

High Adhesion Truck

Screen 1:

Welcome Screen:

Welcome to the High Adhesion Truck module of the ES44AC/DC Mechanical Systems Advanced course.

Screen 2:

Introduction to High Adhesion Truck:

In this module, you will learn how to inspect and maintain the high adhesion truck in a running repair environment.

At the end of this module, you will be able to:

- State the purpose and location of the high adhesion truck.
- Describe the basic operation of a high adhesion truck.
- Describe the major components of a high adhesion truck.
- Describe how to perform running maintenance inspections on the truck and its major components.
- Summarize the major steps to remove and install the truck and its major components.

Screen 3:

Disclaimer:

Please note that this module is for training use only. For complete details of inspection and maintenance of a high adhesion truck, refer to customer-specific drawings, manuals, and procedures.

Screen 4:

Purpose of High Adhesion Truck:

The purpose of the high adhesion truck, also referred to as the HiAd truck, is to distribute the locomotive's weight equally over the axles, transferring the tractive effort (pulling force) and braking effort (stopping force) from the locomotive to the rail. The truck has three axles, which are individually powered by traction motors. Two high adhesion trucks support the entire locomotive. The trucks are commonly referred to as the front truck or number 1 truck and the rear truck or number 2 truck. A locomotive's two truck assemblies are located directly underneath the locomotive platform. The high adhesion truck contains 3 axles and wheel sets. A traction motor powers each axle and is coupled to the axle through a U-Tube assembly and a reduction gear arrangement. The U-Tube wraps around the axle and is mounted to the traction motor. Two roller bearing assemblies within the U-Tube allow the axle to rotate freely. The reduction gear arrangement consists of a small pinion gear and a large bull gear. A gear case, which is attached to the traction motor, surrounds the pinion gear to keep out dirt and moisture and to retain necessary gear lubricant.

Screen 5:**Major Components of High Adhesion Truck:**

When electrical power is applied to the traction motor, the pinion gear, which is part of the traction motor's shaft, turns the bull gear. The bull gear, which is pressed onto the axle, turns the axle. The axle, in turn, causes the wheels to rotate. One side of each traction motor is physically mounted to the truck frame by means of a motor nose support. The truck frame is also supported at each end of each axle by means of two coil springs, an axle or journal housing and an axle or journal bearing. The bearing is pressed onto the end of the axle. The axle housing surrounds the bearing and holds the two coil springs. The other end of the coil springs hold up the truck frame.

Screen 6:**Major Components of High Adhesion Truck (Cont'd):**

Two vertical snubbers, also referred to as primary shock absorbers, are located on one side of the truck to reduce unwanted vertical oscillations. Forces between the truck and the locomotive platform are transmitted through the truck's traction pin bearing assembly to the platform's traction pin. Four loadbearers support the vertical load of the locomotive and also allow for lateral motion between the platform and truck frame. Unwanted movement is lessened by the primary shock absorbers, lateral shock absorbers, and yaw shock absorbers. Finally, brake cylinders, brake rigging, and brake shoes provide braking at each of the six truck wheels.

Screen 9:**Wheels Inspection and Maintenance:**

The wheels on a high adhesion truck transfer the torque generated by the traction motor and apply it to the rails. They are also designed to keep the locomotive on the rail. Periodically inspect the wheels for damage or excessive wear in accordance with Federal Railroad Administration Regulations. The FRA rule for wheel inspection states, "The diameter of the wheels on the same axle shall not vary more than 3/32 inch (0.0938 inches or 2.38 mm); this is equivalent to approximately 2-1/2 tapes." The term "tape", as originally used in measuring locomotive wheels, is the measurement of the circumference of the wheel, where each 1/8ths of an inch (0.125 inches) equals a number on a steel tape measure. In the FRA rule above, the diameter is stated as the actual measurement, while the approximate conversion from "diameter" to "circumference" is also included. The "tape" measurement is provided because it is easier to measure the circumference than the diameter due to the axle and bearing being located in the center of the wheel. Wheels should be turned or replaced if not within the limits listed in the table.

Screen 10:**Wheels Inspection and Maintenance (Cont'd):**

Note: For optimum performance, Engineering recommends that wheels should not vary more than (a) 0.0188 inches (1/2 tape) on the same axle, (b) 0.0750 inches (2 tapes) in the same truck, and (c) 0.3002 inches (8 tapes) under the same locomotive. The diameter

of the wheel set is the average diameter of the two wheels on an axle. Keep the following points in mind when inspecting and maintaining wheels: To measure wheel diameter, flange thickness, and flange height, use a wheel gauge. The wheel diameter is measured by reading the scale on the long arm of the gauge in relation to the top of the witness mark on the wheel and using a conversion chart. Each mark on the scale is a one-eighth inch increase in wheel diameter. The flange height is measured by reading the scale on the pivot arm in relation to the marks on the bend of the gauge. The zero mark on the pivot is used to determine the height. The flange thickness is measured by reading the scale on the pivot arm in relation to the 0 mark on the stationary arm. The mark on the pivot is used to measure the thickness.

Screen 11:

Wheels Inspection and Maintenance (Cont'd):

Do NOT attempt to repair wheels by welding. Turn or mill the wheel set to restore tread and flange contour. Wheels should be removed from service and scrapped when 3 inches (76.2 mm) of wheel diameter material has worn off, or when rim thickness has decreased to 1 inch (25.4 mm). Ensure that the surface finish on reworked wheel flanges does not exceed 250 μ in. (6.35 μ m). This is important because a wheel with a rough flange surface tends to climb the rail.

Screen 12:

Shimming:

Wear and wheel change-outs may cause wheel diameters to become unequal, resulting in greater differences in weight distribution between the axles. Using shims allows greater differences in wheel diameters between wheel sets while keeping axle loading more uniform. Shims are inserted between the coil springs and the spring pads.

Note: FRA Rule 229.73b limits differences in diameter between any two wheel sets in a truck to 3/4 inch (19.1 mm) if shimming is not used. If shims are used at the axle bearing housing springs, the rule permits a difference up to 1-1/4 inches (31.8 mm). The same 1-1/4 inch (31.8 mm) difference is allowed between any two wheel sets on different trucks.

Note: Although 1-1/4 inch (31.8 mm) difference in wheel diameter is acceptable as an FRA limit, wheel diameter variations greater than 1 inch (25 mm) can reduce locomotive performance.

Screen 13:

Shimming (Cont'd):

Typical steps to determine the proper amount of shimming at each axle are as follows:

1. Measure all the wheels on the locomotive.

Note: The average RADIUS for each wheel set is used.

2. Determine the RADIAL difference between the largest wheel set and each of the other wheel sets.

Note: No shims will be applied to the largest diameter wheel set.

3. Using the RADIAL differences, determine the thickness of shims to be used on each of the other axles.

Note: The same size shim combination must be used on both ends of each axle. Consult the displayed table for shim dimensions and part numbers.

