Metro

P3010
Los Angeles LRV

TRUCK AND SUSPENSION

Section 1200
RUNNING MAINTENANCE & SERVICING MANUAL

LIST OF EFFECTIVE PAGES

Insert latest changed pages; dispose of superseded pages in accordance with applicable regulations.

NOTE: On a changed page, the portion of the text affected by the latest change is indicated by a vertical line.

Total number of pages in this section (1200) is **120** consisting of the following:

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4-1 through 4-16	Final Draft-L		
5-1 through 5-28	Final Draft-L		
6-1 through 6-4	Final Draft-L		
I-1 through I-2	Final Draft-L		

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SAFETY SUMMARY

Some of the procedures in this section are preceded by warnings/cautions regarding potential hazards in handling this equipment. These warnings/cautions should be carefully read and understood before proceeding. Failure to observe these precautions may result in serious injury to personnel performing the work and/or bystanders. The key warnings for this equipment are as follows:

Electrical - The electrical equipment described in this section operates at voltages and currents that are extremely dangerous to life. Personnel should closely observe all generally prescribed cautions and warnings before performing any work on the LRV.

Chemicals – Follow safety precautions for handling hazardous chemicals as provided by the manufacturer. The manufacturer's warnings should be closely heeded to avoid personal injury.

Location – Special caution should be taken when accessing or servicing equipment located on the roof and under the car.

Weight – To prevent possible personal injury when attempting to remove or install equipment on the vehicle, adequate support of a lifting device must be used to prevent the equipment from falling. Personnel's failure to heed these warnings could result in severe injury or death and or damage to the equipment.

Contact – Some components in this equipment attain temperatures that can cause severe burns. Closely follow all warnings and recommended procedures for handling these components.

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CHAPTER 1.0

GENERAL DESCRIPTION

1.1 Introduction

This chapter provides basic descriptions of the trucks, their purpose, and relationship to the carbody. Additionally, it lists carbody-to-truck connections, and reference data tables covering truck components and the critical dimensions of the truck.

The main components of the truck include the following:

- Wheel and Axle Assembly
- Frame Assembly
- Bolster Assembly
- Disc Brake Assembly
- Primary Suspension
- Secondary Suspension
- Slewing Bearing

1.2 Maintenance Philosophy

The two primary objectives of any maintenance program are to keep all equipment in good running order and to restore faulty equipment as quickly as possible, after a failure, to maximize vehicle availability. Meeting these objectives requires properly trained personnel using the proper tools, test equipment, and repair facilities.

This manual describes the tools, test equipment, and procedures used for running maintenance.

Removal and installation, troubleshooting, repair and maintenance of equipment performed off the vehicle in a repair shop environment is defined as heavy maintenance. Refer to the Heavy Repair Maintenance Manual for these activities. The lubrication, maintenance, troubleshooting, and repair of equipment while it is installed on the vehicle is defined as running maintenance. This manual addresses those items.

Maintaining a good record keeping system is important because the historical data allows schedulers to predict more accurately when maintenance will be required. It also indicates quantities of repair parts that should be stocked and the workers required to perform the maintenance. These records should include the mileage and in-service time on each vehicle, dates and types of repairs made, dates and types of inspections performed, lubrication and overhaul, and dates and descriptions of all problems reported.

Each truck is equipped with dual-independent suspension leveling systems controlling both the right and left hand suspension airbags on each truck. Leveling valves maintain the car height a fixed distance from the truck under load conditions AW0 through AW3 provided the main reservoir is charged and the suspension supply is not cut out.

Air supply for the leveling system for each truck comes from the main reservoir line passing through check valve (L1.3), see Figure 1-1, Table 1-1 cutout cock (L1.1) and air filter (L1.2). The cutout cock (L1.1) is provided to isolate the leveling system in case of failure or during maintenance operations as shown in Figure 1-1, Leveling System Schematic.

The purpose of the check valve is to prevent suspension air from back-flowing into the MRP. MR air is allowed to flow through the check valve (L1.3) and cutout cock (L1.1) to the truck mounted equipment. In order to fully drain the suspension of air, cutout cock (L1.1) must be closed and a drain plug on each suspension reservoir (L9) must be opened.

The duplex check valve (L7) is a two-way check valve connected in an airline between the two truck air springs. This valve is provided to equalize the air-spring pressures within a preset level in the event of a rupture of an air-spring. The sensitivity of this valve is set to allow a differential of 22-psi (1.5 bar).

Figure 1-1: Truck and Suspension Leveling System Schematic

Table 1-1. Truck and Suspension Component Identification

ID Number	Description
L1.1	Cutout Cock
L1.2	Filter Assembly
L1.3	Check Valve
L3	Leveling Valve
L7	Duplex Check Valve
L9	Suspension Reservoir

1.3 Safety

The importance of safe operation and maintenance cannot be over stressed. These practices are an integral part of all maintenance programs and should be strictly enforced at all times. These are some important points for maintenance personnel to observe:

1. Wear an insulated hard hat when working under the vehicle or any of its components.

2. Wear safety shoes and hard hats when working where objects might fall.

3. Never work on equipment while electrical power is applied unless it is absolutely necessary as part of the maintenance program. Verify that power is removed by checking with reliable equipment.

4. Attach a tag with the name of the person who removed the power from the equipment. That person knows why the power was removed and when it will be safe to restore it. Only the individual whose name appears on the tag, or a person who has his approval should remove the tag and restore power.

5. Use proper lifting equipment to remove and replace heavy components. Make sure the components are securely fastened to the lifting device.

6. Never attempt to perform a two-person operation alone. Know and follow emergency procedures.

7. Never take any short cuts that are not clearly defined and approved.

8. Before carrying out any maintenance work on the equipment, ensure that all electrical supplies are isolated. Ensure that there is no possibility of the circuits accidentally becoming energized while work is in progress. Ensure overhead catenary is isolated and locked off.

9. Chock the wheels to prevent the car from moving. The axle gearbox and the oil can heat up to the point where contact would lead to burns and scalds. Allow sufficient time for the gearbox to cool down before touching it.

10. All defects found during inspection must be recorded and reported to the supervisor. All defects must be corrected.

11. LA Metro rules and standard operating procedures must be followed.

Some of the procedures in this section are preceded by warnings, cautions and notes regarding potential hazards in handling this equipment. All of these warnings should be carefully read and understood before proceeding, and then be followed closely while performing related tasks. The prominent warnings for this equipment are:

WARNING

BECAUSE THIS EQUIPMENT OPERATES AT LETHAL POWER LEVELS, WARNINGS AND REMINDERS ABOUT REMOVAL OF POWER, IN ACCORDANCE WITH LACMTA REGULATIONS SHOULD BE COMPLETELY UNDERSTOOD BEFORE ANY WORK IS BEGUN.

WARNING

SOME COMPONENTS MAY CONTAIN HAZARDOUS CHEMICALS, OR THEIR USE MAY BE REQUIRED IN CLEANING OR SERVICING SUCH COMPONENTS. IN THESE CASES, THE MANUFACTURER'S WARNINGS SHOULD BE CLOSELY HEEDED, AND ONLY THOSE ITEMS SPECIFICALLY AND CURRENTLY APPROVED FOR USE BY LACMTA SHOULD BE EMPLOYED, REGARDLESS OF ANY RECOMMENDED USE IN THE PROCEDURE.

WARNING

MUCH OF THE EQUIPMENT ON THIS VEHICLE IS LOCATED UNDER THE FLOOR. SPECIAL CAUTION SHOULD BE TAKEN WHEN ACCESSING OR SERVICING ITEMS IN THIS LOCATION.

WARNING

SOME COMPONENTS IN THIS EQUIPMENT ATTAIN TEMPERATURES THAT CAN CAUSE SEVERE BURNS, AND OTHERS, IF MISHANDLED, MAY CAUSE SERIOUS CUTS OR PRODUCE TOXIC FUMES OR RESIDUES. CLOSELY FOLLOW MANUFACTURER'S WARNINGS AND RECOMMENDED PROCEDURES FOR HANDLING THESE COMPONENTS.

WARNING

SOME OF THE EQUIPMENT CONTAINS COMPONENTS UNDER SPRING TENSION THAT CAN BE HAZARDOUS IN AN UNCONTROLLED RELEASE. OTHER COMPONENTS CONTAIN FLUIDS OR GASSES UNDER PRESSURE THAT CAN READILY CAUSE PERSONAL INJURY IF IMPROPERLY RELEASED. WARNINGS AND SPECIFIC INSTRUCTIONS FOR HANDLING SUCH COMPONENTS SHOULD BE CLOSELY ADHERED TO.

WARNING

MANY EQUIPMENT ITEMS AND COMPONENTS ARE QUITE HEAVY AND MAY REQUIRE LIFTING DEVICES OR ASSISTANCE FOR THEIR SAFE HANDLING, AND ARE GENERALLY NOTED. HOWEVER, ALL EQUIPMENT THAT LOOKS HEAVY, PROBABLY IS, AND SHOULD BE TREATED ACCORDINGLY.

NOTE: The use of WARNING statements is necessarily limited to significant cases, so that effectiveness will not be reduced by too frequent usage. The absence of such statements does not, in any way, imply the absence of hazards which may be present anytime electrical or refrigeration equipment is activated, or when working on items with inherent hazards, such as those cited above.

1.4 General Maintenance Guide

Although this manual provides step-by-step procedures for component removal and installation, corrective maintenance, and preventative maintenance, the following information is a general guide for maintenance practices:

1. Hardware:

a. When removing either a component or wiring from the vehicle or a subassembly, always reinstall hardware finger tight in the same location from which it was removed. This prevents lost hardware from interfering with mechanical operation of some components and possibly causing electrical shorts.

b. When reinstalling hardware, use the torque values called out in the maintenance instructions for that component.

c. Avoid dropping hardware into the assembly.

d. Install lockwashers first against bolt head or nut, then the flat washer (if any). Remember, flat washers and lockwashers have a purpose. Always replace them.

e. Locking nuts and locking washers are never to be reused. Structural bolts should only be reused after an inspection of the threaded surface to be sure there is no corrosion or deformation of the threads.

2. Wiring:

a. Tag all wires as they are removed so they can be correctly reconnected.

b. Inspect all crimps and terminals for fatigue and broken wiring strands.

c. After installing and reconnecting the component, check all wiring connections with an ohmmeter and the wiring diagram.

3. Lubrication and Cleaning:

a. Use only the cleaning fluids, oils, and greases recommended in this manual. Use of the wrong lubricant may cause harm to the equipment.

b. Carefully gauge the amount of grease when using a grease gun. Determine the number of squeezes of the grease gun handle required to produce one ounce of grease. Too much lubricant may cause harm to the equipment.

c. Carefully gauge the amount of oil when using a plunger type oil can. Determine the number of strokes of the plunger required to produce one ounce of oil. Too much lubricant may cause harm to the equipment.

d. Do not lubricate self-lubricating bearings.

1.5 Reference Data

Table 1-2 lists basic descriptions of major truck components. Table 1-3 lists critical truck dimensions.

Table 1-2. Truck Components

Characteristics	Description
Truck Designation	KD242 (Motor Truck) KD243 (Trailer Truck)
Primary Suspension	Chevron spring
Secondary Suspension	Air spring
Horizontal Damping	Hydraulic lateral damper
Frame	Welded steel plate
Bolster	Welded steel plate
Wheels	Bochum 84*
Axles	Solid axles, 60" centers
Journal Bearings	Tapered roller, Timken E-38710
Friction Brake	Spring loaded pads, disc
Gear Unit	Double reduction parallel drive
Track Brake	Electromagnetic
Motors	Three-phase squirrel cage induction AC motors self-ventilation

*NOTE: The rubber blocks provided by Penn Machine for the Bochum 84 wheels have a maximum shelf life of four (4) years, and must be installed and put into use before the end of its four (4) year shelf life period.

Table 1-3. Critical Truck Dimensions

Measured Item		Dimensions
Truck	Motor Truck Center Truck	13,338 pounds (6050 kilograms) 9,700 pounds (4400 kilograms)
Maximum Truck Width	Motor Truck Center Truck	2,350 millimeters (92.52 inches) 2,500 millimeters (98.43 inches)
Maximum Truck Length	Motor Truck Center Truck	3,565 millimeters (140.35 inches) 3,430 millimeters (135.04 inches)
Wheel Base	Motor Truck Center Truck	2,150 millimeters (84.65 inches) 2,150 millimeters (84.65 inches)
Gauge		1,435 millimeters (56.5 inches)
Height Above Rail		740 millimeters (29.134 inches)
New Wheel Diameter		711.2 millimeters (28.00 inches)

1.6 List of Acronyms

ATP	Automatic Train Protection
HPF	High Positive Friction
HRMM	Heavy Repair Maintenance Manual
I.D.	Inside Diameter
in.	Inch
LACMTA	Los Angeles County Metropolitan Transportation Authority
LCF	Low Coefficient of Friction
LRV	Light Rail Vehicle
mm	Millimeter
MR	Main Reservoir
MRP	Main Reservoir Pipe
Nm	Newton Meter
O.D.	Outside Diameter
psi	Pressure per Square Inch
TOD	Train Operator Display
TWC	Train-to-Wayside Communications

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CHAPTER 2.0

FUNCTIONAL DESCRIPTION

2.1 Introduction

Two types of trucks are provided on this car, a motored truck and a center truck.

The motored truck provides for three interrelated functions. See Figure 2-1. The first is to support the carbody on the track, the second is to absorb and dampen the mechanical forces generated during vehicle movement, and the third is to support the traction motors, brake equipment and the TWC equipment. The center truck supports the articulation section and slewing bearing, friction brake equipment and does not contain any traction power components. See Figure 2-2.

The truck components include the frame and bolster, axles, bearings and wheels, and primary and secondary suspensions. Equipment mounted on the trucks includes traction motors and gear units, friction brakes and electromagnetic track brakes.

The motor trucks are identical and interchangeable, as are all components and subassemblies of each truck. The center truck is not powered and do not include traction motors and gear boxes.

Carbody and truck connections include the following: compressed air line connections for the air springs, load weight system, sanding system, and the brake application system. Electrical connections include: a control circuit harness, power circuits for the track brakes and traction motors, ground cables for the propulsion system, low voltage DC system, ground safety system, and carbody-to-truck grounding. Mechanical connections include the traction motor and the center pivot retaining bolt.

2.2 Overall System Description

This section consists of an overall description of the trucks and detailed descriptions of the truck components. The overall description provides a general introduction to the major mechanical groups of the truck, while the detailed descriptions provide component information. Both the overall and detailed descriptions include the design purpose and operational functions of the equipment, as part of a truck group, and as components.

Each vehicle is equipped with three four-wheel swiveling trucks. Each truck consists of seven subassemblies that are integral elements of the truck itself, and four subsystems mounted on the truck.

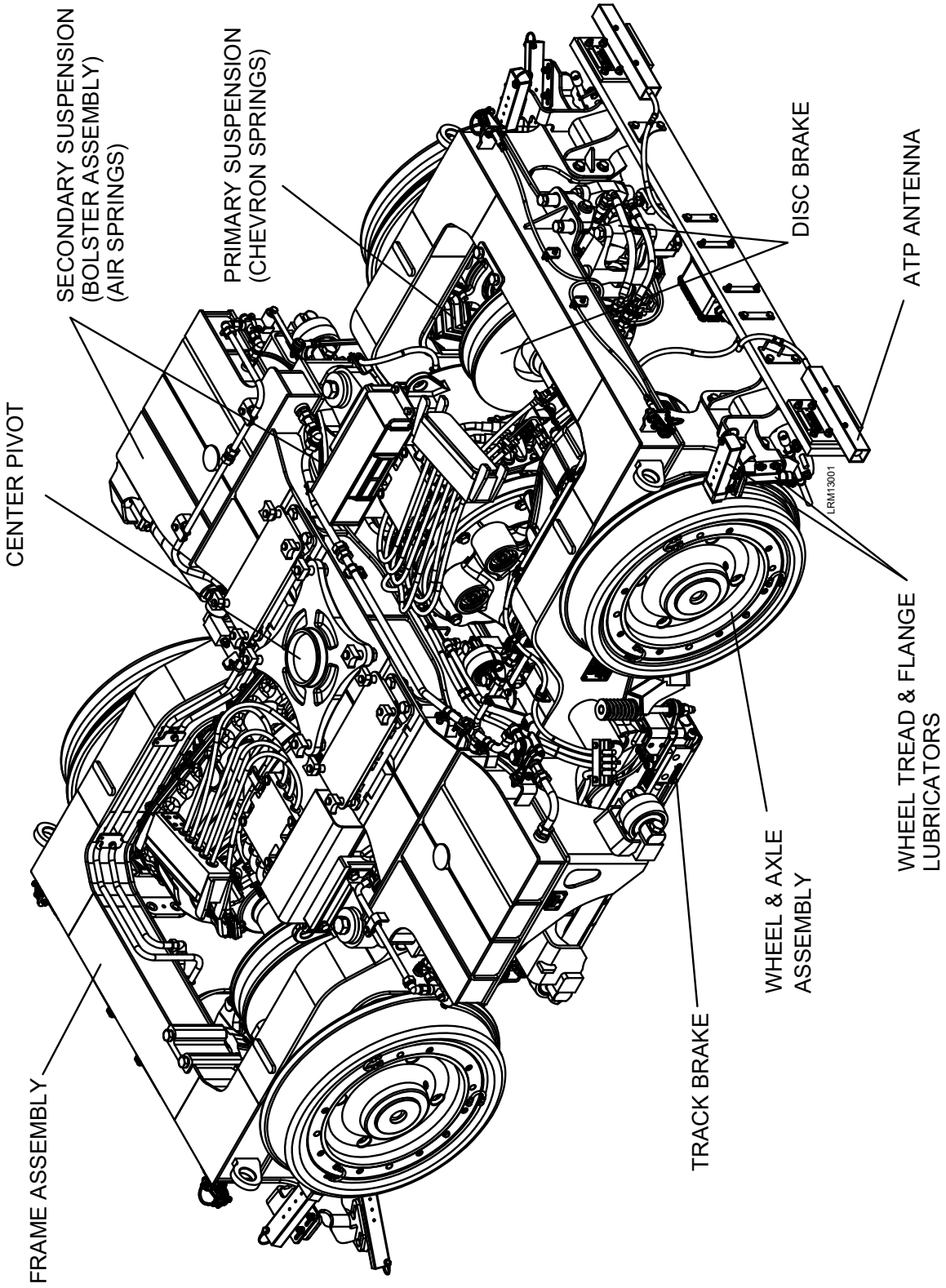


Figure 2-1: Motor Truck Assembly

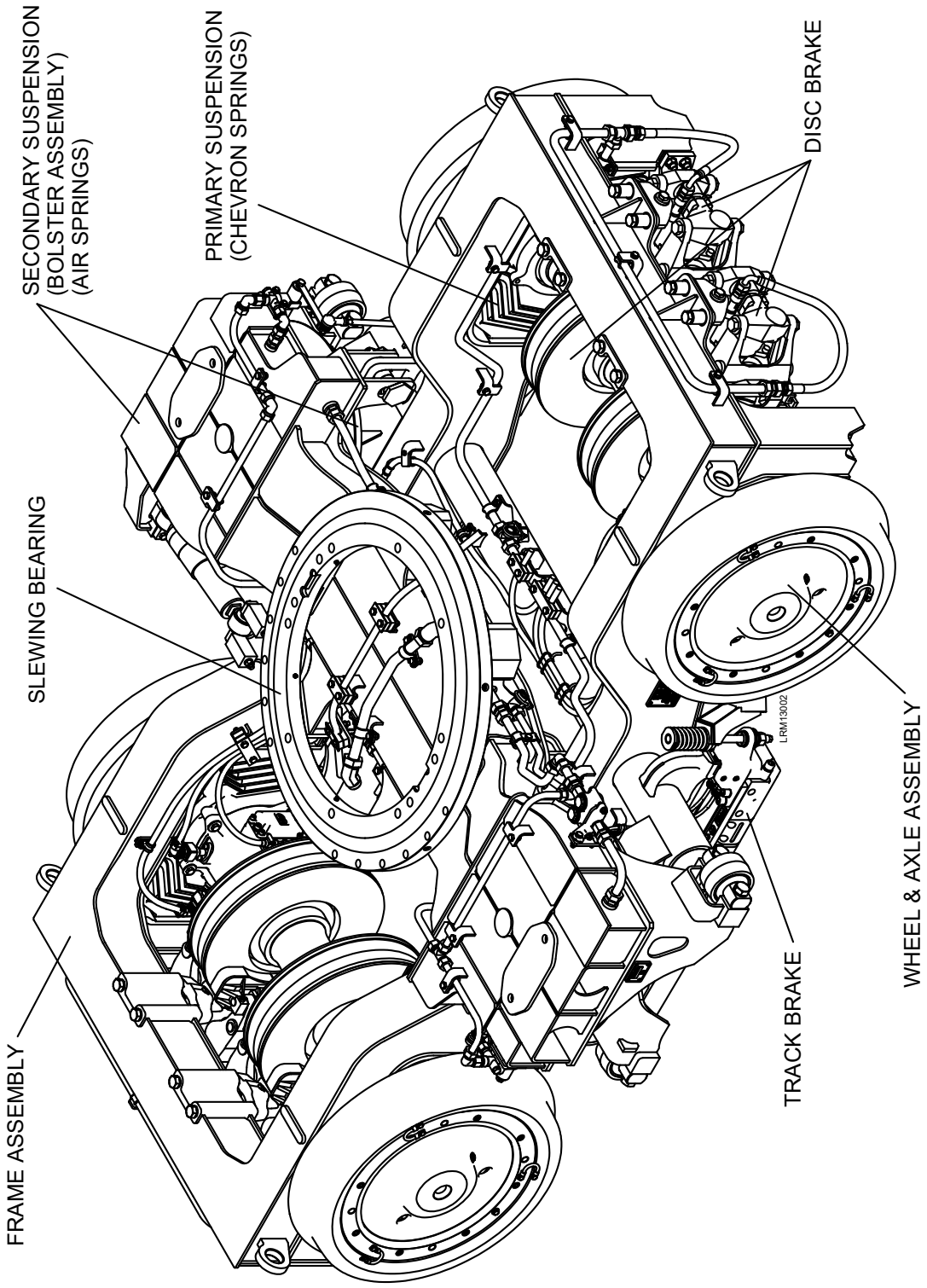


Figure 2-2: Center Truck Assembly

2.2.1 Truck Frame

The frame is a box H configuration, constructed of continuously welded steel sheets. It consists of two side members, one cross member, and component mounting points. Each member is constructed of sheet steel welded into hollow boxes and joined into a rigid H. The frame is the prime structural element of the truck. Operationally, the only functions of the truck frame are to provide support for equipment and to transmit bolster movement to the primary suspension and axle-wheel assemblies.

On the motored truck, the frame provides fixed mounting points for the chevron springs and air springs, the traction motors and gear units, friction brake actuators, track brake, safety bar, sander, lateral damper, bolster anchors, gear unit safety stops, leveling valve rod links, wheel flange lubricator and TWC equipment. See Figure 2-3. On the center truck, the frame provides fixed mounting points for the chevron springs and air springs, friction brake actuators, track brake, lateral damper, and bolster anchor. See Figure 2-4.

2.2.2 Bolster Assembly

The bolster is a long-box configuration, constructed of continuously welded steel sheets. The primary function of the bolster is to provide support for the carbody.

See Figures 2-5 and 2-6 for Motor and Center Truck Bolster Installation.

The bolster assembly consists of a welded steel box that lies laterally on the truck frame. The bolster provides support of the carbody and mounting points for the upper side of the air springs, lateral damper, bolster anchor rods, and leveling valves. Additionally, the bolster provides mounting for the center pivot assembly on the motor truck, the slewing ring on the center truck and the bolster's vertical and horizontal travel stops. The bolster section immediately above each air spring is an air reservoir.

Operationally, the bolster elements function as one component to provide for swivel of the truck in relation to the carbody, transfer of carbody acceleration and braking movement to the truck frame through the bolster anchors, while the air spring suspension absorbs and dampens vertical motion of the carbody.

Individually, the bolster elements function as follows:

- Center Pivot (Motor Truck only)

  The center pivot provides for connection of the carbody to the bolster. Primary center pivot components include upper and lower (bearing seat) radius plates, an expendable wear plate, adjusting plates (shims) to raise the carbody height, a retaining bolt between the carbody and bolster, and a center pivot bushing which keeps the bearing assembly in alignment

- Lateral Damper

  The lateral damper is a hydraulic, telescopic device mounted between the bolster and truck frame. The damper limits and absorbs vibrations and side-to-side pitching of the carbody

