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AOM 6407

STUDENT OUTLINE

MAINTAIN HMMWVA2 SERVICE AND PARKING BRAKE SYSTEMS

LEARNING OBJECTIVES:

1. Terminal Learning Objectives:

a. Given a HMMWVA2, TM 9-2320-280-20-1&2, tools, shop supplies, and equipment, perform organizational maintenance on the service brake system, per the references. (6.4.12)

b. Given a HMMWVA2, TM 9-2320-280-20-1&2, tools, shop supplies, and equipment, perform organizational maintenance on the parking brake assembly, per the references. (6.4.13)

2. Enabling Learning Objectives:

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

(1) test the hydroboost. (6.4.12a)

(2) test the brake proportioning valve. (6.4.12b)

(3) remove the service brake caliper and rotor assembly. (6.4.12c)

(4) inspect the service brake caliper and rotor assembly. (6.4.12d)

(5) install the service brake caliper and rotor assembly. (6.4.12e)

(6) bleed the service brake system. (6.4.12f)

(7) test the service brake system. (6.4.12g)

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

(1) remove the parking brake caliper and rotor assembly. (6.4.13a)

(2) inspect the parking brake caliper and rotor assembly. (6.4.13b)

(3 install the parking brake caliper and rotor assembly. (6.4.13c)

(4 adjust the parking brake assembly. (6.4.13d)

(5 test the parking brake for correct adjustment. (6.4.13e)

OUTLINE

1. INTRODUCTION TO THE HMMWVA2 SERVICE BRAKE SYSTEM

a. Principles of Operation

(1) The first service brake component we want to look at is the hydroboost.

(a) This is the hydroboost. As you can see, it is located on the left side of the engine compartment and attached to the firewall.

(b) The hydroboost converts hydraulic pressure supplied by the power steering pump to mechanical power to the master cylinder. It permits reduced brake pedal effort and travel allowing for decreased stopping distances. The hydroboost unit also includes a nitrogen charged pneumatic accumulator that stores hydraulic pressure for additional power assisted brake applications in the event of a loss of pressure in the steering or brake system. Severity and duration of brake applications determine the number of stops that may be made after hydroboost failure.

(c) To test the hydroboost for serviceability, depress the brake pedal several times to exhaust the accumulator pressure, depress the brake pedal, and start the engine. If the hydroboost is serviceable, the brake pedal should fall, then push back against the operator's foot.

(2) Master cylinder

(a) A master cylinder is attached to the hydroboost and acts as a reservoir for brake fluid and converts mechanical pedal pressure to hydraulic pressure that is then supplied to the brake lines.

(b) Before we check the brake fluid level, the exterior of the master cylinder and cover must be clean. Dirt, water, or grease will contaminate brake fluid causing brake system damage.

(c) Remove the cover from the master cylinder by moving the bailwire. The brake fluid level should be approximately 1/8 of an inch from top of the primary and secondary reservoirs.

(d) If the fluid level is low, make sure you use only silicone brake fluid. Silicone brake fluid has a low water pickup and good corrosion protection. The fluid also provides good lubrication qualities, rubber compatibility, low freezing point, and a high boiling point.

(e) At times, the rubber diaphragm in the cover may be distorted. Always make sure the diaphragm is completely seated before installing the cover to the master cylinder. A distorted diaphragm will cause brake fluid spillage.

(3) Proportioning valve

(a) The proportioning valve, mounted right of the master cylinder, consists of a one-piece housing that contains a valve that provides balanced front-to-rear braking, a pressure differential valve, and a switch.

(b) The pressure-differential valve section activates a brake warning lamp on the instrument panel if a pressure loss in the front or rear brake system occurs.

(c) To test the proportioning valve for serviceability, the vehicle should be at curb weight. Curb weight is the weight of the vehicle with standard equipment, fuel, oil, and coolant.

(d) Driving at a speed of approximately forty-five miles per hour on a dry hard road, decelerate the speed to forty miles per hour and apply sufficient pressure to the brake pedal to lock-up the front brakes. If the rear brakes lock-up before the front brakes, the proportioning valve is unserviceable.

