MAINTENANCE INSTRUCTION

M. I. 1517

Service Department
ELECTRO-MOTIVE DIVISION
GENERAL MOTORS CORPORATION
September, 2001

SCHEDULED MAINTENANCE AND OVERHAUL INSTRUCTIONS HTSC and HTSC-B1 BOGIES

Equipped With
AC Traction Motors

SAFETY PRECAUTIONS

Please refer to the EMD Safety Precautions in appendix to the Locomotive Service Manual whenever routine service or maintenance work is to be performed on any AC traction equipped locomotive.

The maintenance procedure as outlined in this instruction is specific to the HTSC and HTSC-B1 type bogies and is offered for planning purposes only. As written, this document reflects current EMD product design and service experience for the HTSC/HTSC-B1 design type of locomotive bogie with AC traction motors. The content of this M.I. reflects maintenance requirements based on time from delivery, kilometers, or megawatt-hours in service. This recommendation is consistent with present fleet performance and remains within the EMD experience envelope.

This Maintenance Instruction is intended to serve as a guide when establishing maintenance schedules to meet the particular requirements of individual operations and planned economic life of the locomotive bogie. It provides average recommendations, which should ensure satisfactory locomotive operation, and economical maintenance costs where average load factors and climatic conditions are encountered.

The scheduled inspection and maintenance items defined herein are specific to the HTSC and HTSC-B1 bogies. Component renewal provisions are consistent with traditional overhaul procedures.

For planning purposes, EMD has established the following overhaul interval recommendations for the HTSC and HTSC-B1 bogies. These overhaul interval recommendations are based on whichever event occurs first: time, kilometers, or megawatt hours.

HTSC / HTSC-B1 Bogies:

High Speed Service: 6 years / 1,400,000 kms / 23,000 MWHRS.

Heavy Haul Service: 6 years / 1,000,000 kms / 23,000 MWHRS.

NOTE

Kilometer and MWHR values referenced above are defined by Microprocessor Archive Data as accumulated by the locomotive control computer system.

As always, when specific operating conditions severely impact locomotive performance and or reliability, maintenance schedules must be adjusted accordingly.

Prepared by International Technical Services – London, Ontario, Canada

TABLE OF CONTENTS

1.0 GENERAL DESCRIPTION

The HTSC (high traction/speed-three axle) bogie assembly, Figure 1, and HTSC-B1 (high traction/speed-three axle, two traction motor/one idler axle) bogie assembly, Figure 2, support the weight of the locomotive and provide the means for transmission of power to the rails. The HTSC series truck is applied to AC transmission locomotives used in freight service, while the HTSC-B1 is applied to AC transmission locomotives used in passenger service. There are minor differences in specifications between the two types of bogie, however the basic design is similar.

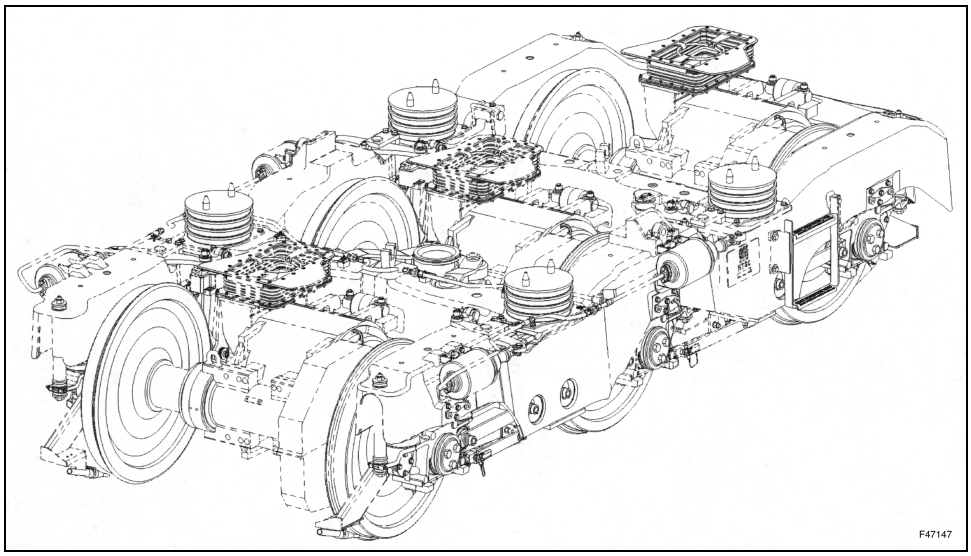


Figure 1 – HTSC Bogie

Like conventional three axle bogies, the axles are held parallel to each other, however the HTSC series bogie is designed as a powered "bolster-less" unit. The locomotive carbody weight is transferred directly to the bogie frame through four rubber "secondary" spring pad assemblies, which also provide yaw stiffness for tracking stability. The relatively stiff "secondary" suspension and uniform traction motor orientation improve weight transfer within the bogie for optimal adhesion performance. A soft "primary" suspension, consisting of twelve single coil journal springs (two at each journal bearing), is designed to provide good ride quality and equalization of wheelset loads for operation over track irregularities.

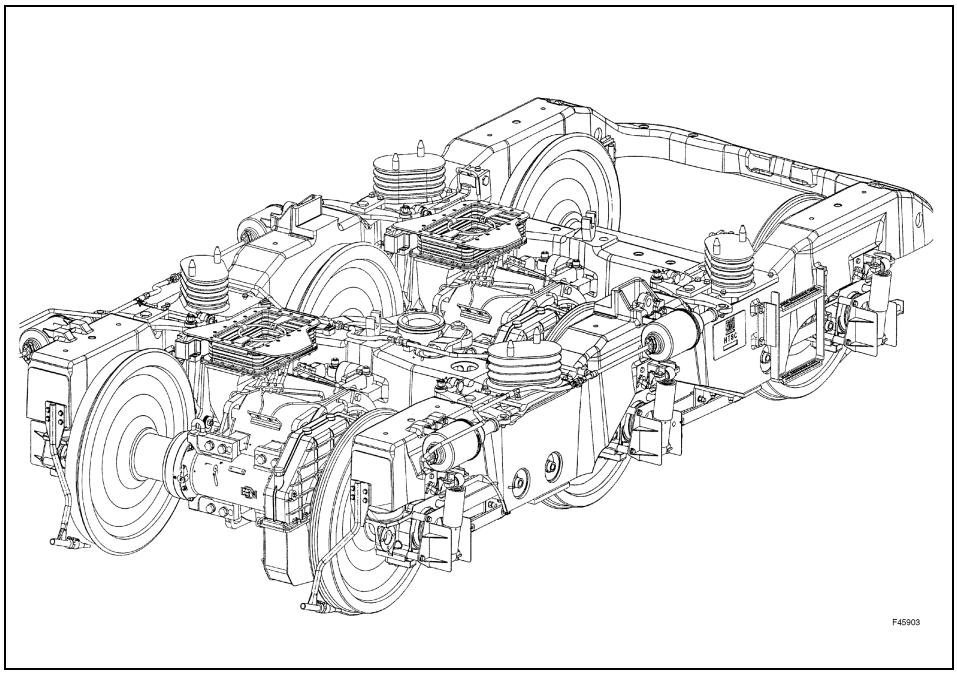


Figure 2 – HTSC – B1 Bogie

Traction loads are transmitted from the bogie to the locomotive underframe through a carbody pivot pin assembly, Figure 3.

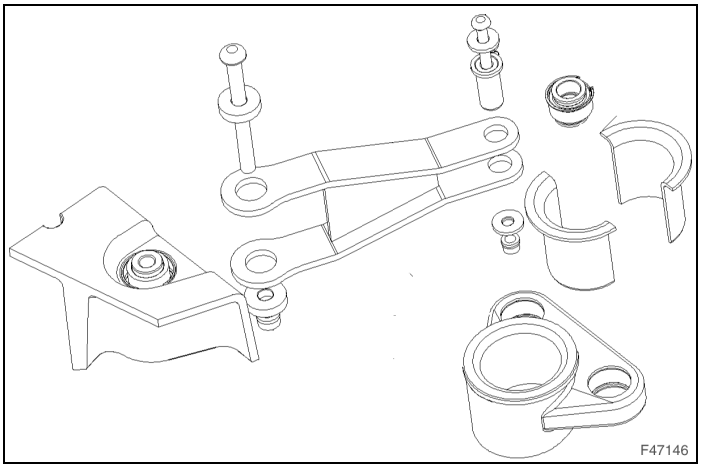


Figure 3 – Typical Carbody Pivot Assembly

Although the bogie frame itself is rigid, the soft spring design allows the end axles "yaw" freedom within the frame to position the wheelset axles to the curves center for reduced wheel and rail wear. A "traction rod" and collar/bushing attached to the journal bearing adapters and bogie frame helps control movement of the end axles and transfers driving force to the bogie frame.

The “soft” primary coil spring suspension also allows for a small amount of “angle of attack” variation, thereby lessening wheel wear in curves.

The bogie is designed to provide for extended maintenance intervals via reduced number of rubbing wear interfaces and improved tracking performance of the wheels on the rails.

Two (HTSC – B1) or three (HTSC) AC traction motors, mounted in each bogie, convert electrical energy into locomotive tractive effort. The motors are geared to the driving axles, which in turn apply force to the rail through the wheels. The driving force is transmitted to the bogie frame through traction rods attached to the axle journal bearing adapters and from the bogie frame to the locomotive underframe through the carbody pivot assembly.

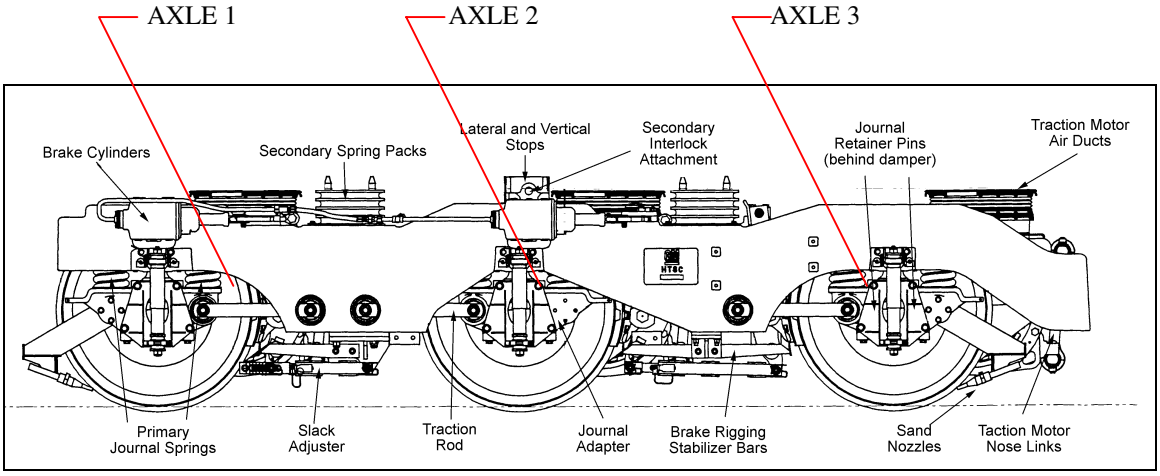


Figure 4 – HTSC Bogie (side view)

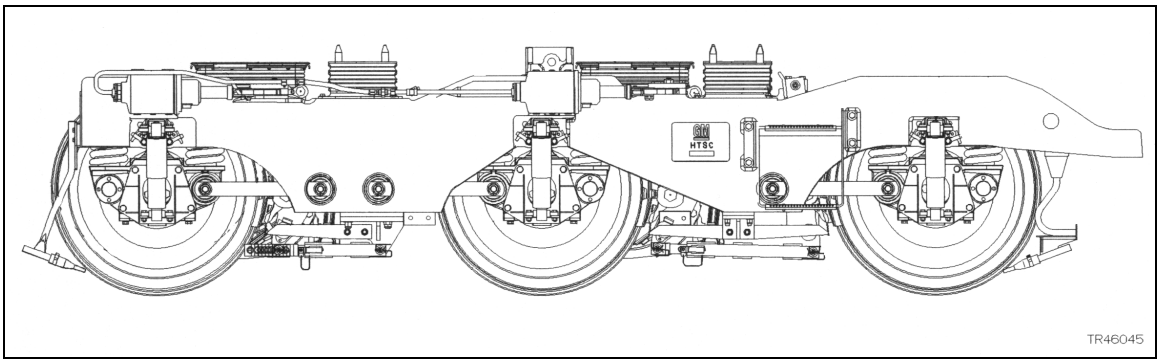


Figure 5 – HTSC – B1 Bogie (side view)

Heavy-duty dampers are used vertically between the journal bearing adapters and the bogie frame at all axles to damp excessive vertical and roll oscillations of the locomotive. Two yaw dampers are mounted diagonally between each bogie and the locomotive underframe to damp the lateral and yaw movements of the bogie for stability at higher road speeds.

Lateral stops are provided on the bogie frame at the center axle position to limit lateral movement between the bogie and underframe. Vertical stop clearance is established between the bogie frame and the underframe using shims at locations inward of the lateral stops near the center axle position. All vertical shims are welded to the underframe, as shown on Figure 6.

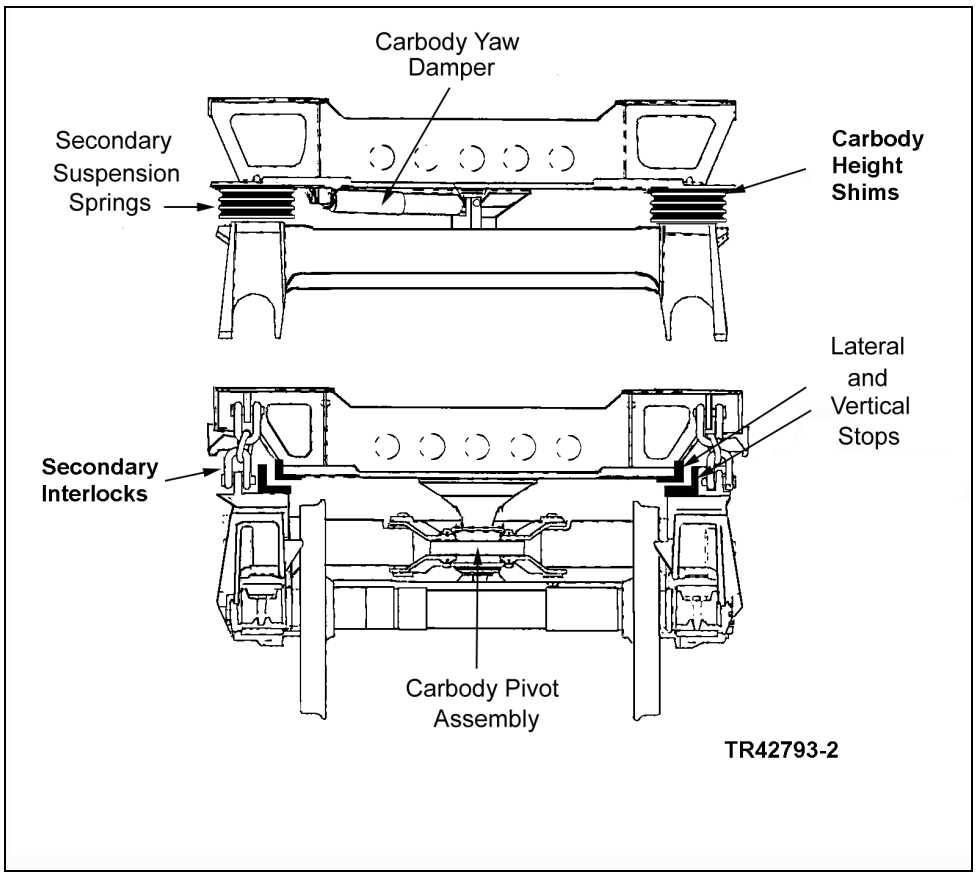


Figure 6 – Secondary Springs and Lateral/Vertical Stops

The bogie vertical stop clearances should be measured at specified intervals as outlined in Scheduled Maintenance.

Secondary Interlocks are located on either side of the bogie frame at the center axle location, Figure 6. These two links serve to prevent separation of the bogie assembly from the locomotive during lifting operations of the locomotive with the bogie(s).

Interlocking of the journal bearing adapter to the bogie frame for lifting is accomplished via a contoured structure on the bearing adapter, and two steel rods which are installed through the bogie frame structure at each journal adapter location (journal retainer pins – Figure 7).

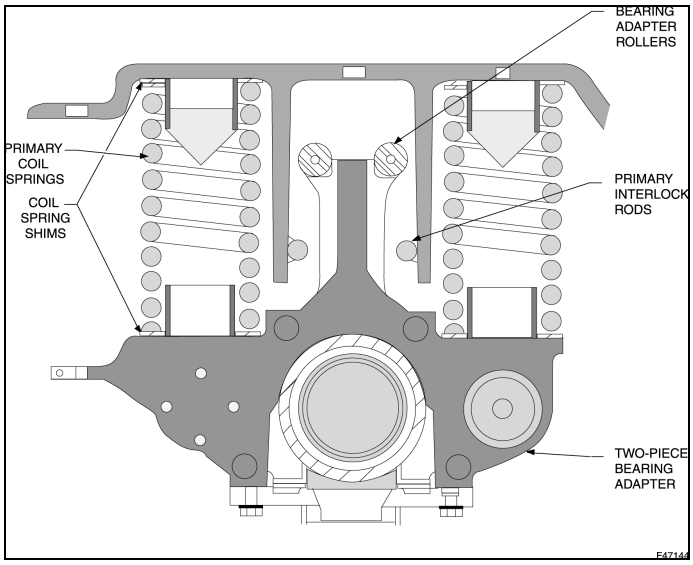


Figure 7 – Journal Adapter and Retaining Pins

The three traction motors are supported on their respective drive axles and at motor nose link assemblies, Figure 8, attached to the bogie frame. A main feature of the HTSC/HTSC – B1 bogie design is the orientation of the traction motors in one direction. This arrangement provides good motor accessibility and maximizes adhesion characteristics.

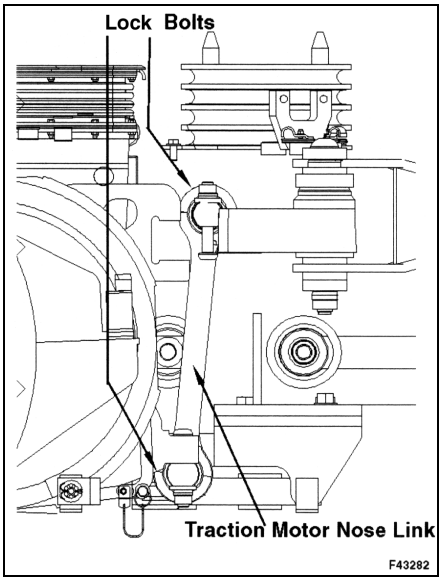


Figure 8 – Typical Traction Motor Nose Link (Dogbone)

The journal bearings transmit the vertical load from the springs to the axles. Resilient wear plates mounted inside the bogie frame limit the lateral thrust movement of the axles. These renewable resilient wear plates, Figure 9, provide the means to maintain the free lateral clearances at the center (middle) axle and at the end (front and rear) axles. Three retainer bolts accessible from the outside of the bogie frame secure the resilient wear plates. These wear plate bolts also serve to secure the upper vertical damper bracket on the HTSC bogie. The HTSC-B1 bogie uses three additional bolts to secure the bracket.

The resilient lateral thrust pads are to be replaced as a set if the free lateral axle clearances exceed the limits specified in the Service Data section. Otherwise, refer to the bogie overhaul section in regard to replacement of cracked or excessively worn thrust pads.

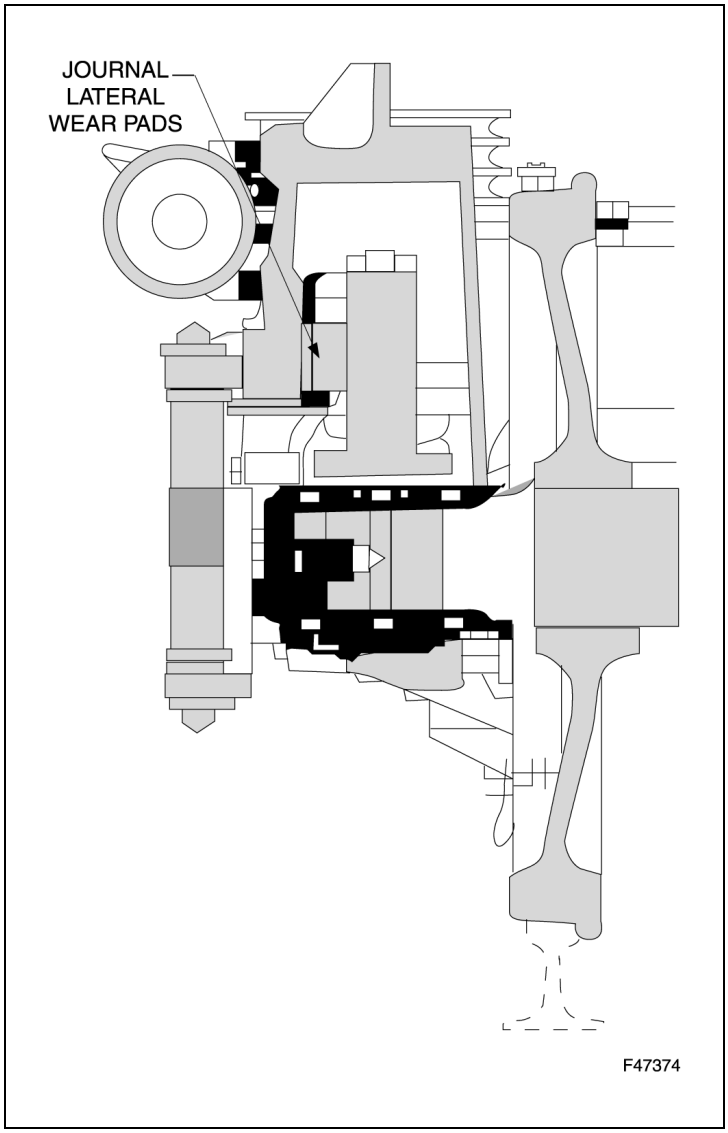


Figure 9 – Lateral Thrust Wear Pads

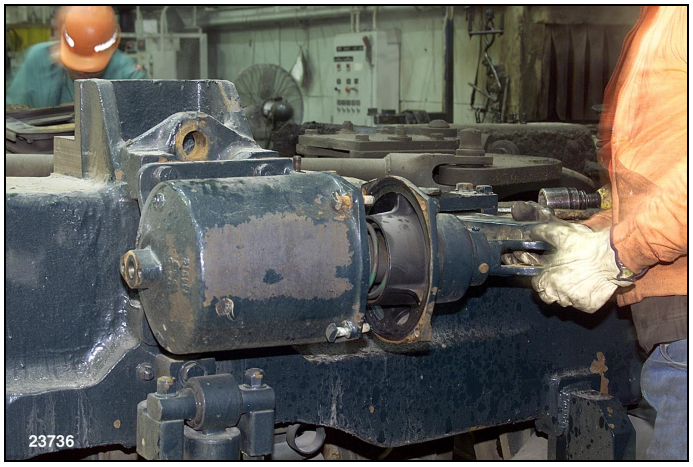


Figure 10 – Typical Air Brake Cylinders

Air brake cylinders and brake rigging mounted on the bogie are used to apply retarding forces to the wheels to slow and stop the locomotive. A single block brake system is used, which utilizes one composition block at each wheel.

