

Traction Motor Combo

Screen 1:

Welcome Screen:

Welcome to the Traction Motor Combo module of the ES44AC/DC Mechanical Systems Advanced course.

Screen 2:

Introduction to Traction Motor Combo:

In this module, you will learn how to inspect and maintain a traction motor combo in a running repair environment. The traction motor combo includes the traction motor, U-tube, axle, wheels, bull gear, and gear case.

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

- State the purpose of the traction motor combo.
- Describe the major components of a traction motor combo.
- Identify the running maintenance requirements for the traction motor combo.
- Describe the basic operation of a traction motor combo.
- Summarize the major steps to remove and install a traction motor combo.
- Summarize the major steps to disassemble and assemble an AC traction motor combo.
- Summarize the major steps to disassemble and assemble a DC traction motor combo.

Screen 3:

Disclaimer:

Please note that this module is for training use only. For complete details of inspecting and maintaining a traction motor combo in a running repair environment, refer to customer-specific drawings, manuals, and procedures.

Screen 4:

Purpose of Traction Motor Combo:

The main purpose of the traction motor combo is to convert electrical energy to mechanical energy for driving the locomotive wheels, a process referred to as motoring. The traction alternator supplies the electrical energy. The secondary purpose of the traction motor combo is to convert the mechanical energy of slowing a moving locomotive to electrical energy utilizing a process referred to as dynamic braking. In dynamic braking, the traction motors function as generators with the electrical energy that they produce dissipated as heat in the dynamic braking resistor grids.

Screen 5:**Major Components of Traction Motor Combo:**

The major components of the traction motor combo are:

- Traction Motor
- Bull Gear
- Axle
- Wheels
- U-Tube
- Gear Case

Screen 6:**Traction Motor:**

The traction motor takes electrical energy from the propulsion system and converts it into mechanical energy for driving the locomotive wheels.

Screen 7:**Bull Gear:**

The bull gear, pressed onto the axle, meshes with the pinion gear on the traction motor rotor to transfer the torque of the traction motor to the axle.

Screen 8:**Axle:**

The axle is used to transfer the rotational force of the traction motor to the wheels. Journal bearings, located on each end of the axle, allow the axle to turn with minimal friction when mounted inside the journal boxes attached to the truck frame.

Screen 9:**Wheels:**

The locomotive rides on the tread of the wheel, and the wheel flange keeps the locomotive on the rails.

Screen 10:**U-Tube:**

The U-tube, mounted to the traction motor, wraps around and houses the axle. The U-tube contains two roller bearing assemblies that support the traction motor and allow axle rotation within the U-tube.

Screen 11:**Gear Case:**

The gear case protects the pinion and bull gears from the outside environment. Additionally, the gear case contains the oil used to lubricate the two gears. On AC traction motors, the oil also lubricates the pinion-end bearing in the traction motor. The gear case

consists of two halves, a top or upper half and a bottom or lower half, which are bolted together.

Screen 14:

Operation of the Traction Motor Combo:

The high adhesion truck uses three AC (5GEB13) or DC (5GE752AH) traction motor combos. The nose of each combo is resiliently mounted to the truck frame with a motor nose suspension, and ends of the combo are allowed to float in the truck frame with a journal housing and nylon wear liners. This holds the combo in the truck in a triangle-shaped configuration. Electricity is supplied to the traction motor from the propulsion system. Coils in the traction motor create a magnetic field, which causes the rotor to turn. On the rotor, the small pinion gear meshes with the larger bull gear on the axle. Depending on the traction motor design, the pinion gear may either be formed as an integral part of the rotor or may be pressed onto the rotor. The bull gear is pressed onto the axle along with the two wheels and the U-tube. Two roller-bearing assemblies allow the axle to rotate freely within the U-tube while the two journal bearings allow the axle to rotate freely within the journal box mounted to the truck. With the traction motor powered, the pinion and bull gears mesh, causing the axle and wheels to turn and power the locomotive.

Screen 15:

Gear Case Oil:

This section provides information on the oil capacity in the gear case and steps for checking, adding, and draining oil in the gear case. The table displays the traction motor gear case oil capacities for the DC (5GE752AH) and AC (5GEB13) traction motor types.

Note: Before checking the gear case lubricant level, the locomotive should be motionless for at least 30 minutes for AC traction motors and 15 minutes for DC traction motors to get an accurate reading.

Caution: NEVER permit the gear case lubrication level to run low, as this could result in pinion end bearing (on an AC traction motor), bull gear, and pinion gear failure. Do NOT use any lubricant other than the recommended gear case lubricant as this also could result in component failure.

The gear case has a fill opening that is either a solid-fill plug or a spring-loaded plug, located in the lower half of the gear case. Check the lubricant level by looking in the fill opening. If the lubricant is below the fill opening, use the proper dipstick to determine how much lubricant to add. Wipe the dipstick with a clean cloth to remove oil, dirt, and sand before inserting it into the gear case. For AC traction motors, if the gear case requires more than 6.5 quarts (6 L) of lubricant, remove and replace the traction motor combo. For DC traction motors, if the gear case requires more than 4 quarts (3.8 L) of lubricant, remove and replace the traction motor combo.

Screen 16:**Gear Case Oil (Cont'd):**

Top off the required quantity of lubricant in the gear case. Allow the lubricant to redistribute and level out, and then recheck the lubricant level. Clean the plug to remove any dirt and particles. Apply an approved sealant to the pipe plug, and then torque the plug to the appropriate torque value. Lock wire the plug so that it does not vibrate loose. To drain the gear case lubricant, remove the drain plug located at the side of the bottom gear case. After draining the gear case, clean the plug to remove any dirt and particles. Apply an approved sealant to the pipe plug, and then torque the plug to the appropriate torque value. Lock wire the plug so that it does not vibrate loose.

Screen 17:**Connection-End Bearing Re-Greasing:**

The traction motor rotor anti-friction Connection-End (CE) ball bearing is packed with grease at motor assembly and requires no attention until wheel change.

Typical steps to re-grease the CE ball bearing during wheel change are as follows:

Note: For the GEB13EB traction motors, apply D50E34 grease or equivalent.

1. Carefully clean off the bearing cap, then remove the bearing cap by removing the bearing cap bolts.
2. Visually examine the bearing rivets, huck bolts, and cage for broken parts or other signs of damage.
3. Clean the old grease out of the bearing cap, then clean and dry the bearing cap.
4. For GEB13A, GEB13B, and GEB13EA traction motors, apply 5 oz. (142 g) of D6A2C17 grease or equivalent and, for GEB13EB traction motors, apply 7 oz. (199 g) of D50E34 grease or equivalent to the bearing cap cavity, then carefully re-install the bearing cap.
5. Torque the bearing cap bolts to the correct torque value.

Note: If the bearing is removed, it must be replaced with a new bearing as pulling the bearing off damages the cage.

Screen 18:**Running Maintenance Schedule:**

The table displays the recommended running maintenance schedule for the traction motor combo and its major components.

Screen 23:**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 24:

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 25:

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 26:

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. Make sure that 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 27:

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 28:

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 29:

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 30:

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 33:

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. Be sure to use a three-point lift to lift the combo.

Screen 34:

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 35:

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 36:

Traction Motor Combo Installation (Cont'd):

12. Connect the AC traction motor nose suspension as follows:
 - a. Release the come-along or chain rigging. 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 the recommended maintenance 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 37:

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 38:

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 boot 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 39:

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 42:

AC Rotor Locking Clamp with Hard Stop Installation:

Caution: The AC rotor must be locked when the motor is transported, other than from work station to work station during processing, to prevent damage to the rotor bearings caused by shock and vibration. This includes traction motors loose, in a combo, and in a truck.

Note: The rotor locking clamp is installed on the Connection End (CE), also referred to as the Opposite Pinion End (OPE), of the AC traction motor.

Typical steps to install the AC rotor locking clamp with a hard stop provided by the use of welded locking nuts on the locking bolts are as follows:

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

Caution: Rotating the rotor while the rotor locking clamp is installed can damage the rotor and the rotor locking clamp and make removal of the rotor locking clamp difficult.

1. Remove the two CE bearing housing bolts opposite to the U-tube side.

Note: Do not remove the bearing cap.

2. Fully retract the two locking bolts of the rotor lock by positioning the inboard-side locking nut against the welded nut on each locking bolt and the outboard-side nut against each locking bolt head.
3. Install the rotor locking clamp by carefully inserting the clamp prong into the framehead exhaust openings, and position it behind the speed sensor gear, such that the two locking bolts line up squarely with the two vacant CE bearing housing bolt holes in the framehead.

Caution: Take care NOT to damage the gear teeth.