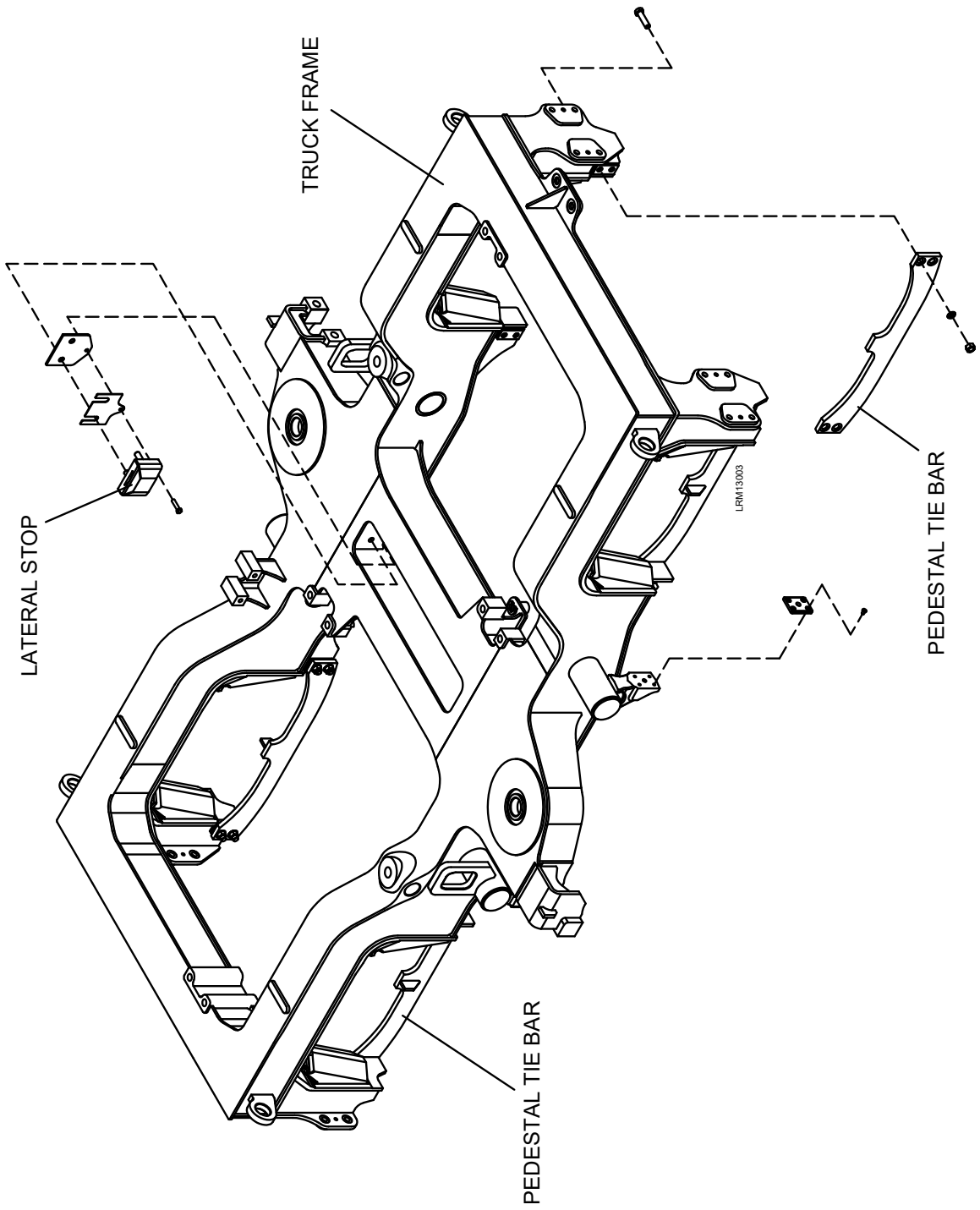


Figure 2-3: Motor Truck Frame

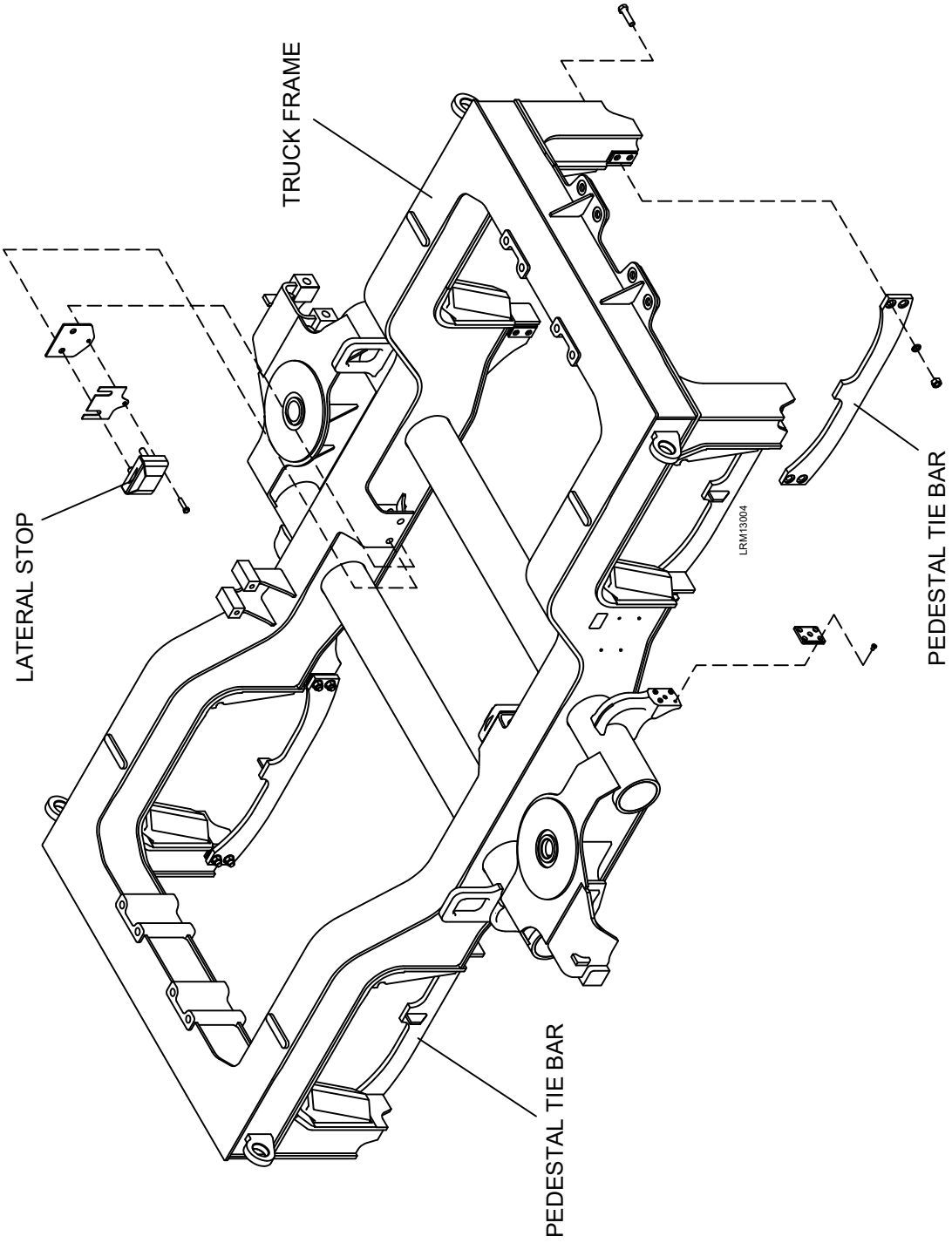


Figure 2-4: Center Truck Frame

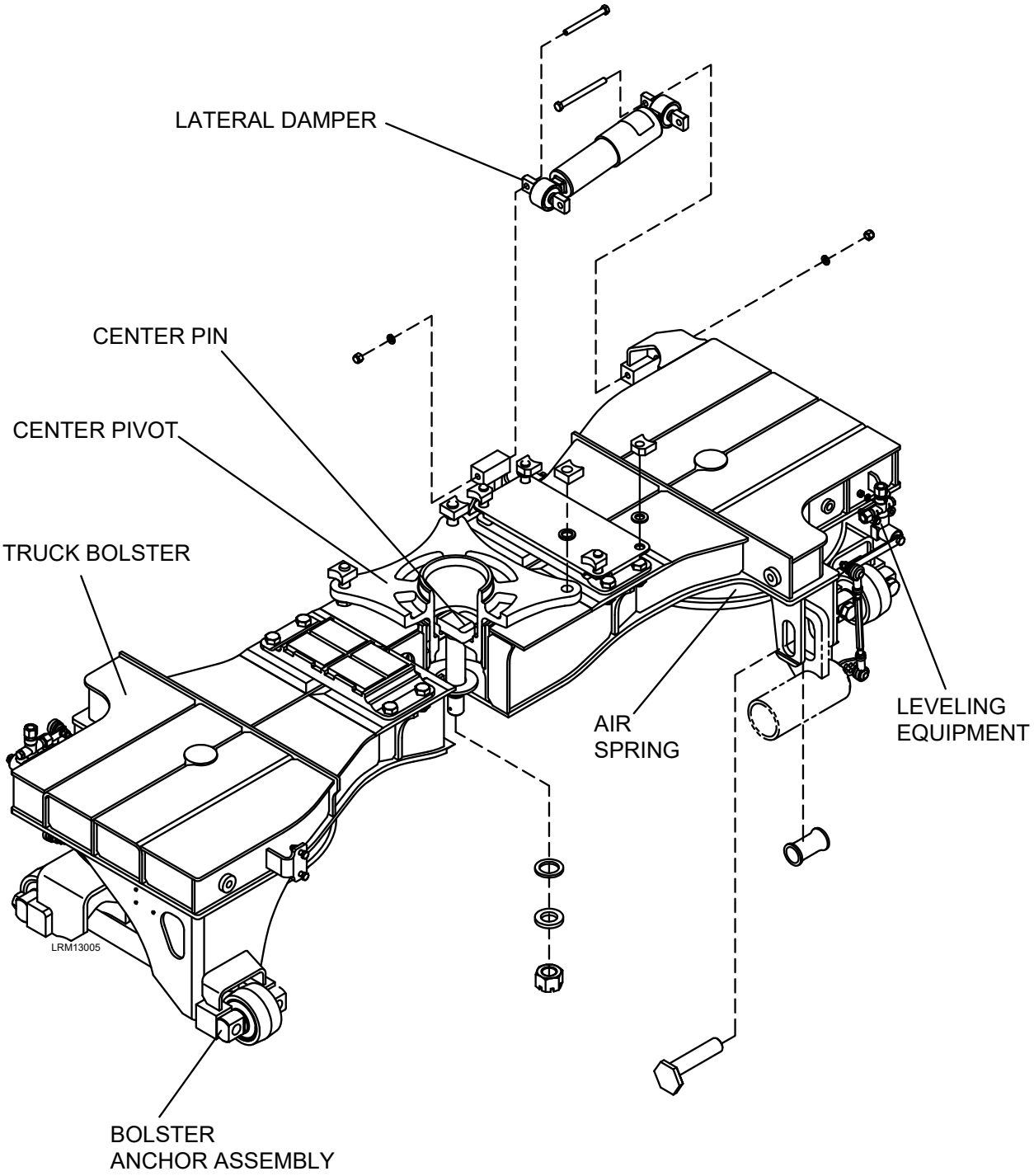


Figure 2-5: Motor Truck Bolster Assembly

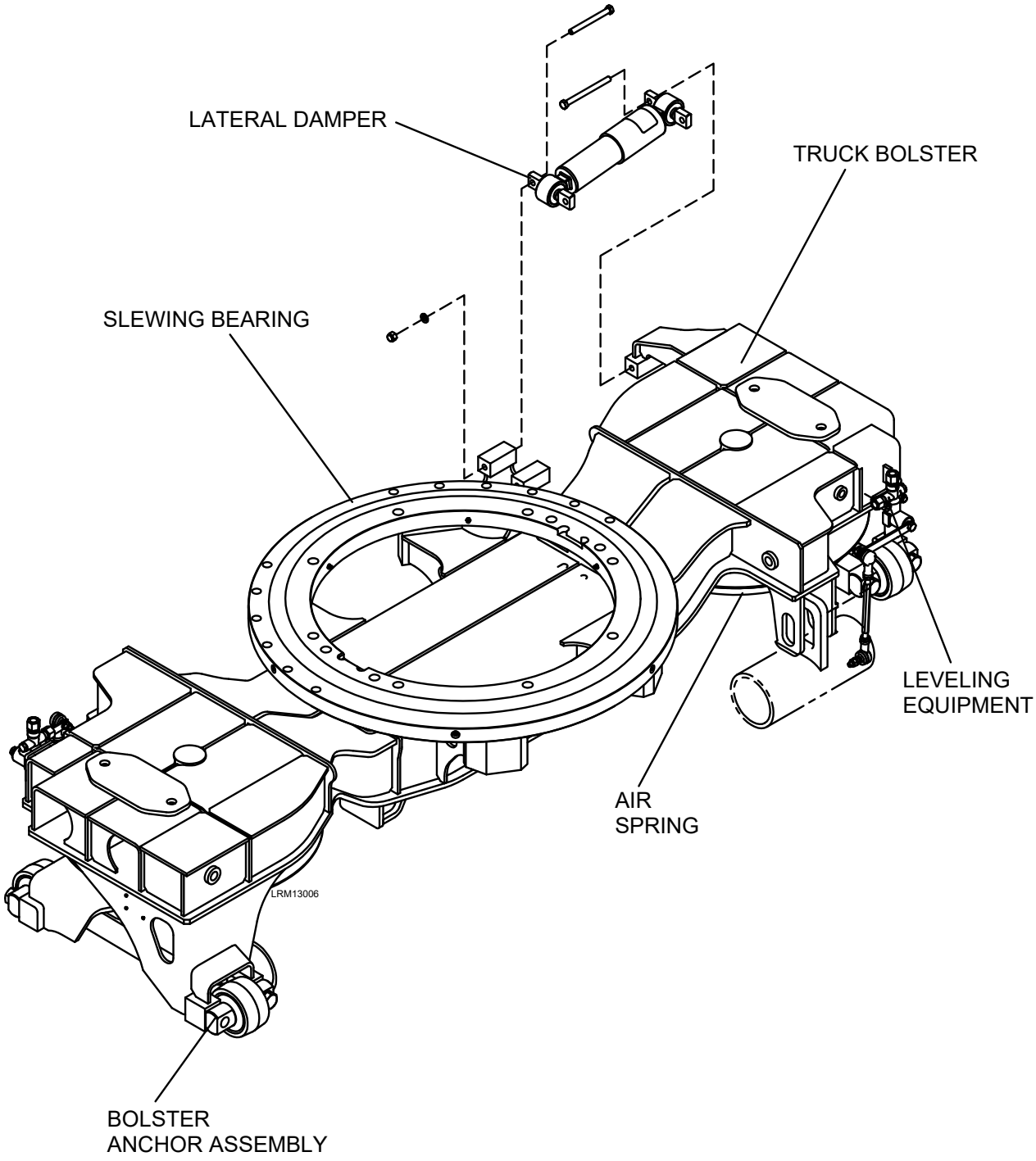


Figure 2-6: Center Truck Bolster Assembly

- Bolster Anchor Assembly

  The bolster anchors are mounted on each side of the bolster and connect to the frame. The anchors have rubber bushings at both ends to isolate the bolster and frame. In addition to connecting the bolster and frame, the anchors transmit acceleration and braking forces from the bolster to the frame and to the primary suspension

- Vertical Stops

  The vertical stops limit the upward and downward movement of the bolster in relation to the frame. In the event of air spring supply system failure, they prevent expansion of the bellows beyond the design limit and control lean of the carbody. In the event of an air spring rupture, they prevent excessive leaning of the carbody (in conjunction with an internal air spring downward stop). Additionally, in a derailment, they ensure that the truck frame (and equipment) remains connected to the bolster and carbody

- Lateral Stops

  The lateral stops are mounted under the bolster and limit the side-to-side travel of the bolster. The stops have weather resistant nylon contact pads and provisions for slotted adjustment plates (shims). In addition to limiting bolster travel, the stops also produce a return action of the bolster toward its center position

- Air Springs, Air Reservoir, Duplex Check Valve, and Orifice

  The air springs provide the secondary suspension system of the truck. There are two rubber bellows type springs per truck, each mounted between the truck frame and bolster. The upper sides of the springs are connected to an air reservoir in the bolster. The flow of air from the reservoir to air spring is controlled by an orifice and a duplex check valve. If an air spring ruptures, the duplex check valve functions to evenly deflate the air springs. The duplex check valve cross connects the bolster reservoirs by means of spring-loaded check valves. The bottom and top of the spring bellows are sealed to the end plates. Operationally, the air springs provide riding comfort, raise or lower the carbody height according to passenger load, and reduce vibrations between the carbody and the truck

- Leveling Valve

  The leveling valves are mounted on the bolster next to the air spring being controlled. The leveling valves are two-port air control valves connected by adjustable levers to the truck frame. Operationally, the valves supply or exhaust air from an air spring and reservoir to keep the carbody at a constant height under all passenger loads

2.2.3 Primary and Secondary Suspensions

The primary suspension consists of eight V-shaped chevron type springs, mounted between the journal bearing housing and the frame, four on each side of the journal bearing housing. See Figure 2-7. Associated components of the primary suspension include: adjusting plates mounted between the bearing housing and springs, a journal bearing housing tie bar/track brake support beam, and a pedestal beam mounted to the truck frame below the journal bearing. The journal bearing housing provides mounting points for the track brake beams. These components are not elements of the suspension.

Operationally the chevron springs provide vertical support for the vehicle, and the smooth transfer of thrust loads generated during vehicle acceleration and braking. The chevron spring adjustment plates provide the means to precisely align the axles, and to maintain axle parallelism (tram) under various chevron spring rates. The (frame) pedestal beam provides a bottom side (backup) stop for the springs, and additionally ensures the retention of the primary suspension and axle assembly within the truck frame in the event of a derailment.

The secondary suspension consists of bellows type air springs, mounted between the frame and bolster. The primary functions of the air springs are to provide ride comfort and to maintain constant floor height under all car loadings.

2.2.4 Axles, Bearings and Wheels

The axle, journal bearing, and wheel assembly provide the transmission of motion from the traction motor-gear unit assembly to the rails. See Figures 2-8 through 2-10. The axles are solid steel with a machined surface and ends that have 60° lathe centers to allow the use of wheel truing machines. The axles have machined seats and seal indents for the wheels, bearings, gear unit, grounding ring, and brake disc. The journal bearings are inboard mounted, standard railroad tapered roller bearings with rubber seals. The wheels are Bochum 84 resilient wheels comprised of a wrought steel hub and a bolt on tire separated by rubber rings to reduce noise, and are sized to provide one inch of wheel tread wear. The wheel hub and tire grounding is accomplished by wire bonding.

NOTE: The bearings and wheel hubs are press fitted onto the axle, after the axle has been pressed through the gear unit and the ground ring and brake disc hub have been pressed on.

Operationally, the axle is the mounting point for all active power train components and the weight bearing member of the power train. The bearings provide reduced rolling resistance for the vehicle and the attachment points for the weight bearing members of the frame. The wheels support the vehicle and transmit acceleration and braking motions to the rails.

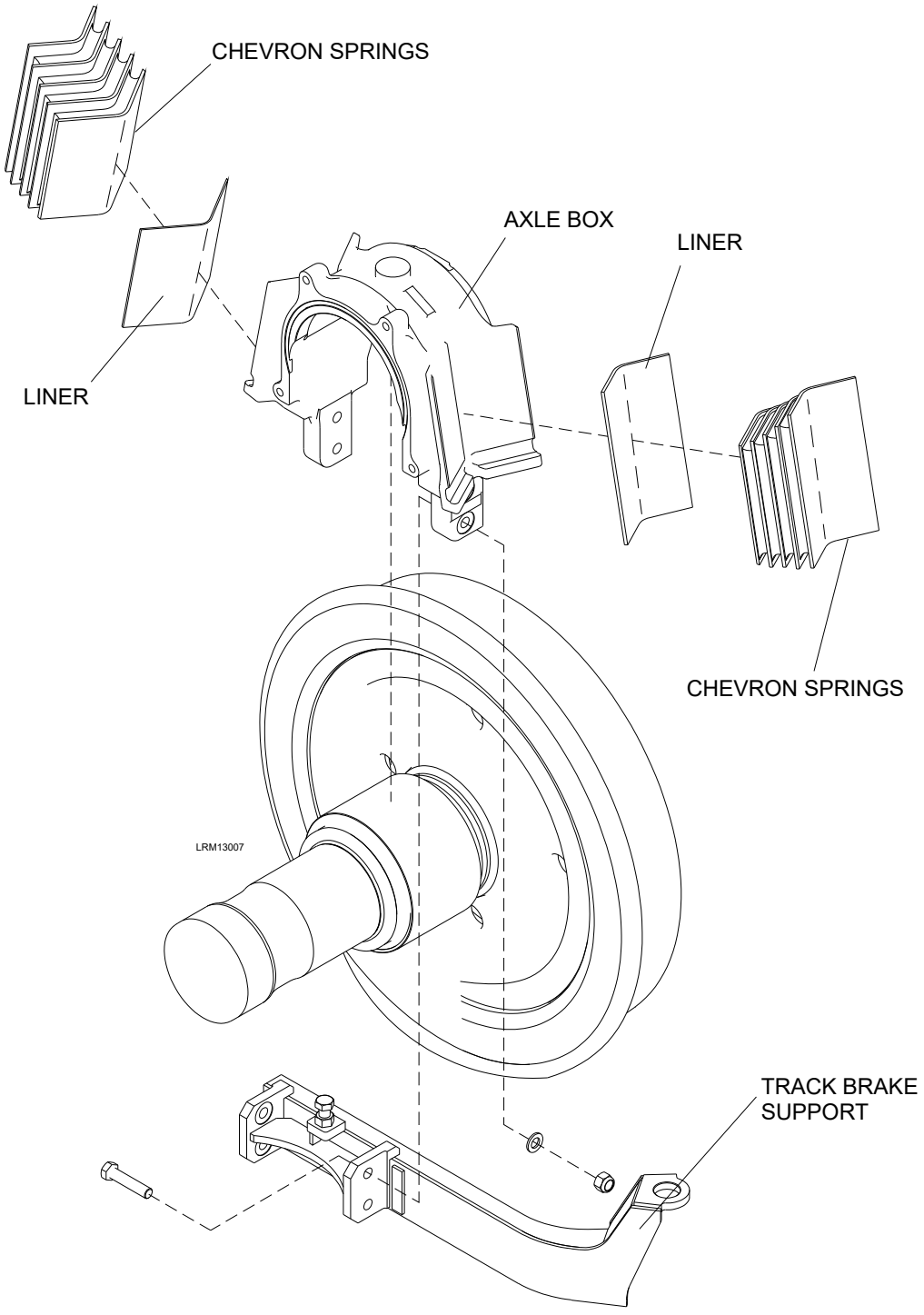


Figure 2-7: Primary Suspension

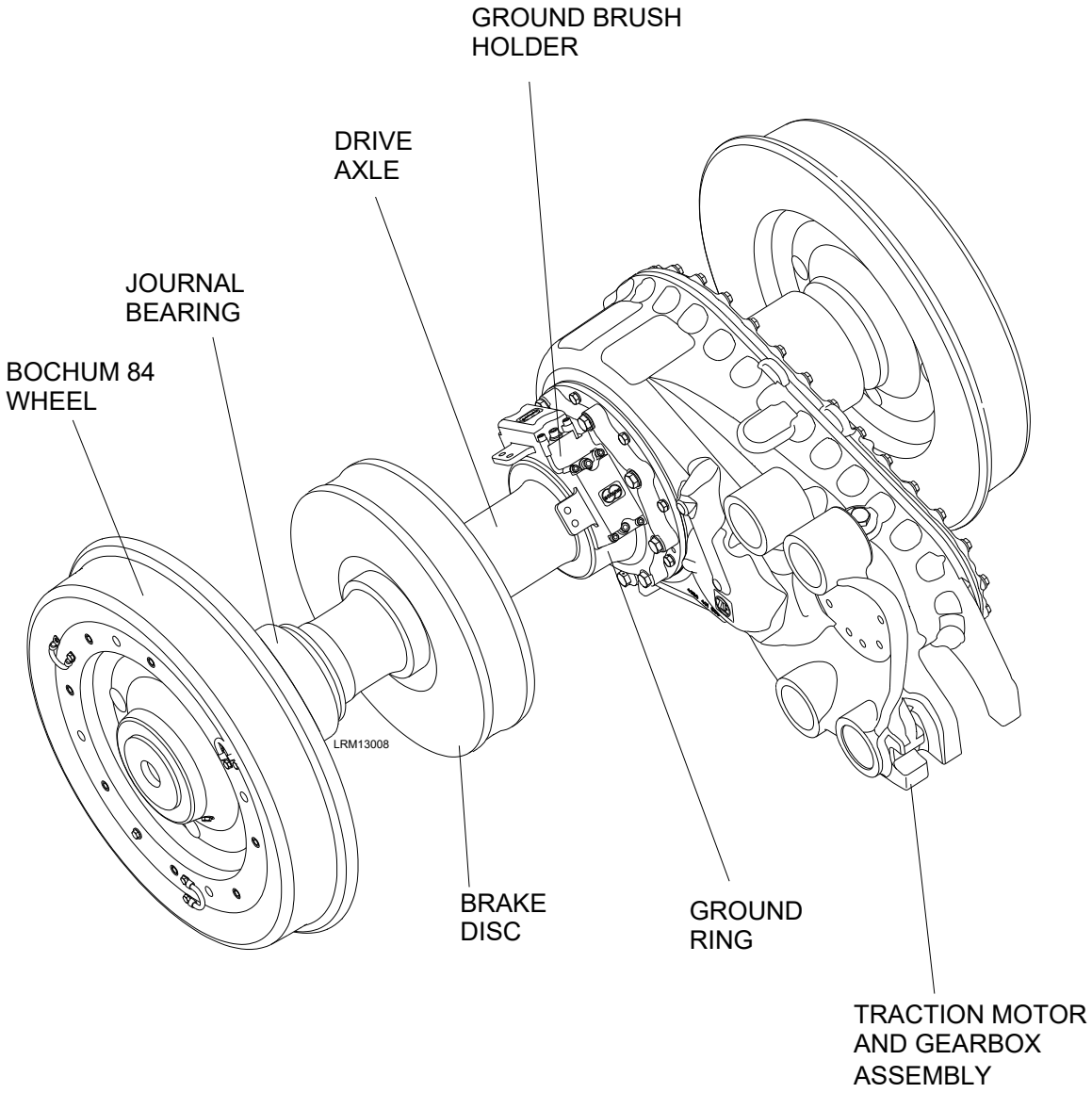


Figure 2-8: Motor Truck Wheel-Axle Assembly

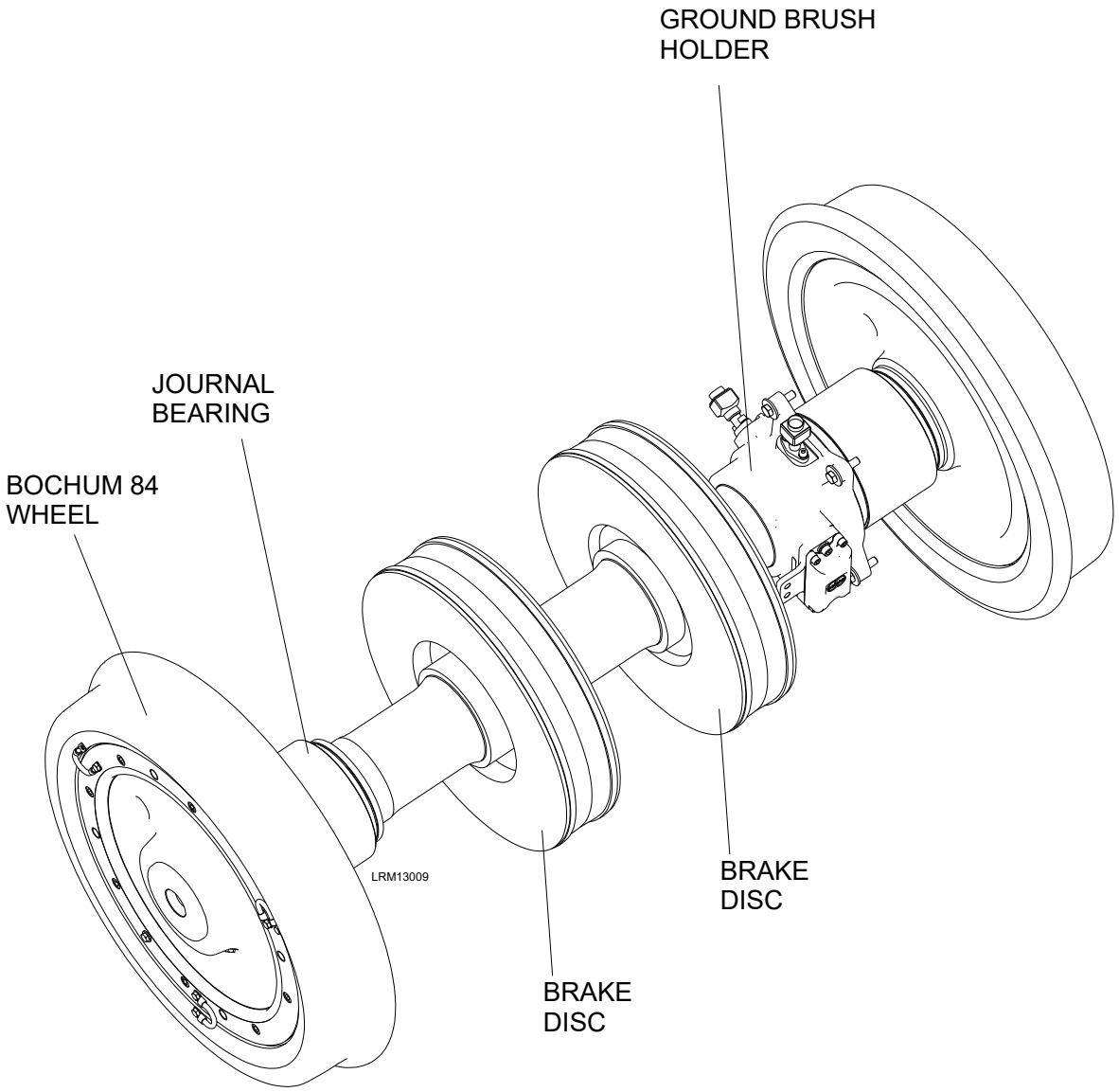


Figure 2-9: Center Truck Wheel-Axle Assembly

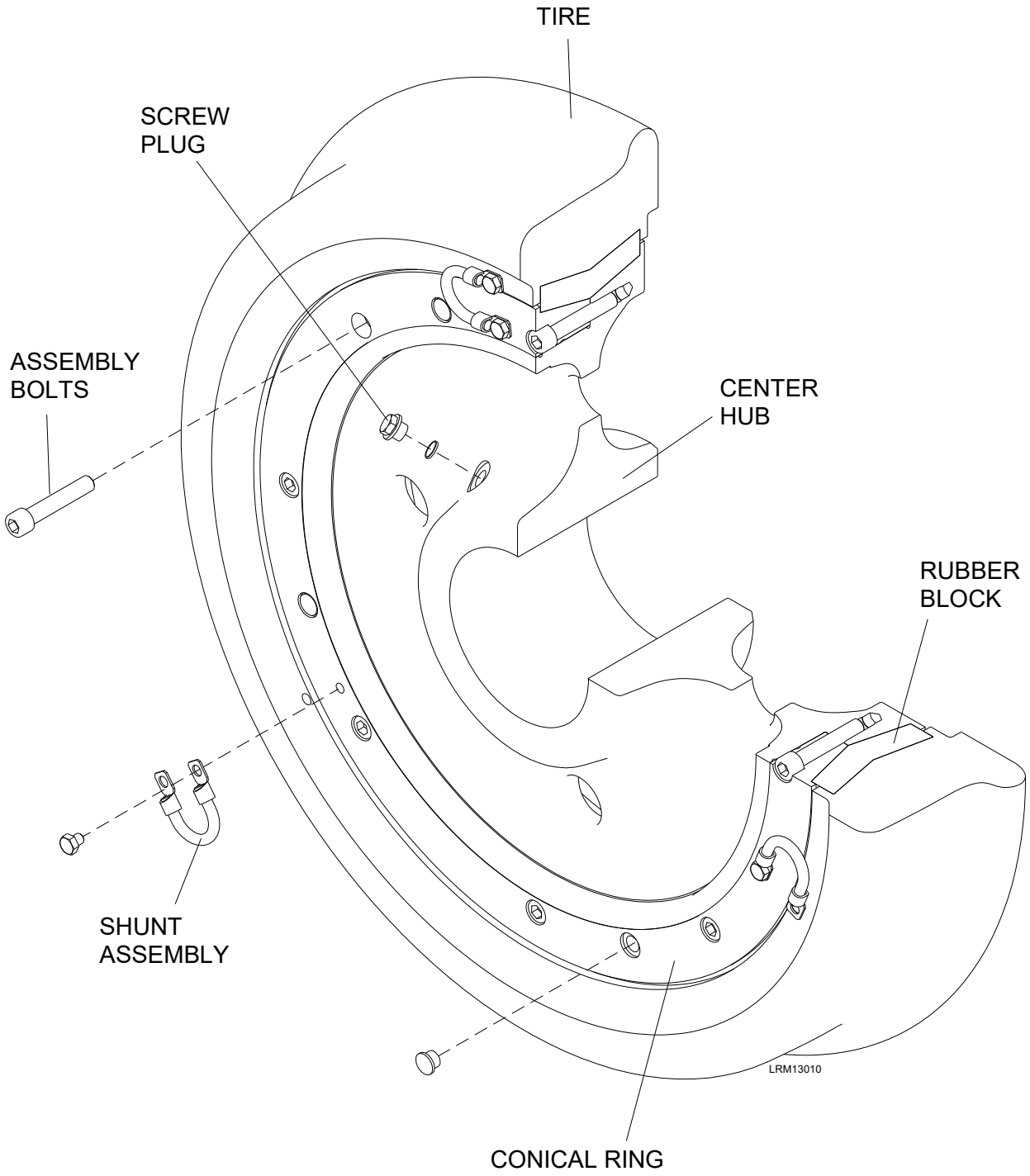


Figure 2-10: Bochum 84 Wheel Assembly

2.2.5 Traction Motor and Gear Drives

NOTE: The motors and gear units are mounted on the outboard trucks of each car, but are not integral elements of it. The traction motors and gear drives are supplied by Toyo Denki, and are covered in Section 0700, Propulsion of this manual. The information provided in this section covers the relationship of propulsion equipment to other truck equipment and maintenance requirements.

The traction motors are three-phase, AC squirrel cage, induction motors that lie parallel to the axles. These motors use a plain ball bearing on the rear end and a roller bearing on the pinion end. Both are lubricated with lithium-based grease. The gear units are a double reduction design with ball and roller bearing mounted shafts. The gear unit lubrication system is a splash-bath reservoir type. See Figure 2-11.

The gear drives are double reduction units in direct line with the motors. The motor and gear unit housings are bolted together and insulated from vibration through resilient bushings. The motor drive shaft and gear drive shaft are connected with a gear-type flexible coupling, capable of allowing operation under most alignment conditions. The coupling sleeve is a two-piece assembly bolted together at the center to facilitate maintenance. Lubrication of the coupling is accomplished with grease packing of the coupler cavity.

The gear unit also provides mounting for two subsystems. Speed sensors are located on the gear unit coupling hub. Axle ground brushes for the propulsion system are mounted on the inboard side of the low speed end of the gear box.

Axles are press fitted through the gear drive. The function of the motors and gear units is the propulsion and dynamic/regenerative braking of the vehicle through the axles and wheels.

