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5-Speed
August 2002

ZF TRANSMISSION MODEL S5-42/S5-47/S5-47M

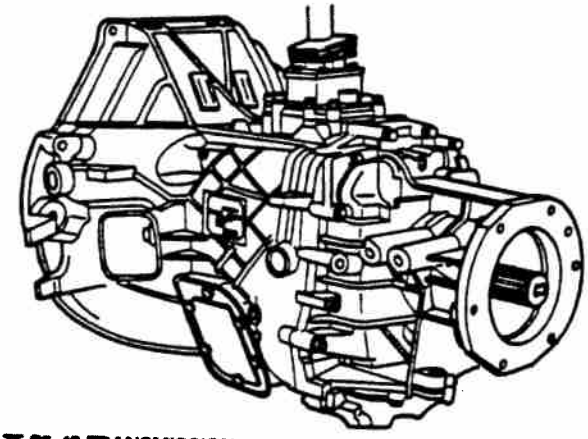
SERVICE MANUAL

DESCRIPTION AND OPERATION (Continued)

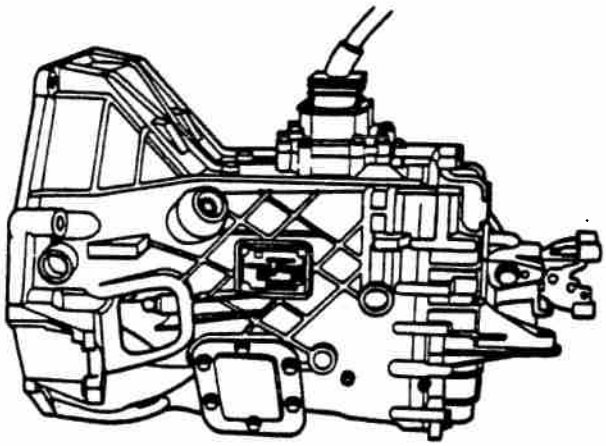
The transmission features an aluminum case (7005) with an integral clutch housing. Because of the aluminum case, the tapered roller bearings of the transmission shafts must be fitted under preload. This is because heat expansion of the aluminum case is greater than that of the steel alloy mainshaft and countershaft cluster gear (7113). If the bearings were not pre-loaded, this would result in excessive end play when the case expands in warm, loaded operating conditions. The transmission also features shrink-fit gears on the countershaft cluster gear. Shrink-fit gears are connected to the countershaft cluster gear by friction only, rather than connected through splines. The gear is heated and lightly pressed onto the countershaft cluster gear. The subsequent cooling of the gear provides the shrink fitting. The countershaft cluster gear is serviced as an assembly.

NOTE: For vehicles equipped with the 7.3L Diesel Engine, this transmission requires use of synthetic MERCON® (Ford part number E6AZ-19582-B, or equivalent meeting Ford specification ESR-M2C163A2) Multi-Purpose Automatic Transmission Fluid or equivalent.

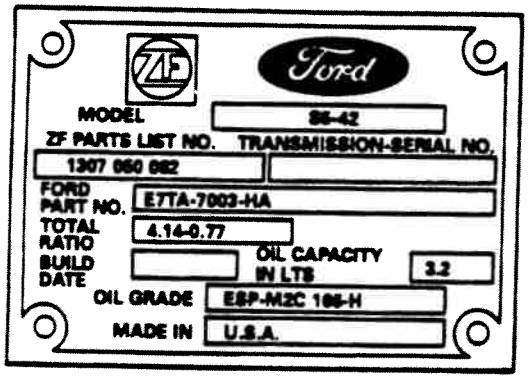
Transmission Identification



ZF S5-42 TRANSMISSION - 4x4 AND F-SUPER DUTY VERSION



ZF S5-42 TRANSMISSION - 4x2 VERSION (EXCEPT F-SUPER DUTY)



TRANSMISSION IDENTIFICATION PLATE

C8182-D

SECTION 07-03B Transmission, Model S5-42 ZF

VEHICLE APPLICATION

F-Series Vehicles Over 8500 lbs. GVW

DESCRIPTION AND OPERATION

Description

The model number for the ZF transmission (7003) is S5-42. This model number can be divided into three parts. First, "S" designates a synchronized transmission. Second, "5" designates the number of forward gears. Finally, "42" is the approximate maximum input torque capacity in tens of lb-ft. In this case 42 equals 420 lb-ft input torque capacity.

The S5-42 ZF transmission is available in both wide ratio and close ratio versions. The wide ratio version is available for all F-Series vehicles over 8500 lbs. GVW, all engines (6007), except F-Super Duty Commercial Stripped Chassis equipped with a diesel engine. The close ratio version is available only in F-Series vehicles with a 7.3L diesel engine and a GVW over 8500 lbs. The ratios are as follows:

	1st	2nd	3rd	4th	5th	Reverse
Close Ratio (Diesel)	4.14	2.37	1.42	1.0	0.77	3.79
Wide Ratio (Gasoline Diesel)	5.72	2.94	1.61	1.0	0.76	5.24

DIAGNOSIS AND TESTING

Inspection and Verification

A troubleshooting guide has been put together to assist in diagnosing transmission-related problems. Use the transmission noise evaluation procedure and troubleshooting guides on the following pages, or refer to Section 08-00. Remember, it is important to get an accurate description of the complaint before any diagnosis can be performed. Ask questions as to whether it occurs hot or cold, during shifting, driving at a particular speed or in a particular gear. If possible, have the customer demonstrate the concern.

Cold Transmission

- Drive the vehicle in all gears (1-5 and reverse gears).
- Evaluate the noise in neutral. Check if there are any noise changes in a particular gear, i.e., 4th gear. In 4th gear, the countershaft cluster gear (7113) is not under load.
- Check if the noise increases when the transmission (7003) is warming up.
- See if the noise is related to engine speed, road speed or gear selection.

Warm Transmission

- Check all gears plus reverse gear and make note of any noise changes in a particular gear.
- Check noise in neutral while parked. Check if the noise disappears at a certain engine rpm or with the clutch pedal depressed.
- Drive in the gear in which the noise is most noticeable. Press in the clutch pedal and leave the gear engaged. If the noise changes or disappears, the noise may be amplified by the vibration of the engine (6007).
- Drive under the same condition again. Press the clutch pedal in and shift into neutral. Release the clutch pedal while the vehicle is coasting down the road. Evaluate the noise, as the rear axle assembly (4006) turns the mainshaft.

Additional Testing For 4x4 Trucks (Non-Electronic Shift)

- Check for any noise change when shifting the transfer case (7A195) between 4x2, 4 high, 4 low or into neutral.
- With the vehicle at a complete stop and the transfer case in neutral, shift through all the gears and evaluate noise at different engine rpm. Check for any noises in neutral at different engine rpm.

NOTE: To isolate clutch concerns from transmission concerns, operate the transmission (7003) at no-load. On 4x4 models, place the transfer case in neutral. Remove the driveshaft on 4x2 models. Run the engine (6007) at 3000 rpm and operate the transmission throughout ranges with the clutch engaged. If hard shifting concern (power to transmission) disappears, the concern may be in the clutch system. An improperly operating clutch can result in hard shifting that is most noticeable in 1st, 2nd, and reverse. The hydraulic release mechanism must work properly. Continued operation with a defective clutch system may result in premature wear or damage of synchronizer (7124).

Hard shifting or difficulty engaging gears may be the result of improper clutch function. Check the release system travel. Minimum travel for the concentric slave cylinder bearing (4.9L and 5.8L engines) and the external system slave cylinder push rod (7.3L and 7.5L engines) is 11mm (7/16 inch). If system travel is less than 11mm, this is an indication of problems in the release system such as excessive flexing of the instrument panel (04320), cracked instrument panel reinforcement at the clutch master cylinder mounting and air or water in the hydraulic clutch hose. Refer to Section 08-00.

If the release system travel is greater than 11mm, and the clutch is suspected, check for clutch reserve as follows:

1. Set the parking brake control (2780) and put the transmission in neutral.
2. With the clutch pedal fully depressed, shift into reverse, then shift half-way between reverse and neutral to defeat the synchronizer.
3. Allow the clutch pedal to fully return and adjust the position of shift control selector lever and housing to obtain light contact between the gear teeth. A slight grind will occur.
4. Slowly depress the clutch pedal until grinding stops. Measure the clutch pedal travel from this position to the full down position (clutch reserve position).

This clutch reserve dimension should be at least 1-1/2 inches. If the reserve is less than 1-1/2 inches, and there are no hydraulic control system concerns, remove the transmission and check for excessive clutch wear. On the 7.3L diesel and 7.5L engines, check for contamination of clutch release hub and bearing and binding on the bearing retainer. Replace the clutch assembly or clutch release hub and bearing as required.

NOTE: On the 4.9L and 5.8L vehicles, the case (7005) is ribbed in order to reduce gear rattle and gear rollover noises.

DIAGNOSIS AND TESTING (Continued)

Symptom Chart

TROUBLESHOOTING GUIDE (Noise While Stopped — Transmission in Neutral)

CONDITION	POSSIBLE SOURCE	ACTION
• Noise Present with Clutch Pedal Fully Depressed	• Engine noise • Clutch release hub and bearing failure. • Pilot bearing failure. • Misaligned transmission.	• REFER to appropriate Shop Manual section for these areas.
• Noise Disappears When Engine rpm Exceeds 1500 Without Depressing Clutch Pedal	• Neutral rollover is caused by the engine firing pulses transmitted through the gear set. Some neutral rollover is normal on the 7.5L application. The dual mass flywheel on the 7.3L Diesel and the two stage clutch on the 4.9L and 5.8L should eliminate this concern on these engines.	• CHECK engine idle quality and speed. A rough or low idle will aggravate this concern.
• Noise Present at Engine Speeds Above Idle	• Insufficient lubrication. • Damaged tapered roller or first and second speed gear bearing. • Scuffed gear tooth contact surfaces.	• DRAIN oil (when required) and FILL with the correct oil, conforming to Ford's specification ESP-M2C-166H Type "H" or MERCON® (Motorcraft). • INSPECT for failure. PAY special attention to the mainshaft front bearing (pocket bearing), located between the input shaft and mainshaft. TURN the gears on the mainshaft to check for failure of needle bearings by feeling for roughness. • DISASSEMBLE transmission and check gear tooth contact surfaces. REPLACE gears as required.
• Noise on PTO-Equipped Transmissions. Remove the PTO and Install a Cover. Evaluate for Noise Without PTO	• Incorrect PTO gear mesh due to: Wrong model PTO, incorrect installation, defective PTO.	• CHECK the mating teeth on countershaft cluster gear and also on the gear of the input shaft for damage. If any parts are damaged, REPLACE. CONTACT PTO supplier / manufacturer to VERIFY model usage, shimming and PTO quality.

TROUBLESHOOTING GUIDE (Noise While Driving)

CONDITION	POSSIBLE SOURCE	ACTION
• Noise is Present in All or Several Gears. Noise Occurs at High and Low Engine Speeds and May Vary with Engine Speed	• Worn or rough output shaft rear bearing. • Needle bearing under mainshaft gears damaged. • Wrong preload on main or cluster shaft bearings. • PTO installed incorrectly.	• DISASSEMBLE transmission and INSTALL new output shaft rear bearing on mainshaft. • REPLACE needle bearing and gear. • DISASSEMBLE transmission and CORRECT preload. • CHECK PTO installation.
• "Rattle" Noise When Taking Off from a Stop and Driving at Less Than 1000 rpm	• "Lugging Rattle."	• OPERATE truck without "lugging." Condition will not shorten the life of the transmission.
• "Clunking" Noise When Shifting or Speeding Up or Slowing Down. Condition is Worse on Bumpy Surfaces	• Freeplay in the system (clutch through axle and fuel injector shutoff timing). Some clunk is normal with the 4.9L and 5.8L. • Loose yoke nut.	• CHECK for excessive backlash of rear axle assembly. Clunk cannot be corrected by repairing transmission unless a defect is evident. • INSTALL a new Spiral Locknut. No staking required. TIGHTEN to 270 N·m or 200 lb-ft.
• Noise While Driving in One Gear Increases With Road Speed	• Worn, imperfect or chipped gear teeth on the affected gear.	• REPLACE affected mating gears.

DIAGNOSIS AND TESTING (Continued)

TROUBLESHOOTING GUIDE (Noise While Driving) (Continued)

CONDITION	POSSIBLE SOURCE	ACTION
• "Whining" Noise at High Engine RPM in 3rd and 5th Gear	• Worn input shaft gear and countershaft drive gear.	• CHECK noise level in 4th gear under same engine conditions. If noise level is less, REPLACE the input shaft and countershaft cluster gear. INSPECT and REPLACE other gears as required.
• Shift Lever "Buzz" Present While Driving, Not Present During a Neutral Engine Run Up While Parked	• Upper shift control selector lever damaged or loose. • Lower shift control selector lever defective.	• CHANGE shift control selector lever. If "buzz" is still present, SEE in which gear the buzz occurs. DISASSEMBLE and INSPECT specific gear. CHECK guide pieces for clearance. • REPLACE lower shift control selector lever. Shift lever E9TZ-7210-G is less sensitive to vibration than earlier design.
• Shift Lever "Rattle" in Neutral Engine Run Up, Primarily Diesel 4x4	• Gearshift lever may not have plastic bushing at the pivot. • Gearshift lever boot incorrectly installed.	• CHECK by temporarily removing the gearshift lever boot. REPLACE if the noise is gone. • Gearshift lever boot must make air-tight seal to shift control selector lever. REPLACE gearshift lever boot if stretched or sealing surface is damaged.
• Moan or Vibration on F-Super Duty at Road Speeds Greater Than 50 MPH	• Aftermarket modifications to frame or driveshaft.	• Non-factory driveshafts should be inspected for: • Size • 0 to 51 inches long — 3 inch diameter tube is OK. • Up to 55 inches long — 3-1/2 inch diameter tube is required. • Up to 59 inches long — 4 inch diameter tube is required. • Working angles greater than 1/2° but less than 3°. • System balanced to within 0.4 in/oz. at the ends and 0.8 in/oz. at the driveshaft center bearing bracket.
• Hard Shift (Particularly 1st, 2nd and Reverse)	• Clutch not releasing completely. • Operator not fully depressing clutch pedal. • Flexing of instrument panel. • Hydraulic clutch hose routed too close to exhaust manifold. • Air/water in hydraulic clutch hose. • Insufficient reserve of synchronizer (a defective clutch system can result in premature loss of synchronizer reserve).	• SEE clutch procedure at the end of this diagnosis guide, or Section 08-00 in this manual. • INTERVIEW operator. • REPAIR instrument panel. • MOVE or SHIELD hydraulic clutch hose. • BLEED clutch system. • REPLACE complete synchronizer and corresponding gear, if required.

DIAGNOSIS AND TESTING (Continued)

TROUBLESHOOTING GUIDE (Shift Concerns)

CONDITION	POSSIBLE SOURCE	ACTION
• Notchy Shifting	• Some notchiness is normal (especially in 3rd gear).	• For excessive notchiness REPLACE with revised synchronizers: 1/2 F0TZ-7124-D 3/4 F0TZ-7124-E 5/R F0TZ-7124-C
• "Grinding" Noise During Shifting	• Synchronizer cone too smooth (after a few thousand miles).	• DO 3 to 5 hard shifts with high engine RPM. If noise is still present, DISASSEMBLE and CHECK for damage (darkened patches OK). REFER to Synchronizer Ring/Synchronizer Body Wear Check, in this section.
	• Synchronizer ring defective.	• CHANGE synchronizer.
	• Insufficient wear limit of synchronizer ring.	• CHANGE synchronizer.
• Walking or Jumping Out on Rough Roads	• Interference or resistance in the mechanism preventing full engagement of the sliding collar.	• REMOVE and DISASSEMBLE transmission and CHECK profile of internal grooves in the sliding sleeve.
	• If sliding collar has been shifted completely into position, some other malfunction could move sliding collar and shift control selector lever out of its proper location.	• CHECK for shift lever interference. The stub lever, gear shift finger or shift forks could be worn. REMOVE transmission and REPLACE damaged parts.
• Note Whether the Unit Walks Out of Gear Under Drive or on a Coast Load. Also, Does the "Walkout" Occur on Smooth or Only on Rough Roads? A Number of Items that Would Prevent Full Engagement of Gears Are:	• Worn or loose engine mounts.	• CHECK engine mounts.
	• Shift fork pads or groove in sliding collar worn excessively.	• REMOVE and DISASSEMBLE transmission and REPLACE damaged parts.
	• Transmission and engine out of alignment either vertically or horizontally.	• MAKE sure transmission is tightly bolted to the engine.
• Walk or Jump Out on Rough Roads	• Use of heavy shift lever extensions.	• Use original equipment gearshift lever. INSTALL heavy duty detent springs (E8TZ-7E218-A).
	• Shifter interlock springs broken or missing.	• REMOVE detent spring plug on detent and REPLACE shifter interlock springs.
	• Detent spring plug not pressed in properly.	• REPLACE with new detent spring plug and PRESS in 1mm (3/64 inch).
	• No preload in drive gear, mainshaft or countershaft cluster gear, caused by worn bearings.	• REMOVE and DISASSEMBLE transmission and REPLACE defective bearings (necessary to reset bearing preload).
	• Grated selector teeth.	• CHANGE synchronizer and gear.
• Excessive Shift Control Selector Lever Movement in 3rd Gear	• 3-4 synchronizer body snap ring not seated in groove on output and fifth gear driveshaft.	• DISASSEMBLE and REPLACE affected parts, PAYING special attention to 3-4 synchronizer, input gear, input shaft pocket bearing and shift fork.
• Gear Cannot Be Engaged	• Clutch not releasing (see hard shift).	• CHECK clutch per procedure at the end of this diagnosis guide, or Section 08-00.
	• Gear selector interlock sleeve jammed in transmission.	• If bent or damaged, REPLACE the gear selector interlock sleeve.
	• Damage to teeth on sliding collar or improper installation (dog teeth worn).	• REPLACE or CORRECT synchronizer. CHECK for damage on the corresponding mainshaft gear in clutch teeth area. REPLACE as required.
	• Jammed pressure pieces in synchronizer.	• REMOVE and DISASSEMBLE transmission and REPLACE pressure pieces.
	• Shift rails out of proper position.	• REPLACE all shift rails, detents and gear selector interlock sleeve.

DIAGNOSIS AND TESTING (Continued)

TROUBLESHOOTING GUIDE (Shift Concerns) (Continued)

CONDITION	POSSIBLE SOURCE	ACTION
• Sticking in Gear	• Clutch not releasing (see hard shift above). • Gear selector interlock sleeve jammed in transmission. • Sliding collar tight on splines (dog teeth damaged).	• CHECK clutch per procedure at the end of this diagnosis guide, or Section 08-00. • If bent or damaged, REPLACE the gear selector interlock sleeve. • REMOVE and DISASSEMBLE transmission.
• Stuck in Gear	• Shift rails out of proper position.	• REPLACE all shift rails, detents and gear selector interlock sleeve.
• High Shift Efforts	• Lack of lubricant or wrong lubricant used, causing build-up of sticky and sludgy deposits on splines of sliding collar. • Case bushing rough, or dragging. • Clutch not releasing (see hard shift above). • Damaged input shaft pocket bearing.	• INSPECT through the PTO openings. If sludge is present, REMOVE and CLEAN the transmission. • Place transmission in 4th gear and ROTATE the mainshaft by hand while the clutch is depressed. If a roughness is felt, REMOVE the case bushing, INSPECT and REPLACE the bearing and input shaft, if required (input bearing preload must be RESET if input shaft is replaced.) • INSTALL a new input shaft and input shaft pocket bearing (necessary to reset bearing preload).
• High Shift Effort in One Gear Only	• Sliding sleeve tight on splines. • Synchronizer teeth chipped or badly mutilated. • Binding or interference of shift control selector lever with other objects or rods inside the cab. • Mainshaft gears seized or galled on either the thrust face or diameters. • Synchronizer (wear limit too low, fractures). • Synchronizer cone smoothness.	• REMOVE transmission and REPLACE affected synchronizer. • REMOVE and DISASSEMBLE transmission and REPLACE damaged parts. • CHECK shift operation in cab. • REMOVE and DISASSEMBLE transmission, REPLACE synchronizer and other affected parts. • REMOVE and DISASSEMBLE transmission, REPLACE synchronizer and other affected parts. • MAKE 3 to 5 hard shifts with high engine rpm.
• High Shift Efforts in Cold Weather, All Gears	• Incorrect, hi-viscosity fluid.	• INSTALL Type H or MERCON® fluid. ROAD TEST the vehicle to IDENTIFY possible damage caused by the wrong fluid. Synthetic MERCON® E6AZ-19582-B will improve cold weather shiftability.

DIAGNOSIS AND TESTING (Continued)

TROUBLESHOOTING GUIDE (Leak Concerns)

CONDITION	POSSIBLE SOURCE	ACTION
• Leak at Case Cover	• Reused or damaged case cover gasket.	• REPLACE with new case cover gasket. Anaerobic Sealant E3AZ-19554-AA meeting Ford specification WSK-M2GA9 can be used with the new gasket.
• Leak at Case Plug	• Sealing ring missing from case plugs (transmissions with an E9TA prefix or later have a sealing surface machined on the housing). • (Transmissions with an F4TA prefix have a sealing ring on the plug with rubber centering feature for improved sealing.)	• INSTALL a new sealing ring. • INSTALL a new sealing ring.
• Leak at Transfer Case Cover	• Bolts loose or damaged transmission case deflector gasket.	• REPLACE transmission case deflector gasket, TIGHTEN bolts to 38 N·m (28 lb-ft).
• Leak at Detent Spring Plug	• Reused or damaged detent spring plugs.	• USE new detent spring plugs when reassembling. Do not DEFORM case around detent spring plug to retain.
• Leak at Large Welch Plug Inside Flywheel Housing. Look for Cracks Around the Hole	• Improper assembly.	• RESEAL, USING Gasket Maker E3AZ-19554-AA or equivalent meeting Ford specification WSK-M2G348-A9. If cracked, REPLACE flywheel housing.
• Leak at Input Shaft Bearing Oil Passage Plug (Inside Flywheel Housing w/7.5L and 7.3L Engine and on Left Side w/4.9L and 5.8L Engine)	• Improper assembly.	• RESEAL, USING Gasket Maker E3AZ-19554-AA or equivalent meeting Ford specification WSK-M2G348-A9. If cracked, REPLACE flywheel housing.
• Leak at Output Shaft Oil Seal	• Output yoke nut loose or improperly staked (4x2, except F-Super Duty).	• REPLACE seal, USING new locknut. TORQUE to 270 N·m (200 lb-ft). **CAUTION: Do not reuse locknut.**
• Leak at Input Oil Seal	• Improper assembly. Seal lip may have rolled during assembly, garter spring may have become dislodged during a previous repair.	• REPLACE front pump support seal USING extreme caution that input shaft does not contact the oil seal during reassembly (if the seal lip is rolled, leaking may not occur for several hundred miles).
• Leak Between Quill Pipe and Flywheel Housing (7.3L and 7.5L Engines Only)	• Damaged O-ring during assembly.	• REMOVE quill pipe, INSPECT sealing surfaces and REPLACE O-ring. LUBRICATE O-ring prior to assembly to PREVENT damage.
• Leak at Case Joint	• Damaged mating surfaces or assembly error.	• REPAIR or REPLACE damaged case. RESEAL with Gasket Maker, E3AZ-19554-AA or equivalent meeting Ford specification WSK-M2G348-A9. TORQUE bolt to 23 N·m (17 lb-ft).

DIAGNOSIS AND TESTING (Continued)

TROUBLESHOOTING GUIDE (Miscellaneous Concerns)

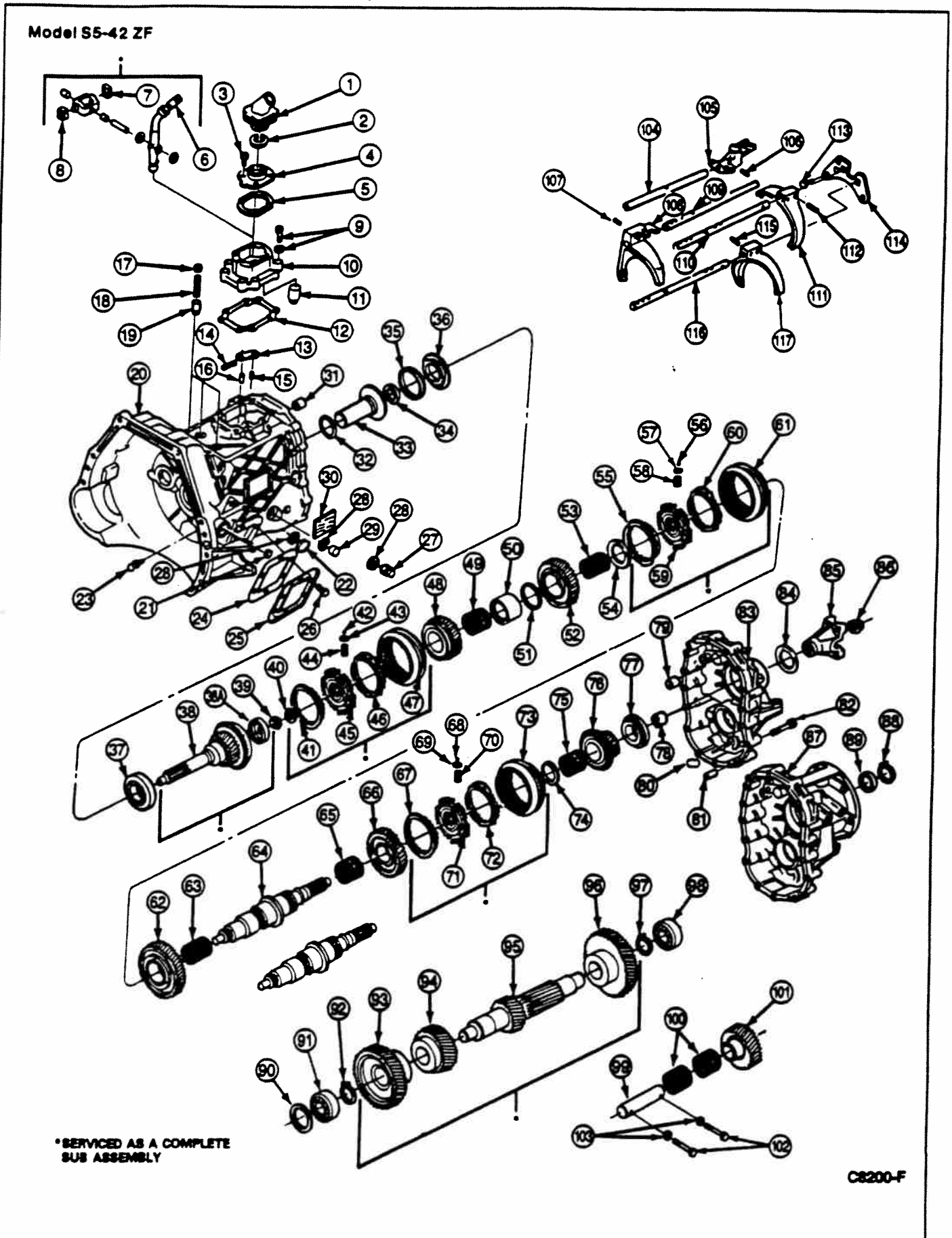
CONDITION	POSSIBLE SOURCE	ACTION
• Cracked Flywheel Housing	• Drivetrain vibration: • Caused by assembly error. • Vehicle modification (drive shaft lengthened or shortened).	• CHECK the integrity of driveshaft attachment. • Non-factory driveshafts should be inspected for: • Size • 0 to 51 inches long — 3 inch diameter tube is OK. • Up to 55 inches long — 3-1/2 inch diameter tube is required. • Up to 59 inches long — 4 inch diameter tube is required. • Working angles greater than 1/2° but less than 3°. • System balanced at 3000 rpm to within 0.4 in./oz. at the ends and 0.8 in./oz. at the center support.
• Cracked Rear Engine Mount Transmission Attachment Ears	• Broken front engine mounts. • Vibration caused by a driveline imbalance. • Rear mount upper flange not flat.	• INSPECT and REPLACE front engine mounts if required. • SEE above. • REPLACE rear mount.

DIAGNOSIS AND TESTING (Continued)

TROUBLESHOOTING GUIDE — BEARING FAILURE

CONDITION	POSSIBLE SOURCE	ACTION
• NOTE: The service life of most transmissions is governed by the life of the bearings. The majority of bearing failures can be related to driveline vibration or contamination of the fluid. Additional reasons for bearing failures are:	• Extended start-up idle in extreme cold may lead to wear of input shaft pocket bearing.	• Synthetic MERCON® E6AZ-19582-B or equivalent meeting Ford specification ESR-M2C163-A2 provides improved lubrication when transmission temperatures remain below minus 20°F for extended periods. Synthetic MERCON® is required in vehicles equipped with 7.3L Diesel Engine.
	• Any combination of operation at or above GVW in high ambient temperatures, on steep grades, or vehicles with high frontal areas (exceeding 60 square feet) can affect all bearings due to temperature buildup.	• Heat buildup may cause break down of the ATF. Synthetic MERCON® can withstand higher operating temperatures.
	• Input shaft pocket bearing not lubricated due to missing, damaged or misinstalled front bearing oil scoop ring.	• REPLACE damaged components and MAKE sure of proper installation of front bearing oil scoop ring. CHECK for proper installation of the snap ring, which retains the 3-4 synchronizer, on the mainshaft next to the front bearing oil scoop ring.
	• Damage due to towing a vehicle greater than 50 miles or at speeds exceeding 35 MPH with the driveshaft installed. Gear bearings are especially susceptible to damage.	• PROVIDE correct towing procedures to tow operator.
	• Vibration break-up of retainer and brinelling of races-fretting corrosion.	• REFER to restrictions of mainshaft in the Miscellaneous Concerns chart of this diagnosis guide.
	• Incorrect preload causes faster wearing of the bearings, due to incomplete contact area.	• Be sure to FOLLOW preload setting procedure in this section.
	• Lack of lubricant or wrong type.	• CHECK for leaks and REPAIR as required. REPLACE with correct fluid.
	• Acid etch of bearing due to water in lube.	• IDENTIFY and CORRECT source of water entry.
	• Worn out due to other part failure.	• REMOVE, DISASSEMBLE and CLEAN the transmission, then REPLACE damaged parts (necessary to reset bearing preload if any bearings are replaced).

DIAGNOSIS AND TESTING (Continued)



DIAGNOSIS AND TESTING (Continued)

Item	Part Number	Description
1	7277	Gearshift Lever Boot
2	7D152	Snap Ring
3	N603264	Capscrew
4	7262	Gearshift Lever Boot Retainer
5	7207	Gasket
6	7210	Shift Control Selector Lever
7	7C371	Guide Piece
8	7C371	Guide Piece
9	7C015	Hex Bolts and Washers
10	7203	Shift Control Housing
11	7E218	Shift Detent Plunger Assembly
12	7185	Gasket
13	7F194	5th-Reverse Interlock
14	7234	Shifter Interlock Spring
15	7B096	Interlock Roll Pin
16	7B096	Interlock Roll Pin
17	7L013	Detent Spring Plug
18	7N120	Spring
19	7247	Shift Rail Detent Plunger
20	7005	Case
21	7L018	Case Plug
22	7A010	Case Plug
23	7B602	Clutch Release Lever Stud
24	7166	Transmission Case PTO Gasket
25	7165	PTO Cover
26	304650	Bolt
27	15520	Backup Lamp Switch
28	7L101	Sealing Ring
29	7A010	Case Plug
30	—	ID Plate (Part of 7003)
31	7D362	Central Shift Rail Bearing
32	7288	Shifter Shaft Seal
33	7050	Release Bearing Guide Tube
34	7052	Oil Seal
35	7029	Input Bearing Front Shim
36	7040	Oil Baffle
37	7025	Case Bearing
38	7017	Input Shaft
38A	7046	Front Bearing Oil Scoop Ring
39	7120	Input Shaft Pocket Bearing
40	7B331	Small Parts Repair Kit
41	—	Gear Synchronizer Ring (Part of 7124)
42	—	Ball (Part of 7B331)
43	7124	Synchronizer
44	—	Spring (Part of 7B331)
45	—	3rd-4th Synchronizer Body (Part of 7124)
46	—	3rd Gear Synchronizer Ring (Part of 7124)
47	—	3rd-4th Sliding Sleeve (Part of 7124)
48	7186	3rd Gear

(Continued)

Item	Part Number	Description
49	7133	Caged Needle Roller Bearing
50	7173	3rd Speed Bearing Spacer
51	7114	Thrust Washer
52	7103	2nd Gear
53	7133	1st Speed Gear Bearing
54	7B331	Small Parts Repair Kit
55	7124	2nd Gear Synchronizer Ring
56	7124	Ball
57	7124	Pressure Piece
58	7124	Spring
59	7124	1st-2nd Synchronizer Body
60	7124	1st Gear Synchronizer Ring
61	7124	1st-2nd Sliding Sleeve
62	7100	First Gear
63	7127	Gear Bearing
64	7061	Mainshaft
65	7127	Reverse Gear Bearing
66	7141	Reverse Idler Gear and Bushing
67	7124	Reverse Gear Synchronizer Ring
68	7124	Ball
69	7124	Pressure Piece
70	7124	Spring
71	7124	5th-Reverse Synchronizer Body
72	7124	5th-Gear Synchronizer Ring
73	7124	5th-Reverse Sliding Sleeve
74	7B331	Small Parts Repair Kit
75	7121	5th Gear Bearing
76	7158	5th Gear
77	7R205	Output Shaft Rear Bearing
78	7072	Spacer
79	7D362	Central Shift Rail Bearing
80	7E290	Magnet
81	—	Dowel (Part of 7003)
82	7A443	Bolt
83	7A039	Extension Housing (4 x 2)
84	7052	Oil Seal
85	7089	Output Yoke (4 x 2)
86	7045	Output Yoke Locknut (4 x 2)
87	7A039	Extension Housing (4 x 4)
88	7B331	Small Parts Repair Kit
89	7052	Oil Seal
90	7119	Thrust Washer
91	7065	Output Shaft Bearing
92	7064	Output Shaft Snap Ring
93	7113	Countershaft Drive Gear
94	7113	Countershaft 3rd Gear
95	7113	Countershaft Cluster Gear
96	7113	Countershaft 5th Gear
97	7064	Output Shaft Snap Ring
98	7065	Output Shaft Bearing
99	7140	Reverse Idler Gear Shaft
100	7E139	Reverse Idler Gear Bearing

(Continued)

DIAGNOSIS AND TESTING (Continued)

Item	Part Number	Description
101	7141	Reverse Idler Gear
102	7214	Reverse Idler Gear Shaft Bolt
103	7K267	Sealing Ring
104	7240	Main Gear Shift Rail
105	7243	Gear Shifter Fork
106	7B096	Roll Pin
107	7B096	Roll Pin
108	7230	3/4 Shifter Fork

(Continued)

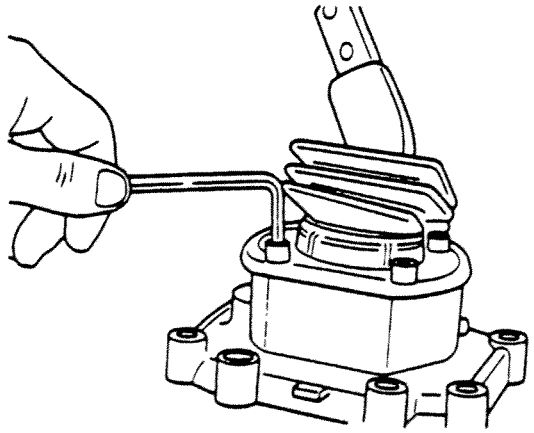
Item	Part Number	Description
109	7241	3/4 Reverse Shift Rail
110	7242	5/Rev Shift Rail
111	7231	5/Rev Shift Fork
112	7B096	Roll Pin
113	7A443	Bolt (3)
114	7K201	Gear Selector Interlock Plate
115	7B096	Roll Pin
116	7358	1/2 Shift Rail
117	7239	1/2 Shift Fork

REMOVAL

Transmission (4x2)

1. Shift the transmission (7003) into neutral.
2. Remove the four screws and remove the gearshift lever boot and gearshift lever boot retainer from the shift control housing.
3. Remove the two bolts and remove the upper shift control selector lever and housing from the lower shift control selector lever and housing.
4. **CAUTION: Remove lower shift control selector lever and housing from the vehicle to prevent getting transmission fluid on the front floor mat or floor carpet.**

   Remove the four Allen-head capscrews from the shift control housing and remove the entire shifter assembly from the top of the transmission.