Screen 43:

AC Rotor Locking Clamp with Hard Stop Installation (Cont'd):

4. Hand thread the two locking bolts into the bearing housing until the welded nut on each locking bolt is positioned against the motor frame head.
5. Pull the rotor lock away from the motor until the clamp prong engages with the speed sensor gear, then back both inboard-side nuts up and away from the welded nuts, until they engage with the clamp bar.

Note: Ensure that both outboard-side locking nuts are not yet engaged.

6. For each locking bolt, hold the bolt head in place while tightening the inboard-side locking nut against the clamp bar to 27 to 31 lb.-ft. (36.6 to 42 Nm).
7. For each locking bolt, tighten the outboard-side locking nut against the clamp bar to 27 to 31 lb.-ft. (36.6 to 42 Nm) to serve as a jam nut to prevent loosening during shipment.
8. Put the two CE bearing housing bolts into a small cloth sack and attach to the rotor locking clamp, with instructions to re-install and torque to the proper value upon removal of the clamp assembly.

Screen 44:

AC Rotor Locking Clamp with Hard Stop Removal:

Typical steps to remove the AC rotor locking clamp with a hard stop provided by the use of a welded locking nut on the locking bolt are as follows:

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

Caution: Rotating the rotor while the rotor locking clamp is installed can damage the rotor and the rotor locking clamp and make removal of the rotor locking clamp difficult.

1. For each locking bolt, loosen the inboard-side locking nut away from the clamp and rotate it all the way up to the welded nut on the locking bolt.
2. For each locking bolt, loosen the outboard-side locking nut away from the clamp and rotate it all the way up to the locking bolt head.
3. Loosen both locking bolts by applying torque to the wrench flat on each locking bolt head, then completely unthread the locking bolts from the motor frame head by hand rotation.
4. Fully retract both locking bolts away from the motor.
5. Remove the rotor locking clamp from the frame-head exhaust opening.
6. Re-install the CE bearing housing bolts and washers in the two vacant CE OPE bearing housing bolt holes, then torque the bolts to 56 to 60 lb.-ft. (76 to 81 Nm).
7. Place the rotor locking assembly at the designated place and save for future use.

Caution: If there is any oil in the gear case, use a three-point lift to raise the combo assembly and keep the gear case level within 4 inches (102 mm) end to end from horizontal. If a traction motor combo with oil in the gear case is tilted, oil will flow past the seals and drains into the traction motor itself.

Screen 45:

AC Rotor Locking Clamp without Hard Stop Installation:

Caution: The AC rotor must be locked when the motor is transported, other than from work station to work station during processing, to prevent damage to the rotor bearings caused by shock and vibration. This includes traction motors loose, in a combo, and in a truck.

Note: The rotor locking clamp is installed on the Connection End (CE), also referred to as the Opposite Pinion End (OPE), of the AC traction motor.

Typical steps to install the AC rotor locking clamp without a hard stop provided by the use of welded locking nuts on the locking bolts are as follows:

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

Caution: Rotating the rotor while the rotor locking clamp is installed can damage the rotor and the rotor locking clamp and make removal of the rotor locking clamp difficult.

1. Remove the two CE bearing housing bolts and washers.
2. Insert the two locking bolts through the locking clamp and thread two nuts onto each bolt.
3. Install the rotor locking clamp prong into the framehead exhaust openings, and position it behind the speed sensor gear, such that the bolts line up squarely with the two vacant CE bearing housing bolt holes in the framehead.

Caution: Take care NOT to damage the gear teeth.

4. Thread the two rotor locking bolts into the CE bearing housing holes in the framehead for approximately ten turns to fully engage the bolts.

Screen 46:

AC Rotor Locking Clamp without Hard Stop Installation (Cont'd):

5. Tighten the first nut on each locking bolt evenly against the locking clamp to tighten it by pushing the clamp away from the framehead and pulling against the back of the speed sensor gear, then torque the nuts to 27 to 31 lb.-ft. (36.6 to 42 Nm).
6. While holding the first nut on each locking bolt in place with a wrench, torque the jam nut on each locking bolt to 27 to 31 lb.-ft. (36.6 to 42 Nm) to prevent loosening during shipment.
7. Put the two bearing housing bolts and washers into a bag-tag and fasten it to the rotor locking clamp, with instructions to re-install and torque to the proper value upon removal of the clamp assembly.

Note: Using a wood beam and threaded rod to force the pinion towards the motor frame is an acceptable alternate method of preventing rotor bearing damage while shipping a traction motor not in a combo.

Note: If both of the above configurations of rotor locking methods are available (clamp with a hard stop and clamp without a hard stop), the configuration with a hard stop (nuts welded to the locking bolts) is the preferred configuration.

Screen 47:

AC Rotor Locking Clamp without Hard Stop Removal:

Typical steps to remove the AC rotor locking clamp without a hard stop provided by the use of welded locking nuts on the locking bolts are as follows:

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

Caution: The AC rotor must be locked when the motor is transported, other than from work station to work station during processing, to prevent damage to the rotor bearings

caused by shock and vibration. This includes traction motors loose, in a combo, and in a truck.

Caution: Rotating the rotor while the rotor locking clamp is installed can damage the rotor and the rotor locking clamp and make removal of the rotor locking clamp difficult.

1. While holding the first nut on each locking bolt in place with a wrench, loosen the jam nut on each locking bolt.
2. Loosen the first nut away from the locking clamp.
3. Unthread both AC rotor locking clamp bolts from the framehead.
4. Remove the rotor locking bolts, the first nut, the jam nut, and the rotor locking clamp from the framehead exhaust opening.
5. Re-install the CE bearing housing bolts and washers in the two vacant CE bearing housing bolt holes.
6. Torque the CE bearing housing bolts to 56 to 60 lb.-ft. (76 to 81 Nm).
7. Place the rotor locking bolts, first nut, and jam nut into the bag-tag, tie the bag-tag to the rotor locking clamp, and save for future use.

Caution: If there is any oil in the gear case, use a three-point lift to raise the combo assembly and keep the gear case level within 4 inches (102 mm) end to end from horizontal. If a traction motor combo with oil in the gear case is tilted, oil will flow past the seals and drain into the traction motor itself.

Screen 48:

DC Armature Locking Bolt Installation:

Caution: The DC armature must be locked when the motor is transported, other than from work station to work station during processing, to prevent damage to the bearings caused by shock and vibration.

Note: A shipping kit, Part number 41B537934G1, may be ordered that contains two long bolts (with heads painted yellow), two jam nuts, and a caution tag. However, when a complete traction motor combo is shipped, the armature is locked using only one bolt.

The armature locking bolt is installed on the commutator end of the DC traction motor. Typical steps to install the DC armature locking bolt on a DC traction motor combo are as follows:

1. Remove one of the two 5/8-inch bolts that are diametrically opposite each other from the commutator end of the traction motor frame.
2. Screw a jam nut onto one of the long bolts from the kit.
3. Thread the long bolt into the traction motor frame until it bears on the commutator end cap.
4. Torque the bolt to 30 lb.-ft. (41 Nm), then secure it with the jam nut.
5. Place the regular bolt and washer into the bag, then tie the tag to the yellow locking bolt for shipment with the traction motor combo.

Caution: To avoid commutator damage, do NOT attempt to rotate the armature with the locking bolt in place.

Screen 49:

DC Armature Locking Bolt Removal:

Note: Before installing a traction motor combo with a set of wheels or a traction motor combo into the truck, the locking bolt must be removed. The proximity of the wheel to the motor makes it impossible to remove the locking bolt later.

Typical steps to remove the DC armature locking bolt from a DC traction motor combo are as follows:

1. Release the jam nut on the yellow bolt and back the bolt out completely.
2. Replace the regular bolt and washer found in the attached bag.
3. Torque the regular bolt to 110 to 120 lb.-ft. (149 to 163 Nm).
4. Place the locking bolt and jam nut into the bag, and save for future use.

Screen 50:

AC Traction Motor Combo: Gear Case Disassembly:

Note: The traction motor combo must be removed from the truck and placed on level ground before the gear case can be removed.

Typical steps to disassemble the gear case are as follows:

1. Drain the lubricant from the gear case by removing the drain plug located on the lower side of the gear case bottom half.
2. Remove the 16 gear case split line bolts and washers and the two gear case mounting bolts.

Warning: The upper gear case weighs approximately 150 lbs. (68 kg). Ensure that the crane and cables are adequate to lift and move the gear case.

3. Attach a lifting cable through the inverted "U-shaped" holes in each end of the upper gear case, and take up the slack in the cables with a hoist or crane.
4. With an overhead crane, lift off the upper gear case, guiding the center bolt pad, located between the axle and pinion bores, through the relief in the traction motor framehead.