(4) Brake lines

(a) brake lines are of seamless steel tubing with a loop in each line to absorb vibration and reduce the possibility of cracks in the line.

(b) brake lines direct brake fluid under pressure from the master cylinder to all four brake calipers.

(5) Disc brake assemblies. Disc brakes are used on all four wheels. The brakes are located on either side of the front and rear differentials to protect the braking surfaces from road-splash and reduce overheating. Each disc brake assembly consists of a caliper, two brake pad assemblies, a rotor, a caliper adapter and caliper yoke.

(a) A one-piece cast iron rotor has integral cast cooling fins between the braking surfaces for heat diffusion. A rotor is attached to the output flange on the front and rear differentials and prevents the output flange from turning when the brakes are applied.

(b) A caliper is positioned on the rotor and slides on two mounting pins which maintain caliper position relative to the rotor and caliper yoke. The caliper converts hydraulic pressure to mechanical force to press the brake pads against the brake rotors.

(c) A caliper yoke is attached to the differential housing by a caliper adapter.

(d) A caliper adapter and caliper yoke cradle the inboard and outboard brake pads.

(e) brake pads apply friction to the brake rotor when the brake pedal is pressed. Inboard and outboard brake pads are interchangeable.

b. <u>Replace The Service Brake Components</u>

(1) Removal

(a) With a container ready to catch the brake fluid, disconnect the brake line from the caliper. Cap the end of the brake line to prevent dirt from entering.

(b) Remove capscrews and washers securing the yoke and caliper to the adapter while noting position of the brake pad surfaces for installation.

(c) Remove yoke and two brake pads from the adapter and remove the rotor.

(2) Cleaning and inspecting

(a) Clean mating surface of the caliper and adapter with dry cleaning solvent and lubricate with a light coat of grease.

(b) Inspect caliper and caliper piston for cracks, pitting, leaks or damage. If any of these faults are evident, replace the caliper.

(c) Inspect locating pin, bearings and bushings.

(d) Inspect the dust boot for tears or deterioration. If either of these faults are evident, replace the caliper.

(e) Inspect rotor for heat cracks, discoloration, pitting or scoring. If any of these faults are evident, replace the rotor.

(f) Inspect brake pads for glazing, oil saturation, and wear to less than 1/8 of an inch. Replace both pads and the pads from the opposite caliper if any of these faults are evident.

(3) Installation

(a) Install the rotor and position brake pads to the adapter, make sure the brake pads are installed with linings facing the rotor. Failure to install them in this manner may cause injury to personnel or damage to the vehicle.

(b) If the yoke locating pins were replaced, apply sealing compound to the threads and install the locating pins in the yoke.

(c) Position yoke onto the adapter and apply sealing compound to the threads of the capscrews. Install the washers and tighten capscrews to forty foot-pounds.

(d) When installing the caliper, it may be necessary to use a "C" clamp and a block of wood to bottom out the piston in the caliper.

(e) Position caliper on the adapter and tighten locating pins to sixty foot-pounds.

(f) Connect brake line to the caliper.

c. Bleed the Service Brake System of Air. If only the front or rear half of the service brake system has been serviced, it is usually necessary to bleed only that half of the system. However, if a firm brake pedal cannot be obtained after bleeding half of the system, it will be necessary to bleed the entire system.

(1) Manual bleeding

(a) Always wear eye protection when manually bleeding the brakes and bleed the system in the following order: right rear, left rear, right front, and left front.

(b) When manually bleeding the brake system, check the fluid level in the master cylinder frequently. If the master cylinder is allowed to become empty, additional air will be drawn into the system.

(c) Remove the protective cap from the bleeder screw and connect one end of a short piece of hose to the bleeder screw. Place the other end of the hose in a container 3/4 full of brake fluid. The end of the hose must be submerged in brake fluid.

(d) Have an assistant pump the brake and hold it down while you open the bleeder screw approximately 3/4 of a turn.

(e) When the brake fluid flows clear and free of air bubbles, tighten the bleeder screw and have your

assistant slowly release the brake pedal. You may have to repeat the procedure more than once to purge the system of air.

(f) Perform the same tasks on the remaining disk brakes. Remember to check the fluid level in the master cylinder frequently and add fluid as necessary.

