

UNITED STATES MARINE CORPS
Logistics Operations School
Marine Corps Combat Service Support Schools
Training Command
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LVSM 7209

STUDENT OUTLINE

MAINTAIN THE LVS BRAKE MECHANISMS AND AXLE ASSEMBLIES

LEARNING OBJECTIVES

1. Terminal Learning Objectives:

a. Given an LVS, TM 2320-20/12A, tools, and equipment, perform second echelon maintenance on the LVS wheel brake mechanism, per the reference. (3521.13.20)

b. Given an LVS, TM 2320-20/12A, LI 2320-12/9B, tools, equipment, and lubricant, perform second echelon maintenance on the axle assembly, per the reference. (3521.13.13)

2. Enabling Learning Objectives:

a. Given an LVS, TM 2320-20/12A, tools, and equipment, test the wheel brake mechanism, per the reference. (3521.13.20a)

b. Given TM 2320-20/12A and partial statements pertaining to the LVS wheel brake mechanism, complete the partial statements to describe the procedures used to diagnose a malfunctioning wheel brake mechanism, per the reference. (3521.13.20b)

c. Given an LVS, TM 2320-20/12A, tools, and equipment, adjust the wheel brake mechanism, per the reference. (3521.13.20c)

d. Given an LVS, TM 2320-20/12A, tools, and equipment, replace the wheel brake mechanism components, per the reference. (3521.13.20d)

e. Given an LVS, TM 2320-20/12A, tools, and equipment, repair the wheel brake mechanism, per the reference. (3521.13.20e)

f. Given an LVS, TM 2320-20/12A, tools, and equipment, remove the axle shaft, per the reference. (3521.13.13a)

g. Given an LVS, TM 2320-20/12A, tools, and equipment, inspect the axle assembly, per the reference. (3521.13.13b)

h. Given TM 2320-20/12A and partial statements pertaining to the LVS axle assembly, complete the partial statements to describe the procedures used to diagnose a malfunctioning axle assembly, per the reference. (3521.13.13c)

i. Given an LVS, TM 2320-20/12A, LI 2320-12/9B, tools, equipment, and lubricant, service the axle assembly, per the references. (3521.13.13d)

j. Given an LVS, TM 2320-20/12A, tools, and equipment, repair the axle assembly, per the references. (3521.13.13e)

k. Given an LVS, TM 2320-20/12A, tools, and equipment, install the axle shaft, per the references. (3521.13.13f)

OUTLINE

1. IDENTIFICATION, LOCATION, AND PRINCIPLES OF OPERATION EMPLOYED IN THE LVS BRAKE MECHANISMS AND AXLE ASSEMBLY (1 AXLE)

a. Construction of the No. 1 Axle Assembly. The No. 1 axle assembly is a forged steel casting that houses the axle carrier and two axle shaft and ball/socket assemblies. It also provides a mounting place for the nose box assembly and inter-axle differential.

(1) The nose box acts as a drop box to transmit power from the transfer case to the inter-axle differential and it also drives the lubrication pump for the No. 1 axle carrier. The nose box is lubricated with gear oil which is isolated from the rest of the axle by seals.

(2) The inter-axle differential receives power from the nose box and distributes it to the No. 1 and No. 2 axles.

(3) The axle carrier, which we commonly call a differential, receives power from the inter-axle differential and distributes it to the axle shafts. The axle carrier is also lubricated with gear oil.

(4) There are two ball and socket assemblies, one at each end of the No. 1 axle assembly. They house the axle shaft and cage ring assemblies and working together, they allow the front wheels to be turned to the left and right. They also provide a mounting area for the brake spider and skein, to which the wedge brake assemblies, brake shoes, hub and drum assemblies, and wheel and tire assemblies are attached.

b. Components of a No. 1 Axle Brake Mechanism. The front axle brake mechanisms employ an air brake chamber, wedge assembly, actuator, brake spider, brake shoes, hub and drum assembly, axle shaft, and the necessary linkages needed to activate the brakes to assist in slowing down or stopping the vehicle.

(1) Wedge brake air chamber. The wedge brake air chamber is a single-diaphragm unit that threads into the No. 1 axle brake spider. The brake chamber consists of a diaphragm and a wedge guide. Air pressure enters the top of the chamber, forcing the diaphragm and wedge guide down.

(2) Wedge assembly. The wedge assembly is made up of the wedge rod, rollers, retaining cage, and return spring. The wedge assembly is installed into the wedge brake air chamber and brake spider. The wedge rod is actuated by the wedge guide in the wedge brake air chamber. As the wedge rod is pushed down, the wedge portion of the wedge rod pushes the rollers out. When the downward pressure on the wedge rod is released, the return spring pushes the wedge rod up and the brake shoe return spring pushes the rollers inward.

(3) Actuator assembly

(a) The actuator assembly consists of automatic adjusting plungers and anchor plungers. Both sets of plungers are installed into the No. 1 axle brake spider. The automatic adjusting plungers are retained in the brake spider and are kept in their proper alignment by one adjusting pawl, a spring, and a hollow capscrew. The anchor plungers are retained by one guide screw per plunger.

(b) The adjusting plungers are made up of a plunger adjusting sleeve, seal, and adjusting bolt. The adjusting bolt has notches in its head for the adjustment and carries a detent arrangement which engages with the brake shoe and prevents accidental rotation of the adjusting bolt.

