VOLUME 1

Introduction

Chassis Frame

Front Axle & Suspension

Rear Axle & Suspension

Air Brakes

Power Drivetrain

Cooling

D3RE

2013

SERVICE MANUAL

APPLIES TO THESE MODELS

ALL AMERICAN REAR ENGINE
TX3 REAR ENGINE
GLOBAL TRANSIT REAR ENGINE

COUNT ON BLUE BIRD

BLUE BIRD

BLUE BIRD

D3RE

10026182
Edition A

The Blue Bird All American complies with all applicable federal and state regulations. These include, but are not limited to, Federal ADA as well as state accessibility, safety and security requirements.

The Blue Bird All American meets all applicable Federal Motor Vehicle Safety Standards (FMVSS) rules and regulations.

In the event of any conflict between the requirements of this publication and any applicable legal requirement, the legal requirement prevails. Technical requirements that exceed the legal requirements are not considered to conflict.

Many of the components of Blue Bird buses are obtained from outside suppliers. Where maintenance and/or service information conflicts with the component manufacturers documentation, the manufactures's documentation prevails.

Blue Bird Corporation continually endeavors to improve its product and reserves the right to change without notice. The material presented in this manual is accurate at the time of publication.

CONTENTS

Volume 1

213
399
413

Volume 2

439
475
483
491
515

Thank You
...and Congratulations!

We at Blue Bird Corporation wish to thank you for your investment of trust in Blue Bird quality, and congratulate you on your operation of Blue Bird's flagship models; the All American RE and All American FE. Blue Bird Engineering continually strives to make serviceability a designed-in feature of both Forward Engine and Rear Engine models.

Blue Bird Strength; Blue Bird Innovation

Blue Bird pioneered the modern D-Type ("transit") school bus platform and takes great pride in it's robust performance, rugged reliability, and heavy duty versatility. The ALL AMERICAN is also all-Blue Bird; both Rear Engine and Forward Engine chassis are built from the ground up at the same Fort Valley, Georgia plant which builds their famous school bus bodies.

The ALL AMERICAN FE and ALL AMERICAN RE, together with their Type C BLUE BIRD VISION, and Type A and Type B MICRO BIRD siblings, comprise a complete line of rugged, built-from-the-ground-up pupil transportation vehicles, providing an ideal fit for any specific school route needs.

First conceived in 1948, the Blue Bird ALL AMERICAN line benefits from over 61 years of continual refinement and modernization. Mated to Blue Bird's renowned school bus body construction standards, the ALL AMERICAN remains the standard by which all transit school buses are measured, and continues to lead the industry in technology, safety, and practical innovation.

Built to purpose. Built to last. Built to bring to your operation maximum economy, efficiency, versatility, and rugged reliability.

Backed By Blue Bird

Blue Bird provides all the behind-the-scenes support you depend upon for success in your school transportation operation:

Blue Bird Authorized Dealers.

Blue Bird administers its full range of Customer Services through a nationwide network of local or regional Blue Bird Authorized Dealers. The Dealer through whom your bus was purchased should always be your first point of contact for information and assistance. Contact information for your dealer is located on the back cover of this manual.

Blue Bird School Bus Support

Your Blue Bird Dealer is equipped and staffed to handle your service-related issues, and also has immediate and direct access to Blue Bird's own factory-based Customer Support. All Blue Bird Support Representatives are true Blue Bird technical experts with long histories at the Blue Bird plants where your buses are built.

Blue Bird School Bus Training

The Training staff of Blue Bird Customer Service conducts an ongoing program of Field Service, Factory Service, and Focussed Training classes and seminars, to ensure that service technicians of Dealers are always up-to-date on the latest service information and techniques. Some of these training classes are open to the service personnel of customers.

Blue Bird Parts Sales

Blue Bird's modern Service Parts facility in Delaware, Ohio ships parts directly to Blue Bird Authorized Dealers and Blue Bird Bus Spec and Bus Care centers nationwide. Blue Bird Parts Sales consists of modern warehousing facilities, efficient ordering and inventory control systems, and expert technical staff who know your bus inside and out. Service Parts also publishes its own parts catalogs, available for customer purchase.

Blue Bird Technical Publications

Blue Bird Driver's Handbooks and Service Manuals are produced and continually updated by a full-time in-house staff with full access to manufacturing assembly lines and Blue Bird Engineering. Additional manuals are available for purchase through your Blue Bird Authorized Dealer.

Blue Bird School Bus Warranty

For your convenience and efficiency, warranty claims are handled at the local Dealer level, as are all other Customer Services. Be assured that your Blue Bird is backed by one of the strongest factory warranties in the industry, and that factory-based Bus Warranty representatives are in constant contact with your local dealer about your warranty issues.

Reporting Safety Defects

If you believe that your vehicle has a defect which could cause a crash or could cause injury or death, you should immediately inform the National Highway Traffic Safety Administration (NHTSA) in addition to notifying Blue Bird.

If NHTSA receives similar complaints, it may open an investigation and, if it finds that a safety defect exists in a group of vehicles, it may order a recall and remedy campaign. However, NHTSA cannot become involved in individual problems between you, your dealer, or Blue Bird Corporation.

To contact NHTSA, you may call the Vehicle Safety Hotline toll-free at:
1–888–327–4236 (TTY: 1–800–424–9153)
or go to:
http://www.safercar.gov
or write to:
Administrator, NHTSA,
400 Seventh
Street, SW., Washington, DC 20590
You can also obtain other information about motor vehicle safety from:
http://www.safercar.gov.

About This Manual

This manual is a reference intended for use by qualified technicians performing maintenance and service procedures on the Blue Bird ALL AMERICAN bus. Blue Bird Technical Publications endeavors to continuously improve the value of its manuals. Your comments and suggestions are welcome and we value the feedback we receive from our users. Send your comments to:

Blue Bird Body Company
Attn: Technical Communications Dept
P.O. Box 937
Fort Valley, Georgia 31030

Safety Precautions

Throughout this manual are precautions labeled Warnings and Cautions, and set in the style shown here:

WARNING ***The Warning designation is generally used for precautions which, if not properly observed while performing the related procedures or handling materials, could result in serious personal injury or death.***

CAUTION ***The Caution designation is generally used for precautions which, if not properly observed while performing the related procedures or handling materials, could result in damage to the bus or its equipment.***

This manual is intended for use by qualified professional service technicians who understand and observe all appropriate safety precautions and procedures associated with work on heavy vehicles. The user of this manual must read and abide by all safety warnings noted not only in this manual, but also on the labels and documentation for all tools, materials, and parts used.

Scope and Content

In the design of the ALL AMERICAN, Blue Bird Engineering has utilized many carefully selected and precisely matched top quality components from some of the most respected names in heavy-duty vehicle industries. Blue Bird designs and configures the systems in which these components are used, but does not manufacture the components themselves. The primary scope of this manual, therefore, is to provide service information about the Blue Bird vehicle itself, i.e.; the systems which Blue Bird designs and builds, but not on the inner workings of purchased components.

Obvious examples are the Cummins engine and Allison transmission. Although this manual includes general maintenance information (such as fluid change intervals), technical information about the engine and transmission is beyond the scope of this manual. Refer to Cummins and Allison manuals which were delivered with the bus, and/or contact the manufacturers and their service outlets for additional information. Your Blue Bird Dealer can assist you in determining specific documents needed, and by providing appropriate contacts.

Organization

The bulk of this manual is arranged in topic chapters, each beginning with a general overview followed by more specific component-level information and, where appropriate, troubleshooting and/or maintenance guidelines.

Like the engine and transmission, many of the bus's system components are not manufactured by Blue Bird. But the understanding of major components is essential to understanding and servicing the system. As a courtesy to our customers, this manual includes many component-specific service documents, obtained directly from the components' manufacturers. These documents are reprinted as appendixes located at the end of the appropriate topic chapters. Because the documents are printed unmodified and in their entirety, each appendix carries its own page numbering within the border of the reduced page. To clearly differentiate these supplemental documents from Blue Bird-authored material, and to provide margin markings to aid the reader in location and navigation, they are reprinted at a slight reduction. The right margin of appendix pages carries the same style page numbering as the rest of the manual. These larger number markings bleed off the right edge to provide a visual index referenced to the Table of Contents. The large page numbers are also the ones referenced in the Index.

The appendixes have a similar marking arrangement across the bottom margin to provide a handy visual indication of the page range of each appendix.

Using the Appendixes

It is important that the user of this manual bear in mind that the appendixes are component manuals and other documentation reprinted with permission in their entirety, and therefore may contain generic and/or additional information not exclusively specific to the Blue Bird ALL AMERICAN. For example, a component-specific document may include general service information covering several models of the manufacturer's product line; including, but not limited to the particular model used in the Blue Bird ALL AMERICAN. The technician must make certain to refer to the section(s) of the appendixes appropriate to the unit being serviced.

Vendor-supplied component documents used in the appendixes may also provide detailed rebuild or reconditioning information which Blue Bird does not recommend. In the interest of safety assurance, Blue Bird policy is to replace—not to rebuild—components such as valves, hydraulic cylinders, etc. Blue Bird assumes no responsibility for disassembly/repair procedures described in the vendor-supplied publications. If in doubt, call your Blue Bird Dealer for advice.

The information contained in this manual is the most current available at the time of publication. Blue Bird follows a policy of continuous product improvement and reserves the right to make product changes without notice and without incurring liability. Also, school buses are built according to a range of differing state specifications and customer-requested options. If any apparent discrepancies are encountered between the material in this manual and the bus(es) being serviced, consult with your Blue Bird Dealer and/or the specific component's manufacturer before proceeding.

About the TechReference DVD

While Blue Bird TechPubs recognizes the practical convenience of physical manuals in the shop, and endeavors to continue improving its technical publications in print form, we also want Blue Bird technicians to be able to utilize the advantages of electronic documentation.

The companion TechReference Digital Versatile Disk included with this book contains this service manual in handy electronic form as well as additional materials which will be of value to the service technician. Manuals on the DVD are saved in Acrobat Portable Document Format (PDF). PDF files can be opened, viewed, navigated, searched, and printed using the freely-distributed Adobe Reader program. For your convenience, the installer for the version of Adobe Reader current at the time of publication is also included on the DVD. You may also download the most current version of Adobe Reader via the internet at www.Adobe.com.

You may use the PDF version of the manual by either reading it directly from the DVD, or by reading it from copies of the files on your computer's internal hard disk. (Reading from the DVD will be somewhat slower than using a copy on your hard disk, but is still reasonable for most users.)

The efficiency of electronic distribution via PDF has also allowed us to include these additional materials:

Drivers Handbook

The Drivers Handbook for the Blue Bird ALL AMERICAN is included on the DVD. This may be used to provide copies of the Operator's Manual to all the drivers in your operation, while leaving the print copy in the bus, or for home or in-office reference.

Additional Component Service Documents

Some chapters of the Service Manual on the DVD may contain additional component-manufacturer documents which are not practical for reprinting in the printed manual. For example, the entire Bendix Steering Gear manual is on the TechReference DVD as an appendix to the Steering chapter.

Service Bulletins or Updates

Depending upon time of publication, some issues of the TechReference DVD may include Service Bulletins or Service Updates which were released between releases of the printed manual.

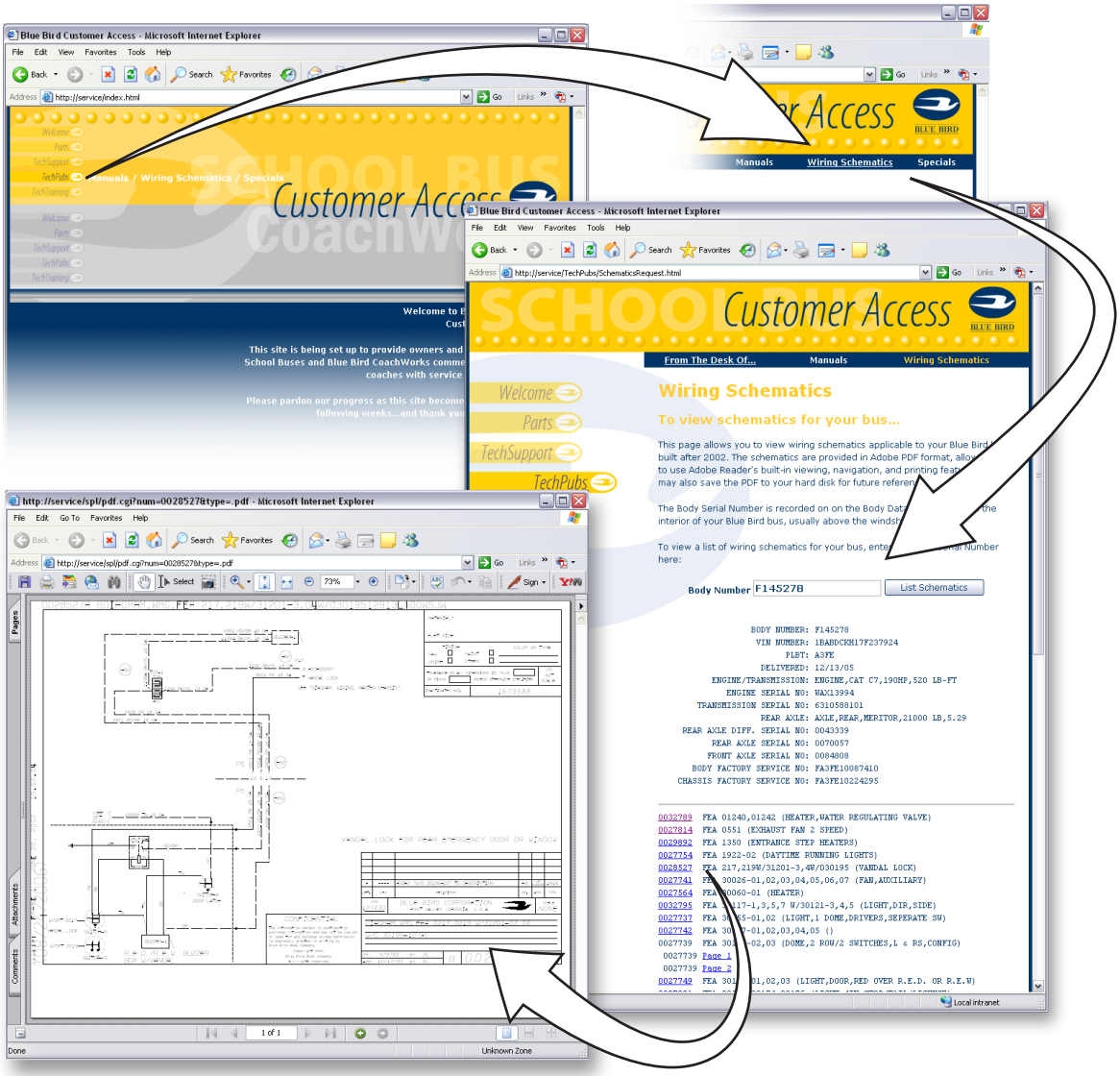
Electrical Schematics

This printed manual contains the main wiring schematics which are most commonly needed in troubleshooting, and which apply to the majority Blue Bird ALL AMERICAN buses. However, the wide range of available options for Blue Bird buses yields a large number of additional wiring diagrams pertaining to specific features.

Blue Bird Technical Communications provides a web page at which you can view additional wiring schematics for your bus at its Customer Access web site:

http://service.blue-bird.com/wiringschematics

Enter the Body Number for your bus. You will be presented a list of wiring schematics. The schematic drawing numbers are links which can be opened in Adobe® Reader™ to browse, zoom, pan, or print the drawing.



Chassis Frame Overview

The Blue Bird All American's chassis frame consists of two main C-channel rails which run the entire length of the bus, and several different kinds of cross members located at strategic intervals. This ladder-like structure forms the backbone of the vehicle's chassis. The exact number and placement of cross members varies according to body length, type of suspension and other equipment.

On Rear Engine All Americans, engines are supported by straight sub-frame members bolted against the bottom flange of the rear end of the main frame rails. Rear bumper brackets and tow hooks are bolted to the sub-frame members. Front bumper brackets are mounted to the main frame rails.

The All American's body assembly is mounted to the chassis's main frame rails by a system of bolted-on clamps and angled brackets. Square rubber pads are clamped at floor-to chassis contact points to help minimize vibration and metal fatigue.

Maintenance Overview

The All American's frame was developed under stringent accelerated wear and fatigue testing to ensure robust performance and long life. The major structural components of the frame should not require servicing under normal conditions. However, they should be included in routine visual inspections. The body-to-chassis attachment points should be regularly inspected and tightened.

- Inspect frame rails and cross members for signs of cracks, vibration, or loose fittings any time work is being performed under the bus, at regular inspection intervals of 3 months. Watch for telltale signs of possible structural damage, such as cracked paint, vibration residue around joints and fasteners, and/or corrosion.

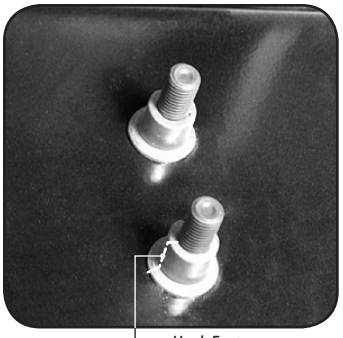
- Check for deteriorated, shifting or missing tie-down pads. Replace if needed.

- After the first 1000 miles of operation and at 3 month intervals thereafter, tighten all body tie-down points to the torque value appropriate for each type of tie-downs.

Huck Fasteners

Frame members and many related components are assembled using special Huck Spin fasteners which provide extremely secure and fatigue-resistant permanent joints. A Huck fastener consists of a threaded pin onto which a collar is permanently swaged under high mechanical pressure.

Huck Spin fasteners require special tools for assembly and should not be considered serviceable items under normal circumstances However, damage due to collision or extreme operating conditions may require replacement of a part which is assembled with Huck fasteners. If the need for such a repair is determined, contact your Blue Bird Dealer or Blue Bird Customer Service for consultation.



Huck Fastener
Removal requires cutting along length of swaged collar.

Removal/Replacement

Although normally meant to be a permanent attachment, a Huck fastener may be successfully removed as follows:

1. Inspect the joint thoroughly and take all safety measures and precautions to ensure that all components, which are affected on both sides of the fastener, are fully supported.

2. Cut along the length of one side of the collar using one of these methods:

   - Drilling: Using a drill bit slightly larger than the nut's wall thickness, drill along the length of the collar, parallel to and against the side of the pin.

   - Grinding: Using a grinding/cutting wheel on a high-speed rotary tool, cut along the length of the collar.

   - Chiseling: Using an air hammer equipped with a chisel blade, cut the collar on one side of its length.

   - Torch: Using an oxy-acetylene cutting torch, cut the collar along one side of its length.

huckspin				grade 8 bolt, washers, nut						
Blue Bird Part Number	Huck Number	Nominal Length	Grip Range	Blue Bird Part Number	Nominal Length	Thread	Flat Washer	Nut	Locking Nut	Material Thickness
1636943	10	2.25	0.43–0.90	0803239	1.5	½–13	1003045	½–20	0850800	0.25–0.75
1636943	10	2.25	0.43–0.90	0803148	1.75	½–13				0.50–1.00
1636950	16	2.60	0.85–1.25	0803148	1.75	½–13				0.50–1.00
1636943	10	2.25	0.43–0.90	0959542	1.75	½–20				0.50–1.00
1636950	16	2.60	0.85–1.25	0959452	1.75	½–20				0.50–1.00
1636950	16	2.60	0.85–1.25	0803205	1.75	½–13				0.75–1.25
1746817	20	2.85	1.09–1.50	0803205	2.00	½–13				0.75–1.25

WARNING ***Whenever using a cutting torch to cut a Huck fastener collar, ensure that the torch does not also damage the mounted brackets or parts. If the fastener to be cut is in proximity to any part that may be damaged by the conducted heat of the cutting operation, use another method to remove the collar.***

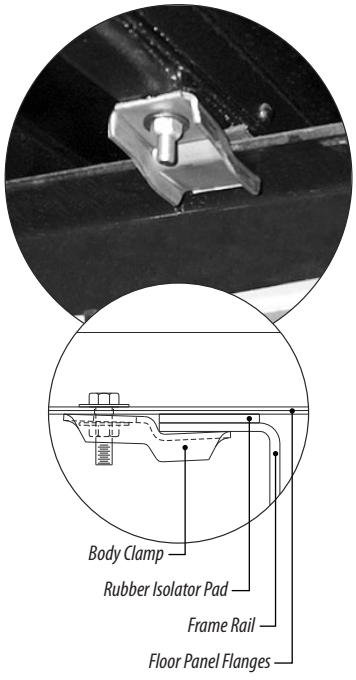
3. After drilling, use a cold chisel to break the collar or to spread it enough to allow removal. Remove the threaded bolt, using a hammer to tap it out if neces-sary.

4. Discard all parts of the removed Huck fastener. Do not attempt to re-use the bolt. Removed Huck fasteners must be replaced with appropriately-sized grade 8 bolts lock nuts, using hardened washers on both sides.

Body Tie-down Clamps and Angles

At most places where a joint between two adjacent body floor sections crosses the main frame rails, body tie-down clamps secure the body to the main frame rails. The clamps bolt to the floor joint body bar angles and, when tightened, clamp against the inboard edge of the frame rail's upper flange.

Wherever equipment mounted between the main frame rails prevents the use of a body tie-down clamp (for example, in the area of the rear mounted fuel tank), body tie-down angles are bolted to the outboard side of the frame rail and to the floor joint body bars.



Inspection/Adjustment

All body tie-down clamps and angles should be checked for proper tightness after the first 1000 miles of operation and every three months thereafter. Tighten to 37–41 ft. lbs. (50–56 Nm).

Rubber Mounting Pads

At each location where an Auxiliary Floor Cross Member crosses the main frame rails, a small square rubber pad is clamped between the body floor and the chassis rail. These pads help minimize vibration and fatigue.

Inspection/Replacement

Loss of the rubber pads can result in an airspace and subsequent loosening of the associated tie-down clamp(s) or angle(s). Wherever the rubber pads have deteriorated or fallen out, they should be replaced as follows:

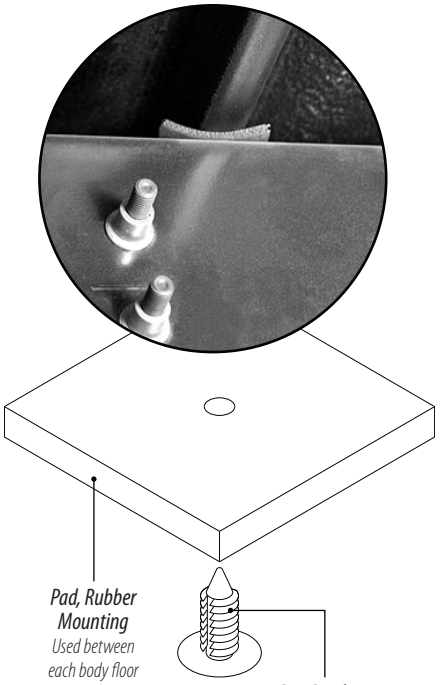
1. Prepare the bus for working underneath according to the precautions in Chapter 1.

2. Loosen the tie-down clamp bolt(s) near the damaged or missing rubber pad.

3. Using an appropriate jack positioned on the Auxiliary Cross Member, raise the body floor only sufficiently to replace the pad.

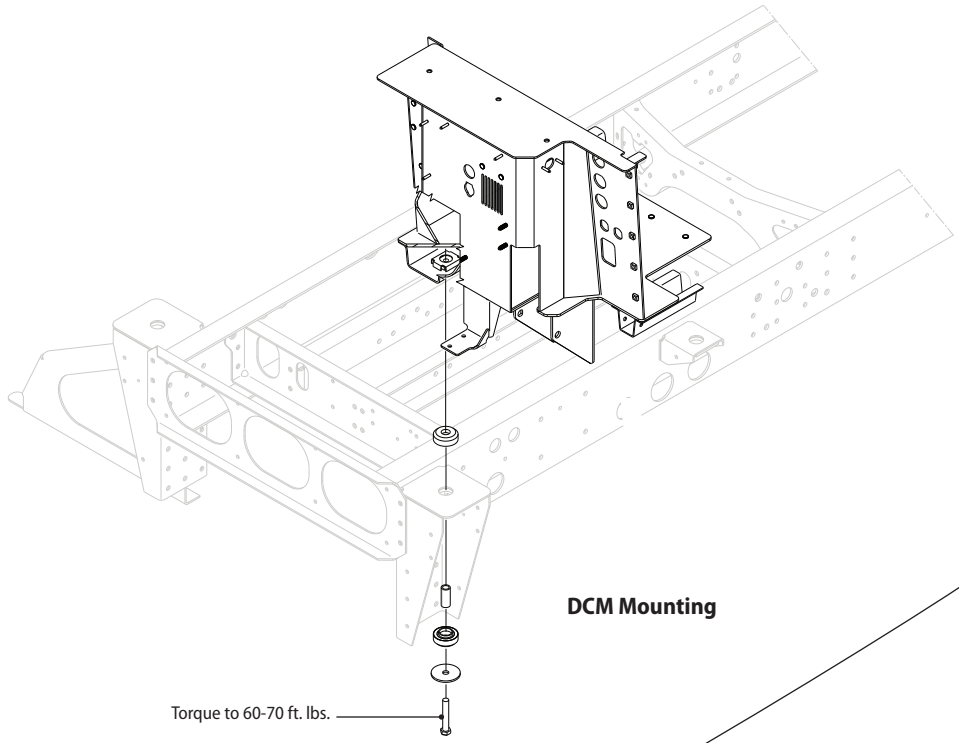
CAUTION ***Raise the body bar with the jack only the minimum distance required, to insert the new pad and its plastic push in retainer. Do not overstress the body. If undue resistance is encountered, loosen more body tie-down points in the vicinity of the repair.***

4. After replacing the pad, retighten all body clamps that were loosened to 37–41 ft. lbs. (50–56 Nm).

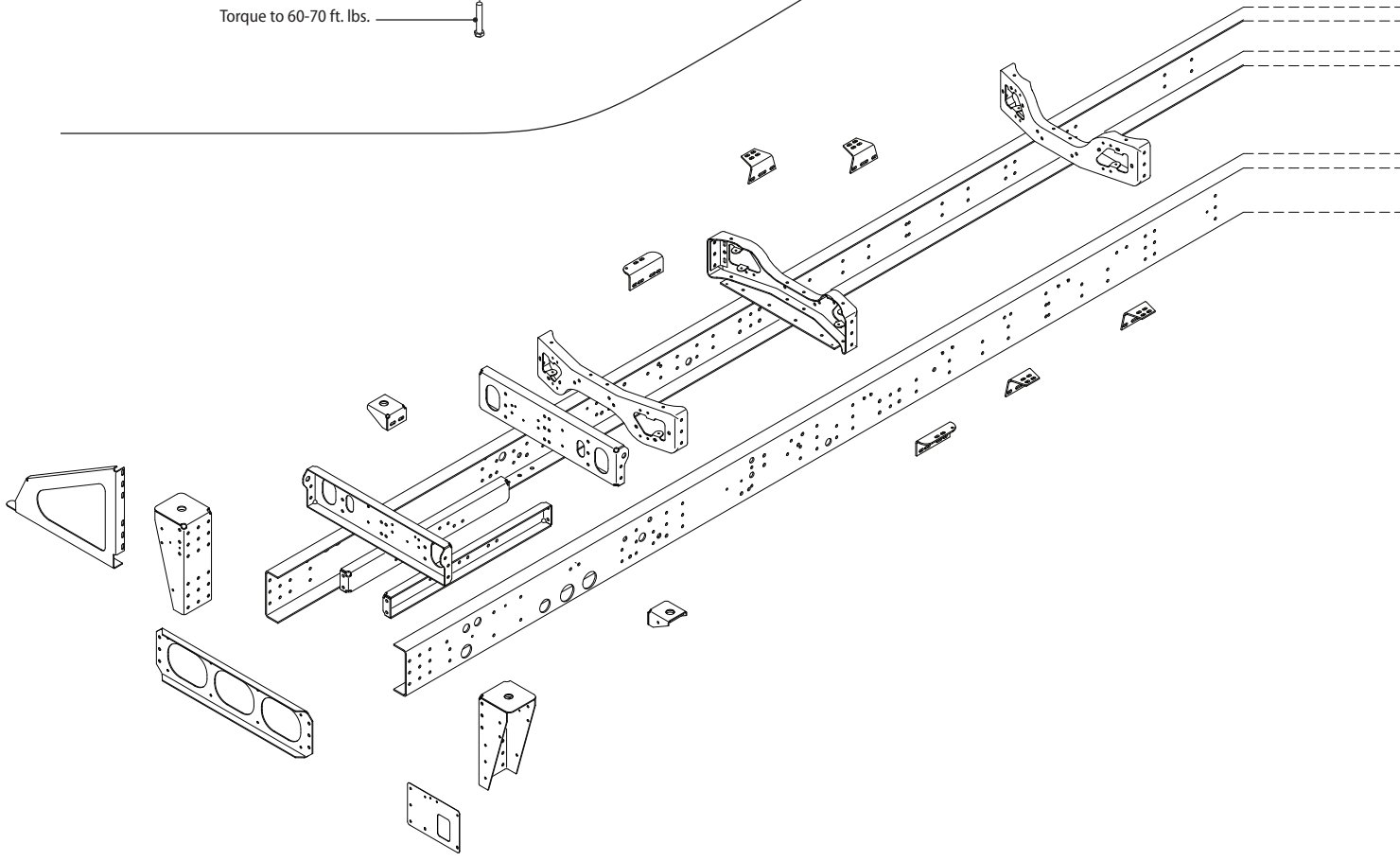


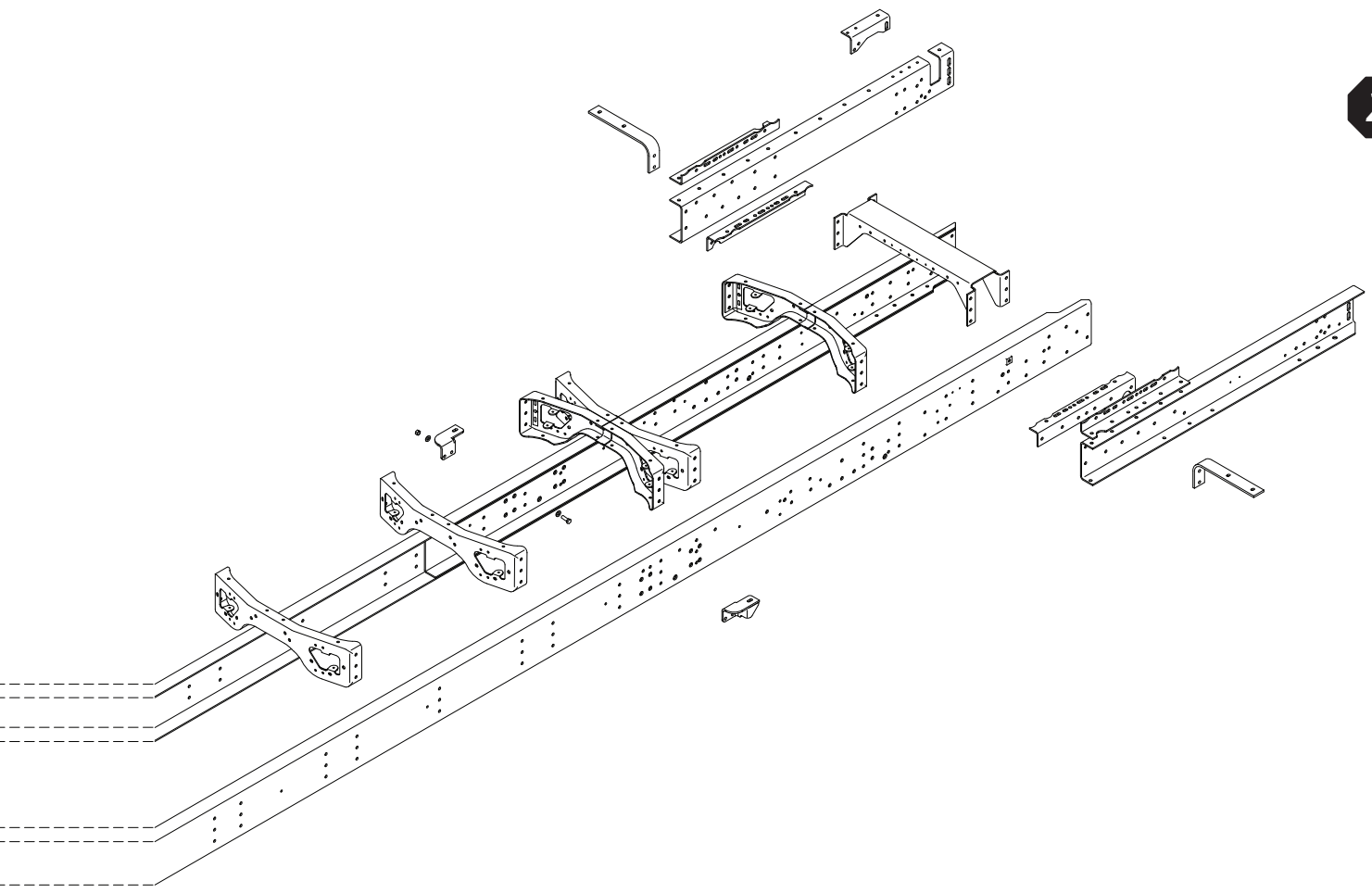
Pad, Rubber Mounting
Used between each body floor crossmember where it crosses the chassis frame rail
BB # 1628833

