



## Assembly/Disassembly Manual

FOR Jerico® WINSTON CUP,  
TOP & BOTTOM LOADER ROAD RACE, AND  
CLUTCH-ASSISTED DRAG RACE FOUR SPEED TRANSMISSIONS

This manual is supplied with your new Jerico transmission as a guide to repair and perform gear ratio changes yourself. Although many similarities exist between the Winston Cup cased transmission and the Top and Bottom Loader cased transmission, there are differences. These differences will be pointed out throughout this manual. It should also be noted the Top and Bottom Loader case is the same for both the Road Race and Drag Race versions. However, crucial differences exist between each version and its intended use. These too will be brought forth where needed within this manual.

Due to the very nature of racing and the inherent danger associated with it, we (Jerico® Performance Products, a Division of Hemmingson Enterprises, Inc.) disclaim any responsibility for injury, loss of life, or loss of property resultant from direct or indirect use of our products. Furthermore, as with almost all products produced within and for the racing industry and its participants, we neither extend nor imply any warranty associated with our products. However, in the name of good business relations with you, our consumer; we do solicit questions and comments addressed to us at the following:

### **IMPORTANT:**

*Each transmission comes with a serial number on the shift side of the case near the bolt ears. Also, you have a customer number that appears on the upper right side of your invoice. Please have your serial number and customer number ready for quicker service, if you need replacement parts or have any further questions or problems.*

## TRANSMISSION DISASSEMBLY:

1. Remove top cover and drain lubricating fluid.
2. Remove shift rods by unbolting the 3/8-24 UNF, Grade 8 bolts, and securing them to their levers. If the main case is to be replaced, remove both the shift rods and levers together by removing the 3/8-24 UNF lock nuts from their shift fingers. Shift arms can be removed by lightly tapping the shift finger in toward the case using a brass hammer so as not to damage their threads.
3. Remove the front bearing retainer held in place by four 5/16-18 X 1" socket head cap screws.
4. Remove the five 7/16-14 X 1 1/2" socket head cap screws holding the tail housing in place. With a rubber hammer tap the bushing end of the housing to break loose the silicone seal between it and the main case. Ensure that no yoke is in place before attempting to do this.
- 4A. For oil pump equipped Road Race and Winston Cup transmissions, it is held in place by two 7/16-14 X 3 3/4" and three 7/16-14 X 2 1/2" socket head cap screws. With the tail housing removed, remove the tail housing adapter plate installed between the tail housing and main case by removing two 7/16-14 X 1 1/2" socket head screws visible with the tail housing off. Again, it may be necessary to break loose the seal between the plate and main case by striking it with a rubber hammer along its sides.
5. Remove detents and detent springs by removing the two 3/8-16 X 1/4" socket head screws located on the left side of the main case's top cover sealing surface and the 3/8-16 X 1/2" socket head cap screw located on the transmission's left side between the 3-4 and reverse shift finger bosses. (For older style Winston Cup cases, only the lower of the two socket head cap screws needs removal.) Removal of the detents and detent springs is accomplished by extending a pocket magnet into the lower reaches of their bores.
6. Remove the 1-2 shift fork's set screw. Then, remove the 1-2 shift rail by rotating it 90 degrees and pulling on that portion extending out past the rear surface of the main case.
7. Remove the 3-4 shift fork's set screw. Then, remove the 3-4 shift rail by extending a long drift punch or Phillips screwdriver through the 1-2 shift rail's rear bore and driving the 3-4 shift rail forward. Several sharp blows may be required as the rail needs to drive the 9/16" plug located on the transmission's front surface out of its bore.
8. Remove the snap ring located on the input shaft just forward of the front bearing. Remove the snap ring located just to the rear of the rear bearing. (Winston Cup and Road Race transmissions have a two piece retainer clamp instead of a rear snap ring. Remove the two 5/16-24 X 7/8" socket head cap screws and lightly tap a screwdriver between the halves separating them.)

***\*\* Winston Cup cased transmissions proceed to step 10.***

9. For Road Race and Drag Race Top and Bottom Loader cased transmissions, rotate the transmission onto its top surface and remove the bottom cover. With the bottom cover

removed, remove the snap-ring from the back side of the main drive cluster gear, sliding it out of its groove and off the main drive cluster gear's spline. This procedure is necessary as the main drive cluster gear must be slid rearward 1/16" to 1/8" to clear radii in the main case's bottom opening as the cluster shaft assembly is lifted from the transmission.

**10.** Rotate the transmission upside down and remove the countershaft. This can be accomplished by striking a drift punch placed on the forward end of the countershaft driving it rearward out the tail end of the main case. With Top and Bottom Loader cased transmissions, the cluster shaft assembly can now be lifted out of the main case and the transmission rotated to an upright position. For Winston Cup cased transmissions rotate the transmission upright as the cluster shaft assembly lays in the bottom of the main case until the main shaft is removed.

**11.** Remove the front bearing by first removing the snap ring about its outer circumference. With the snap ring removed, place two pry bars in the snap ring groove, 180 degrees apart and pry the bearing out of its bore using even pressure on both bars taking care not to cock the bearing in the bore.

**12.** Remove the main drive gear from the input shaft.

**13.** Remove the rear bearing in the same manner as the front bearing was removed.

**14.** With main drive gear removed, split the main shaft from the input shaft by pulling the input shaft forward until the dog ring contacts the main case, or the main drive cluster gear in Winston Cup cased boxes, and first gear contacts the main case by pulling the main shaft rearward.

**15.** Remove the main shaft by placing a thumb on the rear thrust washer while grasping the main shaft. Tilt the main shaft up at the front using your hand in the rear bearing opening as a fulcrum. Failure to support the rear thrust washer with your thumb will allow first gear and the 1-2 slider to slip out of place making removal more difficult. With the main shaft tilted up at the front, place your other hand in and around the back face of first gear lifting the main shaft assembly up and out of the main case while maintaining the tilt up at the front to prevent the 3-4 slider from falling off. With the main shaft assembly removed, the input shaft can now be removed as well as the cluster shaft assembly from Winston Cup cased transmissions.