C8734-1A

5. NOTE: The following step applies only to vehicles equipped with diesel engines.

   Loosen marman clamp at wastegate housing exhaust outlet.
6. Raise the vehicle on a hoist and position safety stands under the vehicle.
7. NOTE: Steps 7-9 apply only to vehicles equipped with diesel engines.

   Remove bolt retaining engine charge exhaust pipe to transmission housing.
8. Remove nuts retaining exhaust extension pipe to muffler and pipe assembly.
9. Remove engine charge exhaust pipe and extension pipe.
10. Disconnect the backup lamp switch (15520) located at the top left hand side of the transmission.
11. If the transmission is to be disassembled, remove the case plug (7A010) and drain the oil from the transmission.
12. Position a transmission jack, such as Rotunda Transmission Jack 077-00008 or equivalent under the transmission. Secure the transmission to the jackstand.
13. Remove the driveshaft (4602) from the vehicle. Disconnect the clutch linkage from the transmission. Refer to Section 05-01 and Section 08-02. Keep transmission in upright position to avoid fluid leakage.
14. On F-Super Duty series vehicles remove the transmission parking brake from the transmission. Refer to the Body, Chassis Manual, Section 06-05. Keep parking brake in upright position to avoid fluid leakage.
15. Remove the transmission rear insulator and lower retainer. Remove the rear engine support (6A023) as described in Section 02-03.
16. Remove the bolts that retain the transmission to the engine (6007).
17. Move the transmission to the rear until the input shaft (7017) clears the flywheel (6375). Lower the transmission from the vehicle. Keep transmission in upright position to avoid fluid leakage.

REMOVAL (Continued)

Transmission (4x4)

1. Shift the transmission (7003) into neutral.
2. Remove the four screws and remove the boot and bezel assembly from the transmission opening cover.
3. **CAUTION: Remove lower lever from the vehicle to prevent getting transmission fluid on the floor mat or carpet.**

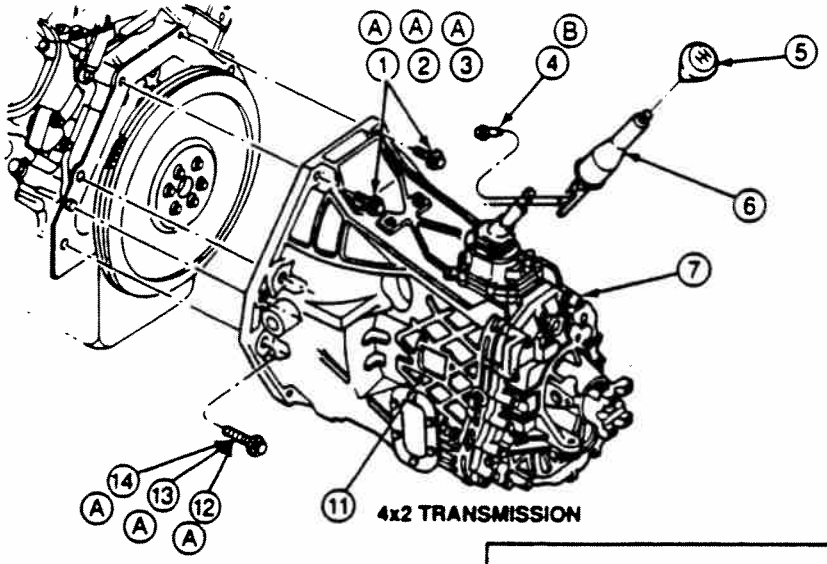
   Remove the four Allen-head capscrews from the shift tower cover and remove the entire shifter assembly from the top of the transmission.
4. NOTE: The following step applies to 7.3L diesel engine vehicles only.

   Loosen marman clamp at wastegate housing exhaust outlet.
5. Raise the vehicle on a hoist and position safety stands under vehicle.
6. NOTE: Steps 6 and 7 apply to 7.3L diesel engine vehicles only.

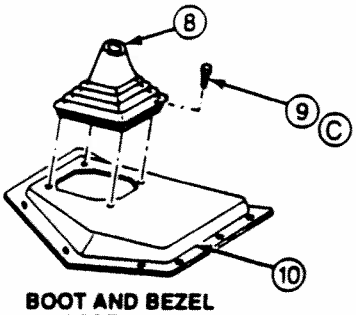
   Remove nuts retaining exhaust extension pipe to muffler and pipe assembly.
7. Remove engine charge exhaust pipe and extension pipe.
8. If transmission is to be disassembled, remove the drain plugs and drain the transmission and transfer case (7A195).
9. Remove the rear driveshaft (4602) from the vehicle. Refer to Section 05-01.
10. Remove the front driveshaft from the vehicle. Refer to Section 05-01.
11. Disconnect the backup lamp switch (15520).
12. Disconnect the clutch linkage from the transmission.
13. If equipped, remove the skid pan from beneath the transfer case.
14. Remove the transfer case according to the procedure outlined in Section 07-07A or 07-07B.
15. Position a transmission jack, such as Rotunda Transmission Jack 077-00008 or equivalent, under transmission. Remove the transmission rear insulator and lower retainer. Remove the crossmember as described in Crossmember Removal and Installation in this section.
16. Remove the bolts that retain the transmission to the engine block.
17. Move the transmission to the rear until the input shaft clears the engine flywheel housing. Lower the transmission from the vehicle.

REMOVAL (Continued)

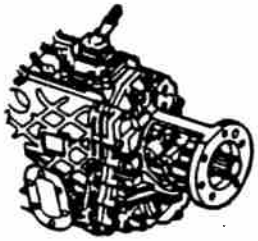
Transmission



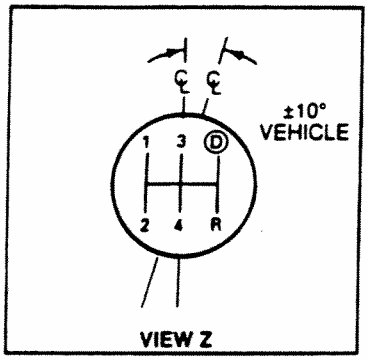
4x2 TRANSMISSION



BOOT AND BEZEL ASSEMBLY



4X4 TRANSMISSION SAME AS 4X2 TRANSMISSION EXCEPT AS SHOWN



VIEW Z

C11502-C

Item	Part Number	Description
1	385739	Bolt, 7/16-14 x 1.62; 4.9L/5.8L
2	57661	Bolt, 7/16-14 x 1.5; 7.5L
3	N808234	Bolt, M12-1.75 x 70; 7.3L
4	N605906	Bolt
5	7213	Gear Shift Lever Knob
6	7210	Shift Lever
7	7003	Transmission
8	7277	Gearshift Lever Boot
9	N610959	Bolt
10	12110	Transmission Floor Cover Plate

(Continued)

Item	Part Number	Description
11	—	Transmission I.D. Plate (Part of 7003)
12	57664	Bolt, 7/16-14 x 2.25; 4.9L/5.8L
13	57666	Bolt, 7/16-14 x 2.75; 7.5L
14	N808235	Bolt, M12-1.75 x 110; 7.3L
A	—	Tighten to 53-72 N·m (39-53 Lb-Ft)
B	—	Tighten to 22-33 N·m (16-24 Lb-Ft)
C	—	Tighten to 5-9 N·m (44-80 Lb-In)

REMOVAL (Continued)

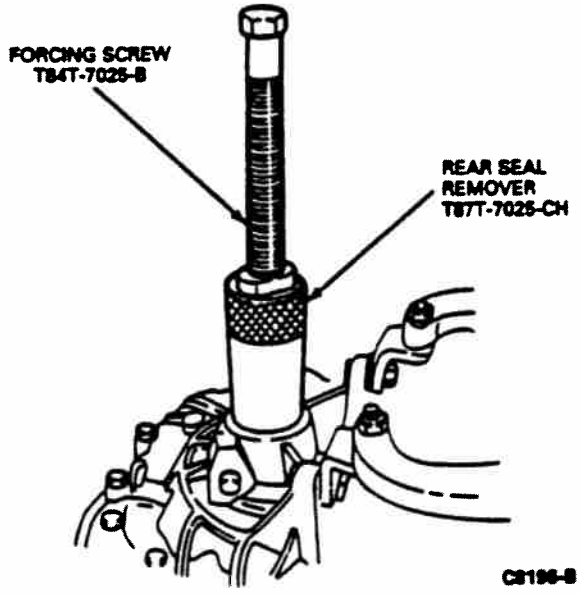
Input Shaft and Extension Housing Seal, 4x2 Transmissions (Except F-Super Duty)

SPECIAL SERVICE TOOL(S) REQUIRED

Description	Tool Number
Companion Flange Holding Tool	T78P-4851-A
Locknut Socket	T87T-7025-AH
Output Seal Replacer	T87T-7025-BH
Rear Seal Remover	T87T-7025-CH
TOD Forcing Screw	T84T-7025-B

Removal

1. Disconnect the driveshaft (4602) from the output flange. Refer to Section 05-01.
2. Attach Companion Flange Holding Tool T78P-4851-A to the transmission output flange with four hex bolts.
3. Loosen the hex nut that holds the output flange to the mainshaft with Locknut Socket T87T-7025-AH. Remove the flange holding tool after loosening the nut.
4. Remove the output flange from the mainshaft.
5. Insert Rear Seal Remover T87T-7025-CH over output end of mainshaft and tighten into oil seal (7052).
6. Assemble TOD Forcing Screw T84T-7025-B into seal remover. Turn forcing screw while holding seal remover to pull oil seal.



C8196-B

Input Shaft and Extension Housing Seal, 4x4 and F-Super Duty Series Transmissions

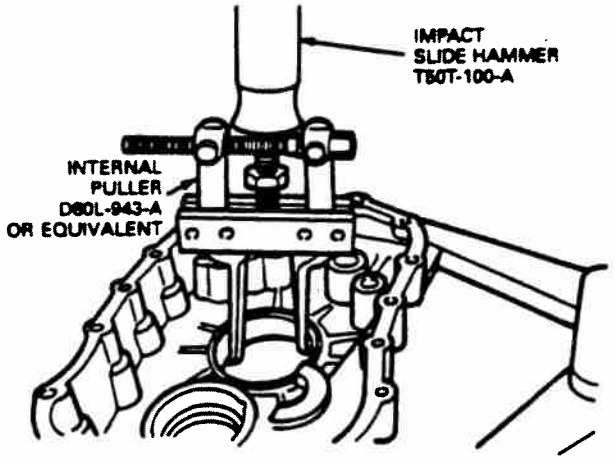
Removal and installation is the same as for the 4x2 with the additional steps of removing and installing the transfer case. Refer to the appropriate section in this manual.

On F-Super Duty series vehicles, remove the transmission mounted parking brake as described in the Body, Chassis Manual, Section 06-05.

Extension Housing

1. NOTE: Refer to Disassembly, Transmission in this section for removal procedure.

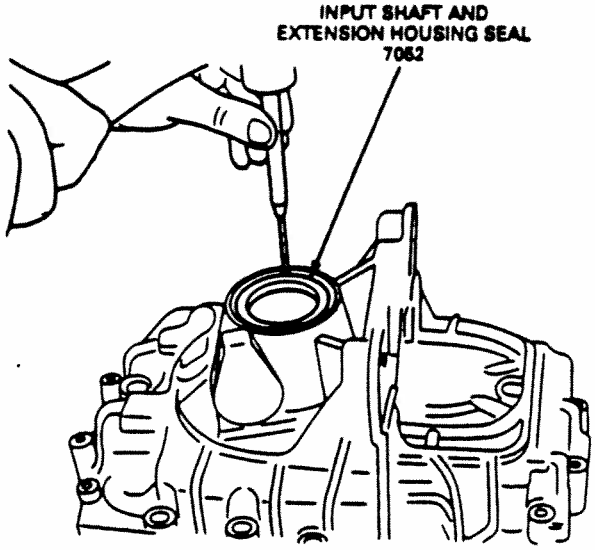
   If required, drive out the two dowel pins from extension housing (7A039).
2. Using Impact Slide Hammer T50T-100-A, and Internal Puller D80L-943-A or equivalent, remove the outer race of output shaft rear bearing (7R205) from the extension housing.



C8737-C

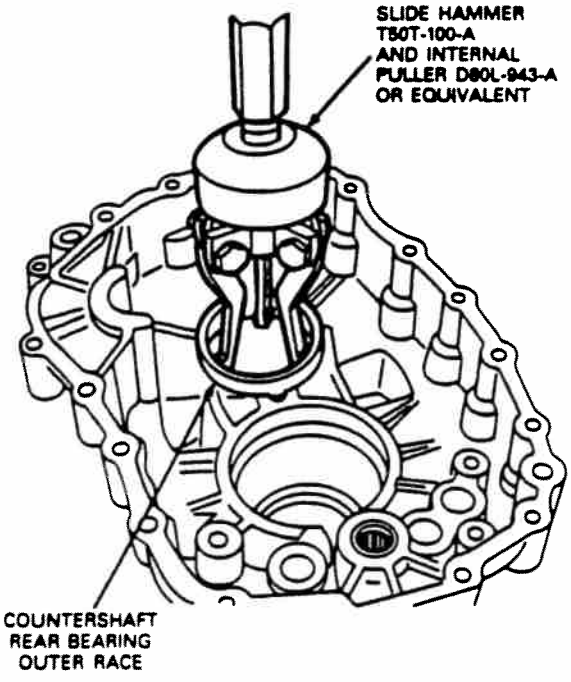
REMOVAL (Continued)

3. Using a suitable drift, drive the oil seal (7052) out of the extension housing and discard.



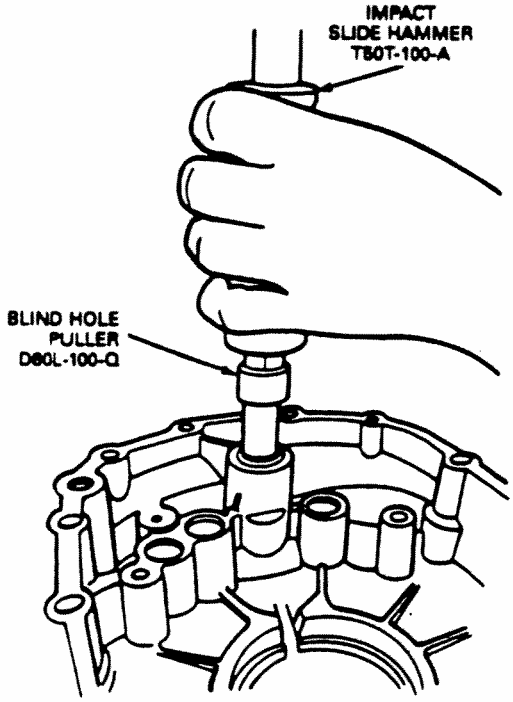
C8728-C

4. Using Impact Slide Hammer T50T-100-A and Bearing Cup Puller T77F-1102-A, remove the countershaft rear bearing outer race from the extension housing.



C8739-B

5. If required, remove the central shift rail bearing from the extension housing. Use Blind Hole Puller D80L-100-Q or equivalent and Impact Slide Hammer T50T-100-A to remove the bearing.

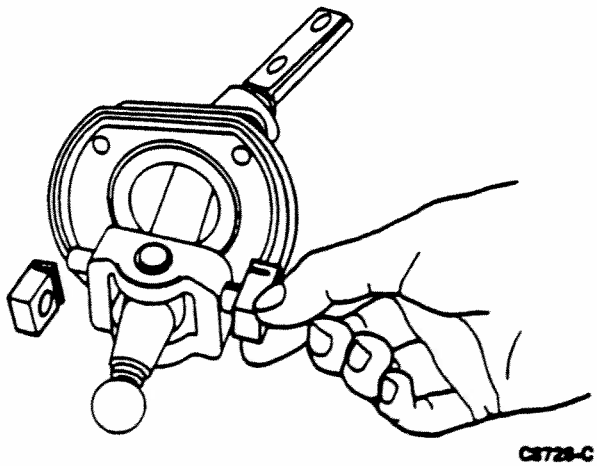


C8740-B

Shift Lever and Boot

Disassembly

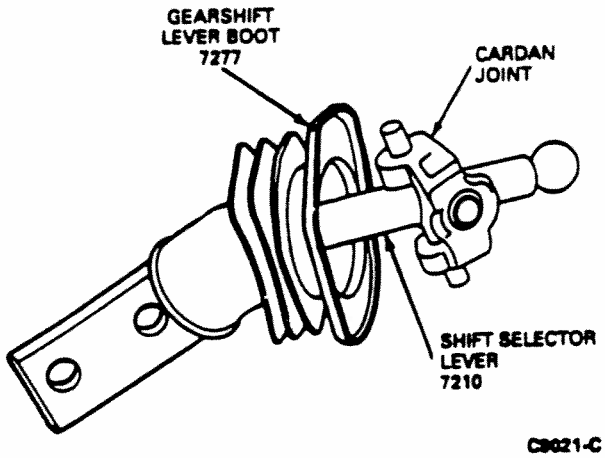
1. Slide the two guide pieces off the cardan joint.



C8729-C

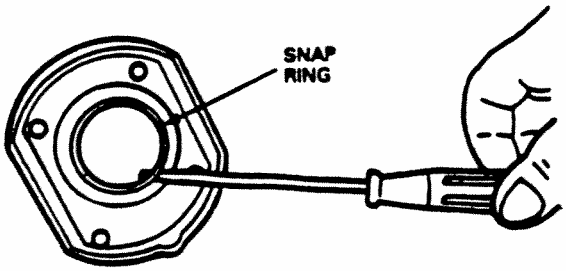
REMOVAL (Continued)

2. Slide the gearshift lever boot and gearshift lever boot retainer as an assembly off past the top of the shift control selector lever.



3. NOTE: A cross-shaft passes through the cardan joint and is pressed into the gearshift lever (7210). Do not disassemble these components.

   Invert the gearshift lever boot and gearshift lever boot retainer and remove the snap ring.



DISASSEMBLY

Transmission

SPECIAL SERVICE TOOL(S) REQUIRED

Description	Tool Number
Bench Mounted Holding Fixture	T57L-500-B
Companion Flange Holding Tool	T78P-4851-A

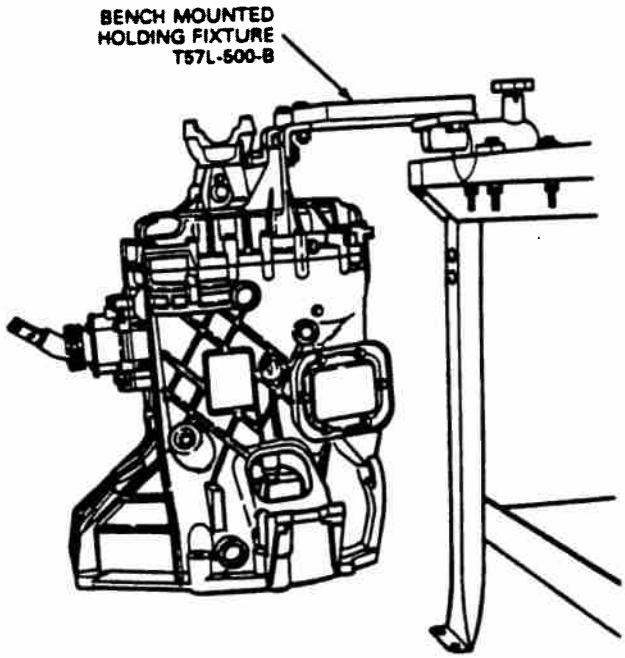
(Continued)

SPECIAL SERVICE TOOL(S) REQUIRED (Cont'd)

Description	Tool Number
Locknut Socket	T87T-7025-AH
Output Seal Replacer	T87T-7025-BH
Gear Pack Holding Fixture	T87T-7025-HH
Shift Rod Support	T87T-7025-JH
Output Seal Replacer	T87T-7025-LH
Remover Tube	T77J-7025-B
Jet Plug Remover	T77L-9533-B

1. NOTE: For 4x4 and F-Super Duty vehicles, start with Step 4.

   Attach the transmission (7003) to the Bench Mounted Holding Fixture T57L-500-B. Place the transmission in a vertical position with the case (7005) pointing downward.

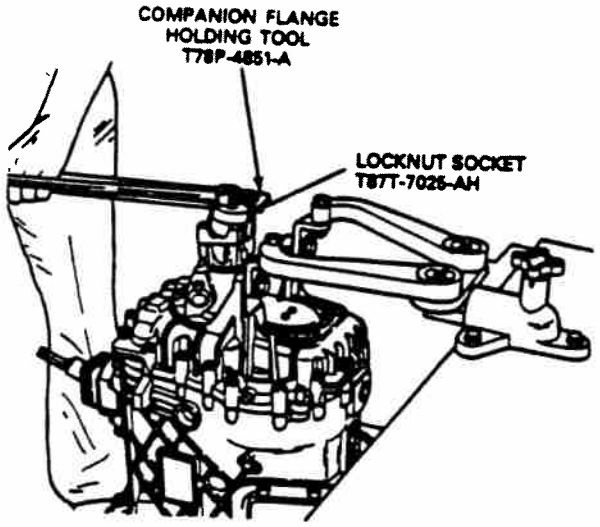


2. Attach Companion Flange Holding Tool T78P-4851-A to the transmission output flange.

DISASSEMBLY (Continued)

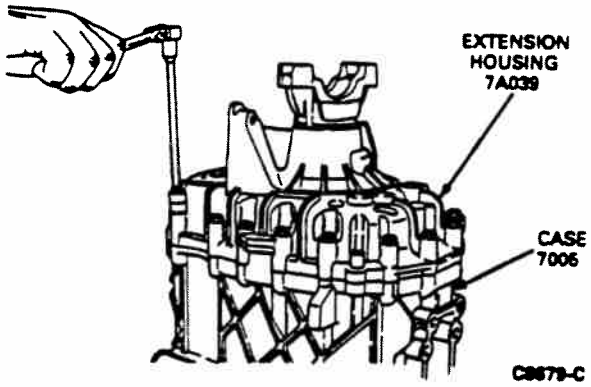
3. **CAUTION: Do not remove the hex nut or output flange at this time.**

   Loosen the spiral-lock yoke nut that holds the output flange to the mainshaft with Locknut Socket T87T-7025-AH. Remove the flange holding tool after loosening the nut.



C9678-C

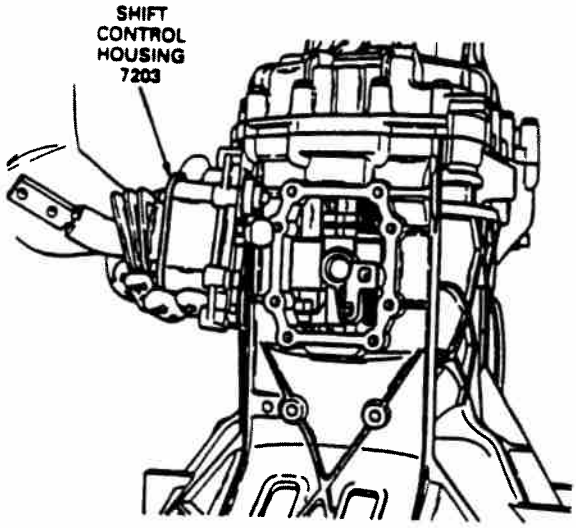
4. Remove 15 of the 17 8mm hex-head screws that hold the case and extension housing (7A039) together. Leave two screws at opposite sides of the extension housing installed.



C9679-C

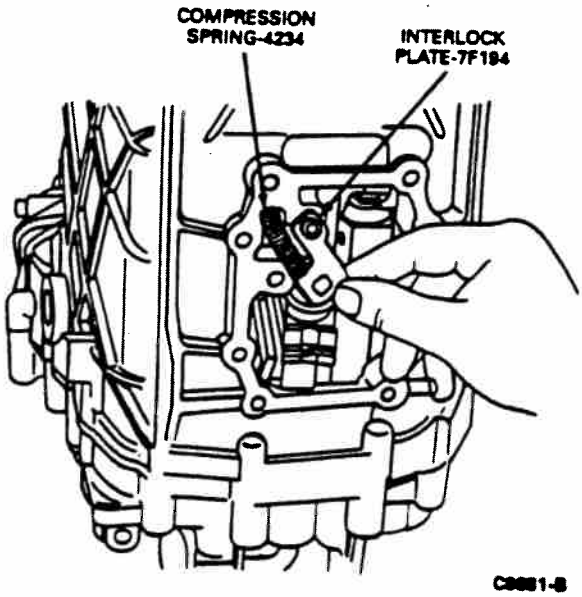
5. Remove any power take-off equipment installed on the transmission.
6. **CAUTION: Make sure that parts do not inadvertently fall into transmission when rotating.**

   Remove the eight 8mm hex bolts that attach the shift control housing to the case. Remove the complete shift control selector lever and shift control housing as an assembly. Rotate transmission on holding fixture so that the case is pointing upward.



C9680-B

7. Remove the gear selector interlock sleeve (7K201) and shifter interlock spring (7234) which serves as a reverse gear interlock.



C9681-B

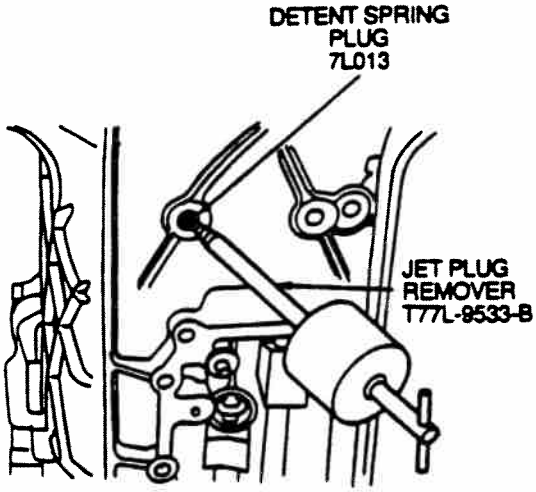
DISASSEMBLY (Continued)

8. **WARNING: DETENT SPRING PLUG IS UNDER SPRING PRESSURE. ALWAYS WEAR PROTECTIVE EYEGLASSES WHEN PERFORMING THIS PROCEDURE TO MAKE SURE THAT DETENT SPRING PLUG DOES NOT STRIKE EYES WHEN IT IS FORCED OUT BY SPRING PRESSURE.**

   NOTE: Discard removed detent spring plugs and replace with new detent spring plugs.

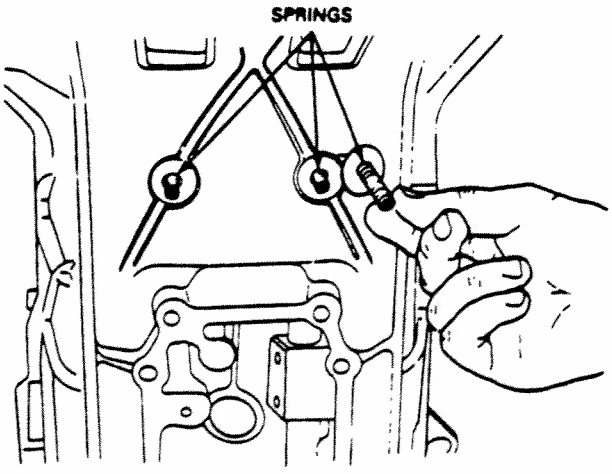
   NOTE: The latest detent spring plugs are of a larger diameter than on older vehicles and will not work on older vehicles.

   Puncture the center of the detent plug and screw in Jet Plug Remover T77L-9533-B and use its slide hammer to remove plug. Repeat this procedure for the other two detent spring plugs in the case.



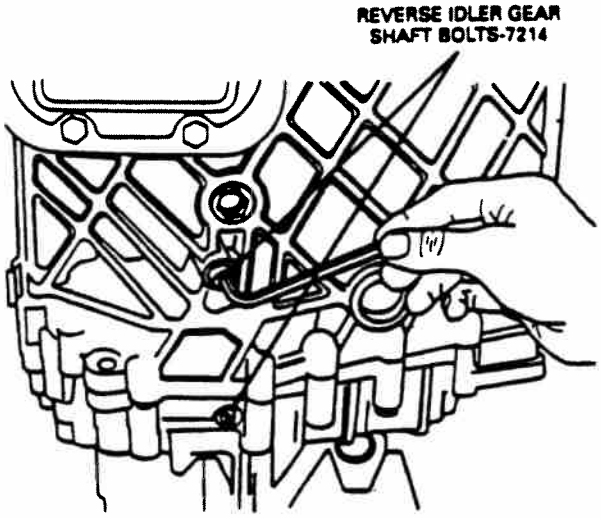
C9682-C

9. Remove the springs that are now protruding from the holes.



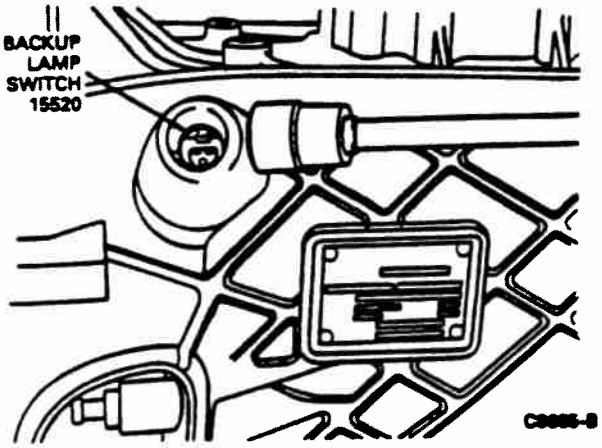
C9683-1A

10. Remove the reverse idler gear shaft bolts.



C9684-B

11. If required, remove the backup lamp switch (15520), located above and slightly forward of the transmission i.d. plate. Remove the sealing ring.



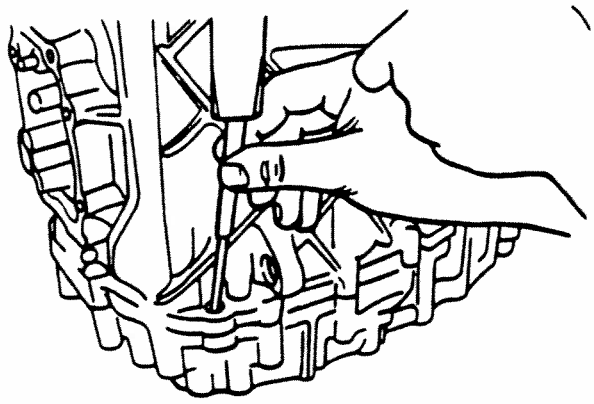
C9685-B

12. NOTE: The mainshaft is facing upward during this operation.

    Use a suitable punch to remove the two dowel pins located in opposite corners of the mating surfaces of extension housing and case. Drive them out toward the rear of the transmission.

DISASSEMBLY (Continued)

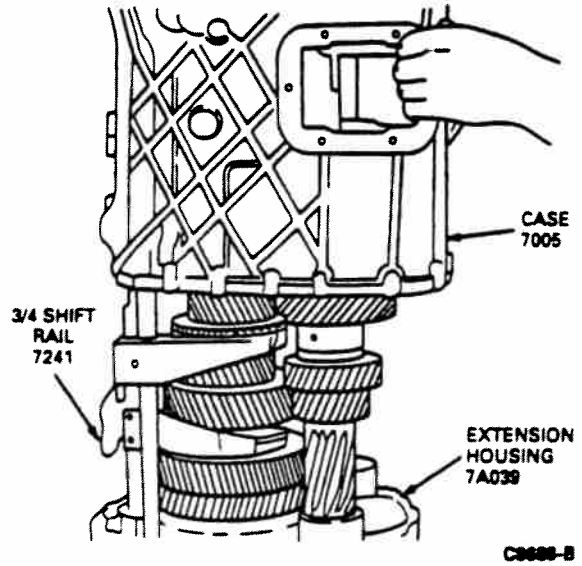
13. Remove the two remaining hex bolts from the extension housing.



C9667-C

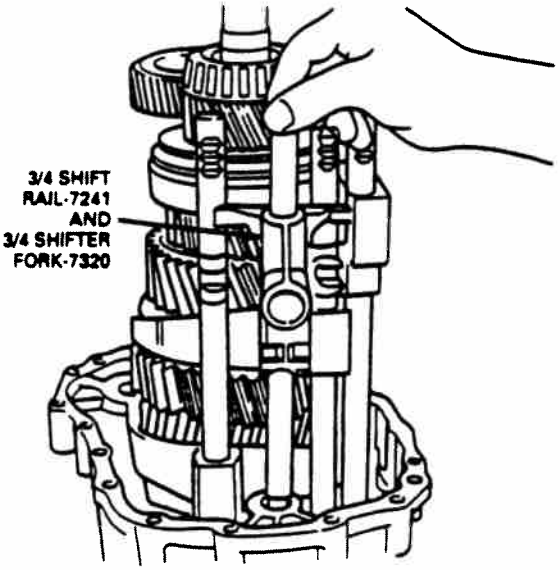
14. **CAUTION: The mating surfaces of case and extension housing are coated with an adhesive sealing agent. If it is difficult to separate case and extension housing because of this adhesive, carefully tap the front of the case with a soft hammer until the bond is loosened. Never use a prying device, such as a screwdriver or chisel, to force case and extension housing apart. This could damage the surfaces and cause leaks.**

Carefully lift the case off of the extension housing. It may be necessary to push the main gear shift rail inwards to prevent it from "hanging up" on the case as it is being removed. Use care to make sure that the main gear shift rail is not lifted off together with the case. Refer to Case in this section for case disassembly and assembly procedures.