Operationally, the traction motors provide motive power and dynamic braking force through the gear unit to the axles and wheels. The speed sensors provide electrical signals utilized for propulsion control and braking control. The axle ground brushes provide (through the ground ring, axles and wheels) the ground leg of the propulsion power system and carbody safety ground.

2.2.6 Disc Brake and Track Brake

NOTE: The disc and track brakes are subsystems mounted on the truck, but are not integral elements of it. A full operational description of the disc brake is presented in Section 1300, Friction Brakes and the Track Brake in Section 1000, Track Brakes of the Running Maintenance and Servicing Manual.

The disc brake units consist of air-cooled axle-mounted discs and frame-mounted caliper assemblies. There is a single disc and caliper assembly on each axle of the motor truck. There are dual discs and caliper assemblies on each axle of the center truck. The discs are attached to steel hubs pressed onto the axles. The caliper assembly consists of left and right brake shoes, and an air operated actuator. There are spring-applied parking brakes on each of the motor trucks. The track brakes consist of electromagnetic units mounted at the side of the truck frame, above the rails.

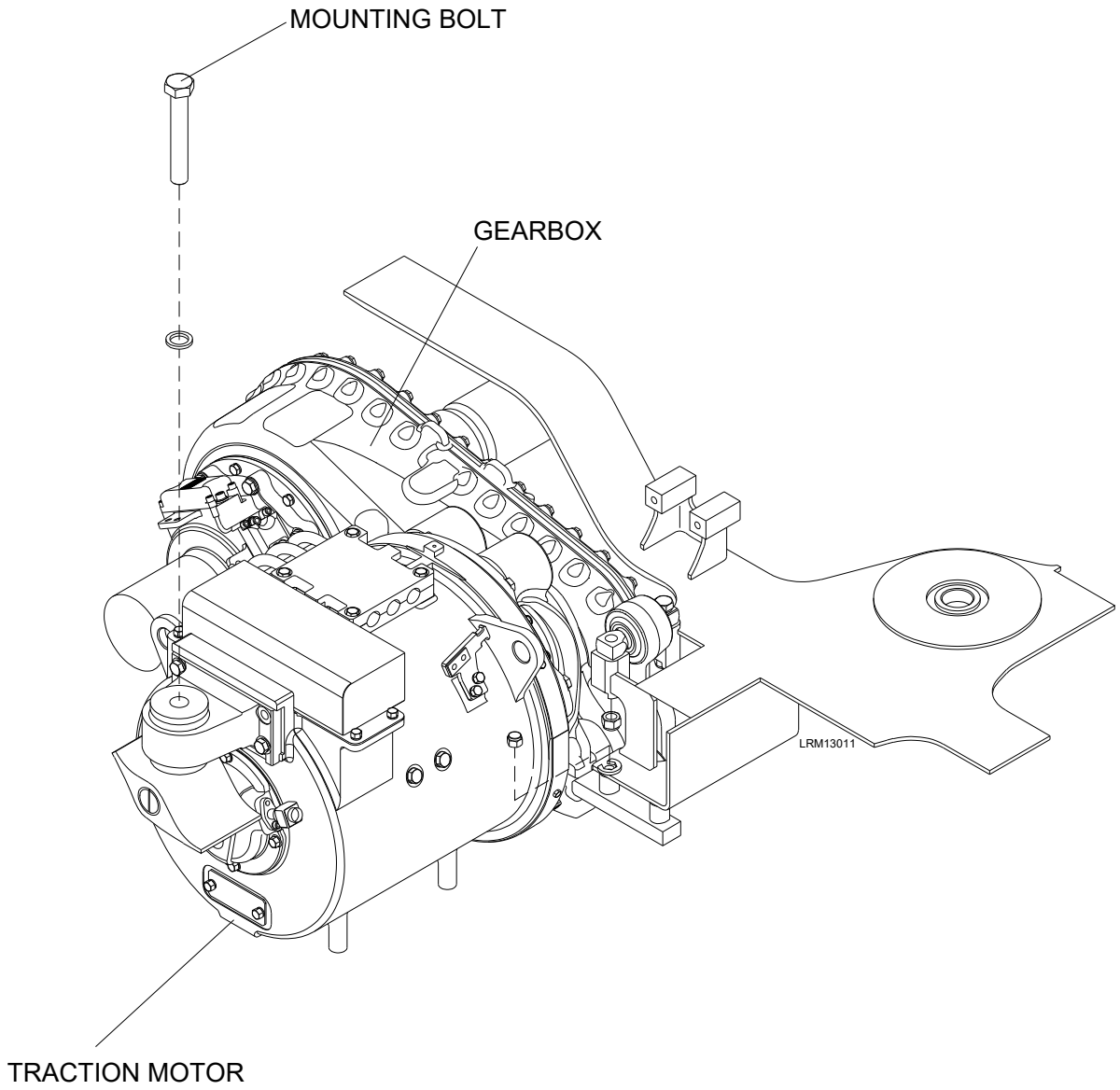


Figure 2-11: Motor and Gear Unit Assembly

Operationally integrated into the traction control system are track sanders mounted in front of the lead wheels on each truck. The function of these brake systems is to slow the vehicle beyond the capability of the regenerative brake system and to bring the vehicle to a full stop.

2.2.7 Wheel Tread and Flange Lubricator

LB Foster Rail Technologies Corp. provides friction management solutions for transit and freight rail systems. LB Foster Rail Technologies Corp. offers two types of solid stick products to control friction levels between the wheel / rail interface: Low Coefficient of Friction (LCF) solid lubricant to reduce the friction coefficient between the wheel flange and rail gauge and High Positive Friction (HPF) to optimize friction levels between the wheel tread surface and top of rail. Unlike traditional friction control methods such as oil and grease, LCF does not migrate to the top of rail, and LCF and HPF do not contaminate the rail and surrounding vehicle structure.

The LCF and HPF system consists of a bracket, a LCF applicator, a HPF applicator, and LCF and HPF solid sticks. The LCF applicator is directed toward the wheel flange contact area while the HPF applicator is directed towards the wheel tread contact area. Both applicators are attached by means of an interface bracket that is mounted to the truck side frame. Slots on both the bracket and applicators allow for precise applicator positioning.

Stainless steel applicators are used to apply both LCF and HPF products. Each applicator employs a constant force spring attached to a removable insert to press each interlocking solid stick against the wheel surface.

To load the applicator, the insert is removed and interlocking solid sticks are loaded into the opening at the end of the tube. The insert is held and secured in place with a lock pin. The LCF applicator can hold a maximum of four solid sticks and the HPF applicator can hold a maximum of three solid sticks.

Wheel friction modification is achieved by the deposition of solid sticks through contact between the wheel surface and the solid sticks. The rubbing effect due to the wheel rotation causes the solid sticks to be transferred on to the wheel surface. LCF and HPF is spread from the wheel directly in contact with the solid sticks to the gauge corner and top of the rail respectively and will then be carried onto the trailing wheels. This action spreads the LCF and HPF from wheel to wheel and from wheel to track, effectively covering all vehicle wheels and track at all points of flange and tread contacts.

2.2.8 Air Filter

The Air Filter, see Figure 2-12 removes debris from the air input to the secondary suspension system on each truck.

The air filter body, (1) Figure 2-13 contains the strainer element (2), which is held by compression spring (3). The compression spring (3) is restrained by the screw plug (5).

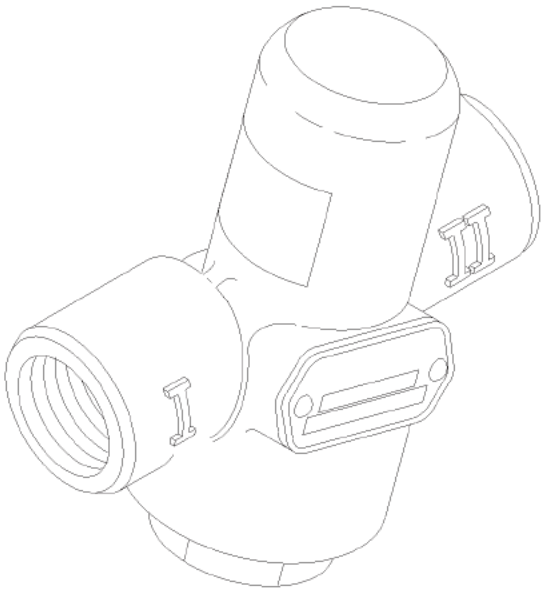
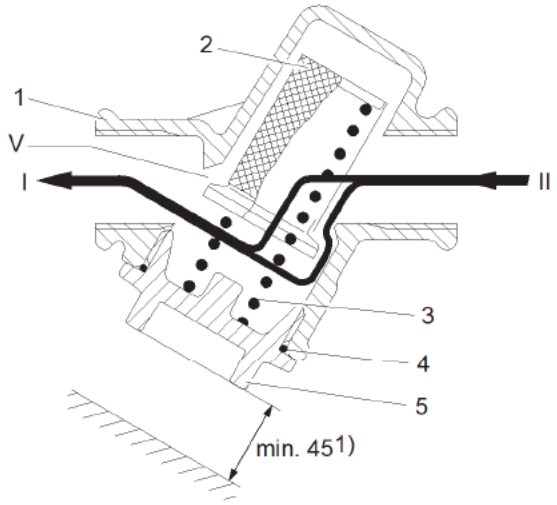


Figure 2-12: Air Filter



1 Body
2 Strainer element
3 Compression spring
4 O-ring
5 Screw plug

I Consumer port
II Air supply port

V Valve seat

1) Clearance for removing strainer element

Figure 2-13: Air Filter Diagrammatic

2.2.9 Check Valve

The model RV-10 check valve, see Figure 2-14, is used in compressed air pipes in which the flow of air must be enabled in one direction and reflux disabled in the other direction to avoid a pressure drop.

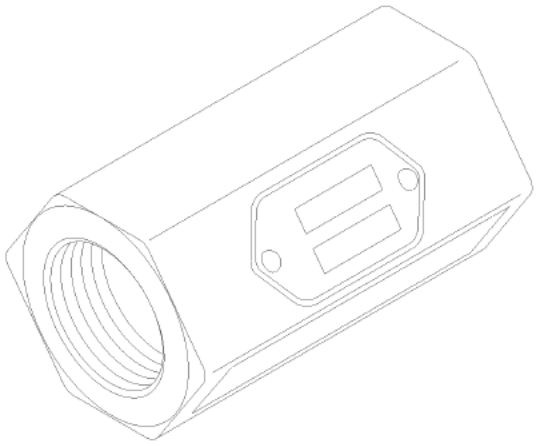
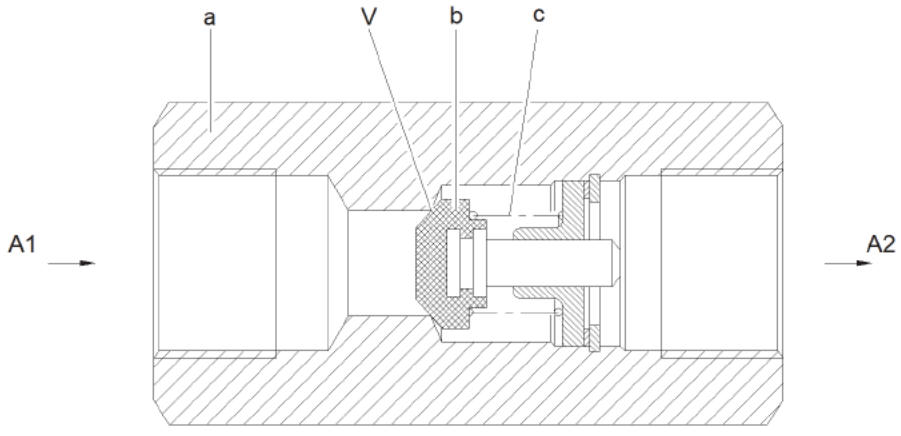


Figure 2-14: RV10 Check Valve

The check valve consists essentially of body (a) (Figure 2-15), the valve cone (b), and the compression spring (c). The body (a) has a valve seat (V). The valve cone (b) is spring-loaded, i.e., it is pressed onto the valve seat (V) by the thrust of the compression spring (c). The body (a) has threads for connecting pipes. The direction of flow is indicated by an arrow on the outside of the body (a).



a	Housing	V	Valve seat	A1	Input
b	Valve cone			A2	Output
c	Compression spring				

Figure 2-15: RV-10 Check Valve Diagrammatic

2.2.10 Cutout Cock Valve

One cutout cock, see Figure 2-16 is located in each motor truck and one in the center truck air supply lines. The cutout cock is provided to isolate the leveling system in case of failure or during maintenance operations. When in the cut out position the cutout cock permits maintenance to the air filter.

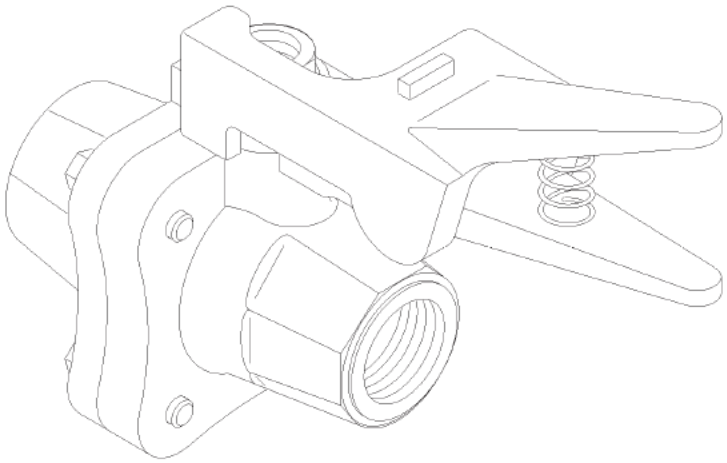


Figure 2-16: Cutout Cock

2.2.11 Duplex Check Valve

The duplex check valve, Figures 2-17 and 2-18 are used in the secondary air suspension system to link two air springs when the pressure differential between the two air springs exceeds 22 psi.

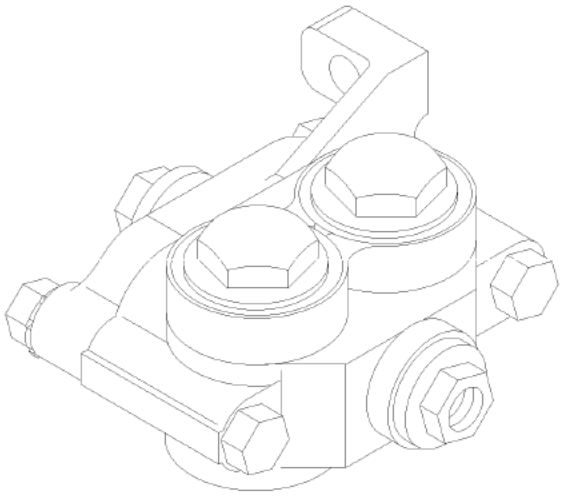
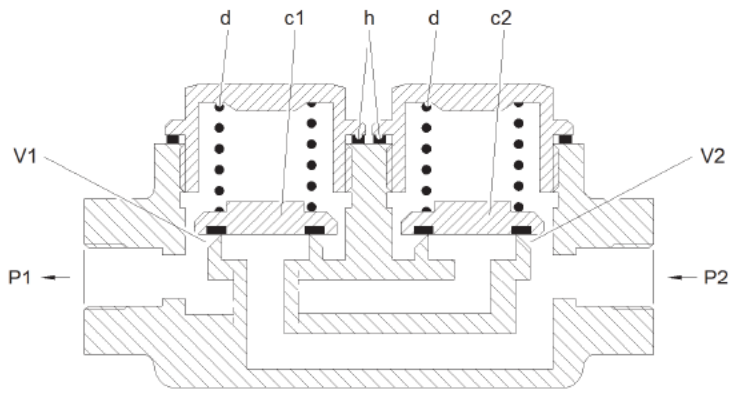


Figure 2-17: Duplex Check Valve



c1	Valve head	d	Compression spring	P1	Air pipe connection
c2	Valve head	h	Sealing ring	P2	Air pipe connection
				V1	Valve seat
				V2	Valve seat

Figure 2-18: Duplex Check Valve Diagrammatic

2.2.12 Leveling Valve

The leveling valve, see Figure 2-19 serves as an actuator in the closed loop of the air suspension system. There are two leveling valves per power truck, and two leveling valve for the center truck.

The leveling valve maintains the car height a fixed distance from the truck under load conditions

The valve, see Figure 2-20 has a port (V) at the top for the auxiliary reservoir, and a port (L) at both left and right for connection to the air spring bellows. Opposite the port (V) is the exhaust port (E).

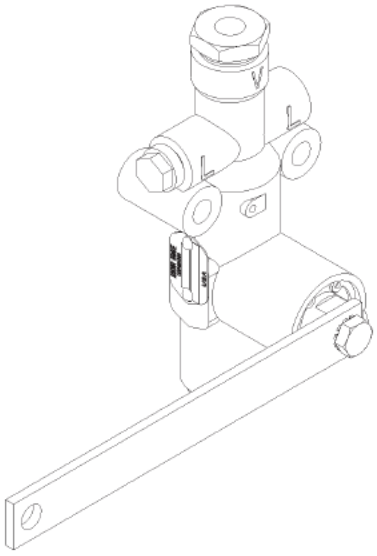
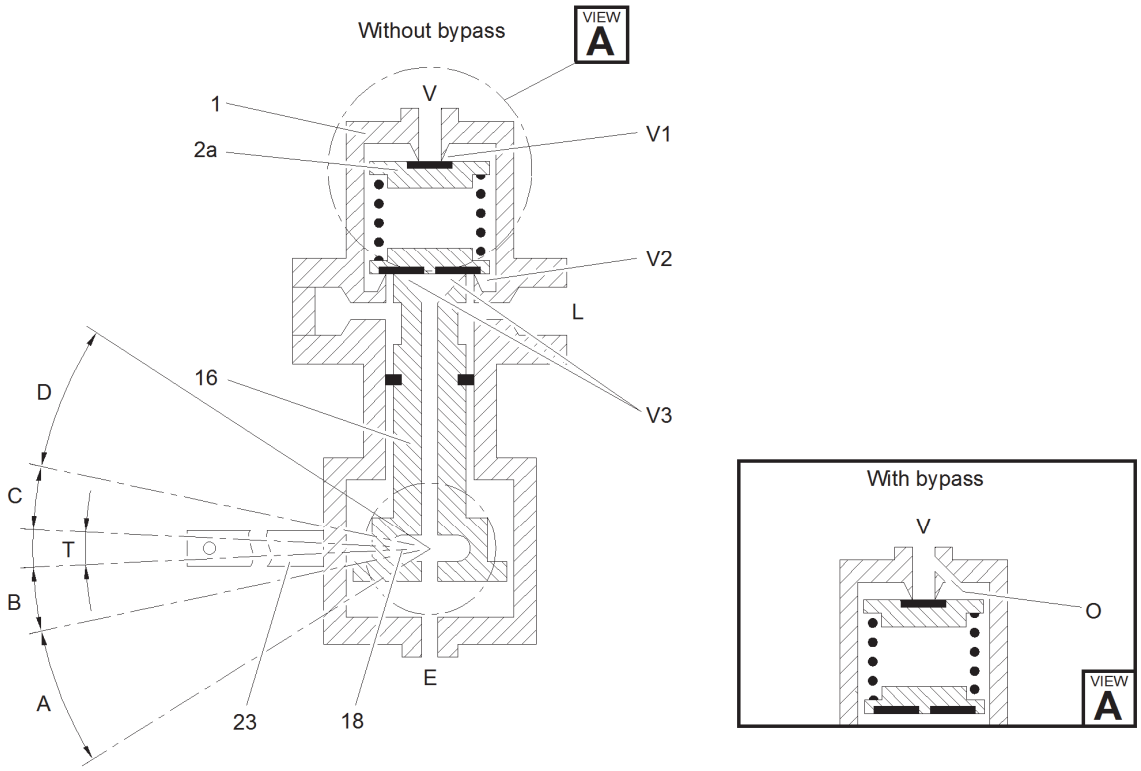


Figure 2-19: Leveling Valve



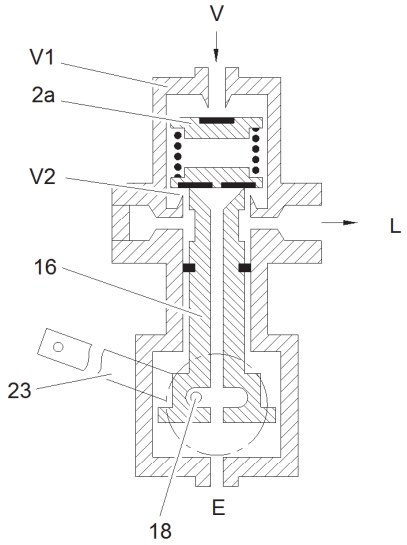
1	Body	E	Exhaust port	A	Unthrottled venting
2a	Valve Head	L	Port for air spring bellows pipe	B	Throttled venting
16	Piston	V	Port for auxiliary reservoir pipe	C	Throttled charging
18	Driver and eccentric	V1	Check valve	D	Unthrottled charging
23	Actuating Lever	V2	Inlet valve	T	Dead motion
O	Bypass Bore	V3	Outlet valve		

Figure 2-20: Leveling Valve at Lap Position

Loading

When the vehicle load is increased, see Figure 2-20 the car body first falls as the air spring bellows are compressed by the heavier load. As the bellows are compressed, the driver (18) is turned via the actuating mechanism, causing the eccentric to move the piston (16) upward and open the inlet valve (V2). The compressed air (V) coming from the auxiliary reservoir is applied to the upper valve head (2a) and opens the check valve (V1). In the throttled version of the leveling valve, the passage of the compressed air (V) is throttled by the fine clearance between the piston neck and housing bore before it reaches (L) and the air spring bellows.

As the actuating lever (23) is increasingly deflected, the piston (16) is pushed further and further upward and - being appropriately shaped - opens the housing bore by an ever-increasing amount. See Figure 2-21. In the un-throttled version of the leveling valve, the charging bore is opened wide once the end of the dead motion is reached. The car body is raised. The actuating lever returns to its horizontal position as soon as the original level setting is reached again. The leveling valve is at the lap position and the inlet valves (V1) and (V2) are closed.



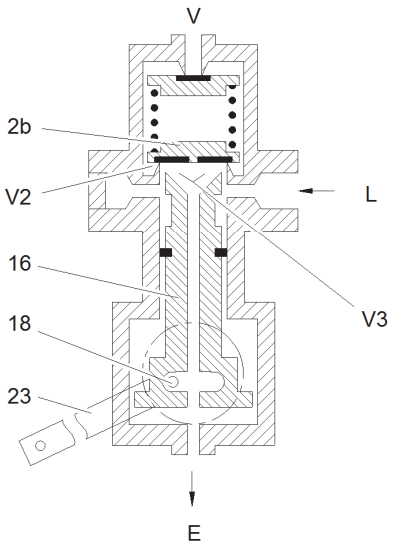
2a	VALVE HEAD	V1	CHECK VALVE	E	EXHAUST PORT
16	PISTON	V2	INLET VALVE	L	PORT FOR SPRING BELLOWS PIPE
18	DRIVER AND ECCENTRIC			V	PORT FOR AUXILIARY RESERVOIR PIPE
23	ACTUATING LEVER				

Figure 2-21: Charging

Unloading

When the vehicle load is decreased the car body rises first as the air spring bellows are extended by the decreasing load. As the bellows expand, the driver (18), see Figure 2-22, is turned via the actuating mechanism, causing the eccentric to move the piston (16) downward and open the outlet valve (V3). The inlet valve (V2) is kept closed by the force of the compression spring and the pressure (V) on the valve head (2b). Communication between the auxiliary reservoir and the air spring bellows is cut off by this action. In the throttled version of the leveling valve, the passage of the compressed air (L) from the air spring bellows is throttled by the fine clearance between the piston neck and housing bore before it passes through the piston's outlet bore on its way to the exhaust port.

The piston (16) opens the housing bore wider and wider as it goes further downward. In the un-throttled version of the leveling valve, the venting bore is opened wide once the end of the dead motion is reached. The car body is lowered so much in this way that it reaches its original level again. The actuating lever reassumes its horizontal position. The leveling valve is at the lap position and the outlet valve (V3) is closed.



2b	VALVE HEAD	V2	CHECK VALVE	E	EXHAUST PORT
16	PISTON	V3	OUTLET VALVE	L	PORT FOR SPRING BELLOWS PIPE
18	DRIVER AND ECCENTRIC			V	PORT FOR AUXILIARY RESERVOIR PIPE
23	ACTUATING LEVER				

Figure 2-22: Venting

CHAPTER 3.0

SCHEDULED MAINTENANCE

3.1 Introduction

Scheduled maintenance of the truck and its components includes inspections and tests at specific mileage-based intervals.

Table 3-1, Scheduled Maintenance Action Index, provides a listing of the items to be checked and cross references them to the sections that cover each item. The scheduled maintenance activities listed in the table cover the items that must be inspected or tested at definite intervals to assure vehicle safety and reliability. Heavy repair and maintenance requirements are located in the Heavy Repair Maintenance Manual.

CAUTION

THE INDEX IS NOT INTENDED TO BE THE FINAL AUTHORITY ON TRUCK EQUIPMENT, AND THEREFORE ASSUMES THAT IN-SERVICE EXPERIENCE WILL PROVIDE MODIFICATIONS TO THE INDEX. FURTHERMORE, THE INDEX ADDITIONALLY ASSUMES THAT OPERATING EVENTS, SUCH AS COLLISION WITH DEBRIS OR AN EMERGENCY BRAKE APPLICATION, WILL INITIATE INSPECTIONS OR TESTS PRIOR TO THE USE OF A VEHICLE IN SERVICE.

3.2 Scheduled Maintenance Action Index

This index lists scheduled inspections, tests, servicing and preventive maintenance procedures. It is tabulated as follows:

1. Column 1, MAINTENANCE INTERVAL. This column indicates the recommended interval for proper preventive maintenance.

2. Column 2, PART DESCRIPTION. This column lists the equipment or component group and items to be inspected or tested.

3. Column 3, SCHEDULED MAINTENANCE TASK. This column lists the maintenance task to perform.

4. Column 4, SECTION REFERENCE. This column states the section number in this chapter or the chapter of this manual which contains the applicable inspection or test procedure.

Table 3-1. Scheduled Maintenance Action Index

Maintenance Interval	Part Description	Scheduled Maintenance Task	Section 1200 Truck & Suspension Running Maintenance & Servicing Manual Section Reference
Every 2 Weeks	Wheel Tread and Flange Lubricator	Replenish the LCF/HPF sticks	Section 3.3.11
		Inspect the applicators to check for debris build-up. Clean if necessary	
		Visually inspect for impact damage. Look for cracks around the mouths of the applicators. Replace if necessary	
		Check tightness of all fasteners. Tighten if necessary	
	Sanding Nozzle	Inspect the nozzles to check for debris build-up. Clean if necessary	Section 3.3.19
		Visually inspect for impact damage. Look for cracks around the mounting points of the nozzles. Replace if necessary	
		Check tightness of fasteners. Tighten if necessary	
10,000 miles	Wheels and Axles	Inspect wheel wear and flats	Section 3.3.10.1
		Inspect axle, wheel centers and tire for defects	
	Wheel Tread and Flange Lubricator	Check applicator alignment. Adjust if necessary	Section 3.3.11
		Perform routine applicator maintenance	
		Visually inspect the bracket for signs of corrosion and fatigue cracks	
		Check tightness of all bracket mounting fasteners. Tighten to installation specifications if necessary	
	Sanding Nozzle	Check nozzle alignment and height, adjust if necessary	Section 3.3.19
		Visually inspect the bracket for signs of corrosion and fatigue cracks	
		Check tightness of all bracket mounting fasteners. Tighten to installation specifications if necessary	

Table 3-1. Scheduled Maintenance Action Index (cont'd.)

Maintenance Interval	Part Description	Scheduled Maintenance Task	Section 1200 Truck & Suspension Running Maintenance & Servicing Manual Section Reference
30,000 miles	Chevron Spring	Inspect for loose or missing adjustment plates	Section 3.3.4.1
		Inspect for loose or missing mounting hardware, pedestal beam and bolts	
	Journal Bearing	Check housing for discoloration, cracks or abnormal appearance	Section 3.3.3.1
		Check grease leakage	
	Wheels and Axles	Inspect shunts and mounting hardware	Section 3.3.10.2
	Slewing Bearing	Bolt inspection	Section 3.3.18.1
		Lubricate slewing bearing	
	Vertical Stop Collar (Gold Line Only)	Check collar thickness	Section 3.3.20
		Measure vertical stop bracket wear	
60,000 miles	Truck Frame	Check for loose or missing pipe and cable clamps, cotter pins, bolts, nuts and brackets	Section 3.3.1.1
		Inspect for oil and dirt deposits and corrosion	
		Inspect for cracked or broken welds	
		Inspect for any misalignment and deformation	
		Inspect for paint chafing, deterioration and condensation	
		Check safety bar and brackets, gear box safety stop, ATP junction box, traction motor safety bracket for mechanical integrity	
		Check all electrical and ground connections for corrosion and loose or missing fasteners	
		Check air piping for leakage	
	Truck Bolster	Check for loose or missing bolts, nuts, cotter pins, and mounting screws	Section 3.3.2.1
		Inspect for oil and dirt deposits and corrosion	
		Inspect for cracked or broken welds	
		Inspect for any misalignment and deformation	
		Inspect for paint chafing, deterioration and condensation	
		Inspect all rubber parts	
		Bolster anchor isolation rubber inspection	
		Inspect bolster anchor rod safety wire for wear	
		Inspect air reservoir drain plug	
		Inspect air suspension system for leakage	

Table 3-1. Scheduled Maintenance Action Index (cont'd.)

