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AOM 6410

STUDENT OUTLINE

MAINTAIN HMMWVA2 STEERING SYSTEM

LEARNING OBJECTIVES:

1. Terminal Learning Objective: Given a HMMWVA2, TM 9-2320-280-20-1, TM 9-2320-280-20-2, tools and shop equipment, perform organizational maintenance on the HMMWVA2 steering system, per the references. (6.4.18)

2. Enabling Learning Objectives: Given a HMMWVA2, TM 9-2320-280-20-1, TM 9-2320-280-20-2, tools and shop equipment, per the references:

a. perform front wheel toe-in alinement. (6.4.18a)

b. perform rear wheel toe-out alinement. (6.4.18b)

c. perform diagnostic testing on hydraulic system with power steering analyzer. (6.4.18c)

OUTLINE

1. INTRODUCTION TO THE HMMWVA2 STEERING SYSTEM

a. System Description

(1) The HMMWVA2 steering system is a hydraulically assisted power steering system. The turning effort at the steering wheel by the driver is transmitted to the steering gear where it is hydraulically multiplied and transferred to the front wheels through the steering linkage. The steering system is identical on all HMMWV models.

(2) The hydraulic power steering system consists mainly of the power steering pump, hydro-boost, steering gear, fittings, and hoses.

b. Power Steering Pump and Oil Reservoir

(1) The power steering pump and oil reservoir assembly is located on the left side of the engine.

(2) The oil reservoir is enclosed by a pump housing and provides a reserve supply of oil to ensure complete filling of the hydraulic system. The pump is belt driven from the engine crankshaft pulley and supplies fluid under pressure which provides a hydraulic boost for the steering gear and braking system.

(3) All pump components function while submerged in power steering fluid through interconnecting pressure and return hoses.

c. Hydro-boost

(1) A hydro-boost is attached to the firewall on the left rear side of the engine compartment.

(2) A hydro-boost converts hydraulic power from the steering system to mechanical power at the master cylinder, providing power assist during braking.

(3) Hydraulic fluid under pressure not used in braking action is directed from the hydro-boost to a power steering gear assembly.

d. Steering Column. A steering column is mounted to the frame behind the dashboard. It connects the steering wheel and the intermediate steering shaft.

e. Intermediate Steering Shaft

(1) The intermediate steering shaft extends from the steering column to a power steering gear. The intermediate steering shaft is universally jointed to the steering column and has a splined yoke, which attaches to the input shaft of the power steering gear.

(2) The intermediate steering shaft permits a change in angle between the steering column and input shaft of the steering gear.

f. Steering Gear

(1) A steering gear is mounted to the frame in the left front of the engine compartment. It is located almost directly below the alternator and connected to the intermediate steering shaft and pitman arm.

(2) The steering gear converts hydraulic power from a steering pump to mechanical power at the pitman arm. The steering gear is capable of being operated manually if a system malfunction occurs.

h. Steering Linkage. Steering linkage consists of a pitman arm, center link, idler arm, two adjustable tie rods and steering arms bolted to the front geared hubs.

(1) Pitman arm.

(a) A pitman arm is attached to the bottom of the power steering gear with a splined shaft, connected to a center link by a bolt stud.

(b) The pitman arm which transfers the steering torque from the power steering gear to a center link supports the left side of the steering linkage.

(2) Center link.

(a) A center link interconnects the pitman arm and tie rods.

(b) The center link transmits movement from pitman and idler arm to the tie rods.

(3) Idler arm.

(a) An idler arm is bolted to the frame and attached to the right side of the center link with a ball stud.

(b) The idler arm serves as a pivot point and supports the right side of the steering linkage.

(4) Tie rod assembly.

(a) The tie rod assemblies interconnect the center link and geared hub at the steering arm.

(b) Tie rods transmit movement from the center link to the geared hub. Tie rods are adjustable and used to increase or decrease toe-in.

2. ALINE THE HMMWVA2 TOE-IN AND TOE-OUT

a. Preliminary Front Wheel Toe-in Alinement Inspections

(1) Check all tires for uniform tread wear and correct tire pressure.

(2) Raise the vehicle and support it under the lower control arms.

(3) Check geared hubs for output spindle end play by grasping the edges of the tires and attempting to move the tires up and down. Adjust the spindle bearings if any spindle movement is apparent.

(4) Check for looseness in upper ball joints by grasping the top of the tires and attempting to move the tires in and out. Replace

upper ball joints if tire movement at the top outer edge of the tires is 3/8 of an inch or more.

(5) Check for looseness in the lower ball joints by grasping the bottom of the tires and attempting to move the tires in and out. Replace lower ball joints if tire movement at the bottom outer edge of the tires is 1/2-inch or more

(6) Lower the vehicle.

(7) Check for looseness in the tie rod ends by attempting to move the tie rods vertically and horizontally. Replace tie rod end(s) if any movement is apparent.

