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Logistics Operations School
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Training Command
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AOM 6406

STUDENT OUTLINE

**MAINTAIN HMMWVA2 TRANSMISSION, TRANSFER,
AND PROPELLER SHAFT ASSEMBLIES**

LEARNING OBJECTIVES:

1. **Terminal Learning Objectives:**

a. Given a HMMWVA2, TM 9-2320-280-20-1&2, tools, and shop supplies, perform organizational maintenance on the transmission/transfer assembly, per the references. (6.4.10)

b. Given a HMMWVA2, TM 9-2320-280-20-1&2, tools, and shop supplies, perform organizational maintenance on the front propeller shaft assembly, per the references. (6.4.11)

2. **Enabling Learning Objectives:**

a. Given a HMMWVA2, TM 9-2320-280-20-1&2, tools, and shop supplies, per the references:

(1) Adjust the transmission shift linkage. (6.4.10a)

(2) Adjust the transfer shift linkage. (6.4.10b)

(3) Check the transfer fluid. (6.4.10c)

(4) Check the transmission fluid. (6.4.10d)

(5) Test the transmission switch. (6.4.10e)

(6) Diagnose cause of the vehicle starting in a shift lever position other than neutral or park. (6.4.10f)

b. Given a HMMWVA2, TM 9-2320-280-20-1&2, tools, and shop supplies, per the references:

- (1) Replace front propeller shaft assembly. (6.4.11a)
- (2) Disassemble universal joint. (6.4.11b)
- (3) Assemble universal joint. (6.4.11c)

OUTLINE

1. INTRODUCTION TO HMMWVA2 TRANSMISSION, TRANSFER, AND PROPELLER SHAFT ASSEMBLIES

a. Transmission: The transmission is a electronically controlled four speed rear wheel drive automatic transmission. The transmission is lubricated with Dextron III.

b. Transfer Assembly

(1) The New Process Gear (NPG) Model 218 transfer assembly is a chain driven gear box with one input and two output shafts. Its purpose is to direct engine-to-transmission power to the front and rear differentials simultaneously. The transmission is lubricated with Dextron III.

(2) The transfer case is a two-piece aluminum housing attached to the rear face of the transmission adapter. The front and rear output shafts are connected to the front and rear differentials by propeller shafts which are linked to the transfer by yokes.

(3) The transfer provides four, full time ranges in a straight line shift pattern.

(4) The transfer case directs power to the front and rear differential simultaneously. This results in the vehicle always being in four wheel drive. The differentials ensure power is applied to the wheel having traction, regardless of which wheel is slipping. This is called torque biasing.

c. Basic Principles of Operation

(1) The transmission employs a torque converter that acts as a fluid coupling to smoothly transmit torque from the engine to the transmission.

(2) Three planetary gear sets provides four forward ratios and reverse. Changing of the gear ratios fully automatic, mainly in relation to throttle opening and vehicle speed.

(3) A hydraulic pump and an electronically controlled valve body is used to operate the various systems contained within the transmission.

(4) The transmission control module (TCM) is an on board computer. The TCM receives and processes input signals from various sensors on the vehicle and delivers output signals to solenoids located in the control valve assembly. Those solenoids control the transmission operating pressure, upshift and downshift patterns and torque converter clutch operation.

(5) As an organizational mechanic you can inspect, adjust and replace the transmission, transfer linkage. Authorized services include replace the transmission filter, neutral safety switch, torque converter clutch switch, replacement and adjustment of the throttle position sensor.

d. Propeller Shafts

(1) To transmit power to the front and rear differentials from the transfer case, the HMMWVA2 employs a front and rear propeller shaft.

(2) The front propeller shaft is a two-piece shaft. It is supported forward of center by a center bearing and has a universal joint on each end and one near center.

(3) The rear propeller shaft is shorter than the front propeller shaft and therefore a center bearing is not required. The rear propeller shaft employs a universal joint at each end.

2. DETERMINE THE SERVICEABILITY OF THE HMMWVA2 TRANSMISSION, TRANSFER AND PROPELLER SHAFTS

a. Adjust Transmission Shift Linkage

(1) Move shift lever to the neutral position.

(2) Remove cotter pin and washer securing the shift rod trunnion to the transmission shift arm.

(3) Move the shifter lever to the "1" position and ensure transmission selector lever is in the forward detent position "1" or low. Turn trunnion until trunnion aligns with shift arm.