Pin, Ratchet
Secures the rubber pad in position.
BB # 1160399



DCM Mounting





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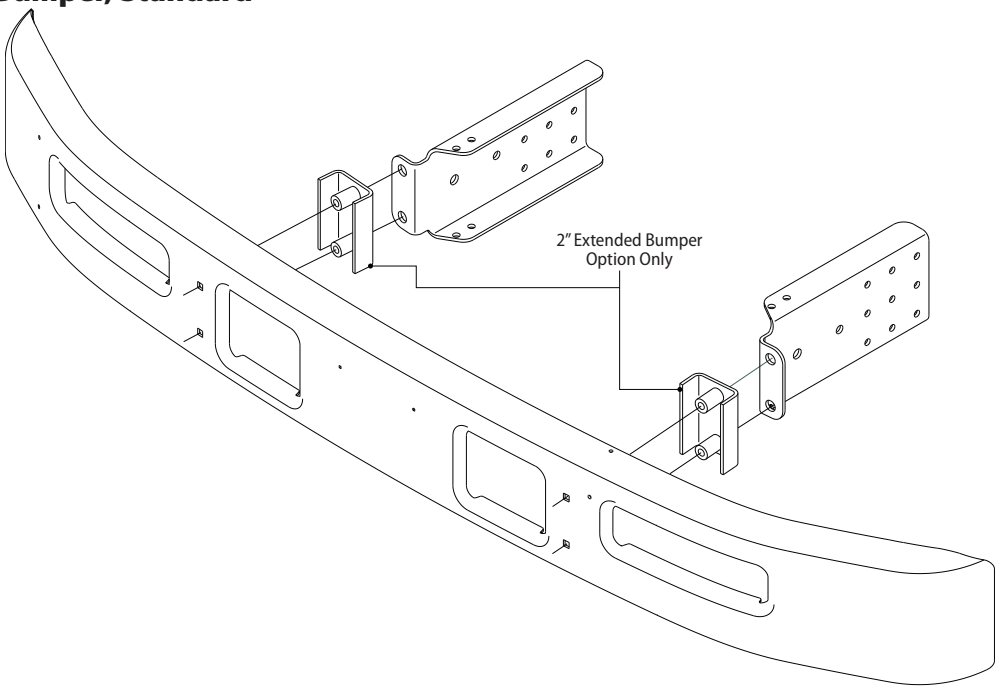
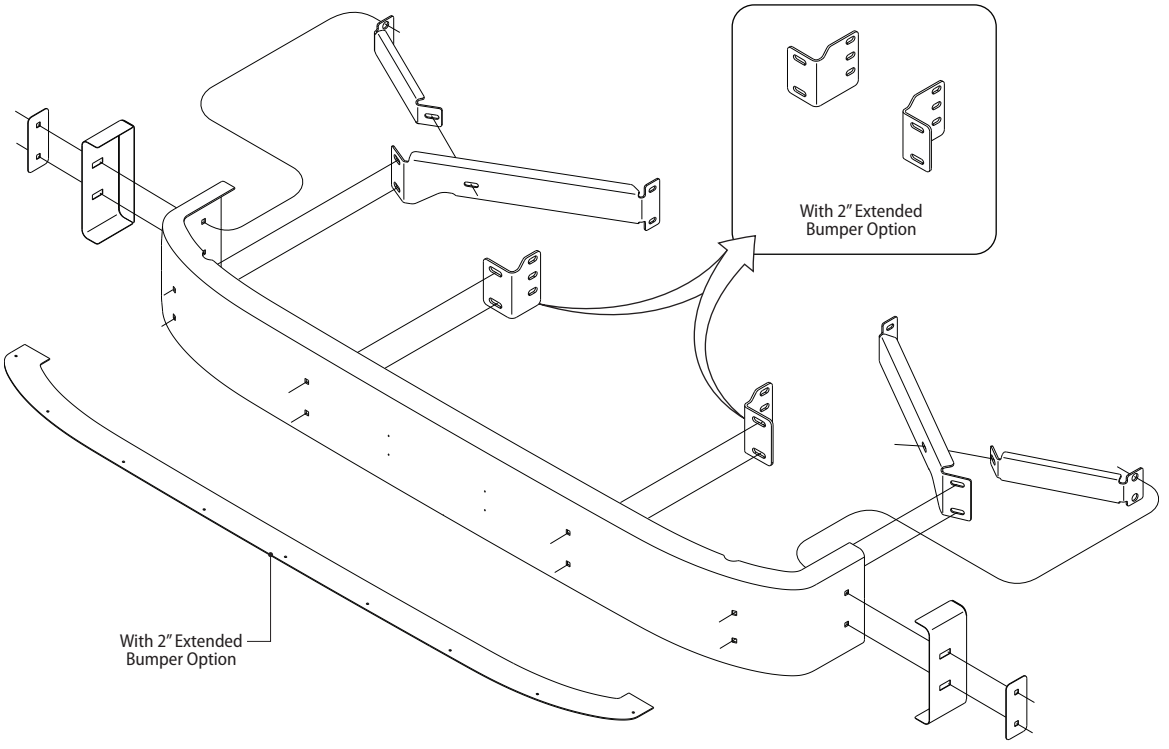
Chassis Frame

Bumpers & Tow Hooks

Front Bumper, Standard



Rear Bumper, Standard



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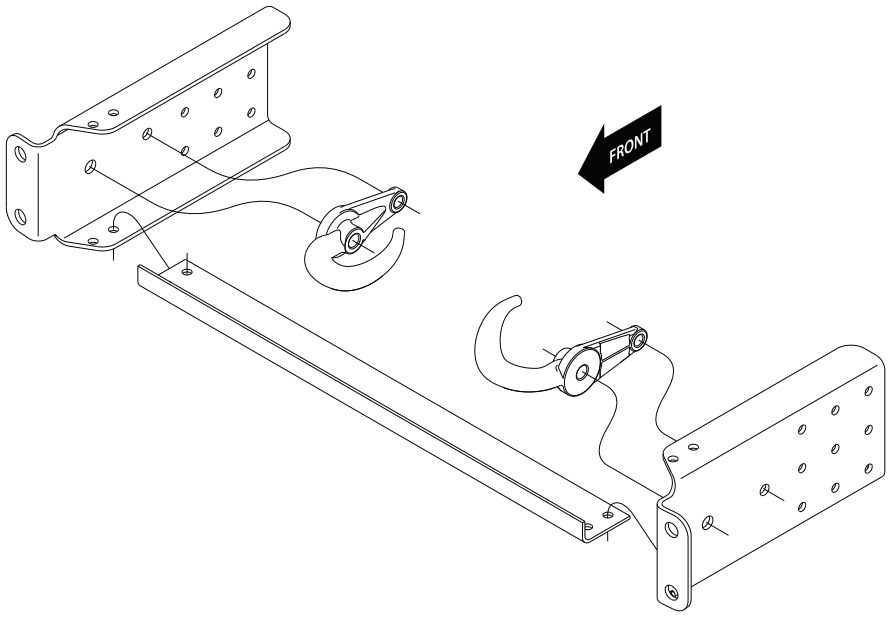
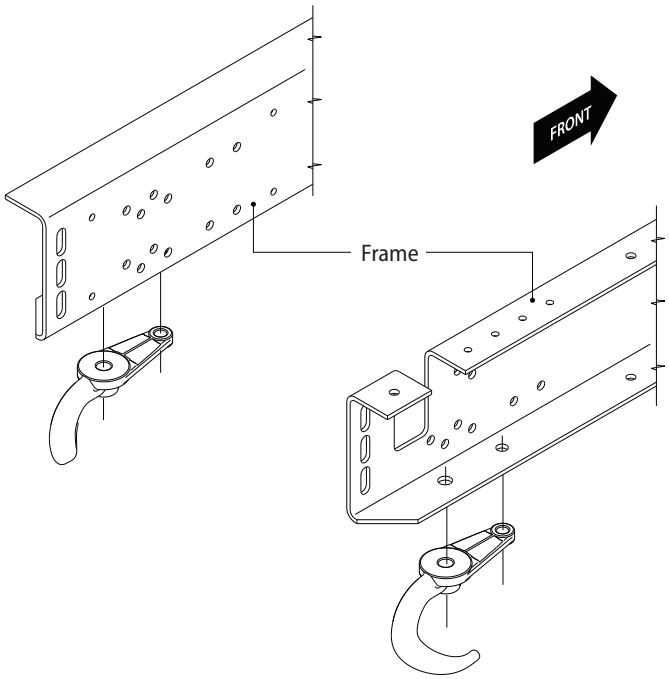
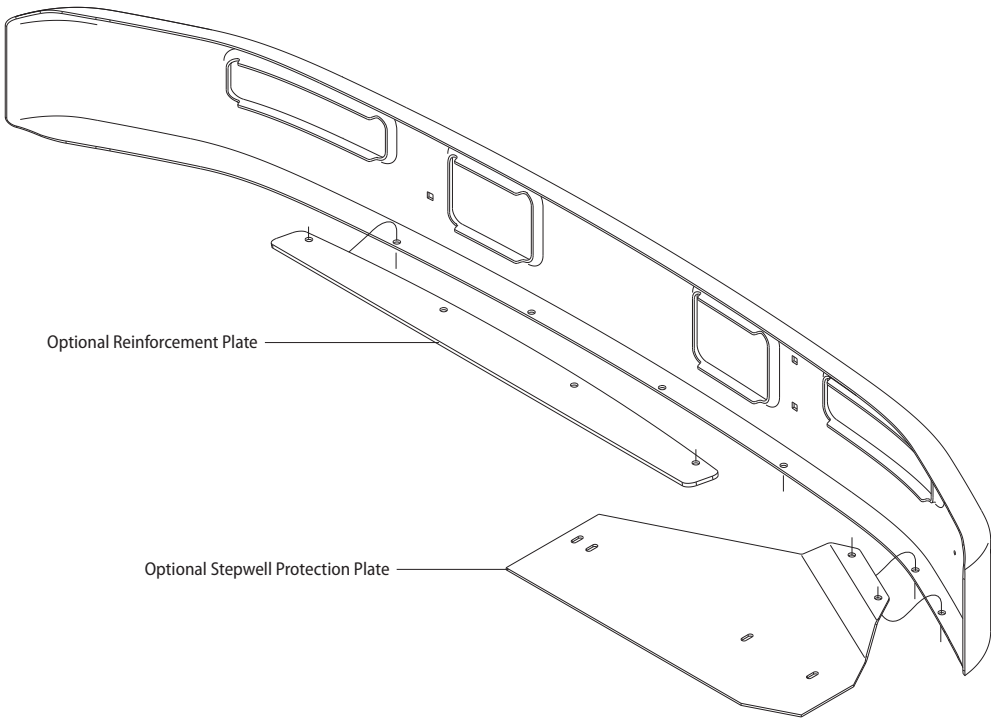
Front Tow Hooks



Rear Tow Hooks



Front Bumper Options



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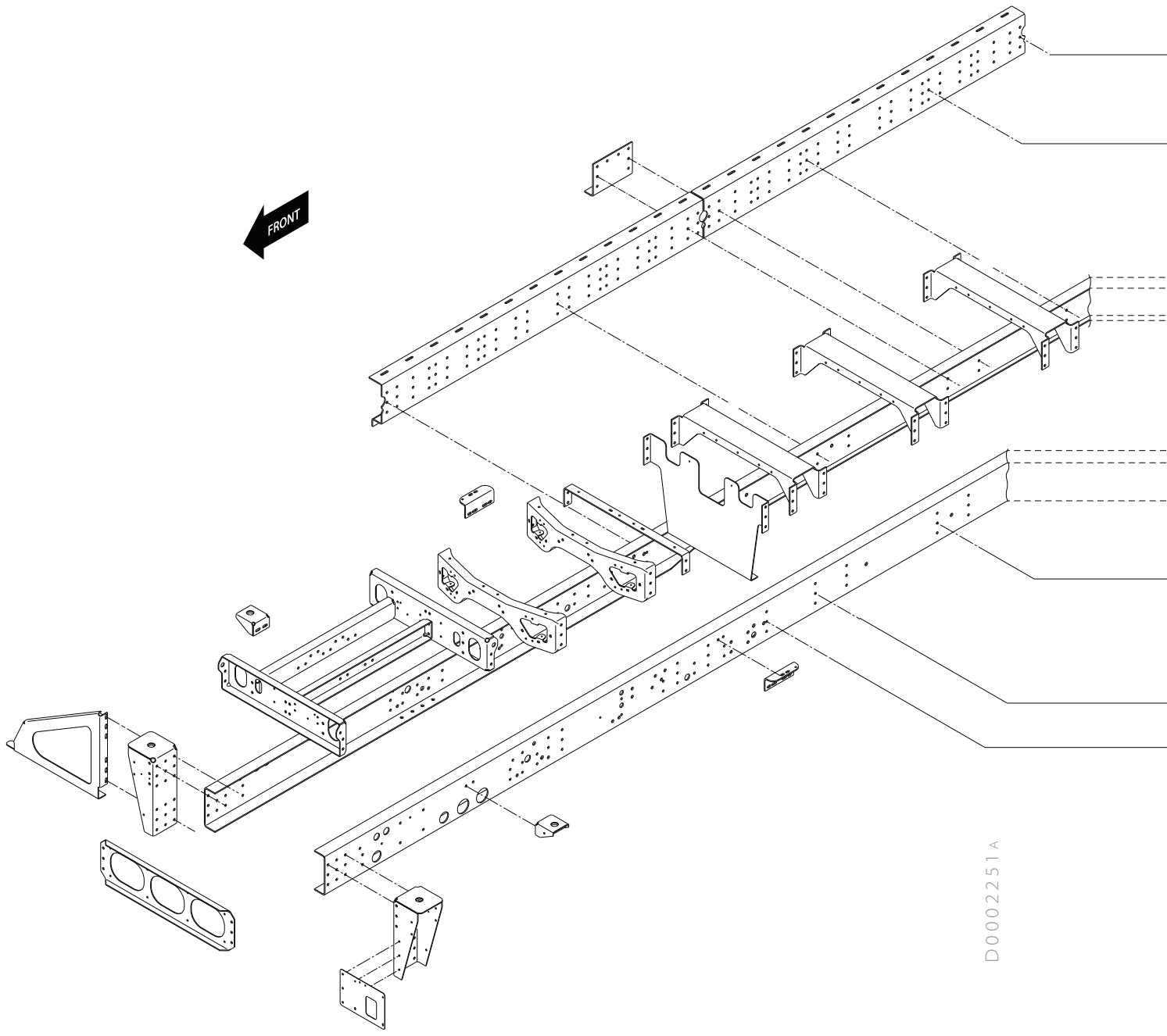
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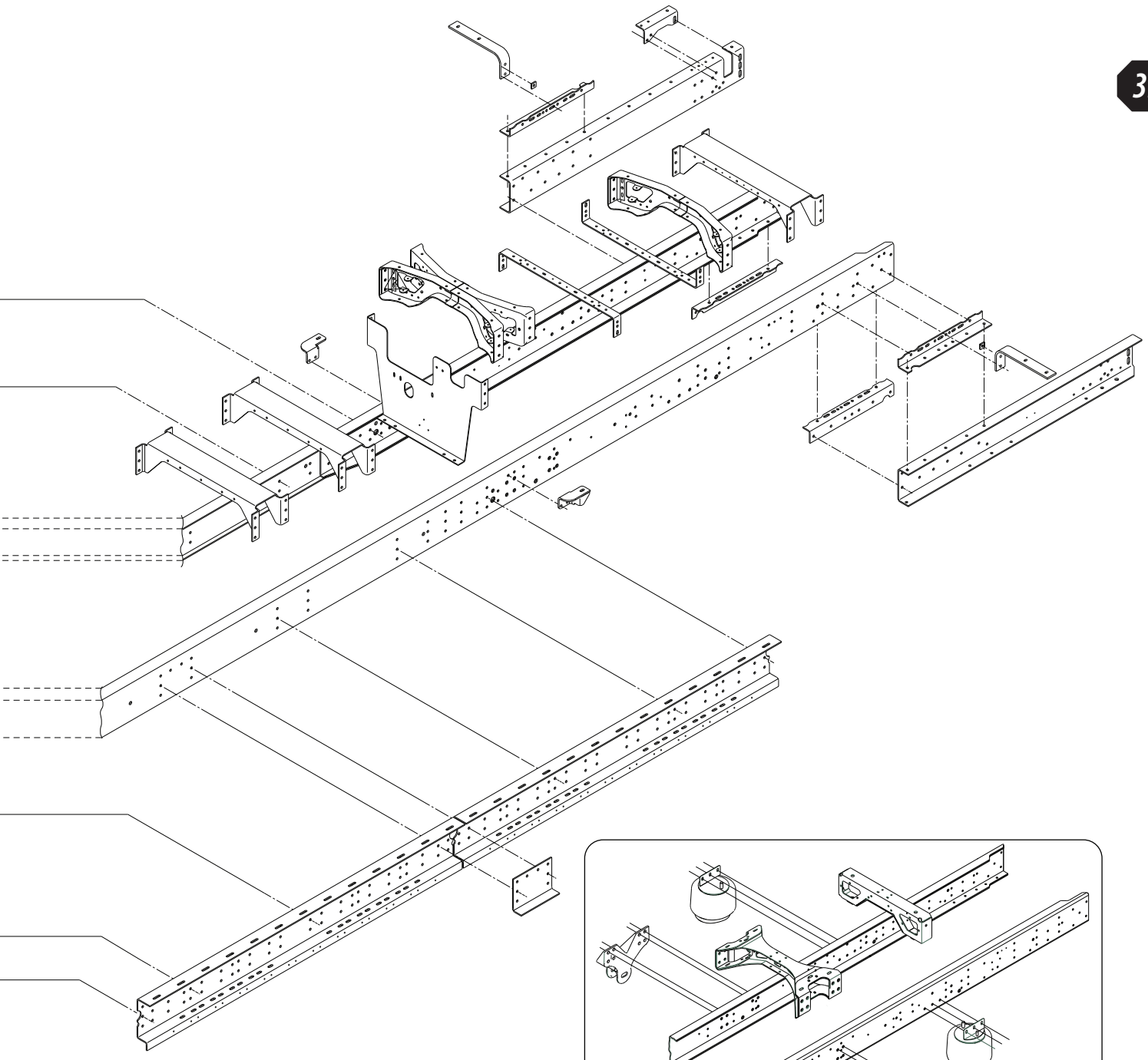
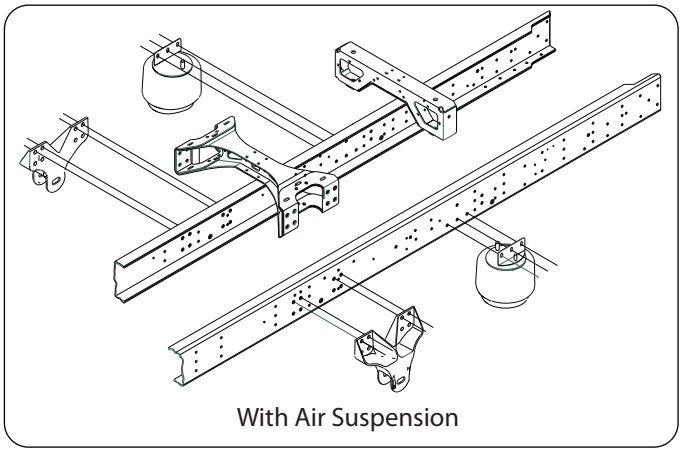




With Air Suspension

Chassis Frame, CNG

Overview

Front Suspensions

The Blue Bird All American is equipped with one of three front suspension systems:

Hendrickson™ SofTek.™ The Softek front suspension is a three parabolic leaf spring configuration, and is standard equipment on both Front Engine and Rear Engine All American.

Hendrickson™ AirTek.™ The Airtek front suspension is an air spring suspension used on both Forward Engine and Rear Engine All Americans equipped with air suspension option. Two leveling valves maintain ride height at varying axle loads.

Ridewell™ Model 227. The Ridewell 227 front suspension is an air spring suspension incorporating a parallel linkage, and is optional on Rear Engine All American only. A single leveling valve is employed to maintain ride height at varying loads.

Axles

Hendrickson™ SteerTek. Both Forward Engine and Rear Engine All Americans are equipped with Hendrickson SteerTek front axles. The SteerTek axle includes an anti-lock brake system and is used in 13,200 and 14,600 lb. capacities on All Americans.

The specific Hendrickson axle model installed may be identified by refering to the axle numbers etched near the center front of the axle's main beam.

Appendixes & Other References

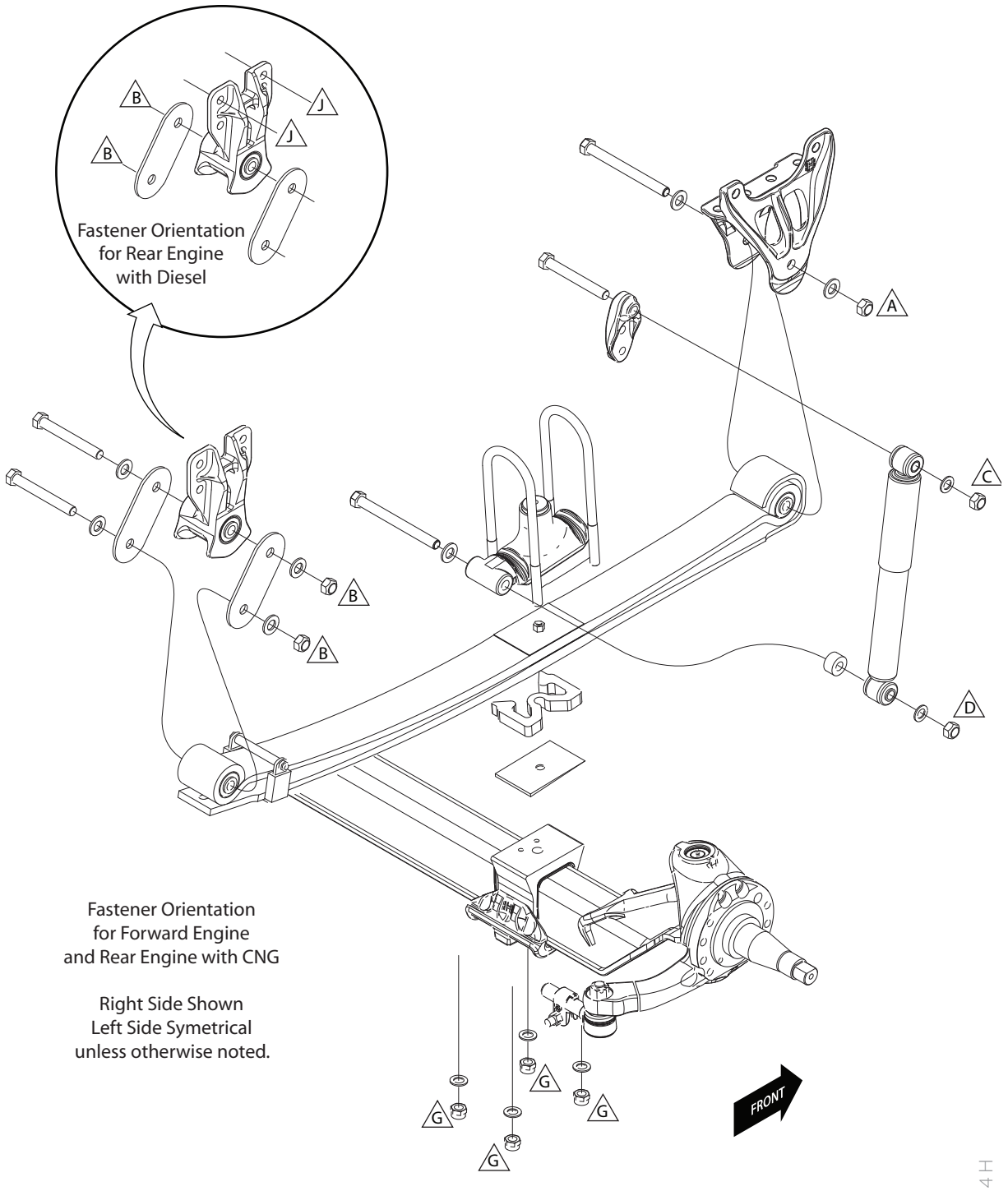
Appendix 1. AirTek & SofTek. Hendrickson Publication number 17730-248 covers maintenance, adjustment, and component replacement information on the SofTek leaf spring suspension. Please note that this Hendrickson publication also incorporates information on Hendrickson's SteerTek front axle and AirTek front air suspension.

Appendix 2. Ridewell Air Ride 227 Service Manual. Ridewell publication covers maintenance, adjustment, and component replacement information on the Ridewell front and rear air suspension

Also See: The Hydraulc Brakes chapter of this manual includes a procedure for removing the front disc rotor/hub assembly.

Maintenance

Maintenance of the front axle and suspension consists of periodic general inspection, checking tightness of fasteners, and lubricating grease fittings. Refer to the maintenance charts in this chapter (also included in the **Specs & Maintenance** chapter) for maintenance inspection intervals. The exploded illustrations in this chapter include torque specifications.



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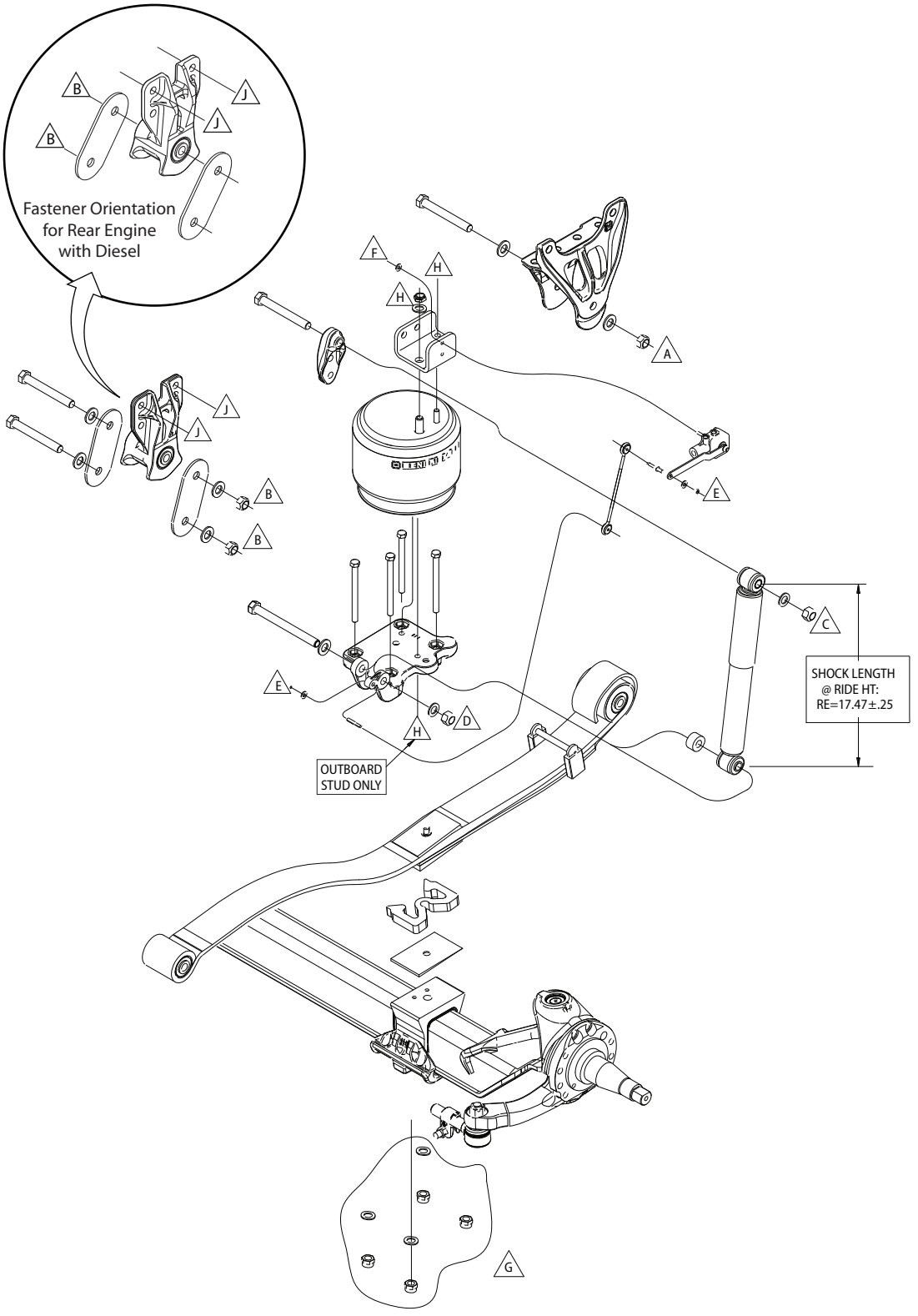
SofTek Front Suspension

Torque Requirements

KEY	DESCRIPTION	TORQUE +- 5%
A	Front Hanger Pivot	300 ft.lbs.
B	Shackle Bracket Pivot	300 ft.lbs.
C	Upper Shock	125 ft.lbs.
D	Lower Shock	125 ft.lbs.
E	Linkage Rod Assy Locknut	11 ft.lbs.
F	Leveling Valve Lockout	8 ft.lbs.
G	Axle Clamp Group Nuts	295 ft.lbs.
H	Air Spring Mounting Stud Locknuts (All)	25 ft.lbs.
J	Shackle Bracket Locknuts	120 ft.lbs.