Screen 14:

Inserting Shims:

Typical steps to insert shims between the coil spring and spring pads are as follows:

1. Position the traction motor combo over a drop table.
2. Remove the axle bearing housing retainers.
3. Lower the drop table until the space between the top of the axle bearing housing and the truck frame is approximately 7 inches (178 mm).
4. At each of the four coil springs, place a spring retaining strap around the truck frame, UNDER the air piping, and THROUGH the spring coils at approximately the fifth coil.

Screen 15:

Inserting Shims (Cont'd):

5. Lower the drop table until the axle bearing housing is clear of the springs.
6. Place the shims as required between the coil springs and spring pads.

Note: Ensure that the ears of the shims are pointing towards the axle.

7. Raise the traction motor combo into position and remove the coil spring retaining straps.
8. Reapply the axle bearing housing retainers, then torque the bolts to the value provided in the Running Maintenance Manual.

Screen 16:

Pedestal Liners Inspection:

Axle bearing housings fit over the axle bearings, providing platforms to hold the coil springs. A pedestal liner is inserted between each axle bearing housing and the truck frame to keep the axle bearing housing and truck frame from rubbing, thus increasing the life of the truck frame. The nylon plastic liner is a wearable item that can be easily replaced. Inspect each pedestal liner for cracks or broken pieces. If they appear to be visually intact, measure the clearances between pedestal liners and the bearing housing

using the specification displayed. If the pedestal liners are damaged or if clearances exceed the maximum worn limits, replace the pedestal liners.

Screen 17:

Pedestal Liners Clearance Measurement:

Note: Because straight-on access is blocked when checking longitudinal clearance, access for the gauge is from the top of the journal housing — the area between the journal housing and the truck frame.

To check the longitudinal clearance, with a tapered gauge, measure the gap between the long-side face of each pedestal liner and the journal housing. The sum of both measurements is called the total longitudinal gap and it should not exceed 1/2 inch.

Note: When checking lateral clearance, access for the gauge is difficult. The truck must be on raised rails, and the access point is from underneath the journal housing.

To check the lateral clearance, with a tapered gauge, measure the gap between the short-side face of each pedestal liner and the journal housing. This is called the lateral gap.

Screen 18:

Pedestal Liners Clearance Measurement and Replacement:

For end traction motor locations (TM1, TM3, TM4, and TM6), no lateral gap measurement should exceed 3/8 inch. For center traction motor locations (TM2 and TM5), no lateral gap measurement should exceed 7/8 inch. If the pedestal liners are damaged or if clearances exceed the maximum limits, replace them as follows:

1. Remove the bearing housing retainer and then remove the damaged or worn liner.
2. Install the new pedestal liner and retainer, then torque the retainer bolts to the proper value.

Screen 21:

Brake Shoes and Rigging Inspection:

Working together, the brake cylinders, brake rigging, and brake shoes apply a stopping force to the wheels. The brake shoes are a high-wear item and must be inspected on a regular schedule. This schedule varies from railroad to railroad and is based on FRA requirements. As you check for brake shoe wear in accordance with your employer's inspection schedule or required federal regulation, look at the adjustment and condition of brake rigging components.

Screen 22:

Brake Shoes and Rigging Inspection (Cont'd):

The following are key items to look for on brake rigging and shoes: When inspecting the brake shoes for wear, see if the brake pad thickness is worn to less than 1/2 inch (13 mm) at any point on the shoe. If it is, replace it. Ensure that the brake shoes are not

binding against the wheel tread surface or flange. If they are, correct this condition. Verify that brake hangers are not causing misalignment of the brake shoe. Repair or replace rigging parts as needed to restore proper brake shoe alignment.

Screen 23:

Brake Shoes and Rigging Inspection (Cont'd):

Inspect brake linkage for missing, broken, or loose parts. Also inspect for badly worn pins, bushings, or wear plates. Repair or replace parts as necessary. Check the brake rigging wear plates located on the hangers and truck frame pads. Replace the wear plates when the working clearance between the wear plate and the mating wear surface exceeds 3/16 inch (4.8 mm). Check the clearance between the brake shoes and wheels. If clearance is more than 7/8 inch (22.2 mm), readjust according to steps discussed in the Brake System Adjustment section. Check brake cylinder piston-rod travel. If piston-rod travel is 6-1/2 inches (165 mm) or more, readjust according to steps discussed in the Brake System Adjustment section.

Caution: Grease or oil on exposed wear surfaces, collect sand, dirt, and grit, causing surfaces to wear faster. Do NOT lubricate brake rigging pins, bushings, or wear plates.

Screen 24:

Brake Shoes Replacement:

Typical steps for replacing brake shoes are as follows:

Note: Ensure that the locomotive is on straight, flat track before any adjustment or replacement is made.

1. Chock at least two sets of truck wheels to prevent the locomotive from rolling in either direction.
2. Release the hand brake (if set), and allow time for the truck wheels to seat against the wheel chocks.

Warning: Ensure that the truck wheels are chocked and the hand brake is released before cutting out the air to the truck that you are going to work on. Ensure that you only cut out one truck at a time. Unexpected motion can occur if the wheels are not chocked, if the hand brake is set when brake air is released, or if the air is cut off to both trucks at the same time. Unexpected rolling of the locomotive can cause serious injury or death.

3. With the locomotive secure, locate and close the truck air cut-out cock on the underside of the locomotive frame.

Note: Close only the truck cut-out cock for the truck being worked on.

4. Move the brake shoe as far as possible from the wheel tread, then remove the retaining key and worn brake shoe from the brake head.

Note: If more clearance is necessary to remove the worn brake shoe, remove the slack adjuster pin.

Screen 25:

Brake Shoes Replacement (Cont'd):

Caution: Brake shoes and the linkage design are matched for proper braking according to locomotive weight. Do NOT replace composition type brake shoes with cast iron shoes. Failure to use the proper replacement shoes may result in over-braking, under-braking, or an unbalanced braking condition.

5. Install a new shoe in the brake head, line up the keyway, and then drive the retaining key to seat tight in the keyway, then check the brake shoe for a tight fit in the brake head.

Note: If the shoe is loose with the key tight in the keyway, the brake head is probably worn and should be replaced.

Note: Newly installed brake shoes must hang true in the brake head. Brake head pins must be snug enough to keep the top end of the brake shoe from flopping onto the wheel, but loose enough to allow the shoe to conform to the wheel surface. The wheels should be free to move up and down in relation to the truck frame and brake shoes.

6. Reinstall any pins that were removed and lock them into place.

Note: Adjust the manual slack adjuster as required.

7. Open the truck air cut-out cock.

Screen 26:

Brake System Adjustment:

Typical steps to adjust the brake system are as follows:

Note: Ensure that the locomotive is on a straight, flat track before any adjustment or replacement is made.

1. Chock at least two sets of truck wheels to prevent the locomotive from rolling in either direction.
2. Release the hand brake (if set), and allow time for the truck wheels to seat against the wheel chocks.

Warning: Ensure that the truck wheels are chocked and the hand brake is released before cutting out the air to truck that you are going to work on. Ensure that you only cut out one truck at a time. Unexpected motion can occur if the wheels are not chocked, if the hand

brake is set when brake air is released, or if the air is cut off to both trucks at the same time. Unexpected rolling of the locomotive can cause serious injury or death.