Maintenance Interval	Part Description	Scheduled Maintenance Task	Section 1200 Truck & Suspension Running Maintenance & Servicing Manual Section Reference
60,000 miles (cont'd.)	Leveling Valve	Visually inspect	Section 3.3.15.1
	Vertical Stop Collar (Blue, Expo and Green Lines Only)	Check collar thickness	Section 3.3.20
		Measure vertical stop bracket wear	
	Truck Bolster	Check air spring height	Section 3.3.2.2
	Wheels and Axles	Measure shunt resistance	Section 3.3.10.3
120,000 miles	Check Valve	Visually inspect	Section 3.3.12.1
	Cutout Cock	Visually inspect	Section 3.3.13.1
	Duplex Check Valve	Visually inspect	Section 3.3.14.1
	Air Filter	Visually inspect	Section 3.3.16.1
	Filter Element	Clean / replace air filter element	Section 3.3.17.1
	Slewing Bearing	Re-torque mounting bolts	Section 3.3.18.2
		Re-apply torque marks	
480,000 miles	Slewing Bearing	Remove slewing bearing and return to Kaydon for rebuild	Section 3.3.18.3
600,000 miles	Chevron Spring	Replace Chevron rubber elements	Section 3.3.4.2
	Air Spring	Replace air spring	Section 3.3.5.1
		Replace O-rings in upper plate	
		Replace O-rings in internal cylinder	
	Lateral Damper	Check for fluid leaks	Section 3.3.9.1
	Journal Bearing	Replace journal bearings	Section 3.3.3.2
	Check Valve	Overhaul	Section 3.3.12.2
	Duplex Check Valve	Overhaul	Section 3.3.14.2
	Leveling Valve	Overhaul	Section 3.3.15.2
600,000 miles or 5 years	Motor Truck Frame	Overhaul	Section 3.3.1.2 HRMM 3.2.1.7
	Motor Truck Bolster	Overhaul	Section 3.3.2.3 HRMM 3.2.2.7
	Center Truck Frame	Overhaul	Section 3.3.1.2 HRMM 3.3.1.7
	Center Truck Bolster	Overhaul	Section 3.3.2.3 HRMM 3.3.2.7

Table 3-1. Scheduled Maintenance Action Index (cont'd.)

Maintenance Interval	Part Description	Scheduled Maintenance Task	Section 1200 Truck & Suspension Running Maintenance & Servicing Manual Section Reference
Perform when de-trucked for other maintenance	Center Pivot Wear Plate	Inspect for wear or check when carbody height adjustments are required	Section 3.3.6
	Center Pivot Bushing	Check center pivot bushing for incorrect seating, abnormal appearance, excessive and uneven wear	Section 3.3.8
Truck Overhaul	Lateral Stop	Inspect the lateral stop	Section 3.3.7
	Wheels/Axle	Remove wheels and gearbox and other components from axle and visually inspect for damage	Section 3.3.10.4
	Truck Frame	Visually inspect welds	Section 3.3.1.2
	Truck Bolster	Visually inspect welds	Section 3.3.2.3

3.3 Scheduled Maintenance Procedures

3.3.1 Truck Frame

3.3.1.1 60,000 Mile Interval

Refer to Sections 3.2.1 and 3.3.1 of Section 1200, Truck and Suspension of the Heavy Repair Maintenance Manual for removal and installation of the truck frames.

Truck frame inspections include visual and physical checks of the frame members listed in Table 3-1. The following should be performed every 60,000 miles:

1. Check for loose or missing pipe and cable clamps, cotter pins, bolts, nuts and brackets. Repair or replace as required.

2. Inspect for oil and dirt deposits, corrosion, cracked or broken welds, misalignment, deformation, paint chafing or deteriorated paint. Clean or repair as required.

3. Tap frame members with a plastic headed hammer and listen for sounds which may indicate accumulations of condensation. Clean or repair as required.

4. Check the safety bar brackets, gear box safety stop, ATP Junction Box and Traction Motor safety bracket for mechanical integrity, cracks, misalignment or deformation. Repair or replace as required.

5. Check all electrical connections and ground connections for corrosion and loose or missing fasteners. Replace or tighten as required.

6. Check air piping for leakage.

3.3.1.2 Truck Frame Weld Inspection

The following should be performed when the truck is detrucked for any reason, including overhaul and maintenance of other components:

The truck frame should be visually inspected for broken or cracked welds. Note that the weld areas may need cleaned for visual inspection.

During overhaul the welds should be inspected using Non-Destructive Testing (NDT). Refer to Section 1200, Truck and Suspension of the Heavy Repair Maintenance Manual for the NDT weld inspection instructions.

3.3.2 Truck Bolster

3.3.2.1 60,000 Mile Interval

Bolster inspections include visual and physical checks of the components listed in Table 3-1. The following should be performed every 60,000 miles:

1. Check for loose or missing bolts, nuts, cotter pins, and mounting screws. Tighten or replace as required.

2. Inspect for oil and dirt deposits, corrosion, cracked or broken welds, misalignment, deformation, paint chafing or deteriorated paint. Clean or repair as required.

3. Inspect all rubber parts for cuts, cracks, wear damage, oil or heat damage, separation at joints, and puffy areas. Replace as required.

4. Inspect all rubber parts for paint chafing or deteriorated paint. Repaint as required.

5. Bolster anchor isolation rubber inspection includes checks for cracks and separation of rubber from the shaft. Cracks of 0.0394 in. (1.0mm) in depth or less are allowable. Shrinkage must not exceed 10% of new isolation rubber thickness. The design thickness is 3.346 in. (85mm). Replace as required.

6. Inspect the bolster anchor rod safety wire for wear at the wire entrance holes. Replace as required.

7. Remove the air reservoir drain plug and allow the accumulated moisture to drain from the reservoir. Inspect the air reservoir drain plug area for indications of air leakage and staining. Replace as required. Install the drain plug. Check the drain plug for leaks using a soap and water solution.

8. Inspect the air spring bellows for indications of leakage. Suspected air suspension system air leaks can be tested with a soap and water solution.

3.3.2.2 120,000 Mile Interval

Measure the distance gauge faces on the truck frame and bolster every 120,000 miles. See Figure 4-6. A properly adjusted leveling valve and bellows in good condition will have a measurement of 5.2 in. (132mm). Deviations from this dimension suggest a defective bellows, incorrect functioning of the air supply system, or a misadjusted leveling valve.

NOTE: Gauge height is dependent upon shims.

3.3.2.3 Truck Bolster Weld Inspection

The following should be performed when the truck is detrucked for any reason, including overhaul and maintenance of other components:

Welds of the truck bolster should be visually inspected for broken or cracked welds. Note that the weld areas may need cleaned for visual inspection.

During overhaul the welds should be inspected using Non-Destructive Testing (NDT). Refer to Section 1200, Truck and Suspension of the Heavy Repair Maintenance Manual for the NDT weld inspection instructions.

3.3.3 Journal Bearing

3.3.3.1 30,000 Mile Interval

Refer to Section 3.4.2 of Section 1200, Truck and Suspension of the Heavy Repair Maintenance Manual for removal and installation of the journal bearings.

The following should be performed every 30,000 miles:

1. Check the entire housing for discoloration, cracks or abnormal appearance. Replace if required. Refer to Section 1200, Truck and Suspension of the Heavy Repair Maintenance Manual.

2. Some grease leakage around the seals may be expected during the initial run-in period. This leakage will reduce to normal after the initial run-in period. When a bearing is found to be leaking excessively, consideration should be given to the date the bearing was last lubricated. If grease has been added recently, or more than once, the leakage can be attributed to an excessive amount of grease in the bearing.

3.3.3.2 600,000 Mile Interval

The following should be performed every 600,000 miles:

1. Thoroughly clean the outside surfaces of the bearings using a degreasing agent. Inspect the bearings as follows:

a. Check for excessive grease leakage. A small amount of leakage may be expected.

b. Visually inspect for a bent or damaged seal.

c. When a bearing is leaking excessively, check for a loose seal by attempting to turn the seal using the bit of a screwdriver as a probe.

d. Visually inspect the bearings for cracked or broken parts.

e. Check the bearing lateral play using a dial indicator, it should be between 0.001 – 0.020 in. (0.03 – 0.51mm).

f. Check for any undesirable condition such as noise or grinding when the bearings are rotated by hand.

g. If any defects are found, the defective bearings must be removed from the axles for disassembly, inspection, and repair.

3.3.3.3 After Derailment, Collision, or Subjected to Damage

1. Roller bearing assemblies on trucks involved in derailment or collision; or subjected to damage by fire, flood, or other causes are recommended be shopped for inspection before being returned to service per steps a through c below. Metro technically qualified personnel may evaluate each incident and determine the appropriate course of action.

a. Bearings must be removed from the axles and sent to a qualified facility for disassembly, cleaning and inspection.

b. After removal of the bearings, all axles must be placed in an axle lathe and checked to determine if they are bent. A bent axle will cause premature bearing damage due to the oscillation movement and uneven load distribution in the bearing.

c. Truck frames should also be inspected to see that they are not bent or distorted. Truck frames that are bent or distorted will impose undesirable loads on the bearing assembly that can cause premature bearing damage.

3.3.4 Chevron Spring

Refer to Sections 3.2.3 and 3.3.3 of Section 1200, Truck and Suspension of the Heavy Repair Maintenance Manual for removal and installation of the chevron springs.

3.3.4.1 30,000 Mile Interval

The following should be performed every 30,000 miles:

1. Visually inspect the chevron spring for loose or missing adjustment plates, mounting screws, pedestal beam and bolts.

3.3.4.2 600,000 Mile Interval

The following should be performed every 600,000 miles:

1. Replace the chevron springs.

3.3.5 Air Spring

Refer to Section 3.4.4 of Section 1200, Truck and Suspension of the Heavy Repair Maintenance Manual for air spring maintenance.

3.3.5.1 600,000 Mile Interval

The following should be performed every 600,000 miles:

1. Replace the air spring.

2. Replace the O-rings in the upper plate.

3. Replace the O-rings in the internal cylinder.

3.3.6 Center Pivot Wear Plate

Refer to Sections 3.2.2 and 3.3.2 of Section 1200, Truck and Suspension of the Heavy Repair Maintenance Manual for removal and installation of the center pivot wear plates.

The center pivot wear plate will normally be inspected when a truck is removed from the vehicle or when carbody height adjustments are required during car leveling. Refer to Section 4.2, Adjustments of this manual section.

Minimum wear plate thickness is 13mm. Wear plates should be renewed when truck is overhauled.

3.3.7 Lateral Stop

Refer to Sections 3.2.1 and 3.3.1 of Section 1200, Truck and Suspension of the Heavy Repair Maintenance Manual for removal and installation of the lateral stops.

The following should be performed during truck overhaul:

Inspection of the lateral stop consists of visual checks and physical measurement of the stop. The rubber bumper inspection includes checking for cracks, scaling and a decrease in thickness. The bumper should be replaced if cracks of 0.0394 in. (1mm) in depth or larger exist, if scaling between the rubber and mounting plate exceeds 5% of the bonded area, or if the thickness loss of the bumper exceeds 10% of new bumper thickness. The design thickness of a new bumper is 1.97 in. (50mm)

3.3.8 Center Pivot Bushing

Refer to Section 3.2.2 of Section 1200, Truck and Suspension of the Heavy Repair Maintenance Manual for removal and installation of the center pivot bushing.

The following should be performed when de-trucked:

Inspection of the center pivot includes visual checks and physical measurement of the bushing. Visually inspect for excessive and uneven wear, incorrect seating, and abnormal appearances. Physically measure the inside wear of the liner. The wear limit is 0.167 in. (4.25mm). New liner inside diameter is 6.693 in. (170mm). Max. bushing inside diameter is 4.157 in. (105.75mm).

3.3.9 Lateral Damper

Refer to Sections 5.2.1.1, 5.2.1.2, 5.3.1.1 and 5.3.1.2 of this manual section for removal and installation of the lateral dampers.

3.3.9.1 600,000 Mile Interval

The following should be performed every 600,000 miles:

The lateral damper should be inspected for fluid leaks. If there is any indication of fluid leakage, the damper should be replaced.

3.3.10 Wheel and Axles

Refer to Sections 3.4.1 of Section 1200, Truck and Suspension of the Heavy Repair Maintenance Manual for removal and installation of the wheels and axles.

3.3.10.1 10,000 Mile Interval

The following should be performed every 10,000 miles:

1. Visually inspect wheel centers, tires, and axles. Check for any developing cracks and defects.
2. Inspect wheel wear and flats.

3.3.10.2 30,000 Mile Interval

The following should be performed every 30,000 miles:

Inspect shunts and mounting hardware.

3.3.10.3 120,000 Mile Interval

The following should be performed every 120,000 miles:

Measure shunt resistance from tire to tire, it must be less than 0.01 ohms.

3.3.10.4 Truck Overhaul Interval

The following should be performed at every truck overhaul:

Remove wheels and gearbox (motor truck) and other components from axle. A full axle requalification is required including Mag Partical inspection, dimensional inspection and visual inspection for damage.

3.3.11 Wheel Tread and Flange Lubricator

WARNING

ALWAYS WEAR THE APPROPRIATE SAFETY EQUIPMENT SUCH AS EYE PROTECTION, WHILE PERFORMING MAINTENANCE ON APPLICATORS. THE CONSTANT FORCE SPRINGS USED WITHIN THE APPLICATORS HAVE SHARP EDGES. USE PROTECTIVE GLOVES WHILE INSPECTING SPRINGS.

THE INSERT IS UNDER SPRING FORCE FROM THE CONSTANT FORCE SPRING. TO PREVENT INJURY, PLACE ONE HAND OVER THE CLOSED END OF THE INSERT BEFORE REMOVING THE LOCK PIN FROM THE APPLICATOR BODY.

Refer to Sections 5.2.1.8 and 5.3.1.8 of this manual section for the removal and installation of the wheel tread and flange lubricators.

3.3.11.1 Routine Applicator Maintenance

The following is considered routine maintenance and should be carried out during applicator refilling or regular service intervals:

1. Remove the end of the lock pin wire from the end of the lock pin and withdraw the insert from the applicator tube.

2. Inspect the lock pin, applicator tube (outer housing) and insert for wear. Replace worn parts as required.

3. The spring must be inspected for wear and/or damage, and should be replaced if required. The following spring inspection procedure should be followed to examine the constant force spring:

   - Uncoil the spring towards the rear of the insert and hold in this position. Note: Allowing the spring to recoil suddenly will cause damage, resulting in premature spring failure.
   - Clean off the top surface of the spring.
   - Visually inspect along the length of the spring for hairline cracks, worn areas from stick chaffing, or evidence of the spring rubbing on the insert.
   - Check the “rivet on” section of the spring, at the bend, for fatigue or cracking.
   - Gently return the spring to the coiled position.

4. Inspect the applicator tube (outer housing) for cracks or flaring at the delivery end due to wheel contact. If cracks or flaring are present, replace the tube. If wheel contact is evident, repair the tube if possible or replace if the damage is too severe. Clean off any debris (dirt, sand, oil, etc.) that may have accumulated on the insert or inside the applicator tube.

5. Check the LCF applicator position with respect to the wheel flange. Refer to Section 3.3.11.2, LCF Applicator Alignment Instructions of this manual section.

6. Check the HPF applicator position with respect to the wheel tread. Refer to Section 3.3.11.3, HPF Applicator Alignment Instructions of this manual section.

7. Install the insert ensuring that it slides in freely and is able to move in and out freely.

NOTE: In order to test for free movement of the stick inside the applicator, place an index finger from each hand onto the side of the protruding section of stick at the delivery end of the applicator. Pull the stick back and release quickly. If the stick is free and unhindered, it will snap back into its original position rapidly and contact the wheel surface.

8. Check that the LCF and HPF sticks are making contact with the wheel and that they are able to move in and out of the applicators freely against the spring pressure. In the event of the sticks not moving freely, check for the following:

   - Applicator damage – Closely inspect the delivery end of the applicator for any deformation or burrs. If there is damage present it is recommended that the applicator be replaced.
   - Insert orientation - If the insert does not move freely, remove and re-insert, making sure the insert is oriented properly.

3.3.11.2 LCF Applicator Alignment Instructions

1. Applicator Angle of Attack

It is critical that the dispensing end of the applicator is directed at the contact patch of the wheel flange as shown in the figure below.

The angle that is made between the applicator and the flat on the back of the wheel should be: $\theta = 43°$

2. Flange to Applicator Spacing

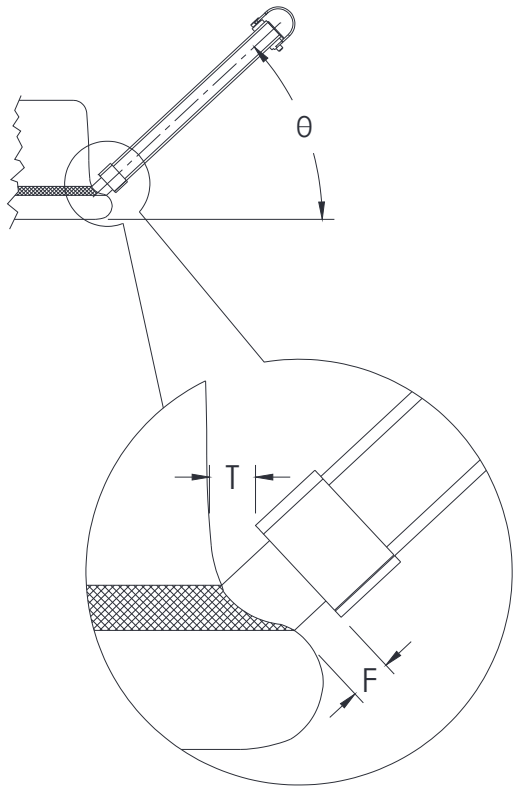
The recommended distance between the dispensing end of the applicator and the wheel flange is as per dimension “F” and “T” shown in the figure below, where:

F = 9.9 mm $^{+2}_{-0}$

T = 10.8 mm $^{+2}_{-0}$

Deviation from this specified range can lead to applicator damage, resulting in reduced product benefits.

The LCF applicator to wheel flange spacing can also be set with an alignment tool. Refer to Section 5.3.1.8 of this manual section for alignment instructions. The alignment tool model G3080000/A is designed specifically for the P3010 LRVs.



3.3.11.3 HPF Applicator Alignment Instructions

1. Applicator Angle of Attack / Position

It is critical that the dispensing end of the applicator is directed at the contact band of the wheel tread as shown in the figure below.

The applicator must be positioned at an angle that is between line 1 (90 degrees to the wheel tread), and line 2 (Parallel with the back of the wheel).

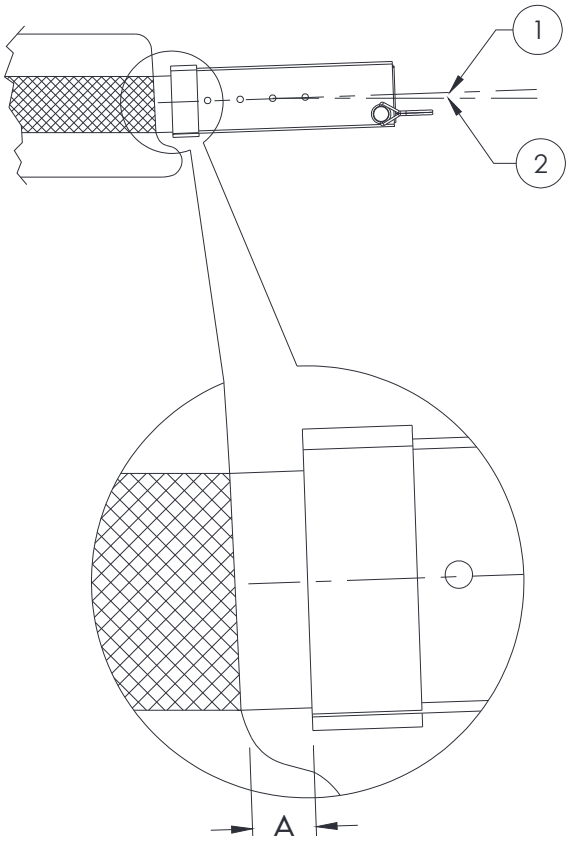
2. Tread to Applicator Spacing

The distance between the dispensing end of the applicator and the wheel tread should be as per dimension “A” shown in the figure below.

A = 14.7 mm $^{+2}_{-0}$

Deviation from this specified range can lead to applicator damage, resulting in reduced product benefits.

The HPF applicator to wheel tread spacing can also be set with an alignment tool. Refer to Section 5.3.1.8 of this manual section for alignment instructions. The HPF alignment tool model G3070000/A is designed specifically for the P3010 LRVs.



3.3.12 Check Valve

Materials Needed:

- Leak detector

3.3.12.1 120,000 Mile Interval

The following should be performed every 120,000 miles:

1. Inspect check valve (1) for obvious visible damage such as dents, scratching, scoring, corrosion, or missing parts. If excessively damaged or missing parts, replace check valve. See Figure 3-1.

2. With brake system pressurized, apply leak detector to pipe connections (2) of check valve (1).

WARNING

HIGH AIR PRESSURE IS VENTED WHEN CUTOUT COCK IS CLOSED. WEAR SAFETY GOGGLES AND EAR PROTECTION AND EXERCISE CAUTION. FAILURE TO COMPLY MAY RESULT IN INJURY.

3. If bubbles form at pipe connections (2) turn off power to air supply unit, vent air suspension pressure by looking at the indicator on the handle for the appropriate supply cutout valve and reposition the valve handle so that the indicator is perpendicular to the piping and the valve is closed, then disconnect and reseal vehicle pipe connections.

4. Remove all traces of leak detector immediately after test.

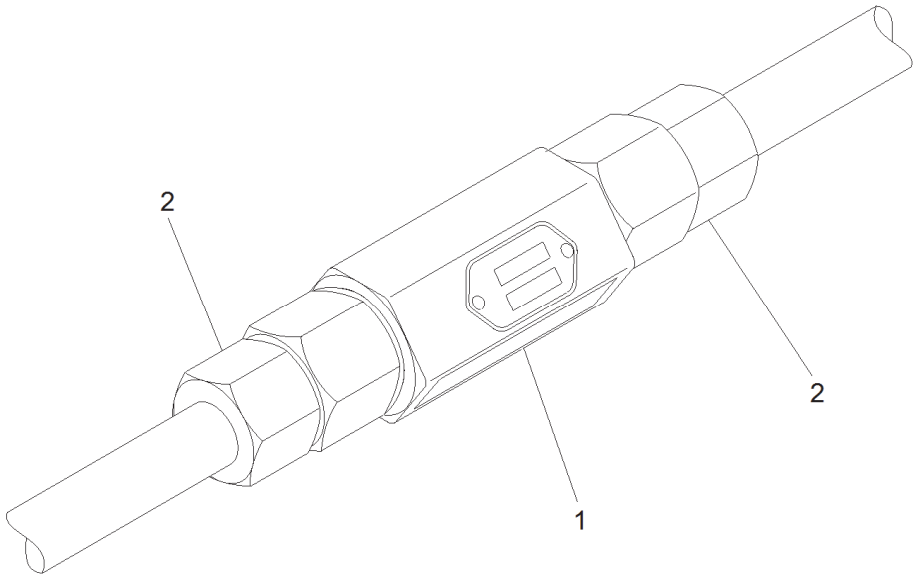


Figure 3-1: Check Valve Inspection

3.3.12.2 600,000 Interval

The following should be performed every 600,000 miles:

Overhaul check valve (1). Refer to Section 3.4.8 of Section 1200, Truck and Suspension of the Heavy Repair Maintenance Manual.

3.3.13 Cutout Cock

Materials Needed

- Leak detector

3.3.13.1 120,000 Mile Interval

The following should be performed every 120,000 miles:

1. Check Suspension Supply Cutout Cock (1) for obvious visible damage such as dents, scratching, scoring, corrosion, or missing parts. If excessively damaged or missing parts, replace Cutout Cock. See Figure 3-2.
2. With brake system pressurized, apply leak detector to pipe connections (2), vent port (3), and body seams of Cutout Cock (1).
3. If bubbles form at pipe connections (2), close Cutout Cock (1) to vent the appropriate air spring pressure and disconnect and reseal vehicle pipe connections.
4. If bubbles form at vent port (3) or body seams, replace Cutout Cock (1).
5. Remove all traces of leak detector immediately after test.

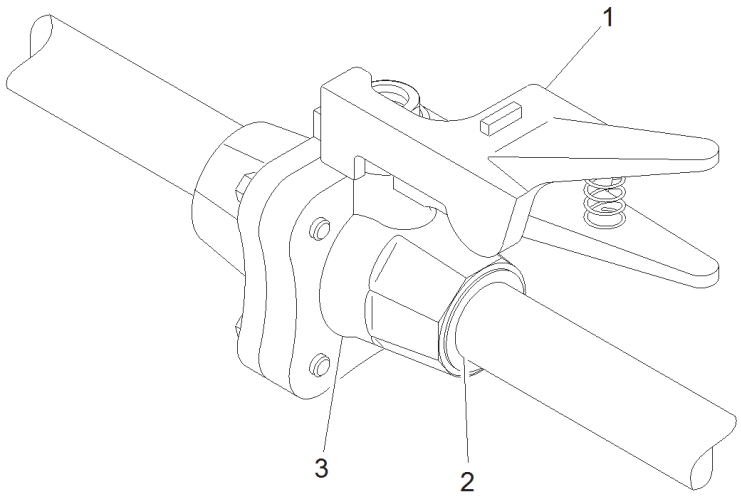


Figure 3-2: Cutout Cock Inspection

3.3.14 Duplex Check Valve

Materials Needed

- Leak detector

3.3.14.1 120,000 Mile Interval

The following should be performed every 120,000 miles:

1. Check duplex check valve (1) for obvious visible damage such as dents, scratching, scoring, corrosion, or missing parts. If excessively damaged or missing parts, replace duplex check valve. See Figure 3-3.

2. With brake system pressurized, apply leak detector to pipe connections (2) and body seams of duplex check valve (1).

WARNING

HIGH AIR PRESSURE IS VENTED WHEN CUTOUT COCKS ARE CLOSED. WEAR SAFETY GOGGLES AND EAR PROTECTION AND EXERCISE CAUTION. FAILURE TO COMPLY MAY RESULT IN INJURY.

3. If bubbles form at pipe connections (2), turn off power to air supply unit, vent air suspension pressure by looking at the indicator on the handle for the appropriate supply cutout valve and reposition the valve handle so that the indicator is perpendicular to the piping and the valve is closed, then disconnect and reseal vehicle pipe connections.

4. If bubbles form at body seams, replace duplex check valve.

5. Remove all traces of leak detector immediately after test.

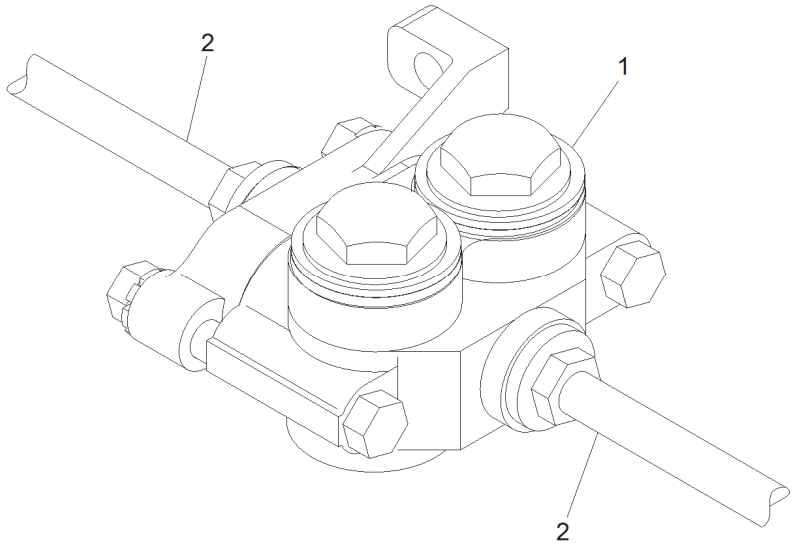


Figure 3-3: Duplex Check Valve Inspection

3.3.14.2 600,000 Mile Interval

The following should be performed every 600,000 miles:

Overhaul duplex check valve (1). Refer to Section 3.4.9 of Section 1200, Truck and Suspension of the Heavy Repair Maintenance Manual.

3.3.15 Leveling Valve

Materials Needed:

- Leak detector

3.3.15.1 60,000 Mile Interval

The following should be performed every 60,000 miles:

1. Check leveling valve (1) for obvious visible damage such as dents, scratching, scoring, corrosion, or missing parts. If excessively damaged or missing parts, replace leveling valve. See Figure 3-4.

2. With brake system pressurized, apply leak detector to pipe connections (2) and body seams of leveling valve (1).

WARNING

HIGH AIR PRESSURE IS VENTED WHEN CUTOUT COCKS ARE CLOSED. WEAR SAFETY GOGGLES AND EAR PROTECTION AND EXERCISE CAUTION. FAILURE TO COMPLY MAY RESULT IN INJURY.

3. If bubbles form at pipe connections (2), turn off power to air supply unit, vent air suspension pressure by looking at the indicator on the handle for the appropriate supply cutout valve and reposition the valve handle so that the indicator is perpendicular to the piping and the valve is closed, then disconnect and reseal vehicle pipe connections.

4. If bubbles form at body seams, replace leveling valve.

5. Remove all traces of leak detector immediately after test.

3.3.15.2 600,000 Mile Interval

The following should be performed every 600,000 miles:

Overhaul leveling valve (1). Refer to Section 3.4.7 of Section 1200, Truck and Suspension of the Heavy Repair Maintenance Manual.

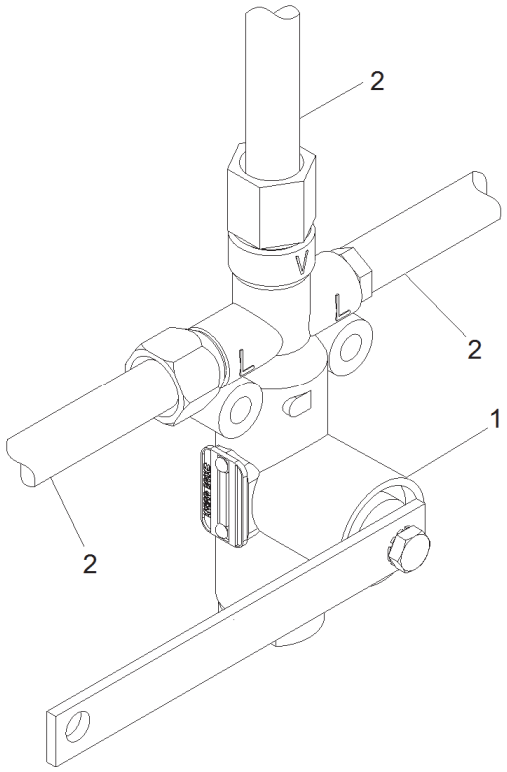


Figure 3-4: Leveling Valve Inspection

3.3.16 Air Filter

Materials Needed:

- Leak detector

3.3.16.1 120,000 Mile Interval

The following should be performed every 120,000 miles:

1. Check LA2100 air filter (1) for obvious visible damage such as dents, scratching, scoring, corrosion, or missing parts. If excessively damaged or missing parts, replace LA2100 air filter. See Figure 3-5.