Front Axle Alignment Specs

Caster:	**4.5° ± 1.5° positive**
Camber:	**± 1.0° (left & right) 2 Total**
Cross Caster:	**1.00° max**
Toe In:	**0.060″ ± .030″**



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AirTek Front Air Suspension

Torque Requirements

KEY	DESCRIPTION	TORQUE +- 5%
A	Front Hanger Pivot	300 ft.lbs.
B	Shackle Bracket Pivot	300 ft.lbs.
C	Upper Shock	125 ft.lbs.
D	Lower Shock	125 ft.lbs.
E	Linkage Rod Assy Locknut	11 ft.lbs.
F	Leveling Valve Lockout	8 ft.lbs.
G	Axle Clamp Group Nuts	295 ft.lbs.
H	Air Spring Mounting Stud Locknuts (All)	25 ft.lbs.
J	Shackle Bracket Locknuts	120 ft.lbs.

Front Axle Alignment Specs

Caster:	**4.5° ± 1.5° positive**
Camber:	**± 1.0° (left & right) 2 Total**
Cross Caster:	**1.00° max**
Toe In:	**0.060" ± .030"**

Ride Height Adjustment

Ride height may be verified by measuring either shock length or air spring height:

1. With leveling valve and linkage installed as shown and air system at 80 PSI or greater, right hand side shock length from centerline of eye to centerline of eye should be 17.47" ± .25" for Rear Engine models.

2. If adjustment is required, loosen leveling valve body mounting fasteners from the frame rail and rotate valve counter-clockwise or clockwise to lengthen or shorten shock dimension.

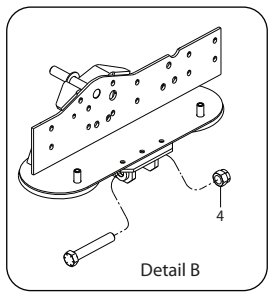
3. Tighten valve mounting fasteners to 8 ft. lbs.

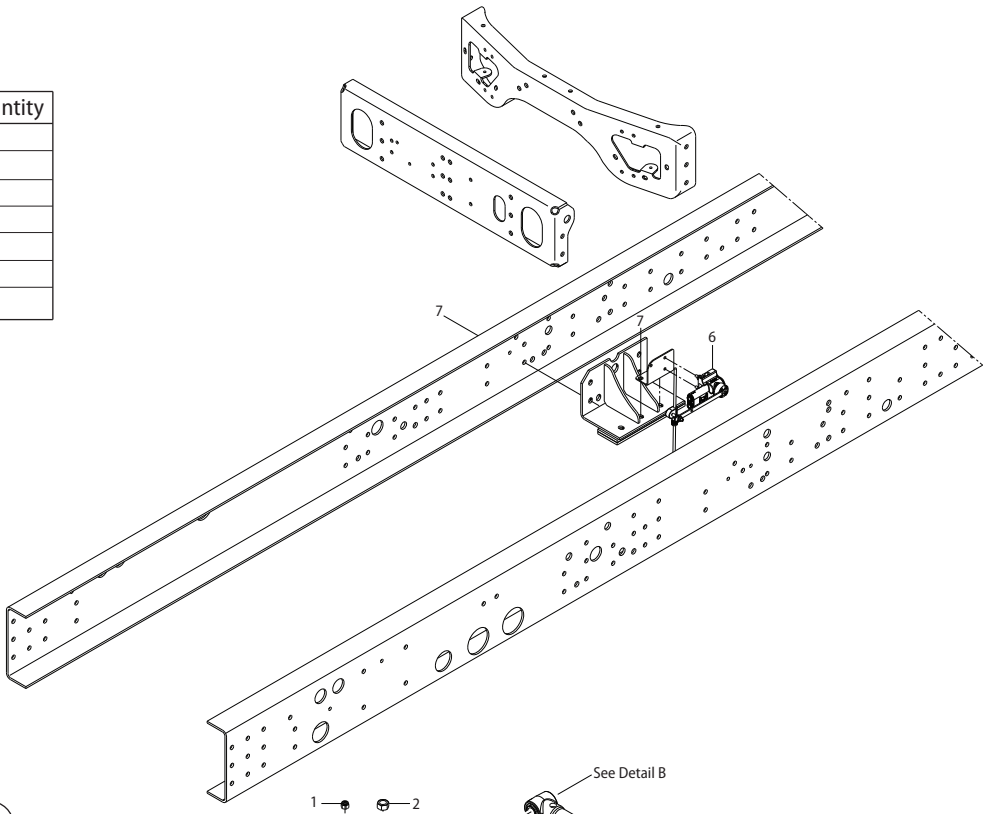
4. Remove vertical link lower grommet from stud on spring pad, lower valve horizontal arm, and release all air from bag.

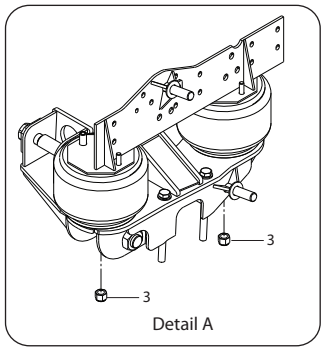
5. Reconnect link and verify shock length according to step 1. If measurement is not correct, repeat steps 1 thru 5 until proper ride height is achieved.

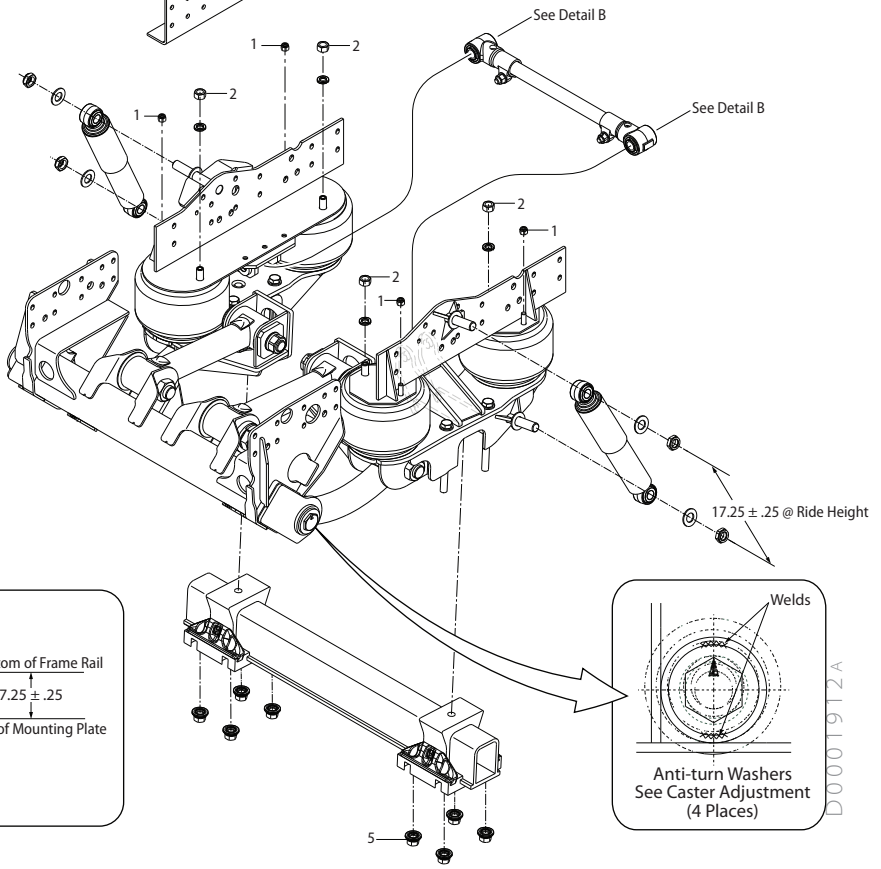
6. Repeat steps 1 thru 5 for left hand side.

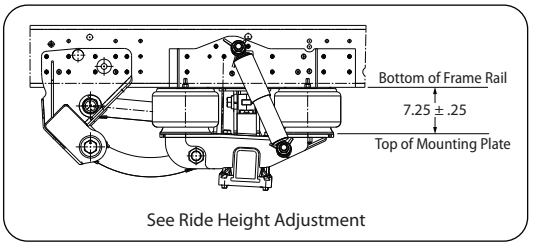
Item	Torque	Quantity
1	25 ft.lbs.	4
2	50 ft.lbs.	4
3	50 ft.lbs.	4
4	460 ft.lbs.	2
5	340-360 ft.lbs.	8
6	60-80 in.lbs.	
7	52-56 ft.lbs.	9











Ridewell Front Air Suspension

Caster Adjustment

With bus at normal ride height, check caster using Beeline or other suitable equipment.If adjustments are required:

Ridewell Axle Adjustment Specs.

Caster: 4.0° ± 1.0°

Toe: .03" ± .030"

1. Knock loose the welded anti-turn washer. Loosen nut on eccentric bolt(s).
2. For caster adjustment, Loosen nut on eccentric bolt(s) and rotate head of eccentric bolt(s) as required.
3. Torque eccentric bolt nut(s) to 1000 ft-lbs.(s) as required.
4. Install anti-turn washer over head of eccentric bolt and weld as shown.
5. Adjust toe by rotating tie rod.

Ride Height Adjustment

Ride height is the distance between spindle and bottom of frame rail: 6.75 ±0.25 w/3.5 drop axle (Rear Engine). Ride height may be verified by measuring either shock length or air spring height. Averaging of side-to-side measurments is recommended.

Shock length @ ride height (eye to eye): 17.12 ±0.25

Air spring height @ ride height: 7.25 ± 0.25. See detail B.

1. Remove the leveling valve linkage vertical rod from horizontal arm and from lower stud.
2. With vehicle on level ground, and 70 -120 psi system air pressure maintained, rotate valve horizontal lever arm down to fully exhaust air springs.
3. Rotate horizontal lever up, filling air springs until vehicle is at specified ride-height (average of left and right sides). Bring arm to neutral (horizontal) position when proper height is reached.
4. Place centering pins in valve to hold arm horizontal. Insert vertical link into upper connector, sliding up or down until lower grommet can be pushed onto lower mounting stud. Tighten hose clamp on upper connector and remove centering pins from valve.

5. Remove vertical link lower grommet from mounting stud and rotate horizontal link down to exhaust air.

6. Reinstall grommet on mounting stud and recheck ride height. If adjustments are necessary, loosen hose clamp, slide connector up or down as required.

7. Tighten clamp and repeat steps 5 & 6 until ride height measurement is within specifications.

Koni Shocks Damping Adjustment

1. Remove the shock absorber from the vehicle. Place the lower eye attachment in a vise. Fully collapse shock absorber while turning the dust cap to the left (counterclockwise) until it is felt that cams of the internal adjusting nut engage in the recesses of the internal foot valve. While engaged, turning the dust cap fully counterclockwise puts the shock at its minimum damping setting. Skip to step 3 if no damping increase is required.

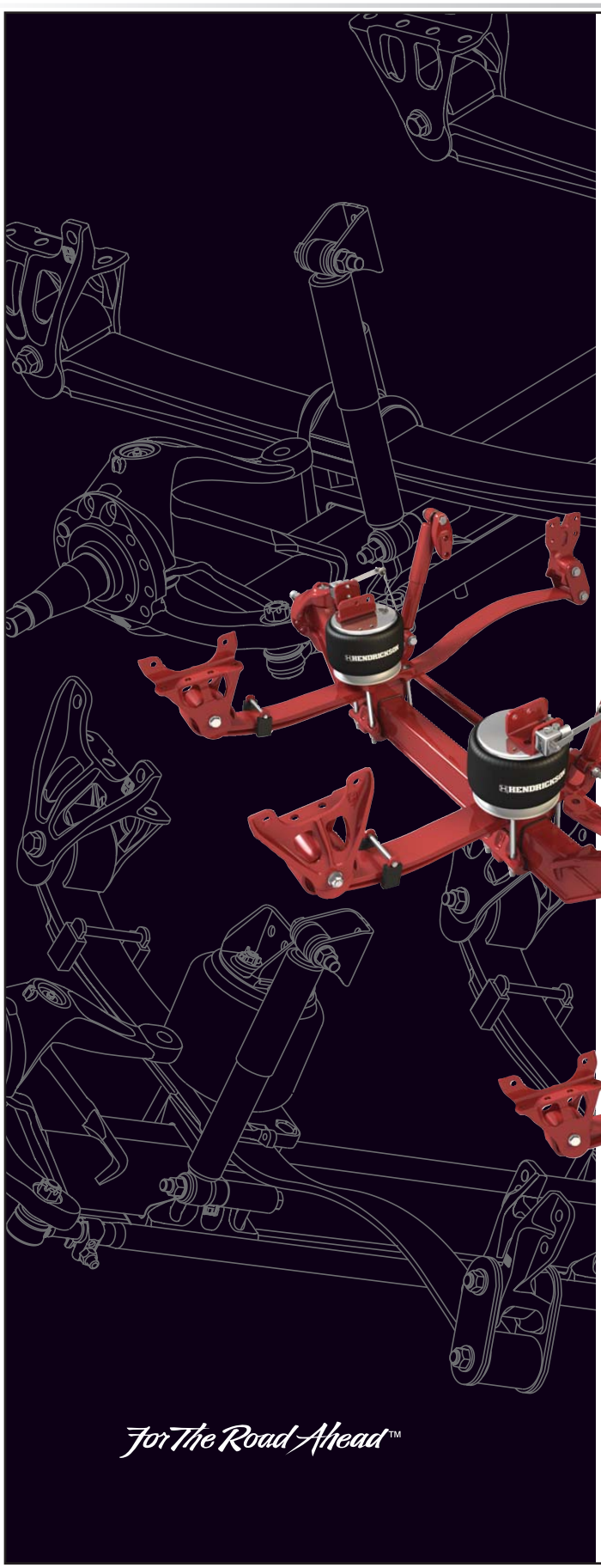
2. Keeping shock absorber collapsed, turn dust cap to the right (clockwise) until a stop is felt. Stop turning and do not use any more force. This is the maximum damping setting. To reduce damping, turn counterclockwise.

3. Pull the shock absorber out vertically without turning for at least ⅜" to disengage the adjusting mechanism. The dust cap may be turned freely. Shock absorber can then be refitted to the vehicle.

4. Make certain that both left and right shocks are at equal settings. Repeat steps 1–3 as required.

Front Axle & Suspension

OPERATION	INTERVAL: MONTHS/MILES whichever occurs first: first 1000 miles	6 / 6,000	12 / 12,000	NOTES
Spring Suspension				
Inspect visually		•		*Check for visual damage. See Hendrickson publication 17730-248.*
Check U-bolt torque	•	•	•	*Tighten to 285–305 ft. lbs (32–34 Nm).*
Lubricate steering grease fittings		•		*Use NLGI #2 EP or equivalent.*
Inspect spring pin lock bolts			•	*Tighten to 380–420 ft. lbs. (515–569 Nm).*
Inspect shackle bracket pivot bolt			•	*Tighten to 380–420 ft. lbs. (515–569 Nm).*
Inspect shocks			•	*Check for signs of leaks, wear, or damage.*
Torque shock mounting bolts			•	*TIghten to 215 ft. lbs. (25 Nm).*
Air Suspension				
Inspect visually		•		*Check for wear, damage, misalignment. See Hendrickson publication 17730-248.*
Check axle to suspension fasteners	•		•	*Tighten to 285–305 ft. lbs (32–34 Nm).*
Lubricate steering grease fittings		•		*Use NLGI #2 EP or equivalent. Lube with suspension loaded.*
Inspect pin lock bolts			•	*Tighten to 380–420 ft. lbs. (515–569 Nm).*
Inspect shackle bracket pivot bolt			•	*Tighten to 380–420 ft. lbs. (515–569 Nm).*
Torque shock mounting bolts			•	*TIghten to 215 ft. lbs. (25 Nm).*
Inspect air spring cushions		•		*Check for wear, abrasions, cuts, or other damage*
Check air spring fasteners			•	
Inspect shocks			•	*Check for signs of leaks, wear, or damage.*
Check suspension height		•		*Shock length, eye to eye: 18.5" ± .25". (470 ± 6mm).*
Check ride height control valve bolts		•		*TIghten to 8–10 ft. lbs. (11–14 Nm).*



TECHNICAL PROCEDURE

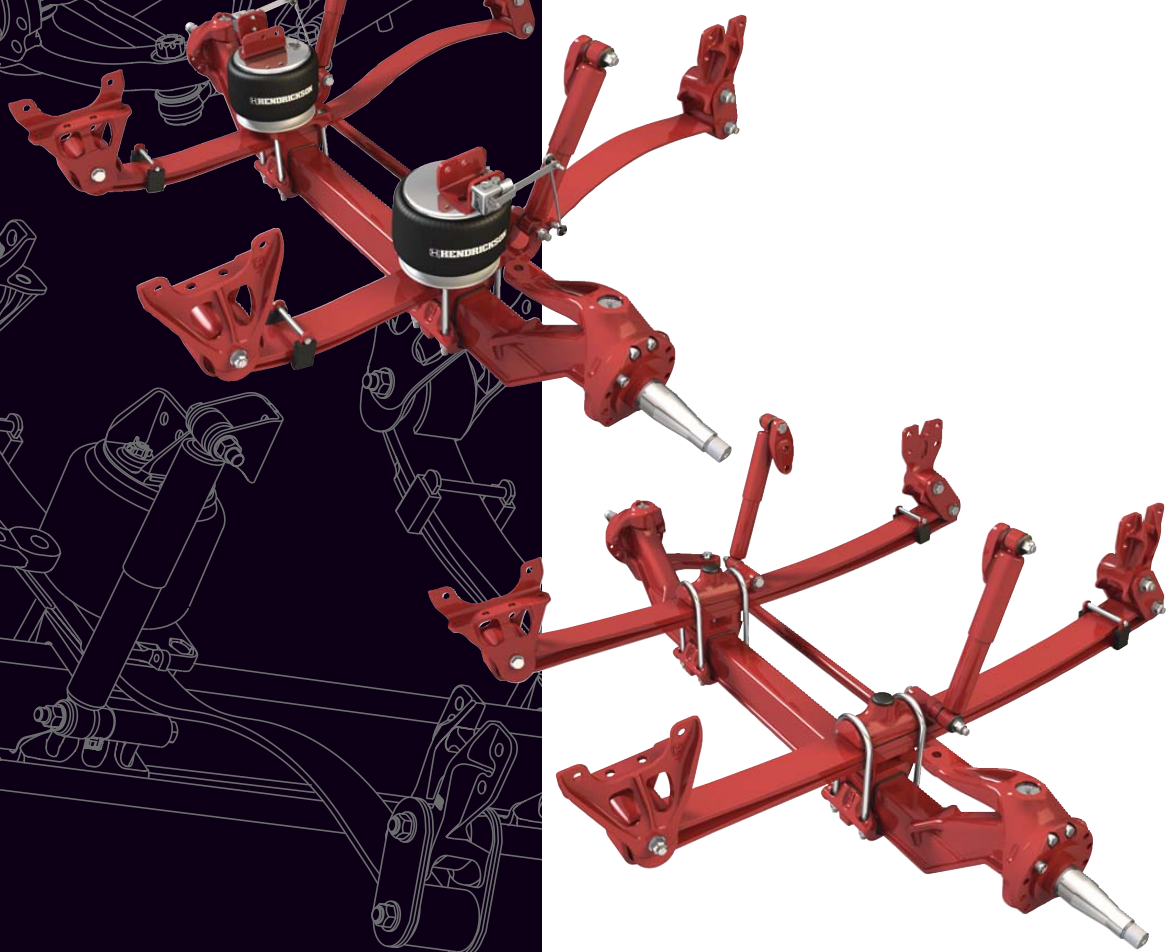
SUBJECT: AIRTEK® & SOFTEK® Service Instructions for Blue Bird Buses

LIT NO: 17730-248

DATE: January 2008 **REVISION:** D

This publication is also available at www.hendrickson-intl.com

AIRTEK®
SOFTEK®



For The Road Ahead™

HENDRICKSON

AIRTEK®

SOFTEK®

TABLE OF CONTENTS

AIRTEK® • SOFTEK® for Blue Bird Buses
January 2008
Rev. D

48

SECTION 1
Introduction

This publication is intended to acquaint and assist maintenance personnel in the preventive maintenance, service, repair and rebuild of the following Hendrickson equipment as installed on applicable Blue Bird Buses:

- **AIRTEK®** — An integrated front air suspension with the STEERTEK axle.
- **SOFTEK®** — An integrated steel spring mechanical suspension with the STEERTEK axle.
- **STEERTEK** — A lightweight, formed and robotically welded steer axle assembly.

NOTE Use only Hendrickson Genuine parts for servicing this suspension system.

It is important to read and understand the entire Technical Procedure publication prior to performing any maintenance, service, repair, or rebuild of the product. The information in this publication contains parts lists, safety information, product specifications, features, proper maintenance, service, repair and rebuild instructions for the AIRTEK/SOFTEK Suspension and the STEERTEK axle.

A Technical Procedure Quiz has been included at the back of this publication. Hendrickson will provide personalized AIRTEK/SOFTEK Technical Procedure Quiz Achievement Certificate to candidates scoring 80% or higher on the test. Simply complete the test and fill in the enclosed answer sheet or write your answers on a separate sheet with the return address, name, phone number, and company name as it will appear on the award to:

Hendrickson
ATTN: Truck Marketing Test Quiz Assessment
800 S. Frontage Road
Woodridge, Illinois 60517

Hendrickson reserves the right to make changes and improvements to its products and publications at any time. Contact Hendrickson Tech Services at 630-910-2800 or e-mail techservices@hendrickson-intl.com for information on the latest version of this manual.

The latest revision of this publication is also available online at www.hendrickson-intl.com.

SECTION 2
Product Description

BLUE BIRD VISION BUSES

FIGURE 2-1
AIRTEK® Air Suspension System
Capacity: 10,000 pounds

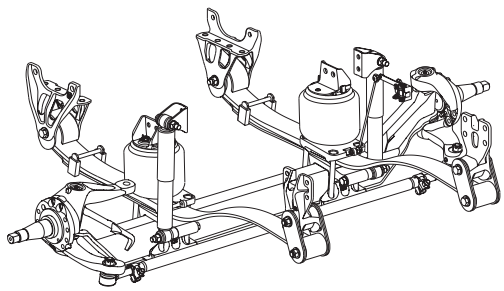
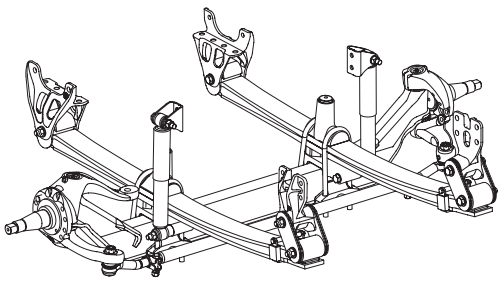


FIGURE 2-2
SOFTEK® Mechanical Suspension System
Capacity: 8,000/10,000 pounds



BLUE BIRD ALL AMERICAN BUSES

FIGURE 2-3
AIRTEK® Air Suspension System
Capacity: 14,600 pounds

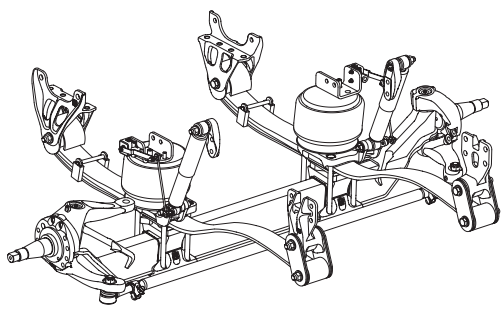
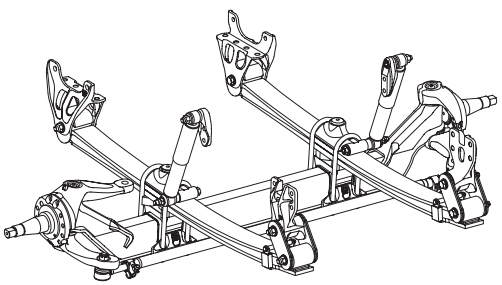
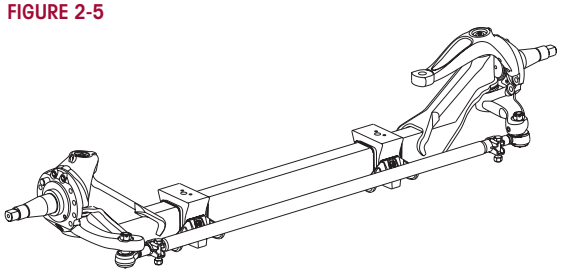


FIGURE 2-4
SOFTEK® Mechanical Suspension System
Capacity: 13,200/14,600 pounds



RIGHT HAND DRIVE AXLE

FIGURE 2-5



AIRTEK®• SOFTEK® for Blue Bird Buses

STEERTEK — The box-shaped design provides a stiffer axle and resists torsional, longitudinal and vertical loads more effectively than traditional axle beams. Together with the front limbs of the leaf springs, the robotically welded axle beam forms a torsion system, enhancing roll stability characteristics and improving handling.

Axle clamp group — The patented clamp group provides four-sided clamping pressure. The Clamp Group consists of the following:

- Top Axle Wrap
- Top Axle Wrap Liner
- Top Spring Pad
- Bottom Axle Wrap
- Bottom Axle Wrap Liner
- ¾" Bolts, Washers and Locknuts

Adjustable tie rod —To help maximize tire life, the tie rod easily adjusts toe-in/out.

Steering knuckles — The steering and tie rod arms are integrated for increased strength and reduced weight. The unique steering knuckle packaging delivers a maximum of 50° wheel cut. The two piece knuckle design makes servicing the kingpin bushings easier.

AIRTEK — Winner of the 2001 Automotive News and Cap Gemini Ernst & Young PACE Award for Product Innovation. AIRTEK is an integrated front air suspension and robotically welded steer axle that work together to form an integrated torsion system. Utilizing a system approach, Hendrickson has engineered and optimized the following components to form a system delivering ride, stability and handling characteristics with reduced weight and maintenance.

Air springs — Exclusive to Hendrickson, the lightweight air springs deliver a soft ride. The air springs are engineered to support 78% of the vertical load while providing a low spring rate. The quick "snap" design for the 10,000 pound capacity, the bolt on design for the 14,600 pound capacity, and the "push-to-connect" air supply design also provide fast and easy removal and installation.

Leaf spring assembly — With its innovative design, the leaf spring provides superior stability, performance and a soft ride. The patented leaf spring shares loads with the air spring. Durable rubber front and patented rear bushings are greaseless and only require periodic inspections.

SOFTEK — is an integrated front mechanical suspension and robotically welded steer axle that work together to form an integrated torsion system. Utilizing a system approach, Hendrickson has engineered and optimized the following components to form a system delivering ride, stability and handling characteristics with reduced weight and maintenance.

Leaf spring assembly — With its innovative design, the leaf spring provides superior stability, performance and a soft ride. Durable rubber front and patented rear bushings are greaseless and only require periodic inspections.

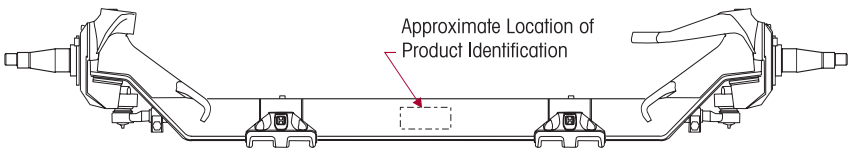
Shock absorbers — AIRTEK/SOFTEK utilizes premium shocks that have been tested and tuned specifically for the suspension system.

Frame brackets — Optimized design delivers weight reduction and proven durability. The front and rear frame brackets are common between the SOFTEK and AIRTEK suspensions.

TECHNICAL NOTES

1. AIRTEK and SOFTEK are approved for 100% on-highway use; other applications must be pre-approved by Hendrickson Sales Engineering. System capacity rating for the suspension represents maximum loads on tires at ground level.
2. The STEERTEK axle for the Vision is available with 69" kingpin intersection (KPI). The STEERTEK axle for the All American is available with 71" kingpin intersection (KPI).
3. AIRTEK suspension weight includes frame and shackle bracket assemblies, main springs, bushings, air springs and air spring bracket, height control system, shocks, upper shock brackets and axle clamp group.
4. SOFTEK suspension weight includes frame and shackle bracket assemblies, steel leaf springs, bushings, shocks, upper shock brackets and axle clamp group.
5. STEERTEK axle weight includes the axle beam, knuckle/steering arm assemblies and tie rod assemblies.
6. AIRTEK and SOFTEK are integral to and available exclusively with the STEERTEK axle. This system is anti-lock braking system (ABS) ready. STEERTEK is compatible with most industry standard wheel ends and brakes. Contact OEM for more information.
7. The STEERTEK axle product identification is etched on the center front of the axle beam providing the following information:
   - Axle part number: Identifies the features of the axle beam.
   - Axle assembly number: Identifies the complete assembly, which includes the steering knuckles and bracket assemblies.

FIGURE 2-6 Front view of STEERTEK axle showing approximate location of Product Identification.



SECTION 3

Important Safety Notice

Proper maintenance, service and repair are important to the reliable operation of the suspension. The procedures recommended by Hendrickson and described in this technical publication are methods of performing such maintenance, service and repair.

The warnings and cautions should be read carefully to help prevent personal injury and to assure that proper methods are used. Improper maintenance, service or repair may damage the vehicle, cause personal injury, render the vehicle unsafe in operation, or void the manufacturer's warranty.

Failure to follow the safety precautions in this manual can result in personal injury and/or property damage. Carefully read and understand all safety related information within this publication, on all decals and in all such materials provided by the vehicle manufacturer before conducting any maintenance, service or repair.

EXPLANATION OF SIGNAL WORDS

Hazard "Signal Words" (Danger-Warning-Caution) appear in various locations throughout this publication. Information accented by one of these signal words must be observed to help minimize the risk of personal injury to service personnel, or possibility of improper service methods which may damage the vehicle or render it unsafe.

This is the safety alert symbol. It is used to alert you to potential personal injury hazards. Obey all safety messages that follow this symbol to avoid possible injury or death.

Additional 'Notes' or 'Service Hints' are utilized to emphasize areas of procedural importance and provide suggestions for ease of repair. The following definitions indicate the use of these signal words as they appear throughout the publication.

DANGER — INDICATES AN IMMINENTLY HAZARDOUS SITUATION WHICH, IF NOT AVOIDED, WILL RESULT IN SERIOUS INJURY OR DEATH.

WARNING — INDICATES A POTENTIAL HAZARDOUS SITUATION WHICH, IF NOT AVOIDED, CAN RESULT IN SERIOUS INJURY OR DEATH.

CAUTION — INDICATES A POTENTIAL HAZARDOUS SITUATION WHICH, IF NOT AVOIDED, MAY RESULT IN MINOR OR MODERATE INJURY, OR PROPERTY DAMAGE.

NOTE — An operating procedure, practice condition, etc. which is essential to emphasize.

SERVICE HINT — A helpful suggestion, which will make the servicing being performed a little easier and/or faster.