(2) Pressure bleeding

(a) As stated earlier, always wear eye protection when bleeding the service brake system and bleed the system in the following order: right rear, left rear, right front, and left front.

(b) Make sure there is brake fluid in the tank; then pressurize the tank with air. Do not exceed the manufacturer's recommended working pressure when pressurizing the tank. A tank pressure of fifteen to twenty psi is sufficient to bleed the system. Open the bleeder screw located on the filler plug to bleed any air that may be trapped in the fluid section of the tank.

(c) Remove the cover from the master cylinder and install the pressure tank bleeder adapter to the master cylinder. Connect one end of the line to the adapter, then connect the other end of the line to the pressure tank.

(d) Remove the protective cap from the bleeder screw and connect one end of a short piece of hose to the bleeder screw. Place the open end of the hose in a container. The end of the hose must be submerged in brake fluid.

(e) Open the valve on the adapter line to allow pressurized brake fluid to enter the brake system.

(f) Open the bleeder screw on the caliper approximately 3/4 of a turn and observe brake fluid in the container. Close the bleeder screw when brake fluid flows free of air bubbles. Perform the same procedures on the remaining disk brakes.

(g) Remove adapter from the master cylinder and install the cover on the master cylinder.

d. <u>Brake System Tests</u>

(1) TM 9-2320-280-20-1 contains a troubleshooting guide that will help you solve problems that may develop in the M998 brake system.

(2) Let's turn to page 2-446 and look at question number 2. Do the service brakes pass the road test procedures at the right?

(3) Page 2-447 contains a list of service brake road test procedures. Take a moment and read the procedures.

(4) For training purposes, we'll say we have one or more of the problems listed with our service brakes. So, the answer to the question "does the service brakes pass the road test" is no.

(5) The flow chart under question no. 2 directs us to go to B1 of page 2-450. Let's turn to page 2-450.

(6) Now, we are asked if the fluid in the master cylinder is free of contamination and filled to the proper level?

(7) If the answer to the question was no, the flow chart directs us to flush and bleed the service brake system. It also directs us to paragraph 7-9 (page 7-18). Look familiar? It should; it's the instructions for pressure and manual bleeding of the brake system.

(8) If the answer to the question was yes, we would continue using the flow chart until we corrected our problem.

(9) Are there any questions about how to use the troubleshooting guide to diagnose service brake malfunctions?

3. INTRODUCTION TO THE HMMWVA2 PARKING BRAKE SYSTEM

a. Principles of Operation. To hold the vehicle stationary when parked, a lever-operated parking brake functions through a cable and rod linkage assembly. When the driver pulls on the parking brake lever, the piston in the calipers ratchet out to force the brake pads against the rotors. The rotors are mounted on the output flanges of the differential.

b. Identification of Parking Brake System Components. The parking brake is a mechanically actuated system that provides a means of keeping the vehicle stationary once it has stopped and assists in emergency stopping if there is a service brake system failure. Follow along as I point to each component on the training aid.

(1) A hand lever permits the operator to engage the parking brake. An adjusting cap on top of the brake lever permits the operator to make minor tension adjustments to the parking brake. The hand lever has a release button to disengage the parking brake.

(2) A brake rod connects the parking brake hand lever to the parking brake system by means of an adjustable clevis.

(3) Brake cables connect the parking brake calipers to the brake rod at the equalizer bar mounted on the frame.

c. Inspect Parking Brake Linkage

(1) Check for bends or damage in the parking brake rod and breaks or fraying in the parking brake cable.

(2) Inspect parking brake linkage, clevis pins, washers and cotter pins for security of mounting and serviceability.

(3) Check rubber boot covering the bellcrank of the parking brake handle and the front of the brake rod for cracks, tears, deterioration, and security.

(4) Inspect parking brake linkage for binding.

d. Remove Parking Brake Caliper and Rotor

(1) Chock the wheels and release the parking brake lever.

(2) Remove skid tubes.

(3) Remove cotter pin, washer, and clevis pin from brake clevis and lever.

(4) Remove clip and disconnect parking brake cable from caliper cable bracket. Discard clip.

(5) Disconnect brake line from coupling.