2. With brake system pressurized, apply leak detector to pipe connections (2) of LA2100 air filter (1).

WARNING

HIGH AIR PRESSURE IS VENTED WHEN BALL VALVE IS CLOSED. WEAR SAFETY GOGGLES AND EAR PROTECTION AND EXERCISE CAUTION. FAILURE TO COMPLY MAY RESULT IN INJURY.

3. If bubbles form at pipe connections (2), turn off power to air supply unit, vent pressure in the circuit by looking at the indicator on the handle for the appropriate supply cutout valve and reposition the valve handle so that the indicator is perpendicular to the piping and the valve is closed, then disconnect and reseal vehicle pipe connections.

4. Remove all traces of leak detector immediately after test.

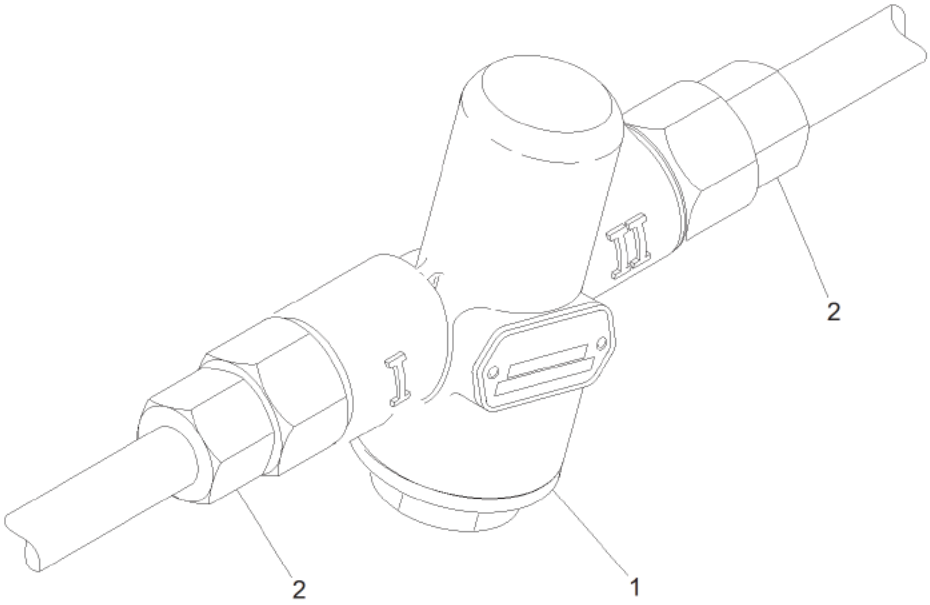


Figure 3-5: LA2100 Air Filter Inspection

3.3.17 Replace Filter Element

Equipment Conditions:

- Wheels chocked
- Holding Brakes applied
- Remove power to ASU

Materials Needed

- Mineral spirits
- Renolit HLT2-KB grease

3.3.17.1 120,000 Mile Interval

The following should be performed every 120,000 miles:

1. Vent pressure in the circuit by looking at the indicator on the handle for the appropriate supply cutout valve and reposition the valve handle so that the indicator is perpendicular to the piping and the valve is closed. See Figure 3-6. Refer to Section 3.19 of Section 1300, Friction Brakes of the Heavy Repair Maintenance Manual.

WARNING

LA2100 AIR FILTER CONTAINS SPRING LOADED FILTER ELEMENT. EXERCISE CAUTION WHEN REMOVING SCREW PLUG. FAILURE TO COMPLY CAN LEAD TO INJURY.

2. Remove screw plug (1) with O-ring (2), compression spring (3), and filter element (4) from housing (5). Discard O-ring (2).

WARNING

SOLVENTS AND SOLVENT FUMES CAN BE HARMFUL TO HEALTH. WHEN USING SOLVENTS, WEAR EYE, SKIN, AND RESPIRATORY PROTECTION. WORK IN WELL VENTILATED AREA. AVOID REPEATED OR PROLONGED CONTACT. KEEP SOLVENT CONTAINER CLOSED. KEEP SOLVENT AWAY FROM SPARKS, FLAMES, AND HEAT. FAILURE TO OBSERVE THESE SAFETY PRECAUTIONS CAN LEAD TO INJURY OR INTOXICATION.

WARNING

CLEANING USING COMPRESSED AIR CAN CAUSE DIRT PARTICLES TO BECOME AIRBORNE. WEAR EYE PROTECTION WHEN CLEANING WITH COMPRESSED AIR TO AVOID INJURY. DO NOT EXCEED 30 PSI. FAILURE TO COMPLY CAN LEAD TO INJURY.

3. Replace or clean filter element (4) in mineral spirits and blow dry with compressed air. Refer to Section 3.19 of Section 1300, Friction Brakes of the Heavy Repair Maintenance Manual.

4. Lightly lubricate replacement O-ring (2) with Renolit HLT2-KB grease.

5. Insert filter element (4), compression spring (3), O-ring (2), and screw plug (1) in air filter. Tighten screw plug securely.

6. Re-pressurize air lines by looking at the indicator on the cutout valve handle for the appropriate cutout cock and repositioning the valve handle so that the indicator is parallel to the piping and the valve is open.

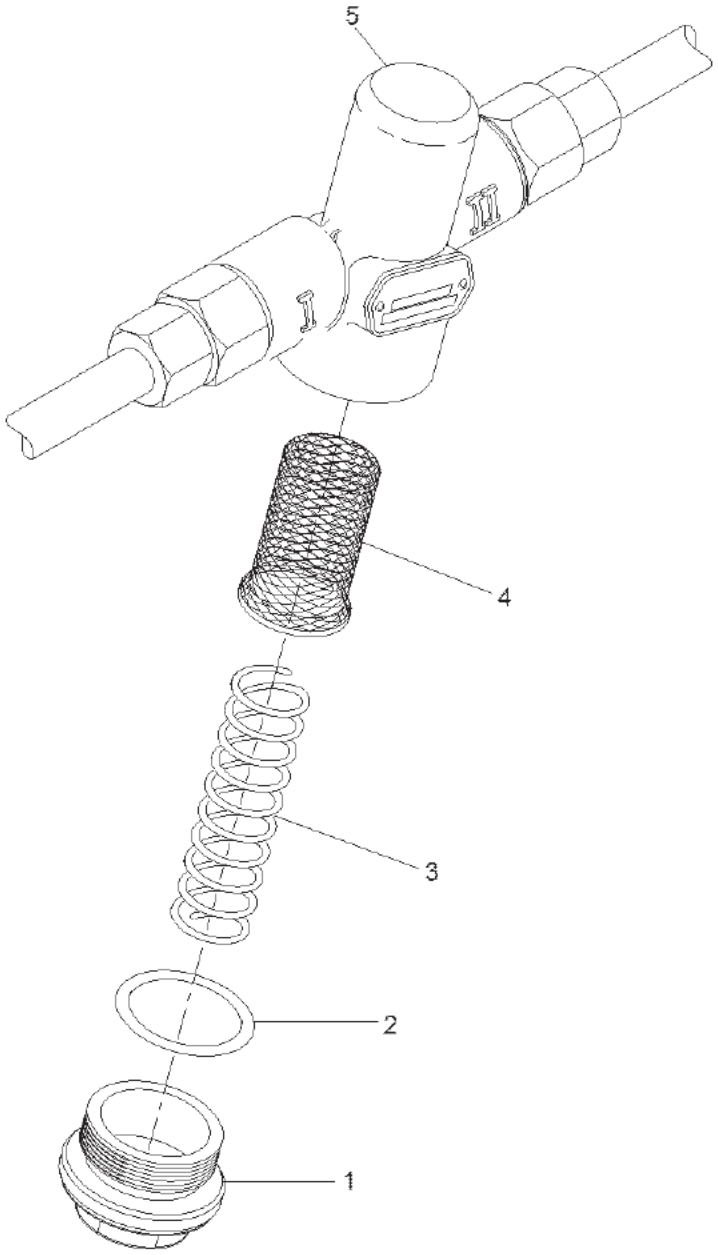


Figure 3-6: Air Filter Element

7. Apply leak detector and test air filter for leakage around screw plug (1) and at vehicle pipe connections.

8. Tighten joints where bubbles form.

9. Remove all traces of leak detector immediately after test.

10. Reapply power to air supply unit at circuit breaker.

3.3.18 Slewing Bearing

3.3.18.1 30,000 Mile Interval

The following should be performed every 30,000 miles on a high rail:

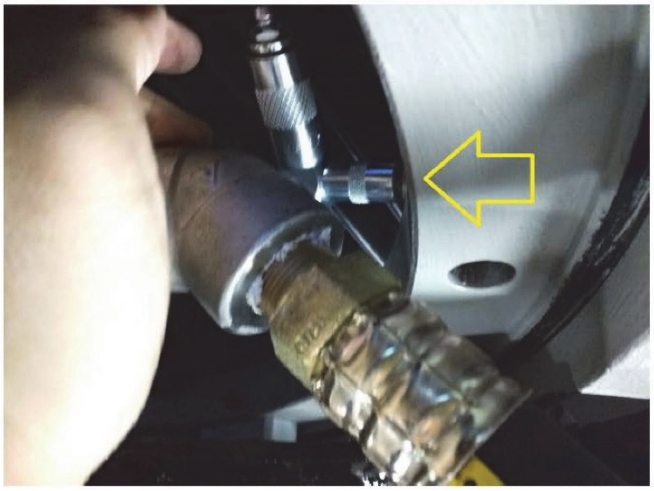
CAUTION

ALWAYS KEEP BOLTS PROPERLY TIGHTENED. FAILURE TO KEEP BOLTS PROPERLY TIGHTENED MAY LEAD TO FATIGUE FAILURE OF BOLTS AND CONSEQUENT BEARING OR BOLSTER DAMAGE.

1. Visually inspect the torque marks on the twelve mounting bolts on the center race of the slewing bearing. These twelve bolts are accessible from the bottom of the slewing bearing under the truck. Replace any bolts with broken torque marks with new hardware. Torque replaced bolts to 217 Nm (160 ft-lbs.) and replace torque marks as necessary. The speed sensor and ground cables may be temporarily disconnected for ease of access for the large torque wrench. Monitor and reinspect any replaced bolts.

2. Grease each of the twelve grease fittings (six on the I.D. and six on the O.D.). The OEM grease is Lithium Grease EP-1 supplied by Varouh Oil Inc. Equivalent alternatives include Energrease LS-EP 1 supplied by BP, HD Lithium 1 supplied by Castrol, and Dura-Lith EP 1 supplied by Chevron.

   The grease should be applied to each of the twelve grease fittings until clean grease can be seen venting at the seals. Use a mirror / light to confirm. To facilitate greasing, a grease gun with a flexible hose and a 90-degree extension with a locking quick-disconnect tip should be used at fittings with low clearance to truck hoses and pipes. Replace any missing dust caps. See the graphic below.



3.3.18.2 120,000 Mile Interval

The following should be performed every 120,000 miles on a high rail:

Re-torque the twelve mounting bolts located on the center race of the slewing bearing to 217 Nm (160 ft-lbs.). Re-apply torque marks. Refer to Section 3.3.18.1 of this manual section for additional information.

3.3.18.3 480,000 Mile Interval

The following should be performed every 480,000 miles:

Remove the slewing bearing and return to Kaydon for rebuild and recertification. For slewing bearing removal and installation instructions, refer to Section 1200, Truck and Suspension of the Heavy Repair Maintenance Manual.

3.3.19 Sanding Nozzle

3.3.19.1 Every Two Weeks

The following should be performed every two (2) weeks:

1. Inspect the nozzles to check for any debris build-up. Clean if necessary, using a stiff-bristled tube cleaner brush.

2. Visually inspect for any impact damage and cracks around the mounting points of the nozzles. Replace if necessary.

3. Check the tightness of the fasteners. Tighten if necessary.

3.3.19.2 10,000 Mile Interval

The following should be performed every 10,000 miles:

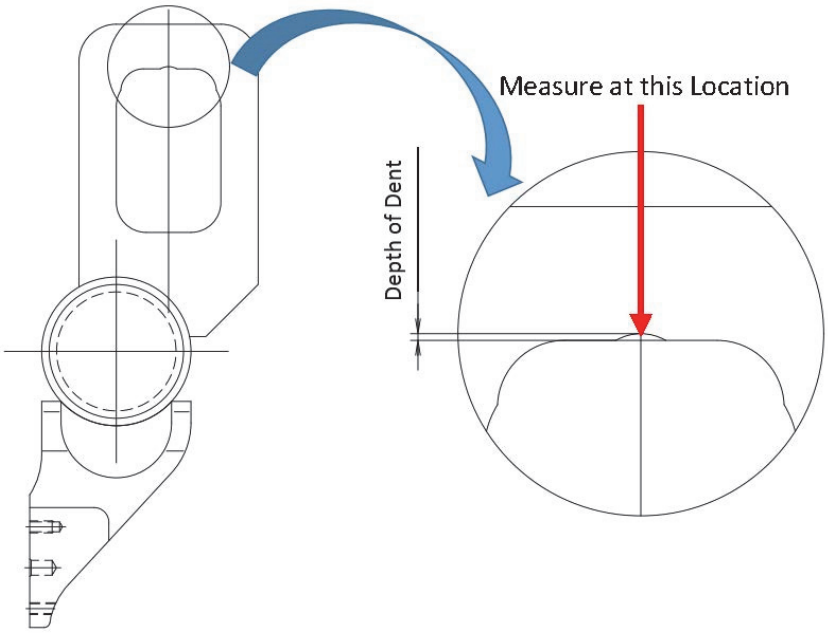
1. Check nozzle alignment and height, adjust if necessary.
2. Visually inspect the bracket for signs of corrosion and fatigue cracks.
3. Check tightness of all bracket mounting fasteners. Tighten to installation specifications if necessary.

3.3.20 Vertical Stop Collars

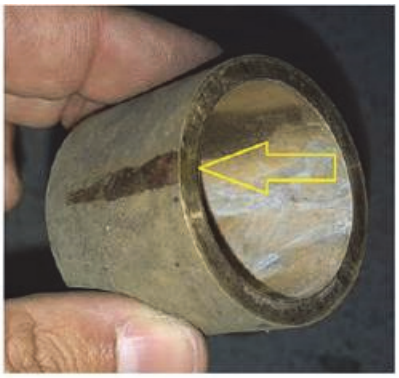
3.3.20.1 30,000 Miles (Gold Line)

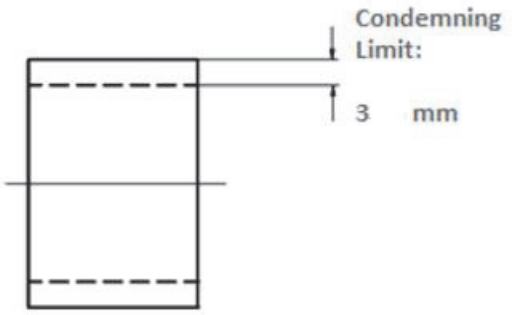
The following should be performed every 30,000 miles at the Gold Line:

1. Remove vertical stop collars and use calipers to check thickness per figure below.
2. Replace vertical stop collars when the thickness of the impacted section reaches 3.0mm.
3. Inspect the vertical stop bracket to ensure the wear is below 4mm. Refer to Appendix B of Section 1200, Truck and Suspension of the Heavy Repair Maintenance Manual for repair instructions if the wear is greater than 4mm.



4. Follow installation instructions given in Sections 5.3.1.3 or 5.3.1.4 (Motor / Center Truck Bolster Safety Stop Installation).





3.3.20.2 60,000 Miles (Blue, Expo, Green Lines)

The following should be performed every 60,000 miles at the Blue, Expo and Green Lines:

1. Remove vertical stop collars and use calipers to check thickness per figure below.

2. Replace vertical stop collars when the thickness of the impacted section reaches 3.0mm.

3. Inspect the vertical stop bracket to ensure the wear is below 4mm. Refer to Appendix B of Section 1200, Truck and Suspension of the Heavy Repair Maintenance Manual for repair instructions if the wear is greater than 4mm.

4. Follow installation instructions given in Sections 5.3.1.3 or 5.3.1.4 (Motor / Center Truck Bolster Safety Stop Installation).

CHAPTER 4.0

CORRECTIVE ACTION & ADJUSTMENTS

4.1 Introduction

This chapter provides inspection and adjustments for the truck and suspension components.

4.2 Adjustments

4.2.1 Truck Height Adjustment

Truck height (measured from the rail top to the bolster top) is primarily adjusted by replacement or shimming of the chevron springs, shimming the air springs or replacement of the truck wheels. The replacement of wheels is not within the scope of this chapter. The replacement and shimming of chevron springs and air springs is covered as part of the truck assembly procedures. Truck height can only be altered in the process of truck assembly or truck tear-down to the axles.

4.2.2 Air Spring Shimming/Adjustment

Car height can further be compensated for by the addition of adjustment plates (shims) under the air spring. A maximum of four (4) adjustment plates can be used under any air spring based on the wheel diameter. The wheel diameter is entered at the maintenance screen on the TOD. See Figure 4-1. The adjustment plates measure 0.196 in. (5mm) thick. When an adjustment plate is added under the air spring, the adjusting rod of the leveling valve must be moved up to the next hole and the special pin/special washer must be rotated to achieve the same vertical clearance as the original (new wheel) setting. See Figures 4-2 and 4-6.

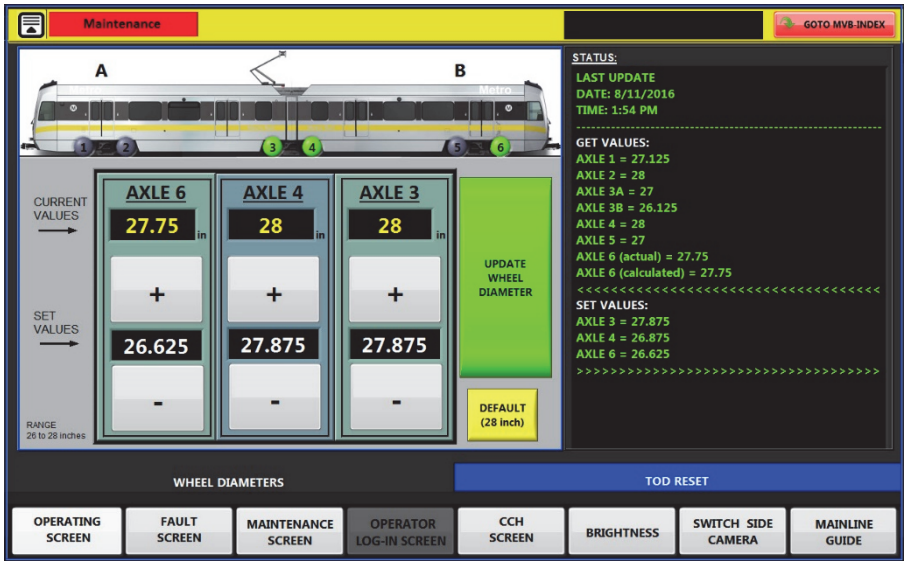


Figure 4-1: TOD Maintenance Screen

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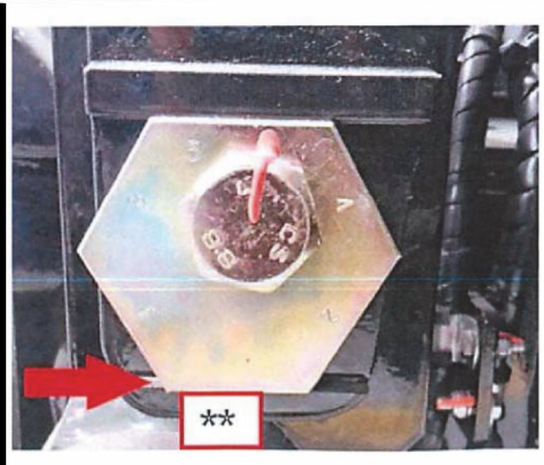
Metro	Shimming Requirements Based on Current Average Wheel Size				
Average Wheel Size	28.25"-27.598" (717 – 701 mm)	27.597"-27.204" (700 -691 mm)	27.203"-26.811" (690-681 mm)	26.810"-26.417" (680-671 mm)	26.416"-26.00" (670-660 mm)
Required Air Spring Height *	132 mm	137 mm	142 mm	147 mm	152 mm
Special Nut/Washer Position **	1	2	3	4	5
Linkage Rod Lower Mounting Hole ***	*	1	2	3	4
Number of Shims Required Under Air Spring	0	1	2	3	4

* Air Spring Height is Measured from the Upper Pad to the Lower Pad. See Picture Below. *

** Special Nut/Washer is Stamped with *, 1,2,3,4 and 5. Align the Proper Number Against the Bottom Stop. See Picture Below. **

*** There Are Six Holes for the Leveling Valve Linkage Rod Bottom End to be Mounted Into. See Picture Below. ***



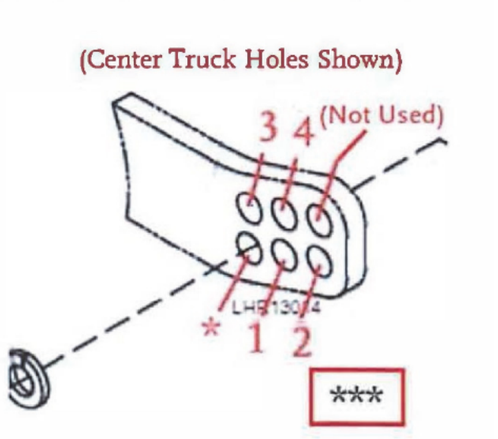


Figure 4-2: Air Spring Shimming / Adjustment

1. Place the vehicle on the carbody hoist.

2. Disconnect the air supply from the main reservoir by looking at the indicator on the main reservoir cutout cock valve handle and repositioning the valve so that the indicator is perpendicular to the piping and the valve is closed. See Figure 5-7.

3. Release the parking brake by using the manual release handle.

4. Disconnect the leveling valve adjusting rods at the lower (truck frame) side. Refer to Section 5.2.1.11 of this manual section. Lower the leveling valve lever to exhaust the air in both air springs.

NOTE: To access the air springs, first remove the lateral damper, bolster anchors and safety stops. Refer to Sections 5.2.1.1 through 5.2.1.4 of this manual section and also Section 3.2.4.5 of the Trucks and Suspension Heavy Repair Maintenance Manual Section.

5. Lift the carbody and truck bolster to ensure sufficient work space to insert the shim(s) under the air spring. See Figures 4-3.

6. Lift the air spring and insert shims based on the wheel diameter. See Figures 4-2 and 4-3.

7. Reconnect the lateral damper, bolster anchors and safety stops. Refer to Sections 5.3.1.1 through 5.3.1.4 of this manual section and Section 3.2.4.10 of the Trucks and Suspension Heavy Repair Maintenance Manual.

8. Connect the leveling valve adjusting rods. Refer to Section 5.3.1.11 of this manual section.

9. Connect the air supply to the air spring by looking at the indicator on the cutout valve handle and repositioning the valve handles so that the indicator is parallel to the piping and the valve is open.

4.2.3 Lateral Stop Adjustment

Lateral stop adjustment consists of adding adjustment plates to the stop as the rubber bumper portion of the stops wear. The critical measurement is between the truck bolster and the contact side of the stop. The measurement must be 0.39 ± 0.078 in. (10 ± 2mm). See Figure 4-4.

The adjusting plates, 0.063 in. (1.6mm), 0.091 in. (2.3mm) and 0.177 in. (4.5mm), are installed behind the rubber portion of the stop. The stop need not be removed should the addition of adjusting plates be required, since the adjusting plates are open on one end and can be inserted by loosening the stop mounting bolts.

Figure 4-3: Shimming

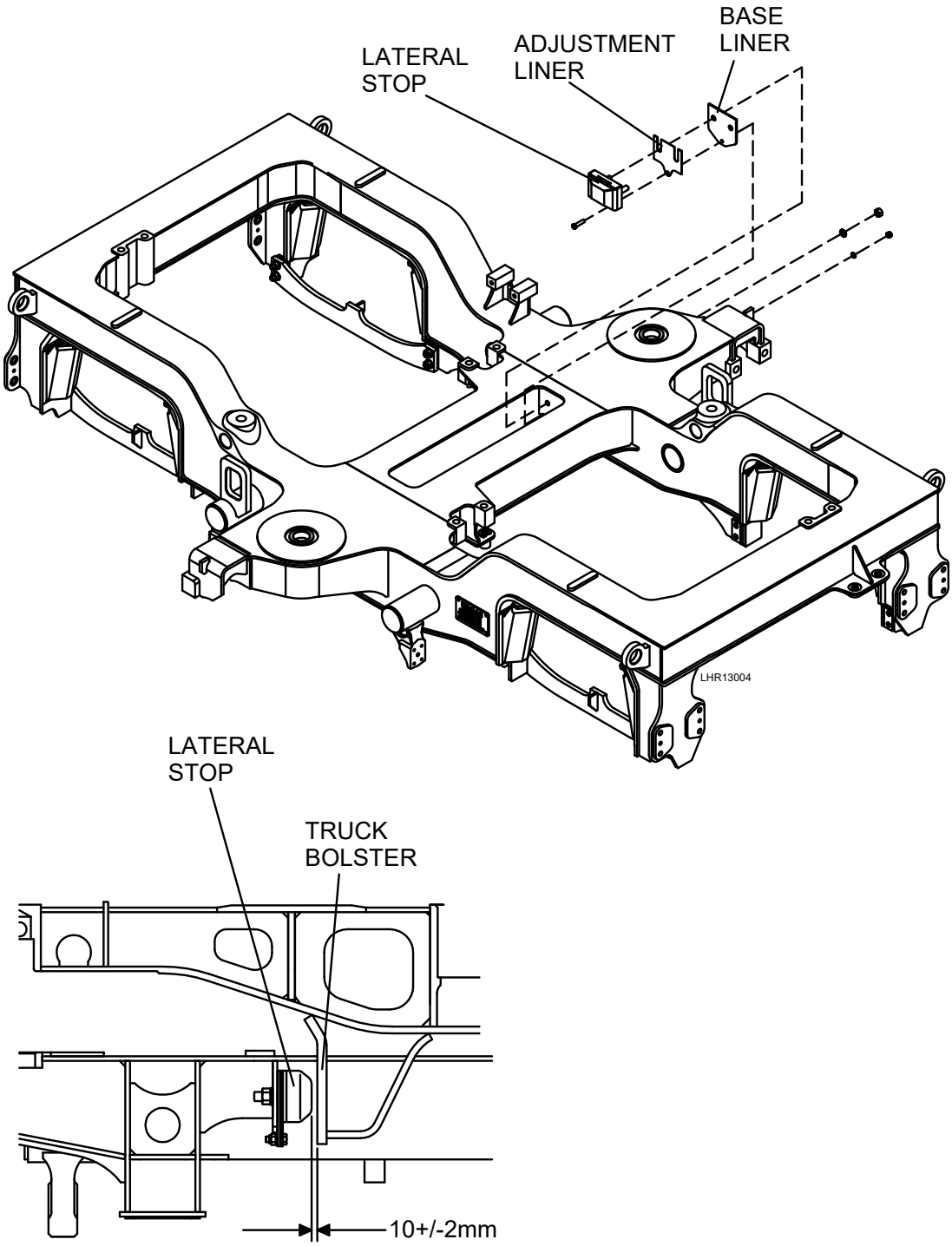


Figure 4-4: Lateral Stop Adjustment

4.2.4 Track Brake Height Adjustment

The track brake height over the top of rail is adjusted as follows:

1. Loosen lock nuts and back off several turns. See Figure 4-5.

2. With vehicle on straight and level track, adjust height of track brake magnet to 0.315 in. (8mm) over top of rail, by turning adjusting nut in appropriate direction. Repeat procedure at opposite end of track brake.

3. Tighten lock nuts and check track brakes for free movement and proper height.

4.2.5 Disc Brake Adjustment

Disc brake adjustments are covered in Section 1300, Friction Brakes of the Running Maintenance and Servicing Manual.

4.3 Car Leveling Procedures

The purpose of car leveling is to keep the car floor height constant under all passenger loads and wear conditions, and to keep the height of couplers within gathering range.

NOTE: Car leveling and car height adjustment should include the review of car and truck history, prior to selecting the method of correction or troubleshooting of leveling and height problems.

Car leveling procedures include the leveling of the car through adjustment of the air spring suspension system, and the raising of car floor height through adjustment of center pivot height. Car height may additionally be raised through shimming the truck chevron springs, the replacement of chevron springs, or the replacement of wheels, which will raise truck height.

1. Leveling Guidelines:

Carbody height cannot be raised through adjustment of the air suspension system. However, an incorrectly adjusted system will alter car height. Inspection of the height gage will provide a rapid indication of the suspension adjustment condition, and the need for readjustment.

2. Conditions Required for Car Leveling:

a. The car must be trucked with the air suspension supply lines connected.

b. The vehicle must be on a level tangent track.

c. The vehicle air supply system must be charged and maintained at operating pressure (130-150 psi).

d. Ensure no personnel or sizeable tools or equipment are on the car (the car should be empty before beginning this procedure).

e. Allow the system to stabilize for at least five (5) minutes before beginning.