**\*\*** Depending on the scope of work required, it may not be necessary to remove the reverse gear assembly. If the main case is to be replaced steps 15 through 17 apply. If not, only step 17 may be followed.

**16.** Remove reverse gear's shift fork's set screw.

**17.** Remove reverse gear's shift rail by rotating it 90 degrees while pulling on that portion extending past the main case's rear surface.

**18.** Remove the reverse idler shaft by striking its front with a drift punch extended through the front bearing's bore driving the shaft rearward from the rear of the main case.

## **CLUSTER SHAFT DISASSEMBLY:**

1. With the cluster shaft standing on its first gear end (smallest gear incorporated on the shaft), remove the top snap ring from the groove at the face of the main drive cluster gear.
2. Remove the main drive cluster gear and the second snap ring located beneath it.
3. Remove the third snap ring located at the forward face of third gear's pinion gear.
4. Remove both third gear and second gear pinion gears from the shaft. Note the position of the raised land on the forward face of second gear's cluster gear and how it provides clearance between the two gears.

## **MAIN SHAFT DISASSEMBLY:**

### ***Winston Cup and Road Race Transmissions:***

1. Remove the snap ring at the forward end of the main shaft, then slide the 3-4 slider and 3-4 slider hub from the main shaft.
2. Remove third gear, its bearing spacer ring, and the two caged needle bearing assemblies.
3. Remove second gear and its caged needle bearing assemblies.
4. Remove the first gear thrust washer, first gear, and its two needle bearing assemblies from the tail end of the main shaft.
5. Remove the 1-2 slider from the 1-2 slider hub.
6. If the main shaft is to be replaced, remove the Spirolox ring (#RST-187) from its groove at the forward face of the 1-2 slider hub. If the main shaft and hub are to be used again, it may not be necessary to remove the 1-2 slider hub from the main shaft.

### ***Drag Race Transmissions:***

1. Remove the snap ring at the forward end of the main shaft. Then, slide the 3-4 slider and 3-4 slider hub from the main shaft.
2. Remove third gear from the main shaft.
3. Remove the snap ring and tabbed thrust washer located at the forward face of second

gear. Then, remove second gear. \*\* If the gear will not slide easily off the shaft, do not force it as this will scar the gear's internal bushing. Many times due to some thrust acting upon both the thrust washer and snap ring a small burr will form on the forward edge of the snap ring groove. This ridge must first be removed using a fine flat file taking away only a minimal amount of material so as not to excessively round the snap ring groove's edges.

4. Remove the first gear thrust washer, first gear, and its two needle bearing assemblies from the tail end of the main shaft.

5. Remove the 1-2 slider from the 1-2 slider hub.

6. If the main shaft is to be replaced, remove the Spirolox ring (#RST-187) from its groove located at the forward face of the 1-2 slider hub. Then, remove the slider hub. If the main shaft and hub are to be used again, it may not be necessary to remove the 1-2 slider hub from the main shaft.

## **DOG RING REMOVAL:**

### ***Drag Race Transmissions:***

As the dog rings are splined directly to second and third gears in Drag Race type transmissions, removal of the Spirolox retainer will allow the dog rings to be separated from their appropriate gears.

### ***Winston Cup and Road Race Transmissions:***

In these type transmissions the dog rings along with second and third gears are splined to inner hubs. Removal of the Spirolox retainers will allow the dog rings and spur gears to be separated from their appropriate inner hubs.

1. With the gear face down, dog ring up, flatten the Spirolox's right hand locking barb using a small jeweler's screwdriver and hammer.

2. Remove the Spirolox from its groove by prying the exposed end up and out of the groove and continuing in such fashion around the circumference of the inner hub.

3. Slide the dog ring and spur gear from the inner hub.

\*\* Upon completion of disassembly, and prior to inspection, wash all parts in a suitable solvent and blow dry.

## **INSPECTION:**

Although the inspection procedures outlined in this manual are the same inspection procedures we use here at Jerico®, magnaflux inspection of critical components can insure a higher level of confidence in those components. Magnaflux inspection of these components should be accomplished as per the inspection equipment's manufacturer's recommended procedures.

### ***Main Case:***

1. Visually check for cracks paying particular attention to the bolting ears and in the areas where damaged parts have impacted the case severely.
2. Check the roundness and concentricity of all holes. Pay particular attention to the countershaft bores as they have a tendency to elongate after a transmission failure.
3. Inspect all threads. Tap and helical as necessary any defective threads.

### ***Main Shaft:***

1. Check bearing journals for scoring, pitting, roundness and concentricity.
2. Check main shaft for straightness. In the event of a drive shaft failure or rear end collision, it may be necessary to check the length of the main shaft between centers. A bend in the shaft will be indicated in the runout noted on the journals. If the gearbox has suffered a catastrophic gear failure, check the shaft for straightness by placing it on V-blocks centered at the rear bearing journal and front input needle bearing journal. Normal shaft runout will average 0.0015" per any one journal. If straightening after any event described above, shaft runout should not exceed 0.003" per any one journal.

### ***Countershaft:***

1. Check for scoring, pitting, roundness and concentricity.

### ***Gears:***

1. Check for pitting, broken teeth, abnormal wear.
2. Visually inspect for cracks. Pay particular attention for cracks propagating at the roots of the gears' teeth.
3. Check first gear's dog ring engagement lugs for burrs on the upper and lower edges. These may be removed with a die grinder and sandpaper roll.

### ***Cluster Shaft:***

1. Check the internal bearing surfaces for pitting and excessive wear.
2. Visually inspect for cracks propagating from the root of the first gear cluster's teeth.
3. Check the first gear pinion for signs of thinning, chipping or excessive wear due to misalignment. Slight chips at the gear tooth's top land can be sanded smooth using a die grinder and sandpaper roll. Ensure that only minimal material is removed, so as not to change the gears profile or diminish tooth contact area.

### ***Reverse Idler and Reverse Idler Shaft:***

1. Inspect the internal bearing surfaces of the idler and external bearing surfaces of the shaft for pitting and excessive wear.