Brake cylinders are mounted outboard of the bogie frame transoms and operate the brake system through a lever arrangement. Manual slack adjusters are fitted to allow for periodic adjustment of brake cylinder travel and brake block renewal.

A manually operated ratcheting type hand brake is fitted to the right rear side of the locomotive, and operates the brake rigging on the #2 bogie position through a mechanical chain linkage.

2.0 GENERAL MAINTENANCE

2.1 BOGIE CLEANING

2.1.1 UNDER LOCOMOTIVE

Bogie(s) should be periodically cleaned while under the locomotive to eliminate any accumulation of oil and road dirt. An oily accumulation presents a fire hazard and tends to increase wear of moving parts on the bogie, as well as detract from the general appearance of the equipment.

CAUTION

When cleaning bogies under the locomotive, the engine should be kept running to supply air under pressure to the traction motors. Discharged air will help prevent over-spray from entering the motors. Care should be taken to direct spray away from any motor openings.

A wetting agent and an alkaline solution type cleaner can be used on the bogie. Spray wetting agent over bogie surfaces and let it remain for 10 to 15 minutes. Then using steam and an alkaline solution in a mixing gun, thoroughly spray entire truck assembly. Rinse assembly with hot water.

2.1.2 TANK CLEANING

When the bogie assembly is removed from the locomotive, the traction motors, traction rods, traction rod bushings, carbody pivot and bushings, wheels, axles, bearing adapters, rubber suspension springs; dampers, and brake cylinders should be removed if the bogie is to be immersed in a cleaning tank containing an alkaline solution. In addition, non-metallic wear components such as the carbody pivot pin liners should not be immersed. After a sufficient time to assure removal of all foreign material, remove the assemblies and rinse thoroughly with hot water remove all cleaning solution.

2.2 LUBRICATION

Periodic lubrication on the bogie assembly is not required. However, depending on the type of traction motor gear and support bearing assemblies used, reference Table 1 lists the lubrication intervals required for their maintenance.

The carbody pivot pin assembly cylinder is lined with nylon alloy bushing halves. The pivot pin is to be coated with a bonded dry spray lubricant at time of overhaul or re-trucking only. No additional oil or grease is needed during operational service.

NOTE

Special care should be taken with all rubber components, the axle lateral wear plates on the bogie frame, dampers, and brake rigging in order to keep them free of oil or grease.

Table 1 - Traction Motor Gear And Axle Lubrication

Roller support bearings (BTR), grease lubricated:	400,000 kms, or at wheel change (whichever comes first)
Oil lubricated gear case:	92 days or as required by locomotive service demands.

2.3 WHEEL AND AXLE INSPECTION

Wheels should be inspected for any visible defects before and/or after each trip. Wheels should be periodically checked for wear, sharp flanges, shelling, cracks, flat spots, and other injurious defects. Corrective action should be taken immediately, if unacceptable defects are found.

REFERENCE

Wheel and axle defects, which typically require the removal of any particular wheelset are well defined and illustrated in the “Wheel and Axle Manual” published by the Association of American Railroads (AAR), 50 “F” Street, North West Washington, D.C. 20001.

Further wheel and axle component inspections and wear limit information is provided in M.I. 1519, entitled: "Wheels, Axles, Axle Gears and Pinions" and at the end of this publication. Use the following guidelines in conjunction with M.I. 1519 when determining wheel and axle condition.

See Service Data for wheel size variation limits.

- Minimum wheel diameter after last truing operation.
- Maximum diameter mismatch of two wheels on a common axle.
- Maximum diameter mismatch between wheels on one axle compared to those of any other axle. These include wheels on the same bogie.
- Minimum rim thickness.
- Axle longitudinal limits.
- Circumferential defects on or below the axle surface.
- Axle Run-out.

2.4 JOURNAL BEARINGS

Under normal operating conditions, running temperatures of approximately 56° C (133° F) above ambient temperatures may be expected. If the bearing appears noticeably warmer than other bearings on the locomotive, the bearing should be checked on the outside face of the adapter with a temperature-indicating crayon 93 ° C (200 ° F), or with a direct pyrometer. If the bearing temperature is in excess of 93° C (200° F), the bearing should be removed from service for further examination.

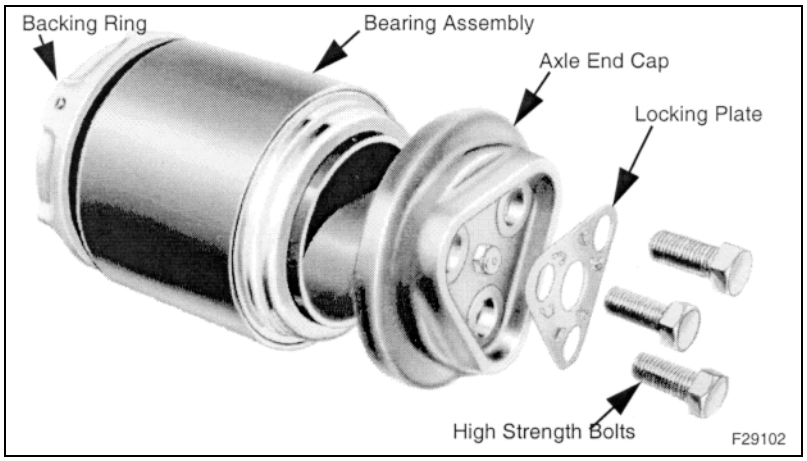


Figure 11 – Roller Type Journal Bearing

In the event that one or more axle end cap bolts are found to be loose or missing from the bearing - the wheel, gear, axle, and journal bearing assembly should be removed from the bogie. The bearing should then be removed from the axle and a full inspection made to determine the cause and possible resultant damage.

A small amount of grease leakage around the seals may be expected during an initial run-in period. This leakage will eventually be reduced to normal "weepage." However, if a bearing appears to be leaking excessively, check for seal damage. Carefully wipe the area around the seal to allow inspection for a displaced or torn seal. Do not use solvents to clean the seal area or a probe to try to displace the seal. Both of these actions will damage the seal and may lead to premature bearing failure.

Distorted, cracked, or damaged axle end caps should be replaced, and the damaged caps should be scrapped.

When locomotives equipped with cartridge-type roller bearings are placed in storage, the hand brake should be set or the wheels chocked to prevent the equipment from moving. It is necessary to periodically move the locomotive to distribute lubricant over the bearing surfaces.

For the checking, removal and installation of journal bearings refer to M.I. 1553. After the installation of the end cap the end cap bolts should be torqued. See Service Data for torque information.

2.5 DAMPERS

There is rarely a partial failure of a damper. When it fails there is no resistance to movement in compression, in rebound or in both directions and a simple manual test can detect the failure.

NOTE

If a damper is new or has not been used for some time, it must be stroked to obtain consistent motion before being checked for control. Resistance developed during testing is proportional to velocity of the test stroke.

Dampers contain a reserve of hydraulic fluid, and allow seepage to lubricate the piston rod. A light film of oil / dust is normal and is not cause for rejection. A failed seal is recognizable by an excessive accumulation of fluid (wet) on the damper. However, it is not possible to ascertain the amount of reserve fluid in the damper and predict remaining life.

Periodic inspection or when loss of damping action is suspected:

1. Check for leaking fluid. Make certain that oil has not been deposited from some other source and check damper per Manual Qualification Procedures before condemning.
2. Perform manual qualification tests to detect gross loss of control.
3. Inspect bushing integrity. Bushings should not permit uncontrolled vertical or lateral movements of the damper.
4. If a failed vertical primary damper is detected, inspect journal springs, lateral thrust pads and wear plates at each journal bearing location as well.

If a failed yaw damper is detected, check the items noted in the above step as well as all traction rods and bushings, carbody pivot and rod assembly and bushings, and secondary springs (rubber pads).

Use the following steps to qualify vertical dampers.

1. Remove the damper from the journal bearing adapter and bogie frame.

NOTE

Vertical dampers must be tested in the normal vertical position. Precautions must be taken to avoid damaging the damper bushings during the testing or wheel maintenance. The HTSC bogie has stud mounted primary vertical dampers; the HTSC-B1 bogie uses bar mounted vertical dampers.

2. Manually stroke the damper while retaining the normal vertical position. Smooth, controlled movement should be felt through both extension and compression.
3. Inspect the end rod to damper body connections for any cracking. Inspect all end connection components, such as washers, rubber bushings and nuts. Replace any components that are cracked chipped or deformed. Renew damper if necessary.

4. If damper tests good, reapply the damper and torque the fasteners. See Service data for torque values.

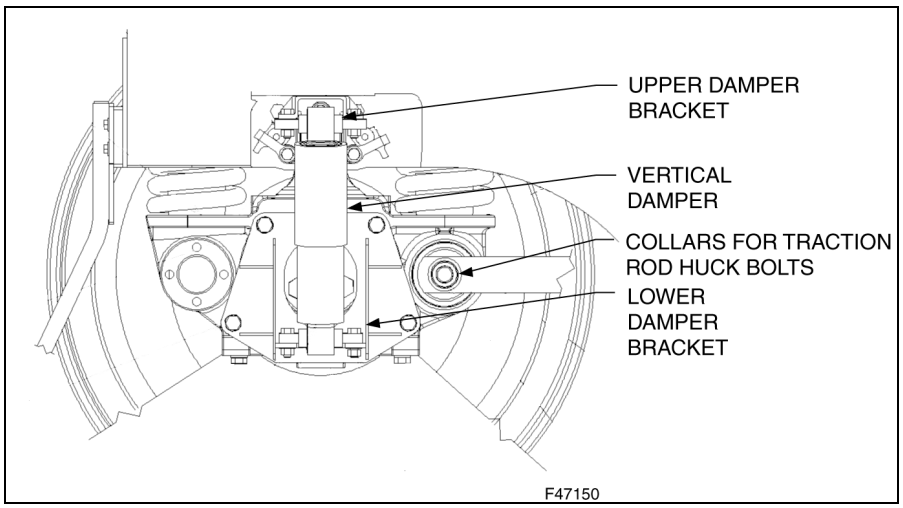


Figure 11 –Typical Vertical Damper

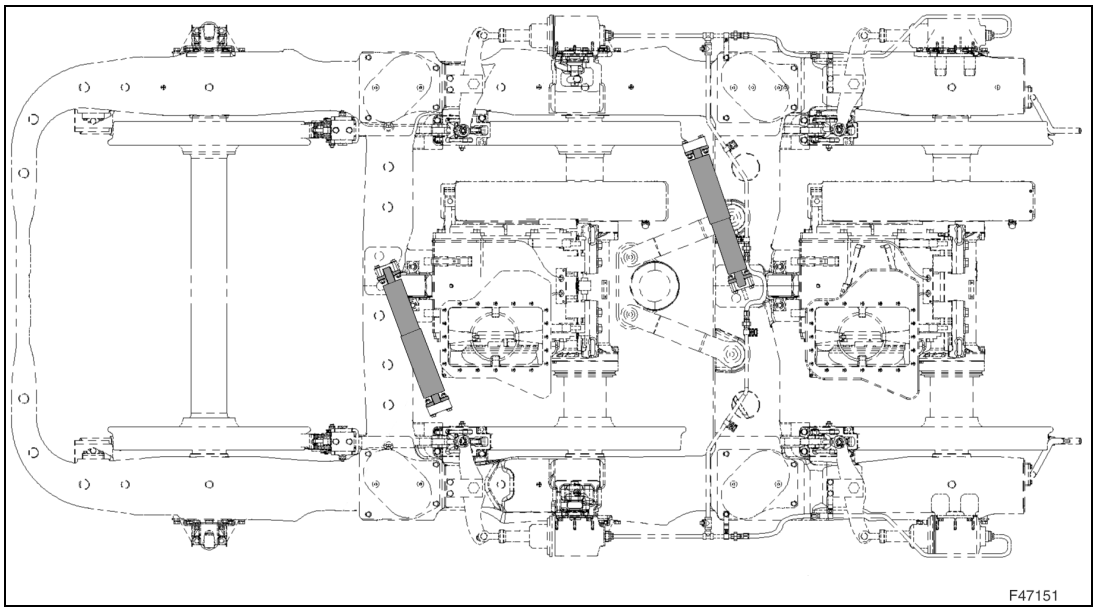


Figure 12 – Typical Yaw Damper

Use the following steps to qualify yaw dampers:

1. Remove the yaw damper from the bogie and underframe.
2. Manually stroke the damper in the horizontal position. Smooth, controlled movement should be felt through both extension and compression.

3. Renew damper if necessary. Inspect bolts, washers and nuts for signs of cracking or damage. Replace as necessary. Reapply damper as per bogie assembly instructions in later section. Torque as per specifications in Service Data.

It is essential that dampers be replaced with the correct type to ensure proper adhesion characteristics and ride quality.

NOTE

Whenever a damper is tested or replaced, the mounting lock nuts, which are removed in the process must be discarded and replaced with new lock nuts of the same type. (HTSC)

2.6 RUBBER SECONDARY SPRINGS

Thoroughly inspect the springs, Figures 13 and 14, for signs of degradation. Grease and dirt accumulations on the rubber spring, resulting from normal service, will not cause deterioration of the rubber material; however, continuous exposure to lubrication and fuel oils has a detrimental effect on the life of the rubber. Take care to keep such oil deposits off the rubber springs. In addition, cleaning the rubber spring will facilitate visual inspection.

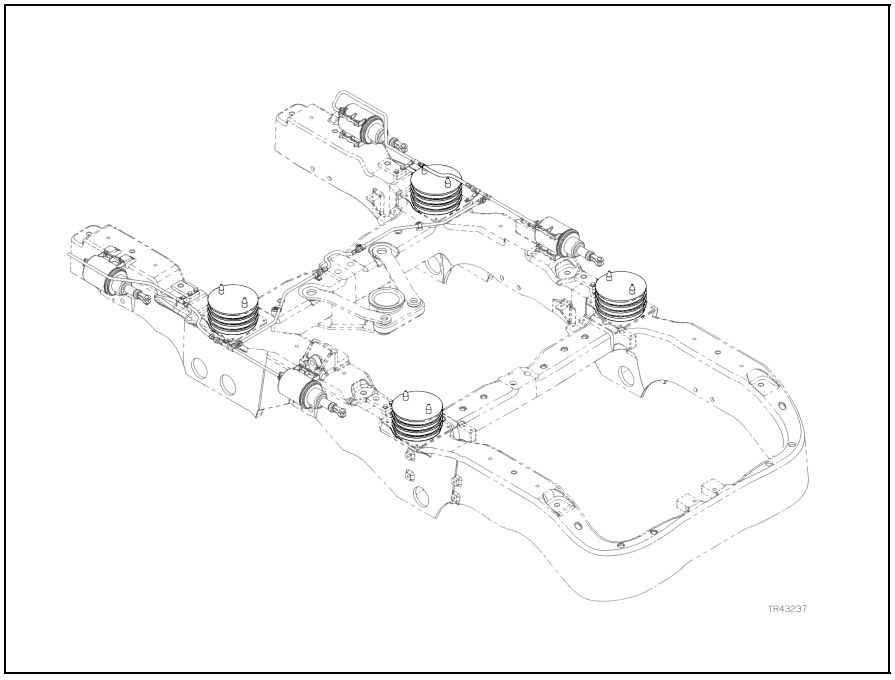


Figure 13 – HTSC Secondary Springs

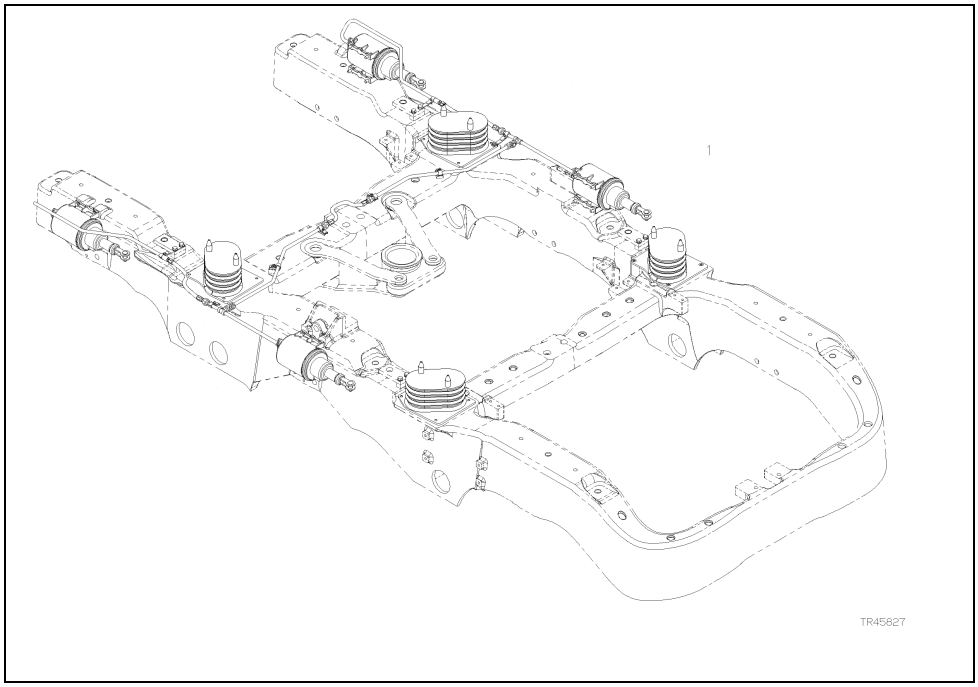


Figure 14 – HTSC – B1 Secondary Springs

To clean the rubber spring, wipe excess grease, oil, and dirt from the spring with a clean cloth soaked in a mild alkali solution. Do not wash the spring in paraffin de-greasing agents (such as trichloro-ethylene), caustic soda, or diesel fuel oil.

Check the unloaded spring for degradation. A certain amount of superficial cracking (crazing) of the rubber surface is not unusual or detrimental to performance. Replace any spring if any layer has a tear or cut, which exceeds 25mm (1") in length and 6.25 mm (1/4") in depth, or if the accumulated tears in any layer exceed 100mm (4").

Lifting of rubber from bonded metal surface is limited to a depth of 12.5 mm (1/2") and/or a total length of 100 mm (4 ") on any one rubber/metal interface. If separation exceeds either of these specifications, the rubber spring should be replaced.

Metal plates separating the rubber layers are covered with a thin layer of rubber on the exposed edges. This is to protect the metal from corrosion. Due to physical contact with foreign objects, in time, it is expected that some of the protective rubber covering at the edges and corners of the metal plates will become split, torn, and ripped away. This is not bonding separation. This condition will not affect the performance of the part, and is not cause for replacement.

Overhanging edges of metal parts are occasionally bent or burred through mishandling or excessive service conditions. This is of no consequence, as the rubber is not trapped and there is no sharp metal edge to come into contact with the free rubber surface. Any excessive burrs should be filed off without touching the rubber.

2.7 BRAKE BLOCK GUIDES

Brake block stabilization guides, Figure 15, are provided on the underside of the bogie frame at the "live" and/or "dead" block lever location. A 6.4mm (0.25") thick X 87.5 mm (3.5") diameter Nylon alloy wear plate is bolted to each brake lever which mates to a spring steel stabilizing bar. Each brake lever uses a guide bracket which straddles the stabilizing bar to maintain brake shoe to wheel alignment. The "dead" brake lever uses a safety hanger, which is a "U" shaped bracket that straddles the lever pivot bracket at the top side of the truck frame to maintain brake shoe to wheel alignment. The stabilizing bars are bolted to brackets under the truck frame. The long bars used between the "live" and "dead" brake levers are further supported by a tie bar assembly connected laterally from the bar on one side of the truck to the other. The wear plates should be replaced when the thickness is half of the original, or 3.2mm (0.125").