3. With the locomotive secure, locate and close the truck air cut-out cock on the underside of the locomotive frame.

Note: Close only the truck cut-out cock for the truck being worked on.

4. To adjust the brake system, lift and rotate the pin retainer and remove the slack adjuster pin.

Warning: Do NOT set the slack adjuster pin in the fully extended position as doing so may cause the slack adjuster to buckle and the brake to fail.

Screen 27:

Brake System Adjustment (Cont'd):

5. With the piston rod fully retracted, adjust the slack adjuster to provide 1/4 inch (6.4 mm) clearance between the brake shoe and wheel, then replace the slack adjuster pin and rotate the pin retainer into place over the pin.

Note: If a slack adjuster is near the adjustment limit, check for excessively worn brake shoes or brake linkage components. Replace worn or damaged parts as needed.

6. Open the truck air cut-out to supply air pressure to the brake system.

Note: Apply and release the air brakes at least twice to check for proper operation of the adjusted air brakes.

Warning: Verify that cylinder piston-rod travel does not exceed 6-1/2 inches (165 mm). Piston rod travel beyond 6-1/2 inches (165 mm) may cause inadequate braking force against the wheels.

7. Check the brake-cylinder piston-rod travel and brake shoe-to-wheel clearances at ALL truck wheels.

Note: Nominal piston-rod travel range is between 2-1/2 and 4-1/2 inches (64 and 114 mm). Brake shoe-to-wheel clearance is 1/4 inch (6.4 mm).

8. If readjustment is required, repeat steps 3 through 7.

Screen 28:

AC Traction Motor Nose Suspension - Inspection and Replacement:

The traction motor nose suspension provides support for the traction motor between the motor and the truck frame. There is one traction motor nose suspension assembly connecting each traction motor nose to the truck frame. There are two types of traction

motor nose suspension. The AC Traction Motor uses a "dog bone" shaped suspension, and the DC Traction Motor uses a laminated rubber-steel stack suspension. Let's first discuss how to inspect and replace an AC traction motor nose suspension. Inspect each suspension assembly for defective rubber mounting bushings. If the mounting bushings are worn, bushing rubber extrudes from the cast link, or bushing rubber appears damaged in any way, replace the suspension assembly. Also, check for loose or missing mounting hardware.

Note: A mounting bushing is worn if there is any clearance between the crossbar and cast link because of missing rubber.

Caution: Remove the suspension link by using a special socket tool to remove the CAMCAR bolts or by cutting the CAMCAR bolts with a torch or hydraulic splitter. If a torch is used, form a shield to protect the rubber parts of the suspension link from heat damage, and use extreme care. Do NOT reuse the bolts, washers, or nuts. Do NOT replace CAMCAR bolts and nuts with ordinary fastener bolts and nuts. Bolts and nuts may loosen during locomotive operation and cause traction motor failure or other equipment damage.

Note: Refer to the applicable Parts Bulletin for recommended replacement parts.

Screen 29:

DC Traction Motor Nose Suspension - Inspection and Replacement:

Typical steps to inspect, remove and replace a DC traction motor nose suspension assembly are as follows:

1. Remove the DC traction motor nose suspension as follows:
 - a. Jack or lift the traction motor nose to compress the suspension assembly approximately 0.5 inches (13 mm).
 - b. Install a 1/2-13 x 6.5 inch (165 mm) long bolt and nut between the U-channels on both sides of the suspension assembly.
 - c. Tighten the nuts to compress the suspension assembly to 11.7 inches (297 mm) or less.
 - d. Lower the traction motor slightly, then remove the cotter pins and retaining pins that secure the vertical keeper pins in the suspension assembly.

Note: The vertical keeper pins should drop out of the suspension assembly when the retaining pins are removed.

- e. Slide the suspension assembly sideways, removing the assembly from the truck frame.
 - f. Inspect the traction motor nose suspension assembly for separation of laminations, badly eroded rubber laminations, or cracked or broken cast

members and, if defective, remove and replace the traction motor nose suspension assembly.

Screen 30:

DC Traction Motor Nose Suspension - Inspection and Replacement (Cont'd):

2. Install the DC traction motor nose suspension as follows:
 - a. Slide the nose suspension assembly sideways, into the truck frame.
 - b. Lower the traction motor combo slightly, and install the cotter pins and retaining pins, securing the vertical keeper pins in the nose suspension assembly.
 - c. Loosen the nuts to de-compress the nose suspension assembly.
 - d. Remove the 1/2-13 x 6.5 inch (165 mm) long bolt and nuts previously installed between the U-channels on both sides of the nose suspension assembly.
 - e. Lower the traction motor nose into position.

Screen 31:

Loadbearers Inspection:

The rubber loadbearers transfer the weight from the locomotive platform to the truck frame and reduce the vibrations transmitted from the truck frame to the platform. The four loadbearers on the topside of the truck frame consist of alternate layers of steel laminations and rubber, which are bonded together. Typical steps to inspect loadbearers are as follows:

1. Ensure that the loadbearer is centered under the locomotive loadbearer pad.
2. Inspect for evidence of motion between the loadbearer and locomotive loadbearer pad.
3. Inspect loadbearers for extreme wear or severe separation of rubber and steel laminations.
 - a. Look for bent or cracked metal.

Note: Bending and cracking of some of the plates is acceptable if rubber is not trapped, and if no sharp cutting edges are in contact with the rubber.

- b. Look for bonding defects.

Note: Separations of rubber and metal plate laminations are acceptable if gaps are less than 3/4 inch (19.1 mm) and no one separation extends beyond 2 inches (51 mm).

Screen 32:

Loadbearers Inspection (Cont'd):

- c. Inspect for damage to rubber.

Note: Cuts or splits in rubber surfaces are acceptable if length of damage does not exceed 2 inches (51 mm), depth of damage does not exceed 1/2 inch (13 mm), and no more than two cuts or splits occur on any one side of a single lamination.

- d. Inspect for oil and grease contamination.

Note: Some softening of the rubber surface from contamination is acceptable, but the loadbearer should be replaced if swelling increases the length or width of a rubber lamination 1/4 inch (6.4 mm) greater than normal.

4. Replace any defective or displaced loadbearers.

Screen 33:

Loadbearers Replacement:

Normally, loadbearers are replaced in a Backshop facility when the truck has been removed from the locomotive. However, in some cases, a loadbearer must be replaced in a Running Repair Service Shop. Typical steps to replace loadbearers are as follows:

1. Remove the safety hooks.
2. Jack up the locomotive high enough so that the loadbearer can be removed.

Caution: Ensure that cables and traction motor air ducts are not damaged or stretched too far while the locomotive is being jacked.

Screen 34:

Loadbearers Replacement (Cont'd):

3. Remove and replace ALL four loadbearers as a set.
 - a. Remove and save the four bolts and lockwashers.

Warning: A loadbearer weighs approximately 90 lbs. (41 kg). Use an adequate lifting device.

- b. Remove and replace the loadbearer.
 - c. Fasten the loadbearer to the truck frame using the four saved bolts and lockwashers.