### ***Dog Rings:***

1. Visually inspect the dog rings for cracks propagating in the radii at the bases of the individual teeth.
2. Inspect the sides of the dog rings' teeth for excessive wear. If the teeth are rounded more than 3/32 to 1/8 inch the dog ring should be replaced.
3. On older transmissions, the third gear dog ring has a tendency to contact the third gear pinion. This can be seen by the contact marks on the back side of the dog ring (that side which mates against the gear). This can be alleviated by either grinding approximately a 0.030" taper starting at the base circle of the dog ring and extending to the tip of each individual tooth, or by replacing the dog ring with a newer styled part.

### ***Sliders:***

1. Visually check the sliders for cracks.
2. Inspect sliders' dog ring engagement lugs for excessive wear. If the teeth are rounded more than 3/32 to 1/8 inch the slider should be replaced. Many times a slider that is worn heavily on its teeth will produce a large burr at the upper and lower ends of the teeth. To prevent this burr from breaking off and circulating in the lubricating oil, with a die grinder lightly grind this burr away leaving a very slight radius on the lugs' upper and lower edges.

### ***Needle Bearings and Thrust Washers:***

1. Check needle bearings for signs of pitting, scoring and excessive heat. If any individual bearings shows signs of defects, replace all the bearings in that group size.
2. Check the caged needle bearing assemblies for signs of pitting, scoring and excessive wear. Check the outer supporting cages for signs of wear and thinning. Replace these assemblies as necessary.
3. Check the two reverse idler and four cluster shaft needle bearing thrust washers for signs of excessive wear. Replace as necessary.
4. Inspect the cluster shaft thrust bearing washer for excessive wear and scoring. Replace as necessary.

## **REASSEMBLY OF MAJOR COMPONENTS:**

### ***Main Case:***

1. Install new shift finger seals using a seal driver or piece of bar stock turned to the dimensions, as seen on the pictorial “Seal Driver” at the end of the book.
2. With the old countershaft O-ring removed, thoroughly clean the groove. Install a new O-ring. On Viton o-rings a drop of oil spread evenly over the whole o-ring will ease installation of it. Other o-rings of different material composition should be installed dry as most lubricants have a tendency to swell the rubber.
3. Using compressed air, blow clean the main case, paying particular attention to the blind detent bores and blind bolt holes.
4. Lay the main case aside until later.

### ***Tail Housing:***

1. With a new rear seal in hand, apply a very thin layer of silicone to the seal’s metal housing’s outer circumference.
2. Next, apply a thin layer of silicone to the chamfer at the upper edge of the tail housing’s rear seal bore.
3. Install the seal by using a seal driver or by placing a flat piece of aluminum or steel or a wood 2 x 4 over the seal and driving it into the housing using a heavy hammer. Ensure that the seal’s metal flange seats flat against the tail housing.



4. On Road Race and circle track applications, install a number 44 hose clamp and two metal tabs to prevent loss of the rear seal. This step is necessary due to the different expansion rates of the aluminum or magnesium tail housings and the metal housing of the rear seal.

#### ***Cluster Shaft Assembly:***

1. With the cluster shaft standing on its first gear end, install the first (lowest) snap ring. Ensure that the snap ring is installed with its sharp edges down away from the gear and its rounded edges face up so as to face second gear's pinion gear. \*\*With the sharp edges face out away from the gear, any thrust the gear may generate will help to develop higher seating forces of the snap ring as opposed to those forces developed with the snap ring's rounded edges face out. Pay particular attention to this in all phases of assembly.

2. Install the second gear pinion with its flat face down toward the first gear end, and the raised face up toward third gear's pinion. The raised face will provide a necessary clearance between the second and third gear pinion gears.

3. Install the third gear pinion with its gear set numbers face up. Then install the second snap ring sharp face up, rounded edges down thus securing second and third gear pinions in place. \*\*Third gear pinion with its gear set numbers face up is the way we install them here at Jerico®. It is important that, once a gear is run awhile, it should not be reversed with the gear teeth then loaded on the opposite side.

4. Install the third snap ring sharp face down. On Top and Bottom Loader transmissions this snap ring is slipped over the spline so that it rests on the cluster shaft between the main drive cluster gear's spline and the second/ third pinion gears' spline. This is necessary so that, like during disassembly, the main drive cluster gear can be slid rearward 1/16" to 1/8" to clear radii in the transmission's main case's bottom opening.

5. Install the main drive cluster gear with its flat face toward the third gear pinion and the concave face up toward the end of the cluster shaft.

6. Install the fourth and last snap ring preventing the main drive cluster gear from sliding off the cluster shaft.

#### ***Reverse Idler:***

1. Place the reverse slider onto the reverse idler gear so its teeth meet those of the reverse idler.

## ***Second and Third Gear Assemblies:***

### ***Drag Race Transmissions:***

1. With second gear lying flat on its face, spline side up, install the 34 tooth spline dog ring onto the gear's spline. Take note of the dog ring's engagement teeth's shape. The teeth's smaller faces mate against the gear while their wider faces are out away from the gear. Installing a dog ring with faces backwards on the gear will result in the transmission jumping out of gear when power is applied to it.
2. Next, install a (#RS-212) Spirolox snap ring into the gear's snap ring groove. Ensure that the Spirolox seats properly in the groove.
3. Repeat step 1 for third gear using a 37 tooth spline dog ring.
4. Repeat step 2 for third gear using a (#RS-187) Spirolox snap ring.