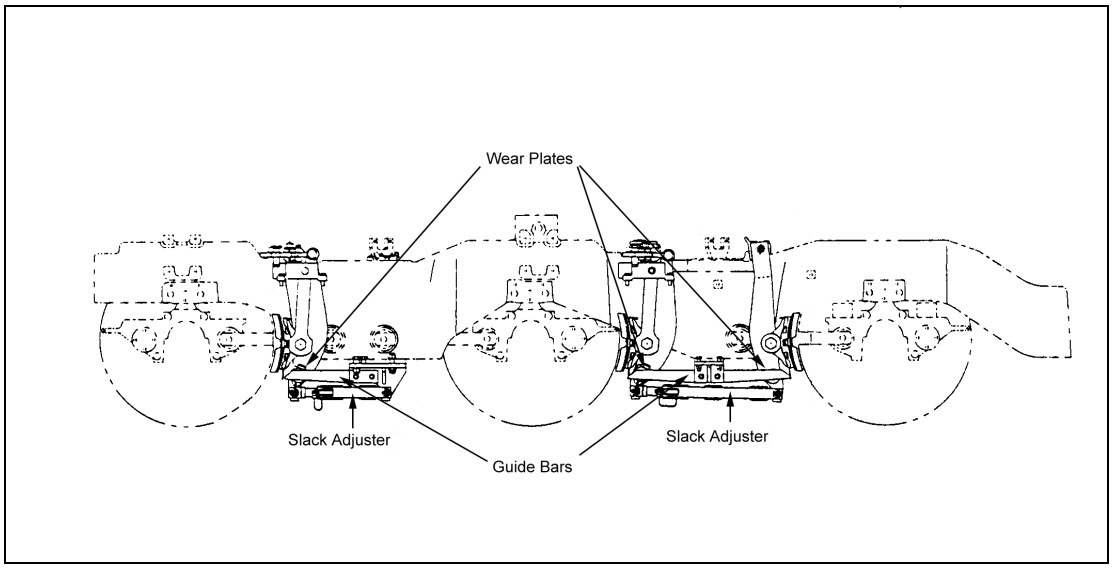


Figure 15 – Typical Brake Block Rigging and Guides

2.8 SLACK ADJUSTERS

2.8.1 GENERAL DESCRIPTION

The brake slack adjuster, Figure 16, is a manually adjusted pin type assembly designed for single block brake locomotives.

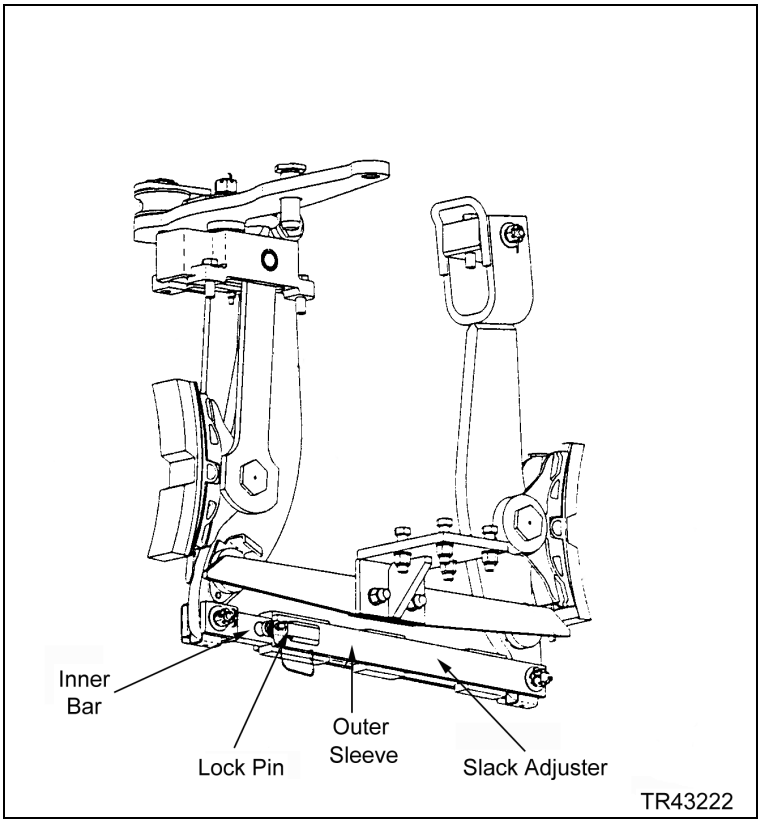


Figure 16 – Slack Adjusters

2.8.2 ADJUSTMENT

Piston travel is set by the placement of a pin into one of the available adjustment holes in the slack adjuster. A spring-loaded clip that is positioned over the pin in service retains the pin. For adjustment, the clip is lifted and simultaneously rotated out of position to enable the pin to be removed. A ring and cable lanyard provides a means to pull the pin to perform an adjustment. The slack adjustment procedure is as follows:

CAUTION

This procedure must be conducted with the locomotive parked on tangent track. If conducted with the locomotive in a curve, error in setting the piston travel will result.

1. With the brakes fully applied, measure the piston travel. Piston travel must not exceed 165 mm (6.5") nor less than 50 mm (2").
2. If the piston travel exceeds 165 mm (6.5"), the slack adjuster must be reset to reduce the piston travel. It is prudent to limit the piston travel allowed to some lower value to allow continued brake block wear and resulting piston travel increase such that the piston travel will not exceed limits prior to the next inspection and adjustment. The operating Railroad must determine these amounts based on their operation and experience.

WARNING!

To avoid potential injury, be certain the locomotive will not roll if the brakes are released before performing the next step. Take measures such as chocking the wheels if necessary. It is strongly recommended that this procedure only be conducted on level track.

3. Release the air brakes on the bogie to be adjusted using the brake cylinder cutout cock on the underframe above the center of the bogie. This will vent all air from this BOGIE, on both sides, so be certain other persons in the immediate area are aware the brake levers will move. Keep hands and feet away from the brake equipment!
4. Lift and turn the pin retainer clip on the slack adjuster to be adjusted and remove the pin.
5. Using a suitable pry bar, work through the pinholes to extend the slack adjuster toward the wheel. When it is judged that the block release is at least 19 mm (3/4") to 32mm (1.25") away from the wheel tread, total for two block position, 16 mm (5/8") to 25 mm (1") away for single block position, reapply the pin in the hole where it best fits.
6. Turn the bogie air cutout cock to apply the brakes. This will apply air to all brake cylinders on this BOGIE, on both sides, so be certain other persons in the immediate area are aware the brake levers will move. Keep hands and feet away from the brake equipment!

7. With the brakes applied, measure the piston travel. It must be a minimum of 50mm (2.0") at the single block positions (axles #1 and #6) and a minimum of 57mm (2.25") at the two block positions (axles #2, 3, 4, and 5). It is desirable to set the piston travel as near to these values as possible, without going less than them, to obtain the greatest interval of time before readjustment is necessary.

2.8.3 GENERAL PHYSICAL INSPECTION

It is recommended that a periodic visual inspection should be performed to find out if there is any damage, e.g. loose or missing lock pins or a bent or damaged assembly. Replace or repair the adjuster as required.

A more detailed description of brake rigging and guides is given in the overhaul section of this M.I.

2.9 HAND BRAKE

2.9.1 DESCRIPTION OF OPERATION

The hand brake, Figure 17, used on HTSC and HTSC – B1 equipped locomotives, is connected by means of a chain and pulley arrangement to a specially designed brake horizontal cross over lever on the rear (#2) bogie. The lever, with a pulley at one end, applies the parking brake to axles #4 and #5 at the rear end of the unit.

Caution should always be exercised when using the hand brake, because brake component damage, obstruction (such as debris or severe icing), or improper adjustment may result in an improper application and little or no brake capability. After setting the hand brake, it is good practice to visually check the brake application.

2.9.2 INSPECTION OF HAND BRAKE CHAIN AND LEVER

The hand brake, chain, and lever should be inspected on a periodic basis, to check for unusual wear. The hand brake chain should not rub against the wheel or bogie during operation. The HTSC-B1 bogie has a special spring pre-tensioning arrangement to prevent this, Figure 17.

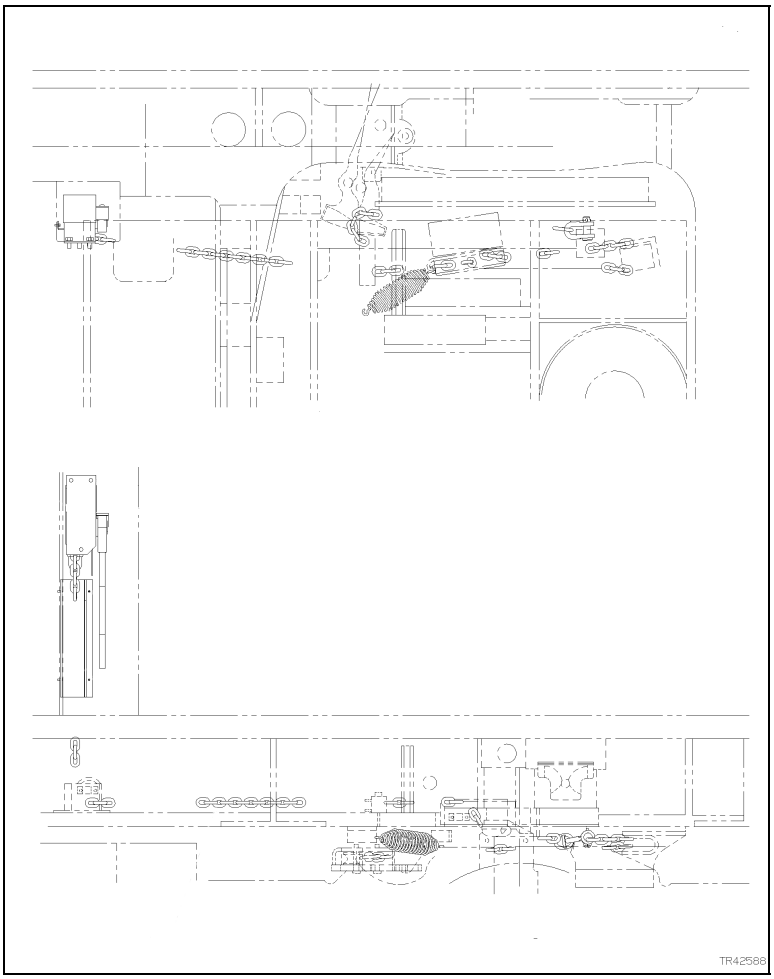


Figure 17 – Hand Brake

2.9.3 ADJUSTMENTS & TROUBLE-SHOOTING

If the hand brake appears to need adjustment, check for wear in the chain, pins, and shackles. Replace any items that have extensive wear. If the parking brake linkage isn't worn, check the service brakes for proper adjustment by referring to the Slack Adjuster Section of this M.I. before making any adjustments to the hand brake linkage. The hand brake linkage is adjusted by varying the number of links in the chain. Once this dimension has been established, it should not have to be re-done.

Check the brake cylinder piston travel with the parking brake applied. If the travel is greater than 165 mm (6.5"), readjust the slack adjuster until the desired travel of less than 165 mm (6.5") is achieved.

2.9.4 MAINTENANCE & LUBRICATION

2.9.4.1 Quarterly

- Check that all fasteners (nuts & bolts), clamps, and brackets are secure.
- Verify condition of chain, shackles, and pins for corrosion, wear and damage. Replace as required.
- Check that the pulley on the brake handle assembly is in good condition and properly secured. Replace if required.
- Chain and other components should be lightly oiled to prevent corrosion.

2.10 GEAR CASES (AC TRACTION LOCOMOTIVES)

2.10.1 GENERAL DESCRIPTION

The Gear Case, which is an integral part of the Traction Motor Assembly, is mounted on support arms at the traction motor.

As illustrated in Figure 18, the gear case is comprised of two close fitting halves to provide a complete oil-tight enclosure. The oil in the gear case is used to lubricate the pinion / bull gear mesh as well as the traction motor rotor support bearing at the pinion end of the motor.

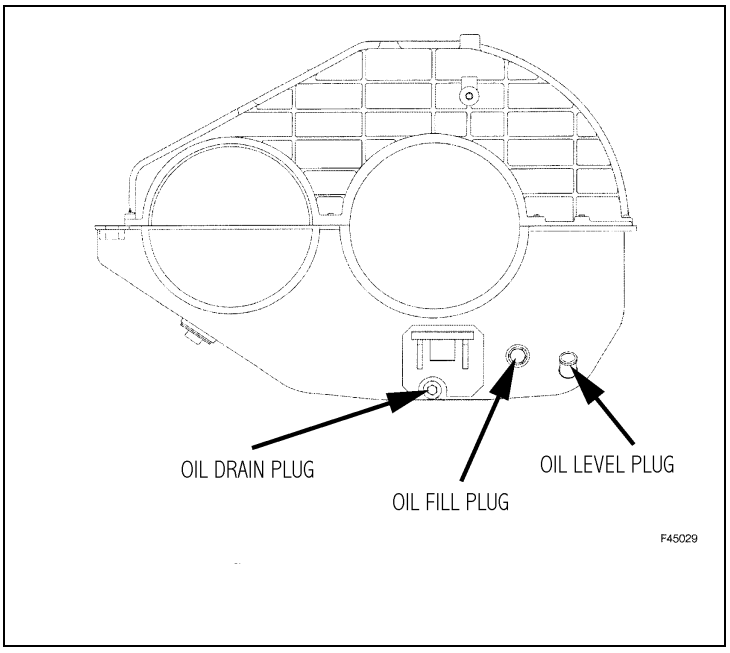


Figure 18 – Typical AC Gear Case

Located on the inboard side of the gear case are three hex head pipe plugs. These plugs cap the openings used for oil fill, oil level), and oil drain as illustrated. When filling the gear case, both the oil fill and oil level plugs must be removed. Lubricant should be added until oil flows from the level plug. Do not use the oil fill hole as a reference for a full gear case.

Overcharging the gear case with lubricant will cause leakage through the seals into the traction motor and will also result in increased oil and bearing temperatures.

On other models there is a fill cap located on the inboard face of the gear case. Proper oil level is maintained by adding lubricant until the level is even with the lip of the fill opening.

When a gear case is removed from the traction motor/wheel axle assembly, the case should be checked for possible damage such as cracks, perforations, or deformation. The case should be cleaned and the old seal assemblies must be discarded. Seal retainers and parting lines must be free of dirt, oil, gasket compound, or any other foreign material.

2.10.2 GEAR CASE REMOVAL

The gear case, Figure 19, is mounted to a support arm on the traction motor, thereby becoming an integral part of the traction motor assembly. The case is made up of two close fitting halves with seals to provide a complete oil-tight enclosure. Both halves are equipped with access plugs or caps to fill and/or drain lubricant.

When a gear case is removed from the traction motor/axle-wheelset assembly, the case should be thoroughly cleaned and the old seals and/or sealing material removed completely and discarded. Seal retainers and all parting lines should be free of dirt, gasket sealing compound, or any foreign material. The material used to form the seal between the case halves is a silicon based RTV liquid sealant. It is imperative that:

- The mating surfaces to which the sealant is applied is thoroughly cleaned;
- The sealant material is not allowed to plug or restrict drain passages in the axle seal area.

Visually inspect the case halve for damage such as cracks, perforations or deformities. Re-apply gear case halves, seals and/or sealing compound.

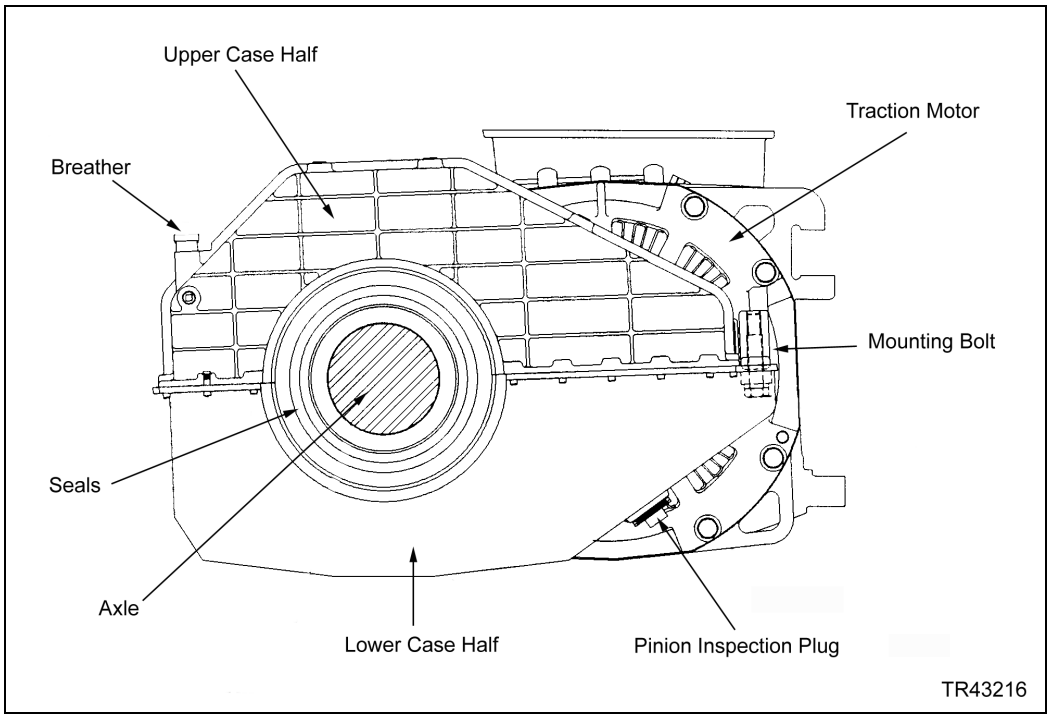


Figure 19 – Traction Motor Gear Case

2.10.3 GEAR CASE APPLICATION

1. Prepare gear cases for application by thoroughly cleaning interior and exterior of chips, loose weld spatter, oil, dirt, or old sealing material. Ensure that all traces of oil have been removed from all gear case sealing surfaces on gear case halves and mating motor seals.
2. Install breather pipe (if removed) into top case half, using "Loc-tite" type thread locking compound. Install the filter and vent cap assembly on breather pipe.
3. Check to see that the three drain holes in lower half bores are unobstructed, clean as required.
4. Wipe all seal surfaces on the gear case halves and the motor axle assembly with a lint-free cloth, to remove all traces of oil. Apply three continuous 6.25mm (¼") beads of RTV sealant to the motor and axle assembly adjacent to the seal tongues as shown in Figure 20.
5. Apply additional 6.25mm (¼") diameter sealant beads at each of the half bores in the upper and lower case halves as also shown in Figure 20. Note that these sealant beads are always placed outboard of the tongue or groove.
6. Apply a 3.125mm (1/8") diameter sealant bead on either the upper or lower gear case parting line flange segments. Form the beads continuously and surround each bolt hole with a ring of sealant. See Figure 20.

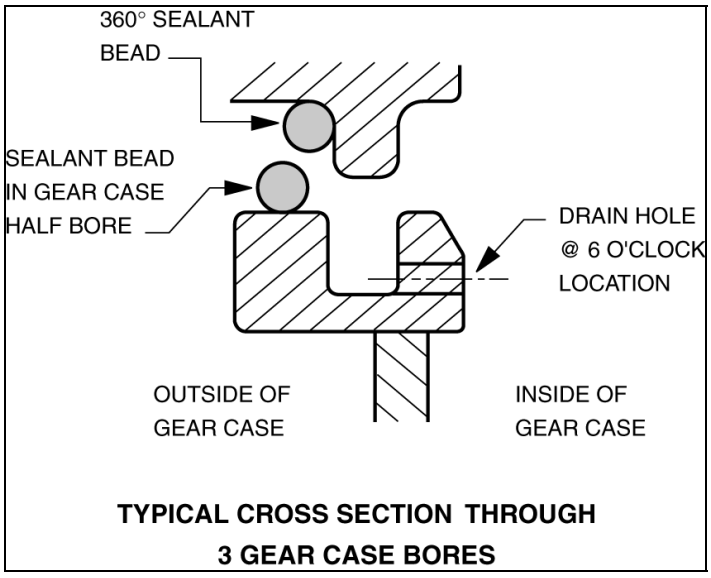


Figure 20 – Gear Case Sealant Beads

7. Install the lower half gear case to the motor assembly, and using Thread-Tex 3202 on threads and washer surfaces, hand tighten the two 1-1/8-7" bolts and washers.
8. Install the upper gear case half to the motor. Apply the 3/8-16" parting line bolts and dry torque to the value indicated in the Service Data Section.
9. Torque the two 1-1/8-7" bolts to the value indicated in the Service Data Section.
10. With the motor in the normal operating position, fill the gearcase with lubricant to the level inside the fill opening on the lower gear case half side. Use only EMD approved synthetic gear lubricant.

2.11 TRACTION MOTOR REPLACEMENT

CAUTION

Journal bearing adapters at both ends of the motor-wheelset being removed must be restrained in such a manner that prevents them from rotating or dropping clear of the bogie frame. Prior to removal of the wheelset, inspect the primary interlock rods (journal adapter retainer pins) to ensure they are secure. This is necessary in order to prevent the journal springs from dropping out of the spring pockets in the bogie frame - which could endanger maintenance personnel.

Whenever a traction motor-wheelset assembly needs to be replaced, the following basic procedures should be used:

1. While supporting the rear of the traction motor with a suitable lift device such as a hydraulic jack, disconnect the nose link (dog bone) rod assembly from the traction motor. If locking bolts were used in the assembly, they will have to be removed with a locking bolt collar splitter or cutting torch.

CAUTION

Use care when removing any locking bolts with a torch in order to avoid damage to the surrounding truck frame, linkages, and bushings. Make sure that all bearing adapter interlock chains are in place, secure and not worn.

2. Remove the bearing adapter cap from the bottom of the journal-bearing adapter.
3. Disconnect the traction motor leads and any other hardware attached to the motor / wheelset or bogie frame that would interfere with the removal – including the wheel flange lubricator nozzles and sanding nozzles, if equipped.
4. Undo the brake slack adjusters and back the brake blocks away from the wheels. Secure all cables and hardware in a manner that places them safely out of the way during removal.
5. Hold the nose link assembly away from the motor. Lift the locomotive or lower the drop table, tilting the traction motor in a manner that will disengage the motor from the bogie frame interlock. Remove the motor / wheelset from beneath the locomotive.
6. Move the replacement wheelset assembly beneath the locomotive. Re-assemble in the reverse order of disassembly and note that the journal bearings seat properly in the adapters before supporting the weight of the locomotive.
7. Using new hardware, apply the journal bearing adapter caps (binders) at all locations, and torque. Refer to Service Data for proper torque limits. Bend the tabs on the lock plate to fully engage one side of the bolt head.
8. Note that as the motor is placed in its' final position, the traction motor/bogie frame interlock (safety bracket) is properly engaged. Reconnect all hardware. Re-adjust the brake slack adjusters.