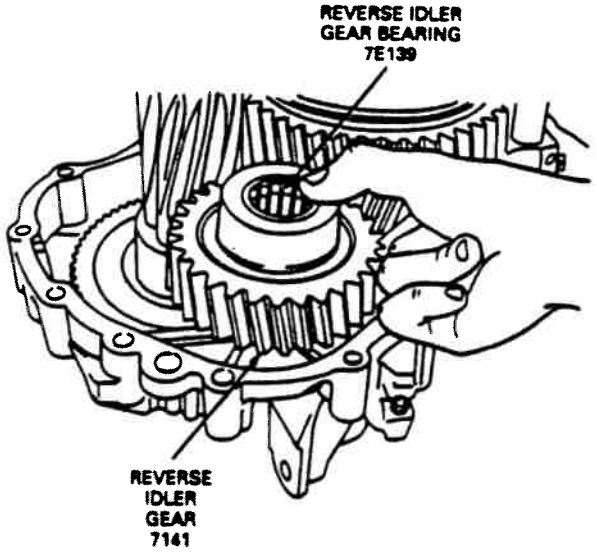
C9668-B

15. Remove the main gear shift rail and and gear shifter fork.



C9669-B

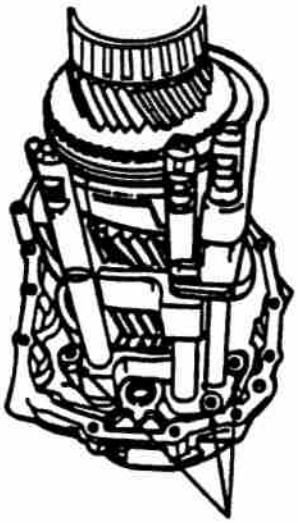
16. Lift the reverse idler gear shaft (7140) out of the reverse idler gear, and remove the reverse idler gear and two reverse idler gear bearings from the case.



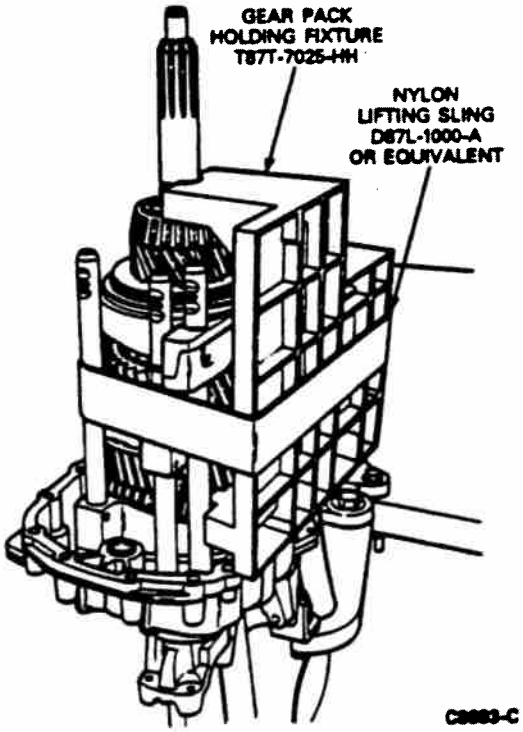
C9671-B

DISASSEMBLY (Continued)

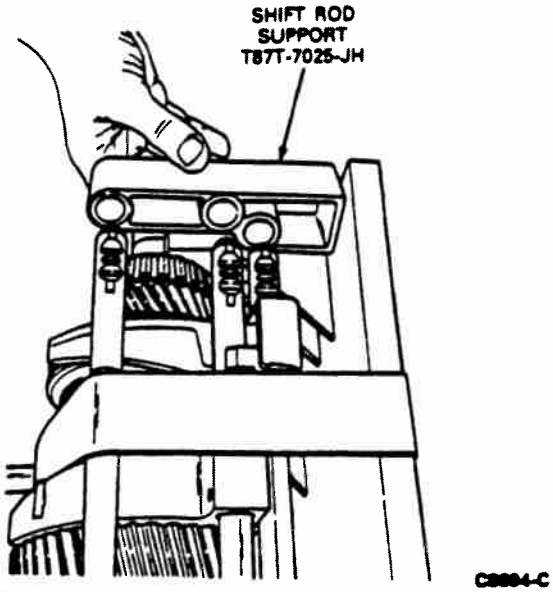
17. Remove the three selector plate bolts that retain the gear selector interlock sleeve to the extension housing.



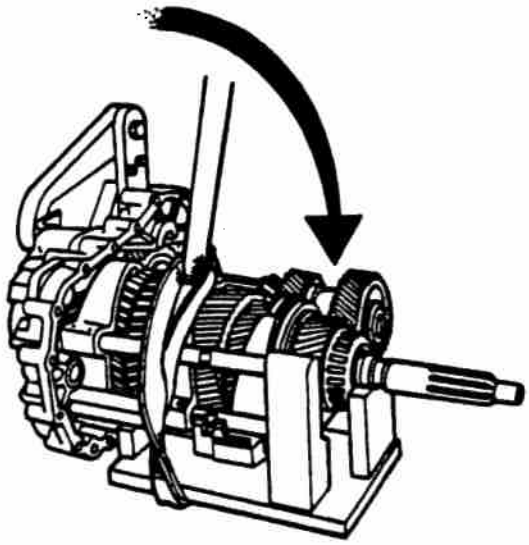
18. With the transmission in a vertical position, use Endless Lifting Sling D87L-1000-A or equivalent to strap Gear Pack Holding Fixture T87T-7025-HH to the mainshaft and countershaft cluster gear (7113). Pass the sling over the shift rails.



19. Place the Shift Rod Support T87T-7025-JH over the ends of the shift rails.

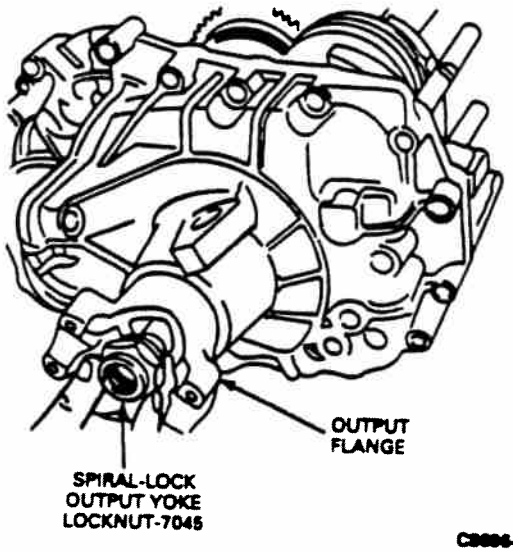


20. Carefully rotate the transmission, together with the gear pack holding fixture, into a horizontal position with the holding fixture beneath the gear pack.



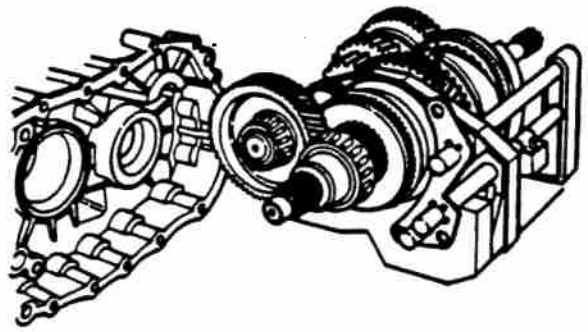
DISASSEMBLY (Continued)

21. Remove the spiral-lock output yoke locknut from the mainshaft. Remove the flange from the mainshaft. If the mainshaft is difficult to remove, tap loose with a hammer.



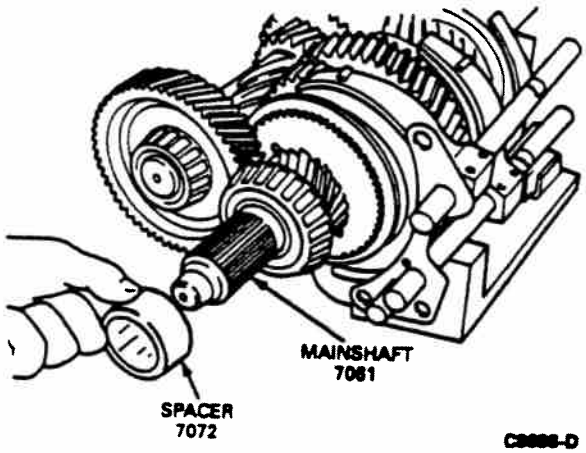
C9666-B

22. Carefully pull the gearpack and shift rails and their holding fixtures forward to dislodge them from the extension housing. Place this assembly on a workbench.



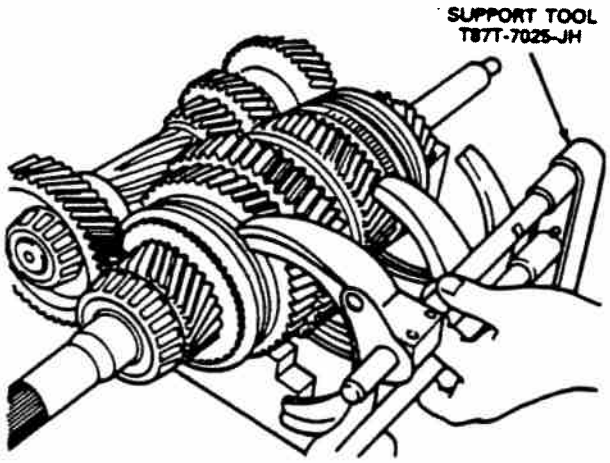
C9667-B

23. If equipped, remove the spacer from the mainshaft.



C9668-D

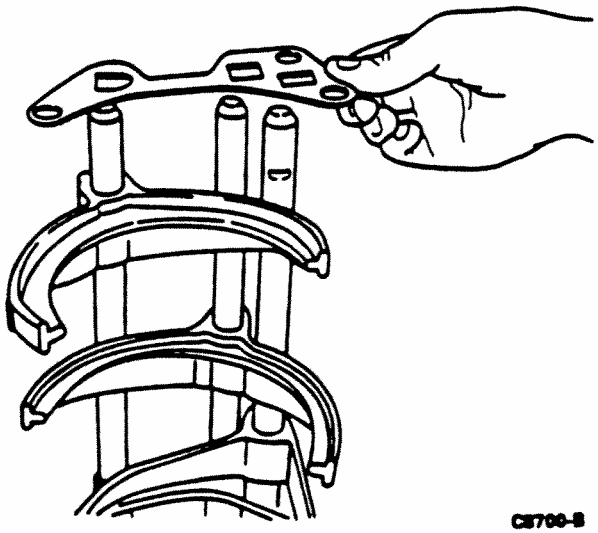
24. Remove the sling from around the shift rails, gearpack, and holding fixture.
25. Turn the gearshift rails approximately 45 degrees to release them from the shift hubs. Lift the gearshift rails, 3/4 shifter forks and gear selector interlock sleeve, together with Shift Rod Support T87T-7025-JH, off the mainshaft.



C9669-D

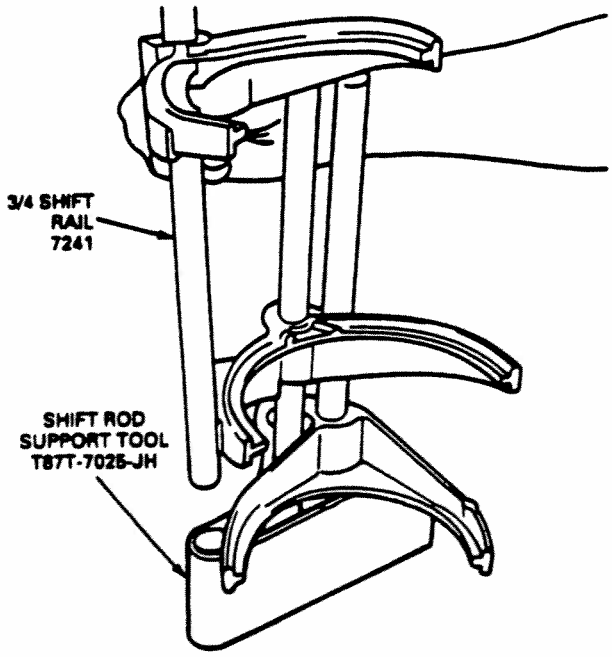
DISASSEMBLY (Continued)

26. Using the shift rod support tool as a base, set the shift rail assembly on a workbench with the shift rails in a vertical position. Remove the gear selector interlock plate.



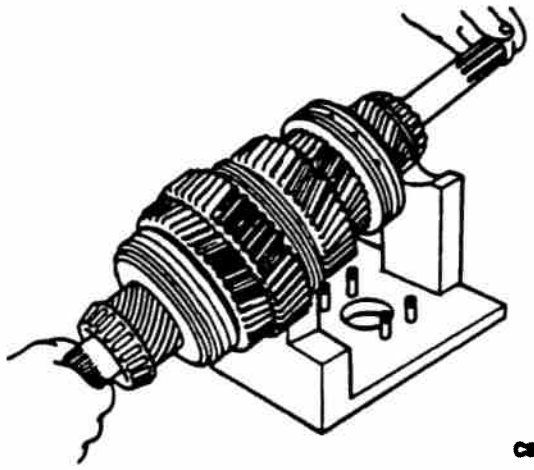
CS700-B

27. Mark each gear shifter fork (7230), shift rail, and position in the holding fixture to make reassembly easier. Lift the shift rails from the support tool. Refer to Shift Rails in this section for disassembly procedures.



CS701-D

28. Lift the countershaft cluster gear off the bench stand. Separate the input shaft (7017) from the mainshaft. Lift the mainshaft from the stand. Refer to Mainshaft, Countershaft and Input Shaft in this section for disassembly and assembly procedures.
29. Remove the rear cover from the holding fixture. Refer to Extension Housing in this section for disassembly and assembly procedures.



CS702-B

DISASSEMBLY AND ASSEMBLY OF SUBASSEMBLIES

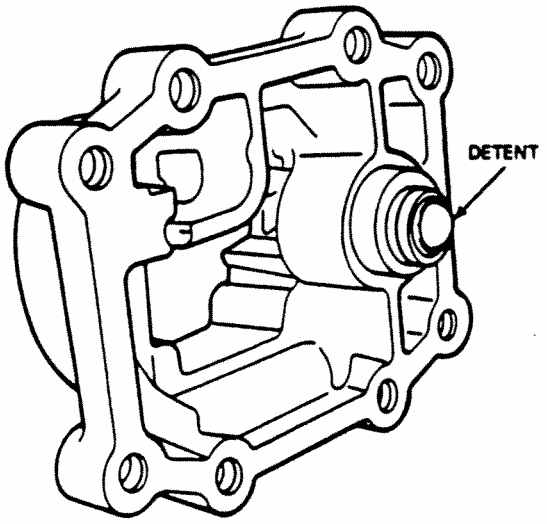
Shift Control Housing Assembly

1. NOTE: Disassembly of parts inside the shift control housing should be confined to replacement of the detent when necessary.

   If required, install a new detent in the shift control housing. Using Rotunda Heat Gun 107-R0300 or equivalent.

DISASSEMBLY AND ASSEMBLY OF SUBASSEMBLIES (Continued)

2. Heat the detent mounting area in the shift control housing to approximately 248°F (120°C). Press the detent into its mounting hole until it rests against its stop in the base of the hole.



Case

SPECIAL SERVICE TOOL(S) REQUIRED

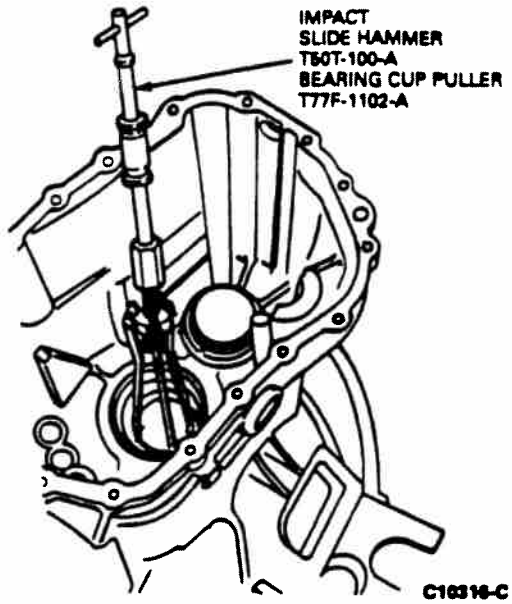
Description	Tool Number
Impact Slide Hammer	T50T-100-A
Bearing Cup Puller	T77F-1102-A
Driver Handle	T80T-4000-W
Bearing Cup Replacer	T73T-4222-A
Needle Bearing Replacer	T87T-7025-DH
Front Seal Replacer	T87T-7025-EH
Mainshaft Front Bearing Cup Replacer	T87T-7025-PH

1. NOTE: Case disassembly is required to enable reuse of smaller parts.

   Using Impact Slide Hammer T50T-100-A and Bearing Cup Puller T77F-1102-A, remove the input shaft bearing outer race from the case (7005).

2. NOTE: The oil baffle will be destroyed when the race is removed. Discard the oil baffle and install a new one during assembly.

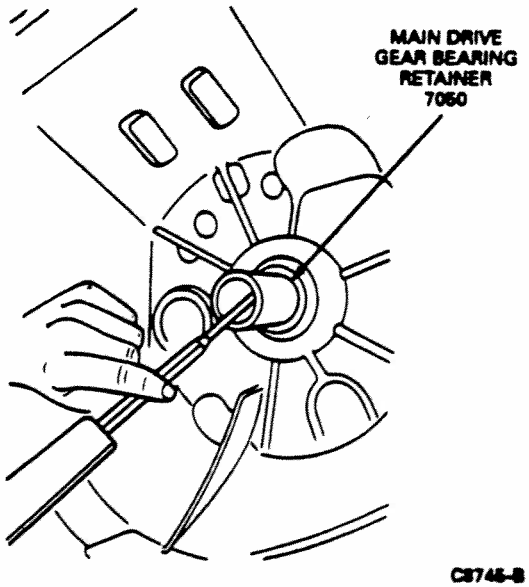
   Remove the oil baffle and input bearing front shims.



3. NOTE: If the release bearing guide tube is being removed, the oil seal (7052) may be removed later when the release bearing guide tube is out of the housing.

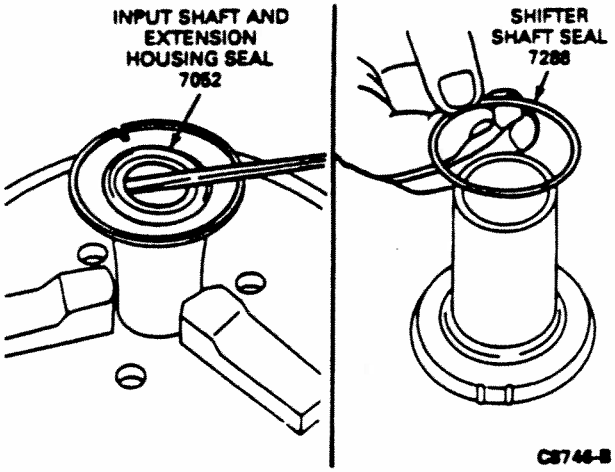
   NOTE: For 4.9L and 5.8L engine applications, the through-bore of oil seal is designed such that oil seal can be removed without having to disassemble the transmission if removal and replacement of oil seal is all that is required. Tap on oil seal with a screwdriver until oil seal turns then use the screwdriver to pry out oil seal. Insert new oil seal and drive it in flush with the case although driving the seal into the case itself is NOT recommended.

   Using a punch, remove the oil seal from the base of the release bearing guide tube (7.3L and 7.5L housings only).

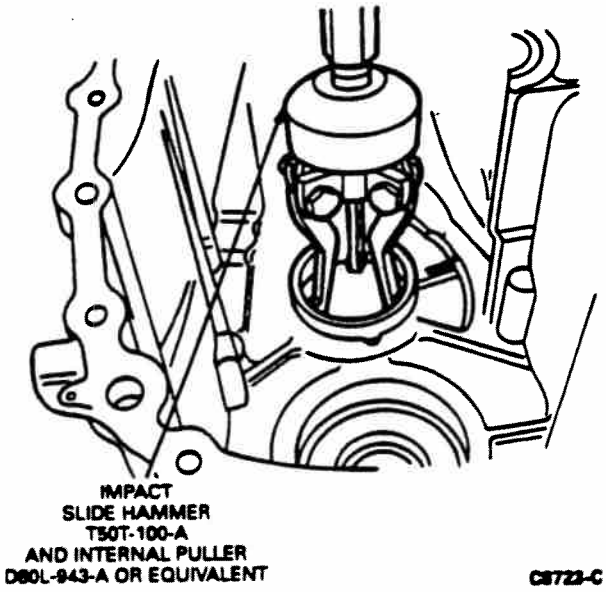


DISASSEMBLY AND ASSEMBLY OF SUBASSEMBLIES (Continued)

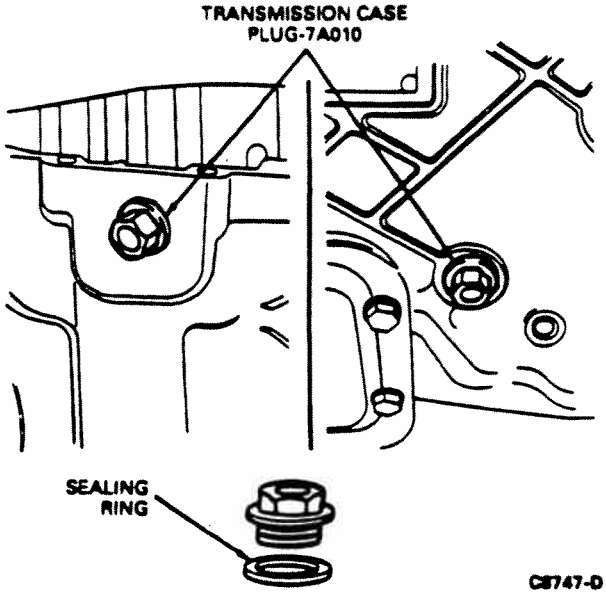
4. If required, carefully drive the release bearing guide tube from the case using a soft mallet.
5. Remove the shifter shaft seal from the release bearing guide tube. If the release bearing guide tube is removed, it must be replaced with a new one.



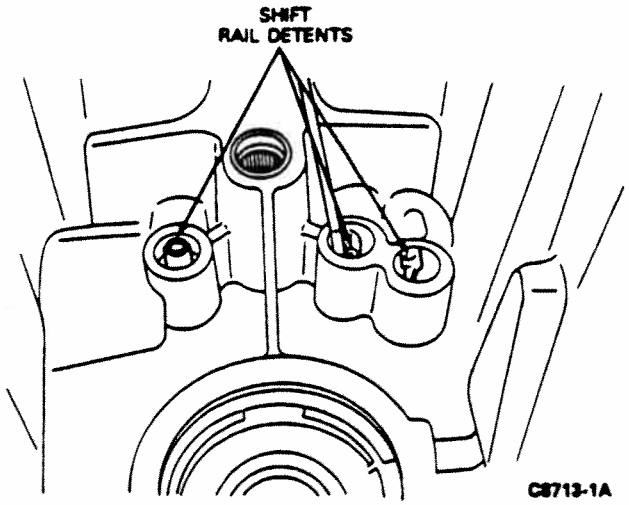
6. Remove the front bearing outer race with Impact Slide Hammer T50T-100-A and Internal Puller D80L-943-A.



7. If required, remove the case plugs (7A010), and sealing rings from the case.

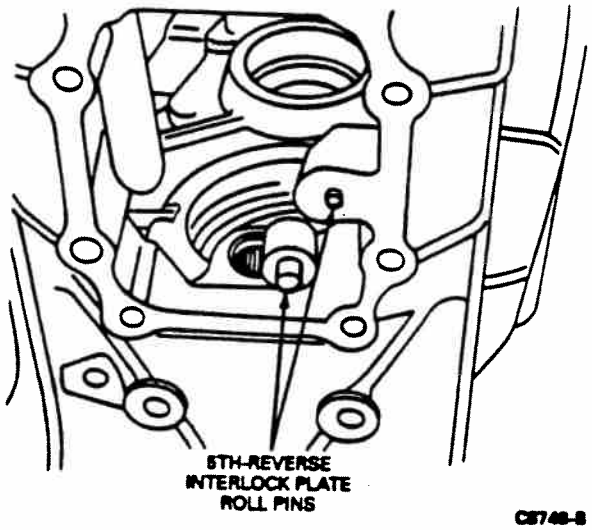


8. If case replacement is required, remove the three shift rail detents from the case.

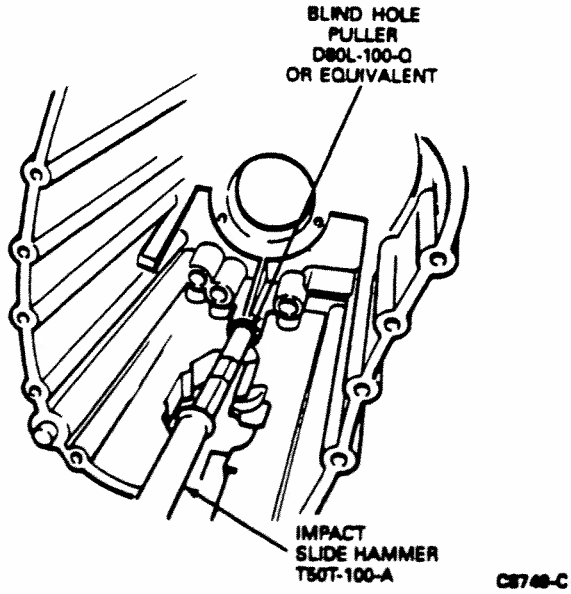


DISASSEMBLY AND ASSEMBLY OF SUBASSEMBLIES (Continued)

9. If required, remove the slotted spring pins that hold the 5th-reverse interlock plate from their bores in the case just below the shift control housing (7203).

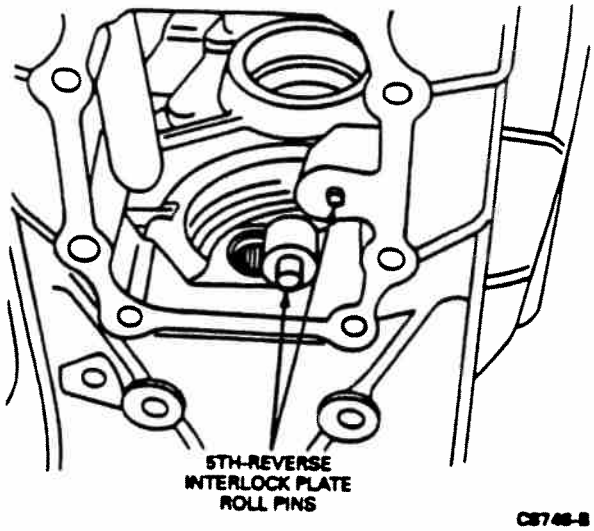


10. If required, remove the central shift rail needle bearing from the case using Impact Slide Hammer T50T-100-A and Blind Hole Puller D80L-100-Q or equivalent.

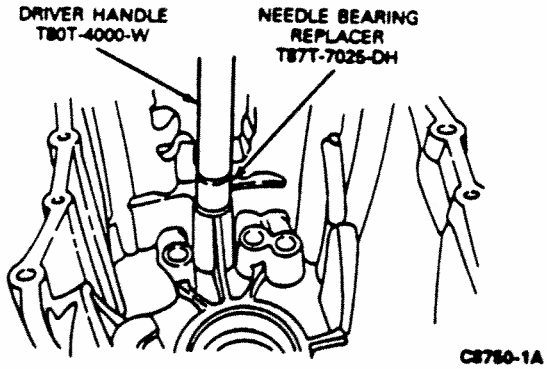


Assembly

1. If they were removed, tap the 5th-reverse interlock plate roll pins into their bores in the case until the bigger one bottoms out (sticks out approximately 8mm (.315 inch); the small one sticks out 4-5mm (.158-.197 inch). Do not allow it to bottom out.



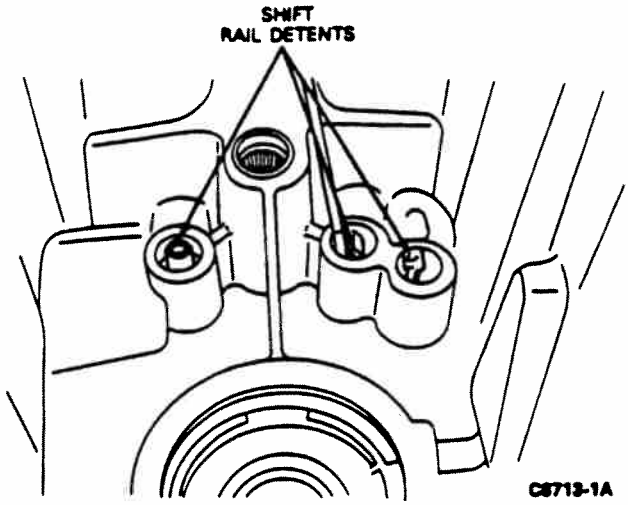
2. Heat the case in the area of the bearing bore of 5/reverse shift rail to 160°C (320°F) with Rotunda Heat Gun 107-R0300 or equivalent. Drive the bearing sleeve in with Needle Bearing Replacer T87T-7025-DH and Driver Handle T80T-4000-W until it is flush with the surface of the bore.



3. If removed, install the case plugs into the case. Tighten to 60 N·m (44 lb-ft). Both case plugs are of the straight thread type which require rubber sealing rings to prevent leakage. (These torque values apply to a cold case.)

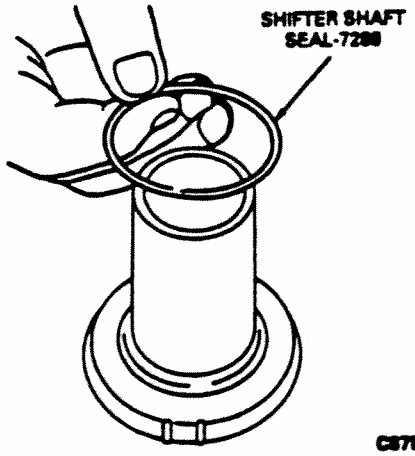
DISASSEMBLY AND ASSEMBLY OF SUBASSEMBLIES (Continued)

4. Insert the three shift rail detent bolts into their respective bores in the case. They must seat in the detents in their respective shift rails and must move freely when in their installed positions.



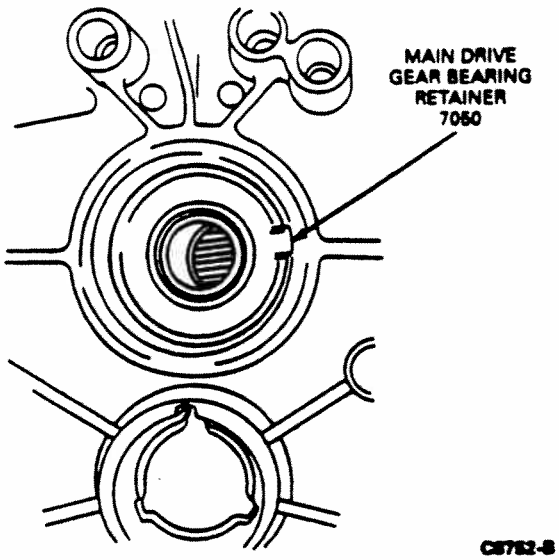
C8713-1A

5. Place a new shifter shaft seal on the release bearing guide tube (7.3L and 7.5L housings only).



C8751-B

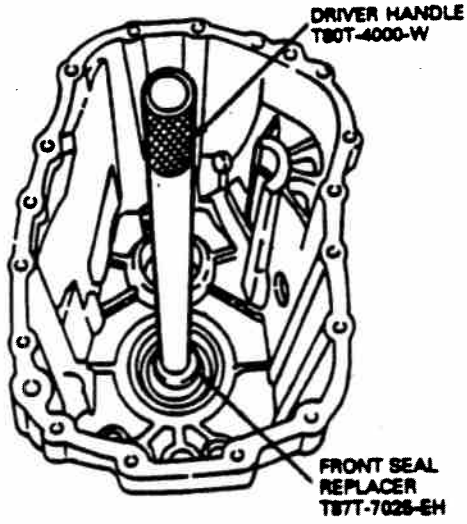
6. Position the main drive gear bearing retainer in the case in such a way that the lug in the release bearing guide tube is in alignment with the recess in the case. Push the release bearing guide tube in until it bottoms against its bore in the case (7.3L and 7.5L housings only).



C8752-B

7. **CAUTION: If the countershaft cluster gear (7113), input shaft (7017), mainshaft or one or more tapered roller bearing has been replaced, it is mandatory that the tapered roller bearings be adjusted to obtain a preload of 0.02 to 0.11mm (0.00079 to 0.00434 inch). Refer to adjustments in this section for procedure.**

   Position the oil seal in the case. Using Driver Handle T80T-4000-W and Front Seal Replacer T87T-7025-EH, drive in the oil seal until it seats against its stop.

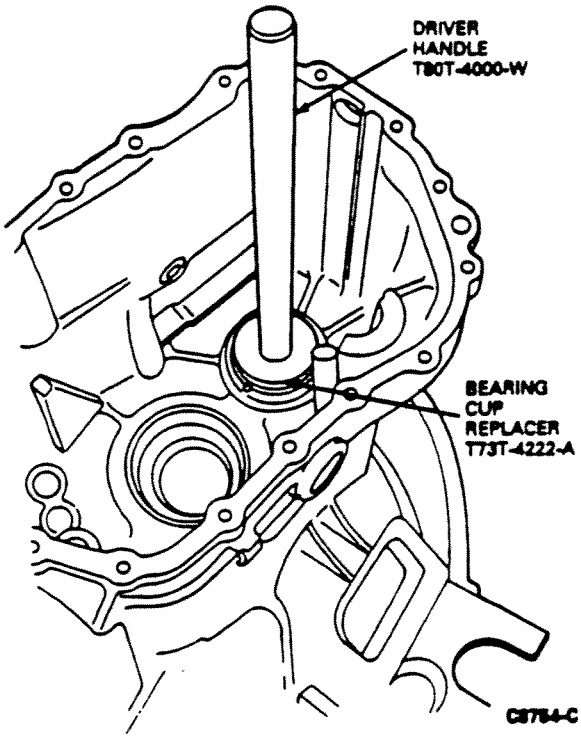


C8753-C

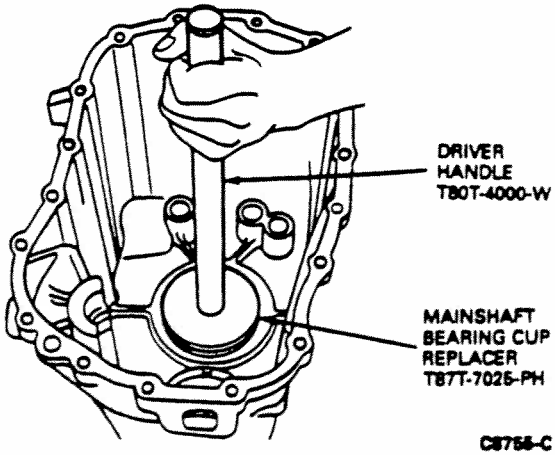
8. Heat up the mounting bore in the case for the outer race of the output shaft bearing (7065) to 160 °C (320 °F) with Rotunda Heat Gun 107-R0300 or equivalent.