Screen 51:

AC Traction Motor Combo: Gear Case Disassembly (Cont'd):

Caution: When prying the lower gear case from the gutter and pinion bore seal, be careful not to damage the gear or pinion teeth.

5. Pry the lower gear case loose from the gutter on one end and the pinion bore seal on the other end.

Warning: The motor, wheels, and axle assembly weighs approximately 13,000 lbs. (6,000 kg). Ensure that the crane and cables are adequate to lift and move the assembly.

6. Attach axle slings. Use a lifting cable at the motor lifting eye and raise the motor, wheels, and axle assembly to approximately one foot.

Note: As the assembly is lifted, guide the center bolt pad through the relief on the framehead while freeing the gear case of the gutters.

7. Remove and discard the gutters and the pinion bore seal.
8. Carefully position the motor on the nose support.

Screen 52:

AC Traction Motor Combo: U-Tube, Wheels, and Axle Assembly Removal:

Typical steps to remove the U-tube, wheels, and axle assembly are as follows:

1. Remove the gear case, as discussed in the AC Traction Motor Combo: Gear Case Disassembly section of this module.
2. Remove the eight bolts and washers that hold the U-tube to the traction motor frame.

Note: If equipped, remove the two 0.625-inch bolts (drain hole plugs) from the middle of the U-tube.

3. Attach a lifting strap to each axle journal bearing, then use jacking bolts, if necessary, to separate the assembly from the traction motor frame.

Warning: When the U-tube, wheels, gear, and axle assembly is lifted, the U-tube will quickly rotate to the open-end up position, and could injure nearby personnel. Support the assembly as it is lifted, allowing the U-tube to turn slowly to the open-end up position.

Warning: The assembly weighs approximately 5,200 lbs. (2,359 kg). Ensure that the crane and cables are adequate to lift and move the assembly.

4. Using a crane or hoist, lift the assembly off the motor.

Screen 53:

AC Traction Motor Combo: U-Tube, Wheels, and Axle Assembly Removal (Cont'd):

Caution: If a high-pressure spray washer is used to clean the U-tube, wheels, gear, and axle assembly, use extreme care to ensure that the spray does not enter the bearings. Do NOT submerge the assembly in liquid.

5. Thoroughly clean the U-tube, wheels, gear, and axle assembly of grease and dirt.
6. After cleaning, apply rust prohibitive to all machined surfaces except the wheels, then cover the assembly in plastic and tape shut until needed.

7. Install guide pins in the bearing cap before removing all the bolts.

Caution: Use the guide pins to keep the alignment of the inner bearing and gasket while the bearing cap is removed. Failure to use guide pins results in misalignment of the inner bearing housing and gasket.

8. Remove the pinion end bearing cap from the traction motor.

Screen 54:

AC Traction Motor Combo: U-Tube, Wheels, and Axle Assembly Removal (Cont'd):

9. Inspect the bearing as follows:
 - a. Verify that the cage is not rubbing the inner ring flange.
 - b. Rotate the bearing by hand, listening for noise and feeling for roughness.

Note: The bearing should turn smoothly and easily. If you hear noise or feel roughness, replace the bearing.

- c. Inspect for metal debris from the bearing rollers, or any other visible defects. If any debris or defect is found, replace the bearing.
- d. Verify bearing clearance with a feeler gauge. It should be 0.012 to 0.016 inches (0.3048 to 0.4064 mm).

Note: If any roller does not fall within the clearance or if measurements between rollers are not equal, replace the bearing.

Screen 55:

AC Traction Motor Combo: U-Tube, Wheels, and Axle Assembly Removal (Cont'd):

10. If no bearing defects are found, flush the bearings with HD 57 oil.
11. Inspect the oil metering hole and trough screen for debris. Flush the trough until no debris washes out.
12. Clean the bearing cap, apply a new gasket, and return the bearing cap to the traction motor.

Note: Ensure that grade 8 bolts are used and are properly torqued.

Screen 56:

AC Traction Motor Combo: U-Tube, Wheels, and Axle Assembly Installation:

Typical steps to install the U-tube, wheels, and the axle are as follows:

1. Clean the traction motor frame and U-tube mounting surfaces with a rag dipped in an approved solvent, then wipe the mounting surfaces with a clean rag to remove excess solvent.
2. Clean the mating surface and apply a gasket (Part Number 41A239176P317) at the pinion end (PE) of the traction motor, where the U-tube and the motor frame join.

3. Clean the mating surface and apply a gasket (Part Number 41A239176P317) at the connection end (CE) of the traction motor, where the U-tube and the motor frame join.
4. Clean the pinion end bearing cap groove with CRC Natural Degreaser.

Screen 57:

AC Traction Motor Combo: U-Tube, Wheels, and Axle Assembly Installation (Cont'd):

5. Install the pinion bore seal into the bearing cap groove as follows:
 - a. Start at the top and work the seal into the groove towards the bottom.

Note: Do NOT stretch the seal on installation; simply roll it over the edge.

Note: Ensure that the seal is not twisted and that it is seated all the way into the groove bottom.

- b. Seat the seal by tapping with a rubber mallet.
 - c. Place the Seating Ring Tool (84A206903P1) over the gasket and rotate it around the gasket.

Note: If the tool catches the gasket, the gasket is not properly seated. Use a rubber mallet to seat the seal until the tool can be rotated fully around the gasket without catching.

Screen 58:

AC Traction Motor Combo: U-Tube, Wheels, and Axle Assembly Installation (Cont'd):

Warning: The U-tube, wheels, gear, and axle assembly weighs approximately 5,200 lbs. (2,359 kg). Ensure that the crane and cables are adequate to lift and move the assembly.

Warning: When the U-tube, wheels, gear, and axle assembly is lifted, the U-tube quickly rotates to the open-end up position, and could injure nearby personnel. As the assembly is lifted, slowly rotate the U-tube to the open-end down position and hold it level to prevent it from returning to the open-end up position.

6. Lift the U-tube, wheels, gear, and axle assembly with a crane or hoist, and rotate the assembly so that the U-tube mounting surface faces downwards. Line up the mounting holes.

Caution: When lowering the U-tube, wheels, gear, and axle assembly, guide the bull gear past the bearing cap to prevent bearing cap damage.

7. Lower the assembly onto the traction motor frame.
 8. Verify that the gear and the pinion are properly aligned and that the teeth are engaged.

Screen 59:

AC Traction Motor Combo: U-Tube, Wheels, and Axle Assembly Installation (Cont'd):

9. Lubricate the threads of the eight U-tube-to-motor mounting bolts and under the bolt heads and both faces of the associated washers with MOLYKOTE® D-321 R lubricant (Part Number 41A219134P9).
10. Start the eight mounting bolts by hand and then evenly torque the bolts to the proper torque value.
11. Install plastic plugs (Part Number 41A235989P5) in both U-tube jacking bolt holes.

Screen 60:

AC Traction Motor Combo: Gear Case Assembly:

Typical steps to assemble the gear case are as follows:

Warning: The motor, wheels, and axle assembly weighs approximately 13,000 lbs. (6,000 kg). Ensure that the crane and cables are adequate to lift and move the assembly.

Caution: Thoroughly clean all components in the gear case before assembly to ensure acceptable performance of the traction motor pinion end rotor bearings and gearing. The split line and pinion bore must be free of oil residue and residual sealant. The baffle and magnetic plugs must be free of dirt and debris.

Note: Use DOW 832 sealant to seal the metal and plastic joints. Full curing time for the sealant is 24 hours.

1. Position the nose of the traction motor down on wooden blocks.
2. Using the Guide Pin Kit (Part Number 41B539007G2), install the motor-side axle seal (gutter) on the axle with the lip of the seal located over the flinger.

Note: The gutter split line should be parallel to the ground with the latch located on the right in the bottom gear case half.

3. Apply a 0.125 to 0.25-inch (3.18 to 6.4-mm) bead of DOW 832 sealant in the groove and latch the seal.
4. Apply a 0.125-inch (3.18-mm) bead of sealant to the latch joint.

Note: Remove excess sealant. Ensure that the sealing surfaces are not pinched or folded.

Screen 61:

AC Traction Motor Combo: Gear Case Assembly (Cont'd):

5. Install the wheel-side axle seal (gutter) to the axle assembly with the lip of the seal located over the wheel and gear hubs.

Note: The gutter split line should be parallel to the ground with the latch located on the left in the bottom gear case half.

6. Apply a 0.125 to 0.25-inch (3.18 to 6.4-mm) bead of sealant in the groove and latch the seal.
7. Apply a 0.125-inch (3.18-mm) bead of sealant to the latch joint, then remove excess sealant.

Note: Ensure that the sealing surfaces are not pinched or folded.