(c) The adjusting bolt is threaded into an adjusting sleeve which is free-fitted inside the plunger. The adjusting pawl has sawtooth-type teeth that engage with the teeth on the outside diameter of the adjusting sleeve. When the brakes are applied, the actuator plunger moves outward. If the travel is less than .040 of an inch, when the brakes are released, all parts will return to their starting position. If the travel is over .040 of an inch, the adjusting pawl is lifted and will drop into the next tooth space on the adjusting sleeve. As the brakes are released, the plunger and sleeve are pushed downward to their original positions in the spider. As this motion occurs, the pawl teeth cause the adjusting sleeve to rotate. The rotation of the sleeve causes the adjusting bolt to advance outward. This outward movement of the adjusting bolt pushes against the

brake shoe assembly which returns the lining to drum clearance back to the original .040 of an inch or less.

(4) No. 1 axle brake spider. The brake spider provides a means of mounting the brake hardware such as the brake shoes, return springs and actuator assembly.

(5) No. 1 axle skein. The axle skein is attached to the No. 1 axle ball joint and provides a mounting for the hub and drum assembly.

(6) Brake shoes. The brake shoes consist of a metal shoe with a lining riveted to the face of the shoe. Two types of linings are used, asbestos and non-asbestos. The brake shoes are secured on the brake spider by retaining capscrews and the return springs. The return springs pull the brake shoes away from the brake drum when the actuator assembly is released.

(7) Hub and drum assembly. The hub is a casting that is installed on the No. 1 axle skein by the use of roller bearings. The bearings allow the hub to rotate with minimal drag. They are held in place by a locknut that is threaded onto the skein. The locknut is locked in place by a capscrew and lockplate. The brake drum is also a casting installed onto the hub. It provides the rotating braking surface. As the brake shoes expand and contact the brake drum, the brake shoes create a drag. When the brakes are released, the return springs pull the brake shoes away from the drum.

(8) Axle shaft assembly. The No. 1 axle shaft assembly provides a means of driving the No. 1 axle hub and allowing for the pivoting of the ball socket. This is done by a cage ring assembly. One end of the axle shaft assembly is splined into the No. 1 differential carrier and the opposite end is splined to the No. 1 axle hub cap which is secured on the hub by studs.

c. Principles of Operation of the LVS Brake Mechanisms and Axle Assembly (1 AXLE)

(1) Wedge Brake Operation. Air pressure enters the wedge brake air chamber, forcing the diaphragm down. As the diaphragm moves, it pushes the wedge rod between the rollers. As the rollers move out, they push against plungers which in turn push the brake shoes out against the brake drum. When the air pressure is released, the diaphragm and wedge assembly are pushed back by the return spring in the wedge assembly. The rollers are pushed in by the brake shoe return springs.

(2) Operation of the "S" camshaft brakes will be discussed later in the lesson.

2. ORGANIZATIONAL MAINTENANCE RESPONSIBILITIES RELATIVE TO THE BRAKE MECHANISMS AND AXLE ASSEMBLIES

a. The organizational maintenance mechanic is responsible for replacing the following components:

- (1) axle shafts
- (2) brake shoes
- (3) No. 1 axle wedge brake assemblies
- (4) No. 1 axle brake spiders
- (5) No. 2, 3, 4 axle slack adjusters and camshafts
- (6) spider brackets
- (7) hub and drum assemblies
- (8) wheel bearings
- (9) wedge and spring brake air chambers

b. The organizational mechanic is also responsible for servicing all four axles and the axle breathers.

3. PERFORMANCE OF SECOND ECHELON MAINTENANCE ON THE LVS NO. 1 AXLE WEDGE BRAKE MECHANISMS

a. Preparing the Vehicle for Brake Maintenance

- (1) First, raise both ends of the front axle assembly.
- (2) Then, position axle stands, rated at 10 tons or greater, evenly under the axle to support the axle.
- (3) Drain all the air system pressure.
- (4) Carefully disconnect the battery ground cable.
- (5) Now, remove the front wheel and tire assemblies.
- (6) Back the brake shoes away from the drums by turning the star wheels.

b. Remove a Hub and Drum Assembly

(1) First, you will remove the hub cap from the hub.

(a) Remove the ten nuts and lockwashers from the hub cap and discard the lockwashers.

(b) Screw two capscrews into the hub cap and release the hub cap from the hub.

(c) Remove the hub cap from the hub.

(2) Remove the wheel bearing locknut from the axle assembly.

(a) Remove the locknut capscrew, lockwasher and lockplate. Discard the lockwasher.

(b) Using the front wheel bearing wrench, remove the bearing locknut from the axle skein.

(3) Remove the outer wheel bearing cone and tag it for later use.

(4) Now you can remove the hub and drum assembly from the axle.

(a) The hub and drum assembly is quite heavy so care should be used in removing it from the axle.

(b) The hub and drum assembly must come straight off and not be dragged across the threads on the end of the skein.

(5) Repeat the procedures on the other end of the axle assembly.

c. Servicing the Wheel Bearing

(1) Remove the inner bearing oil seal from the hub and discard the seal.

(2) Next, remove the inner bearing spacer and inner wheel bearing cone. Tag the bearing cone for later use.

(3) Remove the bearing cup only if it is damaged or if the bearing cone needs to be replaced.