DISASSEMBLY AND ASSEMBLY OF SUBASSEMBLIES (Continued)

9. Position the input bearing front shim with proper thickness in the bore. Using Driver Handle T80T-4000-W and Bearing Cup Replacer T73T-4222-A, drive the output shaft bearing in until it seats against the stop in the case.



10. Heat the case in the area of the bearing (7025) of input shaft to 160°C (320 °F) with Rotunda Heat Gun 107-R0300 or equivalent.
11. Position the correct input bearing front shim in the bore for the bearing. Using Driver Handle T80T-4000-W and Mainshaft Front Bearing Cup Replacer T87T-7025-PH, drive the bearing in until it seats against its stop in the bore.



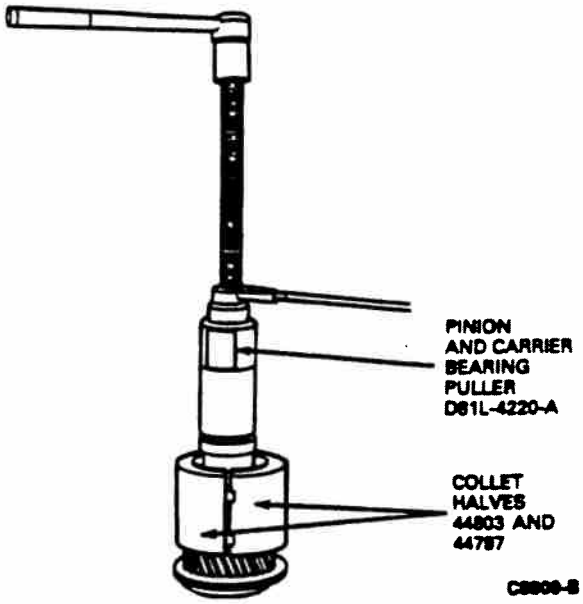
Input Shaft and Bearing

SPECIAL SERVICE TOOL(S) REQUIRED

Description	Tool Number
Axle Bearing / Seal Plate	T75L-1165-B
Pinion Bearing Cone Replacer	T85T-4621-AH

Disassembly

1. Position the two Collet Halves (44803 and 44797) of the Pinion and Carrier Bearing Puller D81L-4220-A or equivalent around the bearing (7025). Install the Puller on the collet halves and pull the case bearing from the input shaft (7017).



Assembly

1. **CAUTION: Inspect the surface of the input shaft in the area of the bearing race to make sure it is smooth and free of burrs.**

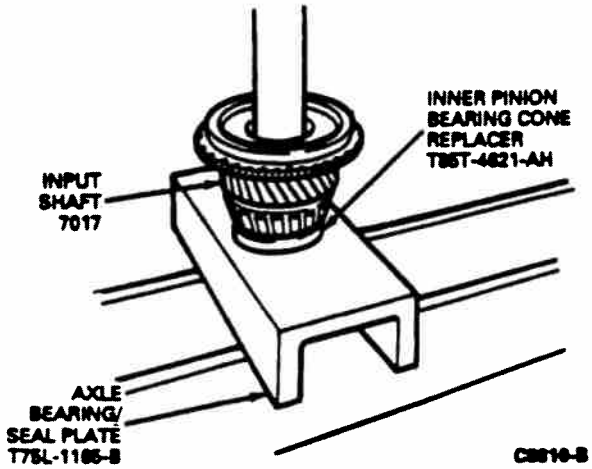
   Place the case bearing on the input shaft.
2. Place Inner Pinion Bearing Cone Replacer T85T-4621-AH over the case bearing.
3. **CAUTION: Make sure that the oil baffle is fully installed and not damaged.**

   Position the case bearing, input shaft, and Bearing Cone Replacer in Axle Bearing / Seal Plate T75L-1165-B as shown in the illustration.

DISASSEMBLY AND ASSEMBLY OF SUBASSEMBLIES (Continued)

4. **CAUTION: Press plunger must not contact pocket bearing outer race.**

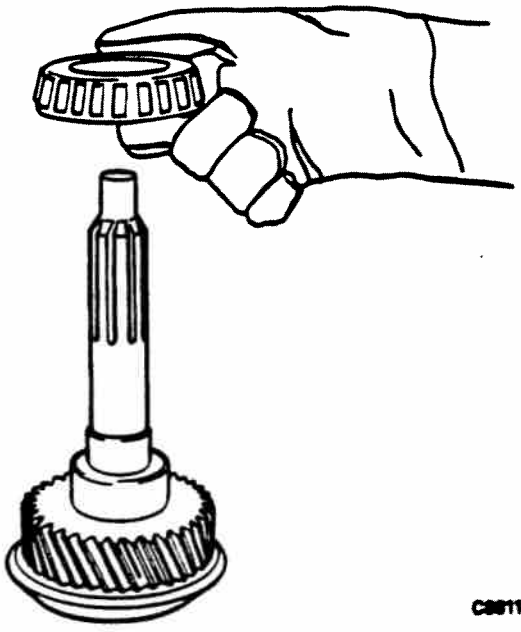
   Press the bearing on until it seats against its stop on the input shaft.



5. **CAUTION: Do not heat the case bearing for more than 15 minutes.**

   CAUTION: Do not drive against the bearing cone. Drive against the inner race only.

   An alternate method is to heat the inner race of the case bearing to 160°C (320°F) with Rotunda Precision Metal Gear / Bearing Heater 130-00002, Heat Gun 107-R0300 or equivalent and position it on the input shaft. Use a suitable tool to seat the case bearing against its stop.



Mainshaft

SPECIAL SERVICE TOOL(S) REQUIRED

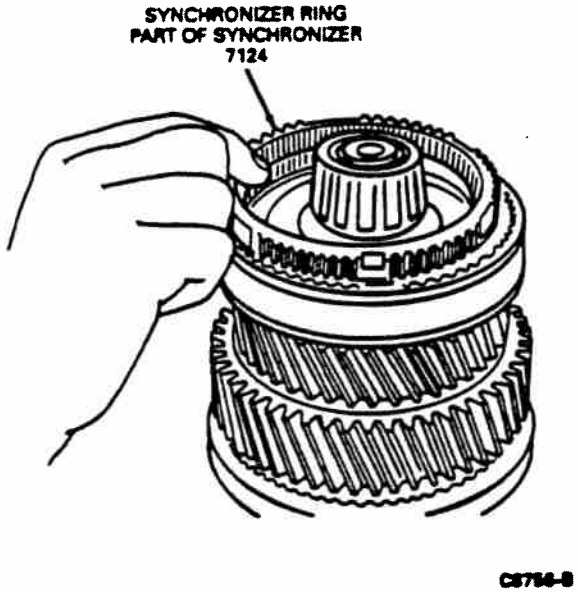
Description	Tool Number
Bearing Collet Sleeve	T75L-7025-G
Remover Tube	T77J-7025-B
Bearing Collets	T87T-7025-FM
Collet Halves	T87T-7025-MH
Pullet Collets	T87T-7025-NH
Collet Retaining Ring	T87T-7025-OM
Pinion Bearing Cone Replacer	T85T-4621-AH

Disassembly

1. NOTE: Use brass pads or equivalent in vice jaws to prevent damage to mainshaft.

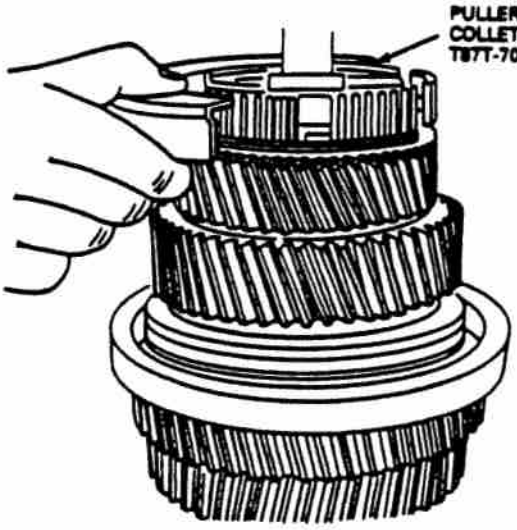
   Clamp the output end of the mainshaft firmly in a vise.

2. Remove the synchronizer ring from the 3rd-4th synchronizer (7124).



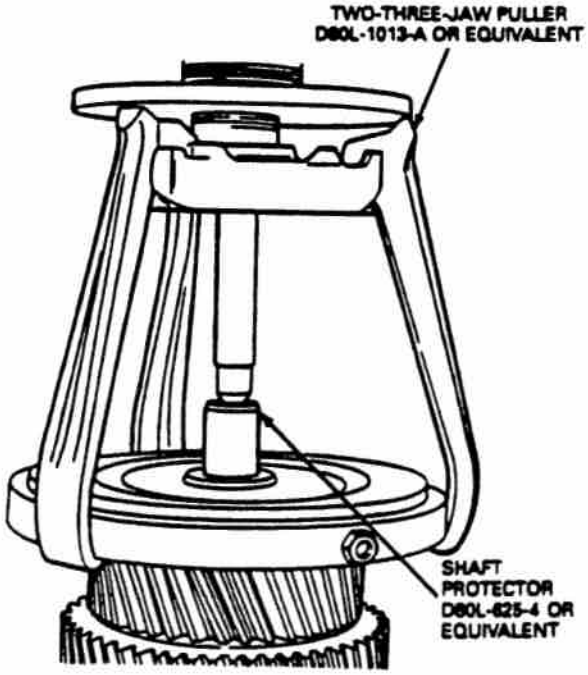
DISASSEMBLY AND ASSEMBLY OF SUBASSEMBLIES (Continued)

7. Position the two Puller Collet Halves T87T-7025-NH on the 3rd-4th synchronizer and slide the collet retaining ring over the collet halves to hold them in place on the synchronizer.



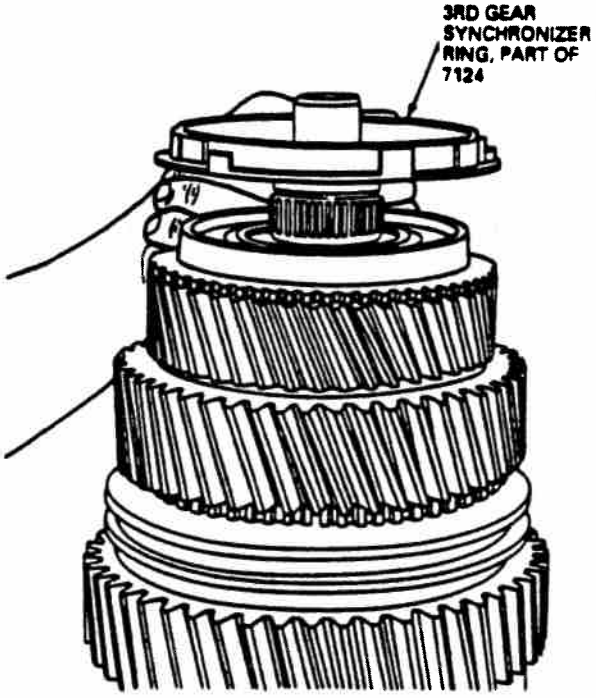
C8761-C

8. Place the Shaft Protector D80L-625-4 or equivalent on the end of the mainshaft. Place the Two-Three-Jaw Puller D80L-1013-A or equivalent on the assembled collet halves and retaining ring and pull the synchronizer from the mainshaft.



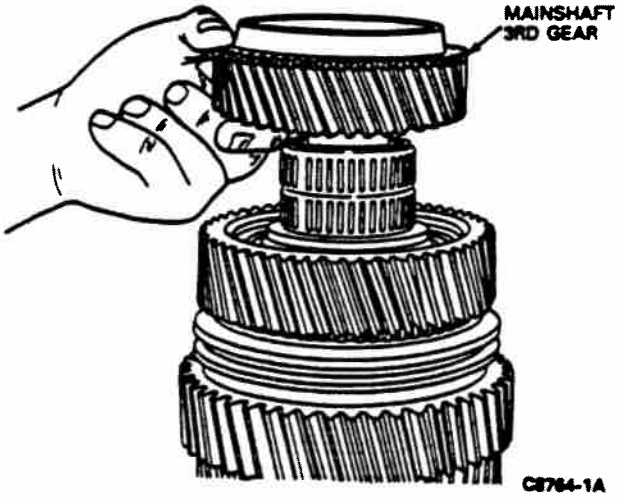
C8762-B

9. Remove the synchronizer ring (part of synchronizer) from the 3rd gear of mainshaft.



C8763-B

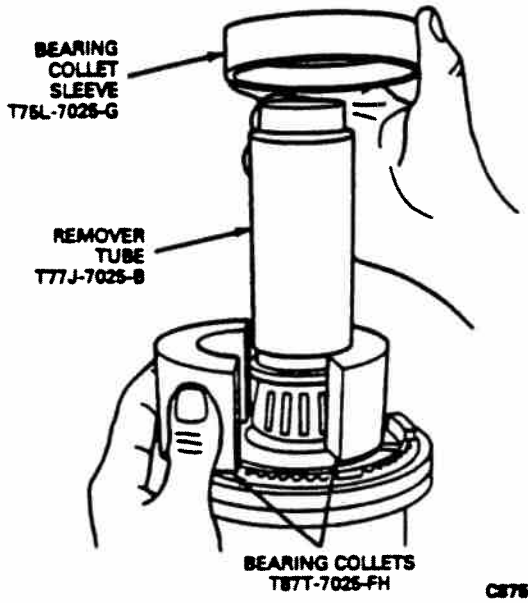
10. Remove the 3rd gear from the mainshaft.



C8764-1A

DISASSEMBLY AND ASSEMBLY OF SUBASSEMBLIES (Continued)

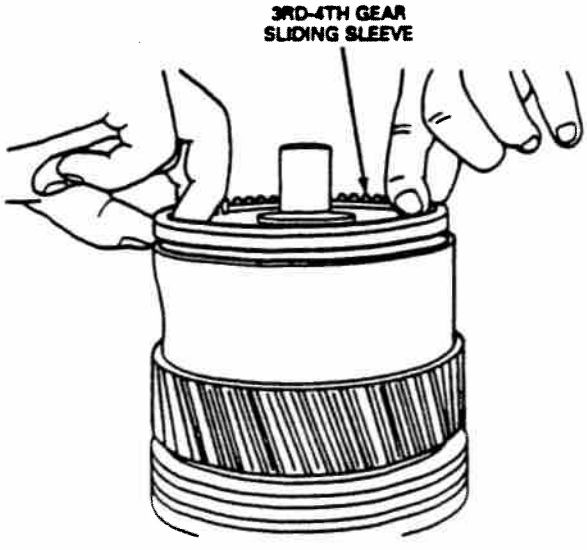
3. Place the Bearing Collets T87T-7025-FH or equivalent on either side of the input shaft pocket bearing. Position the Remover Tube T77J-7025-B in the collets. Pass the Bearing Collet Sleeve T75L-7025-G over the Remover and into the collets so they clamp firmly to the input shaft pocket bearing. Pull the input shaft pocket bearing from the mainshaft.



C8767-C

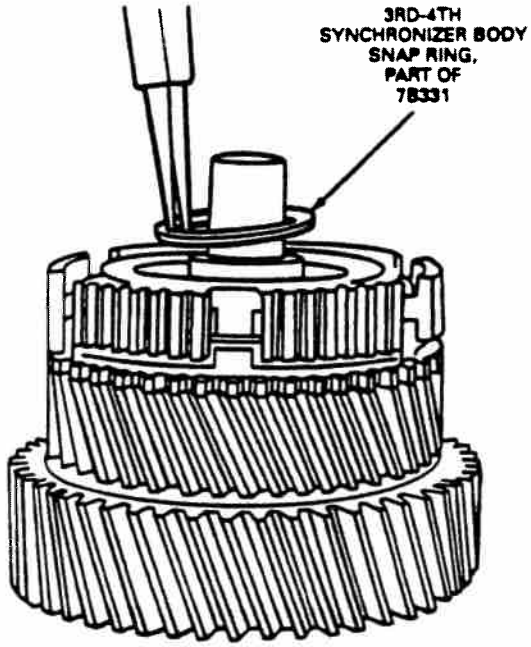
4. **CAUTION: Place a cloth around the synchronizer to catch the compression springs, pressure pieces and balls that will be released when the sliding sleeves are removed.**

   Remove the 3rd-4th gear sliding sleeve (part of synchronizer) from the mainshaft.



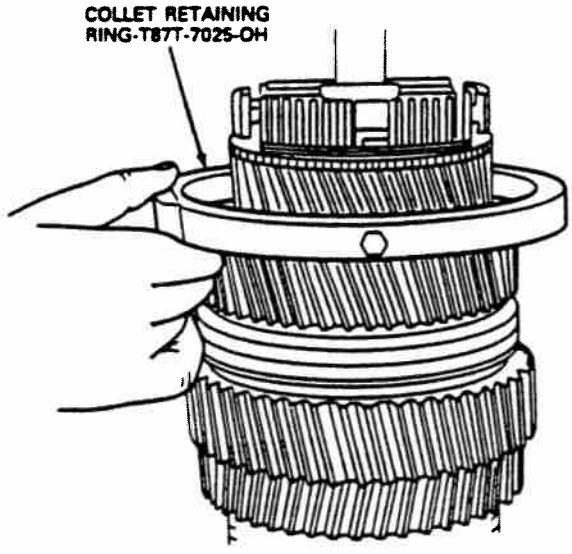
C8758-B

5. Remove the snap ring part of small parts repair kit that retains the 3rd-4th synchronizer body to the mainshaft.



C8759-B

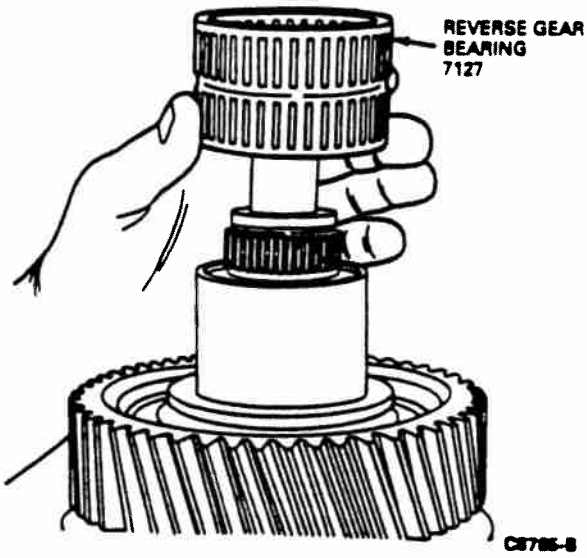
6. Place the Collet Retaining Ring T87T-7025-OH over the mainshaft and let it rest on the mainshaft.



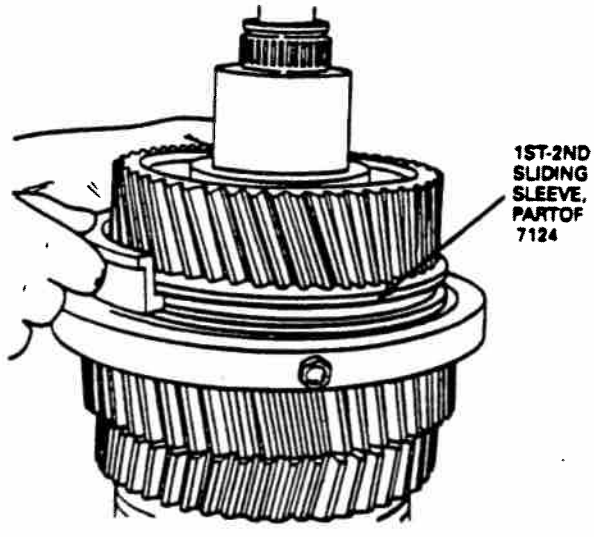
C8760-B

DISASSEMBLY AND ASSEMBLY OF SUBASSEMBLIES (Continued)

11. Remove the reverse gear bearings from the mainshaft.

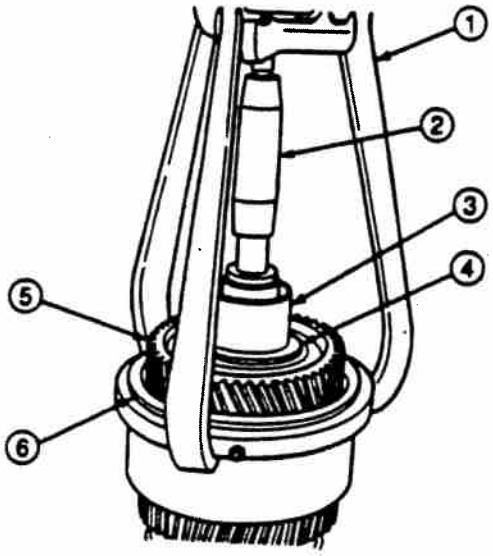


12. Lift the 1st-2nd gear sliding sleeve (part of synchronizer) up as far as it will slide.
13. Position the Collet Retaining Ring T87T-7025-OH over the mainshaft and let it rest on the first gear (1GR)(7100).
14. Position the two Collet Halves T87T-7025-MH so they seat in the groove in the 1st-2nd sliding sleeve (part of synchronizer). Pass the Collet Retaining Ring from below over the two halves and secure them to the sliding sleeve.



15. **CAUTION: Position a cloth around the 1st-2nd synchronizer to catch the springs, pressure pieces and balls that will be released when the sliding sleeve (part of synchronizer) clears the 1st-2nd synchronizer.**

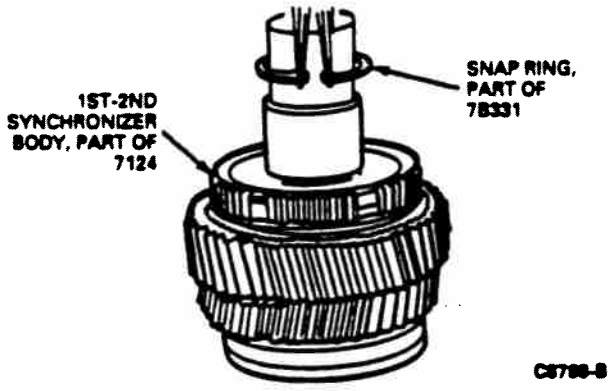
    Position Shaft Protector D80L-625-4 or equivalent on the end of the mainshaft. Position the Two-Three-Jaw Puller D80L-1013-A or equivalent on the Collet Retaining Ring and pull the 1st-2nd sliding sleeve (part of synchronizer), 2nd gear, thrust washer (7119), and input bearing spacer from the mainshaft.



Item	Part Number	Description
1	D80L-1013-A	2-3 Jaw Puller
2	D80L-625-4	Shaft Protector
3	7173	Input Bearing Spacer
4	7119	Thrust Washer
5	7101	Second Gear
6	—	1st-2nd Sliding Sleeve (Part of 7124)

DISASSEMBLY AND ASSEMBLY OF SUBASSEMBLIES (Continued)

16. Remove the snap ring (part of small parts repair kit) retaining the 1st-2nd synchronizer to the mainshaft.



17. NOTE: Use brass pads or equivalent to prevent damage.

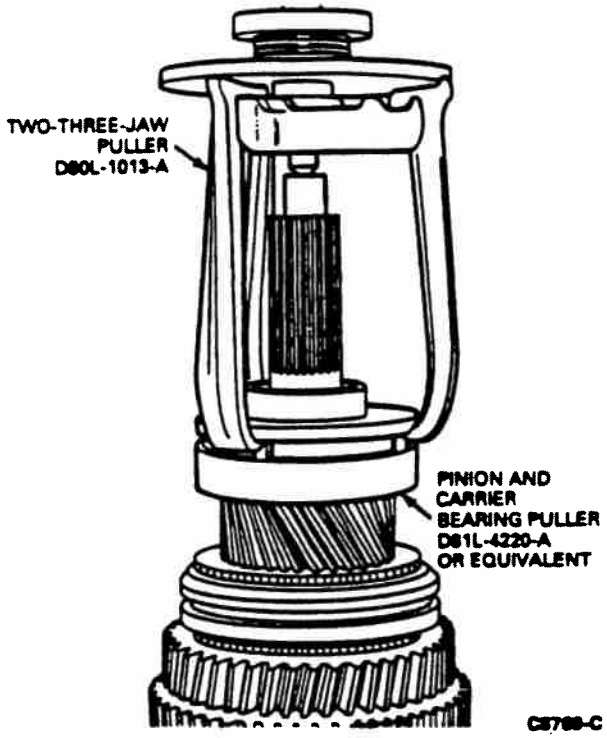
    Reposition the mainshaft in the vise so that the output end of the mainshaft is now facing up.

18. NOTE: On 4x4 versions and F-Super Duty versions, a snap ring (part of small parts repair kit) retaining the taper roller bearing inner race must be removed.

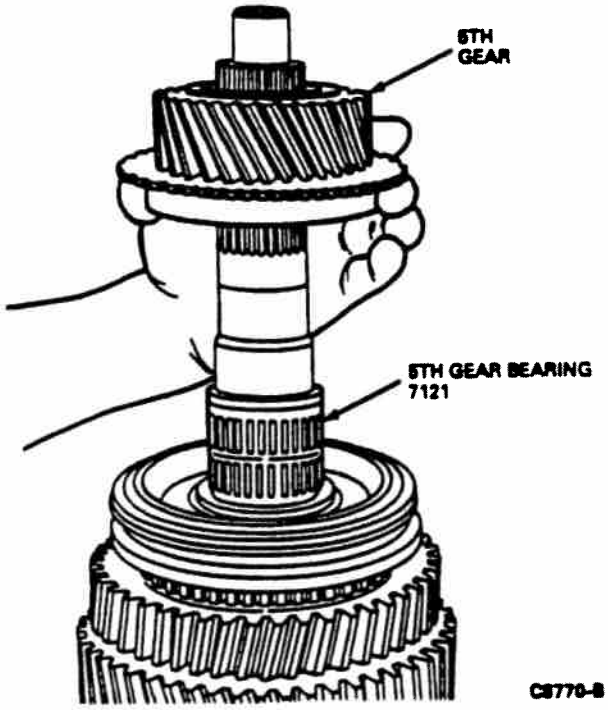
    CAUTION: Failure to use a bearing gripper will destroy the output shaft rear bearing (7R205).

    Position a bearing gripper such as Pinion and Carrier Bearing Puller D81L-4220-A or equivalent on the output shaft rear bearing. The gripper used must pull the output shaft rear bearing by the shoulder of the tapered rollers, not from the bearing cage.

19. Position Two-Three-Jaw Puller D80L-1013-A or equivalent on the bearing gripper and pull the output shaft rear bearing from the mainshaft.

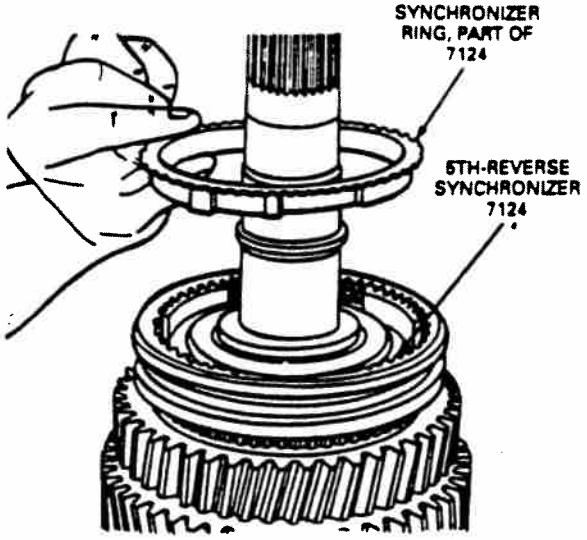


20. Remove the 5th gear from the mainshaft.
21. Remove the 5th gear bearing from the mainshaft.



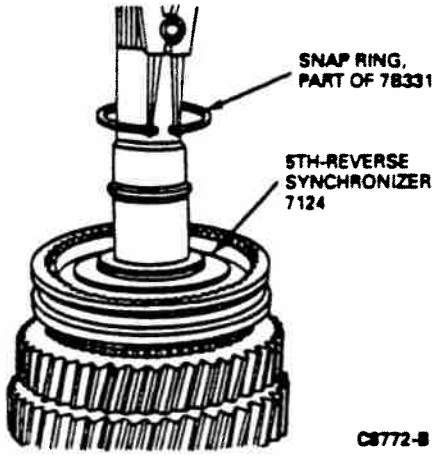
DISASSEMBLY AND ASSEMBLY OF SUBASSEMBLIES (Continued)

22. Remove the synchronizer ring (part of synchronizer) from the 5th-reverse synchronizer.



C8771-B

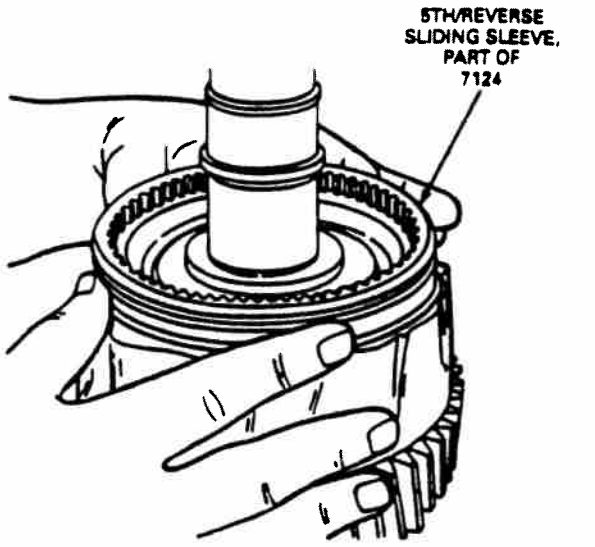
23. Remove the snap ring (part of small parts repair kit) retaining the 5th-reverse synchronizer to the mainshaft.



C8772-B

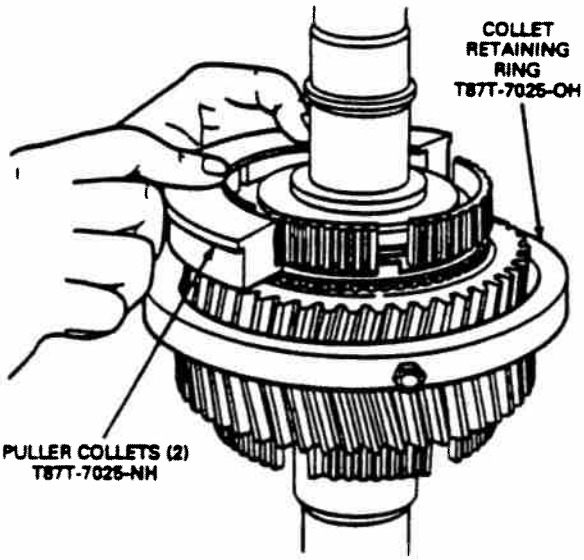
24. **CAUTION: Position a cloth around the 5th-rev synchronizer to catch the springs, pressure pieces and balls that will be released when the sliding sleeve clears the 5th-rev synchronizer.**

    Remove the 5th-reverse sliding sleeve (part of synchronizer).



C8773-B

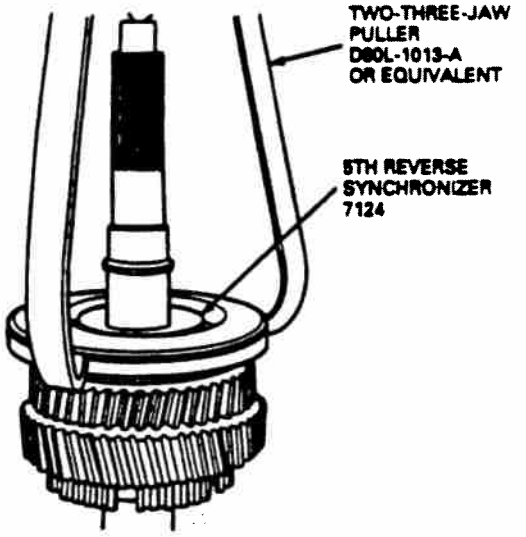
25. Place the Collet Retaining Ring T87T-7025-OH over the mainshaft and let it rest on the 1st gear. Position the Puller Collets T87T-7025-NH so the ridge rests between the synchronizer body (part of synchronizer) and the synchronizer ring (part of synchronizer). Slide the retaining ring upwards around the collets to secure them in position.



C8774-C

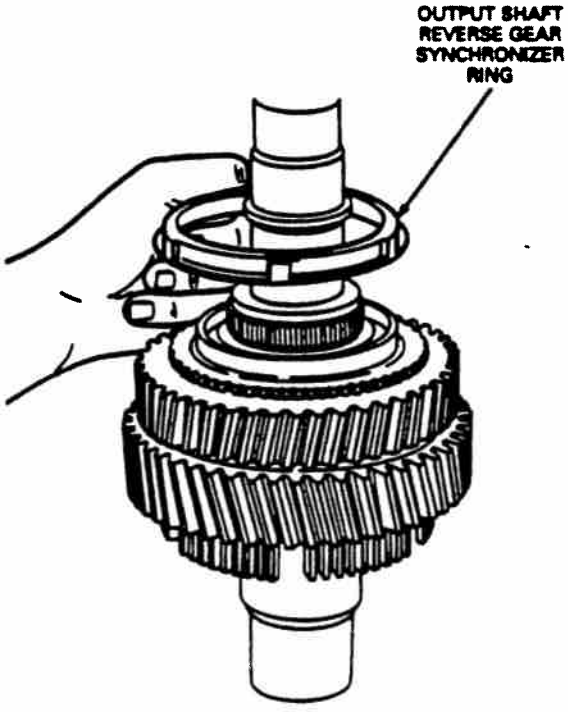
DISASSEMBLY AND ASSEMBLY OF SUBASSEMBLIES (Continued)

26. Position a Two-Three-Jaw Puller D80L-1013-A or equivalent on the collet retaining ring and pull the 5th-Reverse synchronizer from the mainshaft.