Screen 62:

AC Traction Motor Combo: Gear Case Assembly (Cont'd):

8. Prior to installing the bottom gear case half, apply 0.25-inch (6.4-mm) bead of sealant to the groove of the pinion bore seal, continuously around the entire circumference of the seal.

Note: Using the dispensing nozzle, force the sealant into the groove as it is applied. Remove excess sealant.

Warning: The bottom gear case weighs approximately 180 lbs. (82 kg). Ensure that the crane and cables are adequate to lift and move the assembly.

9. Install the bottom half of the gear case, then verify engagement of the gear case leg with the groove in the pinion bore seal, and the motor-side and wheel-side gutters with the gear case opening.
10. Use C-clamps to draw the bottom half of the gear case to within 0.50 inches (12.7 mm) of the U-tube and motor lugs.

Screen 63:

AC Traction Motor Combo: Gear Case Assembly (Cont'd):

11. Remove the adhesive backing from the Gortex tape (Part Number 41E903878P32) and apply the tape to the center bolt pad between the axle bore and pinion bore on the upper gear case half.
12. On the top gear case half, apply a 0.125-inch (3.18-mm) bead of sealant along the entire split line surface, just inside the bolt holes.

Warning: The top gear case half weighs approximately 150 lbs. (68 kg). Ensure that the crane and cables are adequate to lift and move the assembly.

Caution: Before installing the upper gear case half, inspect the pinion bore seal to verify that the seal has not bulged out of the groove. If it has, remove the bottom gear case half and reseal the pinion seal.

13. Install the top half of the gear case, then verify engagement of the gear case leg with the groove in the motor pinion end bore seal, and the motor-side and wheel-side axle seals (gutters) with the gear case opening.

Screen 64:

AC Traction Motor Combo: Gear Case Assembly (Cont'd):

14. Use C-clamps on the split line flanges at the gear case ends to draw the halves together evenly, then position C-clamps near the gear case center line to prevent misalignment.
15. Fasten the gear case halves as follows:
 - a. Install one split line bolt and washer at the axle end, then draw the gear case halves together but do not tighten.

Note: While the gear case is closing, ensure that the pinion end is properly engaging the pinion bearing cap by viewing the process at the open end.

- b. Install and hand-tighten a second bolt and washer on the motor side axle end.
- c. Install and hand-tighten a third bolt and washer between the axle and pinion bores.

Screen 65:

AC Traction Motor Combo: Gear Case Assembly (Cont'd):

- d. Install and hand-tighten a fourth bolt and washer between the axle and pinion bores.
- e. Install the remaining bolts and washers that hold the gear case halves together, and tighten all bolts evenly.
- f. Torque all bolts to the proper value.
- g. Verify closure of the upper gear case half by "shim checking" with a 0.010 inch (0.254 mm) shim in the wheel-side flange at the pinion end.

Note: If the shim fits, loosen all split line bolts, correct the problem, and then re-torque the bolts.

Screen 66:

AC Traction Motor Combo: Gear Case Assembly (Cont'd):

16. Remove the guide pins and install the mounting bolts (one at a time), then hand-tighten the bolts.
17. Torque the gear case-to-motor and gear case-to-U-tube bolts to the proper value, then, to seal out moisture, apply DOW 832 sealant to the open end of the threaded through holes for the gear case mounting bolts, completely filling the end of the bolt holes.

Note: On gear cases equipped with inspection covers, clean the cover and (without gasket) apply a 0.125-inch (3.2-mm) bead of DOW 832 sealant around and between the bolt holes. Install the cover, torque the bolts to the proper value, and apply a safety lock wire.

Warning: The motor, wheels, gear case, and axle assembly weighs approximately

13,270 lbs. (6,019 kg). Ensure that the crane and cables are adequate to lift and move the assembly.

18. Attach a lifting strap to each axle journal bearing, then lift the traction motor, axle, and wheels assembly and rotate 90° to return the traction motor combo to the horizontal position.

Screen 67:

AC Traction Motor Combo: Gear Case Assembly (Cont'd):

19. On gear cases with solid-fill plugs, add lubricant to the gear case as follows:
 - a. Remove the fill plug.
 - b. Fill the gear case with 14.5 quarts (13.7 liters) of lubricant.

Caution: Do NOT overfill the gear case.

- c. Using a clean rag, wipe the magnet on the fill plug.
 - d. Apply Hylomar Thread Sealant to the fill plug threads and torque to the proper value.
 - e. Apply a safety lock wire to the fill plug and the drain plug.
20. On gear cases with spring-loaded fill plugs, add lubricant to the gear case as follows:
 - a. Pull on the plug cover and hold the fill plug open to add lubricant.

Note: The fill plug does not have to be removed to add lubricant.

- b. Fill the gear case with 14.5 quarts (13.7 liters) of lubricant.

Caution: Do NOT overfill the gear case.

- c. Release the plug and allow the spring loading to close the fill plug.

Note: The motor, wheels, gear case, and axle assembly may have to be leveled to completely charge with lubricant. Allow the lubricant to settle before checking against the fill line.

21. Assemble the breather to the top of the gear case.

Screen 70:

DC Traction Motor Combo: Gear Case Disassembly:

Note: The traction motor assembly must be removed from the truck and placed on level ground before the gear case can be removed.

Typical steps to disassemble the gear case are as follows:

1. Drain the gear case lubricant into a suitable container.
2. With the motor and axle assembly in the normal horizontal position, remove the eight split line bolts holding the top half of the gear case to the bottom half.
3. Lift off the top half of the gear case with a crane.
4. Remove the three gear case mounting bolts and washers or washer assemblies that secure the bottom half to the traction motor frame and drop the gear case to the floor.
5. If equipped, discard any Nord Lock or 4-component load washers.
6. Move the gear case to a suitable area.

Screen 71:

DC Traction Motor Combo: Gear Case Disassembly (Cont'd):

7. Carefully inspect the gear case mounting and split line bolts and replace or return to service depending on the following inspection criteria:
 - a. The bolt visually appears bent. Check for a bent bolt by laying it on a flat surface and rolling the bolt.
 - b. The threads are damaged to the point that the bolt cannot be installed by hand.
 - c. The bolts have visible cracks or deformation in shank and threads or underhead radius. Light surface rust is acceptable, but no corrosion pitting is acceptable in the shank, underhead radius, and threads.
 - d. The bolts are corroded to the extent that corrosion cannot be removed with a rag and solvent (such as brake cleaner or alcohol).

Note: All split line bolts that are less than grade 8 should be scrapped.

8. Thoroughly cleanse the gear case split line bolts that can be reused.
9. Clean hardened washers to remove all dirt and oil and return to service.

Note: Scrap any washers that are not visibly flat. Ensure that the surface mounted to the U-tube is free of paint.

Screen 72:

DC Traction Motor Combo: Gear Case Disassembly (Cont'd):

Warning: The traction motor, wheels, and axle assembly weighs approximately 12,000 lbs. (5,443 kg). Ensure that the crane and cables are adequate to lift and move the assembly.

Warning: When the U-tube, wheels, gear, and axle assembly is lifted, the U-tube will quickly rotate to the open-end up position, and could injure nearby personnel. Support the assembly as it is lifted, allowing the U-tube to turn slowly to the open-end up position.

10. Attach a nylon lifting strap to each axle journal bearing.
11. Lift the motor, wheels, and axle assembly and rotate it 90°.
12. Position the motor nose on wooden blocks.

13. Remove the motor-side and wheel-side axle bore seals (gutters) from the axle.

Note: The axle bore seals should be replaced when wheels are renewed.

Screen 73:

DC Traction Motor Combo: U-Tube, Wheels, and Axle Assembly Removal:

Typical steps to remove the U-tube, wheels, and axle are as follows:

1. Remove the gear case as discussed in the DC Traction Motor Combo: Gear Case Disassembly section of this module.
2. Remove the two bolts, plate, and cable cleat holding the traction motor cables to the U-tube.
3. Remove the eight bolts that hold the U-tube to the traction motor frame.
4. If equipped, remove the two 5/8-inch bolts (or drain hole plugs) from the middle of the U-tube.

Note: While removing the traction motor bolts, check the bolt head for the bolt grade. Discard all grade 5 bolts and replace them with grade 8 bolts.

5. Attach lifting cables around both ends of the wheels, gear, axle, and U-tube assembly.

Screen 74:

DC Traction Motor Combo: U-Tube, Wheels, and Axle Assembly Removal (Cont'd):

6. Use jacking bolts, if necessary, to separate the U-tube assembly from the traction motor frame.

Warning: The U-tube, wheels, gear, and axle assembly weighs approximately 6,000 lbs. (2,722 kg). Ensure that the crane and cables are adequate to lift and move the assembly.