### ***Winston Cup and Road Race Transmissions:***

1. Slide second gear's inner hub through second gear. This hub can be identified from the third gear inner hub due to its larger inside diameter. Ensure that the inner hub is inserted through the second gear face with the recess about its inner circumference.
- \*\*** Earlier model transmissions had inner hubs with no land. Their splines were continuous across the outer circumferences with a snap ring groove at each end. Placement at the grooves is different at each end. The thinner section, as measured from the edge of the hub to the snap ring groove, is installed through the second gear face with the recess about its inner circumference while the thicker section is installed out side of the dog ring.
2. Slide a 34 tooth spline dog ring over the inner hub so that the wider face of each tooth is out away from the gear.
  3. With a new Spirolox in hand, spread it so that the left side barb can be slid over a dog ring tooth and flattened. Only the left side barb should be flattened.
  4. Starting with its lower left edge, install the Spirolox, feeding it around into the groove. Ensure that the ring is seating as you proceed around the groove; otherwise, the upper right edge will not seat over its locking barb.
  5. To seat the upper right edge of the Spirolox, take a small screwdriver and place it in the right hand barb's slot, driving the upper right edge into the groove from about a 45 degree angle using a hammer.
  6. Once the Spirolox is installed and seated about its circumference, reset the left side locking barb by punching it down to its original position using a small jeweler's screwdriver.
  7. Repeat steps 1 through 5 for the third gear assembly, using the third gear inner hub which is the hub with the smaller inside diameter.

**\*\*** On older dog rings, ensure that both are properly installed with the ring's wider tooth surfaces out away from the gear. Installing a dog ring backwards will result in the transmission jumping out of gear when power is applied to it. Newer dog rings have a bevel cut on the rear face that extends from the base circle of the dog ring to the outer tips of each individual tooth. This is the face which mates against the gear.

**\*\*** While writing this manual a new inner hub was entered into production that uses a conventional snap ring, thus simplifying installation by eliminating the Spirolox retainer ring. This conventional snap ring affords greater assurance of not unwinding due to its ability to withstand greater rotational forces developed during high rev downshifts. As with all other snap ring installations, ensure that the sharp faces are installed face up away from the dog rings.

### ***Input Shaft:***

1. Install the 37 tooth spline dog ring onto the input shaft so that the surface with the teeth's wide faces seats against the input shaft's snap ring. Newer dog rings are installed with the flat face rearward against the snap ring, bevel face forward toward the front end of the input.

### ***Main Shaft Assembly:***

1. Install the 1-2 slider hub onto the main shaft. Ensure that the inner spline's recess goes on first so that it points to the rear.
  2. Install a (#RS-187) Spirolox into the groove, securing the 1-2 slider hub in place on the main shaft.
  3. Next apply a light film of oil to the first gear journal. Then install the first gear caged needle bearing assemblies and apply a liberal coating of oil to the bearing assemblies.
- \*\*** The word "oil" as used in this manual refers to the recommended lubricant of "Mobil One" 75W90.
4. Apply a film of oil to first gear's inside diameter's bearing surface before sliding it over the caged needle bearing assemblies already on the main shaft.
  5. Install the first gear's thrust washer so that the face with a chamfer about its inside diameter faces the rear face of first gear.

6. Install the 1-2 slider over the front of the main shaft up onto the 1-2 slider hub. Ensure that the reverse gear teeth of the 1-2 slider face the front of the main shaft.

### ***Drag Race Transmissions:***

7. Apply a thin layer of oil to the second gear journal and a moderate layer of oil inside second gear's bushing, before sliding the gear up onto the main shaft with the dog ring

facing the 1-2 slider.

8. Install the tabbed thrust washer with its rounded edge on one face toward the gear, and its sharp edges on the other face, facing out from the gear.
9. Install the (#5100-162) snap ring securing both second gear and the tabbed thrust washer onto the second gear journal of the main shaft. Make sure the snap ring gap is in line with the main shaft slot of the tabbed thrust washer.
10. Apply a thin layer of oil on the third gear journal and a moderate layer of oil inside third gear's bushing before sliding the gear up onto the main shaft with the dog ring facing forward on the shaft.
11. Install the 3-4 slider hub so that the recess in the internal spline faces rearward against third gear.
12. Install the (#5100-131) snap-ring, securing the 3-4 slider hub into place on the main shaft.
13. Install the 3-4 slider on the 3-4 slider hub so that the ramps on the slider's teeth face, as shown in the pictorial section.

#### ***Winston Cup and Road Race Transmissions:***

7. Apply a thin layer of oil on the second gear journal and install the two caged needle bearing assemblies. Apply a liberal coating of oil to the bearing assemblies and a light layer of oil to the inside diameter of second gear's inner hub. Next slide second gear up on to the main shaft and the needle bearing assemblies with the dog ring facing the 1-2 slider.
8. Apply a thin layer of oil on the third gear journal, and install the two third gear caged needle bearing assemblies and then the bearing spacer ring. Apply a liberal coating of oil to the bearing assemblies and a light layer of oil to the inside diameter of third gear's inner hub. Install third gear up onto the main shaft and the needle bearing assemblies with its dog ring facing forward.
9. Install the 3-4 slider hub so that the recess in the internal spline faces rearward against third gear.
10. Install the (#5100-131) snap-ring securing the 3-4 slider hub into place on the main shaft.
11. Install the 3-4 slider onto its hub. On used transmissions, we try to install the slider so that the least worn of the dog ring engagement lugs are in contact with the fourth gear dog ring while under power. Remember: Engine rotation spins the input shaft clockwise.

#### ***Input Shaft, Cluster Shaft and Reverse Idler Needle Bearing Assembly:***

1. Apply a moderate film of "Mobil 1" universal grease to the internal bearing surfaces of the input shaft. Next, install the 15 bearing needles about the inner diameter. Apply a

moderate film of grease to all the bearing needles once in place.

2. Apply a moderate film of Mobil 1 universal grease to the internal bearing surfaces of the reverse idler. Next install the (#C407Q) 44 bearing needles (22 per end) about the inner diameter on each end. Then apply a moderate film of grease to all the bearing needles in place. Finally, on each end of the idler, install a single thrust washer (#RNT-A) on the outer ends of the needles ensuring the thrust washer's sharp edges face in toward the needles providing them a flat surface on which to ride. \*\* On used transmissions, if while during disassembly or washing you lost any of the individual needle bearings, it is better to replace all the bearings than one lost individual needle.