(4) To align shift rod, turn the trunnion that connects the shaft rod to the shift arm in one direction and the trunnion that connects the relay lever to the shift rod in the opposite direction.

(5) When adjustment is correct install washer and cotter pin.

b. Shift Rod Adjustment. The shift rod must be adjusted so that the detents of the transfer case range selector lever correspond with the positions on the transfer case position designator plate in the cab. You will feel the detents when you move the range selector lever. The shift linkage is adjusted in the following manner:

(1) Make sure the parking brake lever is engaged and the transmission shift lever is in drive position.

(2) Place the transfer case shift lever all the way forward in high lock position.

(3) Position a long screwdriver in front of the parking brake lever and transmission lever and behind the knob on the transfer case shift lever to hold the transfer case shift lever forward.

(4) Place the transfer case range lever in the rearmost position ("HL") and turn the shift rod trunnion so that it slips easily into the hole in the bearing and arm assembly.

(5) Secure the shift rod trunnion to the bearing and arm assembly with a washer and cotter pin.

(6) Remove the screwdriver from the transfer case shift lever and place the transmission shift lever in neutral position.

c. Check Transmission Fluid

(1) The transmission level should be checked weekly and filled, if required, with Dexron III only. This is primarily an operator's responsibility; however, during scheduled preventive maintenance checks and services you will be required to service the transmission. The procedures are as follows:

(2) Operate the transmission until normal operating temperatures are reached. Shift the transmission through all drive ranges to fill cavities and fluid passages. This will give you a true reading of the amount of fluid in the transmission.

(3) Position the vehicle on level ground and allow the engine to idle in "N" position with the parking brake applied.

(4) Remove the dipstick. The fluid should be at the crosshatch marks between "FULL" and "ADD".

(5) Add fluid as necessary by pouring it into the dipstick tube. Do not overfill.

(6) The dipstick trans/lock must be in the up position to remove it and install it.

d. Check Transfer Fluid

(1) Remove the fill plug and gasket. The fluid level should be within 1/2 inch of the opening.

(2) Add fluid as necessary.

(3) Install the fill plug and gasket. Tighten to 35 foot-pounds.

e. Testing Transmission

(1) The transmission control module (TCM) is located in the left rear seat compartment. The TCM interprets, analyzes, and records electronic signals for sensors located on the engine, brake pedal, and transmission. The recorded codes stored in the TCM are known as trouble codes which are retrieved using the diagnostic switch cable on the J2 connector of the TCM. The TCM protects the transmission from damage by locking it in second gear, with maximum fluid pressure, until the problem has been corrected.

(2) The diagnostic test codes (DTC) are transmitted from the TCM to the transmission lamp located next to the shift lever. When the diagnostic switch cable is connected to the J2 connector, the system is placed in the diagnostic mode, which causes the transmission lamp to flash. The transmission lamp will flash once, pause, flash twice (meaning code 12), pause flash once, pause flash twice (code 12 again), and do this a total of three times which means the system is operational.

(3) For example, if the TCM is sending the trouble code 74, the lamp will flash 12 three times, flash code 7, and 4, 7, and 4, 7, and 4 code 74, and the 12, 12, 12, which ends the diagnostic check. These codes will repeat again, if not taken out to the diagnostic mode.

f. Neutral Start Switch. The HMMWVA2 should only start when the transmission shift indicator is in "Park" or "Neutral" position. This is a safety feature that is provided by a neutral start switch located at the shift control housing. The procedures for testing the neutral start switch for serviceability was explained in a previous period of instruction and is located in TM 9-2320-280-20-1.

g. Inspect the Propeller Shaft-Universal Joint Assembly

(1) The front propeller shaft consists of the following components:

- (a) Three universal joints.
- (b) Coupling shaft.
- (c) Center Bearing.
- (d) Slip yoke.
- (e) Front propeller shaft.

(2) Check propeller shaft section for bends. Replace any damaged component except the center bearing and coupling shaft. They are the responsibility of intermediate maintenance.

(3) Inspect the universal joint grease fittings for security and serviceability. Tighten or replace the fittings as necessary.

(4) Inspect the front propeller shaft center bearing for roughness or damage.

(a) With the wheels installed, jack up the front of the vehicle until the tires are clear of the shop floor. Place the transfer range selector in neutral. Have an assistant spin either front wheel.

(b) While the shaft is rotating, listen for any unusual noises from the center bearing.