Warning: When the wheels, gear, axle, and U-tube assembly is lifted, the U-tube will quickly rotate to the open-end up position and may injure personnel standing nearby. As the assembly is lifted, support it to allow the U-tube to slowly turn to the open-end up position.

7. Using a crane or hoist, lift the wheels, gear, axle, and U-tube assembly clear of the traction motor.

Caution: If a high-pressure spray washer is used to clean the U-tube, gear, wheels, and axle assembly, use extreme care that the spray does not enter the open labyrinth bearing seals. Do NOT submerge the assembly in liquid.

8. Thoroughly clean the U-tube, gear, wheels, and axle assembly to remove grease and dirt.

9. After cleaning, apply rust prohibitive to all machined surfaces except the wheels, then cover the assembly in plastic and tape shut until needed.

Screen 75:

DC Traction Motor Combo Assembly: U-Tube, Wheels, and Axle Assembly Installation:

Typical steps to install the U-tube, wheels, and axle are as follows:

1. Clean the traction motor frame and U-tube mounting surfaces with a rag dipped in an approved solvent, then wipe the mounting surfaces with a clean rag to remove any excess solvent.
2. Apply a gasket (Part Number 41A239176P317) to the commutator end of the traction motor frame where the U-tube mounts to the frame and trim the gasket to fit.
3. Apply another gasket (Part Number 41A239176P317) to the pinion end of the traction motor frame where the U-tube mounts to the frame and trim the gasket to fit.

Screen 76:

DC Traction Motor Combo Assembly: U-Tube, Wheels, and Axle Assembly Installation (Cont'd):

Warning: The U-tube, wheels, gear, and axle assembly weighs approximately 6,000 lbs. (2,722 kg). Ensure that the crane and cables are adequate to lift and move the assembly.

Warning: When the wheels, gear, axle, and U-tube assembly is lifted, the U-tube will quickly rotate to the open-end up position and may injure personnel standing nearby. As the assembly is being lifted, support it to allow the U-tube to slowly turn to the open-end up position.

4. Lift the U-tube, wheels, gear, and axle assembly with a crane or hoist; rotate the assembly so that the U-tube mounting surface is facing downward.
5. Line up the mounting holes and lower the assembly onto the traction motor.
6. Verify that the two gears are properly aligned and that the teeth are engaged.

Note: While installing the U-tube-to-motor mounting bolts, check the bolt head for the bolt grade. Discard all grade 5 bolts and replace them with grade 8 bolts.

7. Lubricate the threads of the eight U-tube-to-motor mounting bolts and under the bolt heads and both faces of the associated washers with a Wabtec approved Moly-based lubricant (84B565364A1) and wait until dry to touch (approximately 5 minutes) before assembly.
8. Start the eight mounting bolts by hand and then torque the bolts to 1325 ± 75 lb.-ft. (1797 ± 102 Nm).

Note: Follow the proper torque sequence to prevent the U-tube mounting bolts from loosening on the traction motor.

9. Install the two 5/8-inch bolts into the U-tube drain holes.

Screen 77:

DC Traction Motor Combo: Gear Case Assembly:

Typical steps to assemble the gear case after positioning the nose of the traction motor down on wooden blocks are as follows:

Note: Gear cases and U-tubes made prior to October 1989 may require modification to bring them to the latest revision level. Three pipe plugs should be installed on each gear case and a gear case to U-tube mounting lug should be welded to each U-tube. If required, contact your Field Services representative.

Warning: The traction motor, wheels, and axle assembly weighs approximately 12,000 lbs. (5,443 kg). Ensure that the crane and cables are adequate to lift and move the assembly.

Note: Only an approved sealant is to be used to seal the metal and plastic joints. The curing time for the sealant is 24 hours. In most cases, a 0.25-inch (6.4-mm) minimum bead of the approved sealant is required. However, at the gear case split line a 0.13-inch (3.2-mm) maximum bead should be used.

1. Clean the surface of the bull gear flinger on which the motor-side gear case seal (gutter) rides, then lubricate this surface with D50E25C gear oil or equivalent.
2. Install the motor-side axle seal to the axle assembly with the lip of the seal located over the flinger.

Note: The latch should be located on the left (bottom half of the gear case) and the cut-out notch should be located on the right (top half of the gear case).

3. Add a 0.25-inch (6.4-mm) minimum bead of the approved sealant in the groove and latch the seal.

Note: Do NOT apply sealant in excess of a 0.25-inch (6.4-mm) bead at the latch joint. Ensure that all sealing surfaces are not pinched or folded.

Screen 78:

DC Traction Motor Combo: Gear Case Assembly (Cont'd):

4. Clean the surfaces of the wheel and gear hubs on which the wheel-side gear case seal (gutter) rides, then lubricate these surfaces with D50E25C gear oil or equivalent.

5. Install the wheel-side axle seal to the axle assembly with the lip of the seal located over the wheel gear and gear hubs.

Note: The latch should be located on the left (bottom half of the gear case), and the cutout notch should be located on the right (top half of the gear case).

6. Add a 0.25-inch (6.4-mm) minimum bead of the approved sealant in the groove and latch the seal.
7. Add a 0.25-inch (6.4-mm) maximum bead of the approved sealant to the joint where the latch occurs, ensuring that all sealing surfaces are not pinched or folded.

Screen 79:

DC Traction Motor Combo: Gear Case Assembly (Cont'd):

8. Fill the groove in the bottom half of the gear case at the armature bearing cap bore with the approved sealant.
9. Apply an additional 0.25-inch (6.4-mm) bead by 3-inch (76.2-mm) long of the approved sealant to both sides of the split line. Repeat this step for the top half of the gear case, except apply the additional 0.25-inch (6.4-mm) bead of sealant to the entire semicircle.

Note: Ensure that sealant does not block or obstruct the armature bearing cap overboard drain slots.

Screen 80:

DC Traction Motor Combo: Gear Case Assembly (Cont'd):

10. Install the bottom half of the gear case, ensuring that the gear case groove engages with the bearing cap lip and the inner and outer axle seals in the gear case opening.
11. Mount a washer or washer assembly on a 12-point flanged 1.00-8 bolt, then install the first gear case mounting bolt and washer assembly as follows:
 - a. If a Nord lockwasher is used, lubricate the threads of the gear case mounting bolt and both faces of the washer with a Wabtec approved Moly-based lubricant (84B565364A1) and wait until dry to touch (approximately 5 minutes) before assembly, and then install the bolt and washer in the top hole and hand tighten.
 - b. If a solid washer assembly is used, without lubrication, install the bolt and washers in the top hole and hand tighten.
 - c. If a 4-component load washer/spacer assembly is used, without lubrication and while ensuring that the chamfered (colored) side of the load washer is against the bolt head, install the bolt and washers/spacer assembly in the top hole and hand tighten.

12. On the top gear case half, apply a 0.13-inch (3.2-mm) maximum bead of the approved sealant along the engine joint face between the gear case halves and do not allow the approved sealant within 1 inch (25.4 mm) of the split line bolt holes.

Note: Be careful to keep the sealant away from the gear case bolt holes.

Screen 81:

DC Traction Motor Combo: Gear Case Assembly (Cont'd):

13. Install the top half of the gear case and verify engagement of the gear case groove with the bearing cap lip and the axle seals in the gear case opening.
14. Install in pairs and evenly tighten the eight bolts that hold the gear case halves together, starting at the top.
15. Torque the three 3/8-inch bolts to 22.5 ± 1.5 lb.-ft. (30.5 ± 2 Nm).
16. Torque the five 3/4-inch bolts to 198 ± 13 lb.-ft. (268 ± 18 Nm).
17. Install the gear case mounting bolts as follows as the preferred method of installation:
 - a. Lubricate the gear case mounting bolt threads and both faces of the washer with a Wabtec approved Moly-based lubricant (84B565364A1) and wait until dry to touch (approximately 5 minutes) before assembly.
 - b. Using a reduced shank, 1.00-8 threaded bolt (84B534558P1), and Nord lockwasher (84B534568P1) for each bolt position, install the two remaining bolts and install one Nord lockwasher on each of the bolts.
 - c. Using a Norbar torque/angle tool (or equivalent), apply a 425 ± 20 lb.-ft. (576 ± 27 Nm) torque plus a 45° angle to each of the three gear case mounting bolts.

Note: Ensure that the Nord lockwasher halves are properly aligned. If they are not aligned, the bolt must be removed and re-installed with a new Nord lockwasher.

- d. Using a paint pen, draw a line across the top and sides of each bolt head that extends onto the gear case on both sides of the bolt.