3. Apply a moderate film of Mobil 1 universal grease to the internal bearing surfaces of the cluster shaft. Next, install a single thrust washer (#CNT-A) into the needle bearing bore before installing the needles (#C1086Q). Ensure that this thrust washer's sharp edges face up toward the needles. Install the needles (28 per side for a total of 56). Apply a moderate film of grease to the needles once in place. Then install a second thrust washer (#CNT-A) on the outer end of the needles ensuring its sharp edges face in toward the needles' ends. \*\* As with the reverse idler it is better to replace all the needles than any lost individual one.

## **TRANSMISSION ASSEMBLY:**

1. Apply a thin film of Mobil 1 universal grease to the shift finger seals and shift finger thrust surfaces inside the case.

2. With a light film of Mobil 1 75W90 applied to the shift finger shafts, install the shift fingers as shown in the pictorial section.

3. Apply a thin layer of Mobil 1 universal grease to the reverse idler thrust surfaces and idler shaft bores.

4. Set the reverse idler/reverse slider combination between the thrust surfaces and align its bore with the main case's forward and rear idler shaft bores. Where, during rebuilding, the reverse shift fork and shift rail were not removed during disassembly; make sure during this step that the shift finger is in engagement with the slider before installation of the reverse idler shaft.

5. With a light film of Mobil 1 75W90 applied to the reverse idler shaft, slide the shaft through the case's rear idler shaft bore. Sometimes a twisting motion while pushing forward on the shaft will help ease it through both the rear bore and the idler. In newer cases, it may be necessary to drive the idler shaft into its forward bore with moderate strikes of a hammer. Maintain the rear end of the idler shaft flush or only a few thousandths deeper than the main case's rear surface.

6. Rotate the reverse idler to ensure ease of rotation. Make sure it rolls freely with no binding or tight spots.

7. Install a short detent spring (SDP-A) the forward vertical detent bore. Next, add a few drops of oil into the bore. With a pocket magnet, place a detent into the bore.

**8.** With the reverse shift rail lightly oiled, place it through its rear bore and extending on through the reverse shift fork. Now, while pushing forward on the rear of the rail, push down on the pocket magnet with the detent on its end. When the "click" is felt, remove the magnet while continuing to push forward on the rail. An extreme amount of pressure on your hand will be required to push the rail forward into the front bore. This is an extremely difficult task which becomes easier after accomplishing it a few times. The main thing to remember is: Do not overcompress the detent spring and start pushing at the rear of the rail before pushing down on the magnet so that the "click" is felt when the detent first slides under the rail.

**9.** Align the reverse shift forks set screw bore with the set screw bore in the rail (a number 2 Phillips screwdriver does well). Next, install the 5/16-24 X 1" socket head set screw and tighten it hand tight for Drag Race transmissions, or install the 5/16-24 X 1" socket head cap screw with the tapered head and torque it to 28 lb./ft for Winston Cup or Top & Bottom Loader Road Race transmissions.

### ***Winston Cup Cased Transmissions:***

**10.** Apply a liberal film of Mobil 1 universal grease to the cluster shaft's front and rear thrust surfaces of the main case.

**11.** Place the cluster shaft into the main case between its thrust surfaces so that the first gear end is at the case's rear and the main drive gear at the front.

**12.** With a layer of Mobil 1 universal grease applied to the cluster shaft thrust washer bearing, insert the thrust washer between the cluster shaft and the main case's rear thrust surface. The anti-rotating tab slides within the slot of the case's rear thrust surface and the thrust washer's oil relief slots face the cluster shaft.

**13.** Apply a thin film of Mobil 1 universal grease to the front and rear bearing bores of the main cases.

**14.** Place in the input shaft with 37 tooth dog ring into the front bearing bore, letting it lay there to free both hands while installing the main shaft assembly.

**15.** With the main shaft assembly tilted up at the front to an angle of approximately 45 degrees and the right hand placed at the rear of first gear making sure it nor its bearings and slider slip from the main shaft, place the tail end of the main shaft through the rear bearing bore. If working on a table without a transmission mule, place the main case at the table's edge, as the main shaft will extend lower than the case while feeding it through the rear bearing bore.

**16.** Join both input and main shafts together, letting the two rest in the bearing bores. Make sure that once both are together, precautions are taken to prevent inadvertently separating them as the input shaft's needle bearings will fall out of place.

**17.** Place the appropriate shift fork about the respective slider. This step must be accomplished prior to installing either front or rear main bearings.

**18.** Install the rear bearing on the main shaft and on into its main case bore. On some

cases, it may be necessary to lightly tap the bearing into place. Be sure to alternate between sides while tapping the bearing to prevent it from becoming cocked in its bore or on the main shaft.

**19.** Install the main drive pinion gear flat side first so it rests against the input dog ring. Be sure to align the oil groove in this gear with the oil hole in the input shaft spline at the forward base of the input dog ring. It may be necessary with new gears or inputs to drive this gear onto its spline fully with a hammer and drift punch. Be sure not to nick the input's journal surfaces nor any gear teeth.

**20.** Install 3.625" spacer ring about the front bearing. Then install the bearing. As with the rear bearing, it may be necessary to tap this bearing into place. Again, while tapping, be sure to alternate between sides to prevent the bearing from becoming cocked in its bore or on the input shaft.

**21.** With both bearings installed and in place, install the front bearing retaining snap ring (#5100-177) and at the rear bearing, install the two piece retainer collar. Torque the two 1/4-28 X 7/8" long socket head screws to 22 lb./ft.

**22.** With the shift forks placed over their appropriate shift finger levers, drop a long detent into the rear vertical detent bore. Next apply a light film on Mobil 1 75W90 90 oil to both the 1-2 and 3-4 shift rails. Slide the rails through their appropriate bores in the main case and on into the forks enough to hold the forks out of the way while rotating the transmission upside down onto its top surface.