2.12 BOGIE REMOVAL

2.12.1 INSPECTIONS BEFORE BOGIE REMOVAL

The following items should be inspected before the bogies are removed from the locomotive. In addition, these inspections should be part of a routine inspection schedule, to indicate worn parts before they fail.

The list is to be used as a guideline. Each item to be inspected has a reference to a section in this Maintenance Instruction where the inspections to be performed are detailed.

NOTE

Perform inspections with the locomotive on straight level track.

- Yaw Dampers – Reference this M.I., the section on yaw dampers.
- Primary Suspension Springs - Reference this M.I., the section on primary suspension springs.
- Secondary Suspension Springs – Reference this M.I., the section on secondary suspension springs.
- Carbody pivot pin clearance – Reference this M.I., the section on carbody pivot pin.
- Brake rigging – Reference this M.I., the section on brake rigging.
- Wheel condition – Reference M.I. 1518 and 1519, Wheels, Axles, Axle Gears and Pinions, and Service Data section.
- Axle lateral clearances – Reference this M.I., the section on lateral clearances.
- Vertical stop clearances – Reference this M.I., the section on vertical stop clearances.

2.12.2 BOGIE ASSEMBLY REMOVAL

The bogie(s) may be removed from the locomotive by using an overhead crane or jacks to raise the locomotive, or by use of a drop table of sufficient capacity to handle one entire truck assembly.

NOTE

If working on a locomotive equipped with AC traction equipment, it is required ***without exception*** that all appropriate discharge procedures be performed prior to commencing work on the trucks or related components.

1. Secure locomotive and follow discharge procedures before disconnecting any traction motor electrical cables.
2. Align jack stands or drop table as per local requirement, Figure 21.

CAUTION

When jacks are used to raise the locomotive, ensure that all jacks are raised simultaneously in equal amounts. Failure to keep the locomotive level may result in excessive stress on the underframe and carbody structure, or in a failure of the jacks. After the lift is completed, the locomotive should be supported with safety blocking located under the center sills near the jacking pads.

Figure 21 – Typical Jack Alignment

3. Disconnect brake piping; Figure 22, handbrake connections, sanding equipment, and flange lube equipment (if equipped). Secure loose parts and fittings.

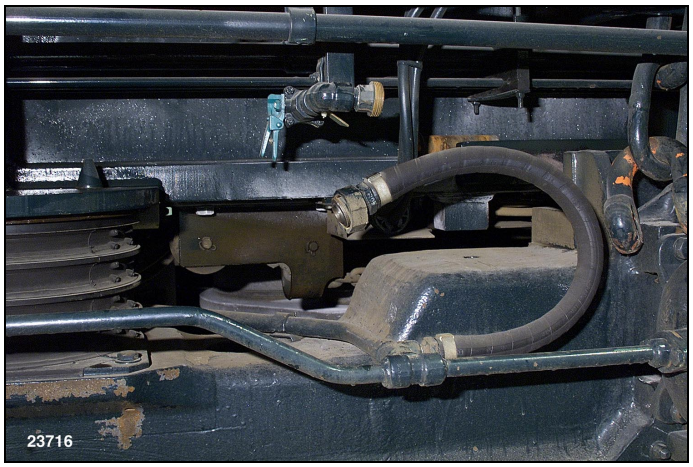


Figure 22 – Typical Brake Cylinder Air Piping

4. Apply penetrating lubricant to secondary spring pins; Figure 23, (HTSC type shown).

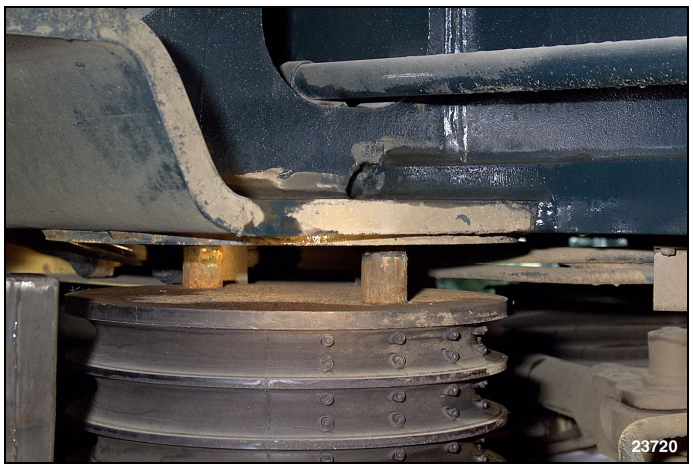


Figure 23 – Secondary Spring Pins (shown with unit lifted)

5. Remove traction motor lead boots/heat shrink tubing and disconnect traction motor leads, ground cables, and unplug lead/s to junction box (if equipped), Figure 24. Also disconnect speed pick-up cable going to #1 Traction motor.

NOTE

Secure cables, hoses, and all other hardware in a manner that places them safely out of the way during the bogie removal.

Figure 24 – Typical Traction Motor Connections (AC motor shown)

6. Remove cotter pins and disconnect secondary interlock shackles from bogie, Figure 25.

Figure 25 – Typical Secondary Interlock Carbody/Bogie Shackles

7. Disconnect yaw dampers from carbody, Figure 26, and secure to bogie. Note that the carbody bolts are 5/8-11 x 3-3/4", while the truck end bolts are 5/8-11 x 2-3/4". Note also that the bolts are fitted with special washers, 1-5/16" OD x 21/32" ID x .105". Retain all washers. Inspect hardware for damage, discard and replace all locknuts, 5/8"-11.

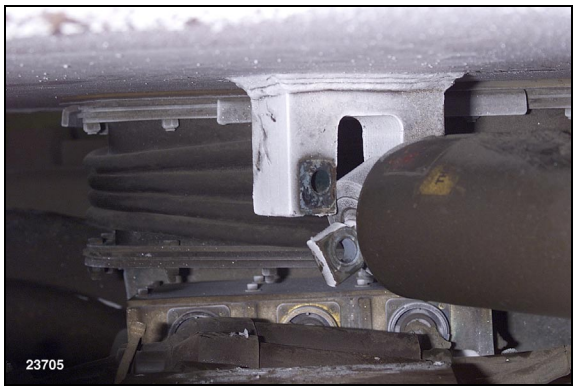


Figure 26 – Removal of Typical Carbody Yaw Dampers

8. Remove and discard lock wire from carbody pivot pin bolts, Figure 27, and remove ¾-10 x 2-1/2" bolts, pivot plate and wear ring, Figure 28. Wear ring should be discarded and a new one fitted on re-assembly.

Figure 27 – Lock Wire and Bolt Removal

Figure 28 – Pivot Plate and Wear Ring

9. Ensure all physical connections between carbody and bogie are removed or disconnected. Lift carbody or lower bogie, ensuring separation of secondary springs from carbody, Figure 29.

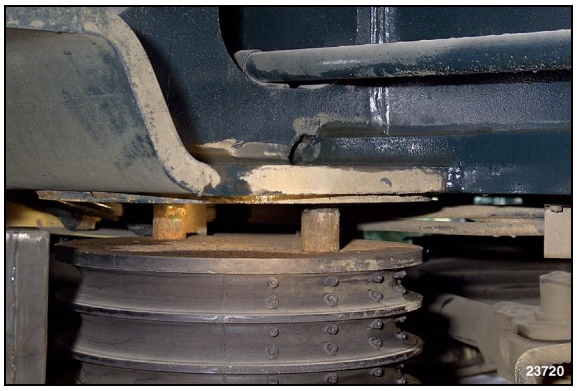


Figure 29 – Secondary Spring / Underframe Separation

10. Remove bogie from under locomotive and locate it right side up in the disassembly area, Figure 30.

WARNING!

When lifting the HTSC-B1 bogie ensure that chains, slings, or other lift devices art **NOT** connected to the rear cross member (transom) of the bogie frame. These bogies have a thinner cross section than the HTSC bogie in this area and may be damaged by the lifting forces. The frame has cast markings identifying the areas that are not to be used for lifting.

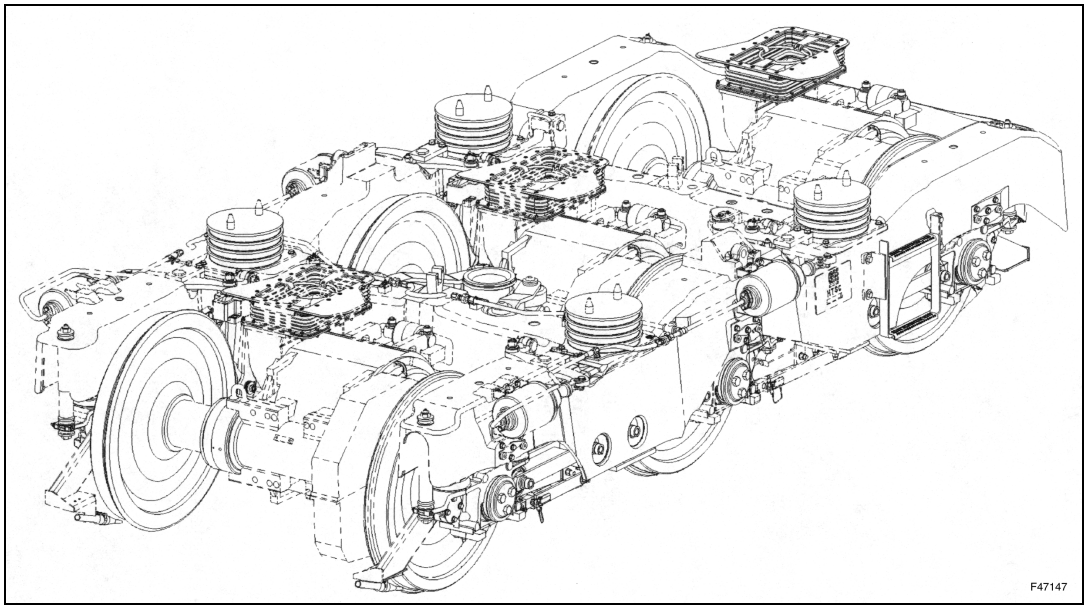


Figure 30 – Typical Bogie In Disassembly Area

2.13 BOGIE APPLICATION

2.13.1 INITIAL INSTALLATION

The bogie(s) may be applied to the locomotive by using an overhead crane or jacks to raise the locomotive, or by use of a drop table of sufficient capacity to handle one entire bogie assembly.

CAUTION

When jacks are used to raise the locomotive, ensure that all jacks are raised simultaneously in equal amounts. Failure to keep the locomotive level may result in excessive stress on the underframe and carbody structure, or in a failure of the jacks.

1. Install nylon alloy wear cylinders in carbody pivot on bogie. Note that the split lines of the two nylon pieces should be positioned towards the sides of the bogie. Ensure carbody pivot has been cleaned of dirt and corrosion. Spray pivot pin with moly lube. Clean the pads on the underframe of any rust, grease and oil prior to bogie application.
2. Roll bogie assembly under raised locomotive, or if using drop table, install bogie on table and raise under locomotive.
3. Verify alignment of the carbody pivot pin with the carbody yoke and the secondary spring pins with the holes in the underframe. Slowly lower the locomotive until the carbody pin enters the nylon insert on the pivot assembly, Figure 31.

Figure 31 – Alignment of Typical Pivot Pin

CAUTION

Great care must be taken during this portion of the application process to prevent damage to the carbody pivot assembly and secondary suspension springs. The pivot pin and alignment dowels should slide into place easily. If this is not the case, slight movement of the bogie will be required to aid in assembly.

Note that the carbody pivot will engage before the tapered pins on the secondary springs. It is permissible to apply anti-seize lubricant to the secondary spring pins, but the flat surfaces must remain dry for operational friction purposes.

2.13.2 VERTICAL STOP CLEARANCE

With the weight of the locomotive fully resting on the bogies, verify the vertical clearance at all four side locations, two per bogie at the center axle location. The vertical stop surfaces on the side of the bogie frame are designed to mate with similar vertical stops (shims) welded beneath the carbody underframe, as indicated in Figure 32.

Clearance is provided between the bogie frame vertical stops and the carbody underframe vertical stops (shims) during normal operation. The vertical stops are designed to prevent excessive tilting or leaning of the locomotive, but are not designed to carry a continuous load.

Vertical stop clearance on a new assembly should be at 16 +/-3.2 mm (0.62” +/- 0.12”)

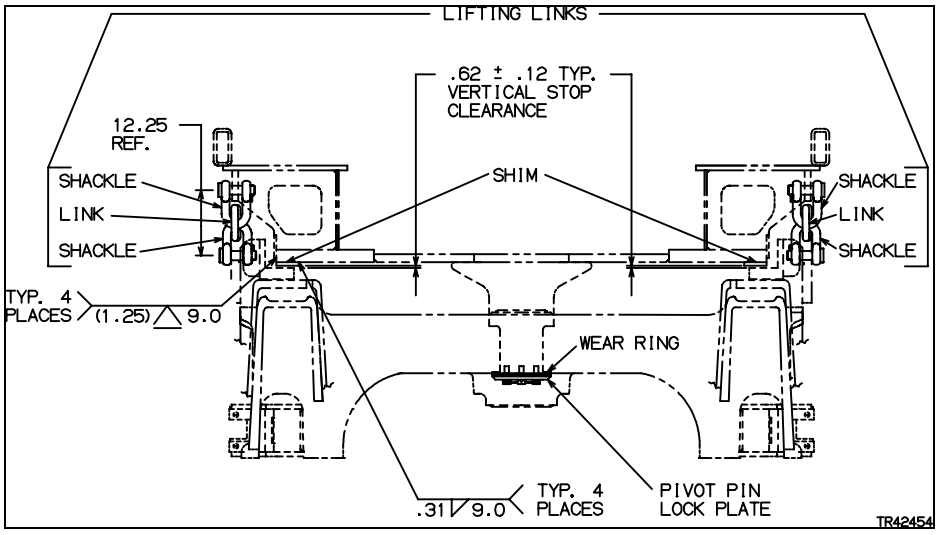


Figure 32 – Vertical Stop Clearance

2.13.3 FINAL INSTALLATION

1. Connect diagonal carbody dampers at carbody bracket using 5/8-11 x 3-3/4" bolt and 1-5/16 OD x 21/32 ID x .105" thick washer. Note that the dust cover end must be attached to the carbody with the label facing up. The bogie end must have the label facing down. Torque to required specifications listed in Service Data.
2. Apply the pivot pin lock plate and new wear ring using ¾-10 x 2-1/2 drilled head bolt and ¾" hardened washer. Use thread-locking compound on bolt threads and torque to required specifications listed in Service Data.
3. Install 14-gauge lockwire (approximately 2 meters or 6 feet), Figure 33, through the holes in all the bolt heads and safety wire in place.

Figure 33 – Application of Safety Wire

4. Connect traction motor leads and traction motor temperature / speed probes or speed cables as required.
5. Attach carbody links to bogie flanges using shackle assembly and new cotter pins.
6. Connect carbody air piping to bogie air piping.
7. Connect truck flange lube equipment if equipped.
8. Connect and adjust handbrake chain.
9. Check and confirm that all bogie and carbody inter-connections have been completed.

3.0 BOGIE OVERHAUL

This section details the procedures required to perform a complete overhaul of the HTSC / HTSC – B1 Bogie Assembly.

NOTE

While the overhaul procedures are similar for the two types of bogies, it is imperative that the correct assembly drawing be used to ensure correct dimensions are achieved.

Following removal from the locomotive (as outlined in the previous section), all traction motor/wheelsets by lifting the bogie off of the traction motors. It is recommended that all overhaul procedures be carried out with the bogie in a normal orientation.

During re-assembly, qualified wheelsets / motors should be applied to the bogie assembly.

3.1 BOGIE DISASSEMBLY

With the bogie assembly removed from the locomotive, the assembly may be disassembled (stripped) to facilitate component inspection, repair, and replacement. The bogie should be located in a suitable work area in a normal orientation. Take care to identify and properly store all components as they are removed to aid in re-assembly. Proceed as follows to disassemble the bogie:

3.1.1 REMOVING VERTICAL DAMPERS

1. Vertical dampers on the HTSC bogie may be removed without disassembly of the mounting brackets. At lower end of damper assembly, hold the damper-mounting stud with an Allen wrench in center while loosening the clamping nut. Remove the retaining bolt and nut from the lower U-connection. While supporting the damper, repeat this procedure for the top clamping assembly, then slide the damper out.

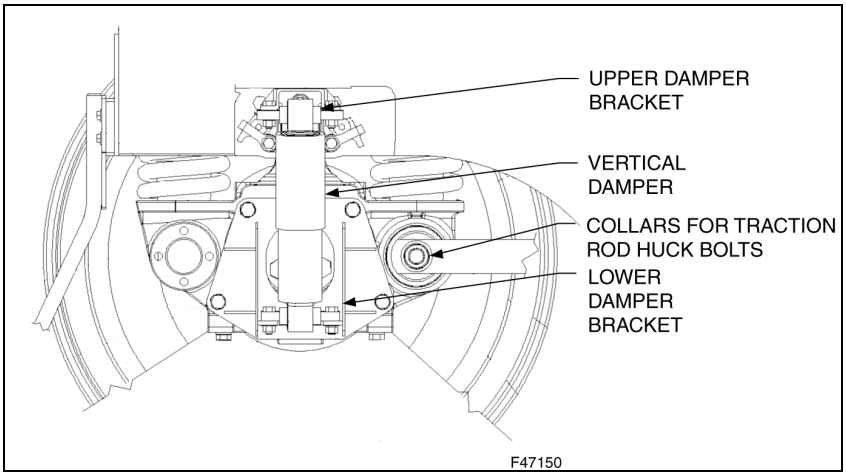


Figure 34 – Vertical Damper Removal

2. Figure 34 shows the configuration on the HTSC-B1 bogie. Here, the damper is removed by loosening the bolts and nuts holding the bar mounts at each end. After all retaining hardware is removed, gently pry the lower portion of the damper away from the lower damper bracket and drop the damper free of the upper bracket on the bogie.

NOTE

Do not remove the bolts that secure the upper bracket to the bogie frame, as these bolts also secure the journal adapter lateral thrust pads.

3. Qualify the unit as per the section on Dampers in this M.I. Inspect all rubber mounting components, replace as required on re-assembly.
4. Loosen all bolts holding the upper and lower damper brackets, and remove both brackets. Inspect both brackets and discard in case of excessive wear, damage due to ballast or object impact, or other damage.

3.1.2 REMOVING TRACTION RODS LOCK BOLT COLLARS

Using the proper size lock bolt splitting tool or cutting torch, cut the collars at both ends of each of the traction rods, taking special care not to damage nearby rubber bushings or the bogie frame. Do not attempt to remove the traction rod lock bolts yet.

3.1.3 REMOVING TRACTION MOTORS/WHEELSETS ASSEMBLY

Follow this procedure when removing traction motors from a locomotive where the bogies have not been removed, or during disassembly after the bogies have been removed from the locomotive:

WARNING

Journal bearing adapters at both ends of the motor-wheelset being removed must be restrained in such a manner that prevents them from rotating or dropping clear of the bogie frame. Prior to removal of the wheelset, inspect the primary interlock rods (journal adapter retainer pins) for securement. This is necessary in order to prevent the journal springs from dropping out of the spring pockets in the bogie frame - which could endanger maintenance personnel.

1. Support the rear of each traction motor assembly with a portable lift device or blocking, which remain in place after the rest of the bogie assembly has been lifted away.
2. Disconnect the traction motor nose link (see Figure 35) assembly from the traction motor. Lock bolts may be removed using a proper sized splitting tool or burned off using a cutting torch (Refer to section on removal and installation of lock bolts for greater details).

Figure 35 – Typical Traction Motor Nose Link Removal (HTCR Shown)

3. Use care when removing any lock bolts with a torch in order to avoid damage to the surrounding bogie frame, linkages, and bushings.

4. Unbolt the journal adapter plates and remove this and bearing adapter spacer from either side of the motor being removed.
5. Disconnect the cables and any other hardware attached to the motor/wheelset or bogie frame that would interfere with removal - including the wheel flange lube nozzles (if used) and sanding nozzles.

WARNING!

When lifting the HTSC-B1 bogie ensure that chains, slings, or other lift devices art **NOT** connected to the rear cross member (transom) of the bogie frame. These bogies have a thinner cross section than the HTSC bogie in this area and may be damaged by the lifting forces. The frame has cast markings identifying the areas that are not to be used for lifting.

6. Shorten brake slack adjusters and back brake blocks away from the wheels. Secure all cables and hardware in a manner that places them safely out of the way during motor removal.
7. Hold the nose link assembly away from the motor. Lift the bogie frame (Figure 36), rolling the traction motor in a manner that will disengage the motor from the bogie frame supplemental interlock (limit stops).

NOTE

In case of a locomotive carbody that has still not been separated from the bogie frames, lift locomotive or lower the drop table to remove the traction motor /wheelset assembly from locomotive.

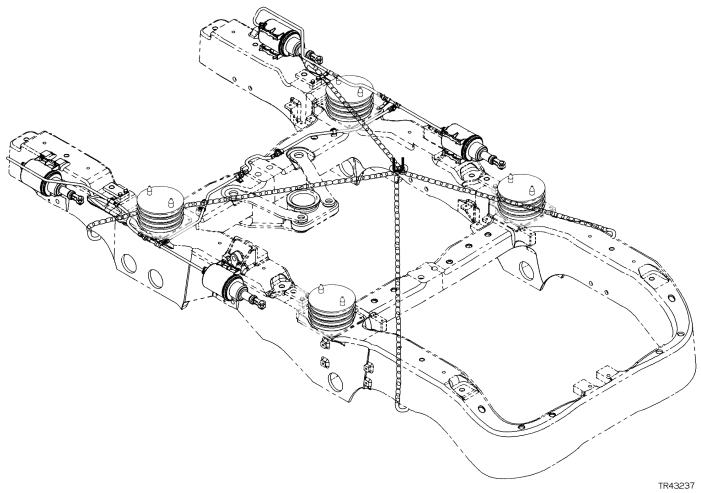


Figure 36 – Lifting of Bogie

8. For a bogie that has been removed from locomotive, lift the bogie frame with all remaining components still attached to it. Lift a small amount and check that all wheelset/motor assemblies separate completely from the bogie assembly. Also ensure that the coil springs are still being retained between the bearing adapters and the bogie frame.
9. Continue to lift the bogie assembly until clear of the traction motor assemblies.
10. Position the bogie assembly with a wooden block beneath all six bearing adapters. The blocks must be of a height sufficient to accommodate the brake rigging, traction motor nose link and other components hanging from the remaining bogie assembly.