Screen 37:

Lateral and Yaw Shock Absorbers Inspection:

Most high adhesion trucks have two lateral and two yaw shock absorbers. The lateral shock absorbers reduce unwanted lateral motion of the locomotive as the truck moves along the track while the yaw shock absorbers reduce side to side sway of the truck and help prevent the truck from "hunting the rail" as the locomotive moves along a straight track. Note that the shock absorber arrangement can vary by customer.

Note: Lateral and yaw hydraulic shock absorbers are sealed by the manufacturer and cannot be refilled with fluid. Leaky shock absorbers must be replaced.

Inspect each lateral and yaw hydraulic shock absorber for leakage or defective rubber mounting bushings. A light film of hydraulic fluid on the body is normal. If the body is wet with fluid, the mounting bushings are worn, or bindings are badly eroded or missing, replace the shock absorber.

Note: Refer to the applicable PARTS BULLETIN for the recommended replacement part number.

Screen 38:

Lateral and Yaw Shock Absorbers Replacement:

Typical steps to replace lateral and yaw shock absorbers are as follows:

1. Remove all four bolts and associated washers and nuts securing the shock absorber.
2. Remove and discard the hydraulic shock absorber.
3. Install new shock absorber.

Note: The mating surfaces and threads of the shock absorbers must be clean and free of oil.

4. Install the bolts and washers on the shock absorber bosses, then torque the bolts to the proper value.

Screen 39:

Vertical Shock Absorbers - Inspection:

A high adhesion truck has two or four vertical snubbers depending on the customer. These vertical snubbers, also referred to as primary shock absorbers, are mounted parallel to the outside axle springs to reduce unwanted movement and vibrations between the axle and the truck frame.

Note: Vertical hydraulic snubbers are sealed at manufacture and cannot be refilled with fluid. Leaky snubbers must be replaced.

Inspect each vertical hydraulic snubber for leakage or defective rubber mounting bushings. A light film of hydraulic fluid on the body is normal. If the body is wet with fluid, the mounting bushings are worn, or the bindings badly eroded or missing, replace both snubbers on that axle.

Screen 40:

Vertical Shock Absorbers - Replacement:

Typical steps to replace vertical snubbers are as follows:

Caution: If one vertical hydraulic snubber is defective and there is another snubber on the same axle, replace both snubbers on that axle. Use only recommended snubbers on the truck to ensure the proper match with locomotive load conditions. Replacement of only one snubber or failure to use the recommended replacement snubbers creates an incorrect damping condition, and may shorten the useable life of snubbers, springs, and other load-support equipment.

1. Remove all four bolts and associated washers and nuts securing each snubber.
2. Remove and discard both used vertical hydraulic snubbers.
3. Install new snubbers.

Note: The mating surfaces and threads of the snubbers must be clean and free of oil.

4. Reinstall the bolts and washers to secure the snubbers in place, then torque the bolts to the proper value.

Screen 41:

Coil Springs – Inspection and Replacement:

There are two coil springs per axle bearing housing. The purpose of the coil springs is to transfer the weight from the truck frame to the wheels and axles, cushion the impact load, and improve ride quality. To visually inspect the coil springs, raise the weight of the locomotive and truck from the axles to expose the springs. Visually inspect each coil spring for breaks, cracks, vertical wear flats, deep nicks, gouges, or other signs of damage. If visible damage to a coil spring indicates that the useful life or performance of the spring may be limited, replace the spring. Remove the coil springs as directed in the Traction Motor Removal section of this module.

Screen 42:

Safety Hooks – Inspection and Replacement:

Located on each side of the truck, the purpose of the safety hooks is to ensure the truck does not become separated from the locomotive in the event of a derailment. Inspect the safety hooks for proper clearances. If the safety hooks do not meet clearances, identify and replace the defective hooks. Typical steps to replace safety hooks are as follows:

1. Remove and save the four bolts and hardened washers from the safety hook.
2. Remove the safety hook.

Warning: Safety hooks weigh approximately 117 lbs. (53 kg). Use an adequate lifting device.

Screen 43:

Safety Hooks – Inspection and Replacement (Cont'd):

3. Re-tap, clean, and lubricate the truck frame mounting holes, then use copper anti-seize to lubricate the frame mounting holes.

Note: The mounting surface must be clean and free of paint.

4. Clean and lubricate previously saved safety hook mounting hardware, then use copper anti-seize to lubricate the hardware.
5. Position the new or repaired safety hook on the truck frame.
6. Install mounting hardware.

Note: Before tightening, ensure that $1\text{-}3/4 \pm 1/4$ inch (44.5 ± 6.4 mm) clearance exists between each safety hook and the platform.

7. Torque safety hook bolts to 350–400 lb.-ft. (474–542 Nm).

Screen 46:

Traction Motor:

Each high adhesion truck contains three axles and wheel sets. This traction motor assembly, also referred to as a traction motor combo, includes the traction motor, U-Tube, wheels, and gear case. The traction motor is coupled to the axle through a U-Tube assembly and a reduction gear arrangement. The reduction gear arrangement consists of a small pinion gear and a large bull gear. When electrical power is applied to the traction motor, the pinion gear, which is part of the traction motor's shaft, turns the bull gear. The bull gear, which is pressed onto the axle, turns the axle. The axle, in turn, causes the wheels to rotate, thus moving the locomotive.

Screen 47:

Traction Motor Combo Removal:

Typical steps to remove the traction motor combo from the high adhesion truck are as follows:

Note: The steps in this demonstration are applicable to both AC and DC traction motors, unless mentioned otherwise. The AC traction motor has been used to depict the steps in this demonstration.

Warning: To ensure the safety of personnel, before proceeding, ensure that the truck and locomotive are securely supported and that the electrical power to the traction motors is OFF.

Warning: On AC locomotives, capacitors in the inverter circuits may not be fully discharged and may contain lethal voltages. Before performing any maintenance on a traction motor or traction motor power cables, open the auxiliary cab door and raise the barrier bar to the vertical position. Raising the barrier bar closes the Capacitor Discharge Switch (CDS). Wait until all lights on the Capacitor Discharge Indicator (CDI) are extinguished before proceeding with any maintenance.

1. Position the traction motor combo to be removed over a single-axle drop table.

Note: If the axle to be removed is at either end of the truck, support the truck frame with suitable blocks to prevent it from tilting.

2. Set the locomotive wheel brakes and chock the wheels on the truck not being worked on, then manually release the brakes on the wheels of the traction motor combo to be removed by closing the cut-out cock in the air line for that truck.

Note: Ensure that all traction motor leads and connection cables are properly marked to ensure correct reconnection.

3. Disconnect all power cables and the motor ground cable of the traction motor combo to be removed from the truck, then secure the cables to prevent damage during traction motor combo removal.

Screen 48:

Traction Motor Combo Removal (Cont'd):

4. Unplug the speed sensor cable of the traction motor combo to be removed, then remove the cable clamp.

Note: Do NOT disconnect the speed sensor from the traction motor.