Also note that particular service operations may require the use of special tools designed for specific purposes. These special tools can be found in the Special Tools Section of this publication.

SAFETY PRECAUTIONS

WARNING

FASTENERS

LOOSE OR OVER TORQUED FASTENERS CAN CAUSE COMPONENT DAMAGE, LOSS OF VEHICLE CONTROL, PROPERTY DAMAGE, OR SEVERE PERSONAL INJURY. MAINTAIN CORRECT TORQUE VALUE AT ALL TIMES. CHECK TORQUE VALUES ON A REGULAR BASIS AS SPECIFIED.

DANGER

AIR SPRINGS

AIR SPRING ASSEMBLIES MUST BE DEFLATED PRIOR TO LOOSENING ANY CLAMP GROUP HARDWARE. UNRESTRICTED AIR SPRING ASSEMBLIES CAN VIOLENTLY SHIFT. DO NOT INFLATE AIR SPRING ASSEMBLIES WHEN THEY ARE UNRESTRICTED. AIR SPRING ASSEMBLIES MUST BE RESTRICTED BY SUSPENSION OR OTHER ADEQUATE STRUCTURE. DO NOT INFLATE BEYOND PRESSURES RECOMMENDED BY AIR SPRING MANUFACTURER, CONTACT HENDRICKSON TECHNICAL SERVICES FOR DETAILS. IMPROPER USE OR OVER INFLATION MAY CAUSE AIR SPRING ASSEMBLIES TO BURST, CAUSING PROPERTY DAMAGE AND/OR SEVERE PERSONAL INJURY.

WARNING

WHEN SERVICING THE VEHICLE OR ATTACHING AN AIR SPRING AND THE VEHICLE IS ON THE GROUND, PRIOR TO AIRING THE SUSPENSION SYSTEM MAKE CERTAIN THE AIR SPRING LOCATOR IS INDEXED INTO THE UPPER AIR SPRING BRACKET PROPERLY, AND THE AIR SPRING IS FULLY SEATED ON THE SPRING TOP PAD. FAILURE TO FOLLOW THESE INSTRUCTIONS CAN RESULT IN PREMATURE AIR SPRING FAILURE, CAUSE PERSONAL INJURY, OR PROPERTY DAMAGE.

WARNING

PRIOR TO AND DURING DEFLATION AND INFLATION OF THE FRONT AIR SUSPENSION SYSTEM, ENSURE THAT ALL PERSONNEL AND EQUIPMENT ARE CLEAR FROM UNDER THE VEHICLE AND AROUND THE SERVICE AREA, FAILURE TO DO SO CAN CAUSE SERIOUS PERSONAL INJURY, DEATH, OR PROPERTY DAMAGE.

WARNING

LOAD CAPACITY

ADHERE TO THE PUBLISHED CAPACITY RATINGS FOR THE SUSPENSIONS. ADD-ON AXLE ATTACHMENTS (I.E. SLIDING FIFTH WHEELS) AND OTHER LOAD TRANSFERRING DEVICES CAN INCREASE THE SUSPENSION LOAD ABOVE THE RATED AND APPROVED CAPACITIES WHICH CAN RESULT IN FAILURE AND LOSS OF VEHICLE CONTROL, POSSIBLY CAUSING PERSONAL INJURY OR PROPERTY DAMAGE.

WARNING

MODIFYING COMPONENTS

DO NOT MODIFY OR REWORK PARTS. DO NOT SUBSTITUTE PARTS OF THE SUSPENSION OR AXLE COMPONENTS, USE OF A MODIFIED OR REPLACEMENT PARTS NOT AUTHORIZED BY HENDRICKSON MAY NOT MEET HENDRICKSON'S SPECIFICATIONS, AND CAN RESULT IN FAILURE OF THE PART, LOSS OF VEHICLE CONTROL, AND POSSIBLE PERSONAL INJURY OR PROPERTY DAMAGE. USE ONLY HENDRICKSON AUTHORIZED REPLACEMENT PARTS, DO NOT MODIFY PARTS WITHOUT AUTHORIZATION FROM HENDRICKSON.

WARNING

SHOCK ABSORBERS

THE SHOCK ABSORBERS ARE THE REBOUND TRAVEL STOPS FOR THE SPRINGS. ANYTIME THE FRONT AXLE ON AN AIRTEK SUSPENSION IS SUSPENDED IT IS MANDATORY THAT THE SHOCK ABSORBERS REMAIN CONNECTED. FAILURE TO DO SO CAN CAUSE THE AIR SPRINGS TO EXCEED THEIR MAXIMUM LENGTH, POSSIBLY CAUSING THE AIR SPRINGS TO SEPARATE FROM THE PISTON, OR CAUSE A REVERSE ARCH IN THE STEEL LEAF SPRINGS, POSSIBLY RESULTING IN PREMATURE STEEL LEAF SPRING FAILURE.

⚠ WARNING

TORCH/WELDING

DO NOT USE A CUTTING TORCH TO REMOVE ANY ATTACHING FASTENERS. THE USE OF HEAT ON SUSPENSION COMPONENTS WILL ADVERSELY AFFECT THE STRENGTH OF THESE PARTS. A COMPONENT DAMAGED IN THIS MANNER CAN RESULT IN THE LOSS OF VEHICLE CONTROL AND POSSIBLE PERSONAL INJURY OR PROPERTY DAMAGE.

EXERCISE EXTREME CARE WHEN HANDLING OR PERFORMING MAINTENANCE IN THE AREA OF THE SPRING ASSEMBLY AND AXLE. DO NOT CONNECT ARC WELDING GROUND LINE TO THE SPRING ASSEMBLY OR AXLE. DO NOT STRIKE AN ARC WITH THE ELECTRODE ON THE SPRING ASSEMBLY OR AXLE. DO NOT USE HEAT NEAR THE SPRING ASSEMBLY OR AXLE. DO NOT NICK OR GOUGE THE SPRING ASSEMBLY OR AXLE. SUCH IMPROPER ACTIONS CAN CAUSE DAMAGE TO THE SPRING ASSEMBLY OR THE AXLE CAN FAIL, AND CAN CAUSE LOSS OF VEHICLE CONTROL AND POSSIBLE PERSONAL INJURY OR PROPERTY DAMAGE.

⚠ WARNING

OFF ROADWAY TOWING

WHEN A VEHICLE IS DISABLED AND EQUIPPED WITH A STEERTEK AXLE, CARE MUST BE TAKEN TO ENSURE THERE IS NO DAMAGE TO THE SUSPENSION WHEN TOWING THE VEHICLE. THE USE OF A TOW STRAP IS NECESSARY TO TOW A DISABLED VEHICLE INTO A REPAIR FACILITY PARKING LOT INTO THE SHOP BAY. THE TOW STRAPS SHOULD BE CONNECTED TO THE TOW HOOKS PROVIDED BY THE MANUFACTURER AT THE FRONT OF THE BUMPER. IF THE USE OF TOW HOOKS IS NOT AN OPTION THEN A TOW STRAP MAY BE WRAPPED AROUND THE FRONT AXLE (SEE FIGURE 3-1) IN A MANNER THAT IS ACCEPTABLE FOR TOWING THE VEHICLE INTO THE SHOP. DO NOT USE A TOW CHAIN AROUND THE FRONT AXLE OR WITH A SINGLE POINT LOCATION TO TOW THE VEHICLE, DOING SO WILL DAMAGE THE AXLE, SEE FIGURE 3-2. FOR DETAILED TOWING INSTRUCTIONS FOR ON-HIGHWAY TOWING SEE SECTION 6.

FIGURE 3-1 ACCEPTABLE

FIGURE 3-2 NOT ACCEPTABLE

⚠ CAUTION

PROCEDURES AND TOOLS

A MECHANIC USING A SERVICE PROCEDURE OR TOOL WHICH HAS NOT BEEN RECOMMENDED BY HENDRICKSON MUST FIRST SATISFY HIMSELF THAT NEITHER HIS SAFETY NOR THE VEHICLE'S SAFETY WILL BE JEOPARDIZED BY THE METHOD OR TOOL SELECTED. INDIVIDUALS DEVIATING IN ANY MANNER FROM THE INSTRUCTIONS PROVIDED ASSUME ALL RISKS OF CONSEQUENTIAL PERSONAL INJURY OR DAMAGE TO EQUIPMENT INVOLVED.

⚠ WARNING

PERSONNEL PROTECTIVE EQUIPMENT

ALWAYS WEAR PROPER EYE PROTECTION AND OTHER REQUIRED PERSONAL PROTECTIVE EQUIPMENT TO HELP PREVENT PERSONAL INJURY WHEN YOU PERFORM VEHICLE MAINTENANCE, REPAIR OR SERVICE.

WARNING

SUPPORT THE VEHICLE PRIOR TO SERVICING

PLACE THE VEHICLE ON A LEVEL FLOOR AND CHOCK THE WHEELS TO HELP PREVENT THE VEHICLE FROM MOVING. NEVER WORK UNDER A RAISED VEHICLE SUPPORTED BY ONLY A FLOOR JACK. ALWAYS SUPPORT A RAISED VEHICLE WITH SAFETY STANDS. BLOCK THE WHEELS AND MAKE SURE THE UNIT WILL NOT ROLL BEFORE RELEASING BRAKES. A JACK CAN SLIP OR FALL OVER. SERIOUS PERSONAL INJURY CAN RESULT.

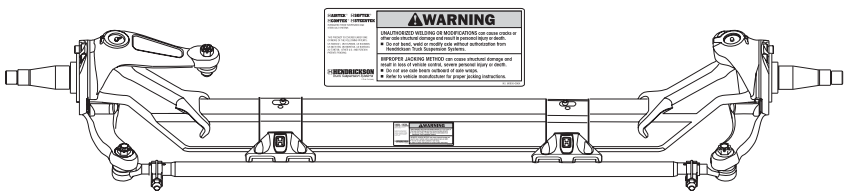
WARNING

AXLE

AXLE CAMBER IS NOT ADJUSTABLE. DO NOT CHANGE THE AXLE CAMBER ANGLE OR BEND THE AXLE BEAM. BENDING THE AXLE BEAM (SEE FIGURE 3-3) TO CHANGE THE CAMBER ANGLE WILL DAMAGE THE AXLE AND REDUCE AXLE STRENGTH, AND WILL VOID HENDRICKSON'S WARRANTY. A BENT AXLE BEAM CAN CAUSE LOSS OF VEHICLE CONTROL, POSSIBLY CAUSING PERSONAL INJURY OR PROPERTY DAMAGE.

FIGURE 3-3

REPLACE ANY SAFETY DECALS THAT ARE FADED, TORN, MISSING, ILLEGIBLE, OR OTHERWISE DAMAGED. CONTACT HENDRICKSON TO ORDER REPLACEMENT LABELS.



STEERTEK IS A UNIQUE AXLE, IN THAT THE KINGPIN IS CRYOGENICALLY INSTALLED IN THE AXLE. THE KINGPIN IS A NON-REPLACEABLE COMPONENT OF THE AXLE ASSEMBLY. DO NOT TRY TO REMOVE THE KINGPIN. IF THE KINGPIN SHOWS SIGNS OF MOVEMENT, CONTACT THE HENDRICKSON TECH SERVICES DEPARTMENT.

THE REPAIR OR RECONDITIONING OF SUSPENSION OR AXLE COMPONENTS IS NOT ALLOWED AS SHOWN ON LABEL IN FIGURE 3-3. HENDRICKSON ADVISES REPLACING ALL COMPONENTS FOUND TO BE DAMAGED OR OUT OF SPECIFICATIONS. ALL MAJOR HENDRICKSON COMPONENTS ARE HEAT TREATED AND TEMPERED. AIRTEK/SOFTEK COMPONENTS CANNOT BE BENT, WELDED, HEATED, OR REPAIRED WITHOUT REDUCING THE STRENGTH OR LIFE OF THE COMPONENT. FAILURE TO FOLLOW THESE GUIDELINES CAN CAUSE LOSS OF VEHICLE CONTROL, POSSIBLE PERSONAL INJURY, DEATH, OR PROPERTY DAMAGE AND WILL VOID APPLICABLE WARRANTIES.

IF A VEHICLE EQUIPPED WITH A STEERTEK AXLE IS INVOLVED IN A CRASH, A THOROUGH INSPECTION OF THE AXLE SHOULD BE PERFORMED NOTING THE CONDITION OF THE AXLE BEAM, KINGPINS, AND KNUCKLE ASSEMBLIES. IF ANY COMPONENT APPEARS DAMAGED THE AXLE SHOULD BE REPLACED. IN THE EVENT THE CRASH RESULTED IN EXCESSIVE SIDE LOAD SUCH AS A BENT WHEEL, HUB, OR SPINDLE, IT IS STRONGLY RECOMMENDED TO REPLACE THE COMPLETE AXLE ASSEMBLY, CONTACT HENDRICKSON TECHNICAL SERVICES WITH ANY QUESTIONS. FAILURE TO REPLACE ANY DAMAGED COMPONENTS CAN CAUSE LOSS OF VEHICLE CONTROL, POSSIBLE PERSONAL INJURY, DEATH, OR PROPERTY DAMAGE AND WILL VOID APPLICABLE WARRANTIES.

WARNING

PARTS CLEANING

SOLVENT CLEANERS CAN BE FLAMMABLE, POISONOUS AND CAUSE BURNS. TO HELP AVOID SERIOUS PERSONAL INJURY, CAREFULLY FOLLOW THE MANUFACTURER'S PRODUCT INSTRUCTIONS AND GUIDELINES AND THE FOLLOWING PROCEDURE:

1. WEAR PROPER EYE PROTECTION
2. WEAR CLOTHING THAT PROTECTS YOUR SKIN
3. WORK IN A WELL VENTILATED AREA
4. DO NOT USE GASOLINE, OR SOLVENTS THAT CONTAIN GASOLINE. GASOLINE CAN EXPLODE
5. HOT SOLUTION TANKS OR ALKALINE SOLUTIONS MUST BE USED CORRECTLY. FOLLOW THE MANUFACTURER'S RECOMMENDED INSTRUCTIONS AND GUIDELINES CAREFULLY TO HELP PREVENT PERSONAL ACCIDENT OR INJURY

DO NOT USE HOT SOLUTION TANKS OR WATER AND ALKALINE SOLUTIONS TO CLEAN GROUND OR POLISHED PARTS. DOING SO WILL CAUSE DAMAGE TO THE PARTS AND VOID WARRANTY.

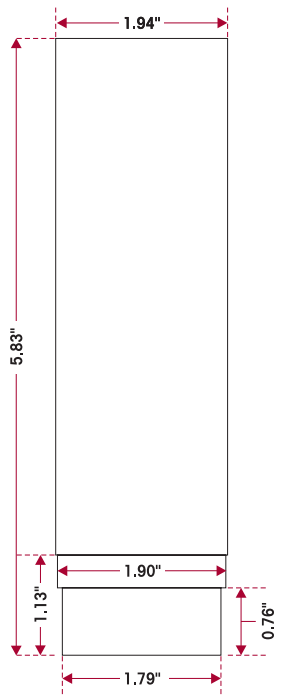
SECTION 4

Special Tools

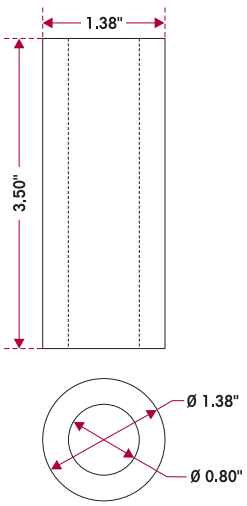
These shop made tools are designed to install and remove kingpin bushings. Bushing tools are made from cold rolled steel or equivalent. Drawings are for reference only. Hendrickson does not supply these tools.

KINGPIN BUSHING TOOLS

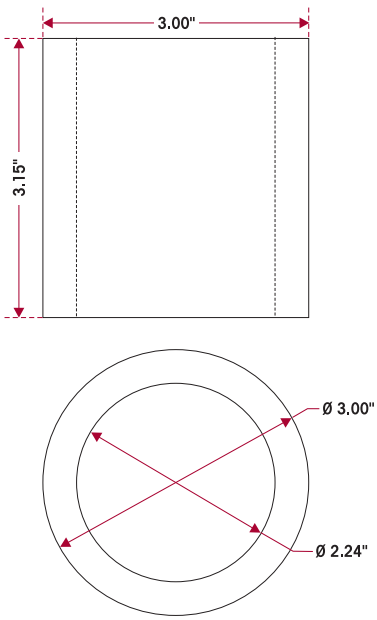
Kingpin Bushing Installer



Kingpin Bushing Removar



Steering Arm Receiver



ADJUSTABLE STRAIGHT FLUTE REAMER

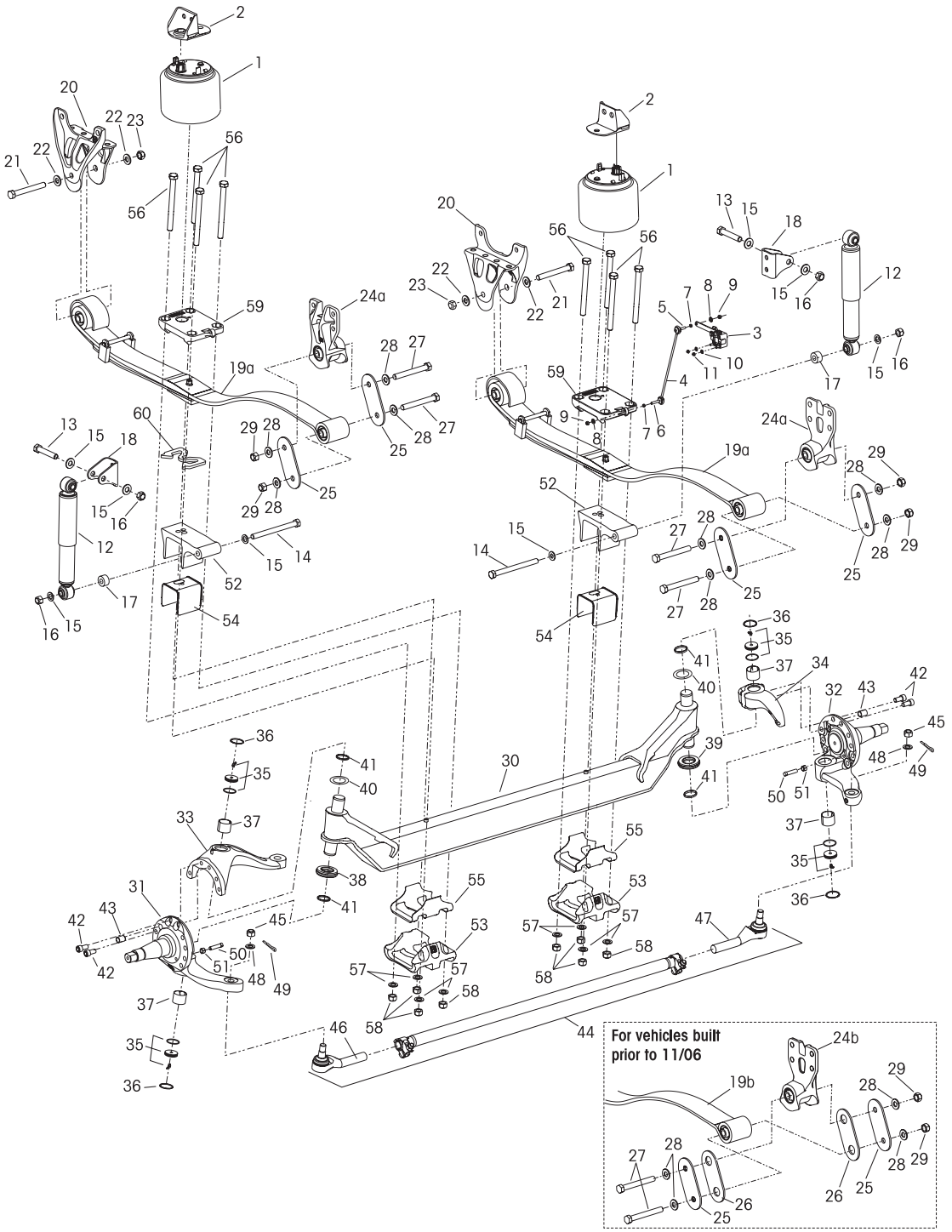
The dimension of cutting diameter must facilitate a range of 1.802" – 1.812"

SECTION 5

Parts List

AIRTEK®

Blue Bird Vision Buses - 10K Capacity

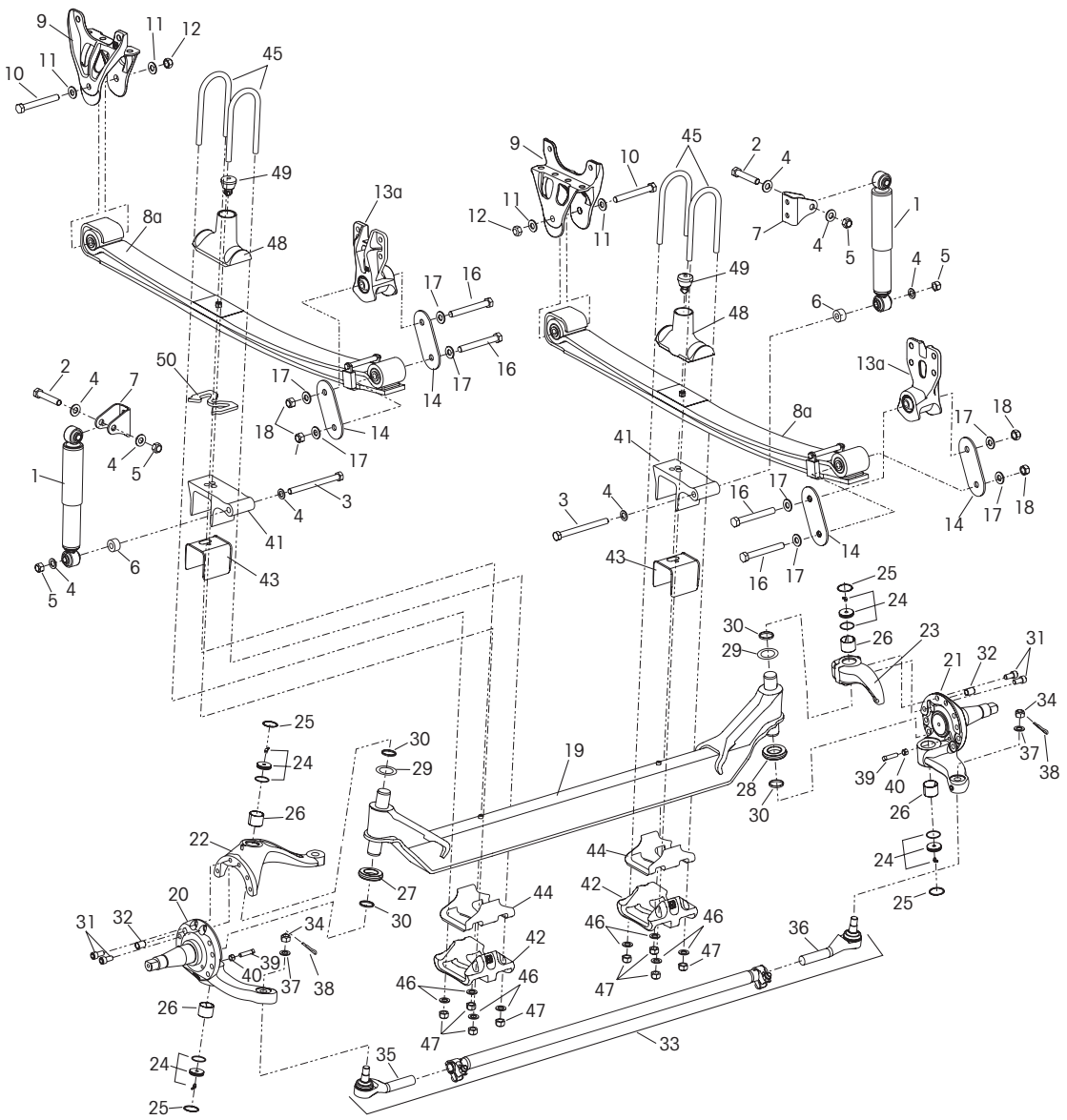


AIRTEK® for Blue Bird Vision Buses - 10K Capacity

KEY NO.	PART NO.	DESCRIPTION	NO.REQ.
1	64075-002L	Air Spring	2
2	60850-001	Air Spring Bracket	2
	59427-008	HCV, Link Mount & Linkage Assembly (Includes Key Nos. 3-11)	1
3	59935-004	Height Control Valve	1
4	59428-006	HCV Linkage (Replaces 59428-001)	1
	64742-001	**Link Mount Service Kit** (Includes Key Nos. 5-6)	
5		*5/16"-18 UNC Stud - 2.07"	1
6		*5/16"-18 UNC Stud - 2.44"	1
7		*5/16"-18 UNC Hex Nut	2
8		*5/16" Hardened Washer	2
9		*5/16"-18 UNC Locknut	2
10		*1/4" Hardened Washer	2
11		*1/4"-20 UNC Locknut	2
12	58913-009L	Shock Absorber (Replaces 58913-008)	2
13		**3/4"-10 UNC Upper Shock Bolt	2
14		**3/4"-10 UNC Lower Shock Bolt	2
15		**3/4" Hardened Washer	8
16		**3/4"-10 UNC Hex Locknut	4
17	59946-001	Shock Spacer	2
18	59423-002	Shock Bracket	2
	60961-163	**Leaf Spring Assembly Service Kit** *For vehicles built prior to 11/06* (Includes Key Nos. 19a, 24a, 25)	
		Leaf Spring Assembly	2
19a	66805-001	*For vehicles built after 11/06*	
19b	60512-000	*For vehicles built prior to 11/06*	
20	64488-002	Front Hanger (Replaces 64488-000)	2
21		**M20 Hex Bolt - 170mm	2
22		**M20 Hardened Washer	4
23		**M20 Locknut	2
		Rear Shackle Bracket	2
24a	66510-001	*For vehicles built after 11/06*	
24b	64316-000	*For vehicles built prior to 11/06*	
25	64314-000	Rear Shackle Plate	4
26	64159-000	Thrust Washer *Only for vehicles built prior to 11/06*	4
27		**M20 Hex Bolt - 150mm	4
28		**M20 Hardened Washer	8
29		**M20 Locknut	4
	60952-XXX	Axle Assembly (Includes Key Nos. 30-55) Contact Hendrickson Tech Serv. for Part No.	1
30	64905-004	Axle & Kingpin Assembly 6.5", 8.5" Ride Height	1
31		LH Lower Steering Knuckle Assembly	1
	58900-035	150 Ackermann Air Brake	
	58900-033	200 Ackermann Air Brake	
	58900-031	250 Ackermann Air Brake	
	58900-055	150 Ackermann Hydraulic Brake	
	58900-053	200 Ackermann Hydraulic Brake	
	58900-051	250 Ackermann Hydraulic Brake	
32		RH Lower Steering Knuckle Assembly	1
	58900-036	150 Ackermann Air Brake	
	58900-034	200 Ackermann Air Brake	
	58900-032	250 Ackermann Air Brake	
	58900-056	150 Ackermann Hydraulic Brake	
	58900-054	200 Ackermann Hydraulic Brake	
	58900-052	250 Ackermann Hydraulic Brake	
33	60903-016	LH Upper Steering Knuckle Assembly	1
34	60904-002	RH Upper Steering Knuckle Assembly	1
	60961-040	**Kingpin Bushing and Bearing Service Kit, Axle Set** (Includes Kit Nos. 60961-009 & -039)	
	60961-009	**LH Kingpin Bushing w/Composite Thrust Bearing Service Kit** (Includes Key Nos.35-38, 40-42, Loctite)	
	60961-039	**RH Kingpin Bushing w/Roller Thrust Bearing Service Kit** (Includes Key Nos.35-37, 39-42, Loctite)	
35	59156-000	Grease Cap Assembly	4
36	58937-000	Retaining Ring	4
37	58909-000	Kingpin Bushing	4
	60961-043	**Thrust Bearing Service Kit, Axle Set** (Includes Kit Nos. 60961-041 & 60961-042)	
	60961-041	**LH Composite Thrust Bearing Service Kit** (Includes Key Nos. 38, 40-42, Loctite)	
	60961-042	**RH Roller Thrust Bearing Service Kit** (Includes Key Nos. 39-42, Loctite)	
38	59828-000	LH Composite Thrust Bearing	1
39	64256-000	RH Roller Thrust Bearing	1
40	60259-002	Kingpin Shim - 0.047"	2
Not Shown	60259-001	Kingpin Shim - 0.005" (As needed for service)	
41	58910-000	Kingpin Seal	4
42	60236-001	5/8"-11 UNC Socket Head Cap Screw	4
Not Shown	60937-000	Loctite (Red) Compound Tube	1
43	64246-000	ABS Sensor Sleeve	2
44		***Tie Rod Assembly, 10K, 5.36 Drop (Includes Key Nos. 45-49)	1
	66699-003	200 Ackermann (Replaces 59948-005)	
	66699-001	250 Ackermann (Replaces 59948-006)	
45		*7/8" Castle Nut	2
	60961-139	***Tie Rod End Service Kit, Axle Set** (Replaces 60961-012) (Includes Kit Nos. 60961-137 & -138)	
	60961-137	***LH Tie Rod End Service Kit** (Replaces 60961-029) (Includes Key Nos. 46, 48-49)	
	60961-138	***RH Tie Rod End Service Kit** (Replaces 60961-030) (Includes Key Nos. 47-49)	
46	66645-001	***LH Tie Rod End (Replaces 64004-001)	1
47	66645-002	***RH Tie Rod End (Replaces 64004-002)	1
48	22962-007	7/8" Flat Washer	2
49	17800-004	Tie Rod Nut Cotter Pin	2
	60961-069	**Stop Bolt Service Kit, One Side** (Includes Key Nos. 50-51)	
50	60238-001	1/2"-13 UNC Square Head Bolt	2
51	60240-000	1/2"-13 UNC Hex Jam Nut	2
52	59952-003	Top Axle Wrap	2
53	64722-003	Bottom Axle Wrap	2
	60961-015	**Top/Bottom Axle Wrap Liner Service Kit, One Side** (Includes Key Nos. 54-55)	
54	60508-000	Top Axle Wrap Liner	2
55	59845-000	Bottom Axle Wrap Liner	2
		Clamp Group Service Kit, One Side (Includes Key Nos. 56-58)	
	60961-051	6.5" Ride Height	
	60961-052	8.5" Ride Height	
56		3/4"-16 UNF Hex bolt	8
	21867-044	6.5" Ride Height - 10.0"	
	21867-045	8.5" Ride Height - 12.0"	
57	22962-001	3/4" Flat Washer	8
58	17700-035	3/4"-16 UNF 2B Nylon Locknut	8
Not Shown	18831-021	Dowel Pin, 8.5" Ride Height - 2.0"	2
59		Top Pad	
	64516-001	LH	1
	64516-002	RH	1
60		Front Axle Spacer	
	64536-010	LH 6.5" Ride Height	1
	64536-060	LH 8.5" Ride Height	1
Not Shown	64536-050	RH 8.5" Ride Height	1