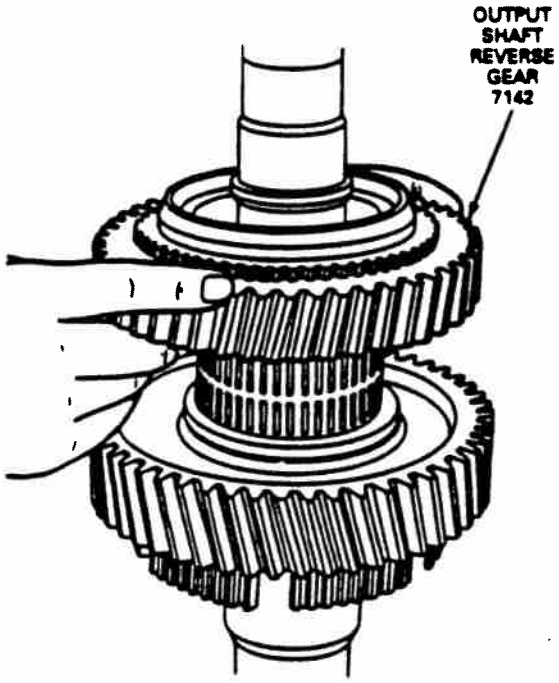
C8775-B

27. Remove the synchronizer ring (part of synchronizer) from the reverse idler gear and bushing (7141).



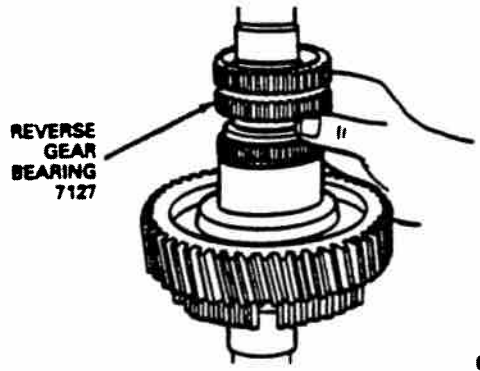
C8776-B

28. Remove the reverse idler gear and bushing from the mainshaft.



C8777-B

29. Remove the reverse gear bearing from the mainshaft.



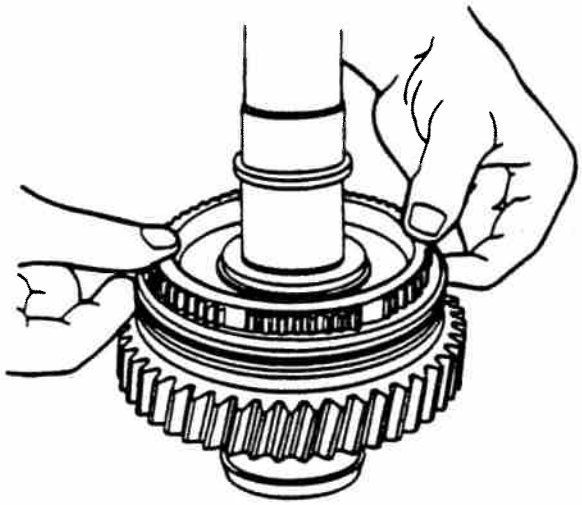
C8778-B

30. Remove the mainshaft from the vise.

DISASSEMBLY AND ASSEMBLY OF SUBASSEMBLIES (Continued)

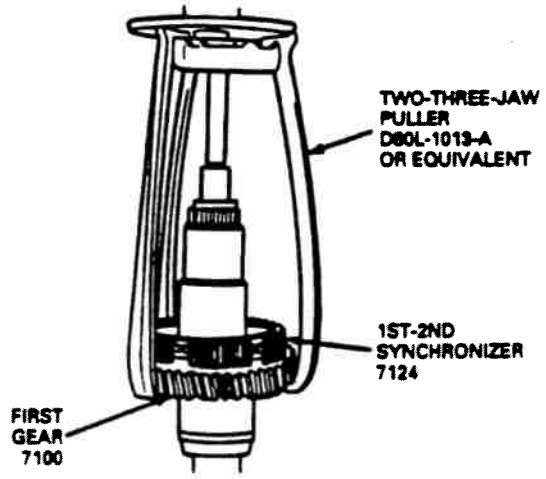
31. **CAUTION: Make sure mainshaft is properly supported.**

    Position the mainshaft in a press as shown in the illustration and press the first gear and the 1st-2nd synchronizer from the mainshaft.



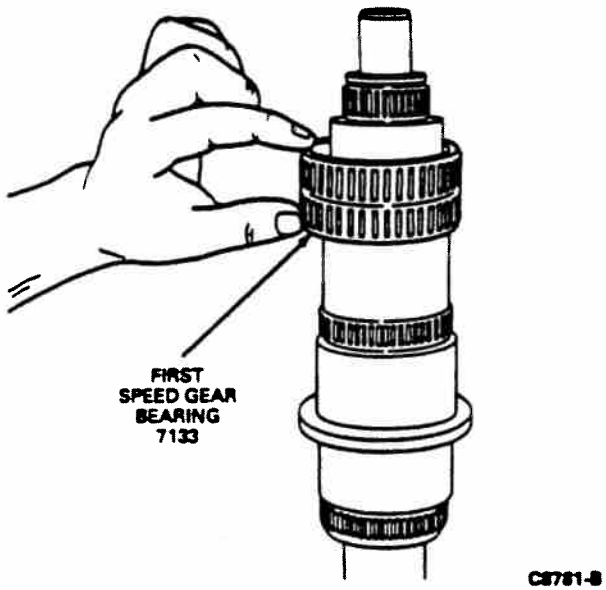
C8798-B

32. An alternate method is to turn the mainshaft over and clamp it at the output end. Position the jaws of 2-3-Jaw Puller D80L-1013-A or equivalent on the first gear and pull the first gear and the 1st-2nd synchronizer from the mainshaft.



C8799-B

33. Remove the first speed gear bearing from the mainshaft.



C8781-B

Assembly

1. NOTE: Use brass pads or equivalent to prevent damage.

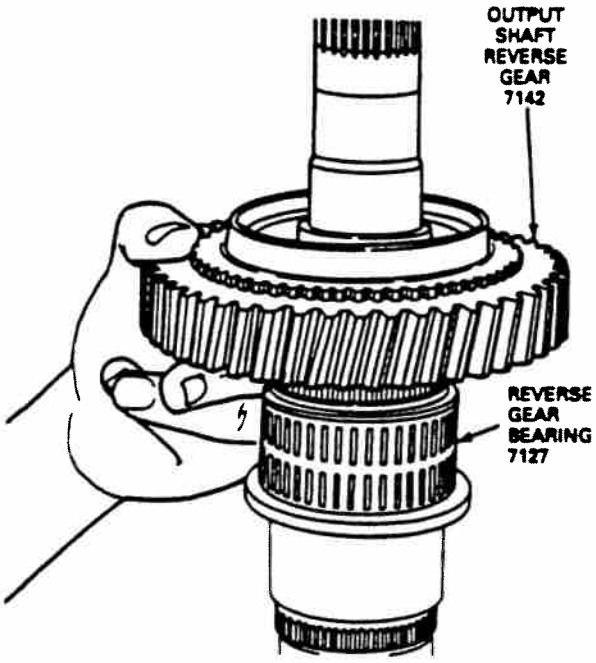
   Clamp the input end of the mainshaft in a vise.

2. Place the reverse gear bearing on the mainshaft.

DISASSEMBLY AND ASSEMBLY OF SUBASSEMBLIES (Continued)

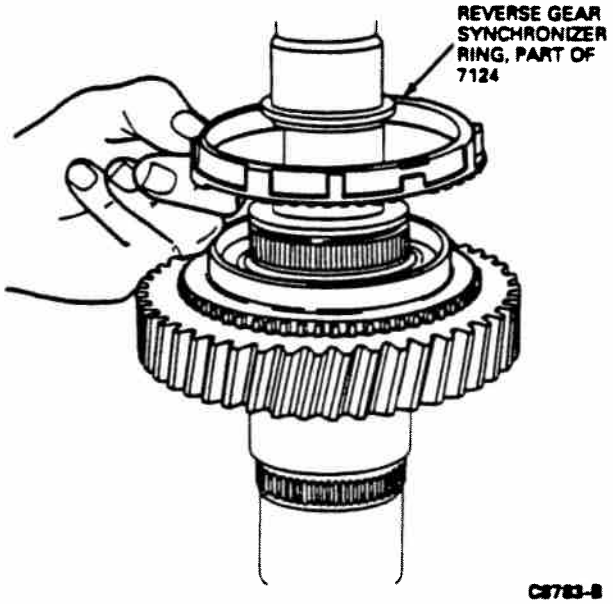
3. **CAUTION: Before installing original synchronizer, check for excessive wear. Refer to wear check of synchronizer under Inspection in this section for procedure.**

   Place the reverse idler gear and bushing on the mainshaft over the reverse gear bearing. The clutching teeth on the reverse idler gear and bushing must face upwards.



C8782-B

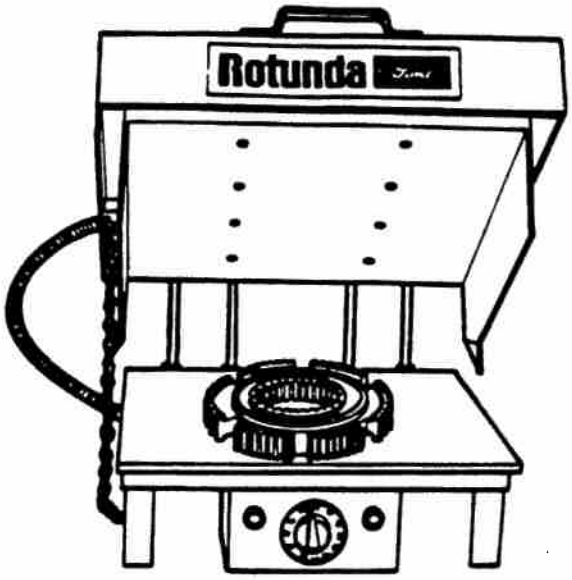
4. Position the reverse gear synchronizer ring (part of synchronizer) on the taper of the reverse idler gear and bushing.



C8783-B

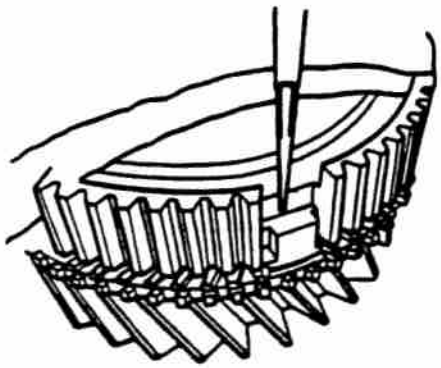
5. **CAUTION: Do not heat synchronizer for more than 15 minutes.**

   Heat the 5th-reverse synchronizer with a Precision Metal Gear / Bearing Heater 130-00002, Heat Gun 107-R0300 or equivalent to 160°C (320°F).



C8784-1A

6. Position the synchronizer on the mainshaft so that the side with the deeper hub faces down and the short lugs on the synchronizing ring (part of synchronizer) engage in the shallow gaps in the synchronizer. Push or lightly tap the synchronizer down until it stops.

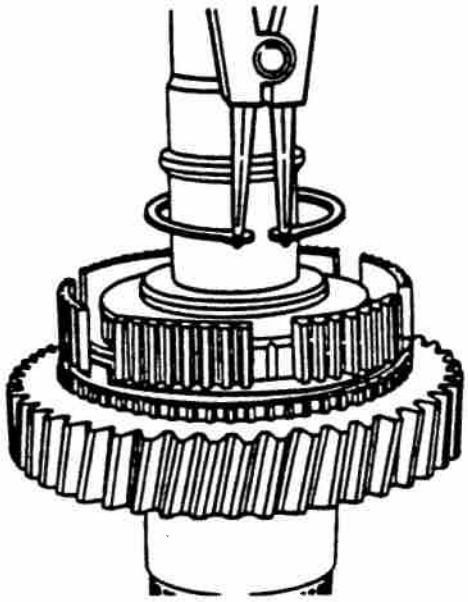


C8785-C

DISASSEMBLY AND ASSEMBLY OF SUBASSEMBLIES (Continued)

7. **CAUTION: Make sure snap ring (part of small parts repair kit) is free of burrs before checking clearance.**

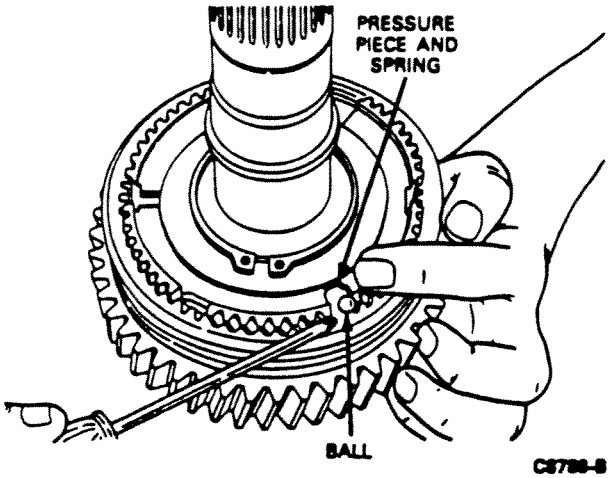
   Install the snap ring (part of small parts repair kit) on the mainshaft next to the 5th-reverse synchronizer. The clearance between the snap ring (part of small parts repair kit) and the synchronizer should not be more than 0.1mm (0.004 inch) with zero clearance preferable.



C8788-C

8. Check the reverse gear end play. End play must be between 0.15-0.35mm (0.006-0.014 inch).
9. There are two grooves on the 5th-reverse sliding sleeve (part of synchronizer). With the two grooves facing up (toward output end of mainshaft), position the sliding sleeve over the synchronizer body (both part of synchronizer). In three positions on the sliding sleeve, three teeth have been cut away. Align these three areas with the three shallow gaps in the synchronizer and the three lugs on the synchronizer ring (part of synchronizer). Slide the sliding sleeve down until it rests over the clutching teeth of reverse idler gear and bushing.
10. **CAUTION: If the original springs (part of countershaft pilot bearing) are being replaced, inspect them before reuse. Refer to Inspection in this section for procedure.**

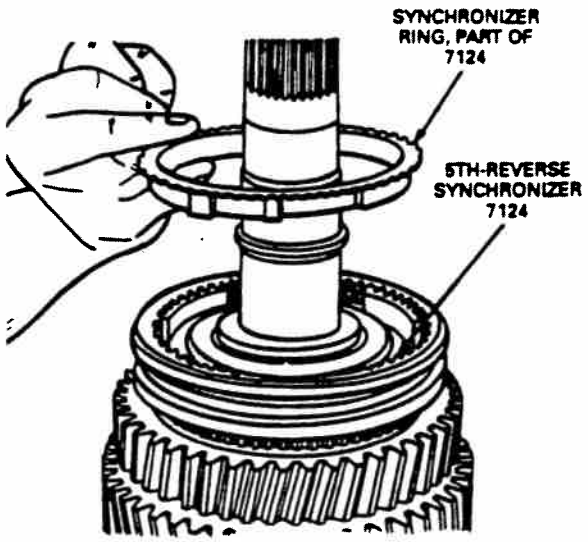
    Insert three compression springs with pressure pieces in the recesses of the synchronizer body (all part of synchronizer).
11. Raise the pressure pieces slightly with a screwdriver. Push in the balls with a screwdriver and slide the pressure piece so that it rests against the ball.



C8789-B

12. NOTE: The short lugs on the synchronizer ring should be located over the shallow gaps in the 5th-reverse synchronizer body.

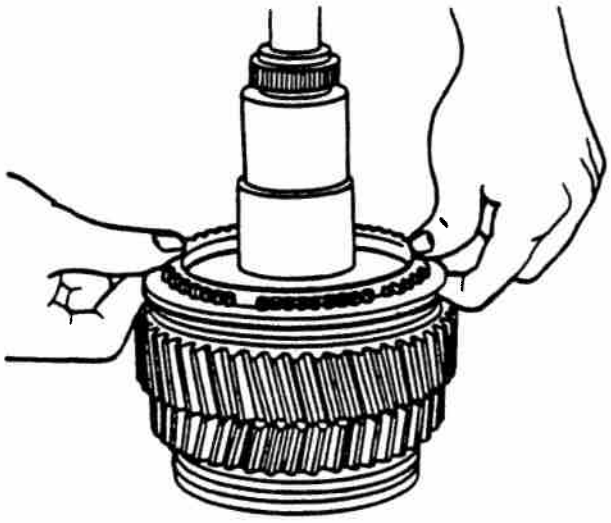
    Place the 5th gear synchronizer ring on the synchronizer body (both part of synchronizer).



C8771-B

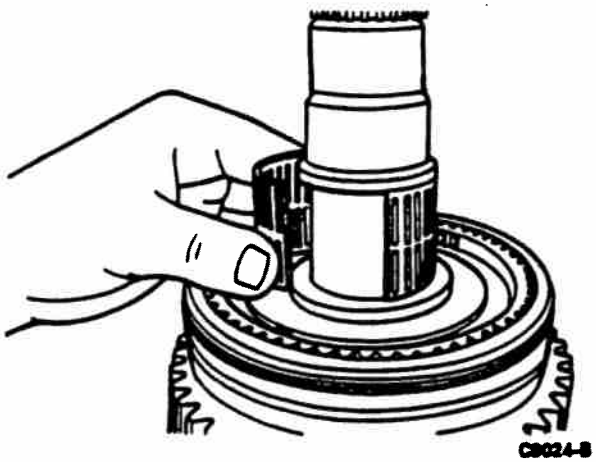
DISASSEMBLY AND ASSEMBLY OF SUBASSEMBLIES (Continued)

13. Push the 5th gear synchronizer ring (part of synchronizer) downwards while pulling the sliding sleeve (part of synchronizer) into the center position.



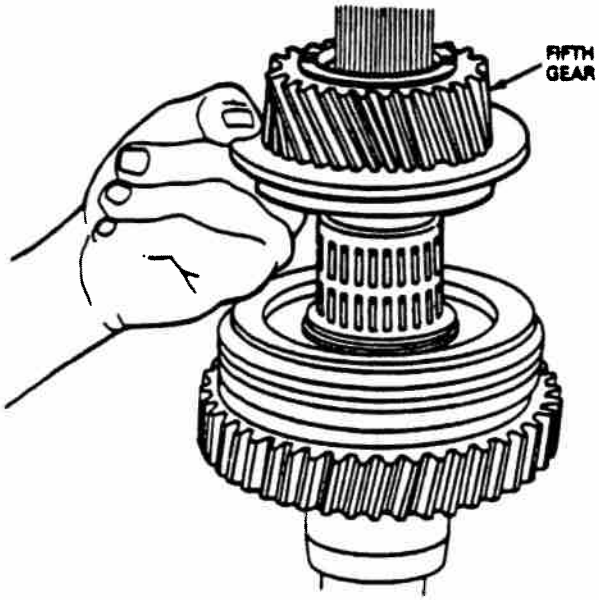
C8788-B

14. Place 5th gear bearing on the mainshaft.



C8024-B

15. Install the 5th gear on the mainshaft over the 5th gear bearing.



C8791-1A

16. **CAUTION: Do not heat the output shaft rear bearing for more than 15 minutes.**

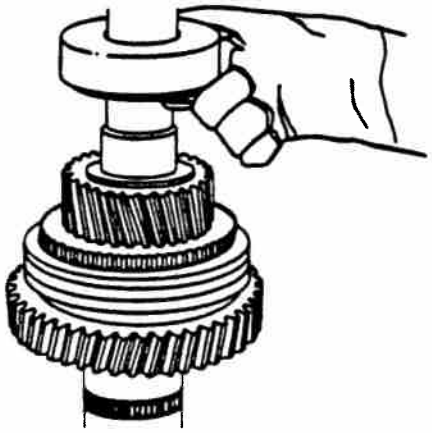
    CAUTION: If necessary to drive the output shaft rear bearing on, drive against the inner race only. Do not drive against the bearing cone.

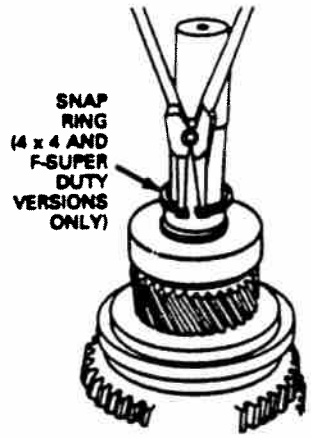
    Heat the inner race of the output shaft rear bearing to 160 °C (320°F) with Rotunda Precision Metal Gear / Bearing Heater 130-00002 or equivalent. Place it on the mainshaft and drive it on if necessary until it seats against its stop on the mainshaft.

DISASSEMBLY AND ASSEMBLY OF SUBASSEMBLIES (Continued)

17. NOTE: On 4x4 and F-Super Duty versions, fit an additional retaining ring (part of small parts repair kit) in the annular groove adjacent to the inner race. It must have an end play of 0.0-0.1mm (0.0-0.004 inch). 0mm (0.0 inch) should be aimed for.

    Check the end play of the 5th gear. End play must be 0.15-0.35mm (0.006-0.014 inch).





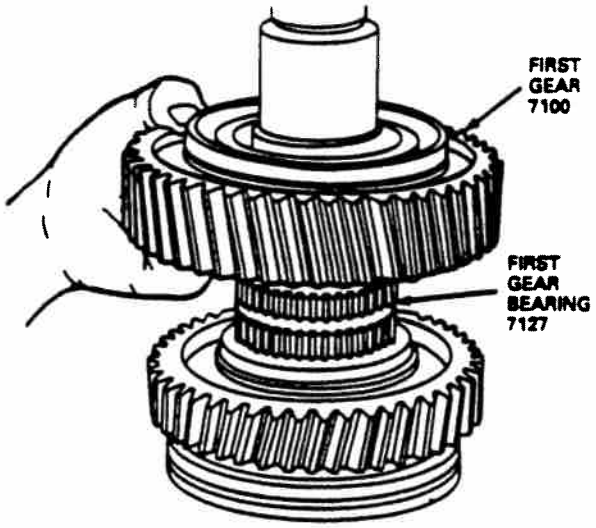
C8792-C

18. NOTE: Use brass pads or equivalent to prevent damage.

    Turn the mainshaft over and clamp it at the output end.

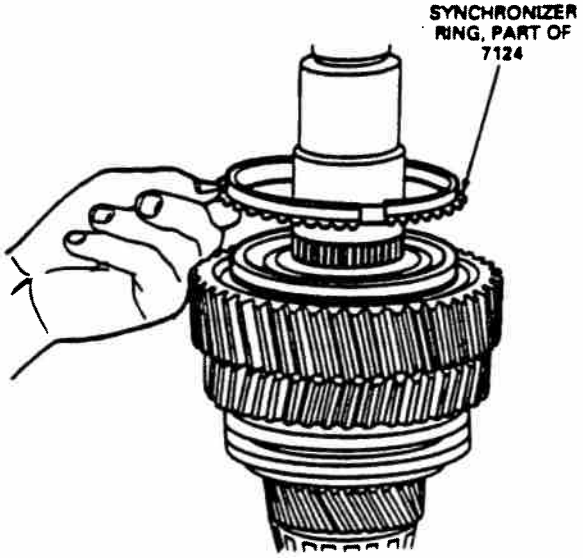
19. Place the gear bearing on mainshaft.

20. Place the first gear over the first gear bearing on the output and fifth gear drive shaft with the taper facing up.



C8793-B

21. Place the synchronizer ring (part of synchronizer) on the taper of the first gear.

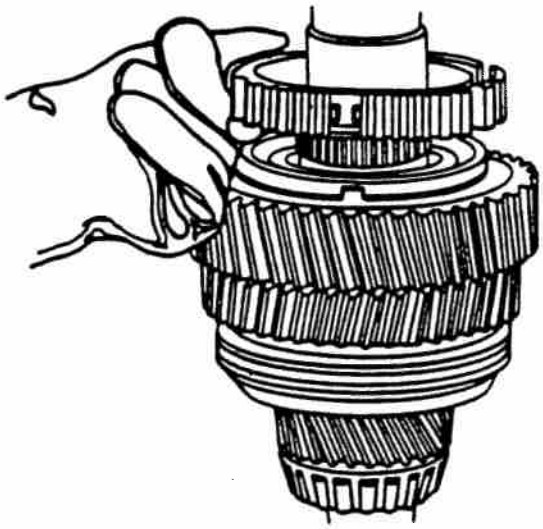


C8794-B

DISASSEMBLY AND ASSEMBLY OF SUBASSEMBLIES (Continued)

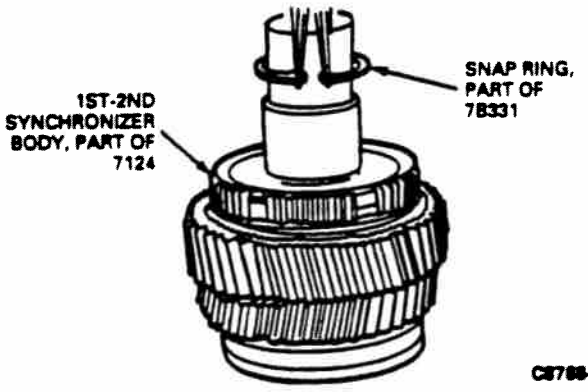
22. **CAUTION: Do not heat the synchronizer for more than 15 minutes.**

    Heat the 1st-2nd synchronizer to 160°C (320 °F) with Rotunda Precision Metal Gear / Bearing Heater 130-00002 or equivalent. Position the synchronizer on the mainshaft so that the short lugs on the synchronizing ring (part of synchronizer) engage in the shallow gaps in the synchronizer. Lightly tap the synchronizer down until it stops against the synchronizer ring (part of synchronizer). When proper installation is made, the word "ENGINE" will be visible on the synchronizer.



C8796-D

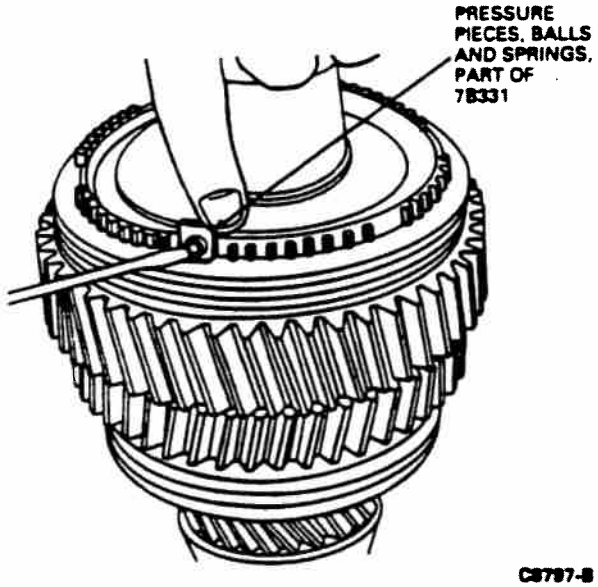
23. Install a new snap ring on the mainshaft next to the 1st-2nd (part of small parts repair kit). Clearance between the snap ring and the synchronizer should not be more than 0.1mm (0.004 inch).



C8798-B

24. Check the end play of the first gear. It must be between 0.15 and 0.35mm (0.006 and 0.014 inch).
25. Position the sliding sleeve over the synchronizer with its tapered collar facing down (toward the output end of the mainshaft). In three positions on the sliding sleeve, three teeth have been cut away. Align these three areas with the three shallow gaps in the synchronizer and the three lugs on the synchronizer ring. Slide the sliding sleeve down until it rests against the first gear.
26. **CAUTION: If the original springs are not being replaced, inspect them before reuse. Refer to Inspection in this section for procedure.**

    Insert three compression springs with pressure pieces (part of small parts repair kit) in the recesses of the synchronizer.
27. Raise the pressure pieces (part of small parts repair kit) slightly with a screwdriver. Push in the balls (part of small parts repair kit) with a screwdriver and slide the pressure piece so that it rests against the ball.

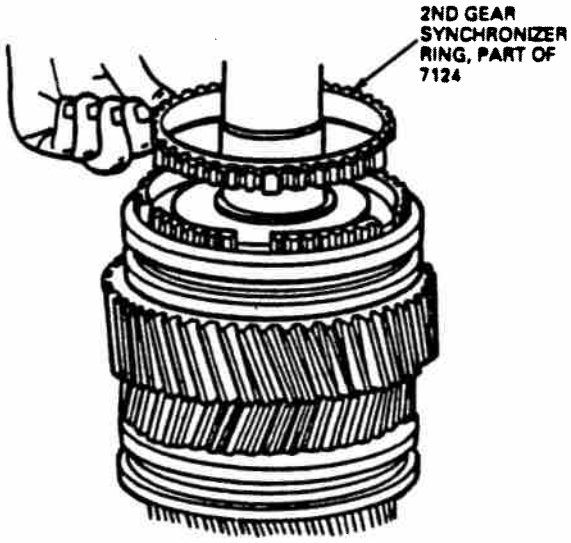


C8797-B

DISASSEMBLY AND ASSEMBLY OF SUBASSEMBLIES (Continued)

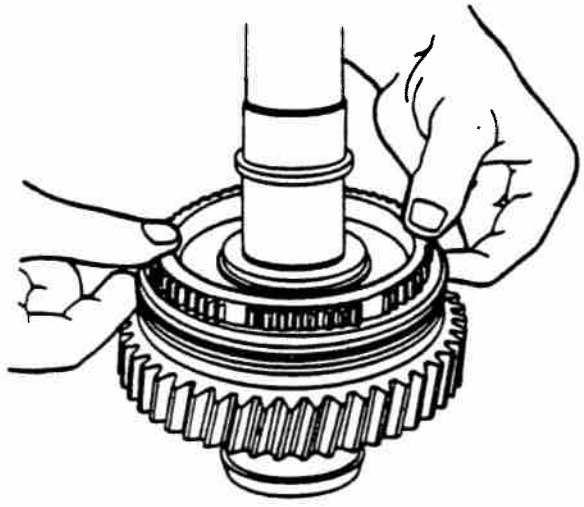
28. NOTE: The short lugs on the synchronizer should be located over the gaps in the 1st-2nd synchronizer.

    Place the 2nd gear synchronizer ring (part of synchronizer) on the 1st-2nd synchronizer.



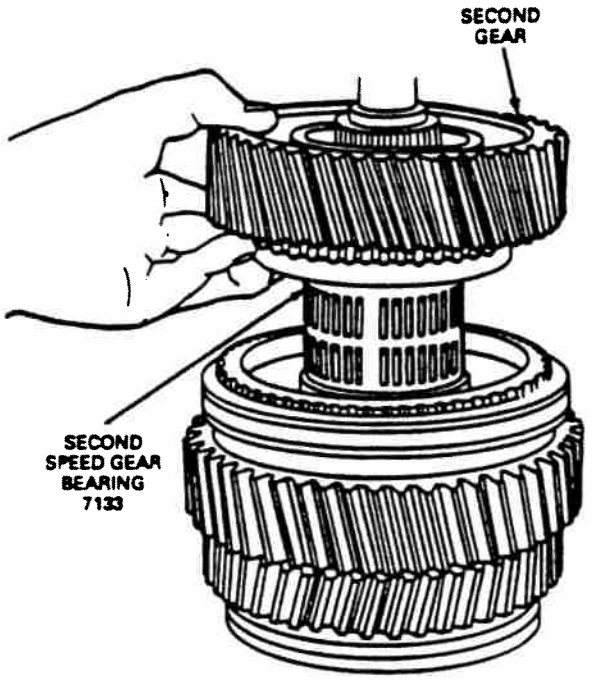
C8799-B

29. Push the synchronizer ring downwards while pulling the sliding sleeve into the center position.



C8799-B

30. Place the second speed gear bearing on the mainshaft.
31. Place the 2nd gear over the second speed gear bearing on the mainshaft. The taper of the 2nd gear must face down on the mainshaft.

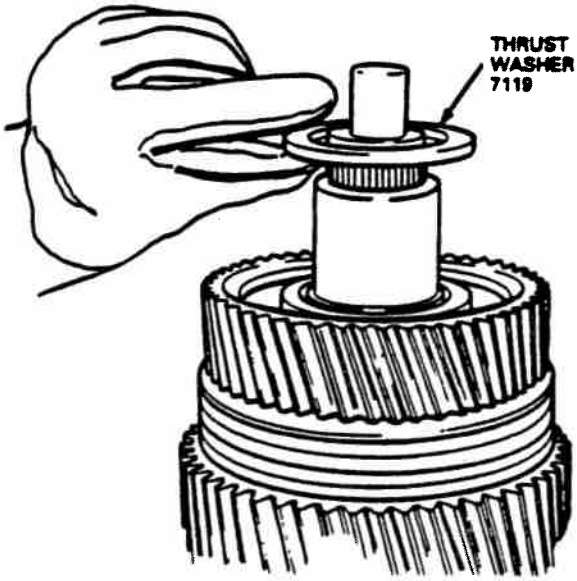


C8800-B

32. **CAUTION: Do not heat the thrust washer for more than 15 minutes.**

    Heat the thrust washer to 160°C (320 °F) with Rotunda Precision Metal Gear / Bearing Heater 130-00002 or equivalent.

33. Position the thrust washer on the mainshaft and tap it down until it seats against its stop on the mainshaft. If necessary, gently tap the thrust washer to fully seat it.



C8801-D

DISASSEMBLY AND ASSEMBLY OF SUBASSEMBLIES (Continued)

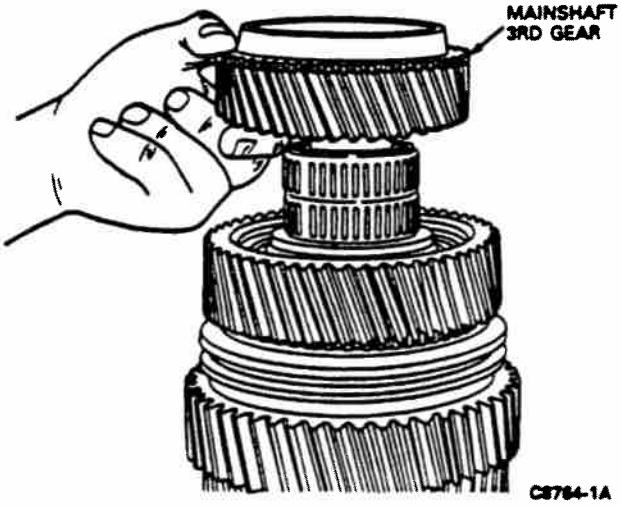
34. **CAUTION: Do not heat the input bearing spacer (7173) for more than 15 minutes.**

    Heat the 3rd speed bearing spacer to 160°C (320°F) with Rotunda Precision Metal Gear / Bearing Heater 130-00002 or equivalent.

35. Position the 3rd speed bearing spacer on the mainshaft and tap it down until it seats against its stop on the mainshaft. If necessary, gently tap the 3rd speed bearing spacer to fully seat it.

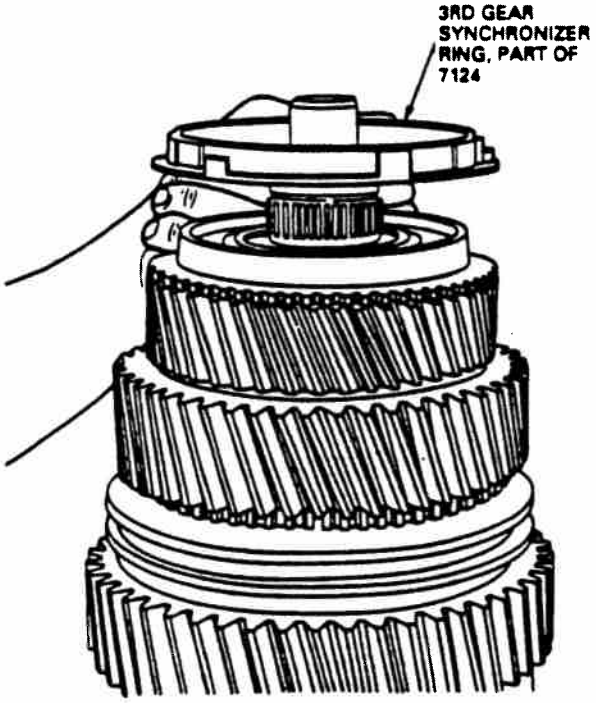
C8662-D

36. Check the end play of the 2nd gear. It must be between 0.15-0.45mm (0.006-0.017 inch).
37. After the 3rd speed bearing spacer has fully cooled, place the 3rd speed gear bearing over it.
38. Place the 3rd gear over the 3rd speed gear bearing on the mainshaft. The taper of the 3rd gear must face up.