5. If equipped, disconnect the bearing temperature sensor cables of the traction motor combo being removed.
6. Remove the pins from the slack adjusters of the traction motor combo to be removed, and adjust the slack adjusters to the shortest length.
7. Remove the brake shoes by removing the keys from the brake heads.

Screen 49:

Traction Motor Combo Removal (Cont'd):

8. If the traction motor combo to be removed is one of the end assemblies on the truck, loosen and remove all but one of the sand bracket bolts at both ends of the axle, and swing the sand brackets away to prevent fouling when the combo is lowered.
9. Disconnect the traction motor air duct from the top of the traction motor.

Note: Cover the traction motor air intake opening to prevent foreign material from entering the traction motor.

10. Remove the pedestal liner and axle journal bearing housing retaining bolts, retainers, and any free pedestal liners.

Caution: When the pedestal liner retaining bolts have been removed, the pedestal liners are free floating and may drop out. Remove any free floating pedestal liners.

11. If the traction motor combo to be removed is in positions 1, 3, 4, or 6:
 - a. Disconnect the axle snubbers from the journal box adapters at both ends of the axle.
 - b. Support the truck frame with wooden blocks and hydraulic jacks from the floor adjacent to the traction motor combo being removed.

Note: If the axle has an optional axle alternator, remove the entire axle journal bearing housing as part of the snubber removal step.

Screen 50:

Traction Motor Combo Removal (Cont'd):

12. Disconnect the AC traction motor nose suspension as follows:
 - a. Place a suitable jack under the lugs or motor frame, and ensure the jack cannot slip off if the motor moves or tries to rotate.

Caution: Disconnect the suspension link by removing the CAMCAR bolts with a special socket or by cutting the bolts with a torch or hydraulic splitter. If a torch is used, form a shield to protect the rubber parts of the suspension link from heat damage and use extreme care. Do not reuse the bolts, washers, or nuts.

- b. Disconnect the suspension link from the motor.

Warning: Do not pull the suspension link away from the motor until the motor is secured properly. Otherwise, the motor will drop.

Note: For AC traction motors located in positions 1, 2, 5, or 6 in locomotives with generation 1 and generation 2 steerable trucks, the suspension link will contact the motor nose bracket. This bracket is attached to rubber mounts and will move to permit the suspension link to clear the motor frame.

- c. Pull the suspension link away from the motor by using a come-along or similar chain rigging.
 - d. Lower the drop table by a few inches while raising the jack to allow the motor safety nose to clear the truck frame.

Screen 51:

Traction Motor Combo Removal (Cont'd):

13. Remove the DC traction motor nose suspension as follows:
 - a. Jack or lift the traction motor nose to compress the suspension assembly approximately 0.5 inches (13 mm).
 - b. Install a 1/2-13 x 6.5 inch (165 mm) long bolt and nut between the U-channels on both sides of the suspension assembly.
 - c. Tighten the nuts to compress the suspension assembly to 11.7 inches (297 mm) or less.

- d. Lower the traction motor slightly, then remove the cotter pins and retaining pins that secure the vertical keeper pins in the suspension assembly.

Note: The vertical keeper pins should drop out of the suspension assembly when the retaining pins are removed.

- e. Slide the suspension assembly sideways, removing the assembly from the truck frame.
- f. Inspect the traction motor nose suspension assembly for separation of laminations, badly eroded rubber laminations, or cracked or broken cast members and, if defective, remove and replace the traction motor nose suspension assembly.

Screen 52:

Traction Motor Combo Removal (Cont'd):

14. In a DC traction motor, check the suspension lugwear plates on the traction motor and, if excessively worn, replace the plates.
15. Lower the drop table by approximately 5 inches (125 mm), place chocks over the rail, and nip the securing bolts to secure the traction motor combo in place.
16. Raise the drop table by 2 inches (50 mm) to compress the coil springs.
17. For the four coil springs at the traction motor combo, place a spring retaining strap around the truck frame, under the air piping and through the spring coils at approximately the fifth coil, then join the strap ends, leaving at least 12 inches (300 mm) of slack in the straps.

Note: Verify that the wooden blocks and hydraulic jacks supporting the truck frame are securely in place if the combo to be removed is in positions 1, 3, 4, or 6.

Screen 53:

Traction Motor Combo Removal (Cont'd):

18. Apply C-clamps on each wheel rim below each side of the axle journal bearing housing to prevent the housing from rotating during traction motor combo removal.
19. Raise the traction motor nose up to clear the nose suspension or the truck frame as the traction motor is lowered.
20. Support the traction motor nose with blocks suitably placed under the frame, such that it cannot slip off if the traction motor moves or rotates.
21. Lower the drop table until the space between the top of the axle journal bearing housing and the truck frame is approximately 7 inches (175 mm), then tighten the coil spring retaining straps to remove any remaining slack.

Screen 54:

Traction Motor Combo Removal (Cont'd):

22. Lower the drop table until the traction motor combo clears the truck and remove any remaining truck pedestal liners.
23. Move the traction motor combo from beneath the truck and locomotive.

Caution: If the gear case is still filled with oil, it cannot be tilted more than 4 inches (102 mm) end to end from horizontal because the oil will run around the seals and drain into the traction motor.

Warning: The AC traction motor combo weighs approximately 13,270 lbs. (6,019 kg), and the DC traction motor combo weighs approximately 12,000 lbs. (5,443 kg). Ensure that an adequate crane and cables are used to lift and move the traction motor combo.

24. Using a suitable hoist, lift the traction motor combo from the drop table and move it to the area assigned for cleaning, maintenance, or storage.
25. Set the traction motor frame in the normal horizontal position on blocks high enough so that the wheels clear the floor.

Caution: After the combo is removed from the truck, if it is not broken down immediately, the rotor (on the AC motor) or armature (on the DC motor) should be locked to prevent possible shipping damage to bearings in the motor.

Screen 55:

Traction Motor Combo Installation:

Warning: The AC traction motor combo weighs approximately 13,270 lbs. (6,019 kg), and the DC traction motor combo weighs approximately 12,000 lbs. (5,443 kg). Ensure that an adequate crane and cables are used to lift and move the combo.

Warning: To ensure the safety of personnel, before proceeding, ensure that the truck and locomotive are securely supported and that the electrical power to the traction motors is OFF.

Warning: On AC locomotives, capacitors in the inverter circuits may not be fully discharged and may contain lethal voltages. Before performing any maintenance on a traction motor or traction motor power cables, open the auxiliary cab door and raise the barrier bar to the vertical position. Raising the barrier bar closes the CDS. Wait until all lights on the CDI are extinguished before proceeding with any maintenance.

Caution: If the gear case is filled with oil, it cannot be tilted more than 4 inches (102 mm) end to end from horizontal because the oil will run around the seals and drain into the traction motor. Use a three-point lift to lift the combo.

Screen 56:**Traction Motor Combo Installation (Cont'd):**

Typical steps to install the traction motor combo into the high adhesion truck are as follows:

1. Remove all dirt and weld splatter from the traction motor nose suspension lugs and the traction motor nose suspension area of the truck frame.
2. Transfer the traction motor combo to the drop table, and place suitable blocking under the motor frame to raise the motor lugs.