(4) Clean the hub and bearing cup with cleaning solvent.

(5) Inspect the hub and bearing cup for damage, signs of pitting, or cracks.

(6) Lubricate the bearing cone with GAA.

(7) Also, lubricate the wall of the hub and the bearing cup with GAA.

(8) Now, install the inner wheel bearing cone into the bearing cup located in the hub.

(9) Install the bearing spacer on top of the inner bearing cone.

(10) Install a new oil seal into the hub, with the lip of the seal facing in and flush with the face of the hub.

(11) Coat the lip of the seal with grease.

(12) Repeat the procedures on the other end of the axle assembly.

d. Removal of the Wedge Brake Components

(1) First, the brake shoes must be removed from the axle assembly.

(a) Remove two cotter pins and two locknuts from in front of the brake shoes. Discard the cotter pins.

(b) Next, remove two washers and springs from the front of the brake shoes and discard the springs.

(c) Remove two brake shoe retainer plates from the brake shoes.

(d) Now, carefully using a pry bar, pry the brake shoes away from the adjusting bolt at the top of the spider. Pull the shoes outward until they clear the retaining screws.

(e) Holding the brake shoes up, pry the upper return spring from the bracket.

(f) Remove the two brake shoes with return springs from the axle assembly and remove the two return springs from the brake shoes.

(g) Repeat the procedures on the other end of the axle assembly.

(2) First, we will disassemble the actuating plunger housing. We will start with the removal of the brake chamber.

(a) Remove the air line and air line fitting from the top of the brake chamber.

(b) Being careful and using a punch and hammer, loosen the collet nut on the brake chamber housing.

(c) Next we will unscrew the brake chamber and remove it from the plunger housing.

(d) Repeat the procedures on the other end of the axle assembly.

(3) Disassembly of the actuating plunger housing will be performed in the following manner.

(a) First, remove the wedge assembly from the rear of the plunger housing. This can be accomplished without the use of tools.

(b) Now, bend the tabs on the two locking plates at the front of the actuating plunger housing and remove the two capscrews from the plunger housing.

(c) Next, remove the two springs and adjusting pawls from the front of the actuating plunger housing.

(d) Remove two retainers and detent washers, one on each side, from the actuating plunger housing and remove the snaprings from the retainers.

(e) Now, remove the two adjusting bolts and adjusting sleeve assemblies from the actuating plunger housing. Turn the adjusting bolts into the sleeves until the snaprings can be removed. Remove the snaprings from the adjusting bolts.

(f) Remove the adjusting bolt from the adjusting sleeve and remove the plunger seals. Discard the plunger seal.

(g) The last items to be removed from the actuating plunger housing are the two actuating plungers.

(h) Repeat the procedures on the other end of the axle assembly.

(4) Disassembly of an anchor plunger housing.

(a) First, bend the tabs on the two locking plates at the front of the anchor plunger housing and remove the two capscrews from the housing.

(b) Next, pull out the two anchor plungers, one on each side, from the anchor plunger housing.

(c) Repeat the procedures on the other end of the axle assembly.

(5) Removal of the spider and skein.

(a) First, remove the twelve locknuts and washers that secure the brake spider to the ball socket. Discard the locknuts.

(b) Next, remove the two capscrews that secure the brake shoe return spring bracket to the spider and remove the bracket from the brake spider.

(c) Mark and remove the brake spider from the ball and socket assembly.

(d) Now, with the spider removed, mark and remove the skein by carefully tapping down on the outer end with a soft-faced hammer.

(e) If the skein is hard to remove in the manner just described, the following procedure may be used.

1 Install the wheel bearing locknut onto the end of the skein.

2 Next, attach a puller to the locknut and pull the skein straight off the ball socket. Be careful not to damage the threads at the end of the skein with the puller.

(f) Repeat the procedures on the other end of the axle assembly.

e. Removal of an Axle Shaft and Cage Ring Assembly. To remove the axle shaft from the axle housing, turn the steering wheel to position the axles straight out from the ball socket. Care must be taken not to damage the inner seal. Pull the axle straight out of the ball socket.

f. Inspection of the Brake Components

- (1) Inspect the brake linings for grease, dirt, or any other contamination.
- (2) Check the brake linings for cracks and uneven wear.
- (3) Check the brake linings for wear. If the linings are less than one-fourth of an inch thick, replace the linings.
- (4) Check the brake shoes for bent or cracked webs and broken welds.
- (5) Check the brake shoes and linings for loose rivets or elongated holes.
- (6) Check the anchor assembly and roller recesses in the shoe webs.
- (7) Check the air chamber for the following:
 - (a) a cracked housing,
 - (b) a bent push rod,
 - (c) a loose clamp ring,
 - (d) a clogged vent hole, and
 - (e) a loose air fitting.
- (8) Inspect the brake drum for these defects:
 - (a) cracks,
 - (b) heat checks or hot spots, and
 - (c) grooving.
- (9) Any part that fails these inspections must be replaced.
- (10) Repeat the procedures on the other end of the axle assembly.

g. Servicing the Front Axle and Breathers. The front axle and the nose box must be checked every 3,000 miles or semiannually and serviced every 6,000 miles or annually. The organizational mechanic is responsible for performing both of those tasks.

(1) First, remove the front axle breather from the axle housing.