(c) Feel the center bearing for vibrations that would indicate a damaged or defective bearing.

3. SERVICE THE HMMWVA2 TRANSMISSION ASSEMBLY

a. Start and run the engine to heat the transmission fluid

(1) Do not shift through the driving gear ranges when warming the transmission fluid prior to draining. Shifting through the driving ranges is a procedure used when checking the transmission fluid level.

(2) The transmission should be warm when draining fluid.

b. Drain Transmission Fluid

(1) Position a drainage container to hold the drained fluid.

(2) Remove the drain plug and allow the fluid to drain.

(3) Inspect the fluid for grit, foaminess, and or milkiness. If any are present notify your supervisor.

(4) Install the drain plug and gasket, tighten the plug to 20 foot-pounds.

c. Remove the transmission filter

(1) Place support under transfer case and remove two locknuts, washers, capscrews, and cross member from support brackets. Discard the locknuts.

(2) Remove seventeen capscrews, oil pan, and gasket from transmission.

(3) Remove magnet from oil pan. Remove filter from transmission.

(4) Clean oil pan thoroughly with dry cleaning solvent.

d. Install Transmission Filter

(1) Install filter in transmission. Install magnet in oil pan.

(2) Install gasket and oil pan on transmission with capscrews. Torque to specifications in TM.

(3) Install cross member on support brackets and with capscrews, washers, and locknuts. Tighten locknuts to 90 foot-pounds.

(4) Remove support from transfer case.

a. The Throttle Position Sensor (TPS) works in conjunction with the transmission control module to control down shifts.

b. Remove Throttle Position Sensor

(1) Disconnect the battery ground cable.

(2) Disconnect engine wiring harness connector from TPS connector.

(3) Remove the two capscrews securing the sensor to the fuel injection pump.

(4) Remove the sensor from the pump.

c. Install Throttle Position Sensor

(1) Ensure throttle is closed and place TPS on throttle shaft of the fuel injection pump.

(2) Rotate TPS counterclockwise to align screws holes in sensor with holes in injection pump.

(3) Secure TPS with two washers and screws. Do not tighten screws.

d. The TPS must be adjusted when it is replaced or when the injection pump is replaced.

(1) Step 1: Install jumper wires between the TPS connector and body wire harness connection.

(2) Step 2: Rotate the ignition switch to the "RUN" position.

(3) Step 3: Using a multimeter, measure voltage between terminals A and C of TPS connector. Voltage should be between 5.8 to 4.5 volts. Multiply by 0.33 to obtain the desired TPS voltage and use this figure to adjust TPS.

(4) Install throttle lever gauge between the injection pump throttle lever stop screw and the casting boss on the injection pump.

(5) Rotate the injection pump throttle lever so that the maximum speed stop screw holds the gauge block against the housing boss.

NOTE: Keep the throttle lever in this position during the remainder of the adjustment steps.

(6) Measure the voltage between terminals B and C of the TPS connector.

(a) If the measured voltage is within the calculated specifications, as indicated in step 3, connect the TPS connector to harness connector.

(b) If the voltage is not within the calculated specifications, go to next page.

(7) Loosen the TPS mounting screws and rotate it towards the rear of the vehicle (counterclockwise direction).

(8) With the voltmeter connected to terminals B and C of the TPS connector, rotate the TPS slowly toward the front of the vehicle (clockwise direction) until the voltmeter indicates voltage as determined in step 3.

(9) Tighten the TPS mounting screws and confirm that the adjustment did not change.

(10) Remove the jumper wires.

(11) Remove the throttle lever gauge.

(12) Connect body wiring harness s connector to TPS connector.

5. TORQUE CONVERTER CLUTCH SWITCH. This switch is a two section device, one side, 24 volts for brake light operation and the other side, 12 volts for the torque converter clutch operation. This switch applies 12 volts DC to the transmission control module signal line. When the brake is applied, this switch opens, breaking the electrical circuit to the TCM creating a zero voltage signal to the TCM causing the torque converter clutch to be released.

6. REPLACE HMMWVA2 FRONT PROPELLER SHAFT

a. Remove The Front Propeller Shaft Assembly

(1) Remove the four capscrews and two bearing straps securing the front propeller shaft assembly to the differential pinion yoke.

(2) Remove four capscrews and two bearing straps securing the front propeller shaft to the transfer case output yoke.

(3) Remove cotter pin and washer securing the transfer case shift rod to the transfer case. Disconnect the shift rod from the transfer case. Discard the cotter pin.