Screen 82:

DC Traction Motor Combo: Gear Case Assembly (Cont'd):

18. An alternate method to install the gear case mounting bolts is as follows:
 - a. Using a solid washer assembly on 1.00-8 bolts, mount the two remaining bolts and washer assemblies and hand tighten.
 - b. Torque the three gear case mounting bolts to 400 lb.-ft. (542 Nm) and then turn them to 55° using the torque/angle wrench.

Note: The torque accuracy should be within $\pm 3\%$ of its maximum torque. The angle accuracy should be within $\pm 3\%$ of its set value. The wrench repeatability should be within $\pm 2\%$ of its set value.

19. Another method to install the gear case mounting bolts is as follows:

- a. Using 4-component load washer assemblies mounted on 12-point flanged 1.00-8 bolts, install the two remaining bolts and washer assemblies and hand tighten.

Note: For each bolt and washer assembly, ensure that the chamfered side (colored side) of the load washer is against the bolt head.

Screen 83:

DC Traction Motor Combo: Gear Case Assembly (Cont'd):

- b. Tighten all three load washer and bolt assemblies by inserting a pin or small Allen wrench in one of the holes in the outer ring of the load washer assembly, then tighten the bolt while rotating the ring back and forth.

Note: Stop tightening the bolt when the load washer is crushed enough that the outer ring no longer rotates easily.

Note: If the outer ring turns hard because of hand pressure on the small pin, it is acceptable. Do not try to turn the outer ring by backing the bolt out. If for any reason the bolt must be loosened or removed, the load washer assembly must be scrapped and a new load washer assembly used.

- c. Torque all three gear case mounting bolts until the inner ring of the load washer assembly compresses and the outer ring is just seized between the two flat washers.

Note: Once the load washer is compressed, do not tighten any further and do not use an impact wrench.

Note: The correct bolt tension will be obtained as follows:

- If a reduced shank bolt and Nord lockwasher are used, apply the correct torque plus the additional angle as specified in the steps.
- If a solid washer assembly is used, torque until the torque/angle reaches its set value.
- If a 4-component load washer is used, stop torquing just as the outer ring stops rotating easily. Rotating hard means that it takes more than 4 lb.-ft. (5 Nm) of torque to rotate the outer ring; to achieve this approximately apply finger pressure on a 4 to 6-inch pin or Allen wrench. It is acceptable if the outer ring does not turn at all at up to 30 lb.-ft. (40 Nm) of torque. The bolt retaining force will still be within acceptable limits.

Screen 84:

DC Traction Motor Combo: Gear Case Assembly (Cont'd):

20. Verify that a bead of the approved sealant is visible at the joints after the bolts have been torqued and that a bead of sealant is visible around the pinion end

armature bearing cap, and that the armature bearing cap overboard drain slots are free of sealant.

Warning: The traction motor, wheels, and axle assembly weighs approximately 12,000 lbs. (5,443 kg). Ensure that the crane and cables are adequate to lift and move the assembly.

Warning: When the traction motor, wheel, and axle assembly is lifted, the U-tube will quickly rotate to the open-end up position, and could injure nearby personnel. Therefore, as the assembly is being lifted, support the assembly by allowing the U-tube to turn slowly to the open-end up position.

21. Attach a nylon lifting strap to each axle journal bearing, then lift the traction motor, axle, and wheel assembly and rotate 90° to return the traction motor combo to the horizontal position.
22. After the 24 hours sealant cure time is over, apply D50E25C gear oil or equivalent to the gear case.

Note: The initial fill capacity of the gear case is 9 quarts (8.5 liters).

23. Check the gear case lubricant level using a dipstick (Part Number 41C637237G1), then install and torque all pipe plugs to 100 to 110 lb.-ft. (136 to 150 Nm).
24. Apply a safety lock wire to the fill plug and the drain plug.

Note: The gear case oil level should never be more than 1.75 inches (44 mm) below the bottom of the fill opening. One quart (1 L) of oil will raise the oil level by approximately 0.375 inches (10 mm).

Screen 87:

Summary:

You have reached the end of this module!

In this module, you learned to:

- State the purpose of the traction motor combo.
 - The main purpose of the traction motor combo is to convert electrical energy to mechanical energy for driving the locomotive wheels, a process referred to as motoring. The traction alternator supplies the electrical energy.
 - The secondary purpose of the traction motor combo is to convert the mechanical energy of slowing a moving locomotive to electrical energy utilizing a process referred to as dynamic braking. In dynamic braking, the traction motors function as generators with the electrical energy that they produce dissipated as heat in the dynamic braking resistor grids.

- Describe the major components of a traction motor combo.
 - The traction motor takes electrical energy from the propulsion system and converts it into mechanical energy for driving the locomotive wheels.
 - The bull gear, pressed onto the axle, meshes with the pinion gear on the traction motor rotor to transfer the torque of the traction motor to the axle.
 - The axle is used to transfer the rotational force of the traction motor to the wheels. Journal bearings, located on each end of the axle, allow the axle to turn with minimal friction when mounted inside the journal boxes attached to the truck frame.
 - The locomotive rides on the tread of the wheel, and the wheel flange keeps the locomotive on the rails.
 - The U-tube, mounted to the traction motor, wraps around and houses the axle. The U-tube contains two roller bearing assemblies that support the traction motor and allow axle rotation within the U-tube.
 - The gear case protects the pinion and bull gears from the outside environment. Additionally, the gear case contains the oil used to lubricate the two gears. On AC traction motors, the oil also lubricates the pinion end bearing in the traction motor. The gear case consists of two halves, a top or upper half and a bottom or lower half, which are bolted together.

- Identify the running maintenance requirements for the traction motor combo.
 - Traction Motors
 - Every 92 days, in DC traction motors, check for loose or missing traction motor commutator covers, check commutator for discoloration and damage, and check for chipped, broken, or damaged brushes. For both AC and DC traction motors, check power leads for abrasion damage and rubbing against other cables or truck parts.
 - When renewing wheels, visually inspect and run traction motors with no load. Check armature bearings for unusual noises and binding and vibration. Check commutator smoothness and resurface, if necessary, using jig grinding device. Clean insulators. Blow out debris with compressed air. Repair covers as required.
 - Traction Motor Combo
 - Every 92 days, inspect gear cases for mechanical damage. Check for damaged or missing fill or drain plugs. Clean metal particles from drain plug if removed. Inspect the entire combo for excessive oil leakage. Check oil level in the gear case. Fill oil to the indicated level below the bottom of the fill opening. If oil loss is greater than limits, remove traction motor combo and inspect it.
 - Every 92 days, inspect gear case mounting bolts and U-tube to traction motor mounting bolts for tightness by hand or a wrench. Check for any gap in the joint visually, by performing a hammer test, or by using a 0.005-inch feeler gauge. If parts are loose, broken, or missing, replace with new parts. Tighten all the bolts to the specified torque values.

- Every 92 days, check accessible gear case split line bolts for looseness by hand or wrench or perform an 8-ounce hammer test. If parts are loose, broken, or missing, replace with new parts. Tighten all the bolts to the specified torque values.
- Annually, drain and refill the gear case.
- When renewing wheels, renew gear case seals. Drain and refill the gear case. Clean and inspect the pinion and bull gears for wear and damage.
- Wheels
 - Daily or per trip, visually inspect the wheel rim versus the witness groove for wheel wear. Check for cracks, shelled treads, or flat spots. Make corrections as required.
- Describe the basic operation of a traction motor combo.
 - Electricity is supplied to the traction motor from the propulsion system.
 - Coils in the traction motor create a magnetic field, which causes the rotor to turn.
 - On the rotor, the small pinion gear meshes with the larger bull gear on the axle. Depending on the traction motor design, the pinion gear may either be formed as an integral part of the rotor or may be pressed onto the rotor.
 - The bull gear is pressed onto the axle along with the two wheels and the U-tube. Two roller-bearing assemblies allow the axle to rotate freely within the U-tube while the two journal bearings allow the axle to rotate freely within the journal box mounted to the truck.
 - With the traction motor powered, the pinion and bull gears mesh, causing the axle and wheels to turn and power the locomotive.

Screen 88:

Summary (Cont'd):

- Summarize the major steps to remove and install a traction motor combo.
 - 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 of the traction motor combo to be removed by closing the cut-out cock in the air line for that truck.
 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.
 4. Unplug the speed sensor cable of the traction motor combo to be removed, then remove the cable clamp.
 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.
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.
10. Remove the pedestal liner and axle journal bearing housing retaining bolts, retainers, and any free 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.
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.
 - b. Disconnect the suspension link from the motor.
 - 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.
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.
 - 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.
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.
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.
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.
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.