Blue Bird Vision Buses - 8K/10K Capacity

SOFTEK®



SOFTEK® for Blue Bird Vision Buses - 8K/10K Capacity

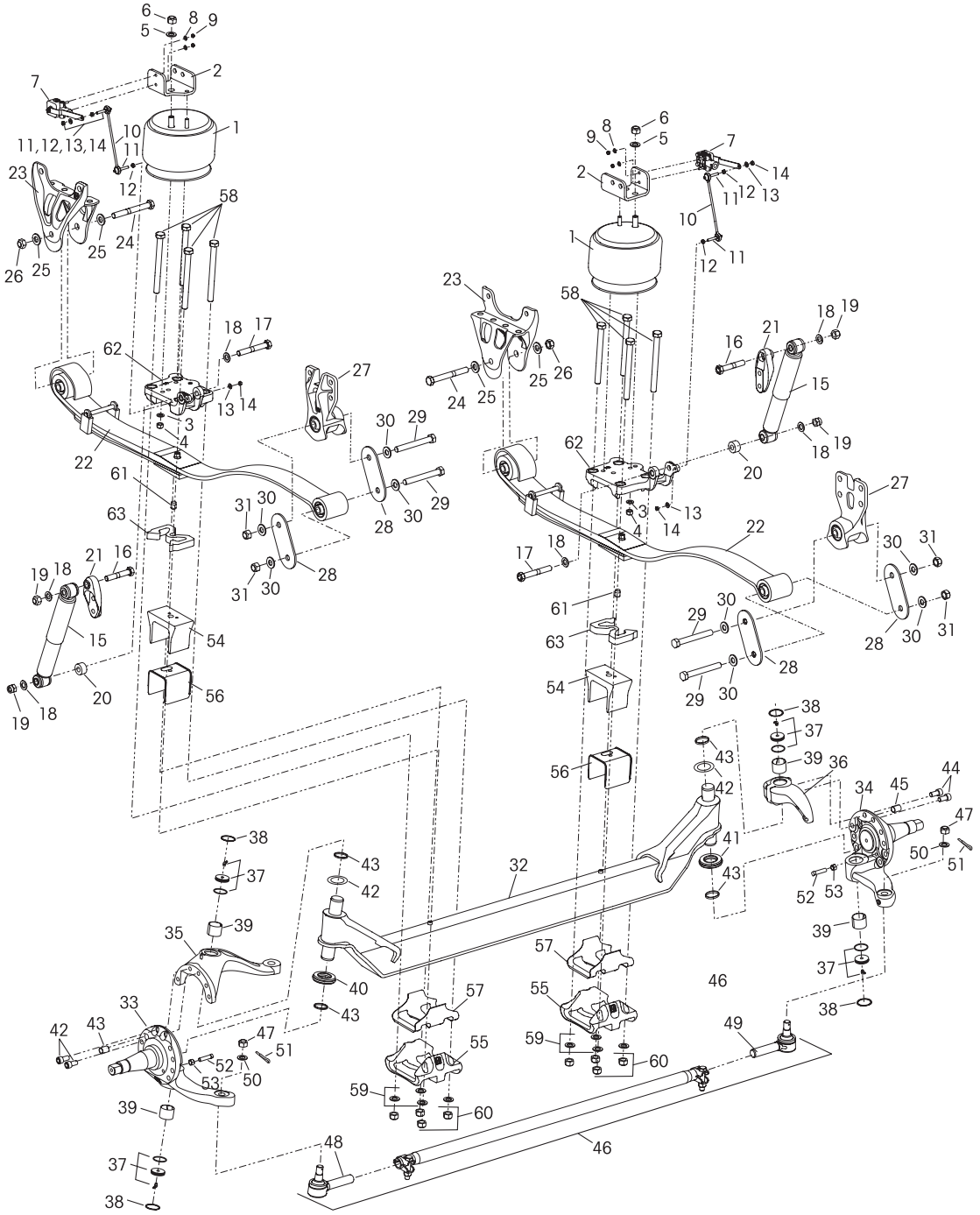
KEY NO.	PART NO.	DESCRIPTION	NO.REQ.
1	58913-009L	Shock Absorber (Replaces 58913-007)	2
2		**¾"-10 UNC Upper Shock Bolt	2
3		**¾"-10 UNC Lower Shock Bolt	2
4		**¾" Hardened Washer	8
5		**¾"-10 UNC Hex Locknut	4
6	59946-001	Shock Spacer	2
7	59423-002	Shock Bracket	2
		Leaf Spring Assembly Service Kit	
		For vehicles built after11/06	
		(Includes Key Nos. 8a, 13a, 14)	
	60961-161	8K	
	60961-162	10K	
		Leaf Spring Assembly	2
8a		*For vehicles built after 11/06*	
	66623-001	8K	
	66624-001	10K	
8b		*For vehicles built prior to 11/06*	
	66364-000	8K	
	60511-000	10K	
9	64488-002	Front Hanger (Replaces 64488-000)	2
10		**M20 Hex Bolt - 170mm	2
11		**M20 Hardened Washer	4
12		**M20 Locknut	2
		Rear Shackle Bracket	2
13a	66510-001	*For vehicles built after 11/06*	
13b	64316-000	*For vehicles built prior to 11/06*	
14	64314-000	Rear Shackle Plate	4
15	64159-000	Thrust Washer	4
		Only for vehicles built prior to 11/06	
16		**M20 Hex Bolt - 150mm	4
17		**M20 Hardened Washer	8
18		**M20 Locknut	4
	60952-XXX	STEERTEK Axle Assembly	1
		Contact Hendrickson Tech Serv. for Part No.	
		(Includes Key Nos. 19-44)	
19	64905-004	Axle & Kingpin Assembly	1
		6.5", 8.5" Ride Height	
20		LH Lower Steering Knuckle Assembly	1
	58900-035	150 Ackermann Air Brake	
	58900-033	200 Ackermann Air Brake	
	58900-031	250 Ackermann Air Brake	
	58900-055	150 Ackermann Hydraulic Brake	
	58900-053	200 Ackermann Hydraulic Brake	
	58900-051	250 Ackermann Hydraulic Brake	
21		RH Lower Steering Knuckle Assembly	1
	58900-036	150 Ackermann Air Brake	
	58900-034	200 Ackermann Air Brake	
	58900-032	250 Ackermann Air Brake	
	58900-056	150 Ackermann Hydraulic Brake	
	58900-054	200 Ackermann Hydraulic Brake	
	58900-052	250 Ackermann Hydraulic Brake	
22	60903-016	LH Upper Steering Knuckle Assembly	1
23	60904-002	RH Upper Steering Knuckle Assembly	1
	60961-040	**Kingpin Bushing and Bearing Service Kit, Axle Set**	
		(Includes Kit Nos. 60961-009 & -039)	
	60961-009	**LH Kingpin Bushing w/Composite Thrust Bearing Service Kit**	
		(Includes Key Nos. 24-27, 29-31, Loctite)	
	60961-039	**RH Kingpin Bushing w/Roller Thrust Bearing Service Kit**	
		(Includes Key Nos. 24-26, 28-31, Loctite)	
24	59156-000	Grease Cap Assembly	4
25	58937-000	Retaining Ring	4
26	58909-000	Kingpin Bushing	4

KEY NO.	PART NO.	DESCRIPTION	NO.REQ.
	60961-043	**Thrust Bearing Service Kit, Axle Set**	
		(Includes Kit Nos. 60961-041& -042)	
	60961-041	**LH Composite Thrust Bearing Service Kit**	
		(Includes Key Nos. 27, 29-31, Loctite)	
	60961-042	**RH Roller Thrust Bearing Service Kit**	
		(Includes Key Nos. 28-31, Loctite)	
27	59828-000	LH Composite Thrust Bearing	1
28	64256-000	RH Roller Thrust Bearing	1
29	60259-002	Kingpin Shim - 0.047"	2
Not Shown	60259-001	Kingpin Shim - 0.005" (As needed for service)	
30	58910-000	Kingpin Seal	4
31	60236-001	⅝"-11 UNC Socket Head Cap Screw	4
Not Shown	60937-000	Loctite (Red) Compound Tube	1
32	64246-000	ABS Sensor Sleeve	2
33		***Tie Rod Assembly, 10K, 5.36 Drop	1
		(Includes Key Nos. 34-38)	
	66699-003	200 Ackermann (Replaces 59948-005)	
	66699-001	250 Ackermann (Replaces 59948-006)	
34		*⅞" Castle Nut	2
	60961-139	***Tie Rod End Service Kit, Axle Set**	
		(Replaces 60961-012)	
		(Includes Kit Nos. 60961-137 & -138)	
	60961-137	***LH Tie Rod End Service Kit**	
		(Replaces 60961-029)	
		(Includes Key Nos. 35, 37-38)	
	60961-138	***RH Tie Rod End Service Kit**	
		(Replaces 60961-030)	
		(Includes Key Nos. 36-38)	
35	66645-001	***LH Tie Rod End (Replaces 64004-001)	1
36	66645-002	***RH Tie Rod End (Replaces 64004-002)	1
37	22962-007	⅞" Flat Washer	2
38	17800-004	Tie Rod Nut Cotter Pin	2
	60961-069	**Stop Bolt Service Kit, One Side**	
		(Includes Key Nos. 39-40)	
39	60238-001	½"-13 UNC Square Head Bolt	2
40	60240-000	½"-13 UNC Hex Jam Nut	2
41	59952-003	Top Axle Wrap	2
42	64722-003	Bottom Axle Wrap	2
	60961-015	**Top/Bottom Axle Wrap Liner Service Kit, One Side** (Includes Key Nos. 43-44)	
43	60508-000	Top Axle Wrap Liner	2
44	59845-000	Bottom Axle Wrap Liner	2
		Clamp Group Service Kit, One side	
		(Includes Key Nos. 45-47)	
	60961-140	6.5" Ride Height	
	60961-141	8.5" Ride Height	
45		¾"-16 UNF U-bolt	4
	64804-110	6.5" Ride Height - 11.0"	
	64804-130	8.5" Ride Height - 13.0"	
46	22962-001	¾" Flat Washer	8
47	17700-035	¾"-16 UNF 2B Nylon Locknut	8
Not Shown	18831-021	Dowel Pin, 8.5" Ride Height - 2.0"	1
	64506-000	Top Pad/Axle Stop Assembly	
		(Includes Key Nos. 48-49)	
48	64519-000	Top Pad	2
49	64080-000	Rubber Axle Stop	2
50		Front Axle Spacer	
	64536-010	LH 6.5" Ride Height	1
	64536-060	LH 8.5" Ride Height	1
Not Shown	64536-050	RH 8.5" Ride Height	1
51	66164-000	Thrust Pad Washer	2
		For 8K vehicles built prior to 2/07	
52	66366-001	Clamp Group Spacer	4
		For 8K vehicles built prior to 2/07	

Blue Bird All American Buses
14.6K Capacity - Left Hand Drive Steertek Axle

AIRTEK®

62



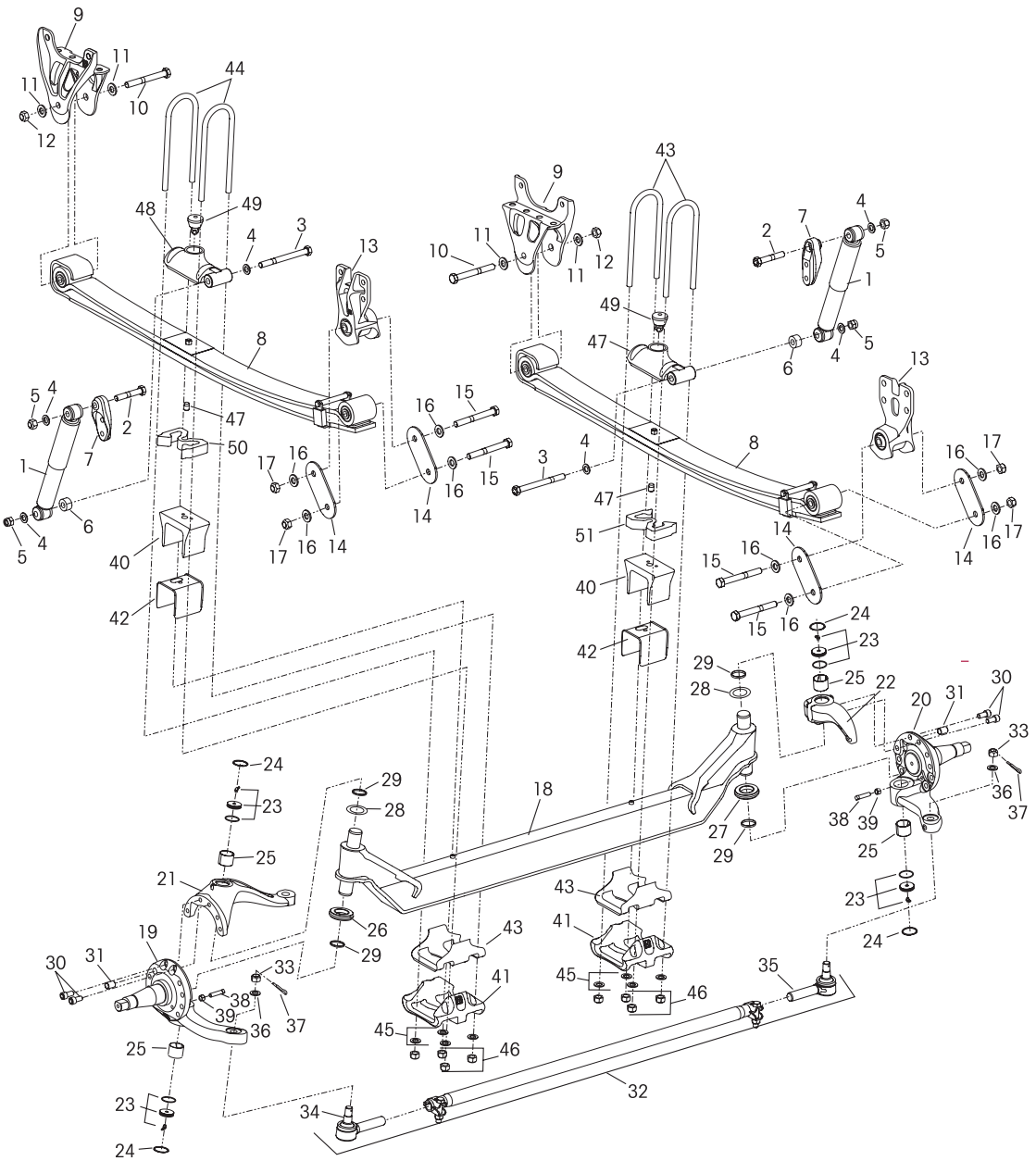
AIRTEK® for Blue Bird All American Buses - 14.6K Capacity

KEY NO.	PART NO.	DESCRIPTION	NO.REQ.
1	66865-002L	Air Spring	2
2	66807-001	Air Spring Bracket	2
3	22962-014	½" Hardened Washer	2
4	17730-015	½"-13 UNC Nylon Locknut	2
5		**¾" Hardened Washer	2
6		**¾"-10 UNC Nylon Locknut	2
	59013-000	Height Control Valve Assembly (Includes Key Nos. 7-9)	2
7	60501-000	Height Control Valve	2
8	22962-028	¼" Hardened Washer	4
9	49983-000	¼"-20 UNC Locknut	4
	66825-001	HCV Linkage Assembly (Includes Key Nos. 10-14)	2
10	59428-005	HCV Linkage	2
11		*5/16"-18 UNC Stud - 2.44"	4
12		*5/16"-18 UNC Hex Nut	4
13		*5/16" Hardened Washer	4
14		*5/16"-18 UNC Locknut	4
15	58913-011L	Shock Absorber	2
16		**¾"-10 UNC Upper Shock Bolt	2
17		**¾"-10 UNC Lower Shock Bolt	2
18		**¾" Hardened Washer	6
19		**¾"-10 UNC Hex Locknut	4
20	59946-006	Shock Spacer	2
21	65000-002	Shock Bracket	2
22	66805-001	Leaf Spring Assembly	2
23	64488-002	Front Hanger	2
24		**M20 Hex Bolt - 170mm	2
25		**M20 Hardened Washer	4
26		**M20 Locknut	2
27	66510-001	Rear Shackle Bracket	2
28	64314-000	Rear Shackle Plate	4
29		**M20 Hex Bolt - 150mm	4
30		**M20 Hardened Washer	8
31		**M20 Locknut	4
	60952-XXX	Axle Assembly (Includes Key Nos. 32-57) Contact Hendrickson Tech Serv. for Part No.	1
32		Axle & Kingpin Assembly 6.8", 7.8", 8.8" and 9.8" Ride Height	1
	64905-004	13.2K	
	64905-007	14.6K	
33		LH Lower Steering Knuckle Assembly	1
	58900-035	150 Ackermann Air Brake	
	58900-033	200 Ackermann Air Brake	
	58900-031	250 Ackermann Air Brake	
	58900-055	150 Ackermann Hydraulic Brake	
	58900-053	200 Ackermann Hydraulic Brake	
	58900-051	250 Ackermann Hydraulic Brake	
34		RH Lower Steering Knuckle Assembly	1
	58900-036	150 Ackermann Air Brake	
	58900-034	200 Ackermann Air Brake	
	58900-032	250 Ackermann Air Brake	
	58900-056	150 Ackermann Hydraulic Brake	
	58900-054	200 Ackermann Hydraulic Brake	
	58900-052	250 Ackermann Hydraulic Brake	
35	60903-055	LH Upper Steering Knuckle Assembly	1
36	60904-002	RH Upper Steering Knuckle Assembly	1
	60961-040	**Kingpin Bushing and Bearing Service Kit, Axle Set** (Includes Kit Nos. 60961-009 & -039)	
	60961-009	**LH Kingpin Bushing w/Composite Thrust Bearing Service Kit** (Includes Key Nos.37-40, 42-44, Loctite)	
	60961-039	**RH Kingpin Bushing w/Roller Thrust Bearing Service Kit** (Includes Key Nos.37-39, 41-44, Loctite)	
37	59156-000	Grease Cap Assembly	4
38	58937-000	Retaining Ring	4
39	58909-000	Kingpin Bushing	4

KEY NO.	PART NO.	DESCRIPTION	NO.REQ.
	60961-043	**Thrust Bearing Service Kit, Axle Set** (Includes Kit Nos. 60961-041 & 60961-042)	
	60961-041	**LH Composite Thrust Bearing Service Kit** (Includes Key Nos. 40, 42-44, Loctite)	
	60961-042	**RH Roller Thrust Bearing Service Kit** (Includes Key Nos. 41-44, Loctite)	
40	59828-000	LH Composite Thrust Bearing	1
41	64256-000	RH Roller Thrust Bearing	1
42	60259-002	Kingpin Shim - 0.047"	2
Not Shown	60259-001	Kingpin Shim - 0.005" (As needed for service)	
43	58910-000	Kingpin Seal	4
44	60236-001	5/8"-11 UNC Socket Head Cap Screw	4
Not Shown	60937-000	Loctite (Red) Compound Tube	1
45	64246-000	ABS Sensor Sleeve	2
46		***Tie Rod Assembly, 14.6K, 5.36 Drop (Includes Key Nos. 47-51)	1
	64006-002	150/200 Ackermann	
	64006-003	250 Ackermann	
47		*7/8" Castle Nut	2
	60961-011	**Tie Rod End Service Kit, Axle Set** (Includes Kit Nos. 60961-027 & -028)	
	60961-027	**LH Tie Rod End Service Kit** (Includes Key Nos. 48, 50-51)	
	60961-028	**RH Tie Rod End Service Kit** (Includes Key Nos. 49-51)	
48	64002-001	LH Tie Rod End	1
49	64002-002	RH Tie Rod End	1
50	22962-007	7/8" Flat Washer	2
51	17800-004	Tie Rod Nut Cotter Pin	2
	60961-069	**Stop Bolt Service Kit, One Side** (Includes Key Nos. 52-53)	
52	60238-001	½"-13 UNC Square Head Bolt	2
53	60240-000	½"-13 UNC Hex Jam Nut	2
54	59952-026	Top Axle Wrap	2
55	64722-003	Bottom Axle Wrap	2
	60961-015	**Top/Bottom Axle Wrap Liner Service Kit, One Side** (Includes Key Nos. 56-57)	
56	60508-000	Top Axle Wrap Liner	2
57	59845-000	Bottom Axle Wrap Liner	2
		Clamp Group Service Kit, One side (Includes Key Nos. 58-60)	
	60961-051	6.8" Ride Height	
	60961-146	7.8" Ride Height	
	60961-052	8.8" Ride Height	
	60961-147	9.8" Ride Height	
58		¾"-16 UNF Hex bolt	8
	21867-044	6.8" Ride Height - 10.0"	
	21867-027	7.8" Ride Height - 11.0"	
	21867-045	8.8" Ride Height - 12.0"	
	21867-035	9.8" Ride Height - 13.0"	
59	22962-001	¾" Flat Washer	8
60	17700-035	¾"-16 UNF 2B Nylon Locknut	8
61		Dowel Pin	
		6.8" Ride Height	None Req.
	18831-022	7.8" Ride Height - 1.13"	2
	18831-021	8.8" Ride Height - 2.0"	2
	18831-023	9.8" Ride Height - 3.0"	2
62		Top Pad	
	66814-001	LH	1
	66814-002	RH	1
63		LH/RH Front Axle Spacer	
		6.8" Ride Height	None Req.
	64536-025	7.8" Ride Height	2
	64536-050	8.8" Ride Height	2
	64536-075	9.8" Ride Height	2

Blue Bird All American Buses
13.2K/14.6K Capacity - Left Hand Drive Steertek Axle

SOFTEK®



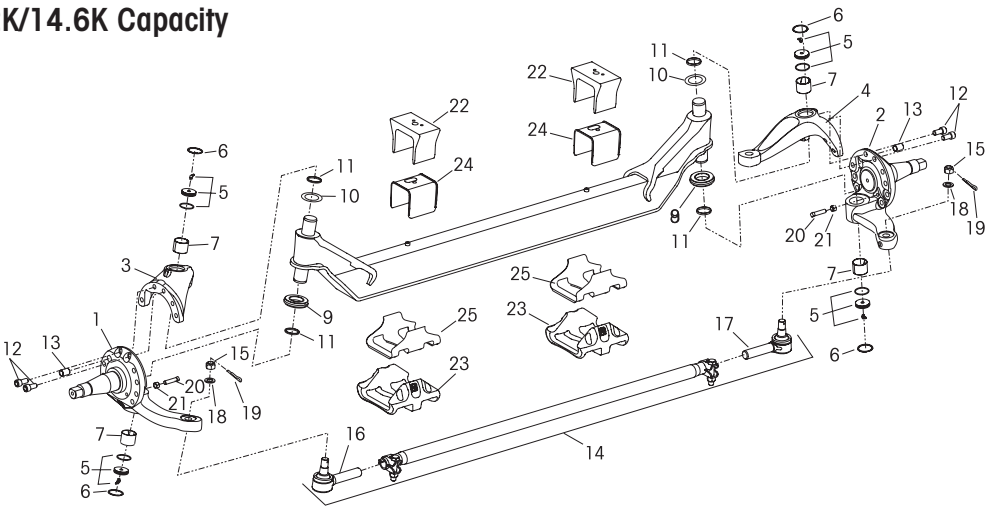
SOFTEK® for Blue Bird All American Buses - 13.2K/14.6K Capacity

KEY NO.	PART NO.	DESCRIPTION	NO.REQ.
1	58913-010L	Shock Absorber	2
2		**¾"-10 UNC Upper Shock Bolt	2
3		**¾"-10 UNC Lower Shock Bolt	2
4		**¾" Hardened Washer	6
5		**¾"-10 UNC Hex Locknut	4
6	59946-001	Shock Spacer	2
7	65000-002	Shock Bracket	2
8		Leaf Spring Assembly	2
	66625-001	13.2K	
	66626-001	14.6K	
9	64488-002	Front Hanger	2
10		**M20 Hex Bolt - 170mm	2
11		**M20 Hardened Washer	4
12		**M20 Locknut	2
13	66510-001	Rear Shackle Bracket	2
14	64314-000	Rear Shackle Plate	4
15		**M20 Hex Bolt - 150mm	4
16		**M20 Hardened Washer	8
17		**M20 Locknut	4
	60952-XXX	STEERTEK Axle Assembly	1
		Contact Hendrickson Tech Serv. for Part No. (Includes Key Nos. 18-43)	
18		Axle & Kingpin Assembly	1
		6.8", 7.8", 8.8" and 9.8" Ride Height	
	64905-002	13.2K	
	64905-005	14.6K	
19		LH Lower Steering Knuckle Assembly	1
	58900-035	150 Ackermann Air Brake	
	58900-033	200 Ackermann Air Brake	
	58900-031	250 Ackermann Air Brake	
	58900-055	150 Ackermann Hydraulic Brake	
	58900-053	200 Ackermann Hydraulic Brake	
	58900-051	250 Ackermann Hydraulic Brake	
20		RH Lower Steering Knuckle Assembly	1
	58900-036	150 Ackermann Air Brake	
	58900-034	200 Ackermann Air Brake	
	58900-032	250 Ackermann Air Brake	
	58900-056	150 Ackermann Hydraulic Brake	
	58900-054	200 Ackermann Hydraulic Brake	
	58900-052	250 Ackermann Hydraulic Brake	
21	60903-055	LH Upper Steering Knuckle Assembly	1
22	60904-002	RH Upper Steering Knuckle Assembly	1
	60961-040	**Kingpin Bushing and Bearing Service Kit, Axle Set** (Includes Kit Nos. 60961-009 & -039)	
	60961-009	**LH Kingpin Bushing w/Composite Thrust Bearing Service Kit** (Includes Key Nos. 23-26, 28-30, Loctite)	
	60961-039	**RH Kingpin Bushing w/Roller Thrust Bearing Service Kit** (Includes Key Nos. 23-25, 27-30, Loctite)	
23	59156-000	Grease Cap Assembly	4
24	58937-000	Retaining Ring	4
25	58909-000	Kingpin Bushing	4
	60961-043	**Thrust Bearing Service Kit, Axle Set** (Includes Kit Nos. 60961-041& -042)	
	60961-041	**LH Composite Thrust Bearing Service Kit** (Includes Key Nos. 26, 28-30, Loctite)	
	60961-042	**RH Roller Thrust Bearing Service Kit** (Includes Key Nos. 27-30, Loctite)	
26	59828-000	LH Composite Thrust Bearing	1
27	64256-000	RH Roller Thrust Bearing	1
28	60259-002	Kingpin Shim - 0.047"	2
Not Shown	60259-001	Kingpin Shim - 0.005" (As needed for service)	
29	58910-000	Kingpin Seal	4
30	60236-001	⅝"-11 UNC Socket Head Cap Screw	4
Not Shown	60937-000	Loctite (Red) Compound Tube	1
31	64246-000	ABS Sensor Sleeve	2

KEY NO.	PART NO.	DESCRIPTION	NO.REQ.
32		Tie Rod Assembly, 14.6K, 5.36 Drop (Includes Key Nos. 33-37)	1
	64006-002	150/200 Ackermann	
	64006-003	250 Ackermann	
33		*⅞" Castle Nut	2
	60961-011	**Tie Rod End Service Kit, Axle Set** (Includes Kit Nos. 60961-027 & -028)	
	60961-027	**LH Tie Rod End Service Kit** (Includes Key Nos. 34, 36-37)	
	60961-028	**RH Tie Rod End Service Kit** (Includes Key Nos. 35-37)	
34	64002-001	LH Tie Rod End	1
35	64002-002	RH Tie Rod End	1
36	22962-007	⅞" Flat Washer	2
37	17800-004	Tie Rod Nut Cotter Pin	2
	60961-069	**Stop Bolt Service Kit, One Side** (Includes Key Nos. 38-39)	
38	60238-001	½"-13 UNC Square Head Bolt	2
39	60240-000	½"-13 UNC Hex Jam Nut	2
40	59952-026	Top Axle Wrap	2
41	64722-003	Bottom Axle Wrap	2
	60961-015	**Top/Bottom Axle Wrap Liner Service Kit, One Side** (Includes Key Nos. 42-43)	
42	60508-000	Top Axle Wrap Liner	2
43	59845-000	Bottom Axle Wrap Liner	2
		Clamp Group Service Kit, One side (Includes Key Nos. 44-46)	
	60961-142	6.8" Ride Height	
	60961-143	7.8" Ride Height	
	60961-144	8.8" Ride Height	
	60961-145	9.8" Ride Height	
44		¾"-16 UNF U-bolt	4
	64804-120	6.8" Ride Height - 12.0"	
	64804-130	7.8" Ride Height - 13.0"	
	64804-140	8.8" Ride Height - 14.0"	
	64804-150	9.8" Ride Height - 15.0"	
45	22962-001	¾" Flat Washer	8
46	17700-035	¾"-16 UNF 2B Nylon Locknut	8
47		Dowel Pin	
		6.8" Ride Height	None Req.
	18831-022	7.8" Ride Height - 1.13"	2
	18831-021	8.8" Ride Height - 2.0"	2
	18831-023	9.8" Ride Height - 3.0"	2
	66806-001	Top Pad/Axle Stop Assembly (Includes Key Nos. 48-49)	
48	66666-000	Top Pad	2
49	64080-000	Rubber Axle Stop	2
50		LH Front Axle Spacer	1
	64536-010	6.8" Ride Height	
	64536-035	7.8" Ride Height	
	64536-060	8.8" Ride Height	
	64536-085	9.8" Ride Height	
51		RH Front Axle Spacer	1
		6.8" Ride Height	None Req.
	64536-025	7.8" Ride Height	
	64536-050	8.8" Ride Height	
	64536-075	9.8" Ride Height	

Right Hand Drive for Blue Bird All American Buses

13.2K/14.6K Capacity



KEY NO.	PART NO.	DESCRIPTION	NO.REQ.
		STEERTEK Axle Assembly (Includes Key Nos. 1-25)	1
	67905-402	SOFTEK Standard Drop - 13.2K	
	67905-404	AIRTEK Deep Drop - 13.2K	
	67905-405	SOFTEK Standard Drop - 14.6K	
	67905-407	AIRTEK Deep Drop - 14.6K	
1		LH Lower Steering Knuckle Assembly	1
	58900-035	150 Ackermann Air Brake	
	58900-033	200 Ackermann Air Brake	
	58900-031	250 Ackermann Air Brake	
	58900-055	150 Ackermann Hydraulic Brake	
	58900-053	200 Ackermann Hydraulic Brake	
	58900-051	250 Ackermann Hydraulic Brake	
2		RH Lower Steering Knuckle Assembly	1
	58900-036	150 Ackermann Air Brake	
	58900-034	200 Ackermann Air Brake	
	58900-032	250 Ackermann Air Brake	
	58900-056	150 Ackermann Hydraulic Brake	
	58900-054	200 Ackermann Hydraulic Brake	
	58900-052	250 Ackermann Hydraulic Brake	
3	60904-001	LH Upper Steering Knuckle Assembly	1
4	70903-001	RH Upper Steering Knuckle Assembly	1
	60961-040	**Kingpin Bushing and Bearing Service Kit, Axle Set** (Includes Kit Nos. 60961-009 & -039)	
	60961-009	**RH Kingpin Bushing w/Composite Thrust Bearing Service Kit** (Includes Key Nos. 5-8, 10-12, Loctite)	
	60961-039	**LH Kingpin Bushing w/Roller Thrust Bearing Service Kit** (Includes Key Nos. 5-7, 9-12, Loctite)	
5	59156-000	Grease Cap Assembly	4
6	58937-000	Retaining Ring	4
7	58909-000	Kingpin Bushing	4
	60961-043	**Thrust Bearing Service Kit, Axle Set** (Includes Kit Nos. 60961-041& -042)	
	60961-041	**RH Composite Thrust Bearing Service Kit** (Includes Key Nos. 8, 10-12, Loctite)	
	60961-042	**LH Roller Thrust Bearing Service Kit** (Includes Key Nos. 9-12, Loctite)	
8	59828-000	RH Composite Thrust Bearing	1
9	64256-000	LH Roller Thrust Bearing	1
10	60259-002	Kingpin Shim - 0.047"	2
Not Shown	60259-001	Kingpin Shim - 0.005" (As needed for service)	
11	58910-000	Kingpin Seal	4
12	60236-001	⅝"-11 UNC Socket Head Cap Screw	4
Not Shown	60937-000	Loctite (Red) Compound Tube	1
13	64246-000	ABS Sensor Sleeve	2
14		Tie Rod Assembly, 13.2K (Includes Key Nos. 15-19)	1
	60239-005	150/200 Ackermann	
	60239-001	250 Ackermann	
15		*⅞" Castle Nut	2
	60961-010	**Tie Rod End Service Kit, Axle Set** (Includes Kit Nos. 60961-025 & -026)	
	60961-025	**LH Tie Rod End Service Kit** (Includes Key Nos. 16, 18-19)	
	60961-026	**RH Tie Rod End Service Kit** (Includes Key Nos. 17-19)	
16	64000-001	LH Tie Rod End	1
17	64000-002	RH Tie Rod End	1
18	22962-007	⅞" Flat Washer	2
19	17800-004	Tie Rod Nut Cotter Pin	2
	60961-069	**Stop Bolt Service Kit, One Side** (Includes Nos. 20-21)	
20	60238-001	½"-13 UNC Square Head Bolt	2
21	60240-000	½"-13 UNC Hex Jam Nut	2
22	59952-026	Top Axle Wrap - 13.2K	2
	59952-031	Top Axle Wrap - 14.6K	
23	64722-003	Bottom Axle Wrap	2
	60961-015	**Top/Bottom Axle Wrap Liner Service Kit, One Side** (Includes Nos. 24-25)	
24	60508-000	Top Axle Wrap Liner	2
25	59845-000	Bottom Axle Wrap Liner	2

NOTE: * Item included in assembly only, part not sold separately.