(2) Clean the front axle breather in cleaning solvent and allow the breather to air dry.

(3) Now, install the front axle breather in the axle housing.

(4) Use the same steps to service the nose box breather.

(5) Change the axle lubricant.

(a) Position a drain pan under the axle housing. Remove the filler plug and then remove the drain plug. Allow the oil to drain into the drain pan.

(b) Once the oil has drained from the axle, position the drain pan under the nose box. Remove the nose box filler plug and then remove the nose box drain plug.

(c) After all oil has been drained, remove any metal particles from the magnetic drain and filler plugs.

(d) Coat the threads on the drain plugs with sealant and install them securely.

(e) Fill the nose box with the proper lubricant until the lubricant is level with the fill hole. Coat the threads of the fill plug with pipe sealant and tighten the plug securely. Follow the lubrication order for the correct oil. This holds true for the axle lubricant.

(f) Fill the axle with the proper lubricant until the lubricant is level with the fill plug hole. Coat the threads of the fill plug with pipe sealant and tighten the plug securely.

(g) Add two pints of axle lubricant through the hole for the lubrication line at the top of the carrier cover.

h. Installation of an Axle Shaft and Cage Ring Assembly

(1) Position the ball socket in the straight ahead position.

(2) Lubricate the axle shaft bushing, the inner walls of the axle ball socket, and the polished surfaces of the axle shaft.

(3) Install the axle shaft and cage ring assembly into the axle housing.

(4) Spread grease over the cage ring.

(5) Coat the back of the skein with silicone sealant, align the marks, and install the skein on the ball socket studs.

(6) Repeat the procedures on the other end of the axle assembly.

i. Installation of the Wedge Brake Components

(1) Align the marks and install the brake spider. If, during the inspection of the spider, a problem was found with the actuating plunger housing, the spider may be turned 180 degrees on the skein. The anchor plunger housing may be used as the actuating plunger housing.

(2) Connect the spring return bracket onto the spider and tighten the capscrews securely. Install the 12 washers and new locknuts and torque the locknuts to 189 foot-pounds.

(3) To install the wedge brake assembly, you must perform the following steps.

(a) Coat the inside of the anchor plunger housing with grease.

(b) Then install the left and right anchor plunger into the anchor plunger housing. Make sure the slots in the plungers align with the capscrew holes. Install the capscrews and locking plates to secure the anchor plungers. Bend the tabs on the locking plates to lock the capscrews in place.

(c) Check the plungers for one inch free movement in and out.

(d) Coat the inside of the actuating plunger housing with grease.

(e) Apply grease to the actuating plungers and install the plungers into the actuating plunger housing, making sure the slots in the plungers align with the capscrew holes.

(f) Now, install the adjusting pawls and springs into the housing. Make sure that the adjusting pawls go into the slots of the actuating plungers.

(g) Apply grease to the rubber of the plunger seals and install them onto the adjusting bolts. Make sure the grooved sides of the seals face towards the heads of the adjusting bolts.

(h) Coat the threads of the adjusting bolts with grease and install them into the adjusting sleeves.

(i) Turn the bolts in until they are just short of bottoming on the plunger seals. Then install the snapring onto the adjusting bolts.

(j) Apply grease to the outside of the adjusting sleeves and install them into the plunger housing. Carefully install the seals onto the plunger housing.

(k) Now, install the adjusting pawl capscrews and locking plates into the housing. Bend the tabs of the locking plates, once the capscrews are secure.

(l) Next, install the detent washers, retainers, and snaprings on the adjusting bolts and place the adjusting bolts at the ends of the plunger housing.

(m) Insert the wedge assembly into the plunger housing and make sure the wedge assembly is properly seated.

(n) Repeat the procedures on the other end of the axle assembly.

(4) After the wedge assembly is inserted, install the air brake chamber as follows:

(a) Apply pipe sealant to the first three threads of the air chamber and thread the air chamber onto the housing until it bottoms out.

(b) Align the service chamber port by backing the air chamber out no more than one turn to align the service port.

(c) Connect the air brake chamber air line.

(d) Connect the battery ground cable, start the engine, and build air pressure to normal operating pressure, then turn off the engine.

(e) Next, have an assistant apply and hold a full brake application.

(f) Turn the collet nut by hand until tight then use a hammer and drift pin to tighten the collet nut 1 1/2 turns more, then release the brake pressure.

(g) Check for air leaks at all connections.

(h) Repeat the procedures on the other end of the axle assembly.

(5) The last step is to install the brake mounting hardware.

(a) First, turn the two adjusting bolts in the actuating plunger housing all the way in.

(b) Next, place one brake shoe on top of the adjusting bolt and the anchor pin. Place the mounting screw through the rear of the spider and through the triangle opening in the brake shoe.

(c) Install the retainer plate, spring, washer and nut on the mounting screw. Do not tighten the nut at this time.

(d) Install the upper return spring into the slot at the top of the brake shoe and set the return spring on the spring bracket.

(e) Now, install the lower return spring in the slot in the bottom of the brake shoe.

(f) While holding the remaining brake shoe, connect the upper and lower return springs into the slots of the remaining brake shoe.

(g) Pull the remaining shoe down onto the adjusting bolt and the anchor; at the same time, make sure the mounting screw comes through the triangle opening in the brake shoe web.