Screen 89:

Summary (Cont'd):

- Traction Motor Combo Installation
 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.
 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.
 5. Raise the drop table with the traction motor combo.
 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.
12. Connect the AC traction motor nose suspension as follows:
 - a. Release the come-along or chain rigging. 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.
 - c. Insert CAMCAR bolts through the suspension link motor lugs and hand-tighten the nuts.
 - d. Tighten the CAMCAR bolts with the special socket until the head shears off each bolt.
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.
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 boot 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 adjustor pins, then adjust the slack adjusters.
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 90:

Summary (Cont'd):

- Summarize the major steps to disassemble and assemble an AC traction motor combo.
 - Gear Case Disassembly
 1. Drain the lubricant from the gear case by removing the drain plug located on the lower side of the gear case bottom half.
 2. Remove the 16 gear case split line bolts and washers and the two gear case mounting bolts.
 3. Attach a lifting cable through the inverted "U-shaped" holes in each end of the upper gear case, and take up the slack in the cables with a hoist or crane.
 4. With an overhead crane, lift off the upper gear case, guiding the center bolt pad, located between the axle and pinion bores, through the relief in the traction motor framehead.
 5. Pry the lower gear case loose from the gutter on one end and the pinion bore seal on the other end.
 6. Attach axle slings. Use a lifting cable at the motor lifting eye and raise the motor, wheels, and axle assembly to approximately one foot.
 7. Remove and discard the gutters and the pinion bore seal.
 8. Carefully position the motor on the nose support.
 - U-tube, Wheels, and Axle Assembly Removal
 1. Remove the gear case.
 2. Remove the eight bolts and washers that hold the U-tube to the traction motor frame.
 3. Attach a lifting strap to each axle journal bearing, then use jacking bolts, if necessary, to separate the assembly from the traction motor frame.
 4. Using a crane or hoist, lift the assembly off the motor.
 5. Thoroughly clean the U-tube, wheels, gear, and axle assembly of grease and dirt.
 6. After cleaning, apply rust prohibitive to all machined surfaces except the wheels, then cover the assembly in plastic and tape shut until needed.
 7. Install guide pins in the bearing cap before removing all the bolts.
 8. Remove the pinion end bearing cap from the traction motor.
 9. Inspect the bearing as follows:
 - a. Verify that the cage is not rubbing the inner ring flange.
 - b. Rotate the bearing by hand, listening for noise and feeling for roughness.
 - c. Inspect for metal debris from the bearing rollers, or any other visible defects. If any debris or defect is found, replace the bearing.
 - d. Verify bearing clearance with a feeler gauge. It should be 0.012 to 0.016 inches (0.3048 to 0.4064 mm).
 10. If no bearing defects are found, flush the bearings with HD 57 oil.
 11. Inspect the oil metering hole and trough screen for debris. Flush the trough until no debris washes out.

12. Clean the bearing cap, apply a new gasket, and return the bearing cap to the traction motor.
- U-tube, Wheels, and Axle Assembly Installation
 1. Clean the traction motor frame and U-tube mounting surfaces with a rag dipped in an approved solvent, then wipe the mounting surfaces with a clean rag to remove excess solvent.
 2. Clean the mating surface and apply a gasket (Part Number 41A239176P317) at the pinion end (PE) of the traction motor, where the U-tube and the motor frame join.
 3. Clean the mating surface and apply a gasket (Part Number 41A239176P317) at the connection end (CE) of the traction motor, where the U-tube and the motor frame join.
 4. Clean the pinion end bearing cap groove with CRC Natural Degreaser.
 5. Install the pinion bore seal into the bearing cap groove as follows:
 - a. Start at the top and work the seal into the groove towards the bottom.
 - b. Seat the seal by tapping with a rubber mallet.
 - c. Place the Seating Ring Tool (84A206903P1) over the gasket and rotate it around the gasket.
 6. Lift the U-tube, wheels, gear, and axle assembly with a crane or hoist, and rotate the assembly so that the U-tube mounting surface faces downwards. Line up the mounting holes.
 7. Lower the assembly onto the traction motor frame.
 8. Verify that the gear and the pinion are properly aligned and that the teeth are engaged.
 9. Lubricate the threads of the eight U-tube-to-motor mounting bolts and under the bolt heads and both faces of the associated washers with MOLYKOTE® D-321 R lubricant (Part Number 41A219134P9).
 10. Start the eight mounting bolts by hand and then evenly torque the bolts to the proper torque value.
 11. Install plastic plugs (Part Number 41A235989P5) in both U-tube jacking bolt holes.

Screen 91:

Summary (Cont'd):

- Gear Case Assembly
 1. Position the nose of the traction motor down on wooden blocks.
 2. Using the Guide Pin Kit (Part Number 41B539007G2), install the motor-side axle seal (gutter) on the axle with the lip of the seal located over the flinger.
 3. Apply a 0.125 to 0.25-inch (3.18 to 6.4-mm) bead of DOW 832 sealant in the groove and latch the seal.
 4. Apply a 0.125-inch (3.18-mm) bead of sealant to the latch joint.
 5. Install the wheel-side axle seal (gutter) to the axle assembly with the lip of the seal located over the wheel and gear hubs.

6. Apply a 0.125 to 0.25-inch (3.18 to 6.4-mm) bead of sealant in the groove and latch the seal.
7. Apply a 0.125-inch (3.18-mm) bead of sealant to the latch joint, then remove excess sealant.
8. Prior to installing the bottom gear case half, apply 0.25-inch (6.4-mm) bead of sealant to the groove of the pinion bore seal, continuously around the entire circumference of the seal.
9. Install the bottom half of the gear case, then verify engagement of the gear case leg with the groove in the pinion bore seal, and the motor-side and wheel-side gutters with the gear case opening.
10. Use C-clamps to draw the bottom half of the gear case to within 0.50 inches (12.7 mm) of the U-tube and motor lugs.
11. Remove the adhesive backing from the Gortex tape (Part Number 41E903878P32) and apply the tape to the center bolt pad between the axle bore and pinion bore on the upper gear case half.
12. On the top gear case half, apply a 0.125-inch (3.18-mm) bead of sealant along the entire split line surface, just inside the bolt holes.
13. Install the top half of the gear case, then verify engagement of the gear case leg with the groove in the motor pinion end bore seal, and the motor-side and wheel-side axle seals (gutters) with the gear case opening.
14. Use C-clamps on the split line flanges at the gear case ends to draw the halves together evenly, then position C-clamps near the gear case center line to prevent misalignment.
15. Fasten the gear case halves as follows:
 - a. Install one split line bolt and washer at the axle end, then draw the gear case halves together but do not tighten.
 - b. Install and hand-tighten a second bolt and washer on the motor side axle end.
 - c. Install and hand-tighten a third bolt and washer between the axle and pinion bores.
 - d. Install and hand-tighten a fourth bolt and washer between the axle and pinion bores.
 - e. Install the remaining bolts and washers that hold the gear case halves together, and tighten all bolts evenly.
 - f. Torque all bolts to the proper value.
 - g. Verify closure of the upper gear case half by "shim checking" with a 0.010-inch (0.254-mm) shim in the wheel-side flange at the pinion end.
16. Remove the guide pins and install the mounting bolts (one at a time), then hand-tighten the bolts.
17. Torque the gear case-to-motor and gear case-to-U-tube bolts to the proper value, then, to seal out moisture, apply DOW 832 sealant to the open end of the threaded through holes for the gear case mounting bolts, completely filling the end of the bolt holes.

18. Attach a lifting strap to each axle journal bearing, then lift the traction motor, axle, and wheels assembly and rotate 90° to return the traction motor combo to the horizontal position.
19. On gear cases with solid-fill plugs, add lubricant to the gear case as follows:
 - a. Remove the fill plug.
 - b. Fill the gear case with 14.5 quarts (13.7 liters) of lubricant.
 - c. Using a clean rag, wipe the magnet on the fill plug.
 - d. Apply Hylomar Thread Sealant to the fill plug threads and torque to the proper value.
 - e. Apply a safety lock wire to the fill plug and the drain plug.
20. On gear cases with spring-loaded fill plugs, add lubricant to the gear case as follows:
 - a. Pull on the plug cover and hold the fill plug open to add lubricant.
 - b. Fill the gear case with 14.5 quarts (13.7 liters) of lubricant.
 - c. Release the plug and allow the spring loading to close the fill plug.
21. Assemble the breather to the top of the gear case.