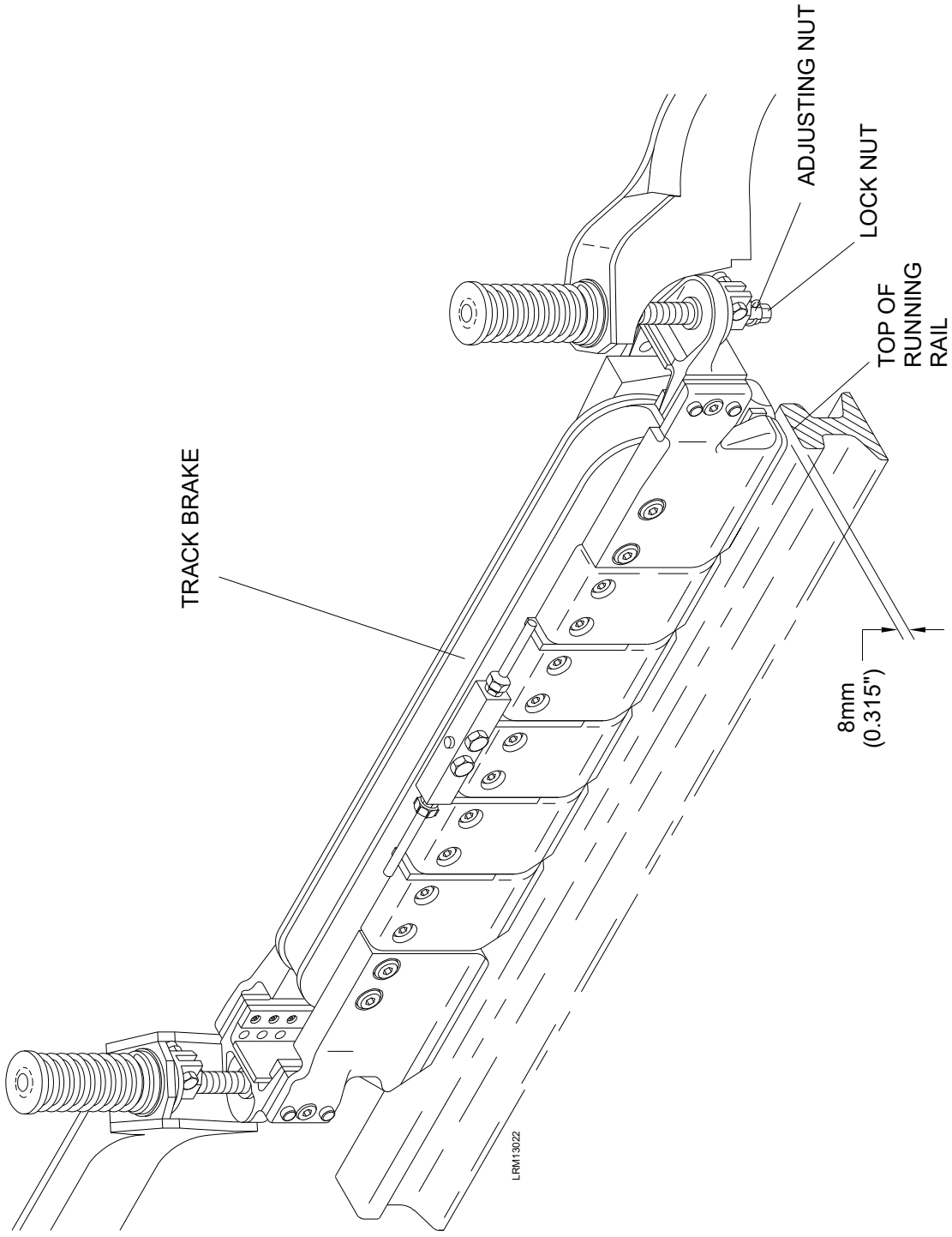
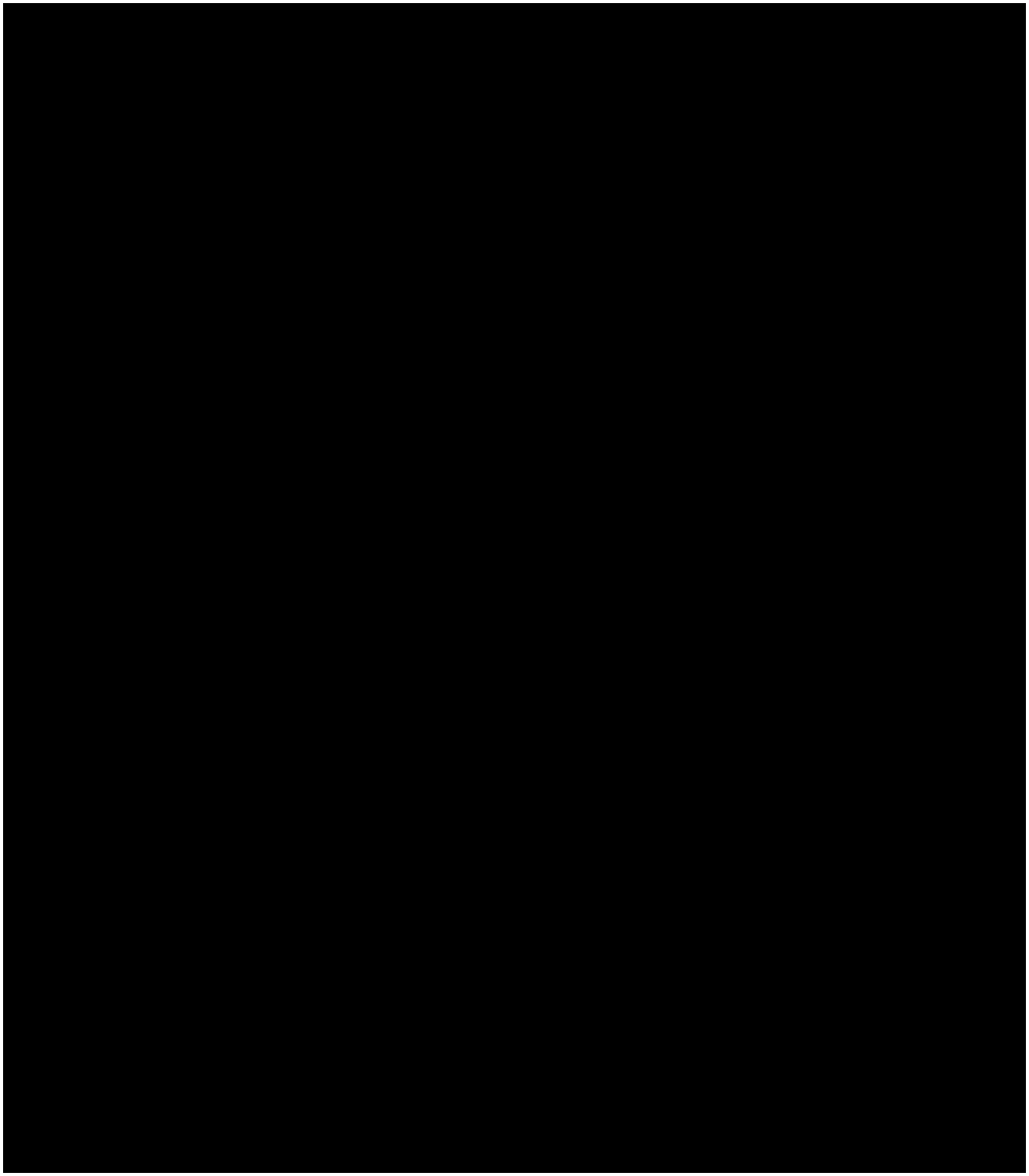


Figure 4-5: Adjustment of Track Brake Height

3. Adjusting Air Spring Height:

a. Check the height gages on each truck. See Figure 4-6. If the measurements are 5.2 inches (132mm), the air springs are at the correct height. Note that if the trucks are shimmed, the dimension must be 5.2 inches (132mm) plus the thickness of the shims.



b. If any indicator is not at 5.2 +/- 0.4 inches (132 +/- 1mm), adjust as follows:

(1) Adjust the clearance between air spring gage faces of each side of the truck to 5.512 inches (140mm) by turning the adjusting rod.

(2) Turn the adjusting rod to exhaust air until the clearance at the gage point is 5.3 inches (135mm). Note that this is done incrementally to each side.

(3) Turn the adjusting rod to exhaust air again, until the clearance between the gage points is 5.2 inches (132mm). Again, this adjustment must be done incrementally on both sides.

(4) After the gage height of 5.2 +/- 0.04 inches (132 +/- 1mm) is reached on both sides, rotate the adjusting rod in the opposite direction until the leveling valve arm is level or in the neutral position. If you charge the air spring you have moved the arm too far and the procedure must be repeated.

(5) Confirm on all trucks on both sides that the gage point dimension is 5.2 +/- 0.04 inches (132 +/- 1mm).

(6) Tighten the lock nuts on the adjusting rod shaft. Reconfirm on both sides that the gage point dimension is 5.2 +/- 0.04 inches (132 +/-mm).

4. Measure Carbody Floor Height:

a. Place one Ø2.00 x 2.00 high (50.8mm) spacer in the floor doorway and one spacer in the opposite doorway.

b. Place an inflexible angle iron or similar rigid bar on top of the two spacers. (see figures below)

c. Lay a second inflexible angle iron or similar rigid bar on top of the rails. (see figure below)

d. Measure the height of both doorways, using a steel tape measure, between the top surface of the first and second bar's top surface. (see figure below)

e. Record the value adjusting the measurement to compensate for the thickness of the angle iron and deducting the height of the spacer. The nominal dimension should be 996 +4 / -14 mm.

4.4 Wheel Tolerance

New wheels paired on an axle assembly shall be within 0.012 in. (0.31mm) of each other. Axle to axle on same truck wheel diameter difference shall be limited to 0.250 in. (6.35mm). Trued wheels paired on an axle assembly shall be within 0.080 (2.03mm) of each other. The reference wheel diameter should be updated on the TOD maintenance screen following wheel truing. Refer to Section 4.4.3 of this manual for instructions on updating the wheel diameter using the TOD maintenance screen.

4.4.1 Condemning Limits

The truck wheels have a new diameter of 28.00 in. (711.2mm) and a condemning limit diameter of 26.00 in. (660.4mm). This is the diameter at which the tire (outer ring that contacts the rail) must be replaced before the wheel can be used in revenue service. Proper measuring equipment must be used to determine a wheel's diameter.

NOTE: Rubber blocks must always be replaced any time a new tire is installed on a wheel.

The condemning limit diameter ensures the residual tire thickness is sufficient to not compromise the wheel's integrity while in revenue service. The condemning limit diameter is for a tire without flats or other damage. A tire should never be machined to its condemning diameter and then put into revenue service. Any tire wear or flats will cause this tire diameter to be below its condemning limit diameter, and therefore subject to forces the tire was not designed to support.

4.4.2 Flats

Tire flats occur when a tire skids along the rail. Flats occur for a variety of reasons, and vary greatly in severity. The lengths listed below show different lengths and the necessary treatment of three ranges of flats.

Flat Length Radial Direction	Necessary Action
3/4 in. (19.1mm) or less	None
3/4 in. (19.1mm) – 1.50 in. (38.1mm)	Blend in flat with grinder
1.50 in. (38.1mm) or more	Recontour tire

4.4.2.1 Severe Flats

A severe flat is a flat that generates enough heat to change the color of the tire to blue. This temperature is approximately 550 degrees Fahrenheit.

A tire with a severe flat as a result of prolonged skidding must be recontoured as soon as possible. The longer a tire with a flat of this severity stays in service the greater the risk of tire fracture, especially as the tire diameter approaches its condemning limit. The tire must be machined until the flat is no longer visible, then an additional 0.200 in. (5mm) on radius, 0.400 in. (10mm) on diameter must be machined to remove any microscopic cracks that may have started as a result of the severe skidding.

NOTE: If recontouring the tire will place it below its condemning limit, the tire and rubber blocks must be replaced.

Tires are safety critical and should be inspected regularly. Any tire suspected of having flats should be carefully inspected and repaired if needed. The tire diameter also needs to be monitored after recontouring. Tires that have been recontoured to within 0.25 in. (6.4mm) of their condemning diameter need to be closely monitored and replaced as they approach their condemning diameter.

4.4.3 Updating Wheel Diameter

Access the maintenance screen shown in Figure 4-7 by selecting the MAINTENANCE SCREEN pushbutton.

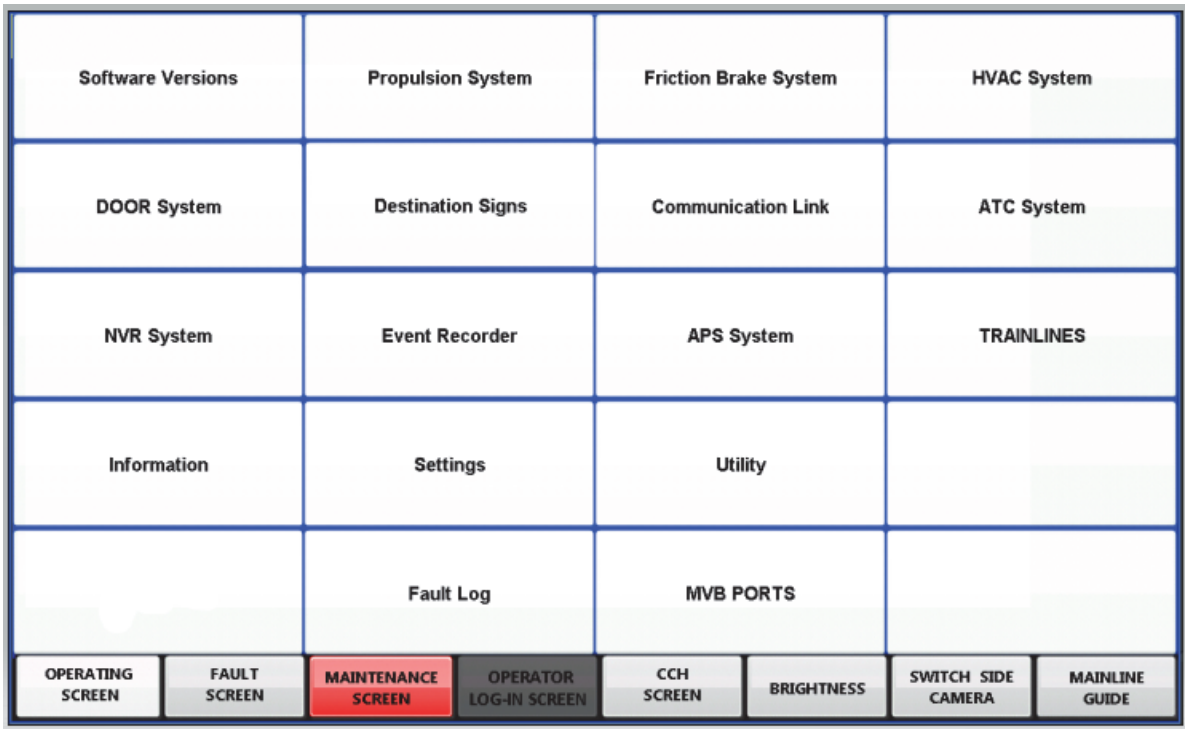


Figure 4-7: Default Maintenance Screen

To access the Wheel Diameters screen press the Utility pushbutton from the Default Maintenance Screen. This will change the screen to the Wheel Diameters screen that is shown in Figure 4-8.

The Wheel Diameters screen is used to set the wheel diameter of the trued wheels. This is necessary to ensure the distance traveled remains accurate. Simply press the plus (+) or minus (-) pushbutton to change the diameter of the wheel. Once the desired size is input, press the green Update Wheel Diameter pushbutton to submit the changes. This screen will initially default to a new wheel setting of 711mm (28 inches). Note that the other axle wheel diameter is calculated based on the update by the control units.

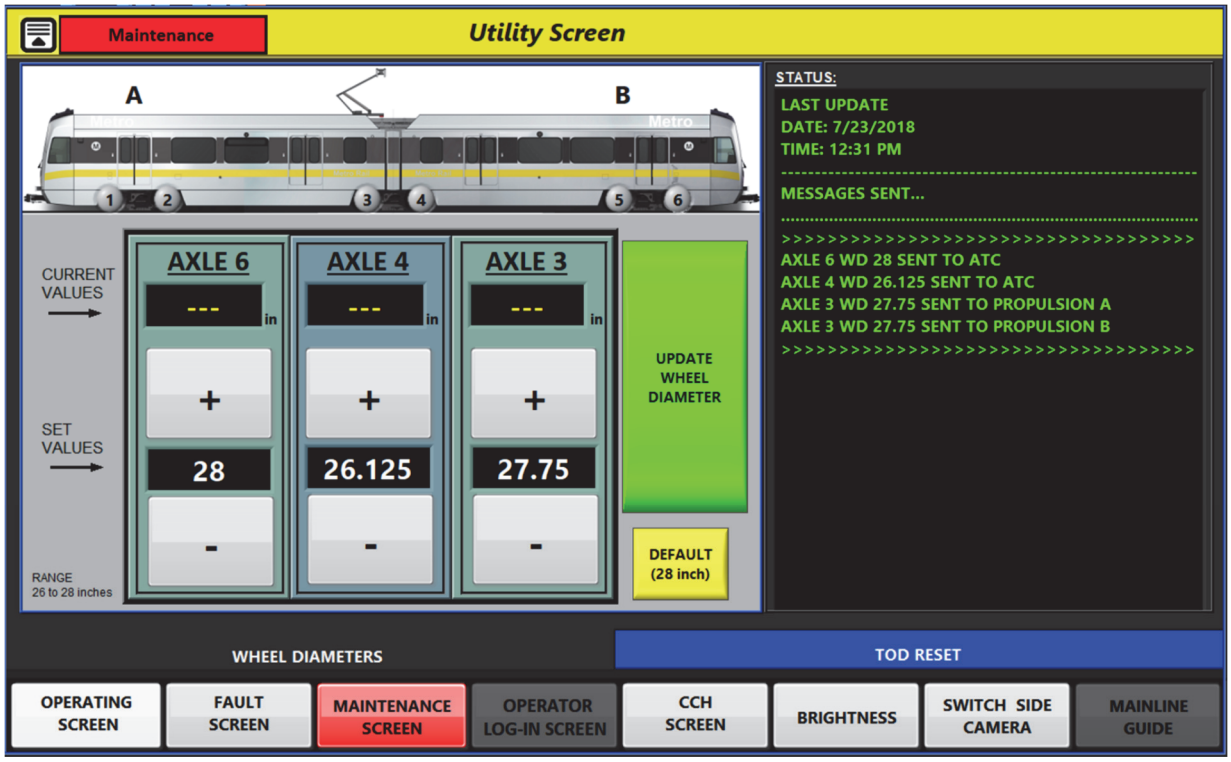


Figure 4-8: Utility Screen (Wheel Diameters)

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CHAPTER 5.0

COMPONENT REMOVAL AND INSTALLATION

5.1 Introduction

This chapter provides removal and installation procedures for the truck and suspension equipment.

5.2 Equipment Removal

5.2.1 Truck Equipment

The truck equipment consists of the following components:

- lateral damper
- bolster safety stop
- motor and center truck disc brake unit
- ATP junction box and antenna
- wheel tread and flange lubricator
- safety bar
- sanding nozzle
- leveling valve

5.2.1.1 Motor Truck Lateral Damper

NOTE: It is recommended that this procedure be accomplished while detrucked from the car.

1. Remove the two M12 lock nuts (1), M12 lock washers (2) and M12 x 145 bolts (3) from the lateral damper (4). See Figure 5-1.

2. Remove the two M12 lock nuts (5), M12 lock washers (6) and M12 x 125 bolts (7) from the lateral damper (4).

3. Remove the lateral damper (4) from the motor truck bolster (8) and the motor truck frame (9).

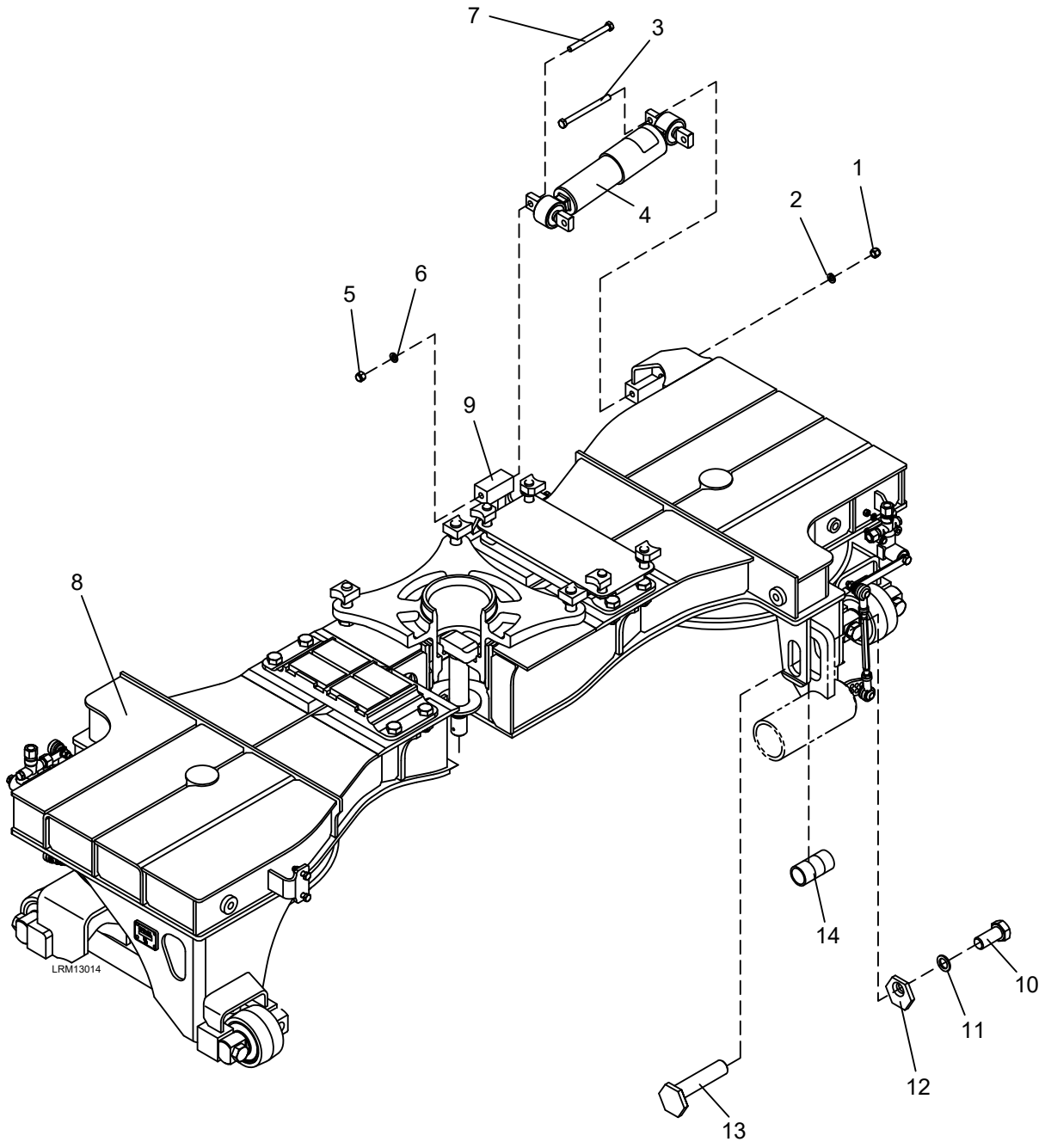

Figure 5-1: Motor Truck Bolster

5.2.1.2 Center Truck Lateral Damper

NOTE: It is recommended that this procedure be accomplished while detrucked from the car.

1. Remove the two M12 lock nuts (1), M12 lock washers (2) and M12 x 145 bolts (3) from the lateral damper (4). See Figure 5-2.
2. Remove the two M12 lock nuts (5), M12 lock washers (6) and M12 x 125 bolts (7) from the lateral damper (4).
3. Remove the lateral damper (4) from the center truck bolster (8) and the center truck frame (9).

5.2.1.3 Motor Truck Bolster Safety Stop

NOTE: It is recommended that this procedure be accomplished while detrucked from the car.

1. Remove the M20 x 35 bolt (10), M20 Nord-Lock washer (11) and special washer (12). See Figure 5-1.
2. Remove the special pin (13).
3. Remove the three collars (14).
4. Repeat steps 1 through 3 for the remaining safety stop.

5.2.1.4 Center Truck Bolster Safety Stop

NOTE: It is recommended that this procedure be accomplished while detrucked from the car.

1. Remove the M20 x 35 bolt (10), M20 Nord-Lock washer (11) and special washer (12). See Figure 5-2.
2. Remove the special pin (13).
3. Remove the three collars (14).
4. Repeat steps 1 through 3 for the remaining safety stop.

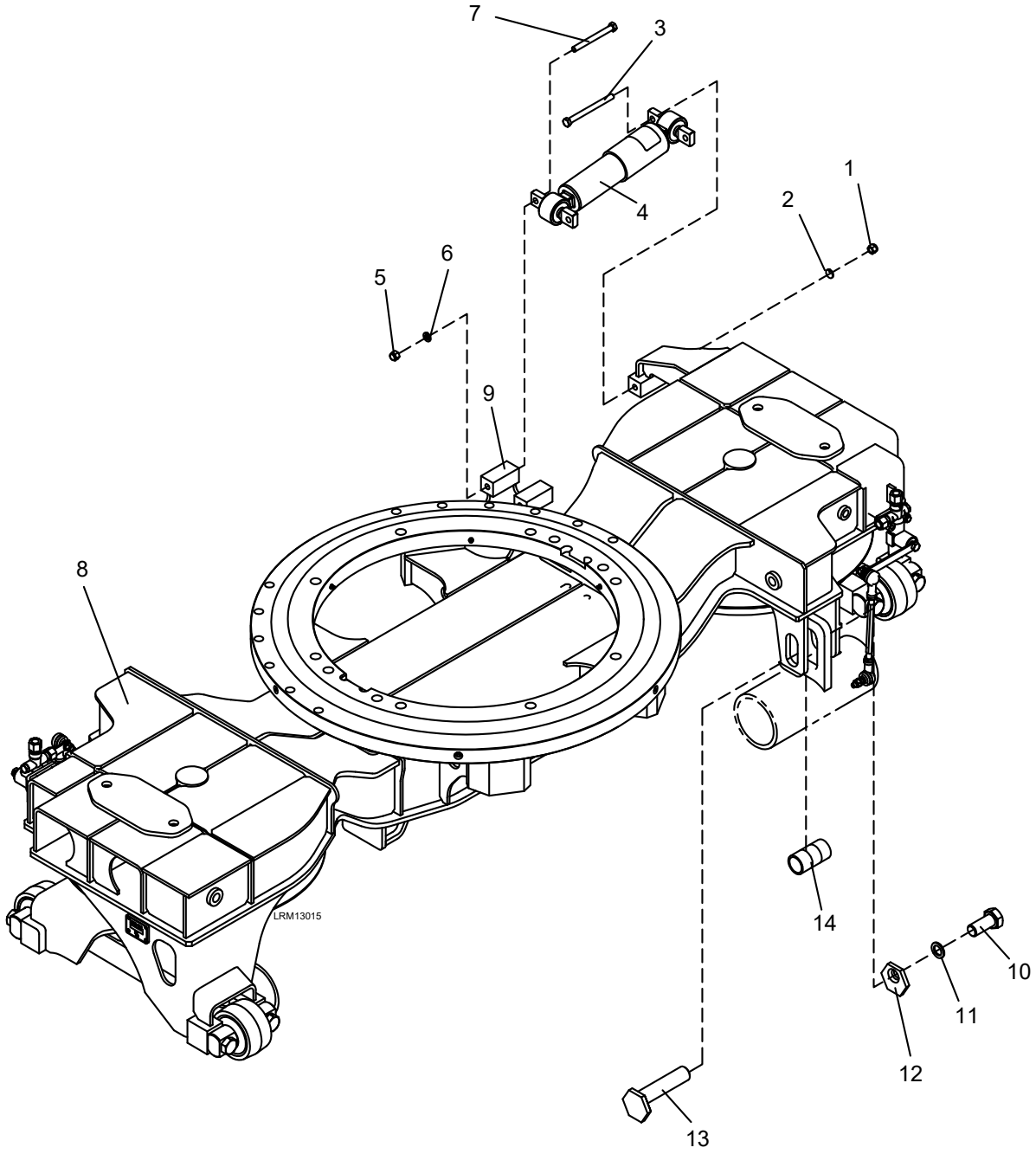

Figure 5-2: Center Truck Bolster

5.2.1.5 Motor Truck Disc Brake Unit

NOTE: It is recommended that this procedure be accomplished while detrucked from the car.

WARNING

USE THE PROPER LIFTING EQUIPMENT TO REMOVE AND REPLACE HEAVY COMPONENTS. ALSO MAKE SURE THE COMPONENT IS SECURELY FASTENED TO THE LIFTING DEVICE. NEVER ATTEMPT TO PERFORM A TWO PERSON OPERATION ALONE. KNOW AND FOLLOW EMERGENCY PROCEDURES.

WARNING

ALL AIR SUPPLY AND/OR ELECTRIC CURRENT TO THESE DEVICES AND/OR ANY COMPONENT PARTS MUST BE CUT-OFF BEFORE THESE DEVICES AND/OR COMPONENT PART ARE REMOVED FROM THE EQUIPMENT ARRANGEMENT.

WARNING

BOTTLED UP AIR UNDER PRESSURE (EVEN THOUGH AIR SUPPLY IS CUT-OFF) MAY CAUSE GASKETS AND/OR PARTICLES OF DIRT TO BECOME AIRBORNE AND AN INCREASE IN SOUND LEVEL WHEN THESE DEVICES AND/OR ANY COMPONENT PARTS ARE REMOVED FROM THE EQUIPMENT ARRANGEMENT. PERSONAL EYE AND EAR PROTECTION MUST BE WORN AND CARE TAKEN TO AVOID POSSIBLE INJURY WHEN PERFORMING ANY WORK ON THESE DEVICES AND/OR COMPONENT PARTS.

1. Use a lifting sling to support the disc brake unit (3) before removal.

2. Disconnect the air supply to the air hoses (1 and 2) from the disc brake unit (3) by looking at the indicator on the handle for the brake cylinder cutout valve and reposition the valve handle so that the indicator is perpendicular to the piping and the valve is closed. Release the parking brakes by using the parking brake release handle (18). See Figures 5-3 and 5-7.