** Not supplied by Hendrickson, used for reference only. Refer to OEM (vehicle manufacturer) for more information. Hendrickson is not responsible for components supplied by vehicle manufacturer. For assistance with maintenance and rebuild instructions on these components see vehicle manufacturer.

*** Hendrickson supplies different tie rod assemblies and each type may take a different replacement tie rod end kit to service. Prior to ordering, find the part number on the tie rod tube, reference Hendrickson Publication No. SEU-0223 or contact Hendrickson Sales Engineering 630.910.2800 for corresponding kit numbers.

NOTE: Quantities of service kit components may vary from amount shown in lists.

SECTION 6

On Highway and On Roadway Recommended Towing Procedure

Hendrickson recommends that a vehicle equipped with a STEERTEK axle be towed by the following methods (listed in order of preference) for ON HIGHWAY or ON ROADWAY applications.

1. Wheel lift method, the ideal towing procedure
2. Towing the vehicle from the rear method
3. Conventional axle fork method

Please read, understand and comply with any additional towing instructions and safety precautions that may be provided by the vehicle manufacturer.

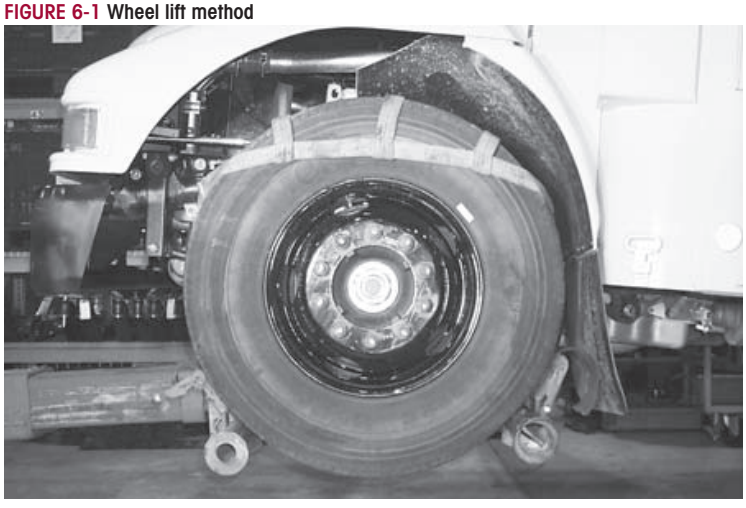
Hendrickson will not be responsible for any damage to the axle, suspension or other vehicle components resulting from any towing method or fixture not authorized by Hendrickson.

Please contact Hendrickson Tech Services at 630.910.2800 or send email to: techservices@hendrickson-intl.com with any questions regarding proper towing procedures for vehicles equipped with a STEERTEK axle.

WHEEL LIFT METHOD—IDEAL

This method provides the greatest ease for towing the vehicle. Lifting at the tires helps reduce the risk of possible damage to the axle, suspension, and engine components during towing operations, see Figure 6-1.

FIGURE 6-1 Wheel lift method



TOWING VEHICLE FROM THE REAR METHOD

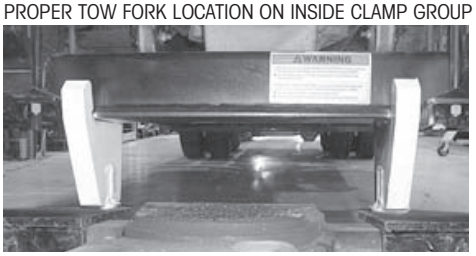
This method is preferred when the proper equipment is not available to perform the wheel lift method and is necessary for wreckers not equipped with an under lift system.

AXLE FORK LIFT METHOD

This is an alternative method for towing the vehicle, but requires standard 5" forks, (see Figures 6-2 and 6-3) and designated lift points inside the axle clamp groups. The following procedure must be used:

- Place a spacer on the boom, to provide adequate clearance between the oil pan and the boom if necessary. Lift the vehicle in order to place spacer under tires. This will provide sufficient room under the axle to locate forks in the proper position.
- Install the fork in the boom properly.
- Position the tow forks directly under the axle, inside the axle clamp groups as shown in Figure 6-2.

FIGURES 6-2 AND 6-3
PROPER TOW FORK LOCATION ON INSIDE CLAMP GROUP ON THE STEERTEK AXLE



- Prior to lifting the vehicle, ensure that the bottom axle plate is flat in the tow fork to minimize any gap between the bottom axle plate and the tow fork, see Figure 6-4 and 6-5. It may be necessary to deflate the air in the steer axle suspension, and/or release the tractor brakes. Deflate the steer axle air springs by disconnecting the height control valve linkage and lowering the height control valve linkage arm. This will exhaust the air pressure in the steer axle air springs.

FIGURE 6-4 WITHOUT GAP

FIGURE 6-5 WITH GAP

NOTE When lifting a vehicle with an under lift boom, care must be taken not to damage the engine's oil pan. Vehicles equipped with a front fairing may require removal of the front fairing prior to towing to prevent component damage.

- Lift vehicle and secure the vehicle to the boom.
- Install safety straps, it is preferred to use nylon safety straps. Chains have a tendency to bind and may cause damage to the axle.

OFF ROADWAY TOWING METHOD

WARNING

WHEN A VEHICLE IS DISABLED AND EQUIPPED WITH A STEERTEK AXLE, CARE MUST BE TAKEN TO ENSURE THERE IS NO DAMAGE TO THE SUSPENSION OR AXLE WHEN TOWING THE VEHICLE. THE USE OF A TOW STRAP IS NECESSARY TO TOW A DISABLED VEHICLE INTO A REPAIR FACILITY PARKING LOT INTO THE SHOP BAY. THE TOW STRAPS SHOULD BE CONNECTED TO THE TOW HOOKS PROVIDED BY THE VEHICLE MANUFACTURER AT THE FRONT OF THE BUMPER. IF THE USE OF TOW HOOKS IS NOT AN OPTION THEN A TOW STRAP MAY BE WRAPPED AROUND THE FRONT AXLE, (SEE FIGURE 6-6) IN A MANNER THAT IS ACCEPTABLE FOR TOWING THE VEHICLE INTO THE SHOP. DO NOT USE A TOW CHAIN AROUND THE FRONT AXLE TO TOW THE VEHICLE, DOING SO WILL DAMAGE THE AXLE AND VOID WARRANTY, (SEE FIGURE 6-7).

THE FOLLOWING METHODS ARE NOT RECOMMENDED FOR:
ON HIGHWAY OR ON ROADWAY TOWING

FIGURE 6-6

NYLON STRAPS ARE ACCEPTABLE FOR OFF ROADWAY TOWING

FIGURE 6-7

CHAINS ARE NOT ACCEPTABLE FOR OFF ROADWAY TOWING

SECTION 7

Preventive Maintenance

Following appropriate inspection procedure is important to help ensure the proper maintenance and operation of the AIRTEK®/SOFTEK® suspension system and component parts function to their highest efficiency.

HENDRICKSON RECOMMENDED PREVENTIVE MAINTENANCE INTERVALS

- **The first 1,000 miles**
- **On-highway** – every 25,000 miles (40,000 km) or 6 months, whichever comes first

COMPONENT INSPECTION

- **Air spring** — Look for chaffing or any signs of spring or component damage.
- **Clamp group** — Check torque on clamp group mounting hardware. Refer to Torque Specifications in the appendix of this publication.
- **Fasteners** — Look for any loose or damaged fasteners on the entire suspension. Make sure all fasteners are tightened to the specified torque. Refer to Torque Specifications in the appendix. Use a calibrated torque wrench to check torque in a tightening direction. As soon as the fastener starts to move, record the torque. Correct the torque if necessary. Replace any worn or damaged fasteners.
- **Front hangers and shackle brackets** — Check for cracks or loose mounting hardware. Replace if necessary, see the Component Replacement Section of this publication for replacement procedure.
- **Operation** — All steering components must move freely through the full range of motion from axle stop to axle stop.
- **Shock absorber** — Look for any signs of dents or leakage, misting is not considered a leak. See Shock Absorber Inspection in this section.
- **Steel leaf spring and wrap leaf assembly** — Look for cracks. Check the front and rear bushings for any wear or deterioration. Replace spring assembly if any of the previous conditions are observed. See the Component Replacement Section of this publication for replacement procedure.
- **STEERTEK Axle** — The axle should be free of any nicks or gouges. Inspect for any cracks or dents on axle.
- **Steering pivot points** — Check for looseness at all pivot points. Inspect and lubricate all pivot points. Refer to the Trouble Shooting Guide Section in the Appendix of this publication.
- **Thrust washers (If equipped)** — Look for any signs of excessive wear to the thrust washers, shackles and shackle bracket. See Thrust Washer Inspection detailed in this section.
- **Tire wear** — Inspect tires for wear patterns that may indicate suspension damage or misalignment. See Tire Inspection in this section.
- **Top and bottom axle wrap liners** — Look for any cracking or broken pieces on liner in load bearing areas. See Axle Wrap Liner Inspection in this section.
- **Top pad (AIRTEK)** — Check for cracks or damage. Replace if necessary, see the Component Replacement Section of this publication for replacement procedure.
- **Top pad and bump stop (SOFTEK)** — Check for cracks and/or missing rubber bump stops. Replace if necessary, see the Component Replacement Section of this publication for replacement procedure.
- **Wear and damage** — Inspect all parts of suspension for wear and damage. Look for bent or cracked parts. Replace all worn or damaged parts.

See vehicle manufacturer's applicable publications for other preventative maintenance requirements.

LUBRICATION INTERVALS

For vehicles equipped with the STEERTEK axle, regular lubrication intervals should be followed to help prevent premature wear to the kingpin bushings and tie rod ends, see lubrication chart below.

NOTE The recommended service lubrication interval is a guideline, the vehicle may require increased lubrication interval depending on severity of operation.

STEERTEK GREASING AND LUBRICATION SPECIFICATIONS

Component	Greasing Interval	Grease	NLGI Grade	Outside Temperature
Kinpin Bushings	Maximum of 25,000 miles (40,225 kilometers) or 90 days, whichever comes first.	Multipurpose Grease	2	Refer to the lubricant manufacturer's specifications for the temperature service limits applicable to your area.
Tie Rod Ends				
Drag Link	See Vehicle Manufacturer			

NOTE: Lubrication greases acceptable for use on the STEERTEK axle will carry a designation of NLGI #2 EP and rated GC-LB or equivalent.

KINGPIN LUBRICATION

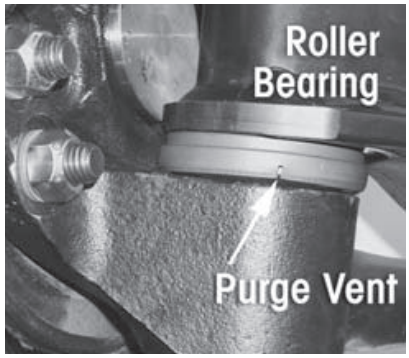
On the Hendrickson STEERTEK front axle the kingpin grease fittings are located on the top and bottom of the kingpin grease caps.

1. Place the vehicle on a level floor.
2. Prior to greasing the kingpins on the vehicle, the suspension must be in a loaded condition.
3. Clean off all the grease fittings and grease gun tip with a clean shop towel prior to lubrication.
4. Lubricate the kingpins through the grease fittings on the top and bottom of the steering knuckle, see Lubrication Specification Matrix above.
5. Force the required lubricant into the upper and lower kingpin grease fittings, until new lubricant flows from the upper axle beam and knuckle and the thrust bearing purge location, see Figures 7-1 and 7-2.

NOTE Greasing at the lower zerk should purge grease from the thrust bearing shell. Both sides purge in the same area. The left side of the axle has a composite style thrust bearing, see Figure 7-1 and the right side of the axle has a steel roller thrust bearing, see Figure 7-2, for right hand drive axle configuration the thrust bearings will be the opposite.

FIGURE 7-1

FIGURE 7-2



TIE ROD END LUBRICATION

LUBRICATION PROCEDURE

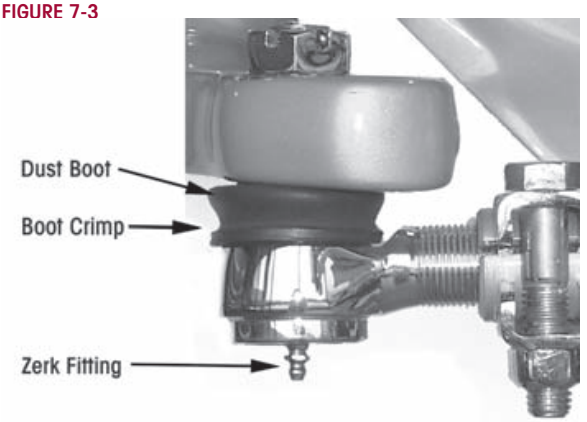
1. Turn the vehicle wheels straight ahead.
2. Wipe the zerk fitting and grease gun tip with clean shop towels.
3. Wipe the seal/boot clean with shop towels.
4. Attach a grease gun to the zerk fitting. Either a hand or pneumatic grease gun is acceptable. If air operated grease gun is used, system air pressure should not exceed 150 psi (1035 kPa).

CAUTION

EXCEEDING THE MAXIMUM AIR PRESSURE TO THE ZERK FITTING CAN CAUSE DAMAGE TO THE DUST BOOT AND COMPONENT FAILURE.

5. Dirt, water, and discolored old grease should flow from the relief vents or purge holes near the boot crimp or bellows area, see Figure 7-3. Continue to purge grease until fresh grease flows from the purge area.

FIGURE 7-3



6. If the tie rod end is designed for lube service and it will not accept grease proceed as follows:
   a. Remove the zerk fitting
   b. Inspect the threaded zerk fitting hole in the tie rod end and remove any obstructions
   c. Install a new zerk fitting
   d. Continue the lubrication procedure
   e. If the tie rod end will not accept grease following this procedure it will be necessary to replace the tie rod end, (see Tie Rod End replacement in the Component Replacement Section of this publication)
7. Apply grease until all the old grease is purged from the boot and fresh grease is coming out.

TIE ROD END INSPECTION

INSPECTION PROCEDURE

Before beginning this inspection procedure, the entire system must be unloaded (i.e., the front end of the vehicle must be raised and supported with safety stands).

CAUTION

DO NOT GREASE THE TIE ROD ASSEMBLY BEFORE PERFORMING THE INSPECTION. DOING SO CAN INHIBIT EFFORTS TO DETERMINE ACTUAL WEAR.

CAUTION

REPLACE THE ENTIRE TIE ROD END IF THE BOOT IS TORN OR MISSING, FAILURE TO DO SO CAN CAUSE PREMATURE WEAR OF THE TIE ROD END.

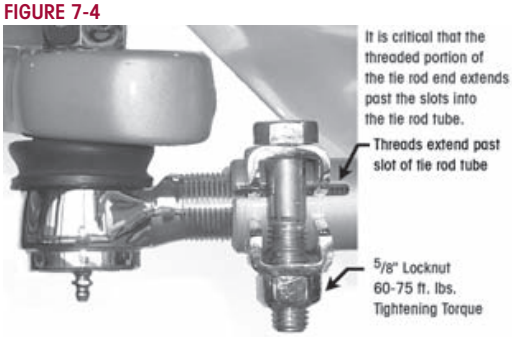
1. Block rear wheels of vehicle. Using the bottom of the axle beam or the frame rails, raise the front end off the ground and support with stands.
2. With the engine off, turn the wheels from full left to full right and then return to the straight-ahead position.
3. Check that the boots are in place and completely installed over the tie rod ends.
4. Check for cracking or tears in the boots. Also check the boot seals for damage. Replace the entire tie rod end if the boot is damaged.

WARNING

THE CORRECT COTTER PIN MUST BE INSTALLED THROUGH THE TIE ROD END WITH THE CASTLE NUT TIGHTENED TO THE PROPER TORQUE SPECIFICATION IN ORDER TO SECURELY ATTACH THE TIE ROD. LOSS OF THE COTTER PIN CAN CAUSE THE TIE ROD END NUT TO BECOME LOOSE AND ADVERSELY AFFECT VEHICLE STEERING AND POSSIBLY RESULT IN TOTAL LOSS OF STEERING CONTROL.

5. Check that the tie rod end nut is installed and secured with a cotter pin. If the cotter pin is missing, check the nut torque specification and then install a new cotter pin. Always tighten the castle nut to specified torque when setting the cotter pin. Do not back off the nut to insert cotter pin.
6. Check that the tie rod end is threaded correctly into the cross tube and is engaged deeper than the end of the cross tube slot. The tie rod end must be visible the entire length of the cross tube slot, see Figure 7-4.
7. Check that zerk fittings are installed. Replace a damaged zerk fitting with a new one.

FIGURE 7-4



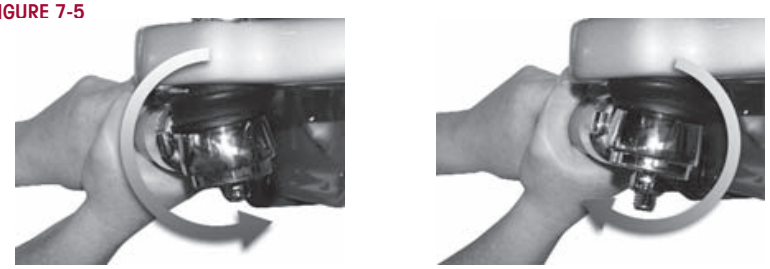
CAUTION

DO NOT USE THE FOLLOWING ITEMS OR METHODS TO CHECK FOR MOVEMENT OF THE TIE ROD ASSEMBLY. DAMAGE TO COMPONENTS CAN RESULT IF:

- A CROW BAR, PICKLE FORK OR 2 x 4 ARE USED.
- ANYTHING OTHER THAN HANDS ARE USED TO GRASP THE CROSS TUBE ASSEMBLY (CAN RESULT IN DAMAGE TO THE CROSS TUBE).
- EXCESSIVE PRESSURE OR FORCE IS APPLIED TO THE TIE ROD ENDS OR THE JOINTS OF THE ASSEMBLY.

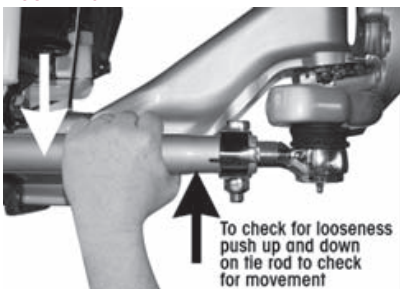
8. By hand or using a pipe wrench, with jaw protectors to avoid gouging the cross tube, rotate the cross tube toward the front of the vehicle and then toward the rear. After rotating, center the cross tube. If the cross tube will not rotate in either direction, replace both tie rod ends, see Figure 7-5.

FIGURE 7-5



9. Position yourself directly below the tie rod end. Using both hands, grab the assembly end as close to the tie rod end as possible (no more than 6" or 152.4mm). Apply hand pressure with reasonable human effort vertically up and down in a push-pull motion several times (using approx. 50-100 lbs. of force). Check for any movement or looseness at both tie rod end locations, see Figure 7-6.

FIGURE 7-6



10. If there is any movement in the tie rod assembly, install a magnetic based dial indicator on the Ackermann arm, see Figure 7-7.
11. Set the dial indicator to zero.
12. Apply hand pressure with reasonable human effort vertically up and down in a push-pull motion several times (using approx. 50-100 lbs. of force). Observe the reading on the dial indicator.
13. If the reading is more than 0.060", replace both tie rod ends at the next service interval.
14. If a tie rod end exhibits 0.125" of movement by hand, the vehicle should be removed immediately from use and the tie rod end be replaced.

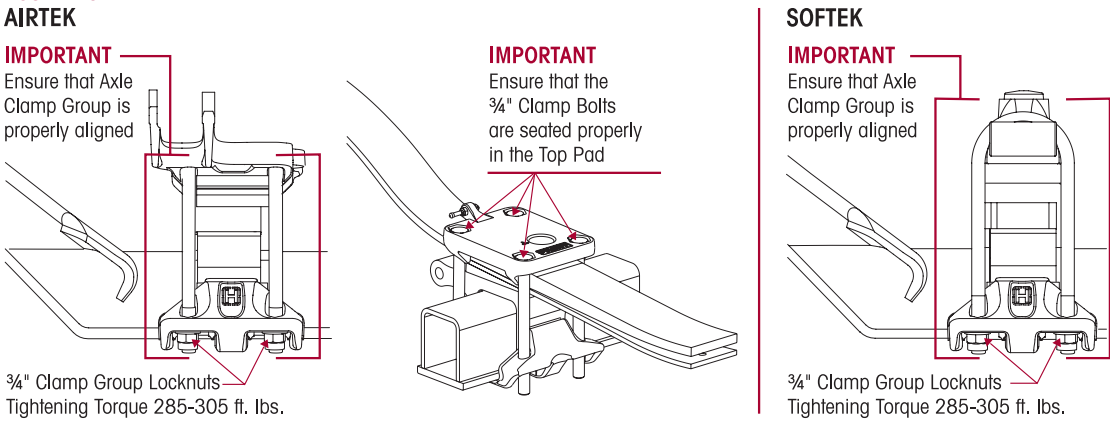
FIGURE 7-7

NOTE According to the Commercial Vehicle Safety Alliance (CVSA), the vehicle "out of service" criteria is: Any motion other than rotational between any linkage member and its attachment point of more than ⅛" (3mm) measured with hand pressure only. (393.209(d)), (published in the North American Standard Out-of-Service Criteria Handbook, April 1, 2006.)

CLAMP GROUP RE-TORQUE INTERVAL

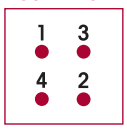
1. Clamp group locknuts must be torque to specification at preparation for delivery.
2. Clamp group locknuts must be re-torqued at 1,000 miles.
3. Thereafter follow the 6 month/ 25,000 mile inspection and annual re-torque interval.
4. Ensure that the clamp group is properly aligned and the hex bolts/U-bolts are seated in the top pad, and the bottom axle wrap is centered on the top axle wrap, see Figure 7-8.

FIGURE 7-8



5. Check for the signs of component or bolt movement.
6. If signs of movement are present, disassemble the clamp group fasteners, check for component wear or damage and replace as necessary, then install new clamp group fasteners and repeat steps 1 through 5.
7. Tighten the clamp group locknuts evenly in 50 foot pounds increments to 285-305 foot pounds torque in the proper pattern to achieve uniform bolt tension, see Figure 7-9.

FIGURE 7-9



TIRE INSPECTION

The leading causes of tire wear are the following, in order of importance:

1. Tire Pressure
2. Toe Setting
3. Thrust Angle
4. Camber

The following tire Inspection guidelines are based upon TMC (Technology & Maintenance Council) recommended practices. Any issues regarding irregular tire wear where Hendrickson is asked for assistance, will require tire and alignment maintenance records, reference TMC's literature numbers RP219A, RP230, or RP 642.

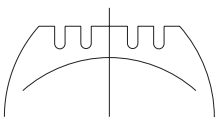
Tire wear is normally the best indicator of vehicle alignment condition. If tires are wearing too rapidly or irregularly, alignment corrections may be needed. The tire wear patterns described below can help isolate specific alignment problems.

The most common conditions of concern are:

- Overall Fast Wear (Miles per 32nd)
- Feather Wear
- Cupping
- Diagonal Wear
- Rapid Shoulder Wear (One Shoulder Only)
- One-Sided Wear

FIGURE 7-10

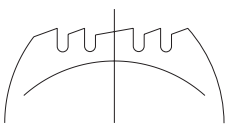
OVERALL FAST WEAR (Miles per 32nd)



Overall Fast Wear — Fast wear can be described as exhibiting a good, but accelerated wear pattern. It is typically caused by operating conditions, such as mountainous terrain, frequency and severity of turning, abrasive road surfaces in combination with vehicle configurations and their attributes-such as power steering, heavy axle loads, high wheel cuts, setback axles, short wheel base tractors, long wheel base straight trucks. To correct this problem, consult with vehicle and tire manufacturers when specifying equipment or replacing tires. For more information, see TMC RP 219A publication, page 11. For information on how to accurately measure and record tire rates, see TMC RP 230 publication.

FIGURE 7-11

FEATHER WEAR



Feather wear — Tread ribs or blocks worn so that one side is higher than the other resulting in step-offs across the tread face. Generally, ribs or blocks exhibit this wear. To spot this problem, do the following:

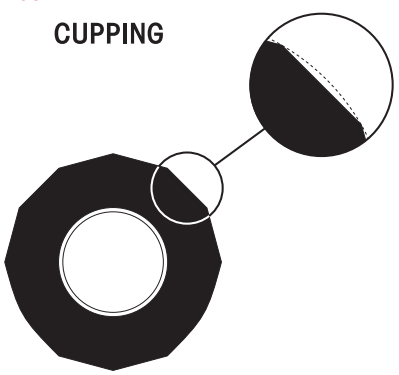
With one hand flat on the tread of the tire and a firm down pressure, slide your hand across the tread of the tire. In one direction, the tire will feel smooth and in the opposite direction there will be a sharp edge to the tread. Typical causes of feather wear include: excessive side force scrubbing, resulting from conditions of misalignment such as excessive toe, drive axle misalignment, worn, missing or damaged suspension components, bent tie rods or other chassis misalignment.

To correct this problem, tires can be rotated to another axle for maximum utilization of remaining tread. Additionally, diagnose the vehicle itself and correct misalignment condition as required. If steer tire feathers are in opposite directions, an improper toe condition is most likely the cause. For more information, see TMC RP 219A publication, page 5.

If feather wear on both steer tires is in the same direction, drive axle or other chassis misalignment is indicated. If one steer tire shows feather wear and the other steer tire has normal wear, a combination of toe and drive axle or chassis misalignment is indicated.

FIGURE 7-12

CUPPING



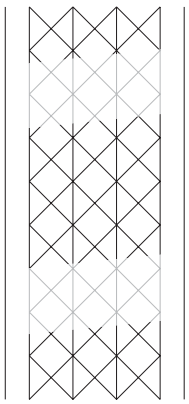
Cupping — Localized, dished out areas of fast wear creating a scalloped appearance around the tire. Cupping, which appears around the tire on the shoulder ribs, may also progress to adjoining ribs, see TMC RP 219A publication, page 7.

Cupping is usually a result of moderate-to-severe imbalance, improper rim/wheel mounting, excessive wheel end play or other assembly non-uniformity. It can also be due to lack of shock absorber control on some suspension types.

To solve cupping problems:

- *Tires* – Correct mismount or balance problem. If ride complaints arise, steer tires may be rotated to drive or trailer axle.
- *Vehicle* – Diagnose component imbalance condition, i.e., wheel, rim, hub, brake, drum. Correct as necessary.

FIGURE 7-13
DIAGONAL WEAR

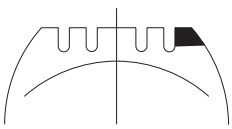


Diagonal Wear — Can be described as localized flat spots worn diagonally across the tread at approximately 25-35° angles, often repeating around the tread circumference. For more information, see TMC RP 219A publication, page 20.

Diagonal wear is usually caused by bad wheel bearings, toe out, mismounting of tire and wheel assembly to axle, and mismatched duals for size and/or inflation pressures. It may start as brake skid. Diagonal wear is aggravated by high speed empty or light load hauls.

To correct diagonal wear, reverse direction of rotation of the tire. If wear is excessive, true tire. If the source of trouble is the vehicle, diagnose cause and correct as needed.

FIGURE 7-14
RAPID SHOULDER WEAR (One Shoulder Only)



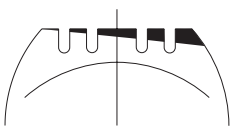
Rapid Shoulder Wear (One Shoulder Only) — Is defined as a tire worn on the edge of one shoulder, sometimes extending to inner ribs. It can progress to diagonal wipeout. For more information, see TMC RP 219A publication, page 22.

This wear condition is usually caused by excessive toe or excessive camber. These conditions can be created by a misaligned or bent axle and can also be caused by loose or worn wheel bearings.

To correct this type of rapid shoulder wear:

- *Tires* – Change direction of rotation of tire. If shoulder wear is severe, remove and retread.
- *Vehicle* – Diagnose misalignment and/or mechanical condition and correct.

FIGURE 7-15
ONE-SIDED WEAR



One-sided wear — Is excessive wear on one side of tire extending from the shoulder towards the center of the tread. For more information, see TMC RP 219A, page 26.

One-sided wear is usually caused by improper alignment, worn kingpins, loose wheel bearings, excessive camber, excessive axle loads, non-parallel axles, or non-uniform tire and wheel assembly caused by improper bead seating or bent wheel.

To correct one-sided wear:

- *Tires* – Depending on severity, rotate tires to another axle position or, if worn to minimum tread depths, submit for possible retreading.
- *Vehicle* – Diagnose mechanical problem and correct.

AXLE WRAP LINER INSPECTION

INSPECTION PROCEDURE

- Axle wrap liners are installed on the STEERTEK axle to help prevent any type of abrasion on the axle at the clamp group area. Any time an axle wrap is removed it is mandatory that the axle wrap liner be replaced.
- Liner Crack Criteria:

  It is possible for the axle wrap liner to crack during service. If the liner is cracked and all the pieces are intact it is not necessary to replace the liner. If the liner is broken out and there are pieces missing the liner must be replaced immediately, see Figure 7-16. See Axle Wrap replacement in the Component Replacement Section of this publication.