C8764-1A

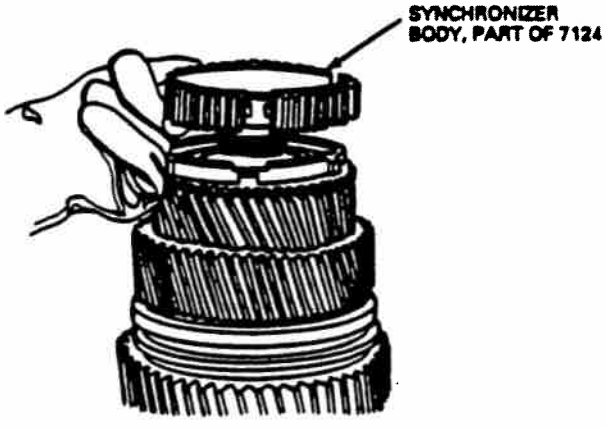
39. Place the 3rd gear synchronizer ring (part of synchronizer) on the taper of the 3rd gear.



C8763-B

40. **CAUTION: Do not heat the synchronizer for more than 15 minutes.**

    Heat the 3rd-4th synchronizer with Rotunda Precision Metal Gear / Bearing Heater 130-00002 or equivalent to a maximum 160°C (320°F). Position the synchronizer on the mainshaft so that the short lugs on the synchronizer ring (part of synchronizer) engage in the shallow gaps in the synchronizer. Lightly tap the synchronizer down until it stops against the synchronizer ring (part of synchronizer). The recess in the synchronizer must face upwards.

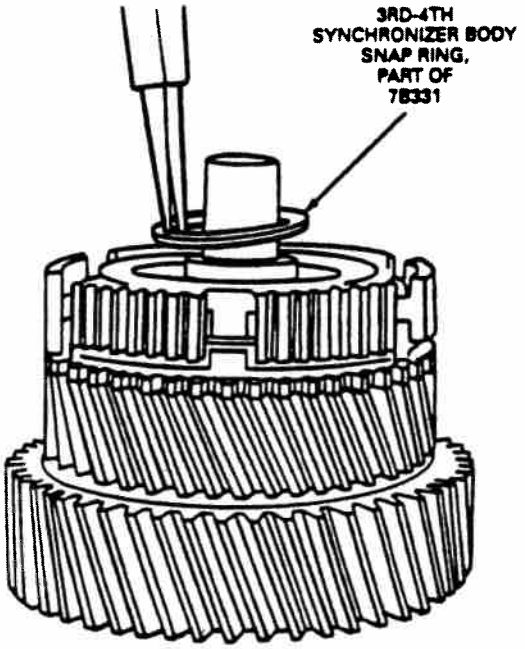


C8663-D

41. Install a new snap ring on the mainshaft next to the 3rd-4th (part of small parts repair kit). Clearance between the snap ring and the synchronizer should not be more than 0.1mm (0.004 inch).

DISASSEMBLY AND ASSEMBLY OF SUBASSEMBLIES (Continued)

42. Check the end play of the 3rd gear. It must be between 0.15 and 0.35mm (0.006 and 0.014 inch).



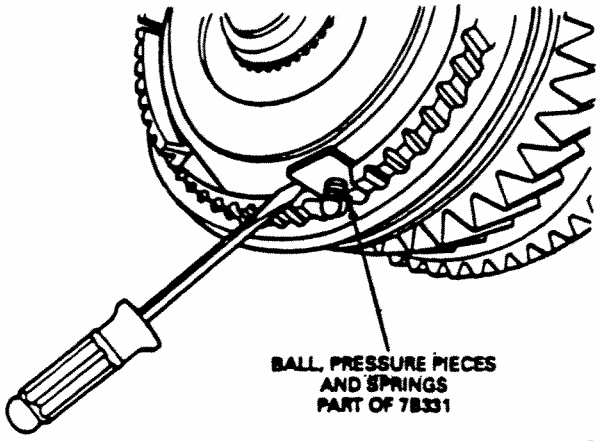
C8786-B

43. Position the sliding sleeve over the synchronizer body (both part of synchronizer) with the smaller of the two grooves facing down. In three positions on the sliding sleeve, three teeth have been cut away. Align these three areas with the three shallow gaps in the synchronizer body and the three lugs on the synchronizer ring (part of synchronizer). Slide the sliding sleeve (part of synchronizer) down until it rests against the 3rd gear.

44. **CAUTION: If the original springs are being replaced, inspect them before reuse. Refer to Inspection in this section for procedure.**

    Insert three compression springs with pressure pieces (part of small parts repair kit) in the recesses of the synchronizer.

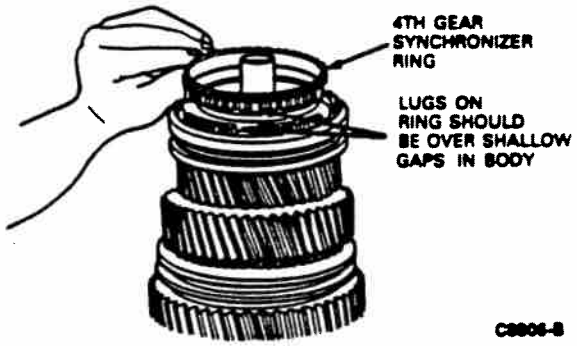
45. Raise the pressure pieces (part of small parts repair kit) slightly with a screwdriver. Push in the balls (part of small parts repair kit) with a screwdriver and slide the pressure piece so that it rests against the ball.



C8805-B

46. NOTE: The short lugs on the synchronizer ring (part of synchronizer) should be located over the shallow gaps in the 3rd-4th synchronizer body.

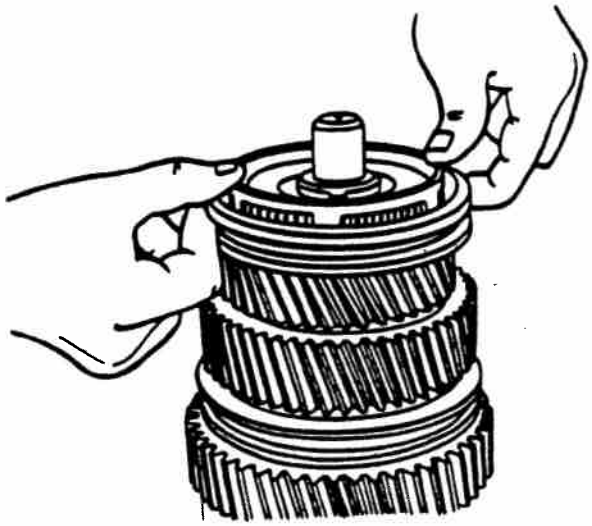
    Place the 4th gear (part of synchronizer) on the synchronizer body.



C8806-B

DISASSEMBLY AND ASSEMBLY OF SUBASSEMBLIES (Continued)

47. Push the synchronizer ring downwards while pulling the sliding sleeve (both part of synchronizer) into the center position.



C9697-B

48. **CAUTION: Do not heat the input shaft pocket bearing for more than 15 minutes.**

    CAUTION: If necessary to drive the input shaft pocket bearing on, drive against the inner race only. Do not drive against the bearing cone.

    Heat the inner race of the input shaft pocket bearing to 160°C (320°F) with Rotunda Precision Metal Gear / Bearing Heater 130-00002 or equivalent. Position it on the mainshaft and drive it on if necessary until it seats against its stop on the mainshaft.

An alternate method is to press the input shaft pocket bearing on using Inner Pinion Bearing Cone Replacer T85T-4621-AH.

C9696-C

Bearing, Countershaft

Disassembly

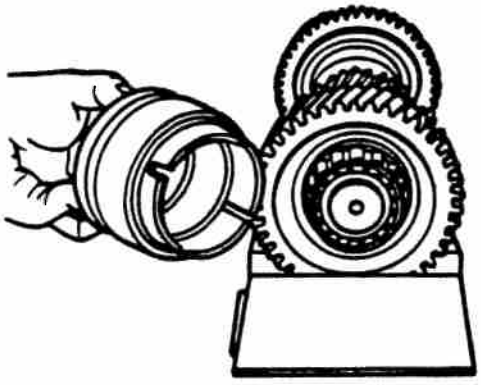
1. NOTE: Do not attempt service procedures on the gears of countershaft cluster gear (7113). Only the bearings can be serviced.

   NOTE: Use brass pads or equivalent to prevent damage.

   NOTE: This procedure can also be used to replace the other countershaft bearing.

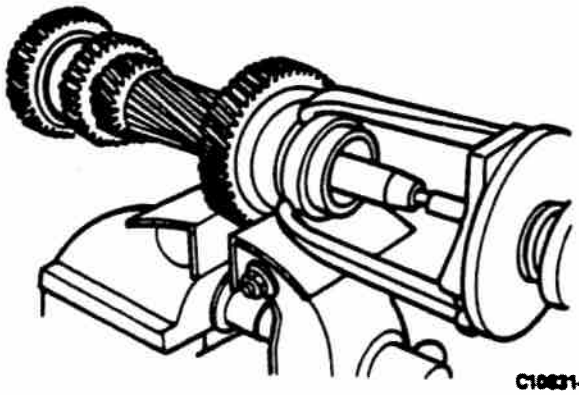
   Position countershaft cluster gear in a vise clamping onto 5th gear (part of countershaft cluster gear).

2. Place puller device, such as Pinion and Carrier Bearing Puller D81L-4220-A or equivalent over the inner ring of the output shaft bearing (7065) located at the output end of the countershaft cluster gear. Turn the knurled ring on the tool to secure it to the ring on the output shaft bearing.



C10630-A

3. Position 2-3-Jaw Puller D80L-1013-A or equivalent over the gripper tool and remove the output shaft bearing from the countershaft.



C10631-A

Assembly

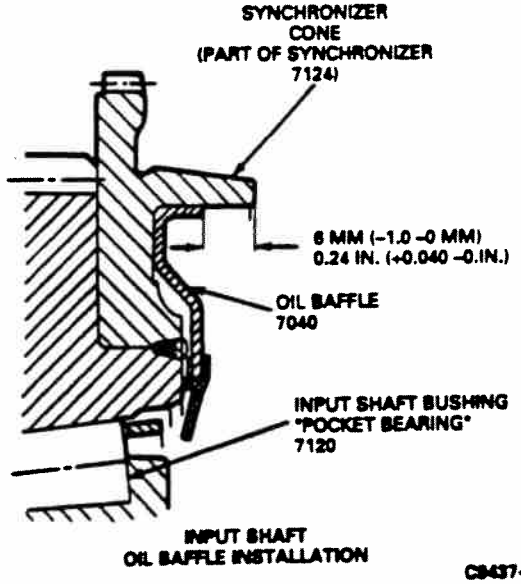
1. Using Rotunda Heat Gun 107-R0300 or equivalent, heat the output shaft bearing not to exceed 160 °C (320°F). **Maximum heating time is 15 minutes.**
2. Install output shaft bearing on end of countershaft cluster gear and drive it to its axial stop.

ASSEMBLY

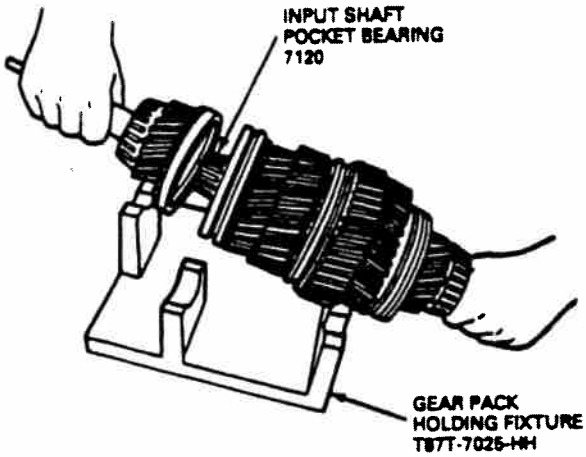
Transmission

NOTE: Any time the transmission (7003) is serviced check the following items:

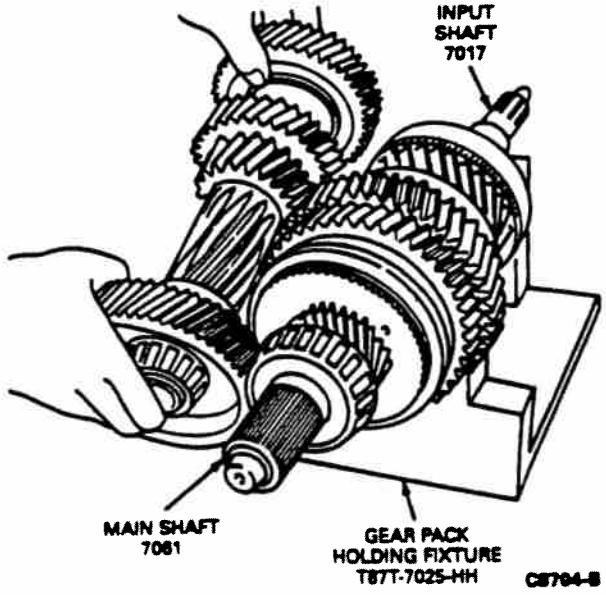
- Confirm that the front bearing oil scoop ring is installed in the input shaft synchronizer cone recess.
- Visually inspect the front bearing oil scoop ring for tears or damage.
- The front bearing oil scoop ring is recessed 6mm (+1 -0) (0.24 inch [+0.04 -0]) below the synchronizer cone edge.
- The front bearing oil scoop ring fits tight and cannot be moved by hand.
- The three lubrication holes in the input shaft (7017) are free of any obstruction.
- The oil channel (in the main case) to the bearing (7025) is free of any obstruction.
- The oil baffle (part of the shim pack) behind the outer race of the bearing is free of damage.
- The synchronizer body snap ring forward of the 3-4 synchronizer package on the mainshaft is in position.



1. Place the input shaft end over the input shaft pocket bearing on the input end of the mainshaft.



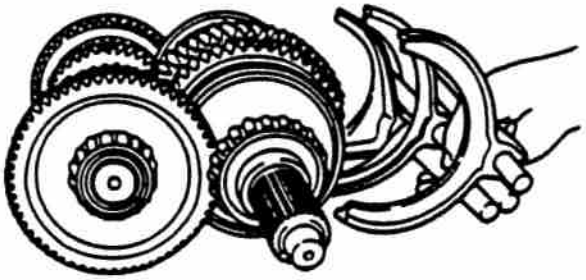
2. Place the mainshaft and input shaft on the Gear Pack Holding Fixture T87T-7025-HH. Place the countershaft cluster gear (7113) on the fixture and mesh the gears of the mainshaft and countershaft cluster gear.



3. Place the three shift rails and forks into the Shift Rod Support T87T-7025-JH in the position from which they were removed during disassembly.

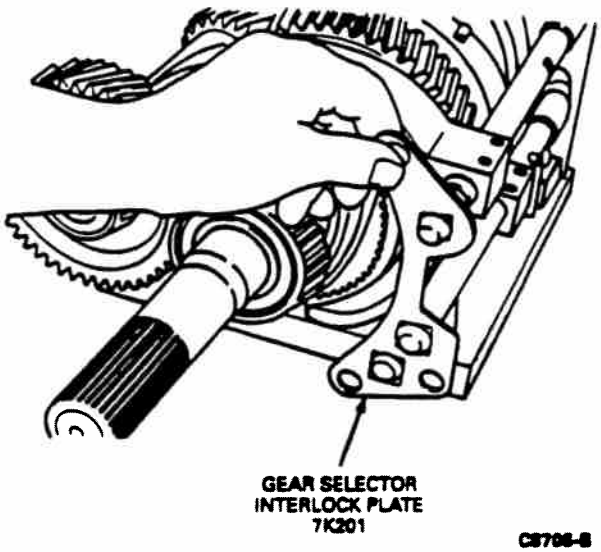
ASSEMBLY (Continued)

4. Position the three shift rail assemblies together with the shift rod support tool and gear selector interlock plate so that the gear shifter forks (7230) engage in the correct sliding sleeves (part of mainshaft synchronizer (7124)).



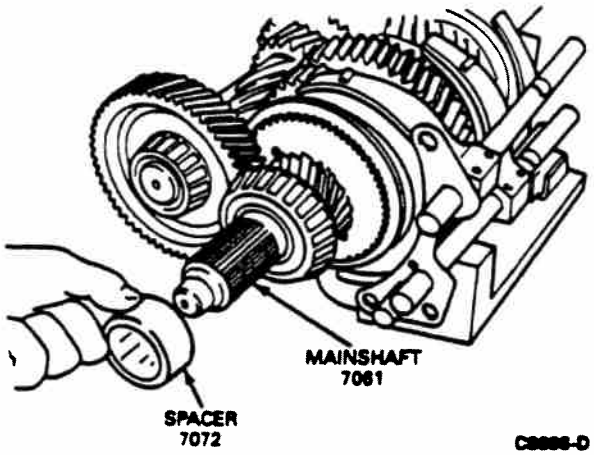
C8706-B

5. Place the gear selector interlock plate on the three gearshift rails and engage it in the grooves of the gear selector interlock plate in the main gear shift rail.



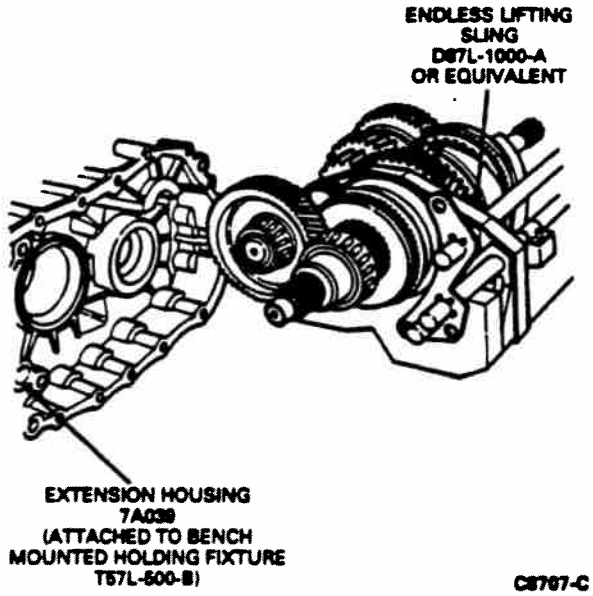
C8706-B

6. Install spacer onto mainshaft.



C8696-D

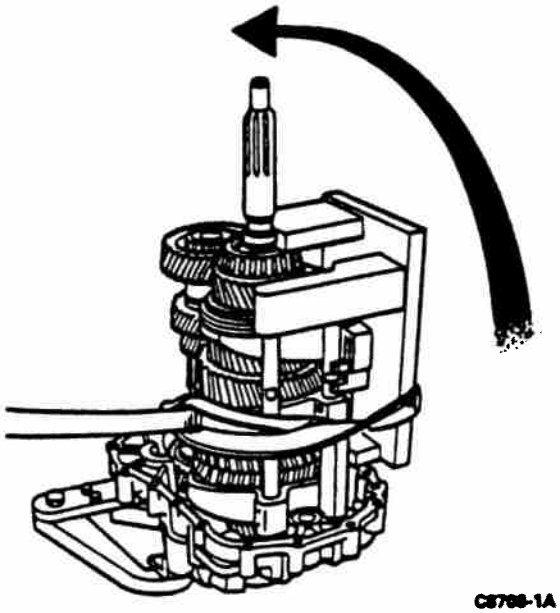
7. Secure the extension housing (7A039) into the Bench Mounted Holding Fixture T57L-500-B.
8. Position endless Lifting Sling D87L-1000-A or equivalent around the shift rails, the holding fixture and the mainshaft and countershaft cluster gear. Position the gear pack into the extension housing and push the mainshaft and countershaft cluster gear and rails forward until the output shaft rear bearing (7R205) and output shaft bearing (7065) seat in their outer races in the extension housing and the gearshift rails slide into their retaining holes in the extension housing.



C8707-C

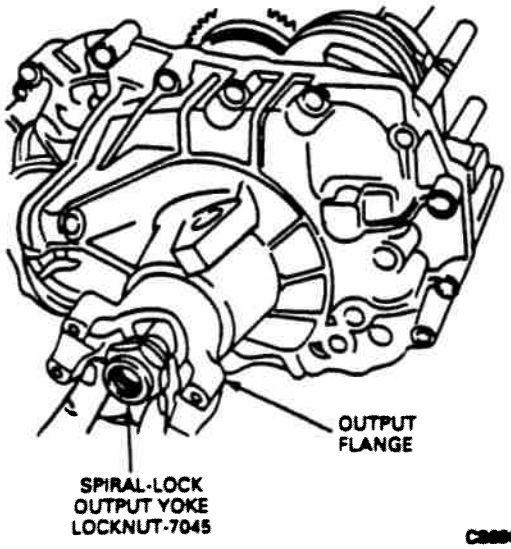
ASSEMBLY (Continued)

9. Rotate the gear pack and extension housing upwards 90 degrees so it is in a vertical position with the input shaft pointing upwards.



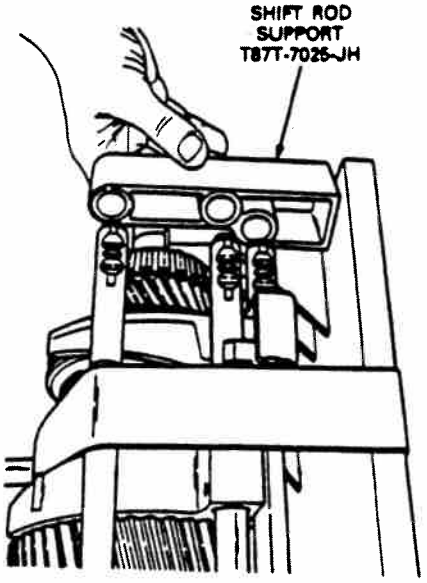
C8708-1A

10. If equipped, slide the output flange onto the end of the mainshaft until it seats against its stop. Screw the spiral-lock output yoke locknut onto the mainshaft until it is finger-tight.



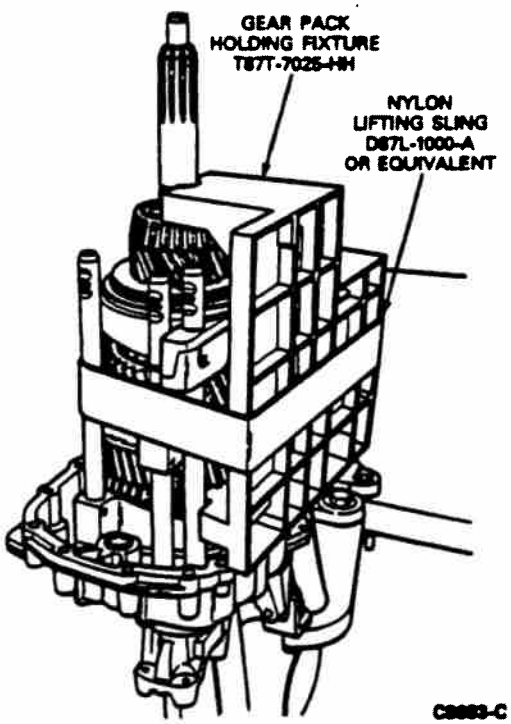
C8696-B

11. Remove the shift rod support T87T-7025-JH.



C8694-C

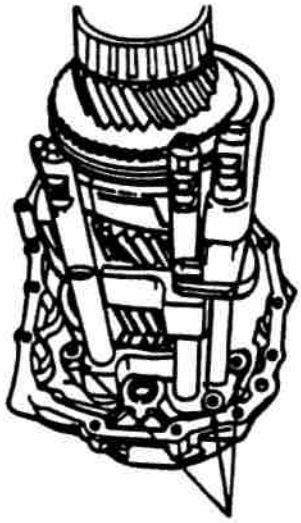
12. Remove the strap and remove the gear pack holding fixture from the mainshaft and countershaft cluster gear.



C8693-C

ASSEMBLY (Continued)

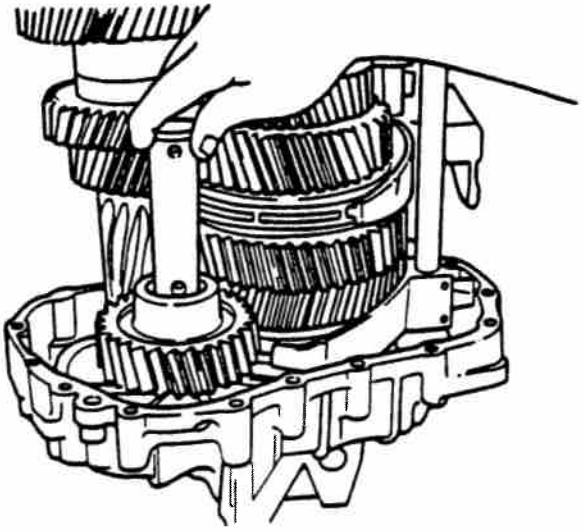
13. Attach the three capscrews that secure the shift interlock to the rear transmission housing. Tighten them to 10 N·m (7 lb-ft). Be sure that the interlock moves freely after tightening the screws.



SELECTOR PLATE BOLTS 7A443

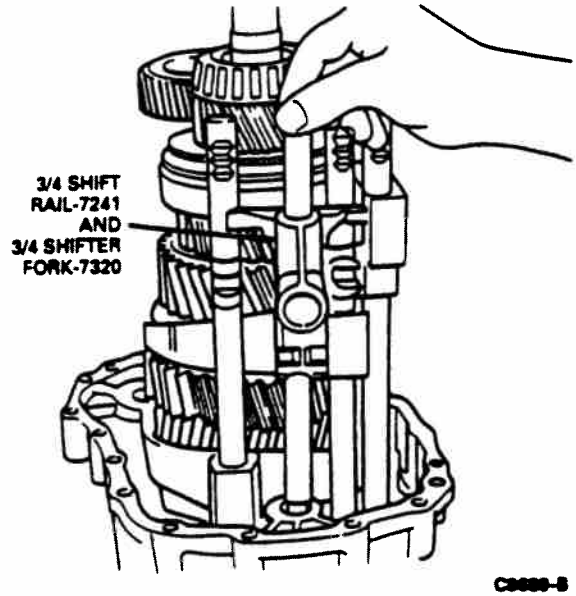
C8692-B

14. Engage the teeth of the reverse idler gear with the reverse idler gear and bushing (7141). Slide the reverse idler gear shaft (7140) downward through the reverse idler gear bearings and into the extension housing. Align the lower of the two threaded holes in the reverse idler gear shaft with the bore in the extension housing. Place a sealing ring on the reverse idler shaft bolt and attach through the bore in the case (7005) into the reverse idler gear shaft. Tighten the screw finger-tight.



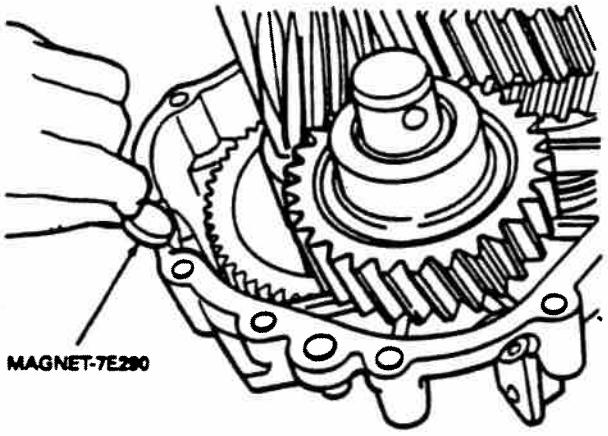
C8710-B

15. Insert the 5/reverse shift rail and gear shifter fork into its bore in the extension housing.



C8689-B

16. If the magnet was removed during disassembly, insert it in the recess in the extension housing.



C8711-B

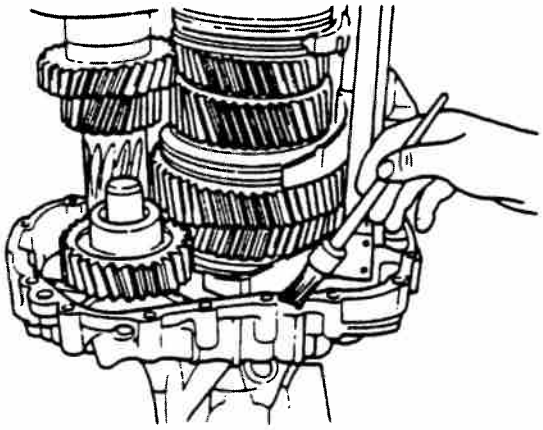
ASSEMBLY (Continued)

17. **CAUTION: The tapered roller bearing preload should be adjusted if either the case or extension housing, countershaft cluster gear, mainshaft, input shaft, or a bearing has been replaced. If the tapered roller bearings on the mainshaft, input shaft, or countershaft cluster gear have to be adjusted, do not apply Gasket Maker E3AZ-19554-AA or equivalent meeting Ford specification WSK-M2G348-A9 at this time.**

    NOTE: Do not wait longer than ten minutes to tighten all 17 bolts, due to the rapid curing time of the sealant.

    CAUTION: Do not use a silicone sealing compound.

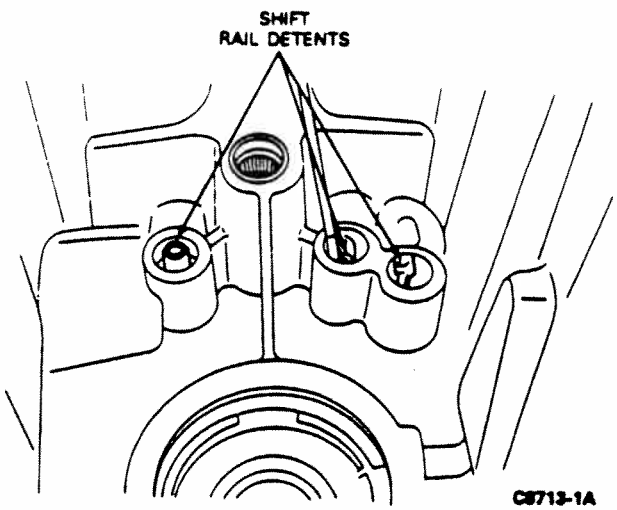
    If the tapered roller bearings do not have to be adjusted, thinly coat the sealing surface of the extension housing with Gasket Maker E3AZ-19554-AA or equivalent meeting Ford specification WSK-M2G348-A9.



C8712-1A

18. **CAUTION: Make sure that the shift rail detents do not obstruct entry of the shift rails.**

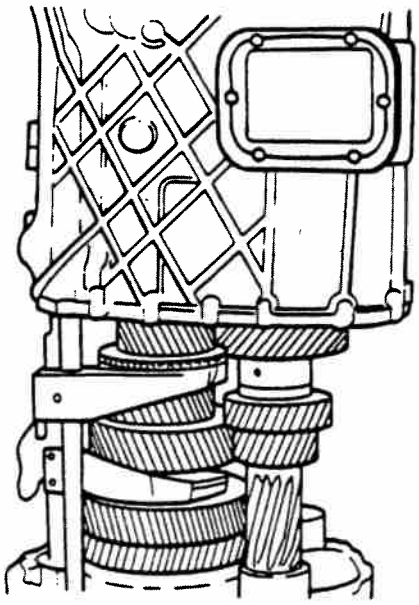
    If removed, push the three shift rail detents back into their holes in the case.



C8713-1A

19. **CAUTION: Be careful that the input shaft does not damage the input shaft seal and extension housing seal. Also be careful that the oil baffle is not bent when the case is positioned over the input shaft.**

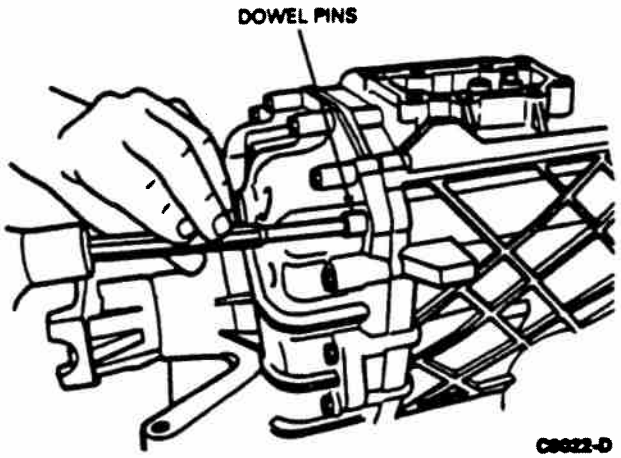
    Carefully place the case over the mainshaft and countershaft cluster gear and gearshift rails until it rests on its mating surface on the extension housing. It may be necessary to push the 5/reverse shift rail inward to clear the inner surfaces of the case.



C9019-1A

ASSEMBLY (Continued)

20. Drive in the two dowels that align the extension housing and the case. Next, insert two hex screws and tighten them finger-tight.



C9022-D

21. NOTE: If it is not necessary to adjust the mainshaft / input shaft preload, install all of the hex screws that attach case to extension housing and tighten to 23 N·m (17 lb-ft).

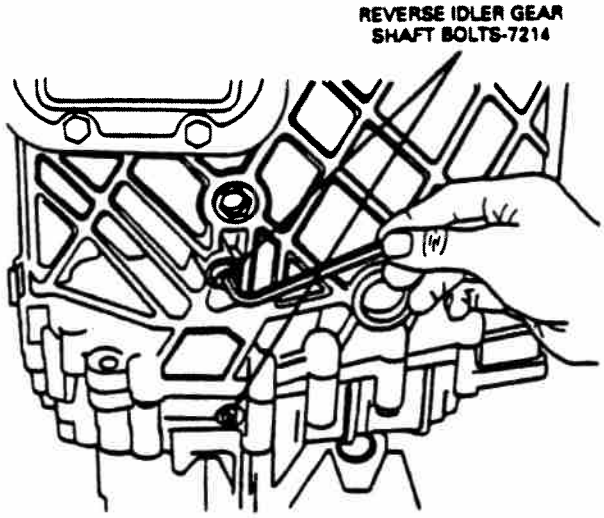
    Screw two additional hex screws into the bores of extension housing near the mainshaft and countershaft cluster gear finger-tight.

22. **CAUTION: The tapered roller bearing preload should be adjusted if either the case to extension housing, countershaft cluster gear, mainshaft, input shaft or a bearing has been replaced. Refer to Adjustments in this section.**

    NOTE: The rear case reverse idler shaft bolt was installed finger-tight earlier.

    CAUTION: Use hand pressure for screwdriver only, do not hammer the caps into position.

    Fit sealing ring to the remaining reverse idler shaft shift rod bolt. Install the screw into the bore in the case and tighten both reverse idler shaft bolts to 22 N·m (16 lb-ft).