Note: The traction motor nose must be raised so that the motor safety lugs engage the truck frame, and the traction motor nose suspension lugs clear the truck frame.

3. Position the drop table and the traction motor combo under the truck with the axle journal bearing housings aligned with the journal bearing housings in the truck frame.
4. Level the axle journal bearing housings, and apply C-clamps on each wheel rim below each side of the axle journal bearing housings to prevent it from rotating during traction motor combo installation.

Note: Ensure that the coil spring seats are in position on the axle journal bearing housings.

5. Raise the drop table with the traction motor combo.

Screen 57:**Traction Motor Combo Installation (Cont'd):**

6. Install the truck pedestal liners, and ensure that the coil springs seat properly as the traction motor combo is raised.
7. Raise the drop table until the axle journal bearing housings are completely in place, with the drop table assuming part of the weight of the truck.
8. Install the four axle journal bearing housing retainers on the truck pedestal legs.
9. Torque the retainer bolts to 296 to 329 lb.-ft. (401 to 446 Nm).
10. Remove the four coil spring retaining straps.
11. Lower the hydraulic jacks and remove all wooden blocks from under the traction motor and the truck.

Screen 58:**Traction Motor Combo Installation (Cont'd):**

12. Connect the AC traction motor nose suspension as follows:
 - a. Release the come-along or chain rigging.

Note: The suspension link should spring back under the motor lugs.

- b. Lower the motor frame until the suspension link is supporting the weight of the traction motor combo.

Note: For AC traction motor combos in positions 1, 2, 5, or 6, the suspension link bracket should be on top of the motor lugs.

- c. Insert CAMCAR bolts through the suspension link motor lugs and hand-tighten the nuts.

Note: On generation 1 and 2 steerable trucks only, if the traction motor combo is being installed in positions 1, 2, 5, or 6, verify truck alignment as described in official publications, before tightening the CAMCAR bolts.

Note: It may be necessary to twist the motor nose bracket, using rubber mounts, to align the bolt holes.

Caution: Do NOT replace CAMCAR bolts and nuts or HUCK pins and collars with ordinary fastener bolts and nuts. Ordinary bolts and nuts may loosen during locomotive operation and cause the traction motor to fail or cause other equipment damage. Refer to the applicable Parts Bulletin for recommended replacement parts.

- d. Tighten the CAMCAR bolts with the special socket until the head shears off each bolt.

Screen 59:

Traction Motor Combo Installation (Cont'd):

13. Install the DC traction motor nose suspension as follows:
 - a. Slide the nose suspension assembly sideways, into the truck frame.
 - b. Lower the traction motor combo slightly, and install the cotter pins and retaining pins, securing the vertical keeper pins in the nose suspension assembly.
 - c. Loosen the nuts to de-compress the nose suspension assembly.
 - d. Remove the 1/2-13 x 6.5 inch (165 mm) long bolt and nuts previously installed between the U-channels on both sides of the nose suspension assembly.
 - e. Lower the traction motor nose into position.

Screen 60:

Traction Motor Combo Installation (Cont'd):

14. For traction motor combos in positions 1, 3, 4, and 6, connect axle snubbers to the journal box adapters at both ends of the axle, then torque the snubber bolts to 197 to 219 lb.-ft. (267 to 297 Nm).
15. Connect the traction motor air duct to the top of the motor.
16. Lubricate the air duct bolts with a Wabtec approved Moly-based lubricant (84B565364A1) or light machine oil.

17. Install the bolts and then torque to 50 to 55 lb.-ft. (68 to 75 Nm).
18. If the traction motor combo installed is one of the end assemblies on the truck, return the sand brackets at both ends of the axle, then install and torque the sand bracket bolts to the proper value.
19. Install the brake shoes and the slack adjuster pins, then adjust the slack adjusters.

Screen 61:

Traction Motor Combo Installation (Cont'd):

20. Connect the speed sensor cable of the traction motor combo to its connection under the locomotive platform.
21. If equipped, connect the bearing temperature sensor cables.
22. Connect all power cables and the traction motor ground cable to their connections under the locomotive platform.
23. Release and remove all jacks and chocks used to support or secure the truck for traction motor combo removal.
24. Activate the brakes by opening the truck cut-out cock.
25. Check the level of lubricant in the gear case, and add lubricant as required.

Screen 62:

High Adhesion Truck Removal:

Typical steps to remove the high adhesion truck from under the locomotive are as follows:

1. Chock at least two sets of truck wheels on both trucks to prevent the locomotive from rolling in either direction.
2. Release the hand brake if set, and allow time for the truck wheels to seat against the wheel chocks.

Warning: Ensure that the truck wheels are chocked and release the hand brake before cutting out the brake cylinder air. Ensure that air is cut out to only one truck at a time. Unexpected motion can occur if the wheels are not chocked, if the hand brake is set when brake air is released, or if the air is cut off to both trucks at one time. Unexpected rolling of the locomotive can cause serious injury or death.

3. With the locomotive secure, locate and close the truck air cut-out cock on the underside of the locomotive frame.

Note: Close only the truck cut-out cock for the truck being removed. Disconnect the hose to that truck's brake cylinders only after all air has been exhausted from the truck air lines.

Screen 63:

High Adhesion Truck Removal (Cont'd):

4. Under the locomotive platform, disconnect the traction motor leads, ground cables, and speed-sensor cables leading to each traction motor.

5. Disconnect the ground cable between the truck and the platform.
6. Disconnect the traction motor air ducts from the top of the traction motors, then cover the traction motor openings to prevent entrance of foreign material.
7. If an axle alternator is installed on the truck being removed, disconnect the alternator cable from the junction box on the alternator, then coil and secure the cable so it will not be damaged.
8. Disconnect all sander hoses from the sander brackets on the truck and disconnect the hoses for the flange lubricators if used.

Screen 64:

High Adhesion Truck Removal (Cont'd):

9. Disconnect the hand brake chain if the long-hood end truck is being removed.
10. Remove the lateral and yaw shock absorbers.
11. Remove both safety hooks from the truck frame.
12. Raise the locomotive platform clear of the truck with jacks or a crane, or lower the truck on a drop table.

Note: Ensure that the cables, air ducts, and hoses are not damaged. If the truck is to be pulled out sideways, the locomotive platform must be raised (or truck lowered) at least 10 inches (254 mm).

13. After the truck is removed from under the locomotive, cover the truck center-pin bearing to prevent contamination with dirt and other foreign materials.

Screen 65:

High Adhesion Truck Installation:

Typical steps to install the high adhesion truck under the locomotive are as follows:

1. Space the trucks approximately 50 ft. (15.2 m) between traction pin bearing assemblies.

Note: When installed on the locomotive, the transom ends of the trucks must be facing each other.

2. Remove the temporary dust covers from the traction motor air duct openings.
3. Inspect the traction motor air ducts between the locomotive platform and the truck and replace any air ducts that are cracked or torn.
4. Coat the center pin on the underside of the locomotive platform with grease.
5. Lower the platform onto the truck (or raise the truck on the drop table), then carefully mate the center pin with the center pin bearing.