(h) Hold the brake shoe in place and install the retainer plate, spring, washer, and nut onto the mounting screw.

(i) Tighten the two nuts until the holes in the mounting screws for the cotter pins are visible. Install two new cotter pins through the holes and bend the end of the pins.

(j) Repeat the procedures on the other end of the axle assembly.

j. Installation of a Hub and Drum Assembly.

(1) Lubricate the axle skein with grease.

(2) Place the hub assembly over the skein and brake assembly.

(3) Slide the outer wheel bearing into the hub and install the wheel bearing locknut on the skein, finger tight.

(4) Tighten the locknut for the bearing preload. The adjustment of the locknut is very important. It must be tight enough to eliminate the end play in the hub, but not too tight to cause excessive drag.

(a) To adjust the bearing preload, use a front wheel bearing wrench and tighten the locknut.

(b) Rotate the drum while tightening the locknut. Tighten the locknut until it is tight against the outer bearing. Then loosen the locknut one quarter turn.

(c) If the locknut tightens half way between the slots in the skein, it may be turned over and reinstalled to obtain the proper position. Aline the slot in the locknut with a slot in the skein.

(d) Install the lockplate through the slot in the locknut and into the slot on the skein. Install the capscrew and new lockwasher and torque the capscrew to 25 foot-pounds.

(5) Pack the inside of the hub cap with a half-inch of grease.

(6) Coat the mating surface of the hub cap with silicone sealant and install the hub cap onto the hub.

(7) Install new lockwashers and nuts and torque the nuts to 130 foot-pounds.

(8) Repeat the procedures on the other end of the axle assembly.

k. Performance of the Post Brake Maintenance Operations. Adjust the brakes by turning the star wheel portion of both adjusting bolts until the brake drum will not turn. Back off both of the star wheels equal amounts until 0.020 - 0.040 of an inch clearance can be measured between the center of each brake shoe and the drum. Repeat the procedures on the other end of the axle assembly.

l. Preparation of the Vehicle For Operation

(1) Remove the axle stands.

(2) Lower both ends of the axle assembly.

(3) Connect the battery ground cable.

4. IDENTIFICATION, LOCATION, AND FUNCTION OF THE COMPONENTS EMPLOYED IN THE LVS BRAKE MECHANISMS AND AXLE ASSEMBLIES (2, 3, AND 4 AXLES)

a. Construction of the No. 2, 3, and 4 Axle Assemblies. The No. 2, 3, and 4 axle assemblies are forged steel castings similar to the No. 1 axle assembly and, like the No. 1 axle, each of these axle assemblies houses the axle shafts and axle carrier. They also provide a mounting place for the brake chamber brackets and for the brake spiders and skeins to which the brake shoes, hub and drum assemblies, and wheel and tire assemblies are attached. The No. 3 assembly axle also incorporates an inter-axle differential.

(1) The axle carriers act as differentials and distribute power to the axle shafts. The carriers are individually lubricated with gear oil.

(2) The inter-axle differential is mounted on the front of the No. 3 axle and distributes power from the transfer to the axle carriers of the No. 3 and No. 4 axles.

b. The rear axle brake mechanisms, as common to the No. 2, 3, and 4 axles, incorporate the spring brake air chambers, slack adjusters, "S" camshafts, brake shoes, hub and drum assemblies, axle shafts and the necessary hardware to secure the components to the axle assemblies.

(1) Spring brake air chamber. The spring brake chamber is a three-section, dual-diaphragm type air chamber. The top section contains a powerful spring and an air diaphragm to compress the spring. The lower section has a diaphragm that is controlled by the brake treadle valve. Air pressure supplied to the top section will compress the powerful spring, releasing the parking brake. For service braking, air pressure enters the lower section and pushes against the lower diaphragm, moving the actuator rod down, applying the brakes. When the air pressure is released, the service spring forces the actuator rod in, moving the diaphragm to the released position. When the air pressure is released from the top section of the chamber, the powerful spring will push the actuator rod down, applying the brakes. The chamber can be manually released by using the caging bolt located on the center section of the air chamber.

(2) Slack adjuster. The slack adjuster is splined to the "S" camshaft and is attached to the spring brake chamber actuator rod. The slack adjuster contains a worm drive mechanism that can be adjusted to compensate for normal wear of the brake shoe linings.

(3) "S" camshaft. The "S" camshaft is held in position by bushings and is connected to the brake shoes by rollers. When the spring brake chamber pushes the slack adjuster down, the "S" cam rotates. When the "S" cam rotates, the shoes are forced out, applying the brakes. When the spring brake chamber releases, the "S" camshaft is rotated in the opposite direction

and the brake return springs pull the brake shoes away from the drum, releasing the brakes.

(4) Brake spider. The brake spider is a casting attached to the No. 2, 3, and 4 axle housing to provide a mounting for the brake hardware.

(5) Brake shoes. Like the brake shoes on the front axle, the brake shoes consist of a metal shoe with a lining riveted to the face of the shoe. Two types of linings are used; asbestos and non-asbestos.

(6) Hub and drum assembly. The hub and drum assemblies used on the No. 2,3, and 4 axles are constructed the same way and serve the same purpose as those on the No. 1 axle.

(7) Axle shaft. An axle shaft for the No. 2, 3, and 4 axles provides a means to drive the hub and drum assembly mounted on the axle. The axle shaft is splined into the differential and is attached to the hub by studs and nuts.