CAUTION

The bogie frame with remaining components should be lifted, right side up, with four chains that are anchored properly and securely to the bogie frame at four locations on the outside of the frame.

The selected chains must enable the bogie frame to be lifted level when all chains are tight.

Before proceeding with the lift, tighten ensure that all chains are tight, all lift connections to bogie frame are secure, and all components still attached to frame are not in the way of a clean lift.

Primary coil springs should be secured with ropes or straps to their bearing adapters or to mating coil paired coil springs so that they do not roll away when the bogie frame assembly is lifted.

3.1.4 DISCONNECTING TRACTION RODS AND REMOVING BEARING ADAPTERS AND PRIMARY COIL SPRINGS

1. After placing supports under each of the traction rods to support them when are loosened, remove all lock bolts at each end of the traction rods by hammering them out, being careful not to damage the remaining rubber traction bushings in the bogie frames, bogie frames and bearing adapters.
2. Loosen the bolts on the upper damper bracket holding the interlock retainer, swing out the retainers, and remove the primary interlock rods.

3. Secure all hanging nose links with straps. Remove the lock collars at the upper connection of each nose link. Lock bolts may be removed using a proper sized splitting tool or burned off using a cutting torch (Refer to section on removal and installation of lock bolts for greater details).
4. Using small sized crane, lift the nose links out and store for reuse.

NOTE

Check coil springs to ensure that they will remain in place and will not roll away, either by the use of ropes or straps attached to the mating springs or the bearing adapter on which each set of springs sit.

5. Lift the bogie frame, leaving the journal adapter assemblies resting on the wooden support blocks. When lifting, ensure that components such as the springs do not fall out. Note the position of the journal adapter support blocks as this will aid in re-assembly.
6. Position the bogie frame on four wooden blocks, with the flat under surfaces of the bogie frame resting on these blocks. As before, the blocks should be high enough to accommodate any components like brake rigging that are still hanging from beneath the bogie frame.
7. The six bearing adapters and coil spring sets are now sitting separated from the bogie frame. Non-metallic straps should be used with a small crane to lift each coil spring and place it on one of its flat end surfaces for later inspection.
8. Disconnect the sander guide brackets by unbolting from bearing adapter and removing. Store for re-use.

3.1.5 REMOVAL OF SECONDARY RUBBER SPRINGS

Unbolt the four secondary springs from the bogie frame. Lift up using the lower steel plate of the rubber spring, by slightly raising it and then hooking on all four corners. Store flat for later inspection.

3.1.6 REMOVAL OF LATERAL THRUST PADS

Lateral thrust pads are located on the inside of the bogie frame adjacent to the primary springs at each journal bearing location. To remove a pad, the vertical damper must have been removed using the procedure previously outlined. Unbolt the three retaining bolts and remove the upper damper bracket and the pad assembly from the bogie frame, holding on to both together. Qualify and renew as required. Replace if the lateral free axle clearance exceeds the limits specified in the Service Data section of this M.I..

3.1.7 REMOVAL OF YAW DAMPERS

Yaw dampers are mounted diagonally between the bogie frame and the locomotive underframe. There are two damper assemblies per bogie. To remove the yaw damper, secure the damper with straps so as to prevent it from dropping. Remove the two remaining mounting bolts and self-locking nuts, and Lift the yaw damper using a small crane and store for later inspection. Discard all self-locking nuts. Qualify the unit as per the section on Dampers in this M.I..

3.1.8 REMOVAL OF CARBODY PIVOT ASSEMBLY

Apply a lifting device to the carbody pivot assembly to support it. The pivot Yoke (Figure 37) is first released by removing the yoke end lock bolts, flanged bushing, and washer.

Lock bolts may be removed using a proper sized splitting tool or burned off using a cutting torch (Refer to section on removal and installation of lock bolts for greater details).

The lock bolts are now removed from the bogie frame end, located on the transom. Inspect the carbody pivot yoke, and carbody traction rods for cracks or excessive wear, replace if either condition exists.

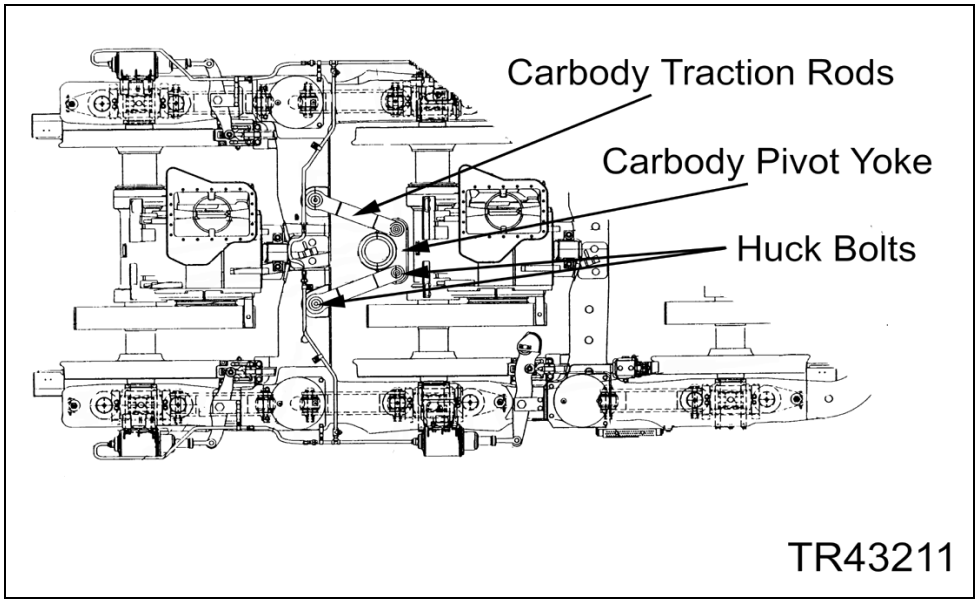


Figure 37 – Carbody Pivot Assembly

Use care when removing any lock bolts with a torch in order to avoid damage to the surrounding rod, pivot assembly, bushings and bogie frame.

3.1.9 REMOVAL OF BRAKE RIGGING COMPONENTS

This process is done with the bogie frame supported on blocks with motor sets and wheelsets already removed. Proceed as follows:

1. Remove all Brake Blocks from the brake lever assemblies by popping out the brake block key in each.
2. Remove the Slack Adjuster Assemblies by unbolting the Pin Assembly at each end. Also remove the clip. Lay the pieces on clean floor or board for later inspection.
3. Remove "Dead" Brake Lever Assembly by unscrewing bolt from the bogie frame. Also remove washer. Lift the assembly with a hoist high enough to clear the bogie frame and lay it on the side.
    a.) Detach Brake Head Assembly by removing the Pin Assembly.
    b.) Remove the Mounting Block Assembly by unbolting Pin Assembly.
4. Disconnect the clevis end of the "Live" Brake Lever Assembly from the Cylinder Lever Assembly by removing the clevis pin assembly. Remove the three Bolts and Washers that mount the brake lever bracket assembly to the bogie frame. With a hoist, lift the whole "Live" Brake Lever Assembly high enough to clear the bogie frame and lay it down on its' side.
    a.) Detach the Clevis from Live Lever Assembly by removing the Pin Assembly.
    b.) Remove the Brake Lever Bracket Assembly from the two Hanger Assemblies by unscrewing Bolt and Nut and the Washer. Also remove the two headless Pins by pushing them out.
    c.) Remove the Brake Head Assembly by unbolting the Pin Assembly.

d.) Disconnect the Cylinder Lever Assembly from the Brake Cylinder Assembly by removing the cotter pin and pin, respectively. Pull out the Ring-Retainer that secures the Pin at the lever fulcrum to the bogie frame. Pull out the Pin to retrieve the Cylinder Lever Assembly.

NOTE

Items 1 to 5 are typical to the Brake Rigging Application on a non-handbrake equipped bogie. In the Brake Rigging Application with a handbrake, one of the Cylinder Lever positions becomes the handbrake hookup. Note the position of this lever relative to the bogie frame to aid in re-assembly. To disassemble, apply steps 4 and 5 above.

3.2 COMPONENT QUALIFICATION

3.2.1 3.2.1 BEARING ADAPTERS

Journal bearing adapters, Figure 38, should be given a thorough visual inspection for signs of overheating, cracks, or evidence of excessive wear in the journal bore and the spring seat area. Welding may repair worn or cracked areas. Grind off excess material and thoroughly clean the adapter before re-assembly.

Figure 38 – Typical Journal Bearing Adapter Bore

3.2.2 BRAKE RIGGING COMPONENTS

All brake rigging components should be thoroughly cleaned and examined for damage and wear. The wear surfaces of the brake rigging are equipped with replaceable hardened bushings, pins, and bolts. Any of these connecting parts that are worn more than specified below should have both parts replaced. Never use a new pin with an old bushing or vice versa.

Cylinder levers, brake levers, and brake rods that are bent may be re-used if they are restored to their original shape. Bolts and nuts that are not subject to wear may be re-used if they are not damaged, but cotter pins must always be renewed.

Qualification and repair procedures for the brake rigging are as follows:

1. Make a visual inspection of the Bar-Stabilizers, which are still attached to the bogie frame for straightness. Out of straight of 0.125” from the clamped portion of the bar necessitates replacement or repair of the part.

2. All bushings must be measured for out of round condition. If a bushing is out of round by 0.094" or more on the diameter, press it out and replace it with a new one. Likewise, if the bushed hole is apparently egg-shaped, build it up with weld and re-drill it to appropriate size before pressing in the new bushing.
3. The Wear Plate on each Brake Lever Assembly must be inspected for considerable wear. Total wear for this part must not exceed 0.19".
4. All pins must be examined for significant deterioration such as cracks, wear and/or bends. If the condition of any pin is enough to jeopardize its function, replace it with a new one. Replace a pin if it is worn out more than 0.063".
5. The Brake Hanger Assemblies of the "live" Brake Lever Assembly should be inspected for twist and shift. The existence of one or both of these deformations will adversely affect the angle of contact between brake shoe and wheel. Repair or replace the part accordingly.

3.2.3 TRACTION ROD BUSHING REPLACEMENT PROCEDURES

The following procedure is to be followed when removing traction rod bushings from a bogie frame. A similar procedure will be followed for removing a traction rod bushing from a bearing adapter. See Figure 39 for the tooling components and procedure needed.

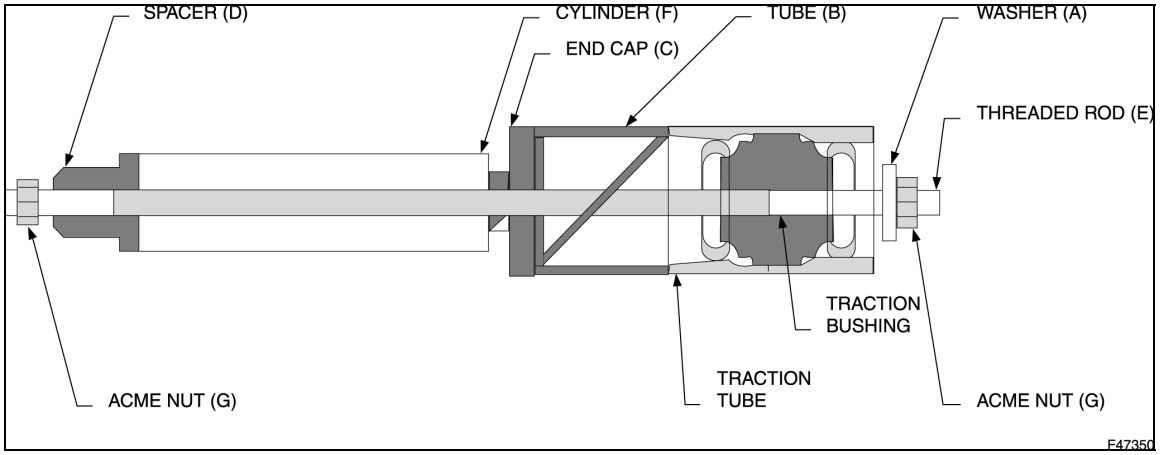


Figure 39 – Removal Of Traction Rod Bushing

NOTE

The threaded stud bolt should be made of heat-treated alloy steel like SAE 4140 with hardness of 30-36 HRC (Rockwell C).

3.2.3.1 Traction Rod Bushing Removal

1. Position stud bolt (E) with flat washer (A) and nut (G) from inside of bogie, so that the stud bolt will protrude through bushing to outside of bogie frame.
2. Install large tube (B) to contact the welded in traction tube sleeve.
3. Install end cap (C) into end of tube (D) so that the counter bore goes into the tube.
4. Install the hydraulic puller (F- hollow hydraulic cylinder) on stud bolt with the ram against the end cap.
5. Install the spacer (D) on the stud bolt and, if necessary, add one or more of the spacer washers, so as to fill the stud bolt leaving enough for the (2) nuts (G) to have a minimum of two threads through the nuts.
6. Install the acme nut on the end of the stud.
7. Connect the hydraulic hoses to the cylinder, keeping fingers clear of the entire load train, and pump to apply pressure until everything has become snug and has made contact.
8. Check to make sure that entire assembly is properly aligned. If not, loosen, re-position components and apply pressure again until all components are in contact, and re-check alignment.
9. Apply ample force to pull bushing out. A small amount of P-80 lubricant may be applied as bushing is coming out. Support the hydraulic cylinder from falling when the rubber bushing is about to come out.

CAUTION:

Do not stand behind hydraulic cylinder (puller) – stand to the side away from the force.

3.2.3.2 Traction Rod Bushing Installation

If the traction tube is new, then no cleaning may be needed. However, after removal of a bushing, the inside of the traction tube may have some remaining rubber pieces or debris. These should be cleaned out with a rotary wire brush until all debris has been removed.

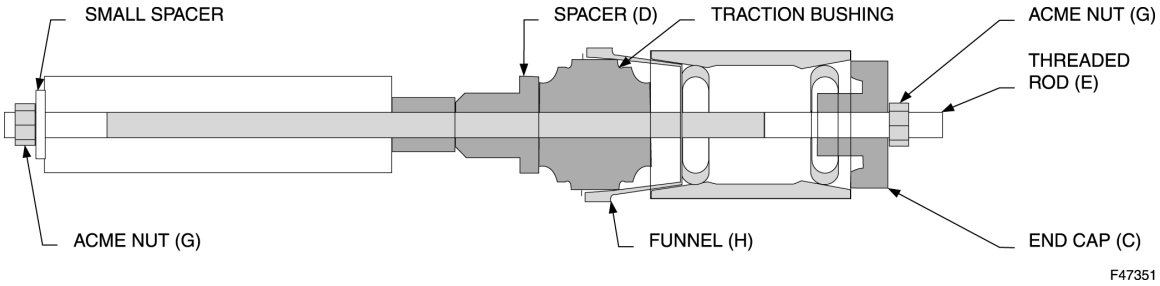


Figure 40 – Installation Of Traction Rod Bushing

CAUTION

P-80 lubricant must be used for bushing assembly. Do NOT use soap, oil, or any other unapproved type of lubricant as this may lead to deterioration of the bushing material.

1. Apply P-80 lubricant to inside of traction tube sleeve and funnel (H) as well as the new traction rod bushing to be installed.
2. Install stud bolt (E) through traction tube sleeve and put end cap [C] on with counter bore facing away from the traction tube sleeve. This will seat against the end of tube.
3. Install small spacer and acme nut (G) with two threads through nut.
4. Install funnel (H) to outside of bogie to seat in traction tube sleeve as per Figure 40.
5. Slide on the traction bushing and slide into the funnel as far as possible.
6. Slide on the spacer (D) against the traction bushing.
7. Slide on the hydraulic cylinder (puller) with the ram against the spacer.
8. Install nut (G) with a minimum of two threads through the nut. If needed, add more spacer washers.
9. Hold up the hydraulic cylinder so that it is in proper position, keeping all hands and fingers clear of the load train components) and apply hydraulic pressure enough so as to align everything. If necessary, apply more P-80 lubricant to the rubber and funnel.
10. Apply more pressure to pull in bushing through funnel into traction sleeve. Stop when the bushing is a little past slot in sleeve. Check bushing to see if it is centered in sleeve slots (equal amounts sticking out on both sides). This should be about 25mm (1”) from edge of slots in sleeve, to allow for bushing spring-back. If not, pull a little more. If the bushing has gone too far, use a pry or crow bar to move back to proper spacing. Note: Once the lubricant is dry, the bushing will take a set and will be hard to move. So all adjustments should be done soon after bushing is inside the traction tube sleeve.

11. Remove the hydraulic cylinder (puller) and funnel.

3.2.4 CARBODY PIVOT ASSEMBLY

Qualification of the carbody pivot assembly (Figure 41) includes inspection of the pivot; wear sleeves, yoke and carbody traction rods. During a bogie overhaul, it will be required to renew the bushings in the carbody traction rods.

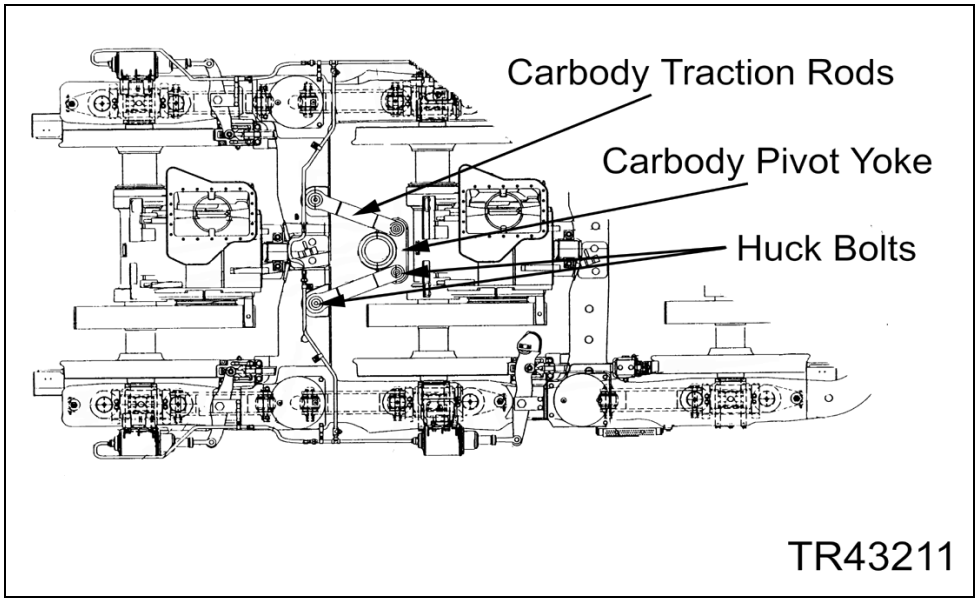


Figure 41 – Typical Carbody Pivot Assembly

Thoroughly clean all components and inspect for damage or fatigue. Carbody rods are equipped with both different special washers at the bogie end and carbody pivot yoke end. All must renewed prior to re-assembly.

3.2.4.1 Carbody Bushing Removal Procedures

There are two bushings per bogie and two bushings per carbody end. Refer to the appropriate print for part numbers and orientation. See Figure 42. These bushings may be removed using a procedure similar that used for removing traction rod bushings.

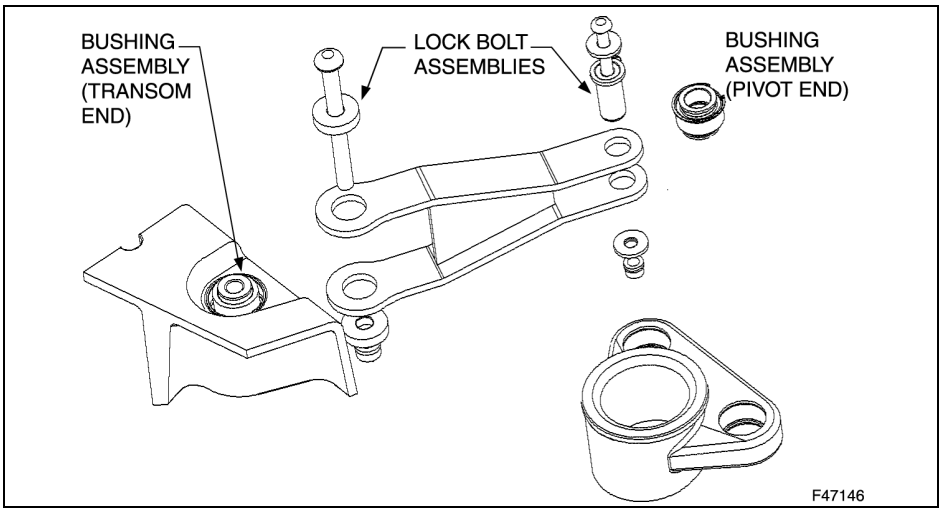


Figure 42 – Carbody Pivot Rod Traction Bushings

3.2.4.2 CARBODY ROD BUSHING INSTALLATION PROCEDURES

1. Place the installation funnel on top of the hole. See figure 43.

CAUTION

P-80 lubricant must be used for bushing assembly. Do NOT use soap, oil, or any other unapproved type of lubricant as this may lead to deterioration of the bushing material.

2. Apply P-80 rubber lubricant to the inside of the hole and funnel, and on the outside of the carbody bushing.
3. Apply the ram at the end of a hydraulic cylinder to the inner metal part of the bushing. During installation, the steel inner member of the bushing must be pushed beyond the 0.605/0.645" dimension to accommodate spring-back (will need about 5,000 lb force). See Figure 48. If the carbody bushing is not in position, it must be repositioned before the lubricant dries. Once the lubricant dries it becomes much more difficult to move the bushing (it requires a larger force to move) and the danger of bushing tearing is present.