FIGURE 7-16

Axle Wrap Liners
Unacceptable Cracks

SHOCK ABSORBER INSPECTION

Hendrickson uses a long service life, premium shock absorber on all AIRTEK and SOFTEK suspensions. When the shock absorber replacement is necessary, Hendrickson recommends that the shock absorbers be replaced with identical Ⓗ Hendrickson Genuine parts for servicing. Failure to do so will affect the suspension performance, durability, and will void the warranty.

Inspection of the shock absorber can be performed by doing a heat test, and a visual inspection. For instructions on shock absorber replacement see the Component Replacement Section of this publication. It is not necessary to replace shock absorbers in pairs if one shock absorber requires replacement.

FIGURE 7-17

HEAT TEST

1. Drive the vehicle at moderate speeds on rough road for minimum of fifteen minutes.

⚠ WARNING

DO NOT GRAB THE SHOCK AS IT CAN POSSIBLY CAUSE PERSONAL INJURY.

2. Lightly touch the shock body carefully below the dust cover, see Figure 7-17.
3. Touch the frame to get an ambient reference. A warm shock absorber is acceptable, a cold shock absorber should be replaced.
4. To inspect for an internal failure, remove and shake the suspected shock. Listen for the sound of metal parts rattling inside. Rattling of metal parts can indicate that the shock has an internal failure.

VISUAL INSPECTION

Look for these potential problems when doing a visual inspection. Inspect the shock absorbers fully extended. Replace as necessary.

FIGURE 7-18

Damaged upper or lower mount

Damaged upper or lower bushing

Damaged dust cover and/or shock body

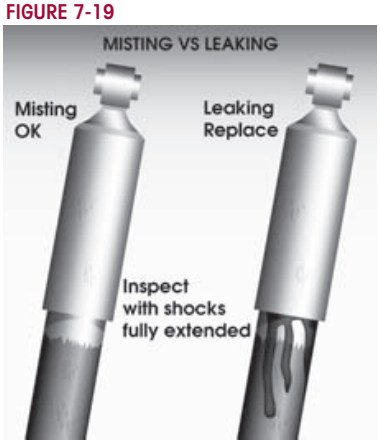
Bent or dented shock

Improper installation example: washers (if equipped) installed backwards.

LEAKING VS. MISTING SHOCK VISUAL INSPECTION

The inspection must not be conducted after driving in wet weather or a vehicle wash; shocks need to be free from water. Many shocks are often mis-diagnosed as failures. Misting is the process whereby very small amounts of shock fluid evaporate at a high operating temperature through the upper seal of the shock. When the "mist" reaches the cooler outside air, it condenses and forms a film on the outside of the shock body. Misting is perfectly normal and necessary function of the shock. The fluid which evaporates through the seal area helps to lubricate and prolong the life of the seal.

FIGURE 7-19



A shock that is truly leaking and needs to be replaced will show signs of fluid leaking in streams from the upper seal. These streams can easily be seen when the shock is fully extended, underneath the main body (dust cover) of the shock. Look for these potential problems when doing a visual inspection. Inspect the shock absorbers fully extended. Replace as necessary.

NOTE

The AIRTEK/SOFTEK suspension is equipped with a premium seal on the shock, however this seal will allow for misting to appear on the shock body (misting is not a leak and is considered acceptable).

If the shock is damaged, install a new shock absorber as detailed in the Component Replacement Section of this publication.

KINGPIN BUSHING INSPECTION

INSPECTION PROCEDURE (STEERING KNUCKLE LATERAL MOVEMENT)

1. Chock the wheels to help prevent the vehicle from moving. Set the parking brake.
2. Use a jack to raise the vehicle until the wheels are off the ground. Support the vehicle with safety stands.

FIGURE 7-20

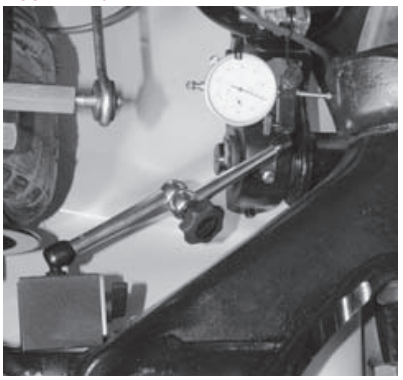
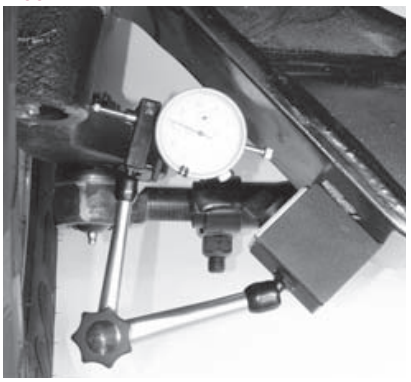


FIGURE 7-21



3. **CHECKING THE UPPER KINGPIN BUSHING**. Install the base of a dial indicator onto the axle beam and face the tip against the steering knuckle, see Figure 7-20.
4. Set the dial indicator to "0" zero.
5. Move the top of the tire in and out by applying reasonable constant pressure and then release, see Figure 7-22.

FIGURE 7-22

6. Check the reading on the dial indicator. If the dial indicator moves more than 0.015", the upper bushing is worn or damaged. Replace both bushings. Refer to the Kingpin Bushing replacement procedure in the Component Replacement Section of this publication.
7. **CHECKING THE LOWER KINGPIN BUSHING**. Install a dial indicator so that the base is on the axle and the indicator tip is against the inside of the bottom of the knuckle, see Figure 7-21.
8. Set the dial indicator to "0" zero.
9. Move the bottom of the tire in and out. If the dial indicator moves more than 0.015", the lower bushing is worn or damaged. Replace both kingpin bushings. Refer to the Component Replacement Section of this publication.

NOTE If one bushing is worn or damaged, it is mandatory to replace both the top and bottom bushings on that knuckle assembly.

STEERING KNUCKLE INSPECTION

CHECKING VERTICAL END PLAY (UP AND DOWN MOVEMENT)

The operating spec for vertical clearance on the steering knuckle is 0.008" to 0.030".

1. Chock the rear tires to help prevent the vehicle from moving.
2. Set the parking brakes.
3. Use a jack to raise the vehicle until both tires are 1" off the ground.

FIGURE 7-23

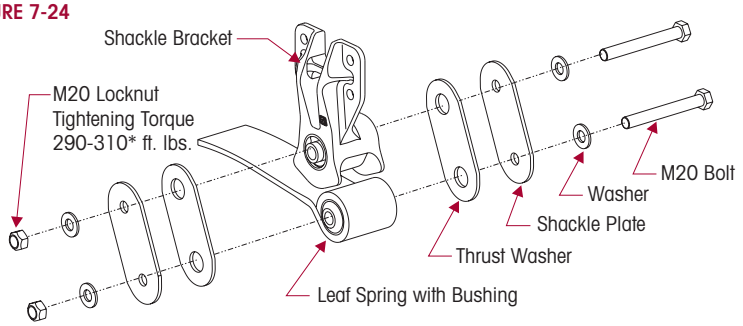
4. Place a dial indicator on each side of the axle as follows:
   a. Index the wheels slightly (left or right).
   b. Place the magnetic dial indicator base on the axle, see Figure 7-23.
   c. Place the tip of the dial indicator on the top of the upper steering knuckle (not on the grease cap).
5. Set the dial indicator to "0" (zero).
6. Lower the jack.
7. If vertical clearance is greater than 0.030", adjust the upper knuckle to obtain clearance specifications, if adjustment does not achieve clearance specification, install shims (Hendrickson part no. 60259-002) between the top of the axle and the bottom of the upper steering knuckle to obtain the proper clearance specification. See Steering Knuckle Assembly in the Component Replacement Section of this publication for proper shim installation.
8. If vertical clearance is below 0.008", adjust the upper steering knuckle to obtain the proper clearance specification, if adjustment does not achieve clearance specification, remove shims. See Steering Knuckle Assembly in the Component Replacement Section of this publication for proper shim removal.

SHACKLE THRUST WASHER INSPECTION (If Equipped)

NOTE SOFTEK Vision 8K capacity vehicles built after 02/2007, and all other vehicles built after 11/2006 are not equipped with shackle thrust washers.

In normal use these components will function satisfactorily, even though the components may show some wear.

FIGURE 7-24



*Specification provided, controlled and subject to change by vehicle manufacturer.

An indication that the shackle thrust washers are worn, or need replacement is when the suspension exhibits one or more of the following conditions:

1. Excessive lateral movement of the spring.
2. The rear spring eye and or thrust washers are in contact with the shackle plates.
3. Normal and unacceptable thickness of the thrust washers (See Figure 7-24) can be measured with a micrometer or a ruler.
   - The normal thickness of a new thrust washer is 3⁄16" (0.187").
   - The minimum thickness allowable for a thrust washer is 3⁄32" (0.090").
   - If one or more of these conditions is experienced, disassembly of the rear shackle assembly is required to replace the thrust washers.
   - If one thrust washer is worn out, Hendrickson recommends both thrust washers on that side of the suspension be replaced. Inspect the thrust washers on the other side of the vehicle and replace if necessary. See Shackle Thrust Washer replacement procedure in the Component Replacement Section of this publication.

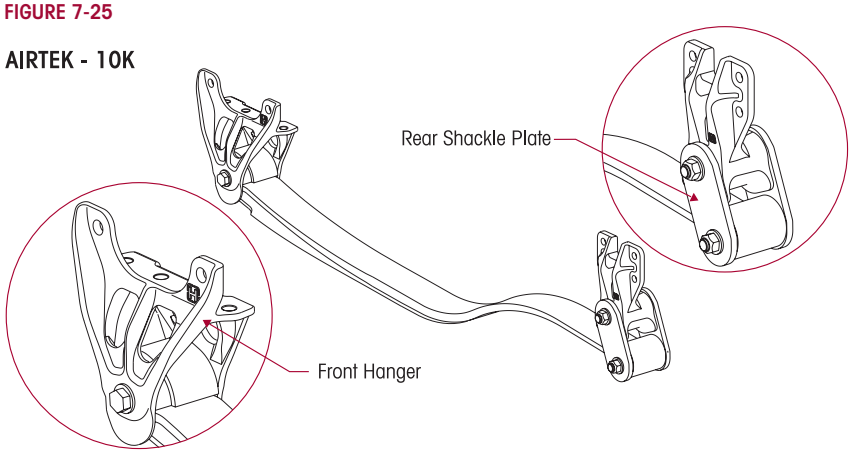
FRONT HANGER/REAR SHACKLE BRACKET SURFACE PAINT WEAR

The Hendrickson front suspension systems AIRTEK and SOFTEK equipped on Blue Bird buses, utilize rubber bushings in the leaf springs. These rubber bushings allow the leaf spring to deflect and contact the front hanger and shackle plates when the bus encounters high lateral acceleration (ex. a highway clover leaf). The rubber bushing will center the leaf spring between the legs of the hanger/shackle plates once the vehicle is driven straight.

This function of the rubber bushing may allow the leaf spring to contact the front hanger/rear shackle plate and possibly remove surface paint from the contact area. Surface paint wear does not cause damage that will affect the function or durability of the front hanger/rear shackle plate or their mating components provided a minimum wall thickness is maintained.

FIGURE 7-25

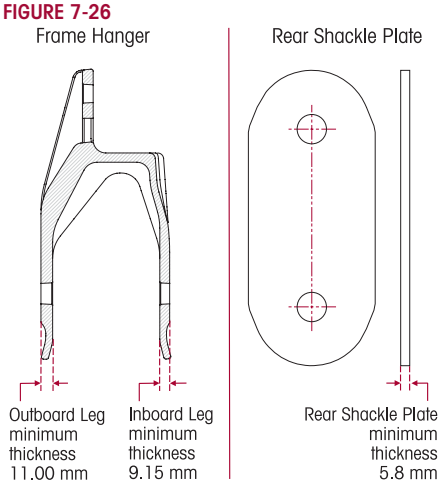
AIRTEK - 10K



An indication that the front hanger/ rear shackle plates are worn and require replacement is when the components no longer meet the following minimum requirements:

- Front hanger inboard leg minimum thickness of 9.15 mm and the outboard leg thickness minimum thickness 11.00 mm, see Figure 7-26.
- Rear shackle plate minimum thickness of 5.8 mm, see Figure 7-26.

FIGURE 7-26

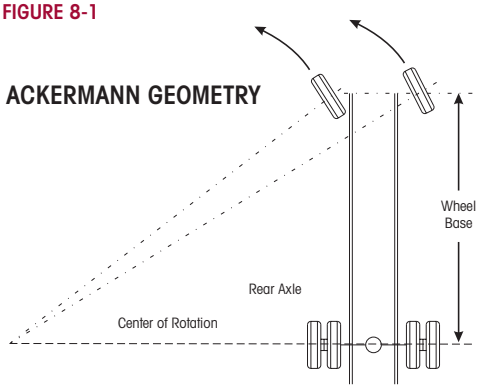


SECTION 8

Alignment & Adjustments

ALIGNMENT DEFINITIONS

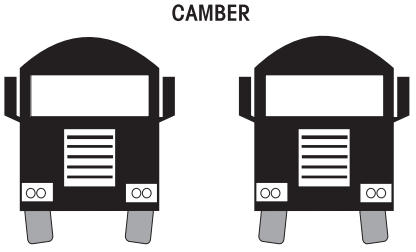
FIGURE 8-1



Ackermann Steering Geometry — The geometry of the four bar linkage consisting of the front axle beam pivot points, tie rod arms, and cross tube and attempts to provide free rolling of front tires in a turn. Ackermann geometry is dependent upon the steering axle track-width and wheelbase of the vehicle. Improper geometry results in wheel scrub in turns which generally appears as toe wear on the tire. Usually more wear is present on one side of the vehicle than the other due to the operational route of the vehicle.

Bump Steer (Feedback) — The feedback felt through the steering linkage to the steering wheel when a steer axle tire hits a bump in the road. This occurs because the axle-end of the drag link and the axle attachment point of the spring do not travel in parallel circular arcs as the suspension moves up and down. This condition can also be caused by trapped air in the power steering system.

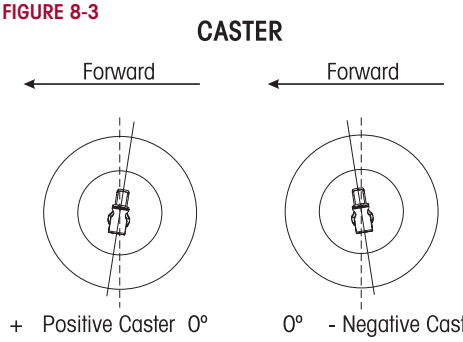
FIGURE 8-2



Camber — The angle formed by the inward or outward tilt of the wheel reference to a vertical line. Camber is positive when the wheel is tilted outward at the top and is negative when the wheel is tilted inward at the top.

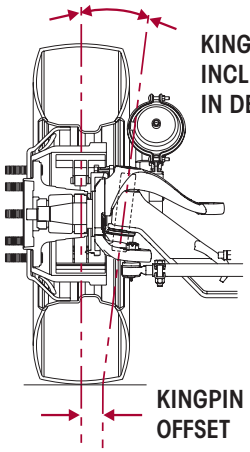
Excessive positive camber may cause smooth wear on the outer half of the tire tread. Excessive negative camber may cause wear on the inner half of the tread. Static-unloaded camber angles are built into the axle to put the loaded tire perpendicular to the road.

FIGURE 8-3



Caster — The forward or rearward tilt of the steering axle kingpin in reference to a vertical line. The angle is measured in degrees. Caster is positive when the top of the steering axis is titled rearward and is negative when the tilt is forward. Proper caster is important for directional stability and returnability. Too much positive caster can cause shimmy, excessive steering effort and is normally a vehicle performance and handling consideration. Uneven positive caster may create a steering pull toward the side with the lower caster. This attribute may be used to compensate for crowned roads.

FIGURE 8-4



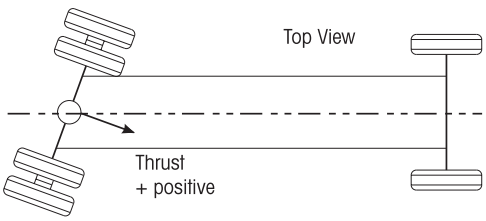
Kingpin Inclination (KPI) — The inward tilt of the kingpin from the vertical. This front suspension parameter has a pronounced effect on steering effort and returnability. As the front wheels are turned around an inclined kingpin, the front of the truck is lifted. This lifting of the vehicle is experienced as steering effort when the turn is executed and exhibits itself as recovery force when the steering wheel is released.

Kingpin Offset — The distance between the center of the tire patch and intersection of the kingpin axis with the ground. This parameter of front end geometry is important in vehicles without power steering and has a major effect on static steering. If there is no kingpin offset, the tires must scrub around the center of the pin patch when turned in a static condition, resulting in higher static steering efforts.

Steering Arm — The component that connects the drag link to the axle knuckle assembly.

FIGURE 8-5

THRUST ANGLE

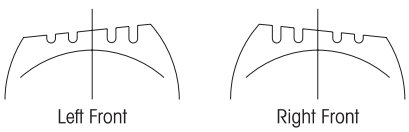


Thrust Angle, Tracking, or Square — The angle formed by the centerline of the vehicle frame (geometric centerline) and the direction that an axle points. As indicated by the term "square", the ideal value for the angle is 0° or when the axle centerline is at 90° or perpendicular to the geometric centerline. Thrust or tracking to the right is positive, and to the left is negative.

A steering correction is required to offset the effect of the thrust angles and keeps the vehicle traveling in a straight line. It results in a lateral offset between the steer and drive axle tires commonly referred to as "dog tracking."

Tie Rod Arm (Ackermann-Arm, Cross Tube Arm) — The component that transmits steering forces between left and right axle knuckle assemblies through the cross tube assembly.

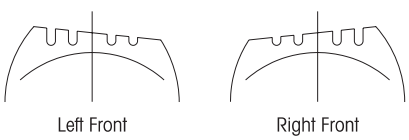
FIGURE 8-6



TOE-IN

Toe-in — is when the horizontal line intersects in front of the wheels, or the wheels are closer together in front than in the back. Toe-in is commonly designated as positive, toe-out as negative. Excessive toe-in wears the outside edge of the tires. Steer axle toe is adjustable to reduce wear to the leading edge of the tire and also to avoid road wander. Toe is adjusted in a static, unloaded condition so that the tires will run in a straight line under a dynamic, loaded condition.

FIGURE 8-7



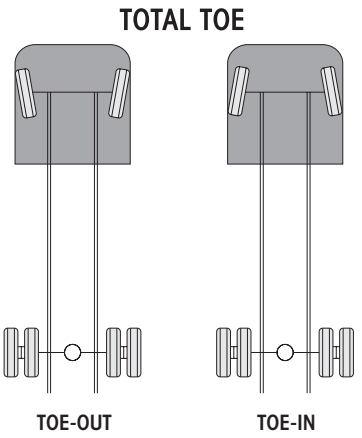
TOE-OUT

Toe-out — Is when the horizontal lines intersect behind the wheels, or the wheels are closer together in back than in front. Toe-in is commonly designated as positive, toe-out as negative. Excessive toe-out wears the inside edge of the tires. Steer axle toe is adjustable to reduce wear to the leading edge of the tire and also to avoid road wander. Toe is adjusted in a static, unloaded condition so that the tires will run in a straight line under a dynamic, loaded condition.

Toe-Out on Turns — (See Ackermann Geometry). Excessive turning angles such as those encountered in pickup and delivery operations may contribute to premature tire wear. Be advised that the greater the turning angles, the more that toe and camber change. If you have any doubt regarding the optimum turning angles for your operation, contact the vehicle's manufacturer, axle OEM, tire OEM and alignment equipment manufacturer for advice.

Total Toe — The angle formed by two horizontal lines through the planes of two wheels. Steer axle toe Is adjustable to reduce wear to the leading edge of the tire and also to avoid road wander. Toe is adjusted in a static, unloaded condition so that the tires will run in a straight line under a dynamic, loaded condition.

FIGURE 8-8



INSPECTION PRIOR TO ALIGNMENT

WHEELS AND TIRES

Examine the following items:

- The tires are inflated to the manufacturer's specified tire pressure.
- The steer axle tires are the same size and type.
- The lug nuts are tightened to manufacturer's specified torque.
- The wheels are balanced and check for tire to rim runout.
- The wheels and tires are free of excessive wear and damage.
- Wheel bearing end play is within OEM specification.

FRONT SUSPENSION

Inspect the following:

- All fasteners are installed and tightened to the specified torque. See Torque Specification Section in the appendix of this publication.
- Leaf springs are free of wear or damage.
- Air springs are free of wear or damage (if equipped).
- Shock absorbers are free of wear and damage.
- Vehicle ride height for both the front and rear are within specification. Follow manufacturer's guidelines (if equipped).
- Front and rear spring mounts for wear or damage.

INSPECT TIE ROD ENDS

Perform the "Tie Rod Inspection" procedure, refer to the Preventive Maintenance Section of this publication.

REAR AXLE AND REAR SUSPENSION

Rear axle misalignment can cause front tire wear. If the outer edge of one front tire is worn and the inner edge of the other front tire is worn, check the following:

- Make sure the rear axle (especially a tandem axle) is correctly aligned. Refer to the procedure from the manufacturer of the vehicle or the suspension.
- All fasteners including U-bolts (if applicable) are installed and tightened to the specified torque.
- The leaf springs are not worn or damaged.
- The bushings in the leaf springs are not worn or damaged.
- The torque rods (if used) are correctly adjusted (if adjustable).
- The frame is not bent or twisted.
- Refer to any additional recommendations and specifications from the manufacturer of vehicle on rear axles and suspensions. Reference the TMC (The Technology & Maintenance Council) Guidelines for Total Vehicle Alignment.

FRONT WHEEL ALIGNMENT

Hendrickson recommends technicians review TMC's publication TMC (Technology & Maintenance Council) "Guidelines for Total Vehicle Alignment".

The AIRTEK/SOFTEK front wheel alignment specification can be found in the Appendix of this publication.

Check the total vehicle wheel alignment when the following occur:

- Every 80,000 to 100,000 miles, or 12-18 months (normal maintenance).
- When the vehicle does not steer correctly.
- To correct a tire wear condition.
- There are two types of front wheel alignment:
  1. *Minor alignment* – a minor front wheel alignment is done **for all** normal maintenance conditions, see below.
  2. *Major alignment* – a major alignment is done when uneven or excessive tire wear is evident, or response at the steering wheel is sluggish, or the need for major wheel alignment check and adjustment is required, see below.

MINOR FRONT WHEEL ALIGNMENT

Perform the minor front wheel alignment in the following sequence:

1. Inspect all systems that affect wheel alignment. Refer to "Inspection Prior to Alignment" in this section.
2. Check the wheel bearing end play.
3. Check and adjust the vehicle ride height (for AIRTEK) as specified in the Preventive Maintenance Section of this publication.
4. Check toe-in and adjust if necessary.

MAJOR FRONT WHEEL ALIGNMENT

Be certain to follow wheel alignment inspection intervals as specified by the original equipment manufacturer. Before performing a major front wheel alignment it is recommended that alignment equipment calibration be checked to ensure proper vehicle alignment.

Major wheel alignment is accomplished in the following sequence of operation:

1. Inspect all the systems that influence the wheel alignment. Refer to the "Inspection Prior to Alignment" in this section.
2. Check and adjust the maximum turn angle, (see "Steering Stop Procedure" in this section), see Figures 8-9 and 8-10.
3. If the vehicle has power steering, check and adjust, if necessary, the pressure relief in the power steering system. Refer to vehicle manufacturer's specifications See Steer Stops in this section.
4. Verify the turning angle per step 2, (toe-out during vehicle turns or the Ackermann angle). Refer to vehicle manufacturer's specifications.

FIGURE 8-9

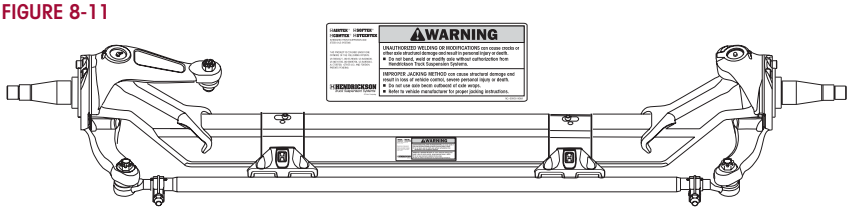
FIGURE 8-10

5. Check the kingpin (or steering axis) inclination (the kingpin inclination is not adjustable). Refer to "Kingpin Inclination", in the Alignment Definitions in this section.
6. Check the camber angle. Do not attempt to adjust. Refer to "Camber" in the Alignment Definitions in this section.

⚠ WARNING

AXLE CAMBER IS NOT ADJUSTABLE. DO NOT CHANGE THE AXLE CAMBER ANGLE OR BEND THE AXLE BEAM. BENDING THE AXLE BEAM TO CHANGE THE CAMBER ANGLE CAN DAMAGE THE AXLE AND REDUCE AXLE STRENGTH, AND WILL VOID HENDRICKSON'S WARRANTY. A BENT AXLE BEAM CAN CAUSE LOSS OF VEHICLE CONTROL, POSSIBLY CAUSING PERSONAL INJURY OR PROPERTY DAMAGE, SEE FIGURE 8-11.

FIGURE 8-11



7. Check and adjust caster angle. Refer to "Caster" in the Alignment Definitions in this section. **The use of two different angle caster shims will not change cross caster.** Cross caster is the difference between the caster readings for left and right side of the vehicle.

SERVICE HINT

Prior to checking caster confirm that the vehicle is at its proper ride height front and rear. The front and rear ride height must be correct to achieve proper caster.

8. Check and adjust toe-in, refer to adjusting the Toe-In under the Alignment Definitions in this section.

AIRTEK RIDE HEIGHT ADJUSTMENT

1. Drive the vehicle onto a level surface.
2. Free and center all suspension joints by slowly moving vehicle back and forth several times without using the brakes. **It is important when coming to a complete stop to verify that the brakes are released.**
3. Chock front wheels.

NOTE

Hendrickson recommends the following be performed during any type of ride height adjustment to help prevent socket head cap screws from loosening from the height control valve housing, and any subsequent air leaks from the height control valve.

4. Prior to adjusting the height control valve, clean the threads of the ¼" valve mounting fasteners to remove any debris and corrosion.

⚠ WARNING

PRIOR TO AND DURING DEFLATION AND INFLATION OF THE FRONT AIR SUSPENSION SYSTEM, ENSURE THAT ALL PERSONNEL AND EQUIPMENT ARE CLEAR FROM UNDER THE VEHICLE AND AROUND THE SERVICE AREA, FAILURE TO DO SO CAN CAUSE SERIOUS PERSONAL INJURY, DEATH, OR PROPERTY DAMAGE.

5. See additional Air Spring Cautions and Warnings in the Important Safety Notice Section of this publication prior to inflating or deflating the suspension system.

SERVICE HINT

It is very important that the leveling valve be cycled completely before and after any ride height adjustments. This cycling of the leveling valve will help to make the adjustment as accurate as possible.

6. Detach the upper rubber grommet of the height control valve linkage from the upper stud and exhaust the suspension system air by lowering the height control valve linkage arm.
7. Re-attach the upper grommet of the height control valve linkage onto the upper stud to fill the suspension system with air. Wait until the airflow to front air springs has stopped.
8. Measure the suspension reference ride height on the shock absorber, see Figures 8-12 and 8-13, measuring from the center of the top mounting bolt to the center of the bottom mounting bolt.

FIGURE 8-12

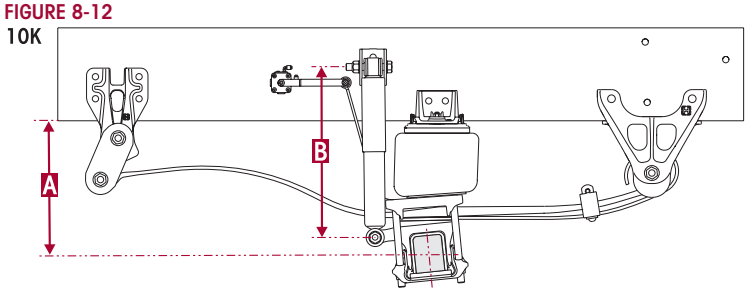
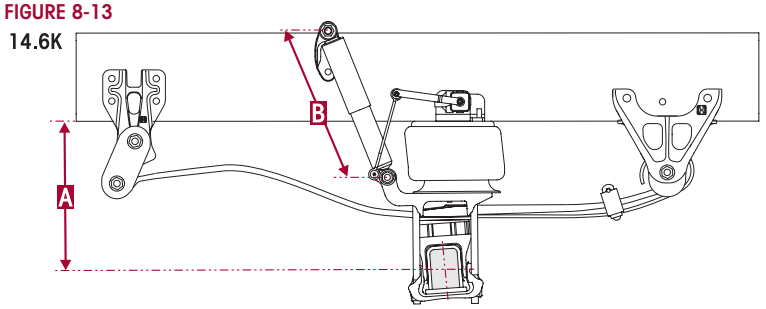


FIGURE 8-13



9. The different referenced ride height measurements are as specified in the following chart. If the reference measurement is not within ± ¼" of the specification, the ride height **MUST** be adjusted.

	AIRTEK (FRONT)		COMFORT AIR (REAR)	
	RIDE HEIGHT	SHOCK ABSORBER LENGTH	RIDE HEIGHT	SHOCK ABSORBER LENGTH
	Dimension A	Dimension B		
Blue Bird Model	From the bottom of the frame to the center of axle	At ride height with a tolerance of ¼"	From the bottom of the frame to the bottom of the main support member.	At ride height with a tolerance of ¼"
Vision 10K	12½"	18 9/16"	4⅞"	22¾"
All American Front Engine	14⅞"	17¼"		
All American Rear Engine	14⅞"	17 15/32"		

10. Detach the upper grommet of the height control valve linkage from the stud on the leveling valve arm and exhaust suspension system air, see Figures 8-14 and 8-15.
11. Adjust the height control valve by loosening the ¼" mounting locknuts and pivoting the valve body about the mounting bolt.

NOTE It is necessary to place a 3/16" Allen wrench in the head of the mounting bolts while adjusting ride height to prevent movement of the bolts, which can cause air leakage in the body of the leveling valve.

12. Facing the air spring from the outboard side of the vehicle, pivot the valve body clockwise to increase the ride height and counter clockwise to decrease the ride height.
13. Tighten the ¼" mounting locknuts to 8-10 foot pounds, (see Figures 8-14 and 8-15) and repeat steps 4 through 10 until the reference measurement equals ± ¼" of the specification, see Figures 8-12 and 8-13.
14. Remove wheel chocks.