(8) Check for worn control arm bushings by rocking the vehicle back and forth while observing the bushing in the control arm for play. Replace upper control arms or the lower control arms if the bushings are worn.

b. Check Front Wheel Toe-in

(1) Position vehicle on level ground with the wheels set straight ahead.

(2) Mark a line on the center tread of the tire 16 1/2 inches from the ground.

(3) Measure total width of the tire tread and record that figure. Where the lines intersect will be the "Point of Measurement" for checking toe-in.

(4) Mark a line on the center tread at one-half the total tread width.

(5) Repeat the entire procedure on the opposite front tire.

(6) Measure distance between the "Points of Measurement" on the front side of the tires and record that figure.

(7) Rotate the tires by moving the vehicle forward until the "Points of Measurement" are 16 1/2 inches above the floor on the rear side of the tires.

(8) Measure distance between the "Points of Measurement" on the rear side of the tires and record that figure. If the measurement is larger on the front side of the tires than the measurement of the rear side of the tires, the tires have toe-out.

(9) Subtract the measurement taken at the front side of the tires, from the measurement taken at the rear side of the tires. The result of this subtraction represents inches of toe-in. Front toe-in

alinement for a HMMWVA2 equipped with radial type tires at vehicle curb weight is 1/4 of an inch, plus or minus 1/16 of an inch. Table 8-1 of TM 9-2320-280-20-2 lists alinement specifications. Adjust toe-in if it is not within specifications; the specifications vary for different HMMWV models.

c. Adjust Front Wheel Toe-in

(1) Loosen locknuts securing the two clamps on each adjusting sleeve. Toe-in can be increased or decreased by changing length of the tie rods. A threaded sleeve is provided for this purpose. Both tie rods must be the same length $\pm$ 1/8 of inch after adjustment.

(2) Turn each adjusting sleeve equally, but in opposite directions.

(3) Roll the vehicle rearward then forward to its original position.

(4) Repeat the toe-in check and adjustment procedures until the correct adjustment is indicated.

(5) Make sure the bolt and nut on the adjusting sleeve clamp nearest to the geared hub is facing the halfshaft. The bolt and nut on the adjusting sleeve clamp nearest the frame must be facing away (180 degrees) from the stabilizer bar to prevent damage to equipment. Secure the two clamps on each adjusting sleeve with the locknuts. Tighten the locknuts to 30 foot-pounds.

(6) Toe-in can be checked with an alignment gage; however, the method we described is reported to be more accurate.

d. Preliminary Rear Wheel Toe-out Alinement Inspections

(1) The vehicle should be at curb weight to ensure proper alinement.

(2) Check all tires for uniform tread wear and correct tire pressure.

(3) Raise the vehicle, and place supports under the lower control arms.

(4) Check geared hubs for output spindle end play by grasping the edges of the tires and attempting to move the tires up and down. Adjust the spindle bearings if any spindle movement is apparent.

(5) Check for looseness in upper ball joints by grasping top of the tires and attempting to move the tires in and out. Replace upper ball joints if tire movement at top outer edge of the tires is 3/8 of an inch or more.

(6) Check for looseness in lower ball joints by grasping bottom of the tires and attempting to move the tires in and out. Replace lower ball joints if tire movement at the bottom outer edge of the tires is 1/2-inch or more.

(7) Lower the vehicle.

(8) Check for looseness in radius rod ends by attempting to move the radius rods vertically and horizontally. Replace radius rod ends if any movement is apparent. Some twisting movement is normal because the rod ends are ball studs.

(9) Check for worn control arm bushings. Replace upper control arms or lower control arms if the bushings are worn.

(10) Set the front wheels in straight ahead position. This can be checked by driving the vehicle a short distance on a flat surface to determine steering wheel position at which the vehicle follows a straight path.

(11) Make sure the front tires are straight, then tape one end of a piece of string to the inner wall of the front tire.

(12) Pull a string across the front of the tire and back to the rear tire until the string touches front of the rear tire on the outboard side. Measure distance between the string and rear side wall of the rear tire.

(a) Distance between the string and rear sidewall of the rear tire should be from zero to one-eighth of an inch.

(b) If the measurement is not within specification, loosen the two locknuts securing the clamps on the radius rod and turn the adjusting sleeve until the measurement is within specifications. After adjustment has been made, roll the vehicle rearward then forward to make sure the adjustment is correct.

(c) If measurement is correct, repeat procedure on the opposite side of the vehicle.

e. Check Rear Wheel Toe-out

(1) Position the vehicle on level ground with wheels set straight ahead.

(2) Mark a line on the center tread of the tire 16-1/2 inches from the floor.

(3) Measure total width of the tire tread and record that measurement.

(4) Mark a line of the center tread at one-half the total tread width. Where the lines intersect will be the "Point of Measurement" for checking toe-out.

(5) Repeat entire procedure on the opposite rear tire.

(6) Measure the distance between "Points of Measurement" on the front side of the tires and record that measurement.

(7) Rotate tires by moving the vehicle forward until the "Points of Measurements" are 16 1/2 inches above the floor on the rear side of the tires.