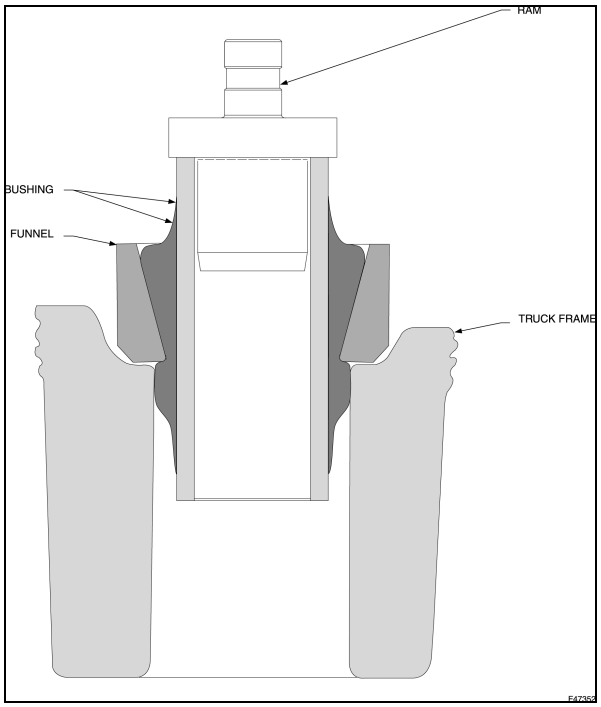


Figure 43 – Carbody Pivot Rod Traction Bushing Alignment

CAUTION

Do not stand behind hydraulic cylinder (puller) – stand to the side away from the force.

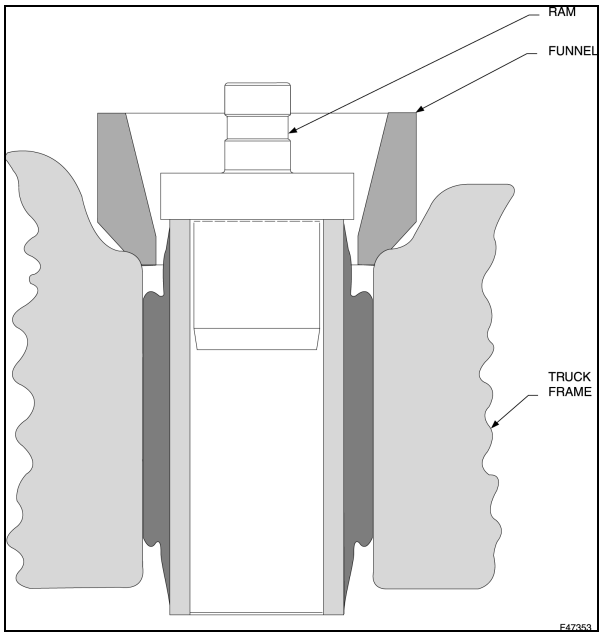


Figure 44 – Carbody Pivot Rod Traction Bushing Installation

4. Using the ram tool shown, see Figure 44 apply P-80 lubricant to the retaining ring (2 per bushing), and push the retainer ring into position with about 6,500 lb. force.

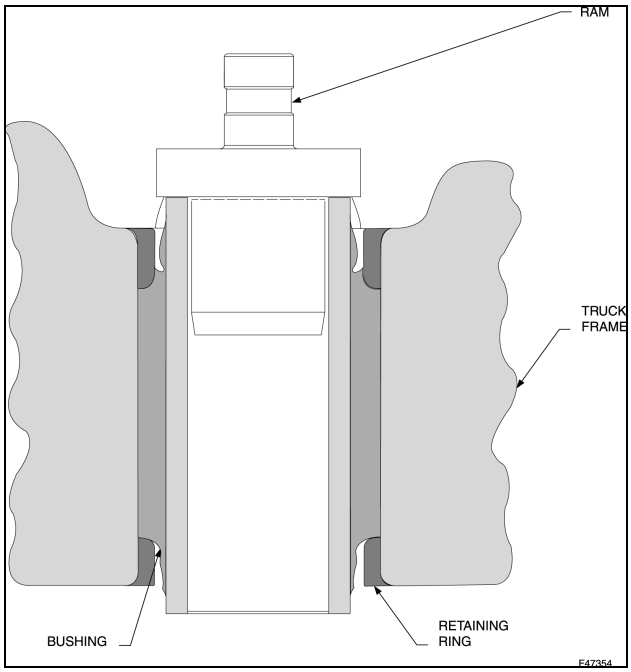


Figure 45 – Carbody Pivot Rod Traction Bushing Retaining Ring Installation

5. Apply the opposing retaining ring. Finished bushing assembly should resemble Figure 46.

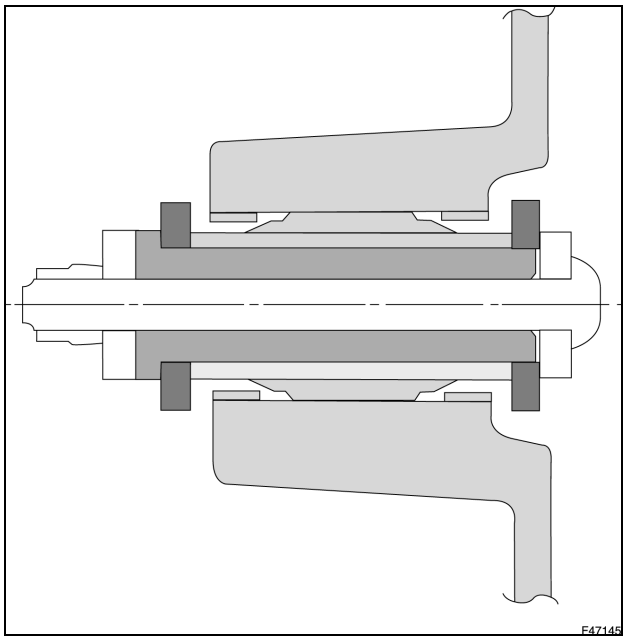


Figure 46 – Completed Carbody Rod Bushing

3.2.5 TRACTION MOTOR NOSE SUPPORT LINKS

Qualification of the traction motor nose support links (dogbones) includes a visual inspection of the links and replacement of the bushing assemblies, Figure 47.

Figure 47 – Typical Traction Motor Nose Support Link (HTCR Shown)

Thoroughly clean all components and inspect for straightness, damage or wear.

Note that the metal supports that protrude from the sides of the bushing have a wider contact surface on one side. This wider surface is the contact area between the support and the bogie or traction motor. Ensure bushings are installed with these wider surfaces facing each other, Figure 48.

Figure 48 – Bushing Orientation

3.2.6 PRIMARY COIL SPRING SUSPENSION

Locomotive bogie frame-to-axle journal primary suspension is provided by steel helical coil springs. Two single coils per journal adapter are utilized that generally provide for large amounts of deflection. This assists in wheel load equalization, and improves the ride quality over rough sections of track.

In the event that a primary spring is found to be broken, it should be renewed along with the remaining spring on the same adapter. In addition, the two springs on the opposite adapter on the same axle should be thoroughly inspected. Periodically in normal service, the coil springs shall be thoroughly inspected for signs of fatigue or degradation.

1. Inspect the coils for breaks or surface cracks. Springs with any indication of surface cracks should be scrapped. Deep sharp surface nicks can cause failure of a spring, and their presence is cause for rejection.
2. Hand wash or shot blast the coil to remove surface rust. “Pickling” the spring is to be avoided. If the cleaning operation removes all indications of surface rust, and does not reveal corrosion pits, the spring is acceptable for qualification. If corrosion pits are visible after the cleaning operation, scrap the affected coil.
3. Smooth worn spots on a coil caused by rubbing - do not condemn the coil. However, it must still pass the other qualification criteria.
4. For spring identification and qualification, refer to M.I. 1512.

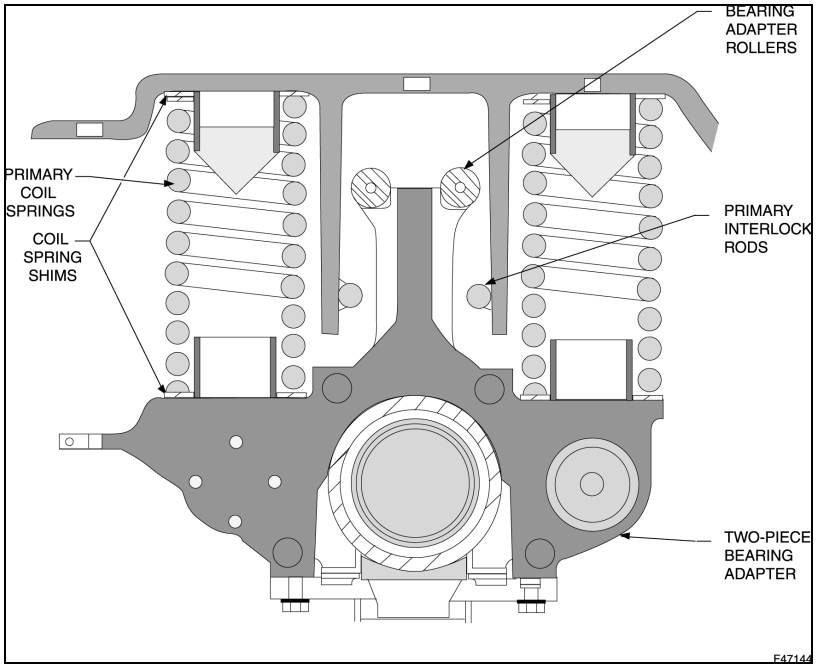


Figure 49 – Primary Coil Springs and Journal Adapter

In order to secure the coil springs on the journal bearing adapters, spring pilot tubes are used along with pilot (wear) plates between the springs and the adapter, Figure 49. Spring pilot tubes and shims (spacers) are also located in the truck frame spring pockets to perform the same function.

3.3 BOGIE FRAME INSPECTION AND RECONDITIONING

Make a thorough inspection for the following and recondition if necessary.

3.3.1 BOGIE FRAME TRAMMING

Tramming of the bogie is done from the spring pocket holes. Clean off the surface (carefully) and locate the tram points. If necessary, insert rods of same sizes in the four opposing holes. Measure the distances between the reference points or between the centers of the rods (if used). The differences between the two distances should be less than the tramming tolerance specified (See Service Data).

Refer to Figure 50 for identification of tram points (spring pocket holes).

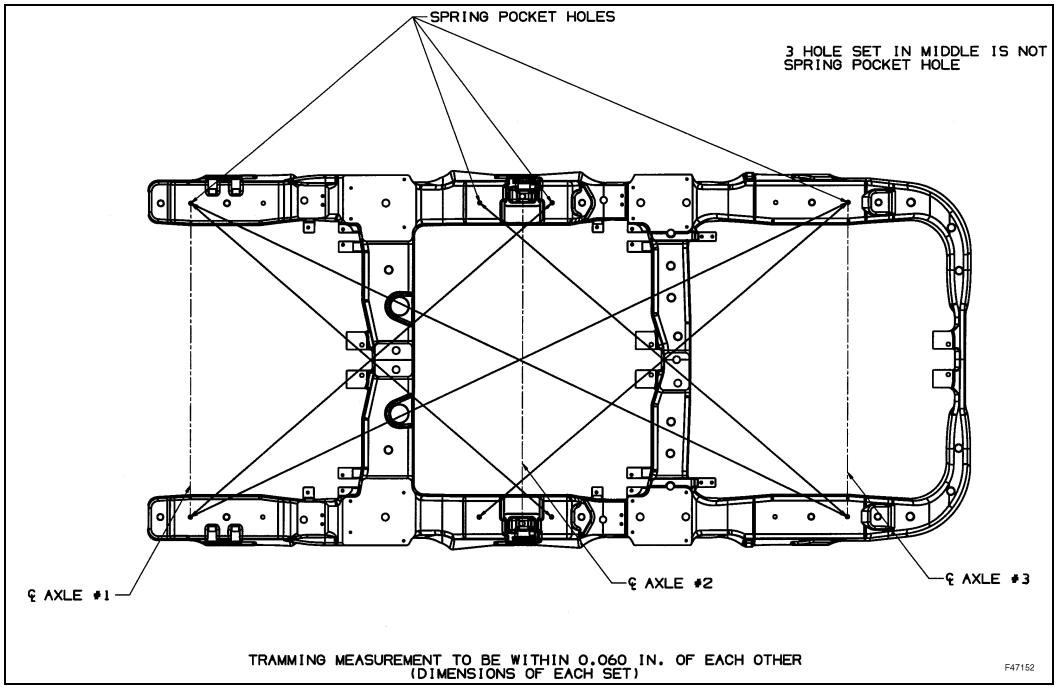


Figure 50 – Typical Tramming Points

Measure the distance between diagonal pairs of tram points. For example, the distance between the left front tram point and the right rear tram point will be considered "L_A" while the distance between the right front and left rear tram points will be considered to be "L_B". If "L_A" is within +/- .06" of "L_B", the tram is considered to be within specification. See Figure 50.

If the tramming dimensions are not within specification, contact your EMD Service representative for corrective procedures.

3.3.2 BENT, BROKEN, OR CRACKED MEMBERS

Inspect all bogie members and weldments for breaks or cracks. The critical areas of the bogie are identified in Figure 51 and require closer attention when inspecting, than other areas of the bogie frame. Perform magnetic particle inspection at any areas suspected of being cracked. Before performing any weld repairs to major structural areas, contact your EMD Service Representative for corrective procedures.

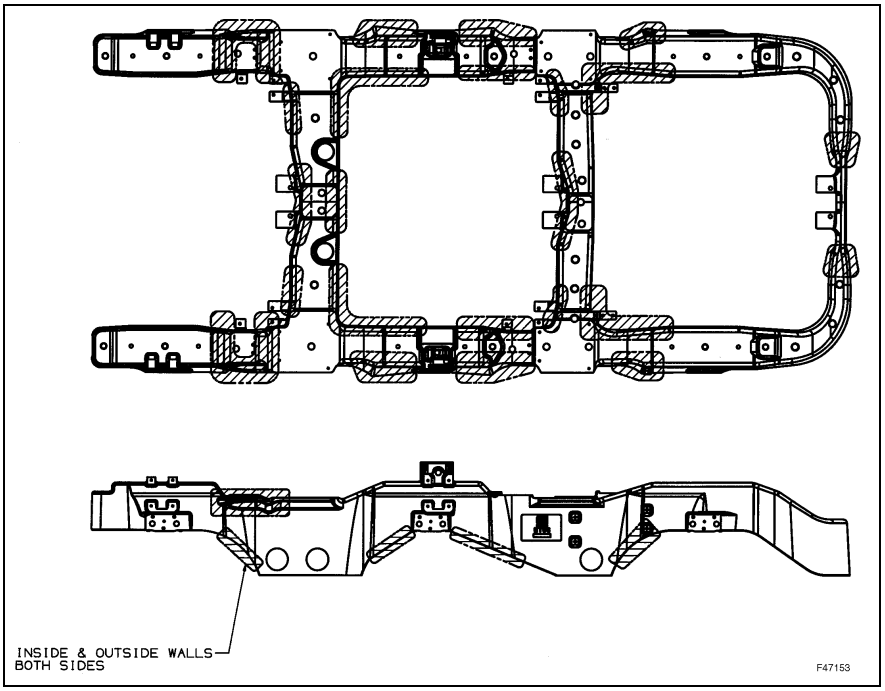


Figure 51 – Critical Frame Areas

Breaks or cracks are repaired by welding, using AWS E-7016 electrode. It is permissible to remove a broken or bent section for straightening if it can be welded back into place after preparing the joint to obtain a 100 percent section of weld with reinforcement as shown in Figure 52.

To minimize localized stressing when several welds are required, allow sufficient time for frame to cool to the touch between welding passes. Water soaked rags or air fans may be used to cool the welding area. Make certain that area to be welded is dry before welding. To further minimize localized stress distortion, each welding pass, except the root pass, should be 100% needle peened. Peen immediately after each pass, except for the final pass. Peen final pass after it has cooled to below 66° C (150° F). Use a needle-peening gun with a minimum of twenty-eight 3-mm wires with rounded end. Avoid excessive peening that will impair the quality of the welds.

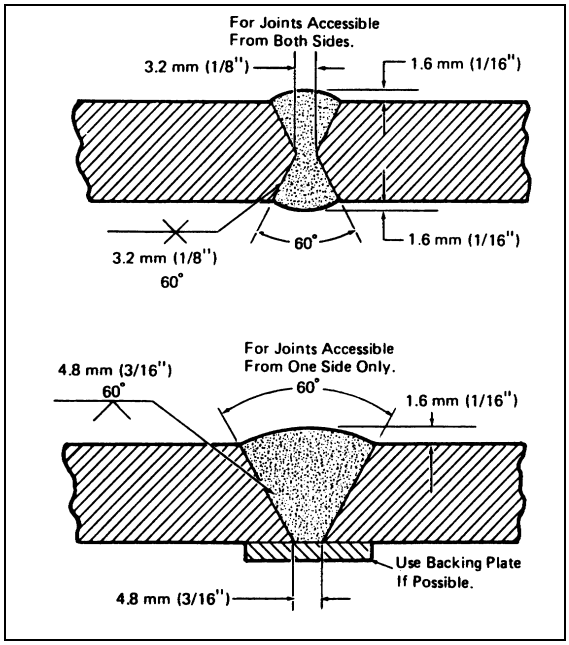


Figure 52 – Preparing Joints For Welding

All welds should be magnetic particle inspected after welds have cooled to below 204 ° C (400 ° F)

Bent sections may be straightened either cold or after application of heat, Figure 53. Before straightening any bent section, determine what effect the straightening will have on the adjoining sections. If necessary, the affected section should be removed from the frame assembly, and rebuilt provided the welding criteria described above is complied with.

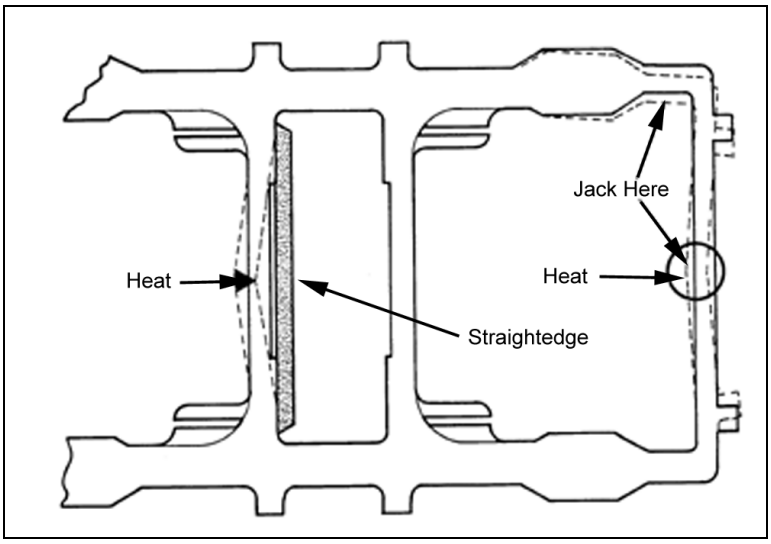


Figure 53 – Bogie Frame Straightening

Jacks, turnbuckles or fixtures designed for straightening members will expedite the straightening of bent sections.

3.3.3 WORN SPOTS

The HTSC bogie frame is designed to have a minimum number of wear surfaces to reduce maintenance. However, it should be periodically checked for worn areas. Worn spots can be repaired by building up the affected area(s) with weld as outlined in the above paragraphs. After the welding operation is complete, grind the area(s) smooth to match its original form. This applies to any area on the frame, machined or otherwise such as the lateral and vertical stop surfaces, or the primary and secondary spring seats.

3.3.4 ELONGATED OR OVERSIZE HOLES

Drilled holes elongated by wear due to loose bolts; screws, sleeves, or bushings can be re-conditioned by either ring or plug welding. Holes that are too small to permit proper manipulation of the welding electrode should be drilled oversize to permit proper access for the electrode. The hole should be re-drilled to proper size after completion of the welding.

3.3.5 WORN BUSHINGS

All bushings should be pressed out and replaced at each bogie overhaul. After the bushing is removed, inspect the drilled hole in the frame for wear or an out-of-round condition. Holes found unsuitable for a new bushing can be reconditioned by ring welding and then drilling to accept the new bushing. Applying a band of heat parallel with the drilled hole may shrink holes that are slightly oversize.

3.3.6 DAMAGED THREADS

All threaded holes should be checked and re-tapped if required. If the threaded holes cannot be reconditioned by re-tapping they should be plug welded, re-drilled and tapped. An alternate method of reclaiming unsatisfactory threaded holes is to re-tap them to accommodate an oversize bolt.

3.3.7 BROKEN OR BENT STUDS

Replace any broken or bent studs with studs that are in satisfactory condition.

3.3.8 MISSING PARTS

Make a thorough inspection to see that all the necessary parts are intact. Special attention should be given to wear plates, cotter keys, washers, bushings, studs, brake guides, and brake pins.

3.4 BOGIE RE-ASSEMBLY

The bogie is assembled in the upright position (normal running position). Reference the appropriate prints for the specific bogie being assembled.

3.4.1 INITIAL BOGIE ASSEMBLY

Unless specifically noted, all bolts are to be torqued to the appropriate values as shown in the Service Data Section. Self-locking nuts with nylon locking inserts are installed satisfactorily when the end of the bolt is either flush with the top of the nut or is protruding through the nut. Lock bolts are to be applied using only the correct lock bolt installation equipment with pressures adjusted to levels recommended by the equipment manufacturer. Refer to the assembly instructions in the section on lock bolts (This M.I.). New cotter pins are to be applied, orientated with the split portion downwards and the long leg bent back sufficiently to ensure security of the pin. When applying components with machined mating surfaces, ensure that all grease or preservative has been removed from both surfaces.