5. PRINCIPLES OF OPERATION OF THE LVS BRAKE MECHANISMS AND AXLE ASSEMBLIES (2, 3, AND 4 AXLES)

a. "S" Cam Operation. The "S" cam brakes on the No. 2, 3, and 4 axles are actuated by spring brake air chambers. The upper section of the spring brake chamber contains a large, powerful spring and a diaphragm to compress the parking brake spring. Compressing this spring releases the parking brake. The lower section of the spring brake chamber is the service section which contains a diaphragm. When air pressure is supplied to this section, the diaphragm is forced down, forcing the push rod and the slack adjuster down. As the slack adjuster moves, it rotates the "S" cam. The brakeshoes, which rest on the cam through rollers, are forced outward against the brake drum. When air pressure is released, the push rod is forced in by the service spring, returning the "S" cam to the released position. The brake shoes are pulled away from the brake drum by the return springs.

6. PERFORMANCE OF SECOND ECHELON MAINTENANCE ON THE LVS 2, 3, AND 4 AXLES AND BRAKE MECHANISMS

a. Preparation of the Vehicle for Brake Maintenance

- (1) Raise both ends of each rear axle assembly.
- (2) Position the axle stands, rated at 10 tons or greater, to support the rear axles.
- (3) Block the wheels and drain the air system.

- (4) Remove the tire and wheel assemblies.
- (5) Disconnect the air lines at the spring brake chambers.
- (6) Cage the spring brake chambers by following these steps.

(a) Remove the caging bolt, nut and washer from the side of the air chamber.

(b) Remove the dust cover and insert the T-end of the caging bolt into the hole in the back of the air chamber. The T-end must engage the key-way inside the chamber then turn the caging bolt clockwise until it stops, which is about 1/4 turn.

(c) Once the caging bolt is properly inserted, install the washer and nut onto the caging bolt and tighten the nut until the spring is fully caged.

(d) Watch the clevis, it must retract as the nut is being tightened. When the spring is fully caged, the caging bolt will stick out three inches.

(e) Repeat the procedures on the other end of the axle assembly.

b. Removal of a Hub and Drum Assembly

(1) Remove eight nuts, lockwashers and dowels and pull the axle shaft out of the housing. There is one on each side of the axle assembly.

(2) Using the wheel bearing locknut wrench, remove the wheel bearing outer locknut and then remove the nut lock. Discard the nut lock.

(3) Remove the inner locknut, using the wheel bearing locknut wrench.

(4) Now, pull the outer wheel bearing cone out of the hub.

(5) Remove the hub and drum assembly from the axle.

(6) Remove the hub from the drum only if the studs, hub, or drum are damaged.

(7) Check the wear sleeve on the skein for grooves or damage. If it is damaged, split the wear sleeve and remove it.

(8) Repeat the procedures on the other end of the axle assembly and on each end of the other two axle assemblies.

c. Servicing a Wheel Bearing

(1) Remove the wheel seal and inner wheel bearing cone from the inside of the hub and discard the wheel seal.

(2) If the bearing cup is damaged or the wheel bearing cone is being replaced, remove the bearing cup from the hub.

(3) Clean the inside of the hub and the wheel bearing cone and bearing cup with cleaning solvent. Clean out the inside of the drum with a clean, oil free rag. Heavy dirt buildup can be removed with a wire brush or the drum can be steam cleaned.

(4) Inspect the wheel bearing cone and bearing cup for pits, chips, or signs of overheating. If damaged, replace them as an assembly.

(5) Inspect the hub and drum for cracks and signs of overheating. If the hub or drum fails inspection, replace it.

(6) If the bearing cup is removed, install the bearing cup into the hub.

(7) Install the inner wheel bearing cone and, using the seal installation tool, install a new wheel seal.

(8) Using the installation tool, install a new wear sleeve on the axle skein, if removed.

(9) Repeat the procedures on the other end of the axle assembly and on each end of the other two axle assemblies.

d. Removal of the Rear Service Brake Components

(1) Carefully pry the two brake shoes away from the "S" cam and remove the roller and pin assembly from each brake shoe.

(2) Lift the bottom brake shoe and remove the single spring at one end of the two brake shoes.

(3) Remove the two shoes from the axle and then remove the two remaining brake springs.

(4) Next, remove the cotter pin at the rear of the slack adjuster and the clevis pin located in one of the holes in the slack adjuster arm. Discard the cotter pin.

(5) Now, remove the "C" clip on the camshaft at the rear of the slack adjuster and discard the "C" clip.

(6) Remove the shim(s) from the camshaft at the rear of the slack adjuster. The number of shim(s) may vary from one unit to another.

(7) Mark the slack adjuster and the camshaft and remove the slack adjuster and washer from the camshaft. Marking will ensure proper installation and aid in the adjustment upon installation.

(8) Remove the camshaft and two seals from the bracket and if the bushings in the bracket housing are worn, remove them also. Discard the seals and camshaft bushings only if the bushings are removed.

(9) Repeat the procedures on the other end of that axle assembly and on each end of the other two axle assemblies.

e. Removal of a Brake Chamber and Spider

(1) Tag and remove the two air lines from the brake chamber.

(2) Remove two nuts and lockwashers and remove the air chamber from the mounting bracket.