**23.** Apply a thin layer of Mobil 1 universal grease to the front and rear countershaft bores of the main cases. Also, apply a thin layer of Mobil 1 75W90 to the countershaft journals. Then align the cluster shaft bore with the main case's countershaft bores, front and rear, while inserting the countershaft through all three starting from the rear. Before driving the countershaft into the most forward bore, ensure that no needle bearings have been displaced and collected at the front bore. In addition, ensure that the countershaft roll pin is aligned with the slot in the rear bore. Lightly to moderately tap the countershaft to get it started straight into its forward bore. Next, drive the counter shaft into place with moderate to heavy blows from a good size hammer. Be sure to strike the countershaft square so as not to chip its edges. Also, be extremely certain not to drive the countershaft any more than flush to a few thousandths deeper than the main case's rear surface. Doing so will eat up the clearances allowed for heat expansion of the rear needle bearing cluster.

**24.** Rotate the transmission back into an upright position. With the sliders placed in a neutral position, rotate the input to ensure ease of rotation of the input shaft and cluster shaft assemblies. Ensure that there is no binding or excessive clatter as the gear teeth mesh with each other. Also, on older transmissions, inspect to ensure that there is no contact between second and third pinion gears, and second and third dog rings.

**25.** Apply Mobil 1 75W90 to the bottom of the forward vertical detent bore. With a detent placed upon a pocket magnet, set it into the bottom of the bore. Hydraulic action will allow the pocket magnet to be removed while a vacuum retains the detent in the bottom of the bore. Be sure reverse is disengaged prior to this step so that the detent will sit at its true bottom, and not on top of the reverse shift rail.

**26.** Now slide the 3-4 shift rail completely through the 3-4 shift fork and on into its rear

bore in the main case's web boss.

**27.** Align the 3-4 shift fork's set screw bore with the tapered countersunk hole for the 3-4 shift rail. Install the 5/16-24 X 1 1/4" long, 14 degree tapered end set screw, using "Loctite" and torque to 28 lb./ft.

**28.** With the 3-4 slider in neutral, apply a shot of oil to the bottom of the vertical detent bore. Using a pocket magnet insert a short detent into the bore. Unlike the previous detent between the reverse and 3-4 rail the magnet will have to remain in place momentarily.

**29.** Now slide the 1-2 shift rail completely through the 1-2 shift fork and on up against the magnet in the forward detent bore. With a steady push at the rear of the 1-2 rail slide the magnet out of the bore, scraping the detent off of it and into its position below the 1-2 rail.

**30.** Align the 1-2 shift fork's set screw bore with the tapered countersunk hole of the 1-2 shift rail. Install the 5/16-24 X 3/4" long, 14 degree tapered end set screw, using "Loctite" and torque to 28 lb./ft.

**31.** In each of the two vertical detent bores place a small detent and a few drops of oil. Next, place a long detent spring in each. Install a 3/8-16 X 1/4" long set screw in each and running it down just flush with the main case's top surface.

**32.** Rotate the transmission onto its right side and install a short detent and a few drops of oil into the side detent bore. Next place a short detent spring (SDP-A) in the bore. Install the 3/8-16 X 1/2" long socket head screw with AN washer and torque to 22 lb./ft.

**33.** Rotate the transmission back upright and perform a check to ensure all detent interlocks and associated shift mechanisms operate satisfactorily.

**a.** With a wrench on the thickest portion of the shift finger flats, shift the transmission into first gear. Rotate the input while trying to shift the gear box into reverse, third and fourth.

**b.** Shift to second and repeat the above procedure.

**c.** Shift the 1-2 slider to neutral and then shift to third. Rotate the input while trying to shift into reverse, first and second gears.

**d.** Shift to fourth and repeat the above procedure.

**e.** Shift the 3-4 slider to neutral and shift the gearbox into reverse. Rotate the input while trying to shift into first, second, third and fourth gears.

Failure to shift into any other gear means all interlocks are in place. Shifting into two gears at once indicates a missing detent between the rails of the two engaged gears. Recheck the 28 lb./ft. of torque on both 1-2 and 3-4 shift forks set screws.

**34.** Install the 9/16 expansion plug in the 3-4 rail's bore opening located on the transmission's front surface.



**35.** Apply a thin layer of Mobil 1 universal grease to front bearing retainer's input seal and the input's seal journal. With a bead of "Hylomar" gasket maker applied to the front bearing retainer's mating surface, install the retainer with the slotted groove pointed straight down and in line with the oil return hole directly centered in the main case below the front bearing. Using four 5/16-18 X 1" long socket head screws with AN washers, torque the retainer bolts to 22 lb./ft. Using a solvent rag, be sure to wipe away any excess gasket maker. Failure to remove excess silicone may result in misalignment of the transmission no matter how exact the bell housing is dialed in.

**36.** Clean the main case's rear surface of any excess grease or oil. Do the same to the tail shaft housing's mating surface. Apply a light film of Mobil 1 universal grease to the tail shaft splines, tail shaft bushing and rear seal.

**\*\***For transmissions equipped with either the one or two stage integral oil pump, refer to Appendix 1 for installation of the tail housing pump assembly.

**37.** Apply a bead of "Hylomar" gasket maker to the tail shaft housing as shown below. Overdoing it on the silicone may clog the oil return hole directly below the rear bearing leading to premature bearing failure. Be careful to avoid doing so.

**38.** Install the tail shaft housing and the five 7/16-14 X 1 1/2" long socket head screws with AN washers. Torque these screws first to 25 lb./ft and again to 35 lb./ft in the sequence shown below.

**39.** Prior to installing the top cover, we recommend the shifter be installed and adjusted as this step is facilitated with the top cover off. Refer to the appropriate Appendix for installation of your particular shifter.

**40.** Install the top cover using ten 5/16-18 X 1" long socket head cap screws with AN washers for the cast finned top cover or ten 5/16-18 X 3/4" long socket head screws for the 1/8" aluminum plate top cover. Torque to 22 lb./ft in an alternating, crisscross fashion starting at the middle and working toward each end.

### ***Top and Bottom Loader Cased Transmissions***

**10.** Apply a thin film of Mobil 1 universal grease to the front end rear bearing bores of the main case.

**11.** Place the input shaft with the 37 tooth dog ring into the front bearing bore, letting it lay there to free both hands while installing the main shaft assembly.