(6) Remove coupling and copper washer from caliper. Discard copper washer.

(7) Remove two capscrews, washers, yoke, and caliper from adapter.

(8) Slide yoke and location pins out from caliper.

(9) Remove six capscrews and lockwashers and lockwashers from halfshaft, rotor and output flange.

(10) Disconnect halfshaft and remove rotor from output flange.

e. Inspect Parking Brake Caliper and Rotor

(1) Clean mating surfaces of caliper and adapter, and lubricate adapter slides with grease.

(2) Clean cooling fins of rotor.

(3) Inspect caliper and caliper piston face for cracks, pitting, or damage. Replace caliper assembly if cracked, pitted, or damaged.

(4) Inspect caliper cable bracket for looseness, damage, and rotation, if found replace bracket.

(5) Inspect dust boot for tears or deterioration, if found replace caliper assembly.

(6) Inspect rotor for heat cracks, discoloration, pitting, and grooves, if found replace.

(7) Inspect yoke locating pins for cracks or corrosion. Perform step 8, if cracked or corroded. If not, perform step 9.

(8) Using 7 mm hex driver, remove locating pins from yoke. Discard locating pins.

(9) Inspect brake pads for glazing, oil saturation, or wear. If glazed, oil saturated or if brake pad thickness is less than 1/8 of an inch, replace both sides.

f. Install Parking Brake Caliper and Rotor

(1) Install halfshaft and rotor torque capscrews to 48 foot pounds.

(2)) Open bleeder valve and depress piston into caliper while rotating piston in a clockwise direction, and at the same time apply pressure until piston is seated in its bore.

(3) Apply sealing compound to threads of locating ins and install locating pins in yoke using a 7 mm hex head driver. Tighten locating pins to 25-35 foot pounds.

(4) Slide yoke and locating pins into caliper.

(5) Apply sealing compound to tapped holes of adapter.

(6) Install a caliper and yoke on adapter with two washers and capscrews. Using a crow foot tighten capscrews to 30-40 foot pounds.

(7) Install copper washer and coupling on caliper and connect brake line to coupling.

(8) Install parking brake cable on caliper cable bracket with clip.

(9) Check position of lever and ensure it is in contact with caliper cable bracket stop.

(10) Install parking brake clevis to lever with clevis pin, washer, and cotter pin.

h. Rear Dual Service/Parking Brake Adjustment. The parking brake mechanism has an automatic adjusting feature and does not require periodic manual adjustment. When parking brake components or rear brake pads are replaced, the parking brake linkage must be initially positioned to ensure proper parking brake system operation. The adjustment procedures are as follows:

(1) Remove clip and spread the boot to allow access to the cotter pin.

(2) Remove cotter pin, washer, and clevis pin securing the clevis to the bellcrank. Discard the cotter pin.

(3) Repeatedly apply and adjust the parking brake hand lever until the bellcrank linear travel is 0.75 of an inch.

(4) Release the parking brake and loosen the lock nut. Adjust the clevis so holes align with the holes in the bell crank. The parking brake clevis must align with the holes in the adjusting bellcrank without forces to obtain proper parking brake adjustment. When correct adjustment has been made, secure the clevis to the bellcrank with clevis pin, washer, and a new cotter pin.

(5) If necessary, you can remove any excess slack in the parking brake cables by turning the parking brake rod clockwise into the clevis. First loosen the locknut behind the clevis four or five turns. Turn the parking brake rod clockwise just enough to remove any excess slack, making sure not to over tighten the brake rod. Over tightening may result in the brakes dragging.

(6) The parking brake rod is properly adjusted if the lever is in contact with the caliper cable bracket stop.

(7) Tighten locknut against the clevis.

(8) Install clip in the boot.

(9) The only additional adjustment necessary is accomplished with the parking brake hand lever.

i. Test the Parking Brake

(1) Apply the parking brake, depress the service brake pedal, and start the engine.

(2) With engine at idle speed, place the transfer shift lever in high, transmission shift lever in drive, and slowly release the service brake pedal.

(3) The parking brake should hold the vehicle stationary, if the vehicle moves, adjust the parking brake.

REFERENCES:

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