT PANEL ELECTRICAL CENTER (AT RIGHT FOOTWELL)
HOT IN ON OR START
ENG ING1 FUSE 19 10A
ENGINE CONTROLS SYSTEM
UNDERHOOD ELECTRICAL CENTER (LEFT SIDE OF ENGINE COMPT)
F10 C2 C10 C1
WHT WHT
F2 C3 B2 E3 C1 B7 C2
PNK PNK PNK PNK
MASS AIR FLOW SENSOR
EVAP CANISTER PURGE VALVE
PNK
A13
SOLID STATE
SKIP SHIFT IND
B11
INSTRUMENT CLUSTER
WHT
PNK
S400 (TRANS HARN, 6 CM REARWARD OF 10-PIN CONN OF FUEL TANK JUMPER HARN)
PNK PNK PNK
2ND & 3RD GEAR BLOCKOUT SOLENOID (LEFT SIDE OF TRANSMISSION)
CLUTCH SWITCH (ABOVE CLUTCH PEDAL)
REVERSE INHIBIT SOLENOID (LEFT SIDE OF TRANSMISSION)
WHT 375 40
GRY 587 34
LT GRN 1652 42
GRY 48 68 C1
2ND & 3RD GEAR BLOCKOUT SOL CTRL
2ND & 3RD GEAR BLOCKOUT SOL CTRL
REV GEAR INHIBIT SOL CTRL
CLUTCH SIGNAL
POWERTRAIN CONTROL MODULE (RIGHT SIDE OF ENGINE COMPT)
100373

Fig. 12: Corvette (5.7L VIN "G") Manual Transmission Solenoids Wiring Diagram