Note: Ensure that the two tangs on top of each of the four loadbearers per truck register properly in the locomotive platform.

Screen 66:

High Adhesion Truck Installation (Cont'd):

6. Install both safety hooks on the truck frame.
7. Install the lateral and yaw shock absorbers.
8. Connect the hand brake chain if the long-hood end truck is being installed.
9. Install the hoses from the sand pipes on the platform to the sander brackets on the trucks, and install the hoses for the flange lubricators if used.

Screen 67:

High Adhesion Truck Installation (Cont'd):

10. Connect the axle alternator cable to the junction box on the alternator if used.
11. Install the traction motor air duct to each of the traction motors.
12. Connect the ground cable between the truck and the platform.
13. Connect the speed sensor cable, traction motor leads, and the ground cable at each traction motor.

Screen 68:

High Adhesion Truck Installation (Cont'd):

14. Connect the air brake hoses from the locomotive platform to the brake cylinder piping on the truck.

Note: Before returning the locomotive to service, the truck cut-out cocks (located under the platform) must be opened.

15. Adjust the truck brake rigging.

Caution: Ensure that the journal bearing housings, traction motor gear cases, and traction motor support bearings have been lubricated before moving the locomotive.

16. Check the traction motor rotation.

Screen 71:

Summary:

You have reached the end of this module!

In this module, you learned to:

- State the purpose and location of the high adhesion truck.
 - The purpose of the high adhesion truck is to distribute the locomotive's weight equally over the axles, transferring the tractive effort (pulling force) and braking effort (stopping force) from the locomotive to the rail.
 - Two high adhesion trucks support the entire locomotive.

- Describe the basic operation of a high adhesion truck.
 - The high adhesion truck contains 3 axles and wheel sets. A traction motor powers each axle and is coupled to the axle through a U-Tube assembly and a reduction gear arrangement.
 - The U-Tube wraps around the axle and is mounted to the traction motor. Two roller bearing assemblies within the U-Tube allow the axle to rotate freely.
 - The reduction gear arrangement consists of a small pinion gear and a large bull gear.
 - A gear case surrounds the pinion gear to keep out dirt and moisture and to retain necessary gear lubricant.
 - When electrical power is applied to the traction motor, the pinion gear turns the bull gear.
 - The bull gear turns the axle which in turn, causes the wheels to rotate.

- Describe the major components of a high adhesion truck.
 - One side of each traction motor is physically mounted to the truck frame by means of a motor nose support.
 - The truck frame is supported at each end of each axle by means of two coil springs, an axle or journal housing, and an axle or journal bearing.
 - The bearing is pressed onto the end of the axle. The axle housing surrounds the bearing and holds the two coil springs. The other end of the coil springs hold up the truck frame.
 - Two vertical snubbers, also referred to as primary shock absorbers, are located on one side of the truck to reduce unwanted vertical oscillations.
 - Forces between the truck and the locomotive platform are transmitted through the truck's traction pin bearing assembly to the platform's traction pin.
 - Four loadbearers support the vertical load of the locomotive and also allow for lateral motion between the platform and truck frame.
 - Unwanted movement is lessened by the primary shock absorbers, lateral shock absorbers, and yaw shock absorbers.
 - Brake cylinders, brake rigging, and brake shoes provide braking at each of the six truck wheels.

- Describe how to perform running maintenance inspections on the truck and its major components.
 - Wheels
 - Periodically inspect the wheels for damage or excessive wear, in accordance with Federal Railroad Administration Regulations.
 - Shimming
 - The use of shims allows greater differences in wheel diameters between wheel sets while keeping axle loading more uniform.
 - Shims are inserted between the coil springs and the spring pads.

- Pedestal Liners
 - To check the longitudinal clearance, with a tapered gauge, measure the gap between the long-side face of each pedestal liner and the journal housing. The sum of both measurements is called the total longitudinal gap and it should not exceed 1/2 inch.
 - To check the lateral clearance, with a tapered gauge, measure the gap between the short-side face of each pedestal liner and the journal housing. This is called the lateral gap.
 - If the pedestal liners are damaged or if clearances exceed the maximum limits, replace them as follows:
 1. Remove the bearing housing retainer and then remove the damaged or worn liner.
 2. Install the new pedestal liner and retainer, then torque the retainer bolts to the proper value.
- Brake Shoes and Rigging
 - The brake shoes are a high-wear item and must be inspected on a regular schedule and replaced as follows:
 1. Chock at least two sets of truck wheels and release the hand brake.
 2. With the locomotive secure, locate and close the truck air cut-out cock on the underside of the locomotive frame.
 3. Move the brake shoe as far as possible from the wheel tread, then remove the retaining key and worn brake shoe from the brake head.
 4. Install a new shoe in the brake head.
 5. Reinstall any pins that were removed and lock them into place.
 6. Open the truck air cut-out cock.
 - Adjust the brake system as follows:
 1. Chock at least two sets of truck wheels and release the hand brake.
 2. With the locomotive secure, locate and close the truck air cut-out cock on the underside of the locomotive frame.
 3. Adjust the slack adjuster, replace the slack adjuster pin, and rotate the pin retainer.
 4. Open the truck air cut-out cock.
 5. Apply and release the air brakes at least twice to check for proper operation of adjusted air brakes.
 6. Check the brake-cylinder piston-rod travel and brake shoe-to-wheel clearances at ALL truck wheels.

Screen 72:

Summary (Cont'd):

- AC Traction Motor Nose Suspension
 - Inspect each suspension assembly for defective rubber mounting bushings. Also, check for loose or missing mounting hardware.

- DC Traction Motor Nose Suspension
 - Typical steps to inspect, remove and replace a DC traction motor nose suspension assembly are as follows:
 1. Jack or lift the motor nose to compress the suspension assembly.
 2. Install and tighten the bolts and nuts between the U-channels of the suspension assembly.
 3. Lower the traction motor slightly, then remove the cotter pins and retaining pins.
 4. Slide the suspension assembly sideways, removing the assembly from the truck frame.
 5. Inspect the traction motor nose suspension assembly for separation of laminations, badly eroded rubber laminations, or cracked or broken cast members and, if defective, remove and replace the traction motor nose suspension assembly.
 6. Slide the nose suspension assembly sideways, into the truck frame.
 7. Lower the traction motor combo slightly, and install the cotter pins and retaining pins, securing the vertical keeper pins in the nose suspension assembly.
 8. Loosen and remove the bolts and nuts between the U-channels of the suspension assembly.
 9. Lower the traction motor nose into position
- Loadbearers
 - Inspect the loadbearers as follows:
 1. Ensure that the loadbearer is centered under the locomotive loadbearer pad.
 2. Inspect for evidence of motion between the loadbearer and locomotive loadbearer pad.
 3. Inspect loadbearers for extreme wear or severe separation of rubber and steel laminations.
 - Replace any defective or displaced loadbearers as follows:
 1. Remove the safety hooks.
 2. Jack up the locomotive high enough so that the loadbearer can be removed.
 3. Remove and replace ALL four loadbearers as a set.
- Lateral and Yaw Shock Absorbers
 - Inspect each lateral and yaw hydraulic shock absorber for leakage or defective rubber mounting bushings.
 - Replace lateral and yaw shock absorbers as follows:
 1. Remove all four bolts and associated washers and nuts securing the shock absorber.
 2. Remove and discard the hydraulic shock absorber.
 3. Install new shock absorber.
 4. Install and torque the bolts and washers on the shock absorber bosses.