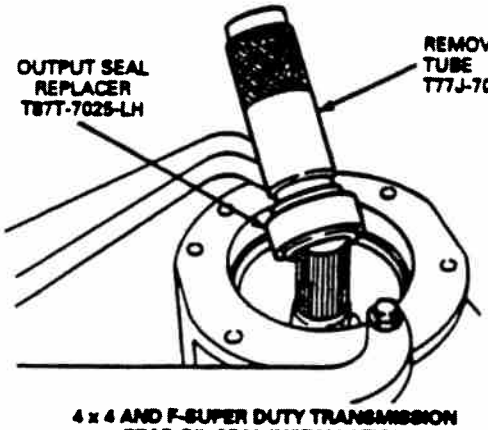
C9094-B

23. Rotate the transmission so the input shaft is pointing down.

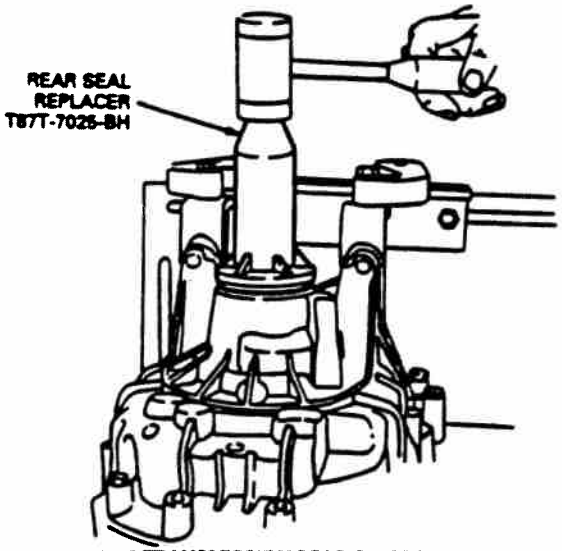
24. On 4x2 transmissions (except F-Super Duty), remove the hex nut that secures the output flange to the mainshaft, then remove the flange from the mainshaft. Position the oil seal (7052) on Output Seal Replacer T87T-7025-BH and position the oil seal and tool in the opening in the extension housing. Apply a little liquid soap around the circumference to minimize friction. Using a soft hammer, gently tap the Rear Seal Replacer until it seats in the opening.

ASSEMBLY (Continued)

25. On 4x4 and F-Super Duty transmissions, use Output Seal Replacer T87T-7025-LH and Remover Tube T77J-7025-B to install the oil seal. Gently tap on tube with a soft hammer until tool seats against its stop.



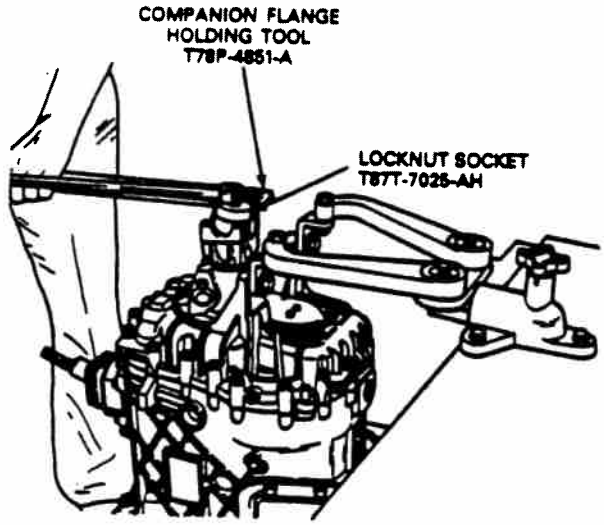
4 x 4 AND F-SUPER DUTY TRANSMISSION REAR OIL SEAL INSTALLATION



4 x 2 TRANSMISSION REAR OIL SEAL INSTALLATION (EXCEPT F-SUPER DUTY) C8715-C

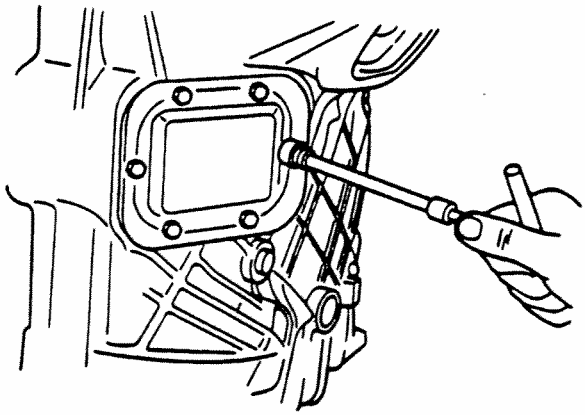
26. **CAUTION: Do not reuse the output yoke locknut after any servicing of the transmission. Always replace it with a new one.**

On 4x2 transmissions (except F-Super Duty), reinstall the output flange on the mainshaft. Install Companion Flange Holder T78P-4851-A. Install a new spiral-lock output yoke locknut onto the mainshaft using Locknut Socket T87T-7025-AH. Tighten the output yoke locknut to 270 N·m (200 lb-ft).



C8675-C

27. If required, install new PTO cover and gasket over the opening in the case using the original attaching screws which have self-sealing threads and tighten to 38 N·m (28 lb-ft).



C8716-1A

28. **CAUTION: The procedure must be followed exactly to make sure that the interlock function operates properly.**

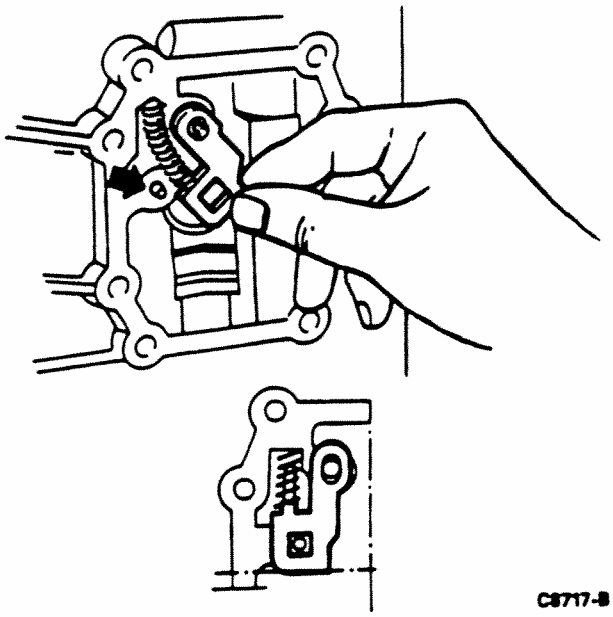
NOTE: Make sure that the interlock plate and shifter interlock spring (7234) do not drop into the case.

Position the 5th-reverse gear interlock plate into its installed position as shown in the illustration following Step 30. Place the gasket over the mating surface of shift control housing in the case.

Make sure that the stop plate moves freely and that the gasket does not interfere with it. The interlock plate must be in a position which is lower than the gasket so that the plate may move freely.

ASSEMBLY (Continued)

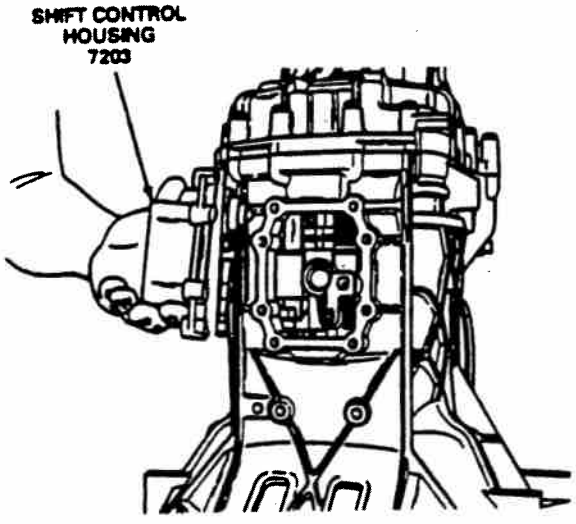
29. Unloaded length of shifter interlock spring is 35.5mm (1.398 inch) minimum.
30. Place the shifter interlock spring above the nose in the interlock plate and move both parts into their installed positions.



C8717-B

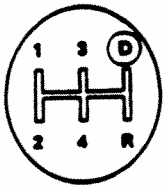
31. **CAUTION: Do not force the shift control selector lever to shift into reverse. Damage to the interlock components could occur.**

    Install the shift control housing (7203). Make sure gasket is positioned correctly.



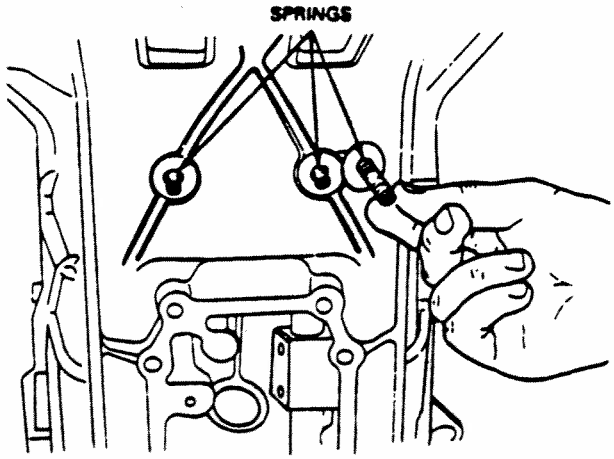
C8719-C

32. Check the functioning of the interlock:
    a. Temporarily install the gearshift lever (7210). The nose on the shift control selector lever located just above the ball must point toward the interlock plate. Install spring washers and tighten screws to 22 N·m (16 lb-ft).
    b. The shift control selector lever cannot be shifted between fifth and reverse if the interlock was properly installed.
    c. Once proper installation of the interlock is confirmed, remove shift control selector lever.



C8719-1A

33. A compression spring is installed into each of the three detent bolts. The positions are shown in the illustration. Before installing the springs, check that their unloaded length is 44.1mm (1.736 inch).

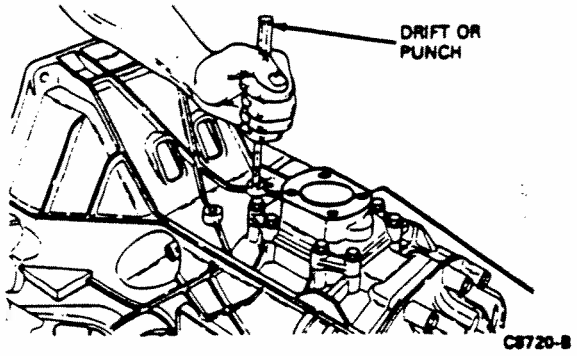


C8883-1A

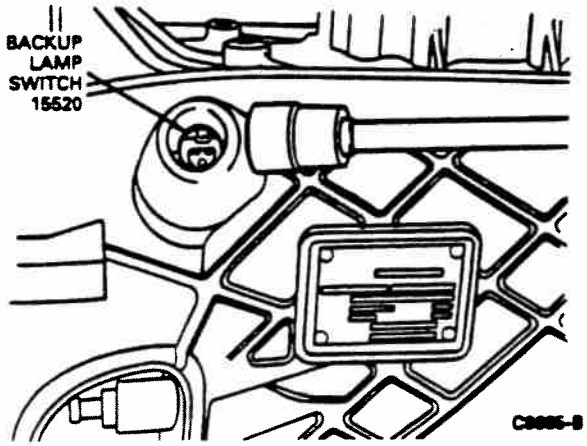
ASSEMBLY (Continued)

34. **CAUTION: Do not strike detent spring plug in center as such an action can cause the detent spring plug to cave in which will result in leakage.**

    Vehicles have revised detent spring plugs on the housing. New detent spring plugs have a 14mm diameter versus the old 10mm diameter. Now detent spring plugs should be installed using a 14mm punch. There is no longer a need to measure the depth of the detent spring plug when installing it due to a positive stop in the housing to which the detent spring plug will be driven.



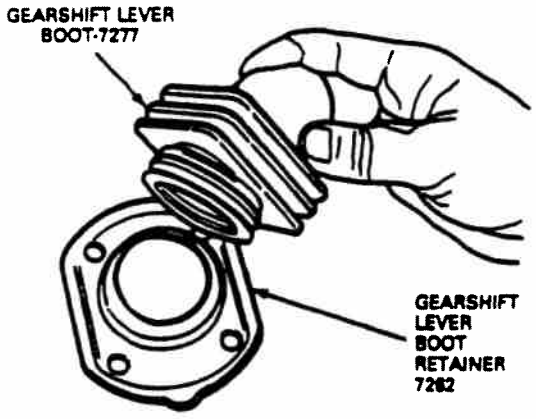
35. If removed, install the backup lamp switch (15520) with a new sealing ring into its mounting boss on the side of the transmission near the i.d. plate. Tighten the switch to 20 N·m (15 lb-ft).



INSTALLATION

Shift Lever and Boot

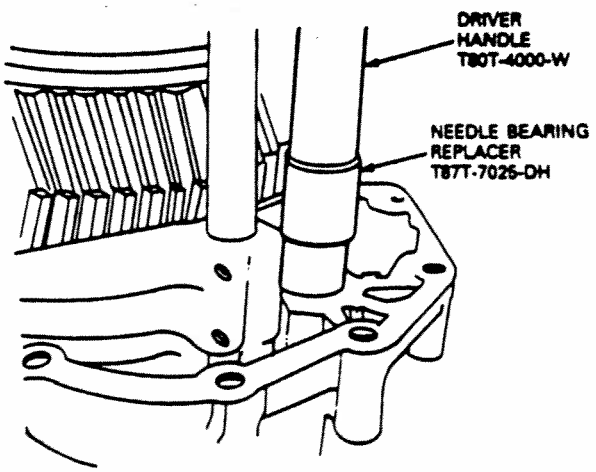
1. Insert the gearshift lever boot in its upright position in the cover of shift control selector lever.



2. Using a screwdriver, install the snap ring inside the gearshift lever boot so that the gearshift lever boot and ring will be secured in the groove in the gearshift lever boot retainer.
3. Slide the gearshift lever boot and cover as an assembly on past the shift control selector lever.
4. Place the two guide pieces on the lugs on the cardan joint. The slotted ends of the guide pieces should be located near the cover pointing inwards toward the gearshift lever (7210).

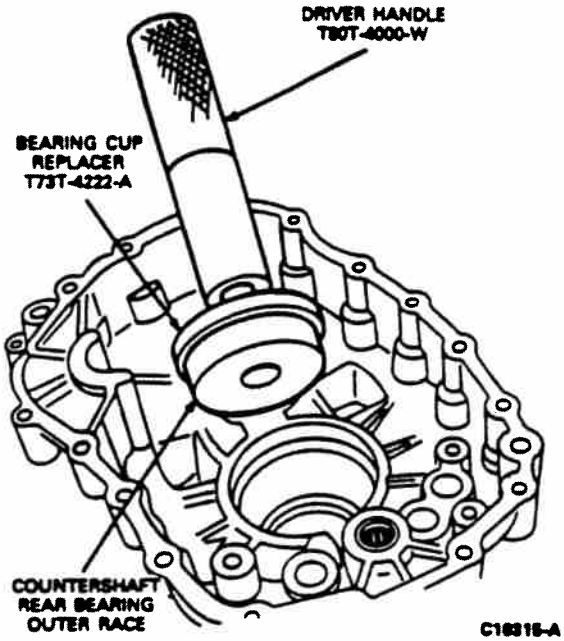
Extension Housing

1. If removed, install the central shift rail bearing into the extension housing (7A039). Heat the extension housing in the area of the bearing bore to 160 °C (320 °F) with Rotunda Heat Gun 107-R0300 or equivalent. Insert the ball sleeve and drive the bearing in until it seats against its stop using Needle Bearing Replacer T87T-7025-DH and Driver Handle T80T-4000-W.



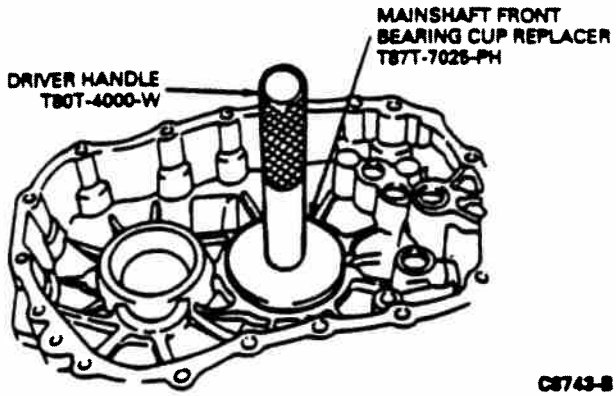
INSTALLATION (Continued)

2. Heat the extension housing in the area of the countershaft rear bearing outer race to 160°C (320°F) with Rotunda Heat Gun 107-R0300 or equivalent. With Driver Handle T80T-4000-W and Bearing Cup Replacer T73T-4222-A, drive the countershaft bearing cup into its bore until it seats against its stop.



3. NOTE: Do not install the oil seal (7052) at this time. The oil seal is installed just prior to installing the output flange.

   Heat the extension housing in the area of the mainshaft outer race to 160°C (320°F) with Rotunda Heat Gun 107-R0300 or equivalent. Using Driver HandleT80T-4000-W and Mainshaft Front Bearing Cup Replacer T87T-7025-PH, drive the bearing cup into its bore until it seats against its stop.



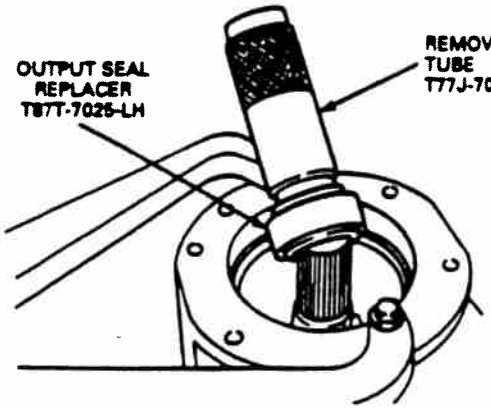
Extension Housing

1. Position the oil seal (7052) on Output Seal Replacer T87T-7025-BH and position the oil seal and tool over the output end of the mainshaft.
2. Apply a little liquid soap around the circumference to minimize friction. Using a soft hammer, gently tap the Rear Seal Replacer until it seats in the opening.
3. Install the output flange on the output end of the mainshaft.
4. Attach Companion Flange Holding Tool T78P-4851-A to the transmission output flange with four hex bolts.
5. **CAUTION: Do not reuse the output flange retaining nut after any servicing of the transmission (7003). Always replace it with a new one.**

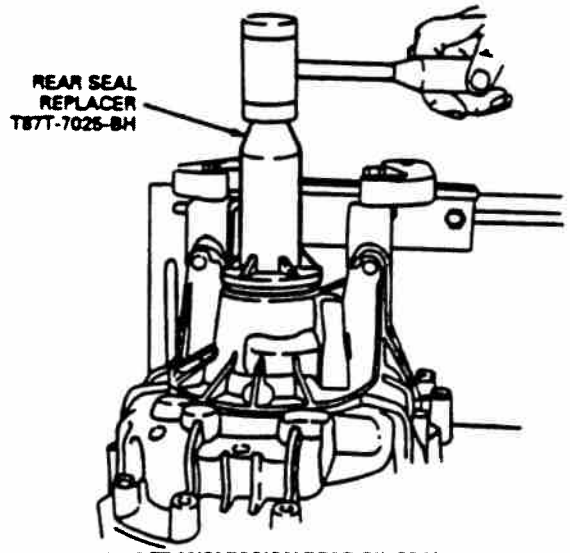
   Install a new output flange retaining nut (F3TZ-7045-A) on the mainshaft with Locknut Socket T87T-7025-AH. Tighten the nut to 270 N·m (200 lb-ft). Remove the flange holding tool after tightening the nut.

INSTALLATION (Continued)

6. Connect the driveshaft to the output flange. Refer to Section 05-01.



4 x 4 AND F-SUPER DUTY TRANSMISSION REAR OIL SEAL INSTALLATION



4 x 2 TRANSMISSION REAR OIL SEAL INSTALLATION (EXCEPT F-SUPER DUTY) CS715-C

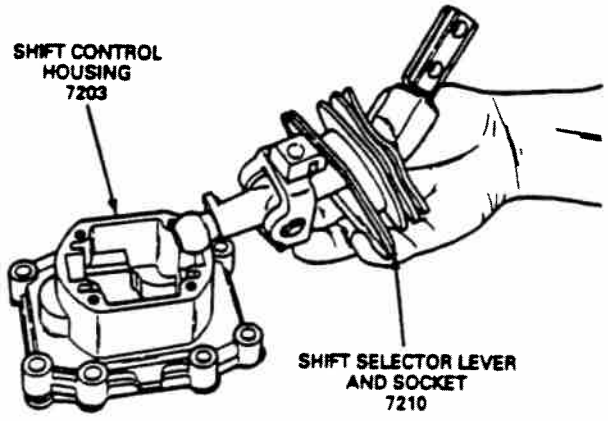
Transmission

1. Place the transmission (7003) on a transmission jack such as Rotunda Transmission Jack 077-00008 or equivalent. Secure the transmission to the jack. Install guide studs in the engine (6007) and raise the transmission until the splines of input shaft (7017) are aligned with the splines of clutch disc (7550). The clutch release hub and bearing must be properly positioned in the clutch release shaft (7515).
2. Slide the transmission forward on the guide studs until it is in position on the engine. Install the attaching bolts and tighten them to 53-72 N·m (39-53 lb-ft). Remove the guide studs and install the two remaining attaching bolts.
3. Install the rear engine support (6A023) as described in Section 02-03. Position the insulator and retainer between the transmission and rear engine support. Install bolts and tighten to 60-80 N·m (45-60 lb-ft).Install the nut retaining the insulator and retainer to rear engine support. Tighten to 68-94 N·m (50-70 lb-ft). Remove the transmission jack.
4. Connect the clutch linkage. Refer to Section 08-02.
5. Connect the backup lamp switch (15520).
6. On F-Super Duty series vehicles, install the transmission parking brake. Refer to the Body, Chassis Manual, Section 06-05.
7. Install the driveshaft. Refer to Section 05-01.
8. Fill the transmission with Motorcraft MERCON® Multi-Purpose Automatic Transmission Fluid, XT-2-QDX or -DDX meeting Ford specification E4AZ-19582-B or equivalent. Remove safety stands and lower the vehicle.
9. NOTE: For vehicles equipped with 7.3L Diesel Engine, use Synthetic MERCON® E6AZ-19582-B, or equivalent Multi-Purpose ATF meeting Ford specification ESR-M2C163A2.

   NOTE: Steps 9-11 apply to diesel engine vehicles only.

   Install engine charge exhaust pipe and extension pipe.
10. Install nuts retaining extension pipe to muffler and pipe assembly. Refer to Section 09-00.
11. Install bolt retaining engine charge exhaust pipe to transmission housing. Tighten bolt to 54-68 N·m (40-50 lb-ft).
12. **CAUTION: Do not use any sealant on gasket.**

    Place a **new**, dry gasket on the upper surface of the shift control housing. Place the shift control selector lever with the attached guide pieces into the guide piece grooves. The slotted ends of these guide pieces must face upward.

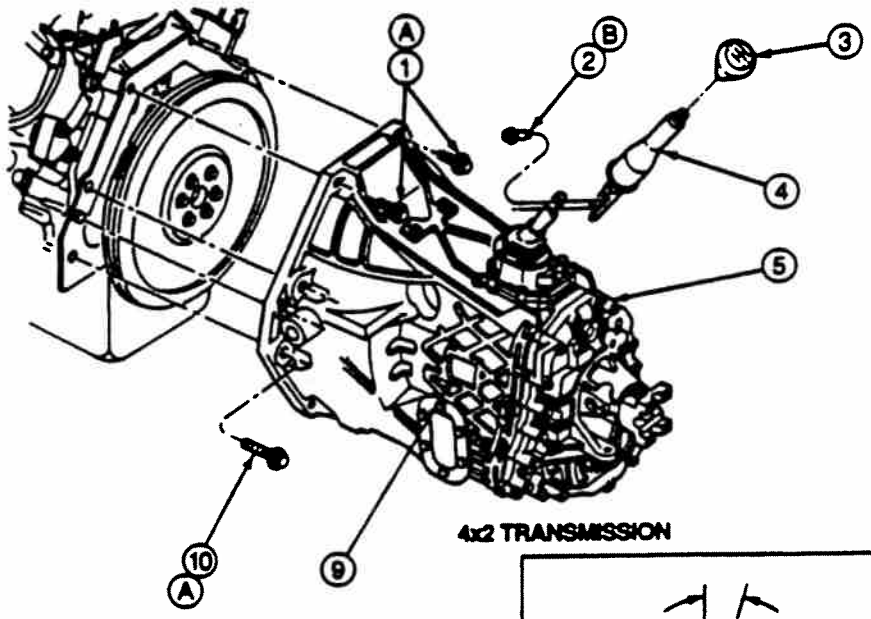


CS727-B

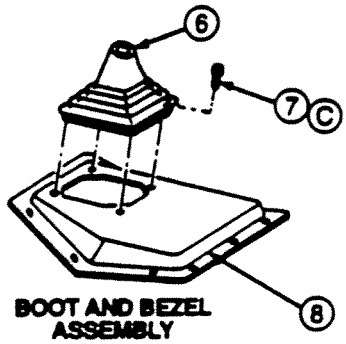
INSTALLATION (Continued)

13. Tighten the four Allen-head capscrews that secure the gearshift lever boot retainer to the shift control housing to approximately 10 N·m (7 lb-ft).
14. Install the inner gearshift lever boot (7277) over the lower gearshift lever (7210).
15. Install the upper shift control selector lever to the lower shift control selector lever and tighten the two retaining screws to 22-33 N·m (16-24 lb-ft).
16. Install the inner gearshift lever boot and the and gearshift lever boot retainer to the opening cover of transmission.
17. Install the gearshift lever knob (7213) on the upper shift control selector lever if removed.
18. For vehicles equipped with diesel engine, install engine charge exhaust pipe to wastegate housing exhaust outlet and tighten marman clamp.

Manual Transmission Assembly

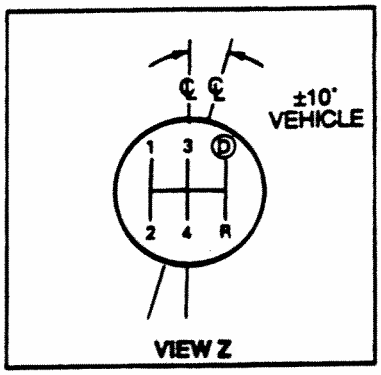


4x2 TRANSMISSION



BOOT AND BEZEL ASSEMBLY

4x4 TRANSMISSION SAME AS 4x2 TRANSMISSION EXCEPT AS SHOWN



VIEW Z

C11502-C

Item	Part Number	Description
1	385739	Bolt, 7 / 16-14 x 1.62; 4.9L / 5.8L
2	57661	Bolt, 7 / 16-14 x 1.5; 7.5L
3	N808234	Bolt, M12-1.75 x 70; 7.3L
4	N605906	Bolt
5	7213	Gearshift Lever Knob
6	7210	Shift Control Selector Lever
7	7003	Transmission
8	7277	Gearshift Lever Boot
9	N610959	Bolt
10	12110	Transmission Floor Cover Plate

Item	Part Number	Description
11	—	Transmission I.D. Plate (Part of 7003)
12	57664	Bolt, 7 / 16-14 x 2.25; 4.9L / 5.8L
13	57666	Bolt, 7 / 16-14 x 2.75; 7.5L
14	N808235	Bolt, M12-1.75 x 110; 7.3L
A	—	Tighten to 53-72 N·m (39-53 Lb-Ft)
B	—	Tighten to 22-23 N·m (16-24 Lb-Ft)
C	—	Tighten to 5-9 N·m (44-80 Lb-In)

(Continued)

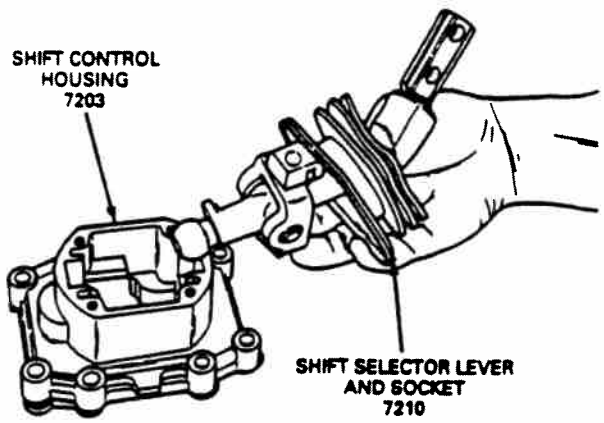
INSTALLATION (Continued)

Transmission (4x4)

1. Place the transmission (7003) on a transmission jack such as Rotunda Transmission Jack 077-00008 or equivalent, and install two guide studs in the transmission front case top holes, to guide the transmission into position. Join together the transmission and engine block mating surfaces.
2. Install the two lower bolts and tighten to 54-68 N·m (40-50 lb-ft). Remove the guide studs and install the upper bolts.
3. Place the rear support bracket in position and install the retaining bolts. Refer to Crossmember Installation in this section. Tighten the bolts to 60-80 N·m (45-60 lb-ft).
4. Install the two bolts at the rear support insulator bracket. Remove the transmission jack.
5. Position the transfer case (7A195) on the transmission jack. Position the transfer case on the transmission, using care to guide the transfer case shift lever through the opening in the floor pan. Install the gasket and six retaining bolts. Tighten the bolts to specifications listed in the appropriate transfer case section in Group 07 in this manual.
6. Install the front driveshaft (4602).
7. Install the rear driveshaft.
8. Fill transfer case and transmission with Motorcraft MERCON® Multi-Purpose Automatic Transmission Fluid XT-2-QDX or -DDX meeting Ford specification E4AZ-19582-B or equivalent.
9. NOTE: For vehicles equipped with 7.3L diesel engine, use Synthetic MERCON® E6AZ-19582-B or equivalent Multi-Purpose ATF meeting Ford specification ESR-M2C163-A2.

   Connect the backup lamp switch (15520).
10. Install engine charge exhaust pipe and extension pipe.
11. Install nuts retaining extension pipe to muffler and pipe assembly. Tighten nuts to 23-33 N·m (17-24 lb-ft).
12. Remove safety stands and lower vehicle.
13. Place a **new**, dry gasket on the upper surface of the gearshift housing. Place the gearshift lever with the attached guide pieces into the guide piece grooves. The slotted ends of these guide pieces must face upward.
14. **CAUTION: Do not use any sealant on gasket.**

    Tighten the four Allen-head capscrews that secure the cover assembly to the gearshift housing to approximately 10 N·m (7 lb-ft).



15. Install the inner boot over the lower shift lever.
16. Install the upper shift lever to the lower shift lever and tighten the two retaining screws to 22-33 N·m (16-24 lb-ft).
17. Install the inner boot and the boot and bezel assembly to the transmission opening cover.
18. Install the shift ball on the upper shift lever if removed.

CLEANING AND INSPECTION

Transmission

Cleaning

1. NOTE: Do not clean, wash or soak transmission seals in cleaning solvent.

   Wash all parts, except seals, in a suitable cleaning solvent. Brush or scrape all foreign matter from the parts. Be careful not to damage any parts with the scraper. Dry all parts with compressed air.

Inspection

1. Inspect case (7005) for cracks, worn or damaged bores, damaged threads, or any other damage that could affect operation of the transmission (7003). Inspect the machined mating surfaces for burrs, nicks or damage.

Case Service

Inspect the case for cracks and stripped threads. Inspect the gasket surfaces and mating surfaces for burrs. Check the vent for obstructions, and check all fluid passages for obstructions and leakage.

Inspect the case bushing for scores. Check all parking linkage parts for wear or damage.

If a transmission case thread is damaged, service kits may be purchased from local jobbers. To service a damaged thread, the following procedures should be carefully followed:

CLEANING AND INSPECTION (Continued)

1. Drill out the damaged threads, **using the same drill size as the thread outside diameter.** For example, use a 5/16-inch drill for a 5/16-18 thread.
2. Select the proper special tap and tap the drilled hole. The tap is marked for the size of the thread being repaired. Thus, the special tap marked 5/16-18 will not cut the same thread as a standard 5/16-18 tap. It does cut a thread large enough to accommodate the insert, and after the insert is installed, the original thread size (5/16-18) is restored.
3. Select the proper coil inserting tool. These tools are marked with the thread size being repaired. Place the insert on the tool and adjust the sleeve to the length of the insert being used. Press the insert against the face of the tapped hole. Turn the tool clockwise and wind the insert into the hole until the insert is one-half turn below the face.
4. Working through the insert, bend the insert tang straight up and down until it breaks off at the notch.
5. Improperly installed inserts can be removed with the extractor tool. Place the extractor tool in the insert with the blade resting against the top coil one-quarter to one-half turn away from the end of the coil. Tap the tool sharply with a hammer until the blade cuts into the insert. Exert downward pressure on the tool and turn it counterclockwise until the insert is removed.

Extension Housing

Inspect the extension housing (7A039) for cracks. Make sure that the machined mating surfaces are free from burrs, nicks or any other damage. If necessary, replace the oil seal (7052) after the extension housing has been installed onto the transmission (7003).

Bearings

1. Rotate the bearings in a cleaning solvent until all lubricant is removed. Hold the bearing assembly to prevent it from rotating while drying it with compressed air.
2. Lubricate the bearings with approved transmission lubricant. Wrap them in a clean, lint-free cloth or paper, until ready for use.

Raceways

1. NOTE: Bearings that have been removed using special service tools may have been damaged simply due to the tool design. Be sure the following checks are made to determine if the bearing can be put back into service.

   Inner Ring Raceway — While holding outer ring stationary, rotate inner ring at least three revolutions. Examine raceway of inner ring for pits or spalling. If pits or spalling are unacceptable, replace the bearing assembly. Light particle indentation is acceptable.
2. Outer Ring Raceway — While holding inner ring stationary, rotate outer ring at least three revolutions. Examine raceway of the outer ring from the same side as the raceway of the inner ring. If raceway is spalled or pitted, similar to that shown, replace the bearing assembly. Light particle indentation is acceptable.

External Surfaces

The bearing must be replaced if damage is found in any of the following areas:

1. Radial cracks on front and rear faces of outer or inner rings.
2. Cracks on outside diameter or outer ring (particularly around snap ring groove).
3. Deformation or cracks in ball cage (particularly around rivets).

Spin Test

1. Lubricate bearing raceways with a slight amount of clean oil. Turn the bearing back and forth slowly until raceways and balls are coated with oil.
2. Hold bearing by inner ring in a vertical position. Vertical movement between the inner and outer rings is acceptable. Spin outer ring several times by hand (do not use compressed air). If roughness or vibration is noticeable or the outer ring stops abruptly, the bearing should be cleaned again and lubricated. Roughness in a bearing is usually caused by foreign particles in the bearing, which comes from inside the transmission case. If bearing is still rough after cleaning and relubricating three times, it must be replaced.
3. Hold bearing by the inner ring in a horizontal position. Spin outer ring several times by hand (do not use compressed air). If bearing is still rough after cleaning and relubricating three times (if not done in Step 2), it must be replaced. If bearing passes the visual inspection and spin tests, it can be reinstalled in transmission.