(3) Remove four nuts and lockwashers and remove the mounting bracket from the rear of the brake spider.

(4) Match mark the brake spider to the axle housing for proper location during assembly, and remove eight locknuts and lockwashers from the axle housing side of the spider. Remove the spider from the axle housing. Discard the eight lockwashers.

(5) Repeat the procedures on the other end of the axle assembly and on each end of the other two axle assemblies.

f. Inspection of the Service Brake Components

(1) Inspect the brake linings for oil contamination and replace the brake shoes if oil is present.

(2) Check the brake linings for grooves, cracks, or wear and replace the brake shoes if the lining is unserviceable.

(3) Check the brake shoe web for bends, cracks or wear and replace the brake shoes if damaged.

(4) Check the brake shoes for loose rivets or elongated holes and replace the brake shoes if the rivets are loose.

(5) Inspect the camshaft for cracks or overheating.

(6) Inspect the cam rollers and pins for cracks or overheating.

(7) Inspect the camshaft bearings and seals for wear or damage.

(8) Inspect the brake spider for cracks or overheating.

(9) Check the anchor pin for flat spots.

(10) Check the spring brake chamber bracket for cracks, bends, or broken welds.

(11) Inspect the spring brake chamber for dents, cracks, or damaged studs.

(12) Inspect the spring brake chamber for damaged air fittings.

(13) Inspect the brake drum for grooves or heat cracks.

(14) All brake components that are damaged will be replaced with serviceable components.

(15) Repeat the procedures on the other end of the axle assembly and on each end of the other two axle assemblies.

g. Installation of the Service Brake Components

(1) First, align the marks and install the brake spider on the axle. Torque the capscrews and new nuts to 180 foot-pounds.

(2) Now, install the spring brake chamber bracket onto the brake spider. Install four capscrews and washers and tighten securely.

(3) If removed, install new cam bushings and seals into the brake chamber bracket.

(4) Lubricate the camshaft, camshaft bushings and seals with grease and slide the camshaft into the brake spider and spring brake chamber bracket.

(5) Install the washer and slack adjuster onto the camshaft. Aline the marks made during removal. Adjust the camshaft end play to within 0.005 - 0.045 inch by adding or removing shims between the slack adjuster and "C" clip. Install a new "C" clip and cotter pin on the rear of the camshaft.

(6) After the camshaft is adjusted, install the brake shoes, return springs, cam rollers, and pins onto the anchor pin and camshaft.

(7) Lubricate the camshaft at its lubrication fitting until grease comes out by the slack adjuster, then lubricate the slack adjuster at its lubrication fitting.

(8) The last step is to install the spring brake chamber onto the spring brake chamber bracket.

(a) Position the air chamber so that the air fittings will point away from the tire.

(b) Position the studs 1/8 inch from the bottom of the slots, install the washers and nuts, and tighten the nuts.

(c) Adjust the clevis to allow the pin to be installed easily and install the clevis pin and a new cotter pin.

(9) Repeat the procedures on the other end of the axle assembly and on each end of the other two axle assemblies.

h. Installation of a Hub and Drum Assembly

(1) Slide the hub and drum assembly over the skein and brake assembly. Be cautious not to nick the wheel seal on the skein.

(2) Now, slide the outer wheel bearing cone onto the skein and into the hub.

(3) Install the inner wheel bearing locknut on the skein and preload the bearings as follows:

(a) Slowly torque the inner locknut to 250 foot-pounds while rotating the drum forward and backwards.

(b) Now, loosen the inner locknut until the nut turns by hand.

(c) Slowly torque the inner nut to 50 foot-pounds while rotating the drum forward and backwards.

(d) Back off the nut 1/8 turn. The hub should turn freely in both directions.

(4) Install a new nut lock and then install the outer wheel bearing locknut onto the skein.

(5) Torque the outer wheel bearing locknut to 250 foot-pounds.

(6) Bend one tab of the nut lock over the inner wheel bearing locknut and one tab over the outer wheel bearing locknut.

(7) Slide the axle shaft into the axle housing.

(8) Install the axle nuts and washers and torque the axle nuts to 90 to 120 foot-pounds.

(9) Repeat the procedures on the other end of the axle assembly and on each end of the other two axle assemblies.

i. Performance of Post Brake Maintenance Operation

(1) Uncage the spring brake chambers.

(a) Slowly unscrew the nut on the caging bolt until the bolt is loose.

(b) Remove the nut and washer.

(c) Turn the bolt counterclockwise and remove it from the air chamber.

(d) Install the bolt in the holder on the side of the air chamber. The nut side of the caging bolt must face away from the tire.

(e) Install the washer and nut onto the caging bolt and tighten the nut securely.

(f) Replace the dust cap in the air chamber.

(g) Repeat the procedures for each spring brake chamber.

(2) Connect the air lines to the spring brake chambers.

(3) Install the wheel and tire assemblies.

(4) Connect the battery cables.

(5) Start the engine and build the air pressure to 80 to 90 pounds per square inch.

(6) Shut down the engine and release the parking brakes.

j. Adjust the service brakes on the rear axles.

(1) Measure brake adjustment.

(a) With an assistant holding the brake treadle valve down, measure the distance between the center of the yoke pin and the chamber bracket. Record the measurement.