3. Remove the air hoses (1 and 2) from the disc brake unit (3).

4. Remove the two M20 x 100 bolts (4) and M20 Nord-Lock washers (5) from the extension sleeves (6).

5. Remove the extension sleeves (6).

6. Remove the two M20 x 230 bolts (7) and M20 Nord-Lock washers (8) from the truck frame (9).

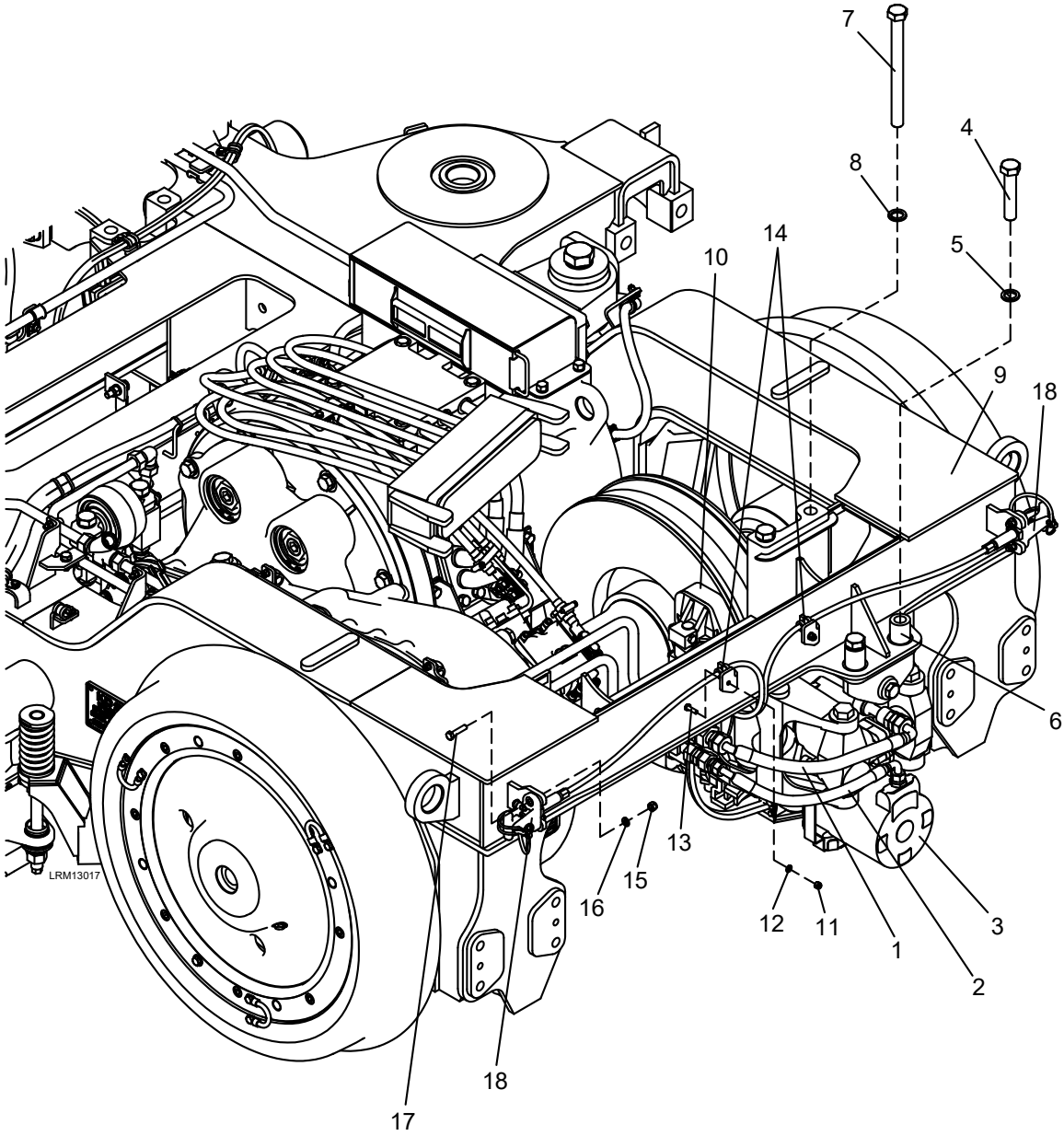

Figure 5-3: Motor Truck Disc Brake Unit

7. Remove the two brake pads (10) from the disc brake unit (3).
8. Remove the M6 lock nut (11), M6 lock washer (12) and M6 x 20 bolt (13) from the pipe clamp.
9. Remove the pipe clamp (14).
10. Repeat steps 8 and 9 for the remaining pipe clamp (14).
11. Remove the two M8 lock nuts (15), M8 lock washers (16) and M8 x 35 bolts (17).
12. Remove the manual release handle (18).
13. Repeat steps 11 and 12 for the remaining manual release handle (18).
14. Remove the disc brake unit (3).
15. Repeat steps 1 through 14 for the remaining disc brake unit (3) on the opposite side of the truck frame (9).

5.2.1.6 Center Truck Disc Brake Unit

NOTE: It is recommended that this procedure be accomplished while detrucked from the car.

WARNING

USE THE PROPER LIFTING EQUIPMENT TO REMOVE AND REPLACE HEAVY COMPONENTS. ALSO MAKE SURE THE COMPONENT IS SECURELY FASTENED TO THE LIFTING DEVICE. NEVER ATTEMPT TO PERFORM A TWO PERSON OPERATION ALONE. KNOW AND FOLLOW EMERGENCY PROCEDURES.

WARNING

ALL AIR SUPPLY AND/OR ELECTRIC CURRENT TO THESE DEVICES AND/OR ANY COMPONENT PARTS MUST BE CUT-OFF BEFORE THESE DEVICES AND/OR COMPONENT PART ARE REMOVED FROM THE EQUIPMENT ARRANGEMENT.

WARNING

BOTTLED UP AIR UNDER PRESSURE (EVEN THOUGH AIR SUPPLY IS CUT-OFF) MAY CAUSE GASKETS AND/OR PARTICLES OF DIRT TO BECOME AIRBORNE AND AN INCREASE IN SOUND LEVEL WHEN THESE DEVICES AND/OR ANY COMPONENT PARTS ARE REMOVED FROM THE EQUIPMENT ARRANGEMENT. PERSONAL EYE AND EAR PROTECTION MUST BE WORN AND CARE TAKEN TO AVOID POSSIBLE INJURY WHEN PERFORMING ANY WORK ON THESE DEVICES AND/OR COMPONENT PARTS.

1. Use a lifting sling to support the disc brake unit (2) before removal.
2. Disconnect the air supply to the air hose (1) from the disc brake unit (2) by looking at the indicator on the handle for the brake cylinder cutout valve and reposition the valve handle so that the indicator is perpendicular to the piping and the valve is closed. See Figures 5-4 and 5-7.
3. Remove the air hose (1) from the disc brake unit (2).
4. Remove the two M20 x 100 bolts (3) and M20 Nord-Lock washers (4) from the extension sleeves (5).
5. Remove the extension sleeves (5).
6. Remove the two M20 x 230 bolts (6) and M20 Nord-Lock washers (7) from the truck frame (8).
7. Remove the two brake pads (9) from the disc brake unit (2).
8. Repeat steps 1 through 7 for the remaining three disc brake units (2).

5.2.1.7 ATP Junction Box and Antenna

WARNING

USE THE PROPER LIFTING EQUIPMENT TO REMOVE AND REPLACE HEAVY COMPONENTS. ALSO MAKE SURE THE COMPONENT IS SECURELY FASTENED TO THE LIFTING DEVICE. NEVER ATTEMPT TO PERFORM A TWO PERSON OPERATION ALONE. KNOW AND FOLLOW EMERGENCY PROCEDURES.

WARNING

ALL ELECTRIC CURRENT TO THESE DEVICES AND/OR ANY COMPONENT PARTS MUST BE CUT-OFF BEFORE THESE DEVICES AND/OR COMPONENT PART ARE REMOVED FROM THE EQUIPMENT ARRANGEMENT.

1. Remove the four cable ties (1) from the cable supports (2). See Figure 5-5.
2. Disconnect the wiring from the ATP junction box (3).
3. Remove the four M10 lock nuts (4), M10 plain washers (5) and M10 x 70 bolts (6).
4. Remove the four clamping plates (8) and the ATP antenna (7).
5. Repeat steps 3 and 4 for the remaining ATP antenna (7).
6. Remove the four M8 lock nuts (9), four clamping plates (10), four M8 plain washers (11) and four M8 x 55 bolts (12) from the ATP junction box (3).
7. Remove the ATP junction box (3) from the safety bar (13).

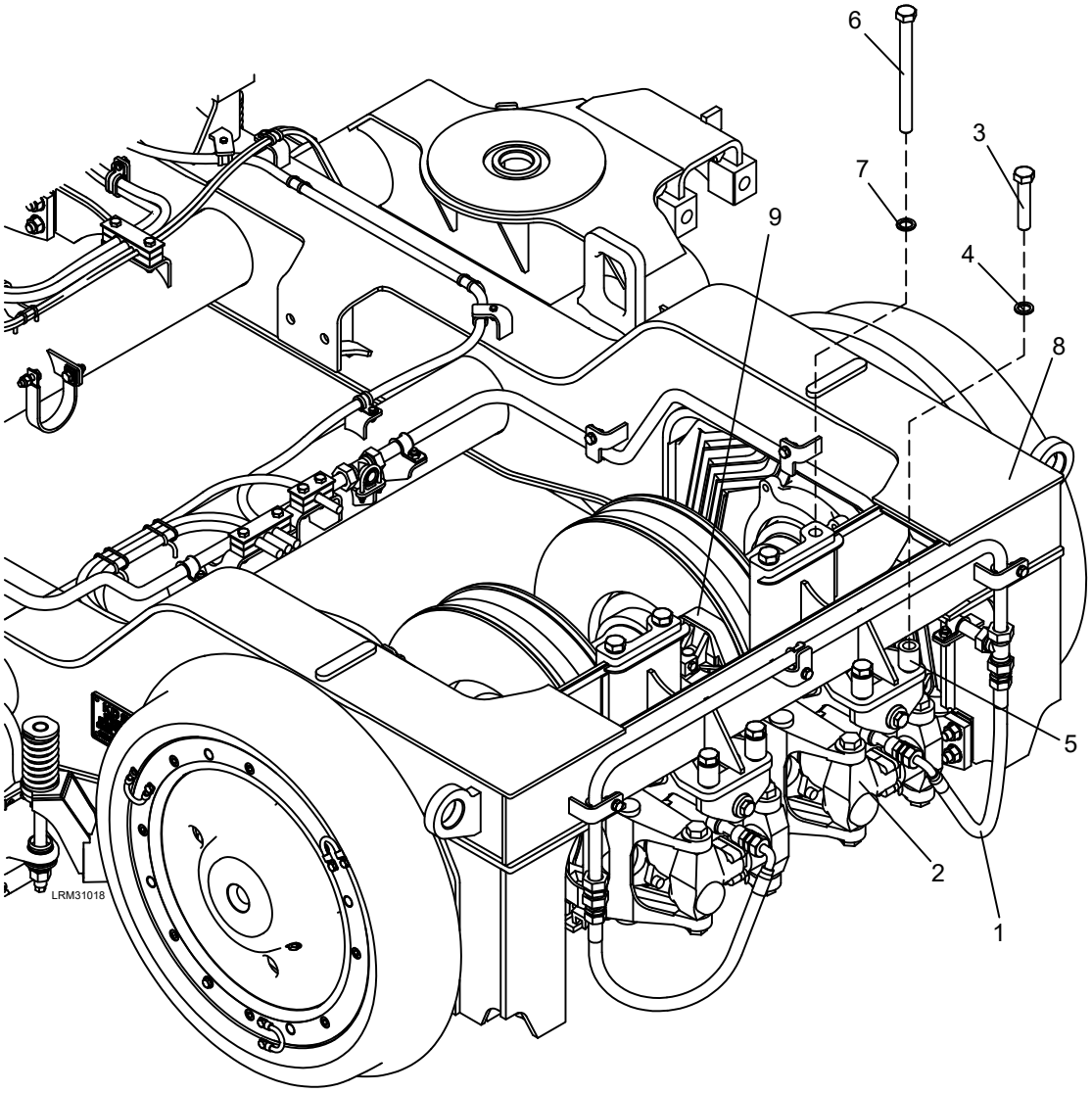

Figure 5-4: Center Truck Disc Brake Unit

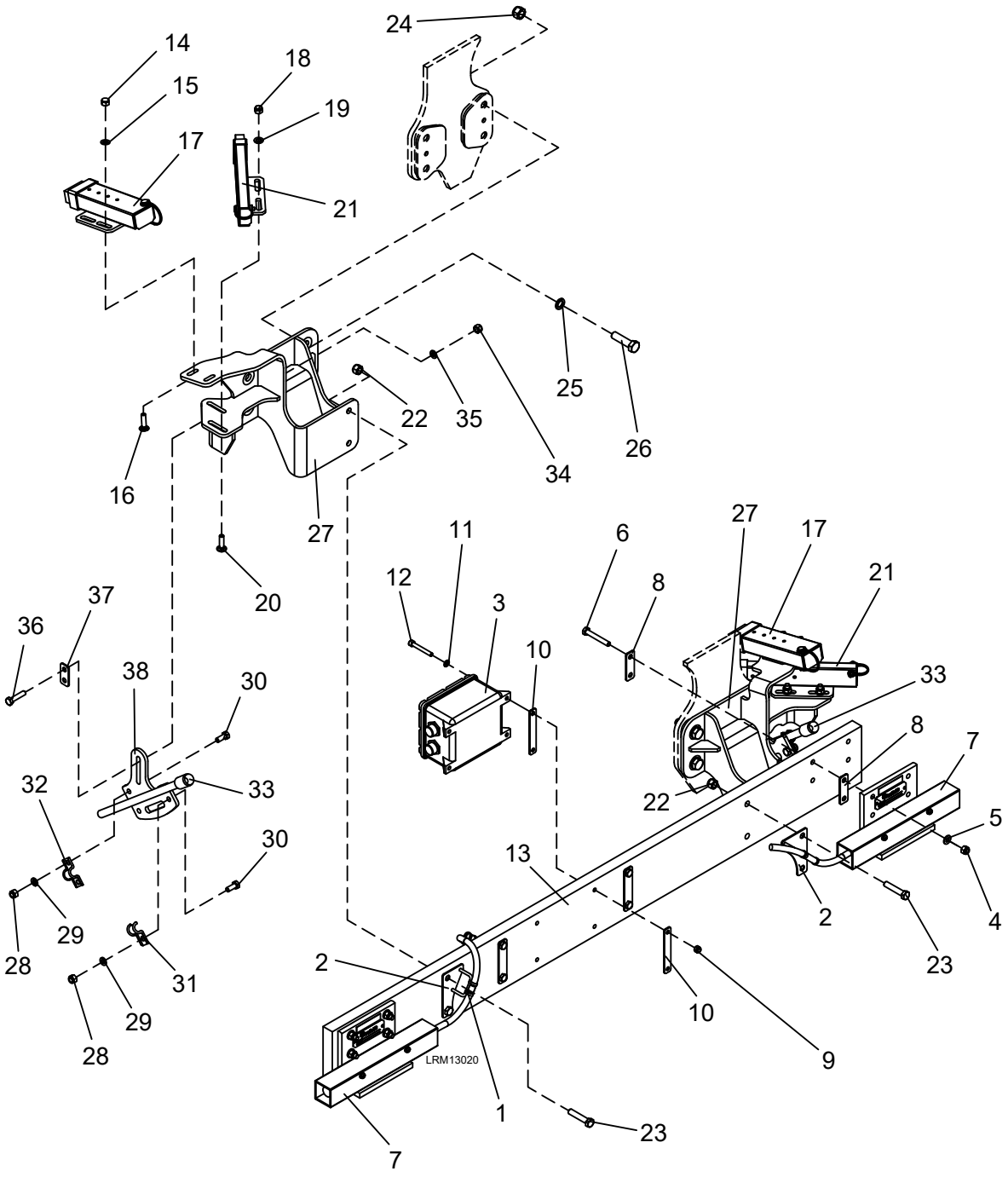

Figure 5-5: Safety Bar

5.2.1.8 Wheel Tread and Flange Lubricator

1. Remove the two M10 lock nuts (14), M10 plain washer (15) and M10 x 35 carriage bolts (16) from the HPF wheel tread lubricator (17). See Figure 5-5.
2. Remove the HPF wheel tread lubricator (17).
3. Repeat steps 1 and 2 for the remaining HPF wheel tread lubricator (17).
4. Remove the two M10 lock nuts (18), M10 plain washers (19) and M10 x 35 carriage bolts (20) from the LCF flange lubricator (21).
5. Remove the LCF flange lubricator (21).
6. Repeat steps 4 and 5 for the remaining LCF flange lubricator (21).

5.2.1.9 Safety Bar

NOTE: To access the safety bar, first remove the ATP junction box, ATP antennas, wheel tread and flange lubricators and sanding nozzles. Refer to Sections 5.2.1.7, 5.2.1.8 and 5.2.1.10 of this manual section.

1. Remove the four M12 lock nuts (22) and M12 x 60 bolts (23) from the safety bar (13). See Figure 5-5.
2. Remove the two cable supports (2).
3. Remove the safety bar (13).
4. Remove the two M16 lock nuts (24), M16 Nord-Lock washers (25) and M16 x 60 bolts (26) from the safety bar bracket (27).
5. Remove the safety bar bracket (27).
6. Repeat steps 4 and 5 for the remaining safety bar bracket (27).

5.2.1.10 Sanding Nozzle

WARNING

BOTTLED UP AIR UNDER PRESSURE (EVEN THOUGH AIR SUPPLY IS CUT-OFF) MAY CAUSE GASKETS AND/OR PARTICLES OF DIRT TO BECOME AIRBORNE AND AN INCREASE IN SOUND LEVEL WHEN THESE DEVICES AND/OR ANY COMPONENT PARTS ARE REMOVED FROM THE EQUIPMENT ARRANGEMENT. PERSONAL EYE AND EAR PROTECTION MUST BE WORN AND CARE TAKEN TO AVOID POSSIBLE INJURY WHEN PERFORMING ANY WORK ON THESE DEVICES AND/OR COMPONENT PARTS.

1. Disconnect the air supply to the sanding equipment by looking at the indicator on the handle for the sanding cutout cock and repositioning the valve handle so that the indicator is perpendicular to the piping and the valve is closed. See Figure 5-7.

2. Remove the three M10 lock nuts (28), M10 lock washers (29) and M10 x 30 bolts (30) from the two pipe clamps (31 and 32). See Figure 5-5.

3. Remove the sanding nozzle (33).

4. Remove the two M10 lock nuts (34), M10 lock washers (35), M10 x 50 bolts (36) and clamping plate (37).

5. Remove the sanding nozzle bracket (38).

6. Repeat steps 2 through 5 for the remaining sanding nozzle (33).

5.2.1.11 Leveling Valve

WARNING

BOTTLED UP AIR UNDER PRESSURE (EVEN THOUGH AIR SUPPLY IS CUT-OFF) MAY CAUSE GASKETS AND/OR PARTICLES OF DIRT TO BECOME AIRBORNE AND AN INCREASE IN SOUND LEVEL WHEN THESE DEVICES AND/OR ANY COMPONENT PARTS ARE REMOVED FROM THE EQUIPMENT ARRANGEMENT. PERSONAL EYE AND EAR PROTECTION MUST BE WORN AND CARE TAKEN TO AVOID POSSIBLE INJURY WHEN PERFORMING ANY WORK ON THESE DEVICES AND/OR COMPONENT PARTS.

1. Disconnect the air supply to the truck bolster by looking at the indicator on the valve handle for the suspension cutout cock and repositioning the valve handle so that the indicator is perpendicular to the piping and the valve is closed. See Figure 5-6.

2. Remove the two M10 lock nuts (1), M10 lock washers (2) and M10 plain washers (3) from the adjusting rod assembly (4). See Figure 5-6.

3. Remove the adjusting rod assembly (4) from the leveling valve (5) and the truck frame (6).

4. Disconnect the leveling valve (5) from the truck bolster piping by loosening the two straight pipe connections (11).

5. Remove the two M8 lock nuts (8), M8 lock washers (9) and M8 x 60 bolts (10).

6. Remove the leveling valve (5) from the truck bolster (7).

7. Repeat steps 2 through 6 for the remaining leveling valve.

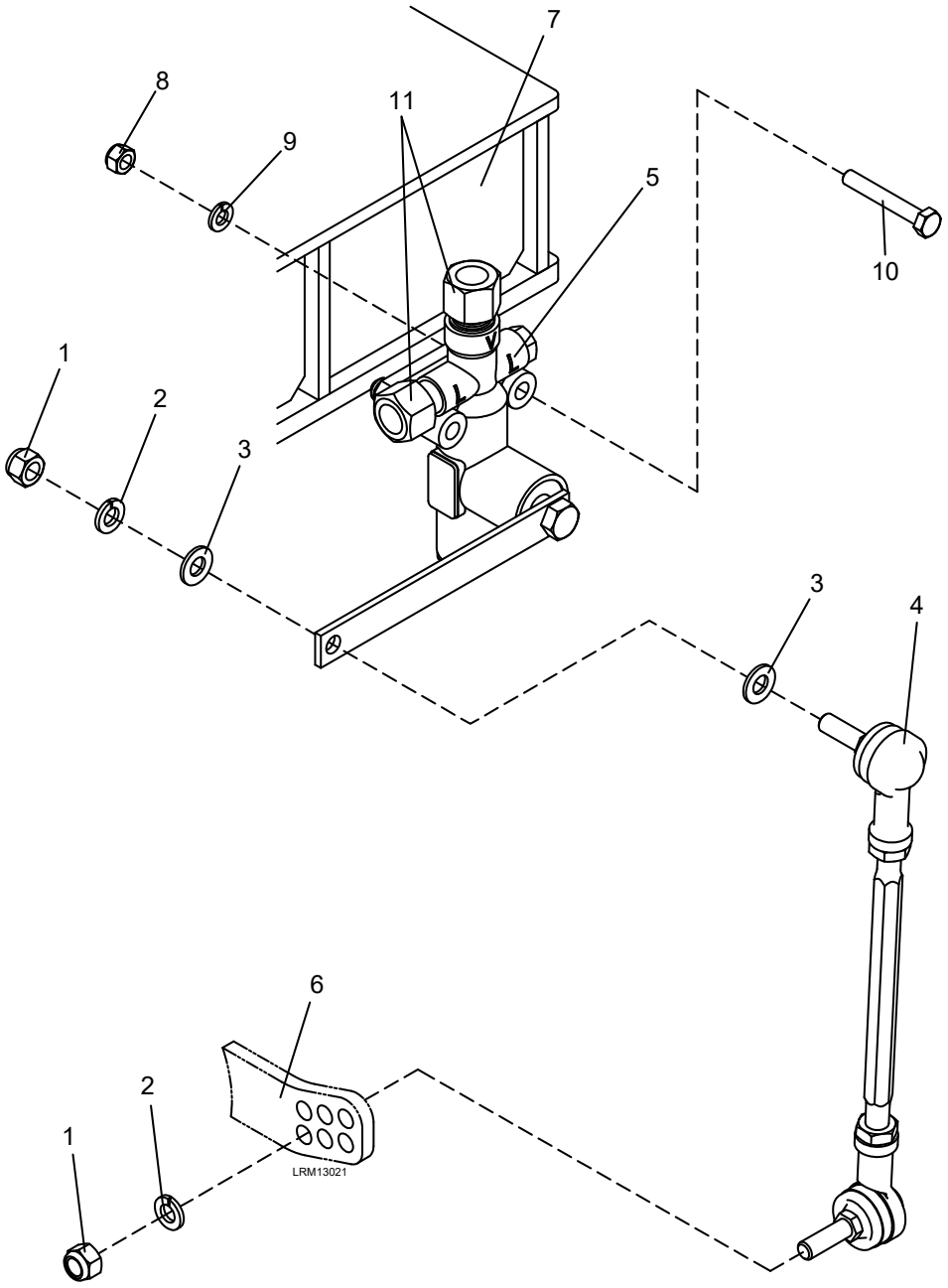

Figure 5-6: Leveling Valve

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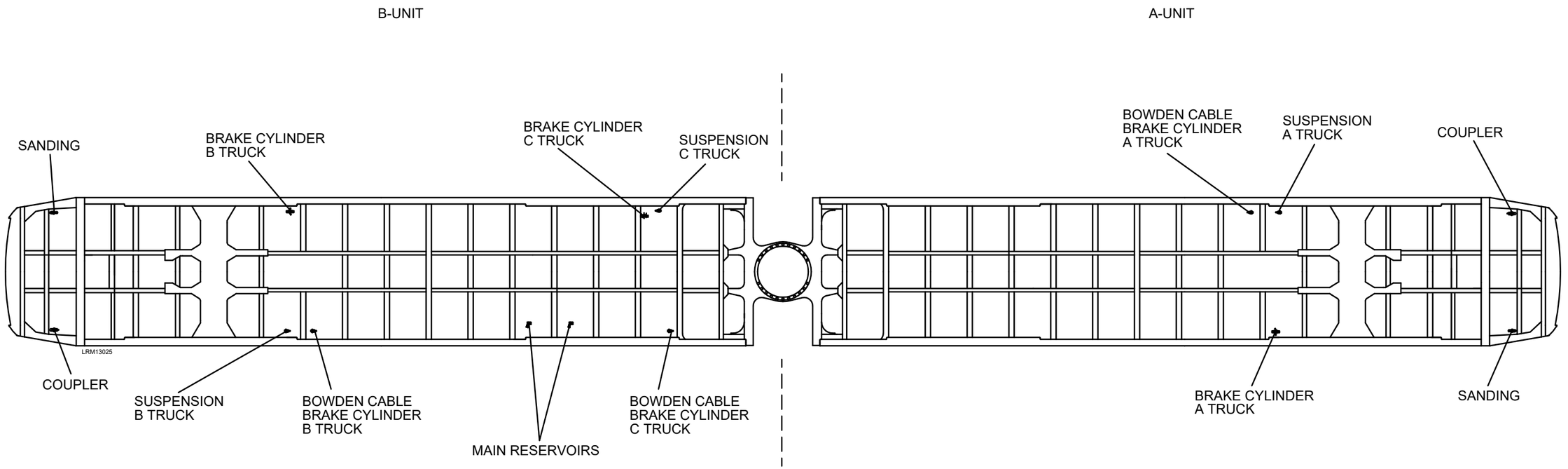


Figure 5-7: Underfloor Cutout Cock Plan

5.3 Equipment Installation

5.3.1 Truck Equipment

The following sections detail the installation of the truck equipment.

5.3.1.1 Motor Truck Lateral Damper

NOTE: It is recommended that this procedure be accomplished while detrucked from the car.

1. Align the motor truck lateral damper (4) with the holes in the motor truck bolster (8) and the motor truck frame (9). Ensure that the motor truck lateral damper (4) is positioned with the name plate on top and towards the outside of the truck. See Figure 5-1.

2. Insert two M12 x 125 bolts (7), two M12 lock washers (6) and M12 lock nuts (5) into the holes in the motor truck frame (9) and hand tighten.

3. Insert two M12 x 145 bolts (3), two M12 lock washers (2) and M12 lock nuts (1) into the holes in the motor truck bolster (8) and hand tighten.

4. Torque all four M12 lock nuts to 91Nm.

5.3.1.2 Center Truck Lateral Damper

NOTE: It is recommended that this procedure be accomplished while detrucked from the car.

1. Align the center truck lateral damper (4) with the holes in the center truck bolster (8) and the center truck frame (9). Ensure that the center truck lateral damper (4) is positioned with the name plate on top and towards the outside of the truck. See Figure 5-2.

2. Insert two M12 x 125 bolts (7), two M12 lock washers (6) and M12 lock nuts (5) into the holes in the center truck frame (9) and hand tighten.

3. Insert two M12 x 145 bolts (3), two M12 lock washers (2) and M12 lock nuts (1) into the holes in the center truck bolster (8) and hand tighten.

4. Torque all four M12 lock nuts to 91Nm.

5.3.1.3 Motor Truck Bolster Safety Stop

NOTE: It is recommended that this procedure be accomplished while detrucked from the car.

1. Lower the motor truck bolster (8) above the motor truck frame (9) until it is aligned with and slightly above the bracket for the safety stop. See Figure 5-1.

2. Insert three collars (14) and the special pin (13).

3. Insert a special washer (12), M20 Nord-Lock washer (11) and a M20 x 35 bolt (10) and hand tighten. Ensure that the special pin (13) is aligned with the bottom edge against the motor truck bolster (8).

4. Repeat steps 2 and 3 for the remaining safety stop.

5. Lower the motor truck bolster (8) onto the motor truck frame (9).

6. Torque both M20 x 35 bolts (10) to 230Nm.

5.3.1.4 Center Truck Bolster Safety Stop

NOTE: It is recommended that this procedure be accomplished while detrucked from the car.

1. Lower the center truck bolster (8) above the center truck frame (9) until it is aligned with and slightly above the bracket for the safety stop. See Figure 5-2.

2. Insert three collars (14) and the special pin (13).

3. Insert a special washer (12), M20 Nord-Lock washer (11) and a M20 x 35 bolt (10) and hand tighten. Ensure that the special pin (13) is aligned with the bottom edge against the center truck bolster (8).

4. Repeat steps 2 and 3 for the remaining safety stop.

5. Lower the center truck bolster (8) onto the center truck frame (9).

6. Torque both M20 x 35 bolts (10) to 230Nm.

5.3.1.5 Motor Truck Disc Brake Unit

NOTE: It is recommended that this procedure be accomplished while detrucked from the car.

WARNING

USE THE PROPER LIFTING EQUIPMENT TO REMOVE AND REPLACE HEAVY COMPONENTS. ALSO MAKE SURE THE COMPONENT IS SECURELY FASTENED TO THE LIFTING DEVICE. NEVER ATTEMPT TO PERFORM A TWO PERSON OPERATION ALONE. KNOW AND FOLLOW EMERGENCY PROCEDURES.

WARNING

ALL AIR SUPPLY AND/OR ELECTRIC CURRENT TO THESE DEVICES AND/OR ANY COMPONENT PARTS MUST BE CUT-OFF BEFORE THESE DEVICES AND/OR COMPONENT PART ARE REMOVED FROM THE EQUIPMENT ARRANGEMENT.