**12.** With the main shaft assembly tilted up at the front to an angle of approximately 45 degrees and the right hand placed at the rear of first gear making sure it nor its bearings and slider slip from the main shaft, place the tail end of the main shaft through the rear bearing bore. If working on a table without a transmission mule, place the main case at the table's edge as the main shaft will extend lower than the case while feeding it through the rear bearing bore.

**13.** Join both input and main shafts together letting the two rest in the bearing bores. Make sure once both are together, precautions are taken to prevent them from

inadvertently slipping apart as the input shaft's needle bearings will fall out of place.

**14.** Install the rear bearing onto the main shaft and on into its main case bore. On some cases, it may be necessary to lightly tap the bearing into place. Be sure to alternate between sides while tapping the bearing to prevent it from becoming cocked in its bore or on the main shaft.

**15.** Install the main drive input gear flat side first so it rests against the input dog ring. On Road Race or Endurance type transmissions, be sure to align the oil groove in this gear with the oil hole in the input shaft at the forward base of the input dog ring. It may be necessary with a new gear or input to drive this gear onto its spline fully with a hammer and drift punch. Be sure not to nick the input journal surfaces nor nick any gear teeth.

**16.** Install the front bearing. On Road Race transmissions, be sure to install the 3.625" spacer ring on the bearing prior to installation. As with the rear bearing, it may be necessary to tap this bearing into place. Again, while tapping, be sure to alternate between sides to prevent the bearing from becoming cocked in its bore or on the input shaft.

**17.** With both bearings installed and in place, install the front bearing retaining snap ring (#5100-177) and on the rear bearing either a 5160-137 snap ring for Drag Race transmissions or a two piece rear bearing retainer on Road Race or Endurance transmissions. On the two piece retainer collar, torque the two 1/4-28 X 7/8" long socket head cap screws to 22 lb./ft.

**18.** Next, rotate the transmission onto its top surface and apply a thin layer of Mobil 1 universal grease to the cluster shaft thrust surfaces of the main case.

**19.** With the main drive gear slid approximately 1/8 to 3/32 inch rearward on the cluster shaft, install the cluster into the case driving the main drive cluster gear forward allowing the cluster to settle into mesh with all main shaft gears.

**20.** \*At this point it would be good to estimate cluster shaft end clearance. We have built some Top and Bottom Loader style transmissions with thrust washer bearings and the majority without. Generally if it came with a thrust washer bearing, it will need one again. If it came without one, it more than likely will not need one. However, as a thrust surface may wear to a point of excessiveness due to some other failure, clean up cut may be taken on the thrust surface and a thrust washer bearing installed.

**21.** With a thin layer of Mobil 1 universal grease applied to the front and rear countershaft bores, apply a thin layer of Mobil 1 75W90 to the countershaft journals. Then align the cluster shaft bore with the main case's countershaft bores, front and rear, while inserting the countershaft through all three starting from the rear. Before driving the counter- shaft into the most forward bore, ensure that no needle bearings have been displaced and collected at the front of the bore. In addition, ensure that the countershaft rolled pin is aligned with its slot in the rear bore. Lightly to moderately tap the countershaft to get it started straight into its forward bore. Next, drive the countershaft into place with moderate to heavy blows from a good-sized hammer. Be sure to strike the countershaft square so as not to chip its edges. Also, be extremely certain not to drive the counter shaft any more than flush to a few thousandths deeper than the main case's rear surface. Doing so will eat up the clearances allowed for heat expansion of

the rear needle bearing cluster and result in catastrophic failure of this bearing cluster.

**22.** Drive the main drive gear forward until its rear snap-ring groove on the cluster shaft is exposed, so that the snap ring can now be set in place securing the main drive gear from any axial movement.

**23.** With the sliders placed in a neutral position, rotate the input to ensure ease of rotation of the input shaft and cluster shaft assemblies. Ensure that there is no binding or excessive clatter as the gear teeth mesh with each other. Also, on older transmissions, inspect to ensure that there is no contact between second and third pinion gears and second and third dog rings.

**24.** Apply a bead of "Hylomar" gasket maker to the case's bottom surface as illustrated. Then install the bottom cover so that the square corners are at the front face of the main case and the rounded corners at the rear. This should place the installed magnet between first and second pinion gears. Using ten 5/16 AN washers and ten 5/16-18 X 1" long socket head screws, tighten the bottom cover securely to 22 lb./ft.

**25.** Rotate the transmission back into an upright position and place shift forks onto their appropriate sliders.

**26.** Slide the one and only long detent into the rear vertical detent bore. Apply a drop or two of Mobil 75W 90 upon its top.

**27.** Apply Mobile 1 75W90 to the bottom of the forward vertical detent bore. With a detent placed upon a pocket magnet, set it into the bottom of the bore. Hydraulic action will allow the pocket magnet to be removed while a vacuum retains the detent in the bottom of the bore. Be sure reverse is disengaged prior to this step so the detent will sit at its true bottom and not on top of the reverse shift rail.

**28.** With a light film of oil applied to the 3-4 shift rail (shortest), insert it through its front bore of the main case and on into the 3-4 shift fork and its rear bore in the main case's web boss.

**29.** Align the 3-4 shift fork's set screw bore with the tapered countersunk hole of the 3-4 shift rail. Install the 5/16-24 X 1 1/4" long, 14 degree tapered end set screw, using "Loctite" on Road Race/endurance transmissions, and dry on Drag Race transmissions; then torque to 28 lb./ft.

**30.** Apply a shot of oil to the bottom of the vertical detent bore. Ensure that the 3-4 slider is placed in a neutral position and then with a pocket magnet, insert a short detent into the bore. Unlike the previous detent between the reverse and 3-4 rail, the magnet will have to remain in place momentarily.

**31.** With a thin layer of oil applied to the 1-2 rail, insert the rail through its rear bore of the main case and on through the 1-2 fork and on up against the magnet in the forward detent bore. With a steady push at the rear of the 1-2 rail slide the magnet out of the bore scraping the detent off of it and into its position below the 1-2 rail.