(b) Next, with the brake treadle valve released, measure the distance between the center of the yoke pin and the chamber bracket. Record the measurement.

(c) Now, subtract the second measurement from the first measurement. If the difference is more than two inches on any one brake assembly, adjust all brakes on the No. 2, 3, and 4 axles.

(2) Adjustment of the rear axle service brakes.

(a) If the brake shoes on one side of the No. 2, 3, or 4 axle need adjustment, both sides of all three axles must be adjusted.

(b) Always adjust the brakes on any piece of equipment that is being towed behind a LVS at the time the LVS brakes are adjusted.

(c) Always block the vehicle's wheels to prevent personal injury or property damage.

(d) First, release the vehicle's parking brake.

(e) Next, jack up the wheel to be adjusted and ensure that it is free of the ground. Support the axle with a jackstand that is rated at ten tons or more.

(f) Using a 9/16 inch box end wrench, tighten the adjusting screw on the slack adjuster until the tire can no longer be turned by hand.

(g) After the adjusting screw is tightened, back out the adjusting screw three clicks or one-fourth of a turn.

(h) After the brake is adjusted, remove the jackstand and repeat the adjustment procedures until all brakes on No. 2, 3, and 4 axles are adjusted.

k. Servicing a Rear Axle Assembly

(1) Servicing a rear axle breather.

(a) The breather locations vary on each axle.

1 On the No. 2 and No. 4 axles, the breathers are located on the top right side of the axle housing.

2 On the No. 3 axle, the breather is located on the top left side.

(b) Clean the area around the breather before removing the breather and remove the breather from the top of each axle assembly.

(c) Cover the breather hole with a shop towel to prevent contamination of the axle assembly.

(d) Clean the breather in cleaning solvent and inspect the breather for damage. If the breather fails inspection, replace it.

(e) Coat the threads of the breather with pipe sealant and install the breather into the axle housing and tighten securely.

(2) Draining, inspection, and filling the rear axle assemblies.

(a) First, make sure the lubricant is warm prior to draining the axles. Warm lubricant will drain faster.

(b) Position a drain pan under the axle and remove first the filler plug and then the drain plug.

(c) For the No. 3 axle only, remove the magnetic strainer and filler plug from the top of the differential carrier cover.

(d) When removing the magnetic drain plug and the magnetic strainer, look for metal particles that may cling to them.

1 Small amounts of fine particles are normal and should be removed from the magnetic plug and magnetic strainer.

2 Large amounts or large particles may be signs of future axle failure. Organizational units should evacuate the vehicle to the next higher echelon of maintenance for determination or repairs.

(e) Clean the pipe sealant from the threads of the magnetic and filler plugs and the openings in the axle housing.

(f) Inspect all threaded areas for damage and repair or replace those items that have failed the inspection.

(g) Coat the threads on the magnetic drain plugs with pipe sealant and install the plugs in the axle housing.

(h) For the No. 3 axle only, coat the threads of the magnetic strainer and install the strainer in the differential carrier cover.

(i) Fill the axles with lubricant until the lubricant is level with the check and fill hole and temporarily install the filler plug finger tight.

(j) Raise the left side of each axle, one at a time, eight inches to allow the lubricant to flow out to the wheel bearings. Lower the axles and refill.

(k) Now, raise the other end of each axle the same way, then lower and refill again to the check and fill hole. Tighten the filler plug on the No. 2 and No. 4 axle securely.

(l) For the No. 3 axle only, add two more pints of lubricant through the filler hole on top of the differential carrier housing. Coat the threads of the filler plug with sealant and install the plug in the housing.

(m) Operate the vehicle to warm the lubricant and inspect for any leaks.

7. DIAGNOSIS OF THE MALFUNCTIONING LVS BRAKE MECHANISMS AND AXLE ASSEMBLIES

a. General

(1) The SLIDE that you see on the screen lists some of the malfunctions that pertain to the brake mechanisms and axle assemblies and are covered in the troubleshooting section of the TM.

(2) To quickly find the troubleshooting procedure you need, use the Symptom Index. Symptoms are listed by components or systems.

(3) Each malfunction symptom given for an individual component or system is followed by steps leading to the cause of the malfunction and the actions required to correct it.

(4) Locate the malfunction symptom then thoroughly read and carefully follow each step of the troubleshooting procedures.

(5) Here are a few simple rules to follow when troubleshooting:

(a) Obtain as much information from the operator as possible about the malfunction.

(b) Never overlook the possibility that the problem may be a simple one and may be repairable with a simple adjustment.

(c) Use as many of your senses as you can to locate and isolate problems. Look at it, listen to it, smell it, and feel it.

(d) Use all available test equipment to help find and isolate problems.

(e) Whenever possible, isolate the system first and then the component causing the malfunction.

(f) Remember, there is a cause for every failed part. Whenever possible, determine the cause of the failure before assuming the malfunction is completely repaired.

(g) Use proven automotive theories and principles when troubleshooting the vehicle.

b. Malfunction: Braking is slow, uneven, or brakes overheat.

c. Malfunction: Differential(s) Noisy.

d. Are there any questions on how to find the procedure for diagnosing a malfunction? If there are no questions, that is all we'll cover on diagnosis. There is no need to cover each one word for word because you won't remember it, but make sure you know where to locate the information.

REFERENCES:

LI 2320-12/9B
TM 2320-20/12A