- Vertical Shock Absorbers
 - Inspect each vertical hydraulic snubber for leakage or defective rubber mounting bushings.
 - Replace vertical snubbers as follows:
 1. Remove all four bolts and associated washers and nuts securing each snubber.
 2. Remove and discard both used vertical hydraulic snubbers.
 3. Install new snubbers.
 4. Reinstall and torque the bolts and washers to secure the snubbers in place.
- Coil Springs
 - Visually inspect each coil spring for breaks, cracks, vertical wear flats, deep nicks, gouges, or other signs of damage. If visible damage to a coil spring indicates that the useful life or performance of the spring may be limited, replace the spring.
 - Remove the coil springs as directed in the Traction Motor Removal section of this module.
 - Safety Hooks
 - Inspect the safety hooks for proper clearances. If the safety hooks do not meet clearances, identify and replace the defective hooks.
 - Replace safety hooks as follows:
 1. Remove and save the four bolts and hardened washers from the safety hook.
 2. Remove the safety hook.
 3. Position the new or repaired safety hook on the truck frame.
 4. Install mounting hardware and torque the safety hook bolts.

Screen 73:

Summary (Cont'd):

- Summarize the major steps to remove and install the truck and its major components.
 - Traction Motor Combo Removal
 1. Position the traction motor combo to be removed over a single-axle drop table.
 2. Set the locomotive wheel brakes and chock the wheels on the truck not being worked on, then manually release the brakes on the wheels by closing the cut-out cock in the air line.
 3. Disconnect all power cables, the motor ground cable, the speed sensor cable, and, if equipped, the bearing temperature sensor cables.
 4. Remove the pins from the slack adjusters and shorten the slack adjusters to the shortest length.
 5. Remove the brake shoes by removing the keys from the brake heads.
 6. Disconnect the traction motor air duct from the top of the traction motor.

7. Remove the pedestal liner retaining bolts, axle journal bearing housing, and any free pedestal liners.
8. Disconnect the nose suspension for an AC traction motor or remove the nose suspension for a DC traction motor.
9. In a DC traction motor, check the suspension lugwear plates and, if excessively worn, replace the plates.
10. Lower the drop table and place chocks over the rail and nip the securing bolts to secure the combo in place.
11. Raise the drop table to compress the coil springs.
12. Place a spring retaining strap around the truck frame, under the air piping and through the spring coils, then join the strap ends.
13. Apply C-clamps on each wheel rim to prevent the housing from rotating during the traction motor combo removal.
14. Raise the traction motor nose up to clear the nose suspension or the truck frame as the motor is lowered.
15. Lower the drop table and tighten the coil spring retaining straps to remove any remaining slack.
16. Lower the drop table until the traction motor combo clears the truck and remove any remaining truck pedestal liners.
17. Move the traction motor combo from beneath the truck and locomotive.
18. Lift the traction motor combo from the drop table and set it aside for cleaning, maintenance, or storage.
- Traction Motor Combo Installation
 1. Transfer the traction motor combo to the drop table, and place suitable blocking under the motor frame to raise the motor lugs.
 2. Position the drop table and the traction motor combo under the truck.
 3. Level the axle journal bearing housings, and apply C-clamps on each wheel rim below each side of the axle journal bearing housings.
 4. Raise the drop table and install the truck pedestal liners.
 5. Install the four axle journal bearing housing retainers on the truck pedestal legs.
 6. Remove the four coil spring retaining straps.
 7. Lower the hydraulic jacks and remove all wooden blocks from under the traction motor and the truck.
 8. Connect the nose suspension for an AC traction motor or install the nose suspension for a DC traction motor.
 9. Connect the traction motor air duct to the top of the motor.
 10. Lubricate the air duct bolts with a Wabtec approved Moly-based lubricant (84B565364A1) or light machine oil.
 11. Install the bolts and then torque to 50 to 55 lb.-ft. (68 to 75 Nm).
 12. Install the brake shoes and the slack adjuster pins, then adjust the slack adjusters.

13. Connect all power cables, the motor ground cable, the speed sensor cable, and, if equipped, the bearing temperature sensor cables to their connections under the locomotive platform.
14. Release and remove all jacks and chocks used to support or secure the truck and for traction motor combo removal.
15. Activate the brakes by opening the truck cut-out cock.
16. Check the level of lubricant in the gear case, and add lubricant as required.
- High Adhesion Truck Removal
 1. Chock at least two sets of truck wheels and release the hand brake.
 2. With the locomotive secure, locate and close the truck air cut-out cock on the underside of the locomotive frame.
 3. Disconnect the traction motor leads, ground cables and speed-sensor cables leading to each traction motor.
 4. Disconnect the ground cable between the truck and the platform.
 5. Disconnect the traction motor air ducts from the top of the traction motors, then cover the traction motor openings to prevent entrance of foreign material.
 6. If an axle alternator is installed on the truck being removed, disconnect the alternator cable from the junction box on the alternator, then coil and secure the cable so it will not be damaged.
 7. Disconnect all sander hoses from the sander brackets on the truck and disconnect the hoses for the flange lubricators if used.
 8. Disconnect the hand brake chain if the long-hood end truck is being removed.
 9. Remove the lateral and yaw shock absorbers.
 10. Remove both safety hooks from the truck frame.
 11. Raise the locomotive platform clear of the truck with jacks or crane, or lower the truck on a drop table.
 12. After the truck is removed from under the locomotive, cover the truck center-pin bearing to prevent contamination with dirt and other foreign materials.
- High Adhesion Truck Installation
 1. Space the trucks between traction pin bearing assemblies.
 2. Remove the temporary dust covers from the traction motor air duct openings.
 3. Inspect the traction motor air ducts between the locomotive platform and the truck and replace any air ducts that are cracked or torn.
 4. Coat the center pin on the underside of the locomotive platform with grease.
 5. Lower the platform onto the truck, then carefully mate the center pin with the center pin bearing.
 6. Install both safety hooks on the truck frame.
 7. Install the lateral and yaw shock absorbers.
 8. Connect the hand brake chain if the long-hood end truck is being installed.

9. Install the hoses from the sand pipes on the platform to the sander brackets on the trucks.
10. Connect the axle alternator cable to the junction box on the alternator if used.
11. Install the traction motor air duct to each of the traction motors.
12. Connect the ground cable between the truck and the platform.
13. Connect the speed sensor cable, traction motor leads, and the ground cable at each traction motor.
14. Connect the air brake hoses from the locomotive platform to the brake cylinder piping on the truck.
15. Adjust the truck brake rigging.
16. Check the traction motor rotation.