1. Place the bogie frame upright on top of four wooden blocks to support the bogie at four locations under the traction rod bushing holes. As per the section on traction rod bushings and carbody bushings, the bushings should be inspected and replaced as necessary. Traction rod bushings in bearing adapters should also be inspected and replaced as needed. Remove plastic pugs from threaded holes.
2. Lateral thrust pads are to be inspected and replaced only if the metal frame or the nylon rubbing surfaces are cracked, or if the lateral axle clearances exceed the limits shown in the Service Data section at the end of this M.I. If needed, a new lateral thrust pad is to be installed together with the upper damper bracket using the same bolts. The bolts and special spring washers are applied from the outside and thread into the lateral thrust pads. The bolts are to be tightened as per the Service Data Section.
3. Secondary rubber springs are to be inspected and replaced, if needed, as per the section on rubber springs (This M.I.). Note that if it is required to renew a secondary spring assembly, they should be renewed as a set (all four on the affected bogie). It will not be required to renew the secondary spring assemblies on the other bogie. Before installing a new spring ensure that the secondary spring mounting surfaces on the bogie frame are clean. Install the secondary spring on the bogie frame with four bolts, with the upper pins aligned in the longitudinal direction as per bogie assembly drawings.

4. Apply carbody traction rods to bogie frame as per view H in the appropriate bogie assembly drawing. The flanged bushing is to be applied from the bottom, and the 1 3/8" lock bolt is to be applied from the top (i.e. collar on bottom). Thick hardened washers are required at both ends. Do not swage the lock bolts at this time.
5. Apply the carbody pivot assembly to the carbody traction rods. The flanged bushing is to be applied from the top as is the 1" lock bolt.
6. Center the pivot assembly to within 1/8" relative to a machined surface on the bogie frame, such as the drilled drain hole for the primary coil spring, or the secondary lateral stop. Swage the collars of both the 1" and 1 3/8" lock bolts. Apply pivot pin wear liners with the split line parallel to the axles.
7. The upper ends of the traction motor nose links are next applied to the bogie frame at each traction motor location. The end rubber bushings are at four (4) degree angles perpendicular to the body of the link. See Figure 54 to note the proper orientation of the link when it is assembled to the bogie frame. Install the 1" lock bolts that attach the nose link to the bogie frame, noting the proper orientation of the lock bolts.

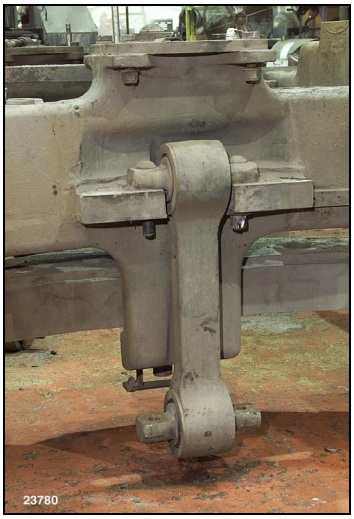


Figure 54 – Typical Orientation of Nose Links (HTCR Shown)

8. At a separate location, place bearing adapters on stands located at the appropriate width and wheelbase, as shown on the bogie assembly drawings. Since there are three each of two part numbers of bearing adapter, ensure that are in the right locations. All tapping pads sticking out from the side must be pointing in the outward direction. Also, in the HTSC bogie #1, the U-shaped openings on axles #1 and #2 bearing adapters face towards the open end of the bogie, and axle #3 bearing adapters face towards the rear of the bogie or towards the end transom. In the same way, in bogie #2, the bearing adapters in axles # 4 and #5 face towards the open end of the bogie, and the bearing adapters for axle #6 face the other way. Another point to note is that the four-hole joints on the bearing adapters for the sander brackets should be pointing outwards for both end axle-bearing adapters.
9. Apply coil spring shims onto the bearing adapters (one shim per spring location). Place the primary journal coil springs on the bearing adapters, and on top of each shim, with the bottom tip of the spring oriented so as to be visible from the outside of the bogie. The coil spring placed on top of the spring can be held in place with a 1/8 – 1/4" bead of silicone applied to the top of the spring.
10. Position, prop up and block all axle traction rods in preparation for the lowering of the bogie frame. Pick up the bogie frame (as per Figure 55) as assembled up to item #5 above, and lower it slowly onto the bearing adapter spring combinations, making sure that the bogie is oriented properly.

WARNING!

When lifting the HTSC-B1 bogie ensure that chains, slings, or other lift devices are NOT connected to the rear cross member (transom) of the bogie frame. These bogies have a thinner cross section than the HTSC bogie in this area and may be damaged by the lifting forces. The frame has cast markings identifying the areas that are not used for lifting.

NOTE

During the lowering of the bogie frame, ensure that the axle traction rods slip into the traction tube slots and engage the inner member of the traction rod bushing in the bogie frame. Remove the block supports for the axle traction rods and continue lowering. Ensure the bogie frame does not contact any traction rod or bearing adapter during lowering. Confirm that all coil springs have engaged the spring pilot tube attachments on the inside of the bogie frame at the spring pocket locations, If a coil spring is not engaged, a rubber sledge hammer can be used to pop the spring into the proper engagement.

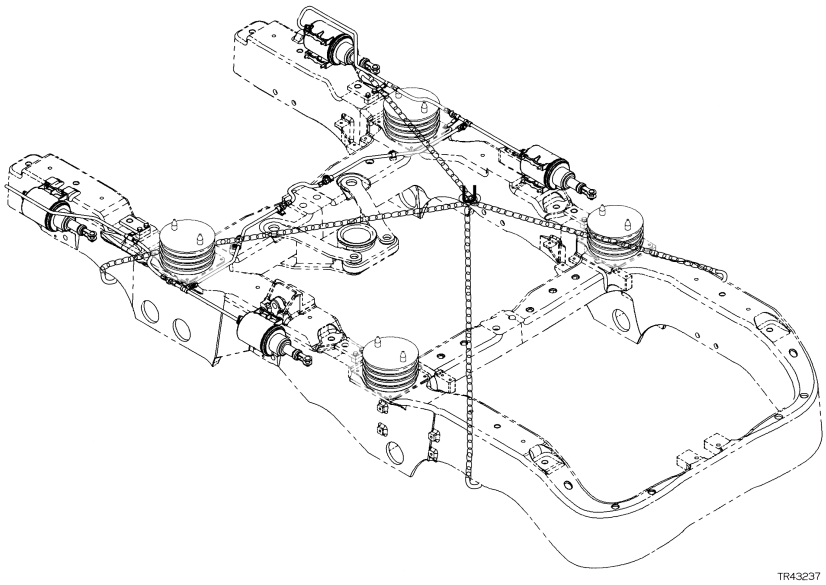


Figure 55 – Bogie Lifting Connections

11. Insert the 1 3/8” lock bolts from the inside of the bogie into each traction rod bushing location in the bogie frame, so that all pin tails of the lock bolt are facing outwards. Center axle traction rod bolts slide in when the bogie frame is almost down. Next slide in the remaining 1 3/8” lock bolts into the traction rod bushings in the bearing adapters, so that the lock bolt head is on the inside and the pin tails are pointing outwards.
12. Lower the bogie frame completely until all its weight is being borne by the coil springs, and disconnect the lifting hooks and shackles. By means of a wrap around chain and hydraulic jack combination to depress the spring at each spring pocket, until the traction rod is horizontal as monitored with a spirit level (within +/- 0.5 °). While holding the traction rod level, swage the lock bolts at both the bogie frame and bearing adapter ends of the traction rods, so that the lock bolts are fully installed.

13. Insert the two primary interlock rods into the bogie frame holes for the purpose, so that the interlock rods are now on either side of the tower of the bearing adapter (part of bearing adapter that sticks up and has an I-beam like section). Bolt the retainer interlocks, with one on each side of the upper damper bracket. Slide the inner flange type end into the slots in the primary interlock rods, so that both interlock rods are held in place and cannot slide out. Release the applied compression on the springs at that pocket, and move to another spring pocket location for assembly of the next traction rod lock bolt combination in the same manner. Again, apply the primary interlock rods and engage with the interlock retainer pins.

3.4.2 BRAKE CYLINDER PIPING

Apply the piping as shown on the appropriate application drawing. When securing unions, ensure that mating surfaces are clean. Adjust piping, hoses and pipe clamps such that any moisture in the pipes will drain into the brake cylinders. Piping may be heated for bending so as to align the piping without being sprung. Apply piping so as avoid kinking hoses. Air test piping for leaks with air and water solution.

3.4.3 ASSEMBLY OF BRAKE RIGGING COMPONENTS

1. Assemble Brake Lever Assembly - Live as shown in Figure 56.

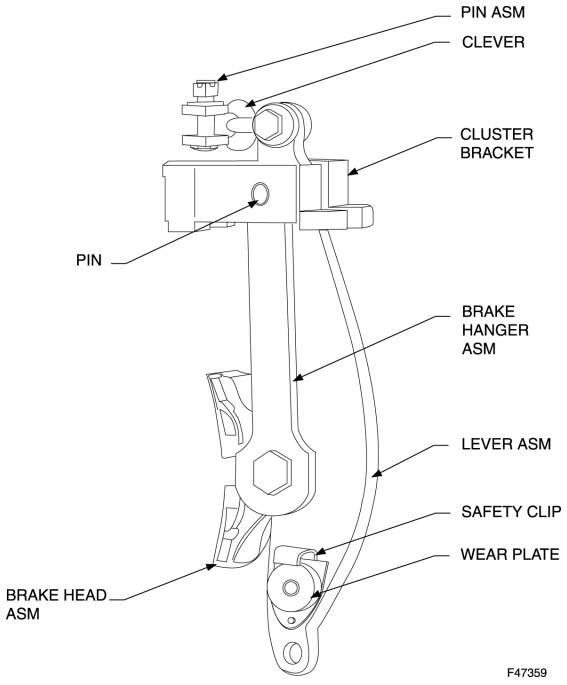


Figure 56 – Brake Lever Assembly – Live

2. Lift each assembly in step 1 with portable hoist onto the bogie frame positioning the cluster bracket assembly on top of the mounting cluster bracket of the bogie, shown in Figure 57. Line up the three holes of the cluster bracket assembly with those of the bogie frame cluster bracket and apply 3 bolts with 3 new washers.

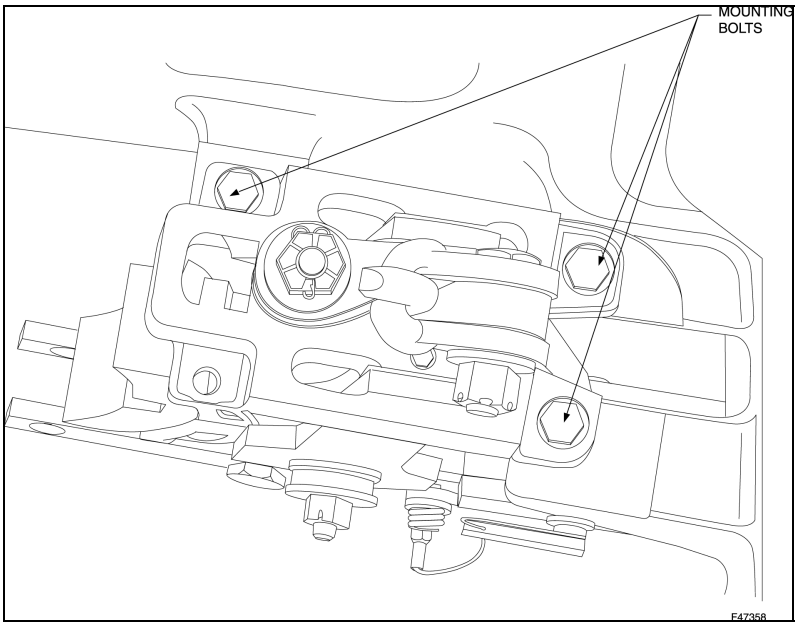


Figure 57 –Brake Lever Assembly Application - Live

3. Assemble Brake Lever Assembly-Dead using Figure 58 as a guide.

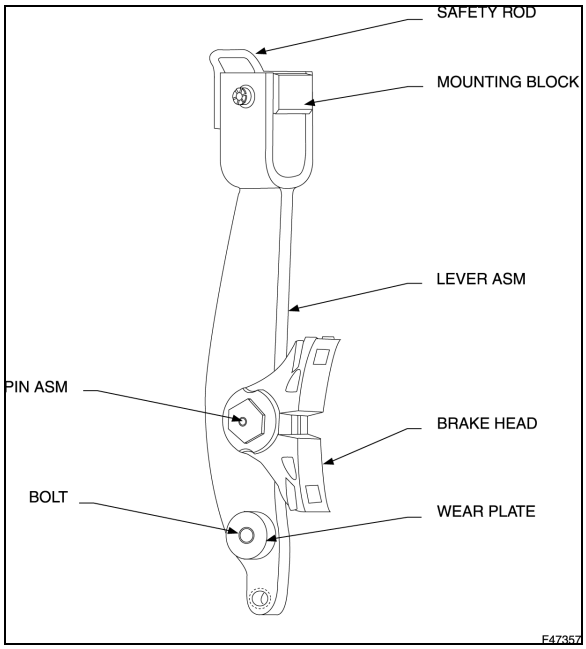


Figure 58 – Brake Lever Assembly – Dead

4. In the same manner, lift each assembly in step 3 onto the bogie frame laying up the mounting block assembly on top of the dead lever mounting bracket as shown in Figure 59. Apply 2 new bolts with 2 new washers.

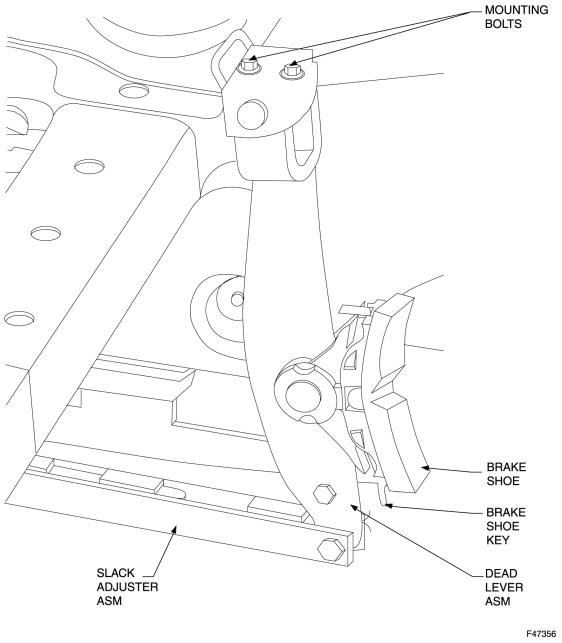


Figure 59 – Brake Lever Assembly Application - Dead

5. With all the Brake Lever Assemblies in place, apply Offset Brake Shoe in each location with Brake Shoe Key, as in Figure 60.

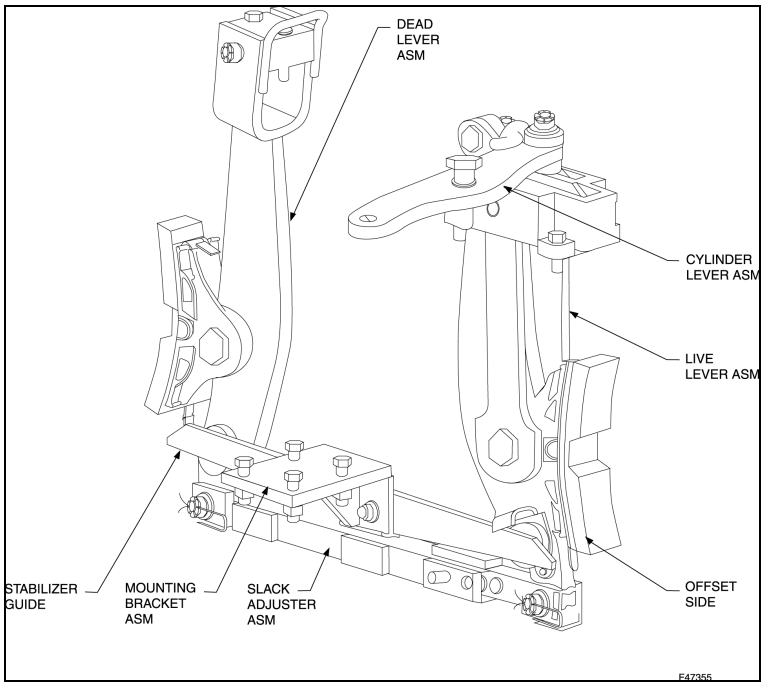


Figure 60 – Brake Shoe Application

NOTE

The offset side of the brake shoe is to be on the outboard side of the wheel.

6. Apply the Cylinder Lever Assembly by introducing the brake side arm through the lever cap fulcrum, drop the Pin into the fulcrum hole and secure it with Ring-Retainer. Pin the cylinder arm to the Brake Cylinder with the vendor pin and cotter pin. See Figure 61. The Handbrake Lever Assembly is applied into the bogie in same fashion. See the appropriate Brake Rigging Application drawing.

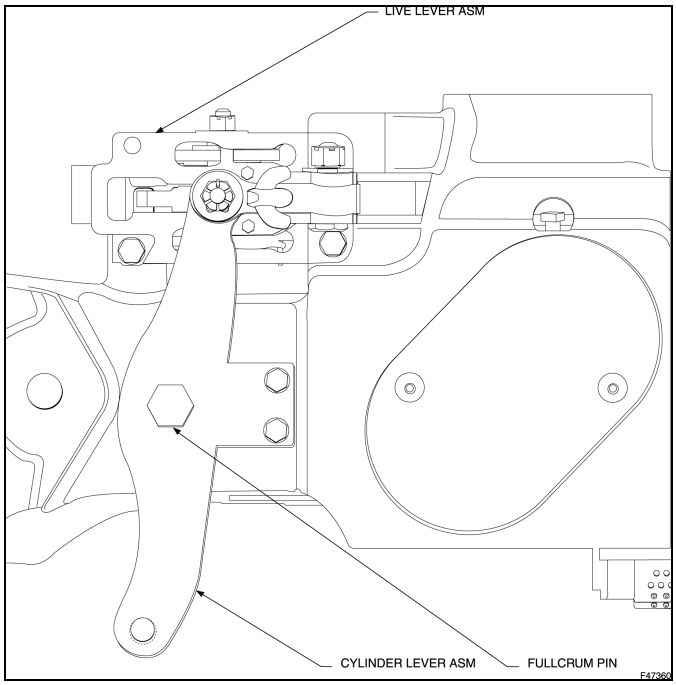


Figure 61 – Application of Brake Cylinder Lever Cross-Over Assembly 47360

7. Apply Slack Adjuster Assembly on the 1-shoe position by attaching the rod end to the Brake Lever Assembly and the tube end to the anchor bracket with Pin Assembly. Apply Clip before putting the Pin Assembly. Apply the same Slack Adjuster on the other side of the bogie, except that the adjuster has to be flipped 180° about the horizontal.
8. Apply the other Slack Adjuster Assembly on the 2-shoe position by orienting the rod end with the Brake Lever Assembly-Live and tube end with the Brake Lever Assembly-Dead, respectively. Remember to apply the Clip before applying the Pin Assembly. Similarly, apply the same adjuster to the other side by flipping it 180° about the horizontal.

3.4.4 TRACTION MOTOR AND WHEELSET (COMBO) APPLICATION

This assembly assumes that three traction motor/wheel-axle-gear assemblies are available. Position the three motor wheelset combos in line and spaced properly for lowering the bogie assembly. The capability for adjusting the motor vertically but rotating about the wheelset axle while the bogie assembly is being lowered onto the combos, will be required. Begin with each of the motor assemblies at a high angle. Lift the bogie assembly connected as shown on Figure 55. Lower the bogie frame onto the three traction motor combos slowly. As the bogie frame lug passes the motor's upper secondary support lug, begin lowering the traction motor simultaneously, or alternate lowering the bogie assembly and motor. Ensure that the motor nose link (with upper end already attached to bogie frame) becomes properly positioned, and that the bearing adapters are fully and properly seated on each of the journal bearings.

NOTE

Motor nose link bushings are installed in links rotated 4 degrees off center. Make sure the nose links are installed to motors and frame with tilt of bushing down in direction of traction motor and up in direction of truck.

1. Apply the 1" lock bolts so as to join the lower end of the nose link to the traction motor nose lug at the lower end. Orient the lock bolts properly, and swage the lock collars in order to complete the installation of the nose link/traction motor lock bolts.
2. Apply the bearing adapter cap plate assembly and the urethane bearing adapter spacer. Note proper orientation of the plate, since the plate can be applied backwards. The portion of the plate assembly that engages one end of the journal bearing race is to be on the wheel side of the journal bearing. When applied between the journal bearing and the plate assembly, the spacer will be slightly loose. If the spacer is snug or appears deformed, check to ensure that the bearing adapter is fully seated onto the bearing at both the front and back.
3. Bolt on the sander guides to the bearing adapters on both end axles. Apply the step assemblies on both sides of bogie #1 only. Apply traction motor air ducts to the tops of each traction motor. Over the opening of the air duct assembly, place a flat board and tape the opening shut so that no foreign matter or debris falls in.

3.4.5 PRIMARY VERTICAL DAMPER APPLICATION

Vertical dampers can be applied during bogie assembly, or later after the bogies have been mated with the locomotive carbody. If installed on the bogie before the locomotive carbody is lowered on it, the dampers will need to be extended (HTSC bogie only).

1. Bolt on the lower damper brackets to the tapping pads sticking out on the side of the bearing adapter. Ensure that the brackets fit well and do not have to be forced into position.
2. Verify that the thickness of the primary vertical damper mounting locations on the bogie frame and on the bearing adapter are 1.00 +/- 0.06", on the upper and lower damper brackets.
3. Apply the top of the primary vertical damper to the bogie frame by removing nut, thick washer, rubber pieces, thin formed washers, and conical nylon sleeve supplied with each damper, then passing the stud through the hole in the upper damper bracket already bolted to the bogie frame.
4. With the lower thin formed washer engaged in the hole in the upper damper bracket, apply the nylon sleeve and the upper thin formed washer. Both upper and lower thin-formed washers are to sit flat and flush against the horizontal plate of the upper damper bracket. Apply rubber, thick washer, and nut on the end of the damper. Use a 3/8" Allen wrench to hold the stud of the damper while the nut is tightened. Torque to 110 ft. lbs. Do not attempt to tighten or torque if the Allen wrench is not sized or seated sufficiently.
5. Apply the lower end of the damper to the lower damper bracket after sliding the vertical damper stud into the U-shaped fork end on the lower damper bracket. Apply the lower connection in a manner similar to the top. Tighten the lower end of the damper to the bracket only when the damper is in the free state.