Screen 92:

Summary (Cont'd):

- Summarize the major steps to disassemble and assemble a DC traction motor combo.
 - Gear Case Disassembly
 1. Drain the gear case lubricant into a suitable container.
 2. With the motor and axle assembly in the normal horizontal position, remove the eight split line bolts holding the top half of the gear case to the bottom half.
 3. Lift off the top half of the gear case with a crane.
 4. Remove the three gear case mounting bolts and washers or washer assemblies that secure the bottom half to the traction motor frame and drop the gear case to the floor.
 5. If equipped, discard any Nord Lock or 4-component load washers.
 6. Move the gear case to a suitable area.
 7. Carefully inspect the gear case mounting and split line bolts and replace or return to service depending on the following inspection criteria:
 - a. The bolt visually appears bent. Check for a bent bolt by laying it on a flat surface and rolling the bolt.
 - b. The threads are damaged to the point that the bolt cannot be installed by hand.
 - c. The bolts have visible cracks or deformation in shank and threads or underhead radius. Light surface rust is acceptable, but no corrosion pitting is acceptable in the shank, underhead radius, and threads.
 - d. The bolts are corroded to the extent that corrosion cannot be removed with a rag and solvent (such as brake cleaner or alcohol).
 8. Thoroughly cleanse the gear case split line bolts that can be reused.

9. Clean hardened washers to remove all dirt and oil and return to service.
 10. Attach a nylon lifting strap to each axle journal bearing.
 11. Lift the motor, wheels, and axle assembly and rotate it 90°.
 12. Position the motor nose on wooden blocks.
 13. Remove the motor-side and wheel-side axle bore seals (gutters) from the axle.
- U-tube, Wheels, and Axle Assembly Removal
 1. Remove the gear case.
 2. Remove the two bolts, plate, and cable cleat holding the traction motor cables to the U-tube.
 3. Remove the eight bolts that hold the U-tube to the traction motor frame.
 4. If equipped, remove the two 5/8-inch bolts (or drain hole plugs) from the middle of the U-tube.
 5. Attach lifting cables around both ends of the wheels, gear, axle, and U-tube assembly.
 6. Use jacking bolts, if necessary, to separate the U-tube assembly from the traction motor frame.
 7. Using a crane or hoist, lift the wheels, gear, axle, and U-tube assembly clear of the traction motor.
 8. Thoroughly clean the U-tube, gear, wheels, and axle assembly to remove grease and dirt.
 9. After cleaning, apply rust prohibitive to all machined surfaces except the wheels, then cover the assembly in plastic and tape shut until needed.
 - U-tube, Wheels, and Axle Assembly Installation
 1. Clean the traction motor frame and U-tube mounting surfaces with a rag dipped in an approved solvent, then wipe the mounting surfaces with a clean rag to remove any excess solvent.
 2. Apply a gasket (Part Number 41A239176P317) to the commutator end of the traction motor frame where the U-tube mounts to the frame and trim the gasket to fit.
 3. Apply another gasket (Part Number 41A239176P317) to the pinion end of the traction motor frame where the U-tube mounts to the frame and trim the gasket to fit.
 4. Lift the U-tube, wheels, gear, and axle assembly with a crane or hoist; rotate the assembly so that the U-tube mounting surface is facing downward.
 5. Line up the mounting holes and lower the assembly onto the traction motor.
 6. Verify that the two gears are properly aligned and that the teeth are engaged.
 7. Lubricate the threads of the eight U-tube-to-motor mounting bolts and under the bolt heads and both faces of the associated washers with a Wabtec approved Moly-based lubricant (84B565364A1) and wait until dry to touch (approximately 5 minutes) before assembly.
 8. Start the eight mounting bolts by hand and then torque the bolts to 1325 ± 75 lb.-ft. (1797 ± 102 Nm).

9. Install the two 5/8-inch bolts into the U-tube drain holes.

Screen 93:

Summary (Cont'd):

- Gear Case Assembly
 1. Clean the surface of the bull gear flinger on which the motor-side gear case seal (gutter) rides, then lubricate this surface with D50E25C gear oil or equivalent.
 2. Install the motor-side axle seal to the axle assembly with the lip of the seal located over the flinger.
 3. Add a 0.25-inch (6.4-mm) minimum bead of the approved sealant in the groove and latch the seal.
 4. Clean the surfaces of the wheel and gear hubs on which the wheel-side gear case seal (gutter) rides, then lubricate these surfaces with D50E25C gear oil or equivalent.
 5. Install the wheel-side axle seal to the axle assembly with the lip of the seal located over the wheel gear and gear hubs.
 6. Add a 0.25-inch (6.4-mm) minimum bead of the approved sealant in the groove and latch the seal.
 7. Add a 0.25-inch (6.4-mm) maximum bead of the approved sealant to the joint where the latch occurs, ensuring that all sealing surfaces are not pinched or folded.
 8. Fill the groove in the bottom half of the gear case at the armature bearing cap bore with the approved sealant.
 9. Apply an additional 0.25-inch (6.4-mm) bead by 3-inch (76.2-mm) long of the approved sealant to both sides of the split line. Repeat this step for the top half of the gear case, except apply the additional 0.25-inch (6.4-mm) bead of sealant to the entire semicircle.
 10. Install the bottom half of the gear case, ensuring that the gear case groove engages with the bearing cap lip and the inner and outer axle seals in the gear case opening.
 11. Mount a washer or washer assembly on a 12-point flanged 1.00-8 bolt, then install the first gear case mounting bolt and washer assembly as follows:
 - a. If a Nord lockwasher is used, lubricate the threads of the gear case mounting bolt and both faces of the washer with a Wabtec approved Moly-based lubricant (84B565364A1) and wait until dry to touch (approximately 5 minutes) before assembly, and then install the bolt and washer in the top hole and hand tighten.
 - b. If a solid washer assembly is used, without lubrication, install the bolt and washers in the top hole and hand tighten.
 - c. If a 4-component load washer/spacer assembly is used, without lubrication and while ensuring that the chamfered (colored) side of the load washer is against the bolt head, install the bolt and washers/spacer assembly in the top hole and hand tighten.

12. On the top gear case half, apply a 0.13-inch (3.2-mm) maximum bead of the approved sealant along the engine joint face between the gear case halves and do not allow the approved sealant within 1 inch (25.4 mm) of the split line bolt holes.
13. Install the top half of the gear case and verify engagement of the gear case groove with the bearing cap lip and the axle seals in the gear case opening.
14. Install in pairs and evenly tighten the eight bolts that hold the gear case halves together, starting at the top.
15. Torque the three 3/8-inch bolts to 22.5 ± 1.5 lb.-ft. (30.5 ± 2 Nm).
16. Torque the five 3/4-inch bolts to 198 ± 13 lb.-ft. (268 ± 18 Nm).
17. Install the gear case mounting bolts as follows as the preferred method of installation:
 - a. Lubricate the gear case mounting bolt threads and both faces of the washer with a Wabtec approved Moly-based lubricant (84B565364A1) and wait until dry to touch (approximately 5 minutes) before assembly.
 - b. Using a reduced shank, 1.00-8 threaded bolt (84B534558P1), and Nord lockwasher (84B534568P1) for each bolt position, install the two remaining bolts and install one Nord lockwasher on each of the bolts.
 - c. Using a Norbar torque/angle tool (or equivalent), apply a 425 ± 20 lb.-ft. (576 ± 27 Nm) torque plus a 45° angle to each of the three gear case mounting bolts.
 - d. Using a paint pen, draw a line across the top and sides of each bolt head that extends onto the gear case on both sides of the bolt.
18. An alternate method to install the gear case mounting bolts is as follows:
 - a. Using a solid washer assembly on 1.00-8 bolts, mount the two remaining bolts and washer assemblies and hand tighten.
 - b. Torque the three gear case mounting bolts to 400 lb.-ft. (542 Nm) and then turn them to 55° using the torque/angle wrench.
19. Another method to install the gear case mounting bolts is as follows:
 - a. Using 4-component load washer assemblies mounted on 12-point flanged 1.00-8 bolts, install the two remaining bolts and washer assemblies and hand tighten.
 - b. Tighten all three load washer and bolt assemblies by inserting a pin or small Allen wrench in one of the holes in the outer ring of the load washer assembly, then tighten the bolt while rotating the ring back and forth.
 - c. Torque all three gear case mounting bolts until the inner ring of the load washer assembly compresses and the outer ring is just seized between the two flat washers.
20. Verify that a bead of the approved sealant is visible at the joints after the bolts have been torqued and that a bead of sealant is visible around the pinion end armature bearing cap, and that the armature bearing cap overboard drain slots are free of sealant.

21. Attach a nylon lifting strap to each axle journal bearing, then lift the traction motor, axle, and wheel assembly and rotate 90° to return the traction motor combo to the horizontal position.
22. After the 24 hours sealant cure time is over, apply D50E25C gear oil or equivalent to the gear case.
23. Check the gear case lubricant level using a dipstick (Part Number 41C637237G1), then install and torque all pipe plugs to 100 to 110 lb.-ft. (136 to 150 Nm).
24. Apply a safety lock wire to the fill plug and the drain plug.