(8) Measure distance between "Points of Measurement" on the rear side of the tires and record that figure. If measurement is larger on the rear side of the tires than the measurement on the front side of the tires, the tires have toe-in. Rear tires should have toe-out.

(9) Subtract measurement taken at the rear side of the tires from measurement taken at the front side of the tires. Result of this subtraction represents inches of toe-out. Rear toe-out alinement for a HMMWVA2 equipped with radial type tires at vehicle curb weight is 1/2 of an inch plus or minus 1/16 of an inch. Table 8-2 of TM 9-2320-280-20-2 lists alinement specifications. Adjust the toe-out if it is not within specifications; the specifications vary for the different HMMWV models.

(10) If toe-out is within specifications, tighten clamps on the adjusting sleeve to 30 foot-pounds.

f. Adjust Rear Wheel Toe-out Alinement

(1) Toe-out can be increased or decreased by changing length of the radius rods. A threaded sleeve is provided for this purpose.

(2) Loosen two locknuts securing the two clamps on each adjusting sleeve.

(3) Turn each adjusting sleeve equally, but in opposite directions.

(4) Roll the vehicle rearward then forward to its original position.

(5) Repeat toe-out check and adjustment procedures until the correct adjustment is obtained.

(6) Secure the two clamps on each adjusting sleeve with locknuts. Tighten the locknuts to 30 foot-pounds.

b. Power Steering Analyzer

(1) The known information block for test B5 informs us wheels, tires, brakes, fluid, pump, pulley and bracket look OK but, there is a problem with hard steering.

(2) Possible problems may be with power steering hydraulics, hydro-boost, steering gear or the fan drive.

(3) Test options inform us a power steering analyzer can be used to test the steering system and to read the reference information.

(4) Reference information states, that if you have a power steering analyzer, you can use it here to test the power steering pump, gear, and rest of the hydraulic system.

(5) This is a power steering analyzer. An analyzer is used to test pressure and flow rate of steering hydraulics. Pressure and flow rate are recorded, then compared to specifications listed in the TM, helping the mechanic to determine serviceability of the steering system components.

e. Power Steering Analyzer Procedure

(1) First disconnect the high pressure hose from the hydro-boost leading to the power steering pump. You can distinguish the high pressure hose from the low pressure by the hose connections. Notice that the low pressure hose is also the largest of the lines and has a clamp for securing it. The high pressure hose is form fitted and does not have a clamp.

(2) Next, connect the analyzer to the hydro-boost and the high pressure hose. Now, open the valve on the analyzer.

(3) Disconnect harness connector at the hydraulic control valve. Check fluid level in the power steering pump and add fluid as necessary.

(4) To make sure we operate the engine at the proper rpm, we'll connect STE/ICE-R.

(5) Start the engine and allow it to idle for approximately 3 to 5 minutes. While you are waiting, check for leaks at power steering connections.

(6) Check gage on the analyzer and record pump pressure and flow rate.

(a) Pressure should be 140 to 170 psi, and the flow should be 2.5 to 2.75 gpm. GPM is the abbreviation for gallons per minute.

(b) If pressure or flow rate is too low, we would check for a restriction in the pressure line from the power steering pump by disconnecting the hose and putting some air into it.

(c) Reconnect the hose and check pump flow again. If pressure is too high, check for a restriction in the pressure line from the hydro-boost to the steering gear.

(d) Remove the pressure relief cartridge and clean screen and bore of the relief valve with compressed air and dry cleaning solvent.

(e) Check pump pressure and flow again. If pressure and flow are not within the specifications, the power steering pump is faulty and must be replaced.

(f) If pressure and flow are within specifications, partially close the valve on the analyzer so pressure increases to 200 psi and record the flow.

(g) Subtract this flow rate from the flow rate recorded earlier. If there is more than 1 gpm difference in flow rates, the power steering pump is faulty and must be replaced.

(h) If the flow rate was OK we would continue testing by closing and partially opening the valve on the analyzer three times and record the highest pressure reading each time. All three readings must be 1300 psi or above. If they are not, the power steering pump must be replaced. A word of warning here, DO NOT leave the valve or the analyzer closed for more than five seconds or the pump will be damaged.

(i) If the three readings were 1300 psi or above, we would open the valve on the analyzer and increase engine speed to 1500 rpm using STE/ICE-R and record the flow. If flow varies more that 1 gpm from the flow rate previously recorded replace the power steering pump.

(7) To test the steering gear, turn the steering wheel all the way to the left, then all the way to the right and record the flow at each stop. The flow should drop to 1 gpm or less. If the flow does not drop, the steering gear is faulty and must be replaced.

(8) To test the hydro-boost, push the brake pedal to the floor of the vehicle and hold it down. The flow should drop to 1 gpm or less. If the pressure did not drop the hydro-boost is unserviceable and must be replaced.

(9) Always bleed the steering system after testing with the power steering analyzer.

REFERENCES:

TM 9-2320-280-20-1
TM 9-2320-280-20-2