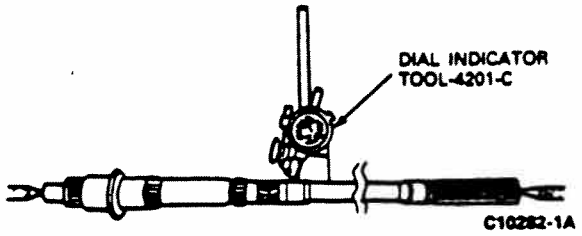
Gears

Inspect the teeth of each gear. If excessively worn, broken or chipped, replace the gear. Excessive wear increases backlash, which results in noise and unacceptable operating characteristics.

CLEANING AND INSPECTION (Continued)

Shaft Inspection

1. Check output shaft for runout by mounting the shaft between V-blocks and applying Dial Indicator with Bracketry TOOL-4201-C to several places along shaft. The standard reading of the indicator for runout should be less than 0.05mm (0.002 inch). If runout exceeds 0.05mm (0.002 inch), replace shaft.



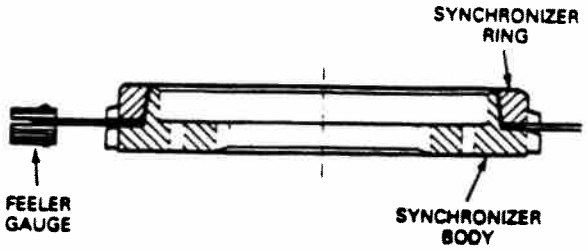
2. Replace input shaft (7017) if splines are damaged. If needle bearing contact surfaces are worn, rough, or other bearing contact surfaces are damaged, replace input shaft.
3. Check countershaft gear teeth and countershaft splines for wear or damage. Replace countershaft if bent, scored, or worn.

Synchronizers

Synchronizer Ring/Synchronizer Body Wear Check

Inspect the internal surface for contact pattern. The contact pattern should be the same on the entire internal circumference of the ring.

Position the synchronizer ring on the synchronizer body as shown in the illustration. Insert a feeler gauge and measure clearance at two opposite points. If clearance is less than 0.6mm (0.024 inch) for the 3rd-4th, 1st-2nd and 5th synchronizers (7124) and 0.4mm (0.016 inch) for the reverse synchronizers, replace the synchronizer, affected mainshaft gear, or both if required to bring to within specification.



GEARS	CLEARANCE
1	0.6 mm (0.024 inch)
2	0.6 mm (0.024 inch)
3	0.6 mm (0.024 inch)
4	0.6 mm (0.024 inch)
5	0.6 mm (0.024 inch)
Reverse	0.4 mm (0.016 inch)

C8725-1B

Synchronizer Compression Spring Tension Check

Check the length of all compression springs of synchronizers (7124).

SPRING SPECIFICATIONS

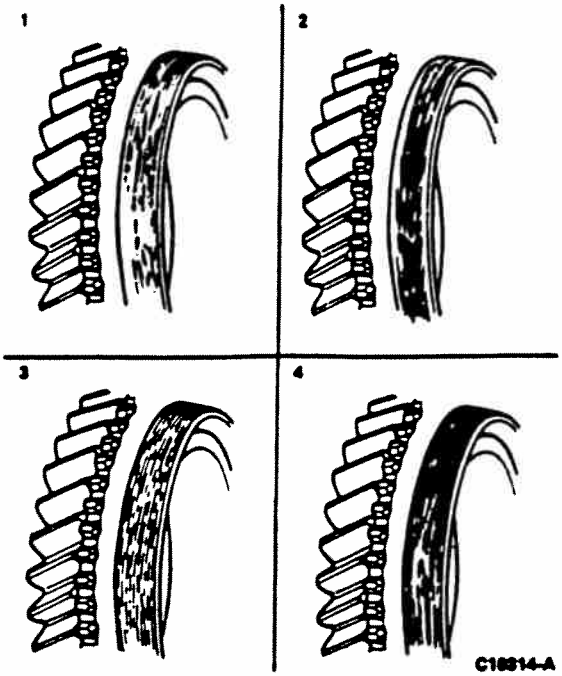
Unloaded Length	O.D.	Wire Diameter
14.6mm (Min.) (0.583 In.)	5.960mm (0.235 In.)	0.95mm (0.037 In.)

Mainshaft and Input Shaft Gears

1. Inspect the friction taper cone on the gears and check for the following wear patterns.
   a. Sporadic slightly darkened patches on otherwise evenly smoothed circumference is acceptable. The patches will appear to be blackish in color and will vary in degree and surface area depending on the synchronizer ring contact area.
   b. Signs of excessive heat will appear to be burnt to a reddish-blue color, mainly on the edges of the cone. This is a result of excessive overloading, operating failure or perhaps a malfunctioning clutch system.
2. Replace gears showing excessively burnt spots (reddish-blue) on the friction taper cone edges. In this case, the selector teeth will be damaged as well.

CLEANING AND INSPECTION (Continued)

3. Reuse the gears if sufficient synchronizer reserve allowance is available and the teeth (dog teeth) are in good condition. Acceptable wear patterns are depicted in the following illustration.



Shift Fork / Clutch Hub Sleeve

Check the contact surfaces of the shift fork and clutch hub sleeve for evidence of wear or damage.

Speedometer Gears

1. Check drive gear, driven gear and driven gear shaft for wear or damage.

ADJUSTMENTS

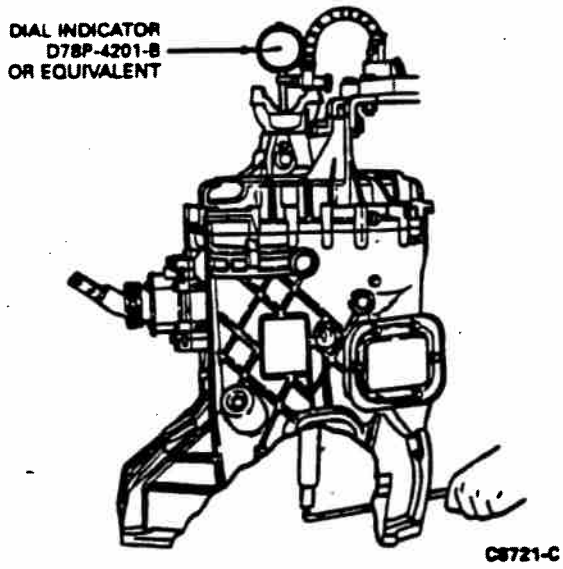
Bearing Preload Adjustment

Measurement and adjustment of the tapered roller bearings is necessary if a housing, countershaft cluster gear (7113), mainshaft or input shaft (7017) has been replaced or if a tapered roller bearing per shaft has been replaced. The mainshaft, input shaft, and countershaft cluster gear should be adjusted to provide a preload of 0.02-0.11mm (0.00079-0.00434 inch). After adjusting the two shafts, each should be rotated a few times to center the rollers in the bearings involved.

Input Shaft and Mainshaft Tapered Roller Bearing Preload Measurement

1. With the transmission (7003) placed on a bench with the output flange facing upward, attach a dial indicator gauge with a magnetic base, such as Dial Indicator / Magnetic Base D78P-4201-B or equivalent to the output flange in such a manner that the measurement bar will rest on the output end of the mainshaft as shown in the illustration.
2. Zero the dial indicator and, using a pry bar, gently pry up the input shaft (7017) and mainshaft.
3. NOTE: Shims and oil baffle must be removed prior to preload measurement. The oil baffle is part of the shim package under the outer bearing race.

   Note the indicator gauge reading. An input bearing front shim and oil baffle which is to be fitted later must have a combined thickness equal to the dimension recorded on the dial plus 0.02-0.11mm (0.00079-0.00434 inch). This will result in obtaining the specified preload after installation of the shims and oil baffle, and mainshaft and countershaft cluster gear (7113).



Countershaft Tapered Roller Bearing Preload Measurement

SPECIAL SERVICE TOOL(S) REQUIRED

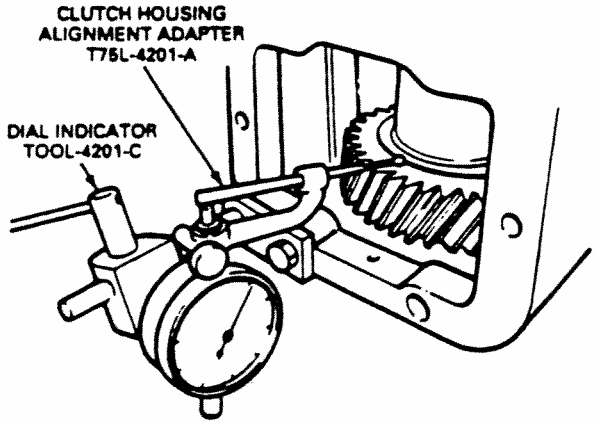
Description	Tool Number
Dial Indicator	TOOL-4201-C
Clutch Housing Alignment Adapter	T75L-4201-A

ADJUSTMENTS (Continued)

1. NOTE: Countershaft is serviced by Ford as an assembly only. Individual countershaft components will not be serviced.

   Using two 10mm hex screws, attach Dial Indicator TOOL-4201-C and Clutch Housing Alignment Adapter T75L-4201-A to the PTO opening in the case (7005) as shown in the illustration. Position the dial indicator gauge to the support in such a way that the measurement bar rests against the flat face of the fourth speed helical gear on the countershaft cluster gear (7113).
2. NOTE: Countershaft thrust washer (7119) under front bearing race must be removed prior to preload measurement.

   Set the dial indicator needle to zero.
3. Insert pry bars through each of the two power take-off openings and position them beneath the 4th speed helical gear on the countershaft cluster gear.Pry up on the countershaft cluster gear.
4. Like the preceding shaft check, the preload should be 0.02 to 0.11mm (0.00079 to 0.00434 inch) after installing the thrust washer.



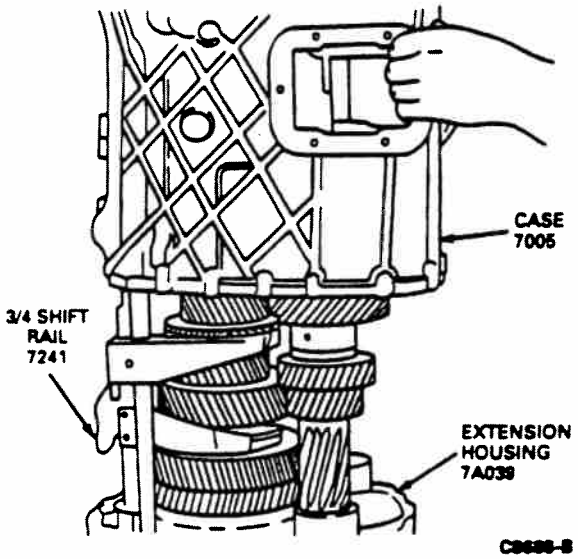
C8722-C

Mainshaft and Input Shaft Tapered Roller Bearing Preload Adjustment

SPECIAL SERVICE TOOL(S) REQUIRED

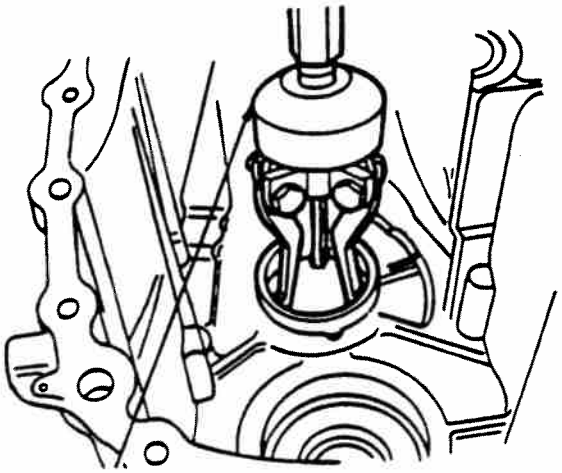
Description	Tool Number
Impact Slide Hammer	T50T-100-A

1. After completing the tapered roller bearing preload measurements described previously, place the case in an upright position with the input shaft (7017) pointing upwards.
2. Drive the two dowel pins out of their holes in the case and extension housing (7A039) and lift the case off the extension housing.



C8638-B

3. Using Impact Slide Hammer T50T-100-A and Internal Puller D80L-943-A or equivalent, remove the countershaft tapered roller bearing outer races and mainshaft tapered roller bearing outer races from the case.

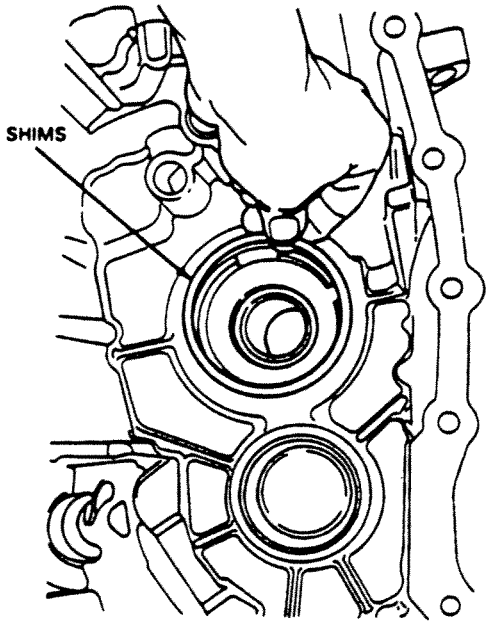


C8723-C

ADJUSTMENTS (Continued)

4. NOTE: Always replace the baffle plate with a new one when removed.

   Fit each race with a shim washer or shim washer and baffle plate to obtain the required preload determined previously. Countershaft preload is established by using shims alone; input shaft and mainshaft preload is established by using shims and a baffle. In both cases the parts are installed beneath the outer race of the tapered roller bearing which seats in the case.



5. **CAUTION: Do not use silicone.**

   Apply Gasket Maker E3AZ-19554-AA or equivalent meeting Ford specification WSK-M2G348-A9 to the mating surfaces of the case and extension housing.

6. Position the case on the extension housing. Install all of the screws that secure the case and extension housing and tighten to 22 N·m (16 lb-ft).

Input shaft and mainshaft should turn freely by hand after preload adjustment.

SPECIFICATIONS

Gear Ratios

	1st	2nd	3rd	4th	5th	Reverse
Close Ratio (Diesel)	4.14	2.37	1.42	1.0	0.77	3.79
Wide Ratio (Gasoline Diesel)	5.72	2.94	1.61	1.0	0.76	5.24

Clearance Specifications

Description	mm	Inches
Countershaft (Preload)	0.02-0.11	0.00079-0.00434
Input Shaft and Mainshaft (Preload)	0.02-0.11	0.00079-0.00434
Mainshaft Reverse Gear	0.15-0.35	0.00591-0.01378
Mainshaft 1st Gear	0.15-0.35	0.00591-0.01378
Mainshaft 2nd Gear	0.15-0.45	0.00591-0.0177

(Continued)

SPECIFICATIONS (Continued)

Description	mm	Inches
Mainshaft 3rd Gear	0.15-0.35	0.00591-0.01378
Mainshaft 5th Gear	0.15-0.35	0.00591-0.01378
Mainshaft Synchronizer Body Retention Rings	0-0.1	0-0.00394

Spring Specifications

	Length	Outer Diameter	Wire Diameter
Detent Springs	44.1mm (1.736 in.) Min.	7.880mm (0.310 in.)	1.250mm (0.049 in.)
Reverse Gear Stop Plate Spring	35.5mm (1.398 in.) Min.	9.040mm (0.356 in.)	1.000mm (0.039 in.)
Synchronizer Spring	14.8mm (0.583 in.) Min.	5.960mm (0.235 in.)	0.950mm (0.037 in.)

Mounting Temperatures

	Temperature	
	C	F
Taper Roller Bearing Inner Race	160	320
Synchronizer Bodies	160	320
Thrust Washer	160	320
Needle Bearing Inner Race	160	320
Bearing Outer Race in Cover	160	320
Ball Bearing Sleeve in Cover	160	320

Approximate Lubricant Refill Capacities

Description	Liters	U.S. Qts.	Imp. Qts.
Motorcraft MERCON® Multi-Purpose Automatic Transmission Fluid XT-2-QDX or -DDX or Equivalent	3.2	3.4	2.8
7.3L Diesel Motorcraft Synthetic MERCON® Multi-Purpose Automatic Transmission Fluid Meeting Ford Specification E6AZ-19582-B ESR-M2C183-A2 or Equivalent	3.2	3.4	2.8

Torque Specifications

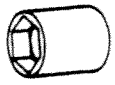
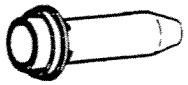
Description	N-m	Lb-Ft
Transmission Case Plug (Straight Threads with Sealing Ring)	60	44
Extension Adapter to Main Case	22	16
End Yoke to Mainshaft	270	200
Shift Tower Cover to Main Case	23	17

(Continued)

Description	N-m	Lb-Ft
PTO Cover Plate	38	28
Idler Shaft Retention	22	16
Shift Rail Plate	10	7
Shift Cover to Tower Cover	10	7
Reverse Switch	20	15
Upper Shift Lever	22-33	16-24
Transmission to Engine Bolts	53-72	39-53
Shift Rail Interlock	10	7
Case to Extension Housing	23	17
Upper Gusset (F-250 4x4)	58-77	43-57
Crossmember to Frame (F-250)	58-77	43-57
Transmission Support Plate to Crossmember (F-250)	81-109	60-81
Transmission Support Plate to Transmission	64-71	47-52
Crossmember to Frame (F-350)	43-57	32-42
Gusset (F-350)	43-57	32-42
Crossmember to Transmission (F-350)	81-109	60-81

SPECIAL SERVICE TOOLS/EQUIPMENT

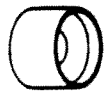
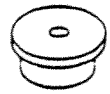
SPECIAL SERVICE TOOLS DESIRED

Tool Number	Description
T87T-7025-AH Locknut Socket	 T87T-7025-AH
T87T-7025-BH Rear Seal Replacer	 T87T-7025-BH

(Continued)

SPECIAL SERVICE TOOLS/EQUIPMENT (Continued)

SPECIAL SERVICE TOOLS DESIRED (Cont'd)

Tool Number	Description
T87T-7025-CH Rear Seal Remover	
T87T-7025-DH Needle Bearing Replacer	
T87T-7025-EH Front Seal Replacer	
T87T-7025-FH Bearing Collets	
T87T-7025-HH Gear Pack Holding Fixture	
T87T-7025-JH Shift Rod Support	
T87T-7025-LH Output Seal Replacer	
T87T-7025-MH Puller Collets	
T87T-7025-NH Puller Collets	
T87T-7025-OH Collet Retaining Ring	
T87T-7025-PH Mainshaft Front Bearing Cup Replacer	

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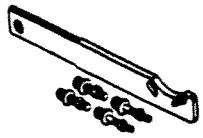
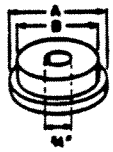
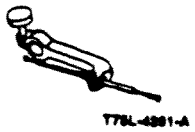
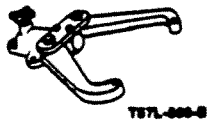
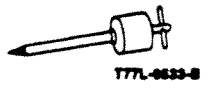
SPECIAL SERVICE TOOLS DESIRED (Cont'd)

Tool Number	Description
T78P-4851-A Companion Flange Holding Tool	
T75L-1165-B Axle Bearing/Seal Plate	
T85T-4621-AH Inner Pinion Bearing Cone Replacer	
T50T-100-A Impact Slide Hammer	
T80T-4000-W Driver Handle	
T77F-1102-A Bearing Cup Puller	
T73T-4222-A Bearing Cup Replacer	
T84T-7025-B TOD Forcing Screw	
T77J-7025-B Remover Tube	
T75L-7025-G Bearing Collet Sleeve for 3.5 Inch Bearing Collets	

(Continued)

SPECIAL SERVICE TOOLS/EQUIPMENT (Continued)

SPECIAL SERVICE TOOLS DESIRED (Cont'd)

Tool Number	Description
T75L-4201-A Clutch Housing Alignment Adapter	
T57L-500-B Bench Mounted Holding Fixture	
T77L-9533-B Jet Plug Remover	

SPECIAL SERVICE TOOLS DESIRED

Tool Number	Description
D81L-4220-A	Pinion and Carrier Bearing Puller
D78P-4201-B	Dial Indicator/Magnetic Base

(Continued)

SPECIAL SERVICE TOOLS DESIRED (Cont'd)

Tool Number	Description
D87L-1000-A	Endless Lifting Sling
D80L-943-A	Puller — Internal
D80L-100-Q	Blind Hole Puller
D80L-1013-A	2-3 Jaw Puller
D80L-625-4	Shaft Protector
TOOL-4201-C	Dial Indicator

ROTUNDA EQUIPMENT

Model	Description
077-00006	Low Lift Transmission Jack
107-R0300	Heat Gun
130-00002	Precision Metal Gear/Bearing Heater

SECTION 07-05 Transmission, Automatic, External Controls

VEHICLE APPLICATION

F-150, F-250, F-350 F-Super Duty and Bronco

DESCRIPTION AND OPERATION

Shift Control Linkage

The transmission shift control linkage or cable transfers the transmission operating mode from the transmission range selector lever to the transmission (7003). The indicated transmission position on the steering gear sector shaft (3575) is transferred to a shift lever on the bottom of the steering column. On vehicles equipped with cable-operated shift systems, the indicated position of the transmission range selector lever is transferred to the transmission through the transmission column shift selector tube (7212), then to the cable, and down to the manual control lever (7A256) at the transmission. On vehicles equipped with transmission manual control selector connecting rods (7326), the transmission manual control selector connecting rod transfers the indicated transmission selector level position through a transmission shift bellcrank (7A185) to a transmission to bellcrank lever rod (7A024). The transmission to bellcrank lever rod transfers the indicated position to the transmission.

Shift Interlock System

All vehicles are equipped with a shift interlock system. The shift interlock system prevents the shifting from PARK (the ignition key is in the RUN position) unless the service brake is depressed. The shift interlock system consists of a shift lock actuator mounted at the base of the steering column. If the ignition key is in the RUN position, the shift lock actuator continually runs unless the brake is depressed.

CLUTCH AND RELEASE SYSTEM FAILURE MODES

❶ Clutch Pedal and Bracket Assembly

- **Wrong assembly bracket**, there are three pedal bracket assemblies. The 7.3L diesel bracket has 7 3/8", the 5.4 and 6.8L brackets have 6 3/4" and the MT has 7.9" of pedal travel. If the 5.4L and 6.8L bracket were to be installed on the 7.3L, than there would be less than an inch of reserve and the clutch may not release completely. Note the diesel 7.3L bracket should have a black overcenter spring. The 5.4L and 6.8L bracket has a blue spring.

- **Bracket not properly secured at top mounting surface.** If the bracket is not properly secured than the pedal loads on the 7.3L vehicle can deflect the dash until the pedal stops at the dash and not at the down stop. This will reduce bearing travel and clutch reserve.

❷ Clutch Hydraulic Assembly

- **Air in the Hyd. system** may cause loss of clutch release bearing travel and failure to release the clutch. This may be caused by several things, first, air trapped in the slave cylinder. The slave is at an angle so it is possible that air can be trapped. The system needs to be bled.

Second, the feed valve on the master cylinder could be faulty, not allowing the system to replenish itself. The entire system needs to be replaced.

Third, the system could be low on fluid. It would need to be bled and topped off.

Fourth, a bad seal or a line rupture can cause the system to drain itself even after being filled.

All of the previous failures can cause the clutch not to release or not to release completely.

- **Slave cylinder not securely locked into position**, can cause the slave piston and rod to be blown out of the cylinder. This will cause a complete loss of system function.

❸ Clutch Release Lever and Bearings

- **Pivot points on bearing can wear 3mm,** this can cause the lever to come closer to the clutch. Depending on clutch, pedal travel, lever and transmission stackups and hydraulic fluid temperatures, the lever may come in contact with the clutch. Producing loud noises emanating from the transmission. This failure is easily detected due to witness marks on the lever and clutch.

- **Antirotation failure of the release bearing** can also cause noises to emanate from the transmission. This can be checked by removing the bearing and seeing whether the housing rotates freely on the carrier.

- **Damage to the Pilot Bearing** can cause drag on the input shaft. Even if the clutch releases completely the shaft could still be spinning. The damage can be caused by input shaft contact with the bearing race during multiple transmission installation and removals.

- **A cracked or broken pivot stabilizer** can cause excessive pedal loads, transmission noises and loss in release travel. The nylon stabilizer can be damaged after several release lever installations and removals or by high clutch housing temperatures.

Clutches

- **The 303 SAC clutch can be miss-adjusted** if the adjusting ring on the clutch is not returned to its new position when the clutch is being reinstalled on the vehicle. In this case the clutch can be in the over adjusted position causing the pedal not to return and the clutch not to release.

- **In cold temperature operation,** the hydraulic system can "pump-up" causing the clutch to over adjust. At temperatures under -20°C the hydraulic system can produce excessive bearing travel if the clutch pedal is depressed repeatedly. If the clutch finger travel exceeds 14mm than the clutch will over adjust.

F Series Clutch Data

Engine	Vehicle	M.Y.	Type	Disc P/N	Diameter mm (in)	Disc Weight kg (lbs)	Disc Inertia kg*m^2	Service Disc P/N
3.9	All	1999	Conventional, Damper	F81A-7550-EB	303 (11.93)	2.13 (4.70)	0.0163	F81A-7550-EB
4.2	All	1999	2 Stage	F81A-7550-AB	290 (11.42)	2.49 (5.49)	0.0163	F81A-7550-AB
5.4 N.A.	5 Spd N.A.	1999	Series Damper	F81A-7550-FA	290 (11.42)	2.99 (6.59)	0.021	F81A-7550-FA
5.4 Mex.	4 Spd. Mex.	1999	Single Stage	F81A-7550-GA	290 (11.42)	2.46 (5.42)	0.0162	F81A-7550-GA
5.8	All	1995 - 96	2 Stage, Series Damper	F4TA-7550-BA	285 (11.2)	2.61 5.75)	0.021	F4TZ-7550-EB
5.8	All	1996 -	3 Stage, Series Damper	F6TA-7550-KA	285 (11.2)	2.13 (4.70)	0.016	F6TA-7550-KA
6.8	All	1998	Conventional, Damper	F81A-7550-EB	303 (11.93)	2.13 (4.70)	0.0163	F81A-7550-EB
7.5	All	Pre 1993	Conventional, Damper	E8TA-7550-RA	305 (12.0)	2.10 (4.63)	0.015	E8TZ-7550-RA
7.5	All	1993 -	Conventional, Damper	F3TA-7550-JA	311 (12.25)	2.35 (5.17)	0.018	F3TZ-7550-JA
7.3 DIT	F250/F350	1994 1/2 -	Rigid Disk, Dual Mass	F5TA-7550-AC	310 (12.2)	1.706 (3.76)	0.0168	F5TZ-7550-AC
7.3 DIT	F450 SD	1994 1/2 -	Dampened, Dual Mass	F5TA-7550-BC	310 (12.2)	2.78 (6.13)	0.020	F5TZ-7550-BC
7.3 DIT	All	1999	Long Travel Damper	F81A-7550-DB	330 (13.0)	3.50 (7.72)	0.027	F81A-7550-DB

15. Check the travel of the clutch pedal. The total travel should be approx 7½".

[redacted]

2ND

PINPOINT TEST F: HARD SHIFTING

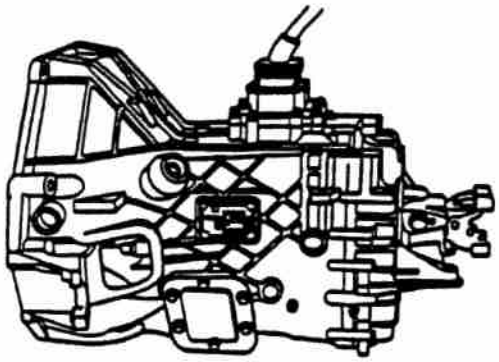
TEST STEP		RESULT	ACTION TO TAKE
F1	CHECK HIGH SHIFTING EFFORTS		
	• Set parking brake. • With shift control selector in reverse, clutch disengaged and engine idling, move shift lever to a position halfway between reverse and neutral. • Slowly engage clutch. • Gear clash can now be heard if an attempt is made to shift into reverse with clutch engaged, and clutch reserve can now be measured. • While maintaining light pressure on shift selector, slowly press clutch pedal toward the floor. At a point in the travel of the clutch pedal the gear clash will stop and the shift selector will slide easily into reverse position. The amount of travel remaining until the pedal touches the floor is defined as reserve. If pedal is all the way to the floor before stopping gear clash, clutch pedal reserve is not adequate. YOU SHOULD HAVE 1" TO 1½" OR LESS THEN 4" WHEN NOT • **Is there adequate clutch pedal reserve?**	Yes No	▶ Clutch system OK. ▶ ADD brake fluid and CHECK for leaks in the clutch system. If OK, GO to **F2**.
F2	INSPECT CLUTCH DISC AND PRESSURE PLATE		
	• Check clutch disc and clutch pressure plate for wear and warpage. • **Is clutch disc and/or clutch pressure plate worn or warped?**	Yes No	▶ REPLACE clutch disc and clutch pressure plate as required. ▶ GO to **F3**.
F3	INSPECT CLUTCH RELEASE HUB AND BEARING		
	• Check for worn or damaged clutch release shaft (if equipped). • Check for worn pilot bearing or clutch release bearing. • **Is clutch pressure plate or clutch release hub and bearing worn or damaged?**	Yes No	▶ REPLACE parts as necessary. REFER to Section 08-02. ▶ CHECK transmission REFER to Section 07 0[illegible] or Section 07-03B.

[redacted]

Sec. 08-00-6

ATTENTION

Please read the enclosed recommended operating instructions and warranty information



Your ZF cores are worth money!!!!

Contact your ZF S5-42 distributor for details . . . and *recycle* your cores into cash!

"NO HASSLE" WARRANTY

Warranty limited to part replacement or repair, if found to be defective in ZF material or workmanship, for 12 months or 12,000 miles from date of purchase. ***Specifically does not cover removal, reinstallation or other costs incidental to repair of the vehicle.***

Warranty claim form must be fully completed and returned to ZF Industries. The Company will pay freight charges from dealer on failed units. Certain failures are subject to warranty analysis, if requested.

All operations guidelines in owner's manual fully apply.

TROUBLE SHOOTING TIPS

Your ZF transmission should:

- Be started in first gear to avoid noise problems.
- Be towed from the rear or the drive shaft must be disconnected before towing.
- Have oil changed after the first 5,000 miles. Approximately every 60,000 miles, thereafter.

  Warning: To avoid stripping the fill or drain plugs, please refer to the O.E. service manual for torque specs.
- For Direct Injection Turbo (D.I.T.) models use ZF approved Castrol Transmax-S Synthetic.

Your ZF transmission should not:

- Be installed with a drive shaft angle of more than 3 degrees.

THANK YOU...DRIVE SAFELY

MOUNTING P.T.O. TO TRANSMISSION

For 6 or 8 Bolt Applications

1. Drain the oil from the transmission and remove the P.T.O. aperture cover plate.
2. Discard the cover plate and cover plate gasket. Sealing surface must be clean and free of gasket material.

   NOTE: Stuff a rag in the aperture opening to prevent dirt from entering the transmission while you are cleaning it.
3. Using your hand, rock the P.T.O. driver gear in the transmission (See Fig. 1.) and the driven gear in the P.T.O. assembly (See Fig. 2.) Rocking the gears provides two important factors.

   (a) It shows you the amount of backlash that has been designed into each unit.

   (b) It is helpful in establishing the proper backlash when installing the P.T.O.

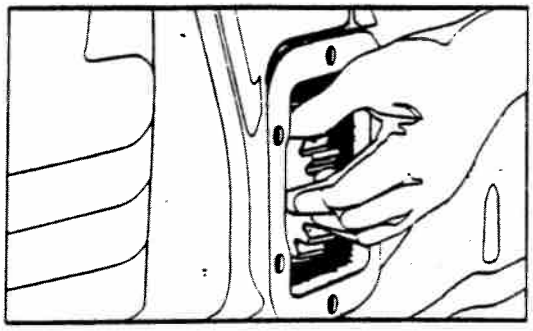


Fig. 1

Technical/Product Bulletin

ZF Industries

To: Manual Group

From: Michael Paterson

Re: Gear Tooth counts for the S5-47 and S5-42

Dear Distributor,

There are a lot of questions regarding the tooth counts on the gears in our transmissions. I hope that this memo will clarify these questions. Please refer to the ratio when using this chart.

	1st	2nd	3rd	4th	5th	Rev	Rev Idler
Ratio	4.14	2.37	1.42	1.00	0.77	3.79	
Speed Gear Tooth Count	48	51	40	34	30	44	29
Counter Gear Tooth Count	14	26	34	41	47	14	

	1st	2nd	3rd	4th	5th	Rev	Rev Idler
Ratio	5.08	2.61	1.53	1.00	0.77	4.66	
Speed Gear Tooth Count	48	37	31	29	25	44	29
Counter Gear Tooth Count	14	21	30	43	48	14	

	1st	2nd	3rd	4th	5th	Rev	Rev Idler
Ratio	5.72	2.94	1.61	1.00	0.76	5.24	
Speed Gear Tooth Count	48	37	30	27	26	44	29
Counter Gear Tooth Count	14	21	31	45	57	14	

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ZF INDUSTRIES, INC.
MANUAL TRANSMISSION DEPARTMENT

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Vernon Hills, Illinois 60061-3182

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Torque & Clearance Specifications
S5-42/S5-47/S5-47M

Torque Specifications

Description	Applied Torque (+-10%)
Case Half Bolts	23Nm
Shifter Housing Bolts	23Nm
Shift Tower Bolts	10Nm
PTO Cover Bolts	38Nm
Fill Plug (Pipe Thread)	35Nm
Fill Plug (Usit Ring)	66Nm
Fill Plug (Alum. Seal Ring)	60Nm
Drain Plug (Pipe Thread)	35Nm
Drain Plug (Usit Ring)	66Nm
Drain Plug (Alum. Seal Ring)	60Nm
Idler Gear Bolts	22Nm
Reverse Switch	20Nm
Output Locking Nut	270Nm
Shift Rail Interlock Bolts	10Nm

Clearance Specifications

Description	Assembly Clearance
Synchro Reserve S5-42	
-matched used gear/used ring	0.65 – 1.1mm
-new gear/used ring	0.80 – 1.1mm
-used gear/new ring	0.80 – 1.1mm
-new gear/new ring	0.90 – 1.1mm

Synchro Reserve S5-47/S5-47M	**1st, 4th, 5th, Rev.**	**2nd, 3rd**
-new gear/new ring	1.4 – 1.7mm	1.2 – 1.5mm
-new gear/used ring	1.3 – 1.7mm	1.1 – 1.5mm
-used gear/new ring	1.3 – 1.7mm	1.1 – 1.5mm
-used gear/used ring	1.15 – 1.7mm	0.95 – 1.5mm

Gear Clearance 1st	0.15 – 0.35mm
Gear Clearance 2nd	0.15 – 0.45mm
Gear Clearance 3rd	0.15 – 0.35mm
Gear Clearance 5th	0.15 – 0.35mm
Gear Clarance Rev.	0.15 – 0.35mm