(4) Remove the locknuts, washers, and capscrews securing the center bearing to the engine mount.

(5) Move the front propeller shaft forward, then rearward over top of the transfer case and remove the front propeller shaft.

b. Disassemble Front Propeller Shaft Assembly

(1) Prior to disassembly, mark the slip yoke and coupling shaft for a reference point during assembly.

(2) Place the yoke in a vise.

(3) Pry the dust cap off the yoke. Discard the dust cap.

(4) Pull the drive shaft apart from the coupling shaft.

c. Disassemble Universal Joint

(1) Remove tape from the universal joint that is to be disassembled.

(2) Remove two bearing cups from the cross. Do not drop the bearing cups. Needle bearings can be easily lost.

(3) Remove two snap rings from the yoke.

(4) Position the propeller shaft in a vise with a 1-1/8 inch or 28 millimeter socket between the vise jaw and the bearing cup being removed. Make sure the open end of the socket is facing the bearing cup.

(5) Place an 11/16 inch or 17 millimeter socket between the opposite bearing cup and the vise jaw. Make sure the open end of the socket is facing the vise jaw.

(6) Press the bearing cup out of the yoke.

(7) Remove the bearing cup from the cross.

(8) Reverse the position of the sockets and press the remaining bearing cup out of the yoke.

(9) Remove the cross from the yoke.

d. Clean and Inspect Propeller Shaft Components

(1) Use dry cleaning solvent to clean all metallic parts except for the universal joint cross. Again, use caution when cleaning with solvent.

(2) Inspect drive shaft, coupling shaft, and slip yoke for cracks or dents. Replace any component that is cracked or dented.

(3) Inspect splined end of the coupling shaft and slip yoke for damage. Replace either if damaged.

(4) Inspect grease fittings and universal joints for serviceability. Replace universal joints or grease fittings if they are unserviceable.

(5) Inspect the center bearing for roughness or damage by spinning it by hand. If it is rough, noisy or damaged, replace the coupling shaft.

e. Assemble Universal Joint

(1) Making certain that grease fitting on the cross faces the yoke, install the cross in the yoke.

(2) Install bearing cup in the yoke.

(3) Make sure the bearing cup is aligned with the yoke before pressing in with a vise. Damage to the cross and bearing cups will result if they are misaligned and then forced into the yoke.

(4) Place the yoke in a vise with an 11/16 inch or 17 millimeter socket between the vise jaw and the bearing cup.

(5) Press the bearing cup into the yoke far enough to install the snap ring.

(6) Install the snap ring in the yoke.

(7) Install the other bearing cup in the yoke.

(8) Place the yoke in a vice with an 11/16 inch or 17 millimeter socket between the bearing cup and the vise jaw.

(9) Press the bearing cup into the yoke far enough to install the snap ring.

(10) Install snap ring in the yoke.

(11) Install bearing cups in the cross.

f. Assemble Front Propeller Shaft

(1) Make sure that the grease fitting on the dust cap is aligned with the wide spline in the slip yoke.

(2) Install dust cap on the yoke.

(3) Coat splines on the coupling shaft with grease.

(4) Make sure that the wide spline on the coupling shaft is aligned with the wide spline in the yoke.

(5) Install the coupling shaft into the yoke.

g. Install Front Propeller Shaft Assembly

(1) Install the front propeller shaft over the exhaust pipe and top of the transfer case.

(2) Install the front propeller shaft to the differential pinion yoke and secure it with two bearing straps and four capscrews. Tighten the capscrews to 13-18 foot-pounds.

(3) Secure the center bearing to the engine mount with washers, capscrews, and locknuts. Tighten the capscrews to 60 foot-pounds.

(4) Connect the transfer case shift rod to the transfer case and secure it with a washer and cotter pin.

(5) Install the front propeller shaft to the transfer case output yoke and secure it with two U-bolts and four capscrews. Tighten the nuts to 13-18 foot-pounds.

h. Lubricate Propeller Shaft and Universal Joints

(1) Refer to LO 9-2320-280-12 when lubricating the propeller shaft and universal joints.

(2) In general, you should:

(a) Lubricate the assembly with a low pressure lubrication gun, and

(b) Service the assembly every 3,000 miles or semiannually. If operating conditions are severe, service at 1,000 mile intervals.

REFERENCES:

TM 9-2320-280-20-1

TM 9-2320-280-20-2