NOTE

Do not hold the damper to one side while tightening. To check if the damper is in its free state, examine the larger diameter upper tube and the clearance to the smaller diameter lower tube. This clearance should be equal all around the damper.

6. After the lower nut has been torqued, apply the retainer bolt across the U-opening so as to secure the lower end of the damper. This bolt does not need to be torqued. Tighten to a snug fit.

3.4.6 SECONDARY YAW DAMPER APPLICATION

The yaw dampers should be installed with the right side up (as marked on the yaw damper), with the smaller end of the yaw dampers attached to the bogie at the yaw damper bracket, as shown in the appropriate bogie assembly print.

3.5 BOGIE APPLICATION TO LOCOMOTIVE

1. Install nylon-alloy wear cylinder halves in carbody pivot on bogie. Place cylinder halves so that separation line faces sides of bogie. Ensure carbody pivot has been cleaned of dirt and corrosion. Spray pivot with moly lube.
2. Roll rebuilt bogie assembly under raised locomotive, or if using a drop table, install bogie on table and raise bogie up under locomotive. Ensure contact areas are cleaned of dirt and corrosion.
3. Align carbody pivot pin with pivot and secondary rubber spring pins with appropriate holes in carbody underframe, Figure 62, and Figure 63. Note that the carbody pivot will meet the bogie before the secondary spring pins meet the carbody. Anti-seize lubricant is permissible on the pins only of the secondary rubber springs. The flat plate surface must remain dry for friction purposes.

Figure 62 – Typical Carbody Pivot Pin Installation (HTCR Shown)

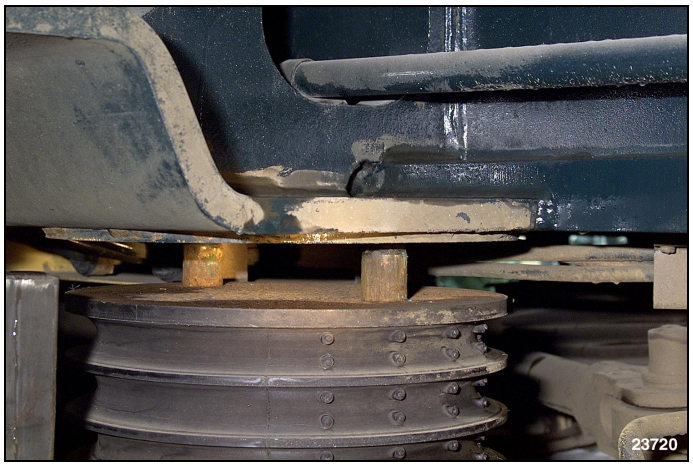


Figure 63 – Typical Secondary Spring Alignment (HTCR Shown)

4. Connect diagonal carbody dampers at carbody bracket, using bolt (5/8-11 x 3-3/4") and washer (1-5/16 OD x 21/32 ID x .105" thick). Torque to specification. See Service Data.
5. Install new carbody pivot pin wear ring and plate using drilled head bolts (3/4-10 x 2-1/2") and washers (3/4" hardened). Torque to specifications. See Service Data. Install 14-gauge lock wire, Figure 64, (approximately 2 meters or 6 feet) through the holes in the bolt heads and safety wire them in place.

Figure 64 – Typical Carbody Pivot Pin Lock Wire (HTCR Shown)

6. Connect traction motor leads, traction motor temperature probe plug, and traction motor speed plug, as equipped.
7. Attach carbody links to bogie flanges, Figure 65, using shackle assembly and new cotter pins.

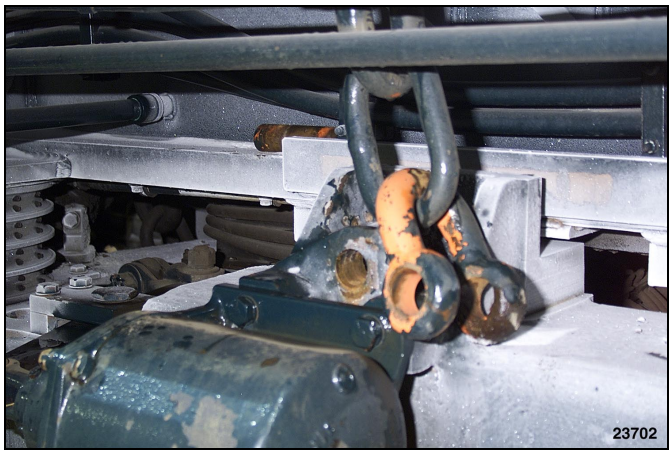


Figure 65 – Typical Carbody Interlock Links (HTCR Shown)

8. Connect carbody air piping to bogie air piping, Figure 66.

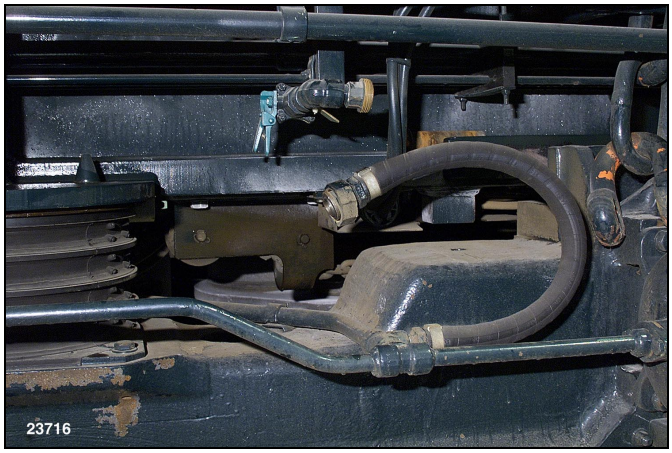


Figure 66 – Typical Air Brake Piping (HTCR Shown)

9. Connect bogie flange lube equipment if equipped.
10. Connect and adjust handbrake chain.
11. Check bogie and carbody to ensure all loose ends have been accommodated.

4.0 SPECIAL PROCEDURES

4.1 LOCK BOLTS

There are four locations at which lock bolts are used in the HTSC and HTSC B-1 bogie (Ref. Prints 40075078 and 40075079 – views and sections in this paragraph refer to these drawings): (1) Carbody traction rods at the bogie end (Section F-F and View H exploded), (2) Carbody traction rod connection at pivot pin end (Section G-G and View H), (3) Axle traction rod connections (both ends), and (4) Traction motor nose link connections (both ends).

The first two connections normally should not need to be disassembled or re-assembled, except at bogie overhaul, as needed. The axle traction rod and nose link assemblies will need to be disassembled and re-assembled each time the traction motor/wheelset combination is removed or re-installed. The general instructions given here apply to all the lock bolt connections, although the hardware set and orientation of each fastener is different. Since the lock bolt does not use threads, but instead makes use of locking grooves, there are no nuts needing to be torqued. Instead, there is a collar that is swaged (cold formed) onto the locking grooves that holds the connection secure.

4.1.1 REMOVING LOCK BOLTS

Lockbolt removal is accomplished by either cutting the collar with a cutting torch or with a mechanical cutting tool. The cut collar and loose lockbolt are waste and must be discarded.

Before removal of lockbolt, ensure that mating parts are secure and that when the lockbolt (pin) comes loose, the lockbolt either remains in position, falls safely, or will be held securely.

Note that all mating components should be blocked, held up by straps or secured as needed.

CAUTION

All safety precautions and procedures of the lockbolt and lockbolt tool manufacturer should be strictly adhered to. Ensure that hose connections are tight, and that hand tool and power rig connections are secure and proper. Do not stay directly in line with the lockbolt during installation. Push the tool as far as possible onto the collar before pulling trigger. Keep hands clear from connection before pulling trigger. When the collar is cut, release trigger. Keep hands and fingers out of nose openings, and hold hand tool only below hand guard. Stop tool operation in case of breakage or wrong adjustment, or if hoses are leaking or cables damaged.

If using a cutting torch, cut the collar longitudinally (in the same direction as the axis of the pin) along its entire length. Be careful to not damage other components, rubber bushings or bogie frame with the cutting torch flame, placing a steel sheet or protection as necessary between working area and adjacent components.

4.1.2 LOCK BOLT INSTALLATION

The pin or lockbolt is inserted into the prepared hole together with all the washers, bushings and other components that are to be joined in the connection, Figure 67.

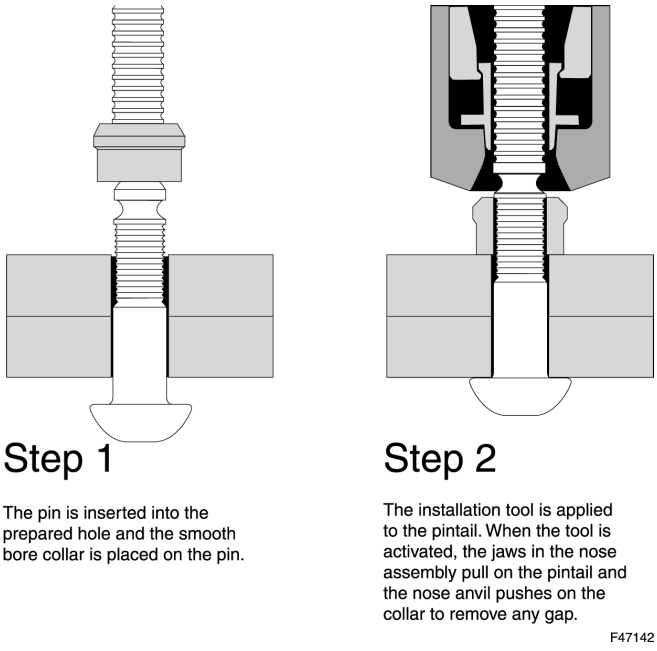


Figure 67 – Lockbolt Installation

Then, the mating smooth bore locking collar is slipped on to the pin, with its bevel end towards the outside.

The lockbolt installation tool (which is hydraulically operated, and is connected to its power source) is applied to the pintail (end of lockbolt that is opposite to the head).

When the trigger of the lockbolt tool is activated, Figure 65 the chuck jaws in nose of the tool assembly pull on the pintail, inducing an initial clamp load, and the nose anvil pushes on the collar to remove any gap.

As the tensile load is increased, the nose anvil of the tool overcomes the resistance of the beaded collar and begins to move over the collar toward the work pieces, thus swaging the collar onto the annular locking grooves of the pin, and locking in the full clamp load.

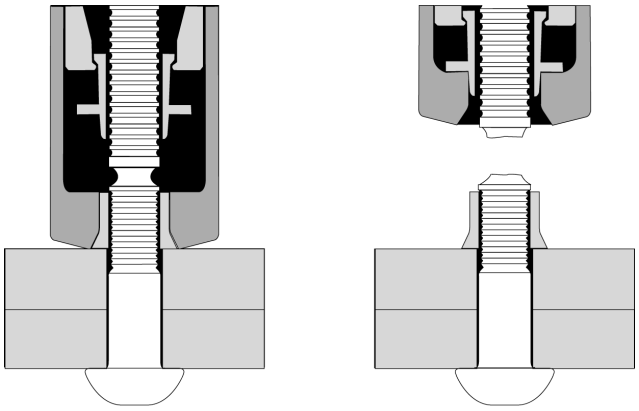
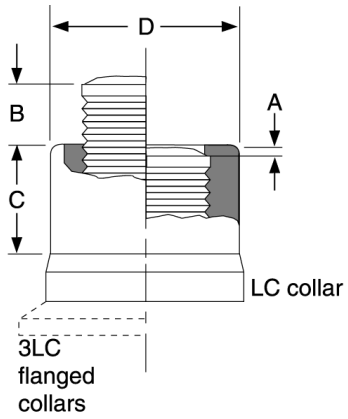


Figure 68 – Final lock Bolt Assembly

After the swaging of the collar is complete, the tensile force on the pintail continues to increase until fracture occurs at the breakneck groove separating the pintail from the installed fastener. The collar is automatically separated from the tool and the remaining fractured pintail containing the pull grooves is ejected. Note that the installed lockbolt collars must within dimensions shown in Figure 69.



Huck Bolt Dia.	Collar Part #	A max	B max	C min	D max
1"	40034493	1/16"	3/8"	7/8"	1.465"
1 3/8"	40022911	1/4"	11/16"	1 1/4"	2.020"

F47143

Figure 69 – Lockbolt Finished Dimensions

CAUTION

All safety precautions and procedures of the lockbolt equipment manufacturer should be strictly adhered to. Never install a lockbolt without a lock collar, as the lockbolt may be forcefully ejected. Ensure that hose connections are tight, and that hand tool and power rig connections are secure and proper. Do not stay directly in line with the lockbolt during installation. Push the tool as far as possible onto the pin and collar before pulling trigger. Keep hands clear from connection before pulling trigger. When the pin snaps, release trigger. Keep hands and fingers out of nose openings, and hold hand tool only below hand guard. Stop tool operation in case of breakage or wrong adjustment, or if hoses are leaking or cables damaged.

5.0 SERVICE DATA - BOGIE ASSEMBLY

5.1 REFERENCES

5.1.1 MAINTENANCE INSTRUCTIONS

Coil, Elliptic, and Rubber Bogie Spring, Qualification and Replacement……...M.I. 1512

Wheels, Axles, Axle Gears and Pinions……..M.I.1519

Grease Lubricated, Cartridge-Type Journal Bearings……M.I. 1553

Lubricant Specifications……M.I. 1756

AC Traction Motor Maintenance - ITB2622-ØTAØ2…….….M.I. 3908

Traction Motor Roller Support Bearing…….……M.I. 3912

Handbrake……..M.I. 1577

5.1.2 TYPICAL PARTS CATALOGUES

GT46-MAC E26

GT46-PAC E35

5.1.3 DRAWING NUMBERS

Bogie Assembly #1 (HTSC) 40075078

Bogie Assembly #1 (HTSC-B1) 40087064

Bogie Assembly #2 (HTSC) 40075079

Bogie Assembly #2 (HTSC-B1) 40087065

Bogie Application (HTSC) 40075354

Bogie Application (HTSC-B1) 40087066

Traction Motor Mounting (HTSC) 40077463

Traction Motor Mounting (HTSC-B1) 10662933

Traction Motor (HTSC) 40075420

Traction Motor (HTSC-B1) 40086754

Gearcase Upper and Lower (HTSC) 40076186

Gearcase Upper and Lower (HTSC-B1) 40076352

Traction Rod Assembly 40072213

Carbody Rod Assembly 40074009

Brake Rigging Application (non-handbrake)..... 40080256

Brake Rigging Application (handbrake) 40075357

5.1.4 OTHER REFERENCES

"Wheel and Axle Manual" - Association of American Railroads (AAR)

5.2 WEIGHTS

5.2.1 COMPONENT WEIGHTS

COMPONENT	UNIT WEIGHTS (approx)	
	Lbs.	Kg.
TM - 1TB2622-0TB02	4,685	2125
Pinion	85	39
Wheel - 43"	980	445
Axle - Broad Gage (driver)	1,360	617
Axle – Broad Gage (idler)	1,300	590
Support Bearing Housing	382	173
Spacer	4	2
Gear (GT46MAC)	490	222
Gear (GT46PAC)	445	203
Gearcase (Upper & Lower)	228	104
Journal Bearings	108	49
Bearing Adapter Assembly	270	123
Bearing Adapter Bot. Plate	39	18
Sander Brackets	48	22
Spring - Single Coil	80	36
Spring Pads - Steel	2.5	1
Primary Interlock	10	5
Damper - Primary Vertical	18	8
Traction Rod - Primary	39	18
Bogie frame Assembly	12,440	5643
Brake Rigging	1,332	604
Brake Cylinders	122	55
Brake Piping	100	45
Pivot Assembly	135	61
Carbody Rod w/bushing, bolts	106	48
Rubber Spring Assembly - Sec.	130	59
Secondary Interlock	27	12
Yaw Damper - Secondary	75	34
TM Nose Link	100	45
TM Air Duct	86	39
Misc. Pins, Bolts, Etc.	200	91
Bogie Mounted Steps	27	12
Primary Damper Brackets	30	14

NOTE

All weights provided are estimates to assist in lifting and moving tasks. If accurate weights are needed, then the components and sub-assemblies should be weighed.

5.2.2 ASSEMBLY WEIGHTS

Assembly	Lbs.	Kgs.
Wheel/Axle/ Gear Assembly (WAG) (includes 2 journal bearings)	4,446	2,017
Traction Motor Assembly with WAG (includes pinion, gearcase, and 2 journal adapters)	10,046	4,558
HTSC Bogie Complete	47, 986	21, 772
HTSC-B1 Bogie Complete	41,350	18,761

5.3 Special Torque Values

Yaw Damper (5/8-11) ..... 156 N.m. (115 ft.lbs)
Carbody Pivot Plate (3/4-10) ..... 278 N.m. (205 ft.lbs)
Lower Damper Bracket (3/4-10) ..... 156 N.m. (115 ft.lbs)
Upper Damper Bracket/Thrust Pads -
HTSC (5/8-11) ..... 156 N.m. (115 ft.lbs)
Vertical Damper – HTSC-B1 (5/8-11) ..... 156 N.m. (115 ft.lbs)
Journal Adapter (3/4-10) ..... 278 N.m. (205 ft.lbs)
Secondary Spring Base (5/8-11) ..... 156 N.m. (115 ft.lbs)
AC Gearcase – Parting (3/8-16) ..... 156 N.m (115 ft.lbs)
AC Gearcase - Mounting (1-7/8- 7) ..... 1342 N.m. (990 ft.lbs)

5.4 MAINTENANCE AND WEAR LIMITS

5.4.1 WHEEL LIMITS

5.4.1.1 Wheel Size Variation Limits

The following limits apply to wheel diameters. The "new" values listed below are to be used when turning (truing or profiling) wheels in the shop. The "worn" values are to be used when inspecting locomotives to determine need for wheel turning.

Between two wheels on the same axle:	New……..0.020" (0.5 mm)
	Worn…….0.063" (1.6 mm)
Between axles within a bogie:	New 0.125" (3.2 mm)
	Worn 0.25" (6.4 mm)
Between bogies:	New 0.56" (14.2 mm)
	Worn 1.25" (31.8 mm)

5.4.1.2 Wheel Size Minimums

Minimum wheel diameter (approximately) .....40.0" (1,016 mm)

Minimum rim thickness .....1.0" (25.4 mm)

5.4.2 WEAR LIMITS ON BOGIE COMPONENTS

5.4.2.1 Total Free Lateral Axle Clearances Between Lateral Thrust Pads and Bearing Adapters

These are shown below as axle left and right totals, which can be measured on both sides with feeler gauges (Axle #1 is lead locomotive axle at cab end)

HTSC Bogie

Axles 1, 3, 4, and 6 Bogie end axles –

Nominal is 0.38" (19.6 mm) .....0.62" (15.7mm)

Axles 2 and 5 Bogie middle axles –

Nominal is 0.62" (115.7mm) .....1.00" (25.4 mm)

HTSC-B1 Bogie

Axles 1, 3, 4, and 6 Bogie end axles –

Nominal is 0.24"(9.3 mm) .....0.50"(12.7 mm)

Axles 2 and 5 (Bogie middle axles –

Nominal is 0.62"(115.7 mm) .....1.00" (25.4 mm)

5.4.2.2 Wear of Nylon Pivot Liners (Split Half-Cylinder)

The thickness of the liner should be measured with a micrometer with round end tips or with a caliper.

New liner thickness..... 0.365 +/- 0.010" (15.7 mm +/- 0.25 mm)

Liner set to be replaced if thickness is less than 0.300" (7.6 mm)

5.4.2.3 Secondary Vertical Stop Clearances

This is measured between the bogie and the underframe on each side of the bogie at the center axle position.

Minimum gap at any location

Nominal is 0.63" +/- 0.12" (1.6 mm +/- 3.1 mm).....0.25" (6.4 mm)

5.5 ROUTINE MAINTENANCE EQUIPMENT and SPECIAL TOOLS

5.5.1 FIXTURES

Lifting Fixture (Traction Motor, Axle and Wheel assembly)
……* File No. 288

Wall Mounted Fixture To Test Dampers
……...* Work Sketch #41089

5.5.2 5.5.2 GEAR RATIOS

HTSC 90:17

HTSC-B1 ..... 77:17

* Note: File Drawings and Work Sketches are available from the EMD Service Department. These drawings include construction details of tooling that can be manufactured.

5.5.3 SPECIAL LUBRICANTS

P80 Rubber Lubricant 8251651

5.5.4 COMMON PART NUMBERS

COMPONENT	HTSC	HTSC - B1*
Traction Motor and Pinion Asm	40075420	40086754
Wheel 43”	40077314	10662497
Axle – Broad Gage	40076350	Idler Axle – 10662499
Support Bearing Housing	40075563	
Spacer	40076798	
Gear – Axle	40074148	10662230
Gearcase (Upper & Lower)	40076186/40076352	
Journal Bearings	40077969	40050858
Bearing Adapter Asm	40074918/10664372	40089242
Bearing Adapter Bottom Plate	40082305	
Sander Brackets	40082928	40092266
Spring – Single Coil	40075318	40090911
Spring Pad – Steel	40025675	
Spring Pad – Polyurethane		40087273
Primary Interlock	40074621	
Damper – Primary Vertical	40082318	40090983
Traction Rod – Primary	40072213	
Bogie frame Asm	40074880	40087063
Brake Rigging	40080256	
Brake Cylinders	40080262/40080263	
Brake Piping	40075358	
Pivot Asm	40075080	
Carbody Rod – with Bushing/Bolts	40074009	
Rubber Spring Asm – Sec.	40075328	40090677/40090678
Secondary Interlock	40083646/40083645	
Primary Damper Brackets	40090385/10884581	40089946/40089920
Yaw Damper – Secondary	40057722	40090992
Tm Nose Link	40075326	
TM Air Duct	40058521	

*Where different

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