**32.** Align the 1-2 shift fork's set screw bore with the tapered countersunk hole of the 1-2 shift rail. Install the 5/16-24 X 3/4" long, 14 degree tapered end set screw using "Loctite" on Road Race/endurance transmissions, and dry on Drag Race transmissions,

torque to 28 lb./ft.

**33.** In each of the two vertical detent bores, place a small detent and a few drops of oil. Next, place a long detent spring in each. Install a 3/8-16 X 1/4" long set screw in each running it down just flush with the main case's top surface.

**34.** Rotate the transmission onto its right side and install a small detent and a few oil drops into the side detent bore. Next, place a short detent spring (SDP-A) in the bore. Install the 3/8-16 X 1/2 long socket head screw with AN washer and torque to 22 lb./ft.

**35.** Rotate the transmission back upright and perform a check to ensure all detent interlocks and associated shift mechanisms operate satisfactory.

**a.** With a wrench on the thickest portion of the shift finger slots, shift the transmission into first gear. Rotate the input while trying to shift the gearbox into reverse, third and fourth gears. **b.** Shift to second and repeat the above procedure.

**c.** Shift the 1-2 slider to neutral and shift to third. Rotate the input while trying to shift into reverse, first, and second gears.

**d.** Shift to fourth and repeat the above procedure.

**e.** Shift the 3-4 slider to neutral and shift the gearbox into reverse. Rotate the input while trying to shift into first, second, third and fourth gears.

Failure to shift into any other gear means all interlocks are in place. Shifting into two gears at once indicates that there are missing detents between the rails of the two engaged gears. Recheck the 28 lb./ft of torque on both 1-2 and 3-4 shift fork's set screws.

**36.** Install the 9/16 expansion plug in the 3-4 rail's bore opening located on the transmission's front surface.

**37.** Apply a thin layer of Mobil 1 universal grease to the front bearing retainer's input seal and the input's seal journal. With a bead of "Hylomar" gasket maker applied to the front bearing retainer's mating surface, install the retainer with the slotted groove point straight down and in line with the oil return hole directly centered in the main case below the front bearing. Using four 5/16-18 X 1" long socket head screws with AN washers, torque the retainer bolts to 22 lb./ft. With a solvent rag be sure to remove any excess silicone. Failure to remove excess may result in misalignment of the transmission no matter how exact the bell housing is dialed in.

**38.** Clean the main case's rear surface of any excess grease or oil. Do the same to the tail shaft housing's mating surface. Apply a light film of Mobil 1 universal grease to the tail shaft splines, tail shaft bushing and rear seal.

**\*\*** For transmission equipped with either the one or two stage integral oil pump refer to Appendix 1 for installation of the tail housing pump assembly.

**39.** Apply a bead of "Hylomar" gasket maker to the tail shaft housing as shown below.

**40.** Install the tail shaft housing and the five 7/16-14 X 1 1/2" long socket head screws. Torque these screws first to 25 lb./ft and then again to 35 lb./ft in the sequence shown below.

**41.** Prior to installing the top cover, we recommend the shifter be installed and adjusted as this step is facilitated with the top cover off. Refer to the appropriate Appendix for installation of your particular shifter.

**42.** Install the top cover using ten 5/16-18 X 1" long socket head cap screws with AN washers for the cast finned top cover or ten 5/16-18 X 3/4" long socket head screws for the 1/8" aluminum plate top cover. Torque to 22 lb./ft. in an alternating, crisscross fashion starting at the middle and working toward each end.

## **APPENDIX ONE**

### ***Tail Housing Installation for Oil Pump Equipped Transmissions***

**1.** Apply a thin layer of gasket maker to the pump mating surface of the tail housing.

**2.** Fasten the pump to the tail housing by installing the six 1/4-20 X 1" long socket head cap screws until they contact the pump surface. Do not tighten.

**3.** Apply a bead of either Hylomar or Loctite Ultra Black silicone gasket maker to the tail housing adapter plate as shown.

**4.** Install the tail housing adapter plate with its two 7/16- 14 X 1 1/2" long socket head cap screws. Use two of the tail housings 2 1/4" long mounting bolts to help center the plate as illustrated below. Torque the two adapter plate bolts first to 25 lb./ft then to 35 lb./ft. While tightening the plate, be sure to maintain it centered in relation to the bolts on the left side. Once the adapter plate is tightened in place, remove the two 2 1/4" long bolts used to help center it.

**5.** Apply a light layer of Mobil 1 universal grease to the splines of the main shaft and to the rear bushing and seal of the tail housing.

**6.** Install the tail housing/oil pump assembly. Torque the 7/16-14 socket head mounting bolts first to 25 lb./ft, then to 35 lb./ft in the pattern shown below.

**7.** Tighten the six 1/4-20 X 1" long socket head cap screws, securing the pump to the tail housing to approximately 35 lb./in. Rotate the main shaft and adjust the pump up or down, right or left, until no binding and ease of rotation occurs.

**8.** Again, tighten the six socket head cap screws to 60 lb./in in the sequence shown below. Double check ease of rotation prior to tightening to a final torque of 90 lb./in.

**9.** Prime the pump and rotate the main shaft in both directions to ensure adequate lubrication of the pump gears prior to connecting any lines.

## **APPENDIX TWO**

### ***Single Stage Oil Pump Overhaul***

#### ***Disassembly:***

- 1.** With the pump assembly removed from the transmission's tail housing, remove the four 1/4-20 X 1" long socket head screws, securing the pump port plate to the rest of the pump assembly.
- 2.** Remove the 10-32 X 7/8" long socket head screw securing the pump's idler shaft retainer to the idler shaft.
- 3.** Press the idler shaft from the pump assembly.
- 4.** Remove the five 1/4-28 X 1 1/8" long socket head screws from the pump housing assembly and separate the two stages from the pump divider plate.
- 5.** Remove the pump gears from the first stage housing.
- 6.** Wash and dry all parts prior to inspection.