WARNING

BOTTLED UP AIR UNDER PRESSURE (EVEN THOUGH AIR SUPPLY IS CUT-OFF) MAY CAUSE GASKETS AND/OR PARTICLES OF DIRT TO BECOME AIRBORNE AND AN INCREASE IN SOUND LEVEL WHEN THESE DEVICES AND/OR ANY COMPONENT PARTS ARE REMOVED FROM THE EQUIPMENT ARRANGEMENT. PERSONAL EYE AND EAR PROTECTION MUST BE WORN AND CARE TAKEN TO AVOID POSSIBLE INJURY WHEN PERFORMING ANY WORK ON THESE DEVICES AND/OR COMPONENT PARTS.

1. Use a lifting sling to support the disc brake unit (3) during installation.
2. Lift the motor truck disc brake unit (3) into alignment with the holes in the motor truck frame (9). See Figure 5-3.
3. Insert two knock out pins at the M20 x 100 bolt (4) locations to align the motor truck disc brake unit (3).
4. Insert two M20 Nord-Lock washers (8) and M20 x 230 bolts (7) and temporarily tighten.
5. Remove the knock out pins.
6. Insert two extension sleeves (6), M20 Nord-Lock washers (5) and M20 x 100 bolts (4) and temporarily tighten.
7. After checking for alignment, torque two M20 x 100 bolts (4) and M20 x 230 bolts (7) to 450Nm.

8. Attach the air hose (1) and torque to 40Nm.
9. Attach the air hose (2) and torque to 12Nm.
10. Unlock the stopper on the underside of the motor truck disc brake unit (3).
11. Insert two brake pads (10) noting that the key way in the brake pad (10) is installed correctly into the motor truck disc brake unit (3).
12. Lock the stopper of the motor truck disc brake unit (3).
13. Lay manual release cables along the end beam of the motor truck frame (9).
14. Align the manual release handle (18) with the holes in the truck frame bracket.
15. Insert two M8 x 35 bolts (17), M8 lock washers (16) and M8 lock nuts (15) and torque to 14Nm.
16. Repeat steps 15 through 17 for the remaining manual release handle (18).
17. Install two pipe clamps (14) using an M6 x 20 bolt (13), M6 lock washer (12) and M6 lock nut (11) for each manual release cable and torque to 7Nm.
18. Repeat steps 1 through 20 for the remaining motor truck disc brake unit (3) on the opposite side of the motor truck frame (9).
19. Connect the air supply to the motor truck disc brake units (3) by looking at the indicator on the cutout valve handle for the brake cylinder cutout cock and repositioning the valve handle so that the indicator is parallel to the piping and the valve is open. See Figure 5-7.

5.3.1.6 Center Truck Disc Brake Unit

NOTE: It is recommended that this procedure be accomplished while detrucked from the car.

WARNING

USE THE PROPER LIFTING EQUIPMENT TO REMOVE AND REPLACE HEAVY COMPONENTS. ALSO MAKE SURE THE COMPONENT IS SECURELY FASTENED TO THE LIFTING DEVICE. NEVER ATTEMPT TO PERFORM A TWO PERSON OPERATION ALONE. KNOW AND FOLLOW EMERGENCY PROCEDURES.

WARNING

ALL AIR SUPPLY AND/OR ELECTRIC CURRENT TO THESE DEVICES AND/OR ANY COMPONENT PARTS MUST BE CUT-OFF BEFORE THESE DEVICES AND/OR COMPONENT PART ARE REMOVED FROM THE EQUIPMENT ARRANGEMENT.

WARNING

BOTTLED UP AIR UNDER PRESSURE (EVEN THOUGH AIR SUPPLY IS CUT-OFF) MAY CAUSE GASKETS AND/OR PARTICLES OF DIRT TO BECOME AIRBORNE AND AN INCREASE IN SOUND LEVEL WHEN THESE DEVICES AND/OR ANY COMPONENT PARTS ARE REMOVED FROM THE EQUIPMENT ARRANGEMENT. PERSONAL EYE AND EAR PROTECTION MUST BE WORN AND CARE TAKEN TO AVOID POSSIBLE INJURY WHEN PERFORMING ANY WORK ON THESE DEVICES AND/OR COMPONENT PARTS.

1. Use a lifting sling to support the disc brake unit (2) during installation.
2. Lift the center truck disc brake unit (2) into alignment with the holes in the center truck frame (8). See Figure 5-4.
3. Insert two knock out pins at the M20 x 100 bolt (3) locations to align the center truck disc brake unit (2).
4. Insert two M20 Nord-Lock washers (7) and M20 x 230 bolts (6) and temporarily tighten.
5. Remove the knock out pins.
6. Insert two extension sleeves (5), M20 Nord-Lock washers (4) and M20 x 100 bolts (3) and temporarily tighten.
7. After checking for alignment, torque two M20 x 100 bolts (3) and M20 x 230 bolts (6) to 450Nm.
8. Attach the air hose (1) and torque to 40Nm.
9. Unlock the stopper on the underside of the center truck disc brake unit (2).
10. Insert two brake pads (9) noting that the key way in the brake pad (9) is installed correctly into the center truck disc brake unit (2).

11. Lock the stopper of the center truck disc brake unit (2).

12. Repeat steps 1 through 13 for the three remaining center truck disc brake units (2).

13. Connect the air supply to the center truck disc brake units (2) by looking at the indicator on the cutout valve handle for the brake cylinder cutout cock and repositioning the valve handle so that the indicator is parallel to the piping and the valve is open. See Figure 5-7.

5.3.1.7 ATP Junction Box and Antenna

NOTE: First install the safety bar. Refer to Section 5.3.1.9 of this manual section.

WARNING

ALL ELECTRIC CURRENT TO THESE DEVICES AND/OR ANY COMPONENT PARTS MUST BE CUT-OFF BEFORE THESE DEVICES AND/OR COMPONENT PART ARE REMOVED FROM THE EQUIPMENT ARRANGEMENT.

1. Insert four clamping plates (10), the ATP junction box (3), four M8 plain washers (11), and four M8 x 55 bolts (12) and four M8 lock nuts (9) into the holes of the safety bar (13). See Figure 5-5. Torque to 5.5Nm.

2. Insert four clamping plates (8) and four M10 x 70 bolts (6) into the holes in the safety bar (13).

3. Align the ATP antenna (7) with the M10 x 70 bolts (6).

4. Insert four M10 plain washers (5) and four M10 lock nuts (4) and torque to 17Nm.

5. Connect the antenna cable to the ATP junction box (3).

6. Repeat steps 2 through 5 for the remaining ATP antenna (7).

7. Attach cable ties (1) at each of the four cable supports (2).

5.3.1.8 Wheel Tread and Flange Lubricator

NOTE: First install the safety bar. Refer to Section 5.3.1.9 of this manual section.

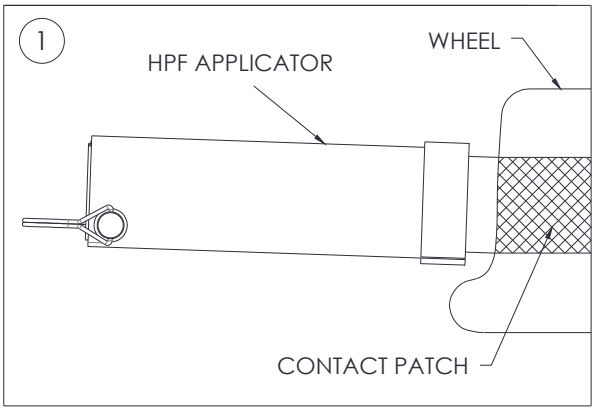
1. Align the HPF wheel tread lubricator (17) with the slots in the safety bar bracket (27). See Figure 5-5.

2. Insert two M10 x 35 carriage bolts (16), M10 plain washers (15) and M10 lock nuts (14) and temporarily tighten.

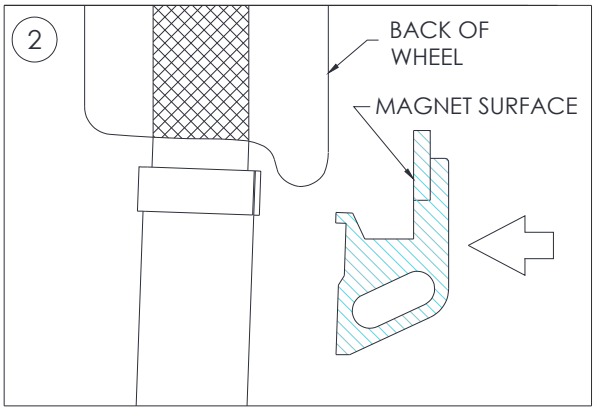
3. Align the LCF flange lubricator (21) with the slots in the safety bar bracket (27).

4. Insert two M10 x 35 carriage bolts (20), M10 plain washers (19) and M10 lock nuts (18) and temporarily tighten.

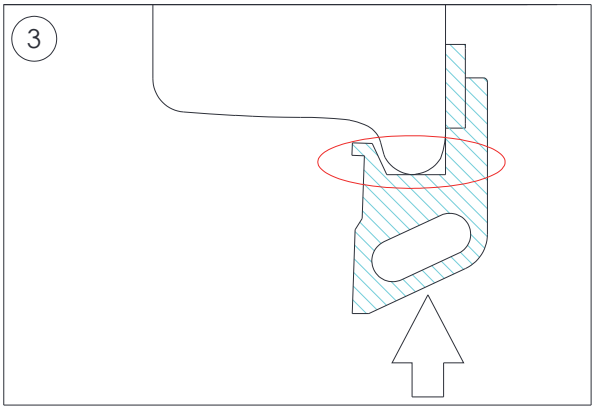
5. HPF wheel tread lubricator alignment procedures are as follows:



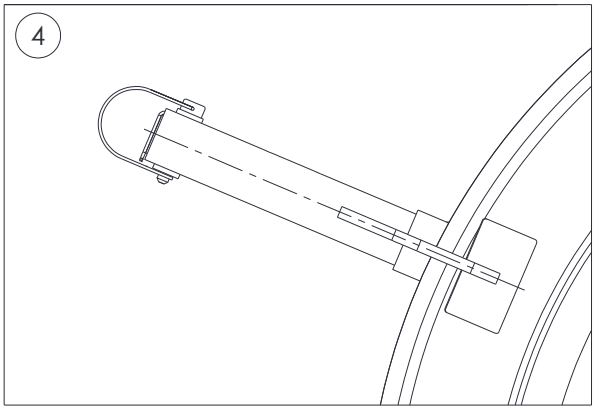
Step 1: Position the applicator so that the applicator centerline is perpendicular to the wheel tread. Apply, but not fully tighten, nuts to applicator fasteners to allow for further adjustment.



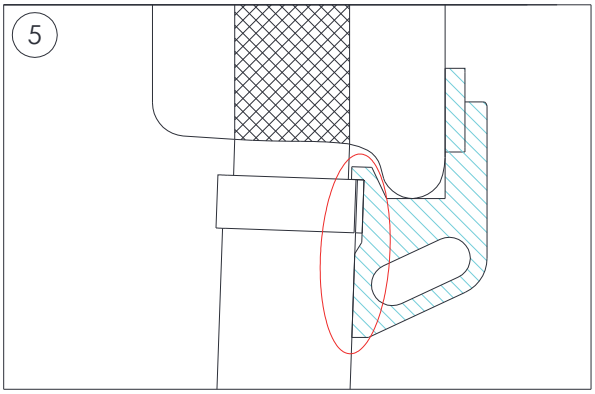
Step 2: Place the alignment tool (G3070000/A) magnet surface against the back of the wheel.



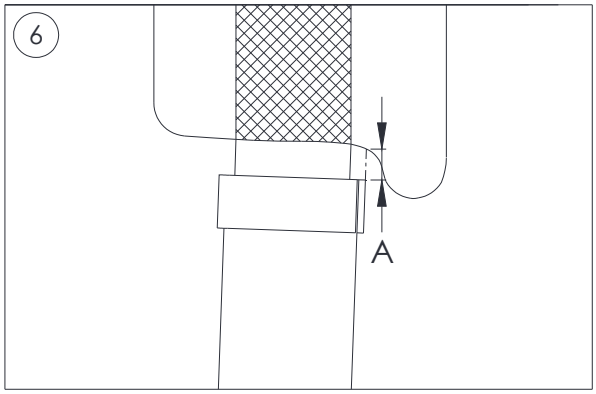
Step 3: Push until the tool surface contacts the flange crown.



Step 4: Ensure the centerline of the alignment tool is aligned with the centerline of the applicator during adjustment.

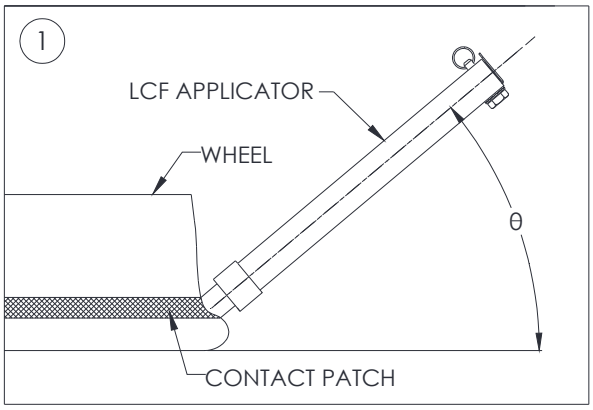


Step 5: Adjust the applicator so that it rests flush against the alignment tool as shown in the figure. Once complete, tighten the applicator fasteners to the correct torque specification.

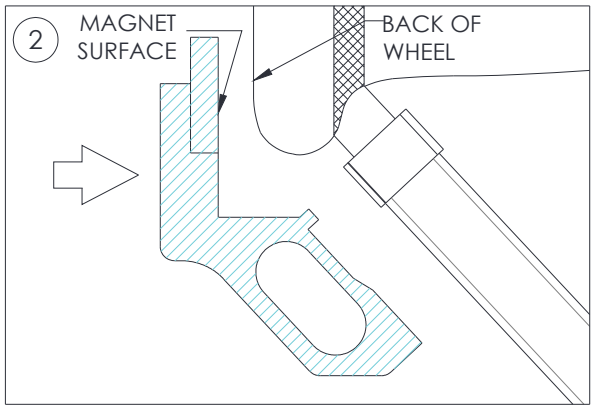


Step 6: Remove the alignment tool and check the tread to applicator spacing. The dimensions should be as specified in Section 3.3.11.3 of this manual section.

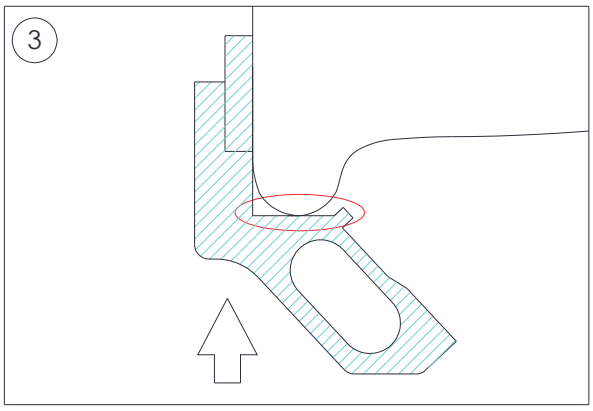
6. LCF flange lubricator alignment procedures are as follows:



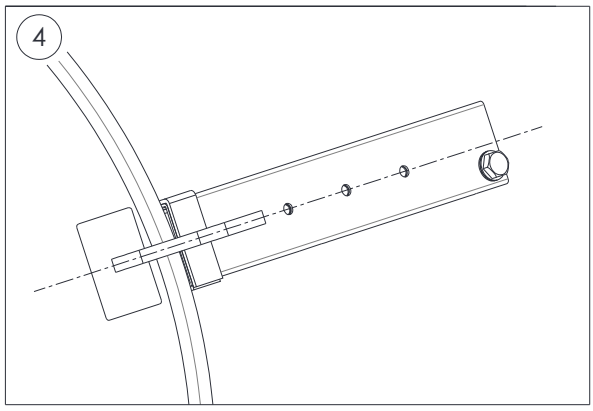
Step 1: Position the applicator so that the angle between the applicator and back of wheel is 43°, as specified in Section 3.3.11.2 of this manual section. Apply, but not fully tighten, nuts to applicator fasteners to allow for further adjustment.



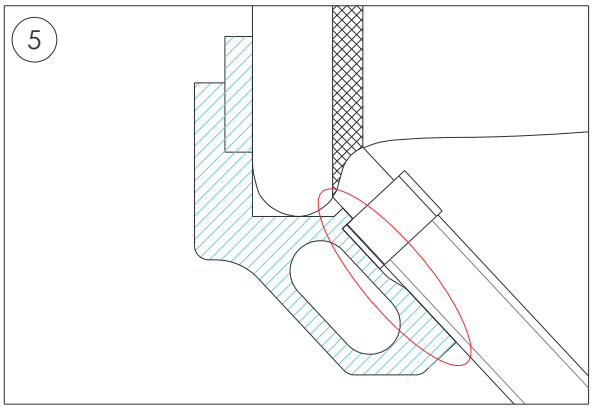
Step 2: Place the alignment tool (G3080000/A) magnet surface against the back of the wheel.



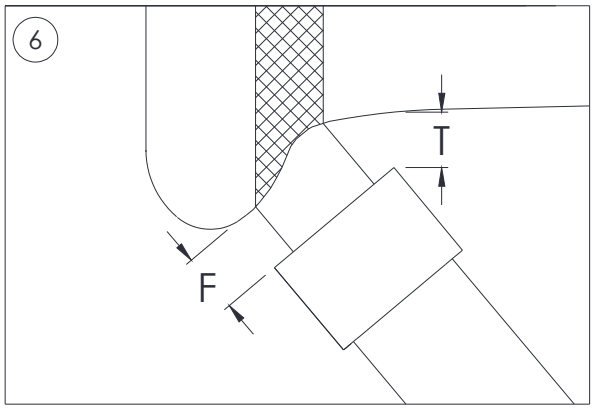
Step 3: Push until the tool surface contacts the flange crown.



Step 4: Ensure the centerline of the alignment tool is aligned with the centerline of the applicator during adjustment.



Step 5: Adjust the applicator so that it rests flush against the alignment tool as shown in the figure. Once complete, tighten the applicator fasteners to the correct torque specification.



Step 6: Remove the alignment tool and check the flange to applicator spacing. The dimensions should be as specified in Section 3.3.11.2 of this manual section.

5.3.1.9 Safety Bar

1. Align the safety bar bracket (27) with the holes in the truck frame. See Figure 5-5.
2. Insert four M16 Nord-Lock washers (25), M16 x 60 bolts (26) and M16 lock nuts (24) and torque to 210Nm.
3. Repeat steps 1 and 2 for the remaining safety bar bracket (27).
4. Align two cable supports (2) with the holes in the safety bar (13).
5. Insert four M12 x 60 bolts (23) and M12 lock nuts (22) into the holes in the safety bar bracket (27).
6. Torque the M12 lock nuts (22) to 37Nm.

5.3.1.10 Sanding Nozzle

NOTE: First install the safety bar. Refer to Section 5.3.1.9 of this manual section.

WARNING

BOTTLED UP AIR UNDER PRESSURE (EVEN THOUGH AIR SUPPLY IS CUT-OFF) MAY CAUSE GASKETS AND/OR PARTICLES OF DIRT TO BECOME AIRBORNE AND AN INCREASE IN SOUND LEVEL WHEN THESE DEVICES AND/OR ANY COMPONENT PARTS ARE REMOVED FROM THE EQUIPMENT ARRANGEMENT. PERSONAL EYE AND EAR PROTECTION MUST BE WORN AND CARE TAKEN TO AVOID POSSIBLE INJURY WHEN PERFORMING ANY WORK ON THESE DEVICES AND/OR COMPONENT PARTS.

1. Align the sanding nozzle bracket (38) with the holes in the safety bar bracket (27). See Figure 5-5.
2. Insert a clamping plate (37), two M10 x 50 bolts (36), M10 lock washers (35) and M10 lock nuts (34) and torque to 27Nm.
3. Place the sanding nozzle (33) on the sanding nozzle bracket (38).
4. Insert a pipe clamp (31), M10 x 30 bolt (30), M10 lock washer (29) and M10 lock nut (28) and temporarily tighten.
5. Insert a pipe clamp (32), two M10 x 30 bolts (30), M10 lock washers (29) and M10 lock nuts (28) and temporarily tighten.
6. Use a plastic hammer to adjust the position of the sanding nozzle (33) to approximately 40 degrees between the nozzle and top of rail. See Figure 5-8.
7. Torque the three M10 lock nuts to 27Nm.
8. Connect the air supply to the sanding equipment by repositioning the indicator on the valve handle for the sanding cutout cock valve so that it is parallel to the piping.

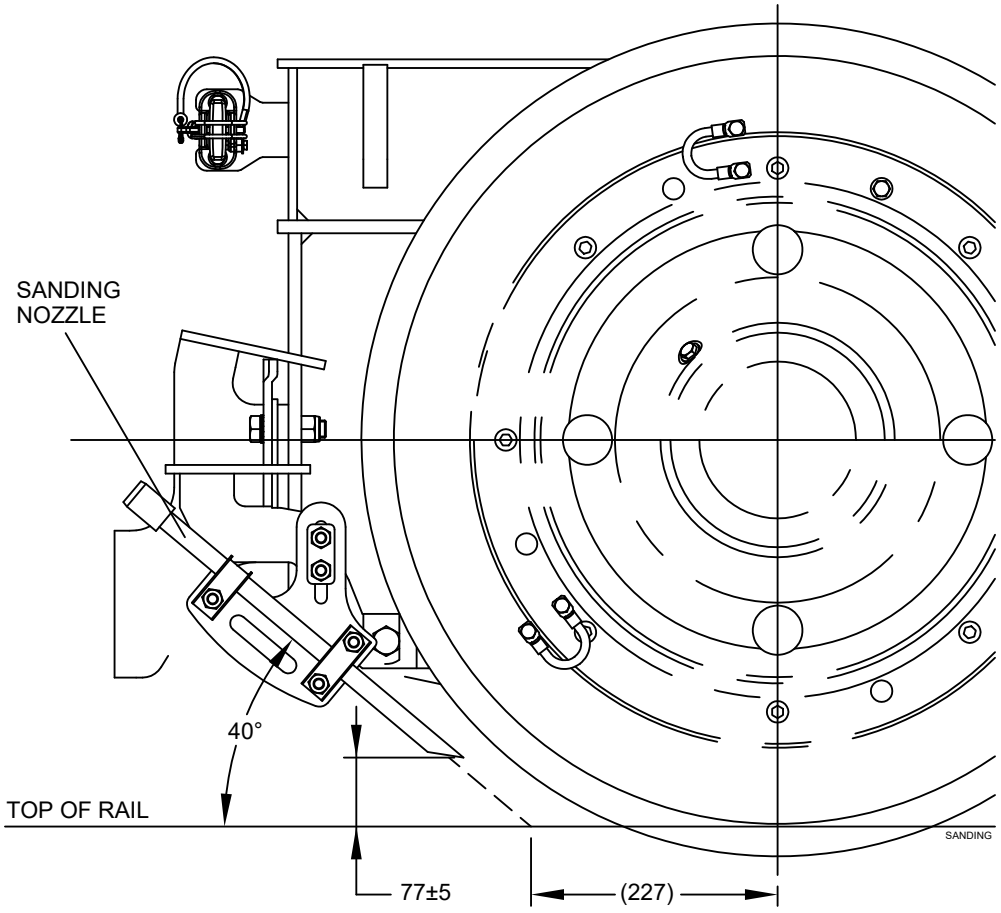


Figure 5-8: Sanding Nozzle Adjustment

5.3.1.11 Leveling Valve

WARNING

BOTTLED UP AIR UNDER PRESSURE (EVEN THOUGH AIR SUPPLY IS CUT-OFF) MAY CAUSE GASKETS AND/OR PARTICLES OF DIRT TO BECOME AIRBORNE AND AN INCREASE IN SOUND LEVEL WHEN THESE DEVICES AND/OR ANY COMPONENT PARTS ARE REMOVED FROM THE EQUIPMENT ARRANGEMENT. PERSONAL EYE AND EAR PROTECTION MUST BE WORN AND CARE TAKEN TO AVOID POSSIBLE INJURY WHEN PERFORMING ANY WORK ON THESE DEVICES AND/OR COMPONENT PARTS.

1. Align the leveling valve (5) with the holes in the truck bolster (7). See Figure 5-6.
2. Insert two M8 x 60 bolts (10), M8 lock washers (9) and M8 lock nuts (8) and torque to 23Nm.
3. Adjust the thread gap of the adjusting rod assembly (4) until they are equal.

4. Insert the adjusting rod assembly (4) into the holes in the leveling valve (5) and the truck frame (6). The “R” end is installed on the truck bolster (7) and the “L” end is installed on the truck frame (6). Refer to Figure 4-2 to insert the adjusting rod assembly (4) into the proper position on the truck frame (6) based on the wheel diameter. Refer to Section 4.3 of Section 1200, Truck and Suspension of this manual section for the Car Body Floor Height Adjustment procedure.

5. Insert two M10 plain washers (3), M10 lock washers (2) and M10 lock nuts (1) and torque to 27Nm.

6. Connect the piping to the leveling valve (5).

7. Connect the air supply to the leveling valve by repositioning the indicator on the suspension cutout cock valve so that it is parallel to the piping. See Figure 5-7.

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CHAPTER 6.0

TROUBLESHOOTING

6.1 Introduction

The system may develop an operational problem due to a mechanical or an electrical condition. This chapter gives a guide for troubleshooting based on observed problems.

Table 6-1. Suspension Troubleshooting

Symptom	Probable Cause	Remedy
Noticeable impacts to carbody each time acceleration or deceleration power is applied.	(1) Center pivot has worn causing excessive gap between carbody and truck bolster center pivot. (2) Bolster anchors defective or excessive wear in rubber mounts.	(1) De-truck suspected truck and check center pivot. (Heavy Maintenance) (2) Inspect and replace anchor(s) and mounts.
Car has poor ride qualities.	Air suspension differential valve failure or leveling valve damping oil level low.	Replace valve. (Heavy Maintenance)
Car too low.	(1) Leveling valve stuck at exhaust. (2) Leveling valve set too low. (3) Air supply low. (4) Air supply leaking.	(1) Replace valve. (2) Adjust linkage. (3) Check compressor. (4) Check springs/bolster.
Car too high. Car riding hard.	(1) Leveling valve stuck open. (2) Leveling valve set too high.	(1) Replace valve. (2) Adjust linkage.
Audible leak is detected at one or more air springs.	Leak in air spring or air lines.	Replace air spring (Heavy Maintenance) or run leakage test. Leakage Test: With pressure on the air system coat all air lines and connections with liquid soap. Bubbles indicate a leak.
Car leans to one side.	Leveling valves set incorrectly.	Adjust linkage on leveling valves.

Table 6-2. Air Filter Troubleshooting

Symptom	Cause	Remedy
Air discharging constantly from air filter	Leaking pipe fittings	Test for leakage. Tighten the pipe fittings and/or replace the seals
Downstream air pipes or units are contaminated	Strainer element (b) dirty or frozen	Inspect filter element. Clean or defrost strainer element
	Unit defective	Remove and replace air filter
Little or no air flow	Strainer element (b) dirty or frozen	Check the air compressor drier/filter elements and replace as needed
	Unit defective	Remove and replace air filter

Table 6-3. Check Valve Troubleshooting

Symptom	Probable Cause	Corrective Action
Air discharging constantly between check valve and base plate	Fastening screws loose	Check fastening screws. Retighten and perform leak test
	O-rings (e) are damaged	Remove valve and check O-rings. Replace O-rings, install valve, and perform leak test
Air discharging constantly from the check valve	Unit is defective	Remove and replace the unit. Perform leak test
Air reflux through the check valve	Unit is defective	Remove and replace the unit. Perform leak test

Table 6-4. Leveling Valve Troubleshooting

Symptom	Probable Cause	Corrective Action
Air discharging constantly from the air pipe connection	Pipe connection loose or seal defective	Perform leak test. Tighten pipe connections. If necessary, replace seal.
Air discharging constantly between body and adapter nipple	Adapter nipple loose or sealing ring defective	Perform leak test. Tighten adapter nipple (24mm). If necessary, replace sealing ring.
Air discharging constantly from screw plug	Screw plug loose or its seal is damaged	Perform leak test. Tighten adapter nipple (24mm). If necessary, replace sealing ring.
Charging or venting of air spring bellows does not match the vehicle load	Actuating linkage damaged	Inspect the linkage. Repair linkage or replace if necessary
	Actuating lever loose	Inspect actuating lever. Leveling valve needs re-adjusted. Remove and replace
	Valve is defective	Remove and replace
Air reflux from the air spring bellows to the auxiliary reservoir when the air supply pressure port V is lowered	Valve is defective	Remove and replace. Overhaul valve

Table 6-4. Leveling Valve Troubleshooting (continued)

Symptom	Probable Cause	Corrective Action
Air discharging constantly from the valve through exhaust port E, at the lap position	Valve is defective	Remove and replace. Overhaul valve
Charging time is too long	Strainer in port L and/or V is dirty	Remove and replace. Overhaul valve
Venting time is too long	Strainer in port L and/or fabric filter in filter plug (exhaust E) is dirty	Remove and replace. Overhaul valve

Table 6-5. Cutout Cock Troubleshooting

Symptom	Probable Cause	Corrective Action
Handle not closing	Valve mechanically frozen	Replace valve
Handle closes without pinching the handle	Spring defective	Replace valve
Handle will not lock in fully closed or open position	Spring defective	Replace valve

Table 6-6. Duplex Check Valve Troubleshooting

Symptom	Probable Cause	Corrective Action
Air discharging at pipe fittings P1 and/or P2	Pipe fittings P1 and/or P2 loose	Leakage test. Tighten fittings
Air discharging at screw plugs (g)	Screw plugs (g) loose and/or sealing rings (h) defective	Verify plug is tightened at specified torque. Tighten screw plugs and/or replace sealing rings
Air discharging between body (a) and bracket (b)	Hexagon nut (i) loose and/or O-rings (k) defective	Leakage test. Tighten hexagon nut (i) and/or replace O-rings (k)
Pressure difference between P1 and P2 exceeds 22 psi (i.e. pressure not balanced)	Unit defective	Measure pressure at both air springs. Remove and replace unit
Pressure difference between P1 and P2 does not stop at minimum difference permitted (i.e. pressure balanced constantly)	Unit defective	Measure pressure at both air springs. Remove and replace unit

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