FIGURE 8-14

10K

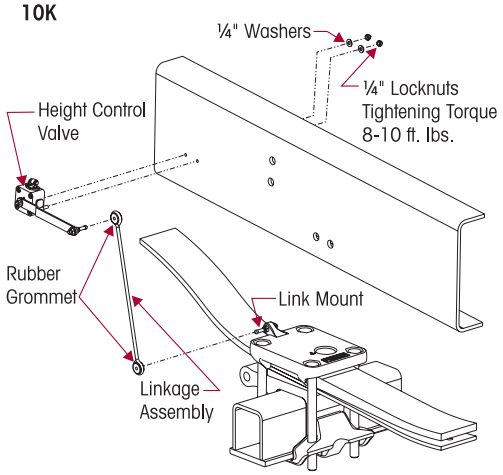
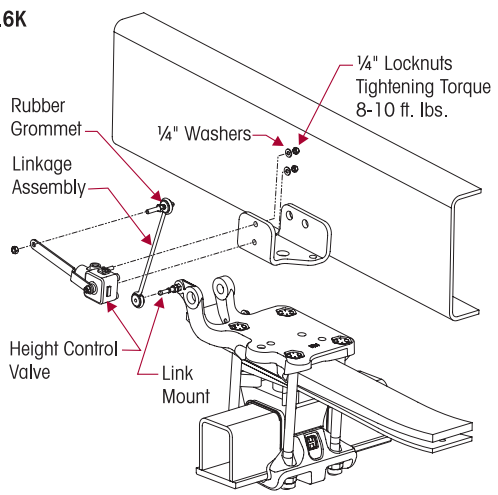


FIGURE 8-15

14.6K



AIRTEK HEIGHT CONTROL VALVE TEST

The height control valve test can be done with Barksdale Test Kit (Model 55521).

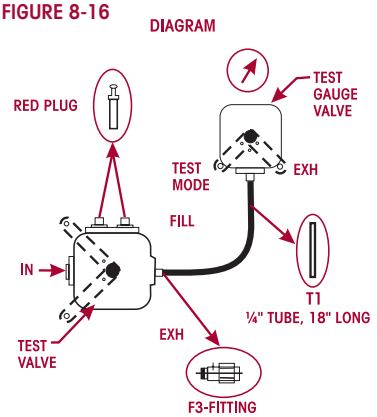
KIT CONTENTS

QTY.	DESCRIPTION	QTY.	DESCRIPTION	QTY.	DESCRIPTION
1	Gauge	1	Valve	2	Plug
1	(F3) Fitting	1	(T1) Tubing ¼"	1	Fitting
1	Flush Plug	1	Tool	1	O-Ring

HEIGHT CONTROL VALVE TEST INSTRUCTIONS

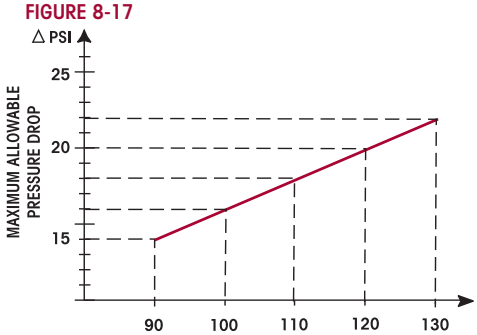
1. Disconnect linkage from valve handle.
2. Lower height control valve linkage arm down to exhaust air from the suspension system.
3. Remove the tubing from both air spring ports, see Figure 8-16. Place supplied tool around the tubing, press down to pull out tubing. **DO NOT CUT THE TUBING.**
4. Install the red plugs supplied into the air spring ports.
5. Use needle nose pliers to remove the "flapper" from the valve exhaust port.

FIGURE 8-16



6. Install hex fitting F3 (the one with a small pin protruding) into the exhaust port. To install hex fitting into exhaust port align pin on fitting with slot on exhaust port, push in and rotate clockwise to stop.
7. Connect one end of the tubing (T1) to this port and one end into the test gauge valve.
8. Rotate the test gauge valve handle to test mode, see diagram in Figure 8-16.
9. Rotate handle on valve being tested to fill mode.
10. Observe pressure reading for a period of 30 seconds.

FIGURE 8-17



PRESSURE DROP VS. INLET PRESSURE IN 30 SECONDS. FOR LEAKAGE RATE OF 50 cc/min

11. Refer to chart for maximum allowable pressure drop vs. inlet pressure in. 30 seconds, see Figure 8-17. The valve is good if the pressure drop does not exceed the maximum allowable.
12. Rotate vehicle valve handle to exhaust mode.
13. Rotate test gauge valve handle to test mode. Repeat steps 10 and 11.
14. Replace valve if maximum allowable drop is exceeded.

This test is complete. Remove the test gauge valve and fitting from the exhaust port. Remove the red plugs from the air spring ports. Reconnect the air spring tubing to the valve, ensuring that the air lines are pushed fully into the PTC fittings. Reconnect the linkage to the valve handle. Suspension ride height will automatically return to the correct position.

STEERING STOP

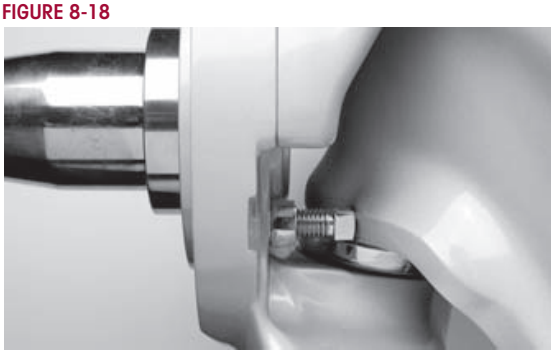
ADJUSTMENT PROCEDURE

When the axle or lower steering knuckle is replaced, the steering stop adjustment must be checked.

The steering stop adjustment procedure is as follows:

1. Drive truck onto turntables and chock the rear wheels.
2. Measure the wheel cut. The wheel cut is determined by steering the tires. Wheel cut is measured at the inside wheel only, therefore the tires must be turned to the full lock position for each right hand and left hand direction. Refer to the vehicle manufacturer for exact specifications.
3. Increase the wheel cut by loosening the jam nuts and screw the axle stops in clockwise.
4. Tighten the jam nuts.

FIGURE 8-18



NOTE

It is very important that the sides of the square head axle stops are set parallel to the axle beam to ensure a good contact point on the axle, see Figure 8-18.

5. Decrease the wheel cut by loosening the jam nuts and screw the axle stops out counter-clock-wise.
6. Tighten the jam nuts to 40-60 foot pounds torque.
7. Measure the wheel cut and check for any interference with related steering components.

⚠ WARNING

ALWAYS CHECK/RESET THE STEERING GEAR BOX POPPET WHEN THE WHEEL CUT IS DECREASED. FOLLOW MANUFACTURER'S GUIDELINES FOR THE GEAR BOX POPPET RESETTING PROCEDURE. FAILURE TO DO SO CAN RESULT IN PREMATURE FAILURE OF THE AXLE OR STEERING KNUCKLE. THIS CONDITION CAN CAUSE LOSS OF VEHICLE CONTROL, PERSONAL INJURY OR PROPERTY DAMAGE AND VOID WARRANTY.

TOE SETTING

1. Place the vehicle on a level floor with the wheels in a straight ahead position.
2. Raise the vehicle and support the front axle with jack stands.
3. Use paint and mark the center area of tread on both steer axle tires around the complete outer diameter of the tires.
4. Scribe a line through both steer axle tires in the painted area around the complete outer diameter of the tires.
5. Raise the vehicle and remove the jack stands.
6. Set the vehicle on the ground.

NOTE

Do not measure toe-in with the front axle off the ground. The weight of the vehicle must be on the front axle when toe-in is measured.

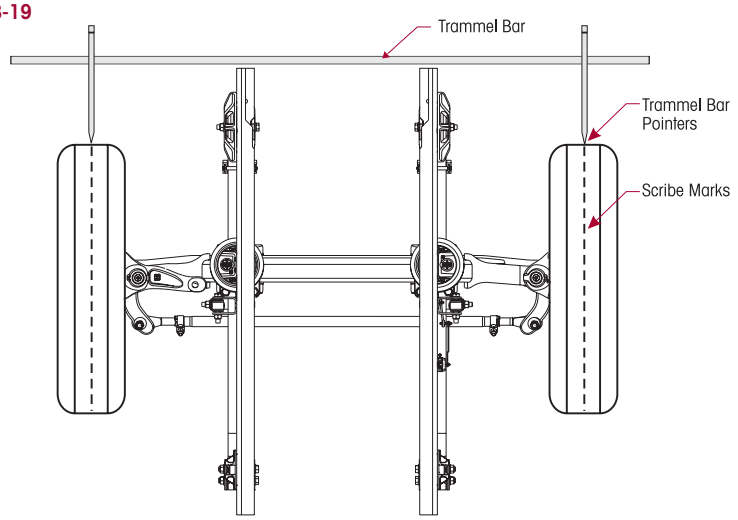
7. Use a trammel bar and measure the distance between the scribe marks at the rear of the steer axle tires. Record the measurement.

8. Install the trammel bar and measure the distance between the scribe marks at the front of the steer axle tires. Record the measurement, see Figure 8-19.

NOTE When setting up the trammel bar the pointers should be level with the spindles at the front and rear of the steer axle tires.

9. To calculate the toe setting subtract the front measurement from the rear measurement, the difference between the two will equal the toe-in/toe-out measurement.

FIGURE 8-19

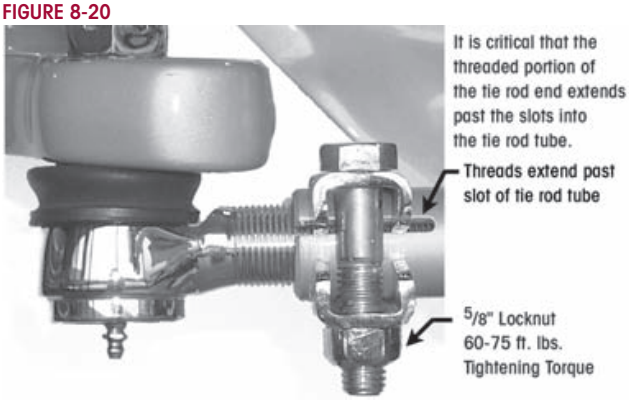


10. If the toe measurement is not within the specifications of 1/16" ± 1/32" (0.060" ± 0.030"), it will be necessary to adjust the toe setting. Refer to the following procedure.
    a. Loosen the tie rod cross tube clamp bolts and locknuts.
    b. Turn the tie rod cross tube until the specified toe-in distance is achieved.

⚠ WARNING

THE THREADED PORTION OF THE TIE ROD END MUST EXTEND PAST THE SLOTS INTO THE TIE ROD CROSS TUBE, SEE FIGURE 8-20. FAILURE TO DO SO CAN CAUSE COMPONENT TO FAIL CAUSING LOSS OF VEHICLE CONTROL AND POSSIBLE PERSONAL INJURY OR PROPERTY DAMAGE.

FIGURE 8-20



    c. Tighten the bolt and locknut on the tie rod cross tube to 60-75 foot pounds torque.

11. Repeat steps 1-9 until the correct toe setting is achieved.

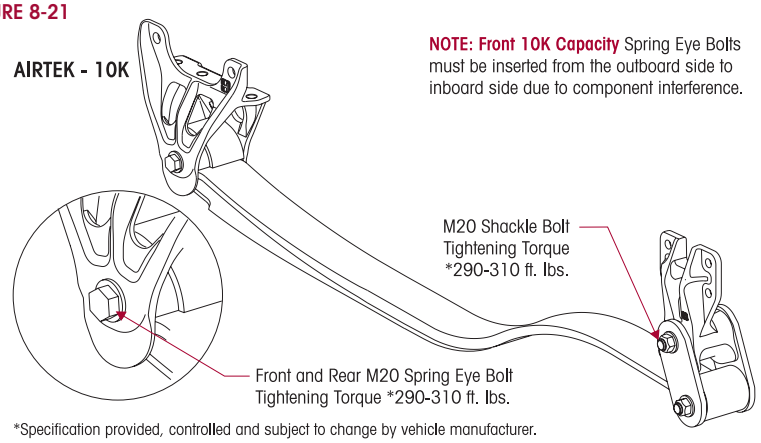
SPRING EYE RE-TORQUE

This procedure to re-torque is necessary when replacing

- Front Hanger
- Shackle Assembly
- Steel Leaf Spring Assembly

AIRTEK RE-TORQUE PROCEDURE

FIGURE 8-21



*Specification provided, controlled and subject to change by vehicle manufacturer.

1. Chock the rear wheels of the vehicle to prevent movement.
2. Verify ride height. Adjust if necessary, see AIRTEK Ride Height adjustment procedure in this section.
3. Loosen all six (6) front and rear spring eye bolts, see Figure 8-21.

NOTE

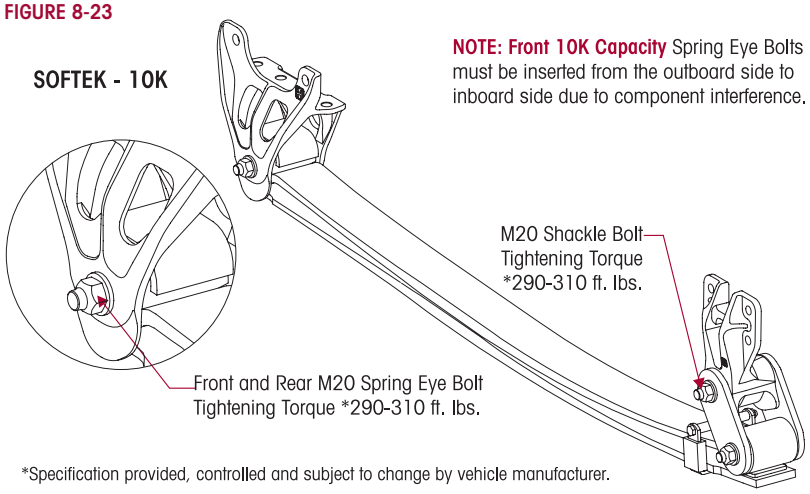
DO NOT remove the spring eye bolts.

4. Let the suspension settle.
5. Tighten the front M20 spring eye bolt locknuts to vehicle manufacturer's specifications.
6. Tighten the rear M20 spring eye bolt and shackle bolt locknuts to vehicle manufacturer's specifications.
7. Affix a straight edge to the bottom of the frame rail in front of the air spring, see Figure 8-22.
8. With the vehicle on a level surface measure the distance from the top of the straight edge to the ground on both sides of the vehicle and record the measurements.
9. Measure the difference from one side to the other.
10. Do a road test and repeat measurement steps 7 to 9.
11. If the measurement is less than ⅜" the vehicle is level. If measurement is more than ⅜" contact Hendrickson Tech Services.

FIGURE 8-22

SOFTEK RE-TORQUE PROCEDURE

FIGURE 8-23



1. Chock the wheels.
2. Loosen all six (6) front and rear spring eye bolts, see Figure 8-23.

NOTE Do not remove the spring eye bolts.

3. Let the suspension settle.
4. Tighten the front M20 spring eye bolt locknuts to vehicle manufacturer's specifications.
5. Tighten the rear M20 spring eye bolt and shackle bolt locknuts to vehicle manufacturer's specifications.
6. Affix a straight edge to the bottom of the frame rail behind frame hanger, see Figure 8-22.
7. With the vehicle on a level surface measure the distance from the top of the straight edge to the ground on both sides of the vehicle and record the measurements.
8. Measure the difference from one side to the other.
9. Do a road test and repeat measurement steps 7 to 9.
10. If the measurement is less than ⅜" the vehicle is level. If measurement is more than ⅜" contact Hendrickson Tech Services.

SECTION 9

Component Replacement

FASTENERS

Hendrickson recommends that when servicing the vehicle to replace the removed fasteners with new equivalent fasteners. Maintain correct torque values at all times. Check torque values as specified. See Hendrickson's Torque Specifications in the Appendix of this publication. If non-Hendrickson fasteners are used follow torque specifications listed in the vehicle manufacturer's service manual.

SPACERS

There are different front axle spacer configurations for each front suspension system. Prior to disassembly of the front axle clamp group, note the orientation and quantity of the front axle spacer(s) (if equipped). It is required that the axle spacers be installed in the same orientation and location as removed to preserve the existing vertical alignment. Refer to the Parts List Section of this publication.

AIRTEK HEIGHT CONTROL VALVE – 10K

DISASSEMBLY

1. Drain the air from the secondary air tank.

⚠ WARNING

PRIOR TO AND DURING DEFLATION AND INFLATION OF THE FRONT AIR SUSPENSION SYSTEM, ENSURE THAT ALL PERSONNEL AND EQUIPMENT ARE CLEAR FROM UNDER THE VEHICLE AND AROUND THE SERVICE AREA, FAILURE TO DO SO CAN CAUSE SERIOUS PERSONAL INJURY, DEATH, OR PROPERTY DAMAGE.

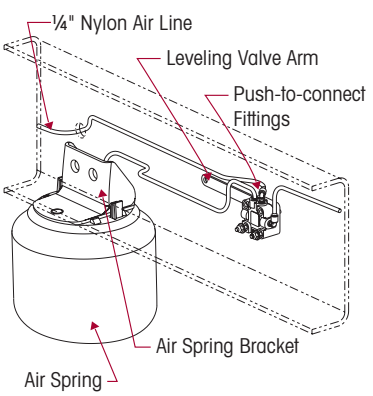
2. See additional Air Spring Cautions and Warnings in the Important Safety Notice Section of this publication prior to inflating or deflating the suspension system.
3. Deflate the air springs by removing the height control valve linkage at the rubber grommet and lowering the height control linkage arm. This will exhaust the air pressure in the air springs.

⚠ CAUTION

THE PUSH-TO-CONNECT FITTINGS ARE NON-SERVICEABLE. IT IS NECESSARY TO CLEAN THE DIRT AND DEBRIS AWAY FROM THE PUSH-TO-CONNECT FITTINGS AND THE AIR LINES TO HELP PREVENT ANY FOREIGN MATERIAL FROM ENTERING THE AIR SPRING, AIR SYSTEM OR DAMAGING THE PUSH-TO-CONNECT FITTINGS. CLEAN PUSH-TO-CONNECT FITTINGS USING SOAPY WATER AND A SOFT BRISTLED BRUSH AND DRY WITH COMPRESSED AIR.

4. Remove the air lines from the height control valve, see Figure 9-1. The air lines are push-to-connect. Push in on the air line to release tension, push down on the collar and pull out the air line.
5. Remove the two ¼" mounting nuts and washers.
6. Remove the height control valve.

FIGURE 9-1 10K

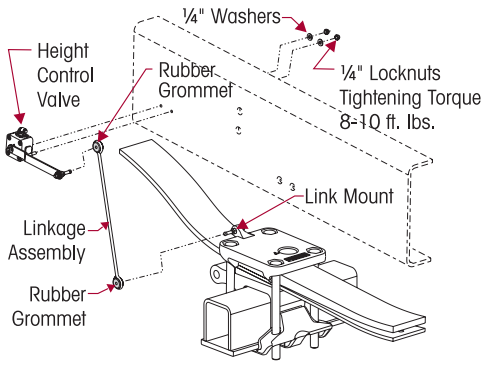


ASSEMBLY

1. Attach the height control valve on the vehicle frame as shown in Figure 9-1.

2. Attach the ¼" washers and the locknuts. Do not tighten the locknuts to specified torque until after the proper ride height is attained. Mount the height control valve parallel to flange of the frame, see Figure 9-2.

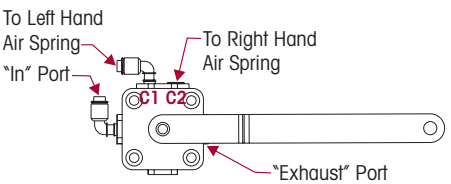
FIGURE 9-2 10K



SERVICE HINT

When replacing or installing nylon air line tubing into quick-connect fittings, it is critical that the end of the air line is cut square. Improper cut of the end of the air line tubing can cause the air line to seat improperly in the quick connect fitting causing air leakage.

FIGURE 9-3 10K



3. Attach the air lines to the height control valve, see Figure 9-3.
4. Install the height control valve linkage assembly.
5. Adjust the height control valve to proper specifications. See the Alignment & Adjustments Section of this publication for proper ride height adjustment.
6. Tighten the ¼" locknuts to 8-10 foot pounds torque.

AIRTEK HEIGHT CONTROL VALVE – 14.6K

DISASSEMBLY

1. Drain the air from the secondary air tank.

⚠ WARNING

PRIOR TO AND DURING DEFLATION AND INFLATION OF THE FRONT AIR SUSPENSION SYSTEM, ENSURE THAT ALL PERSONNEL AND EQUIPMENT ARE CLEAR FROM UNDER THE VEHICLE AND AROUND THE SERVICE AREA, FAILURE TO DO SO CAN CAUSE SERIOUS PERSONAL INJURY, DEATH, OR PROPERTY DAMAGE.

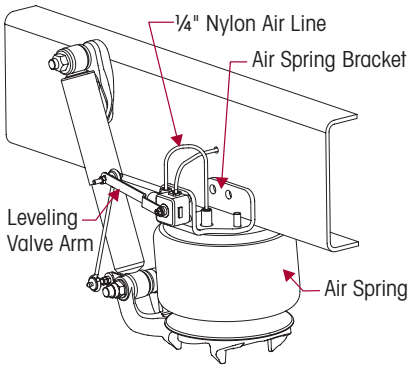
2. See additional Air Spring Cautions and Warnings in the Important Safety Notice Section of this publication prior to inflating or deflating the suspension system.
3. Deflate the air springs by removing the height control valve linkage at the rubber grommet and lowering the height control linkage arm. This will exhaust the air pressure in the air springs.

⚠ CAUTION

THE PUSH-TO-CONNECT FITTINGS ARE NON-SERVICEABLE. IT IS NECESSARY TO CLEAN THE DIRT AND DEBRIS AWAY FROM THE PUSH-TO-CONNECT FITTINGS AND THE AIR LINES TO HELP PREVENT ANY FOREIGN MATERIAL FROM ENTERING THE AIR SPRING, AIR SYSTEM OR DAMAGING THE PUSH-TO-CONNECT FITTINGS. CLEAN PUSH-TO-CONNECT FITTINGS USING SOAPY WATER AND A SOFT BRISTLED BRUSH AND DRY WITH COMPRESSED AIR.

4. Remove the air lines from the height control valve, see Figure 9-4. The air lines are push-to-connect. Push in on the air line to release tension, push down on the collar and pull out the air line.
5. Remove the two ¼" mounting nuts and washers.
6. Remove the height control valve.

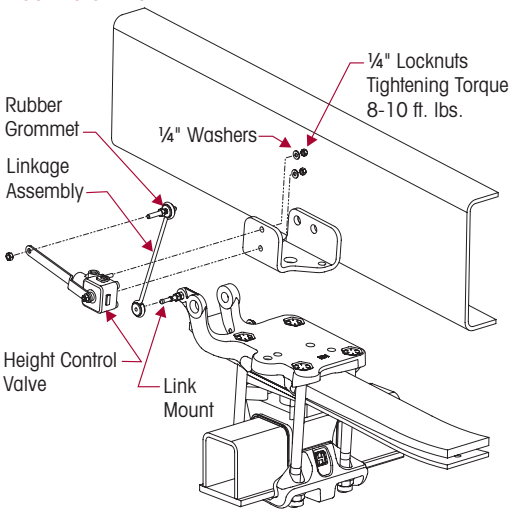
FIGURE 9-4 14.6K



ASSEMBLY

1. Re-install the air fittings into the height control valve. Ensure the Teflon® thread sealing ring is seated around the base of the fitting's hex shoulder. Torque to 3-15 foot pounds (4-20 Nm).
2. Install the height control valve to the upper air spring bracket by attaching the ¼" washers and locknuts. Torque to 8-10 foot pounds, see Figure 9-5.

FIGURE 9-5 14.6K



3. Install the air lines to the height control valve. Refer the Plumbing Diagram Section of this publication.

WARNING

PRIOR TO AND DURING DEFLATION AND INFLATION OF THE FRONT AIR SUSPENSION SYSTEM, ENSURE THAT ALL PERSONNEL AND EQUIPMENT ARE CLEAR FROM UNDER THE VEHICLE AND AROUND THE SERVICE AREA, FAILURE TO DO SO CAN CAUSE SERIOUS PERSONAL INJURY, DEATH, OR PROPERTY DAMAGE.

4. See additional Air Spring Cautions and Warnings in the Important Safety otice Section of this publication prior to inflating or deflating the suspension system.
5. Inflate the suspension by connecting the height control valve linkage to the height control valve arm and lower mounting bracket. Verify the air springs inflate uniformly without binding.
6. Remove the frame supports.
7. Remove the wheel chocks.
8. Verify proper ride height adjustment, (see ride height adjustment in the Alignment & Adjustments Section of this publication).

AIRTEK AIR SPRING – 10K

DISASSEMBLY

1. Place the vehicle on level floor.
2. Chock the wheels.
3. Raise the frame.
4. Support the vehicle with frame stands.

WARNING

WHEN SERVICING THE VEHICLE OR ATTACHING AN AIR SPRING AND THE VEHICLE IS ON THE GROUND, PRIOR TO AIRING THE SUSPENSION SYSTEM MAKE CERTAIN THE AIR SPRING LOCATOR IS INDEXED INTO THE UPPER AIR SPRING BRACKET PROPERLY, AND THE AIR SPRING IS FULLY SEATED ON THE SPRING TOP PAD. FAILURE TO FOLLOW THESE INSTRUCTIONS CAN RESULT IN PREMATURE AIR SPRING FAILURE, CAUSE PERSONAL INJURY, OR PROPERTY DAMAGE.

WARNING

PRIOR TO AND DURING DEFLATION AND INFLATION OF THE FRONT AIR SUSPENSION SYSTEM, ENSURE THAT ALL PERSONNEL AND EQUIPMENT ARE CLEAR FROM UNDER THE VEHICLE AND AROUND THE SERVICE AREA, FAILURE TO DO SO CAN CAUSE SERIOUS PERSONAL INJURY, DEATH, OR PROPERTY DAMAGE.

5. See additional Air Spring Cautions and Warnings in the Important Safety Notice Section of this publication prior to inflating or deflating the suspension system.
6. Remove the air from the air system by disconnecting the height control valve linkage at the rubber grommet of the height control valve arm and allow the arm to drop. This will exhaust air from the system.

WARNING

IF THE AIR SPRING IS TO BE RE-INSTALLED; INSPECT LOCK-TABS FOR DAMAGE OR CRACKS PRIOR TO RE-INSTALLATION. CARE MUST BE TAKEN TO REMOVE DIRT AND DEBRIS FROM THE PUSH-TO-CONNECT FITTING. FAILURE TO DO SO CAN RESULT IN THE PUSH-TO-CONNECT FITTING FAILING TO SEAL WITH THE AIR LINE.

7. Disconnect the air line to the air spring.
8. Raise the frame to allow for air spring removal.
9. Separate the air spring from the upper air spring bracket by applying downward pressure on air spring, see Figure 9-6, pushing outward on the lock-tabs outside the bracket, and inward on inlet lock-tabs. This will dislodge the air spring from the upper air spring bracket.
10. Apply upward pressure between the base of the air spring and the top pad. This will dislodge the air spring from the top pad, see Figure 9-7.
11. Remove the air spring.

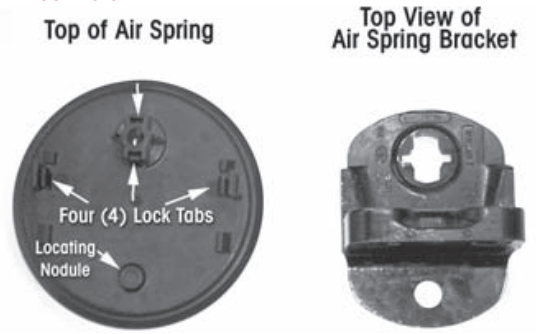
FIGURE 9-6

FIGURE 9-7

ASSEMBLY

1. Insert the air spring into the top pad. Make sure the lock tabs click in place.
2. Compress the air spring and slide into vertical position. There is a locating nodule on the air spring to index the position in the upper air spring bracket.
3. Pull the air spring up into the upper air spring bracket until the air spring snaps into place in the upper air spring bracket. Verify all four lock-tabs are engaged, see Figure 9-8.

FIGURE 9-8



SERVICE HINT

When replacing or installing nylon air line tubing into quick-connect fittings it is critical that the end of the air line is cut square. Improper cut of the end of the air line tubing can cause the air line to seat improperly in the quick connect fitting causing air leakage.

4. Install the air line into the air spring.

⚠ WARNING

WHEN SERVICING THE VEHICLE OR ATTACHING AN AIR SPRING AND THE VEHICLE IS ON THE GROUND, PRIOR TO AIRING THE SUSPENSION SYSTEM MAKE CERTAIN THE AIR SPRING LOCATOR IS INDEXED INTO THE UPPER AIR SPRING BRACKET PROPERLY, AND THE AIR SPRING IS FULLY SEATED ON THE SPRING TOP PAD. FAILURE TO FOLLOW THESE INSTRUCTIONS CAN RESULT IN PREMATURE AIR SPRING FAILURE, CAUSE PERSONAL INJURY, OR PROPERTY DAMAGE.

⚠ WARNING

PRIOR TO AND DURING DEFLATION AND INFLATION OF THE FRONT AIR SUSPENSION SYSTEM, ENSURE THAT ALL PERSONNEL AND EQUIPMENT ARE CLEAR FROM UNDER THE VEHICLE AND AROUND THE SERVICE AREA, FAILURE TO DO SO CAN CAUSE SERIOUS PERSONAL INJURY, DEATH, OR PROPERTY DAMAGE.

5. See additional Air Spring Cautions and Warnings in the Important Safety Notice Section of this publication prior to inflating or deflating the suspension system.
6. Air up the suspension.
7. Check the air spring for leaks.
8. Check the ride height and adjust if necessary. See Alignment & Adjustments Section of this publication for the proper ride height adjustment.
9. Remove the wheel chocks.

AIRTEK AIR SPRING – 14.6K

DISASSEMBLY

1. Place the vehicle on level floor.
2. Chock the wheels.
3. Raise the frame.
4. Support the vehicle with frame stands.

⚠ WARNING

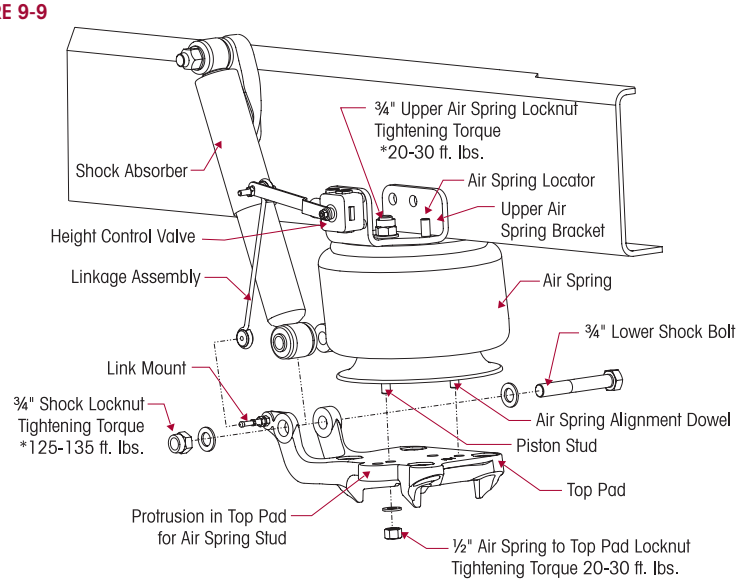
WHEN SERVICING THE VEHICLE OR ATTACHING AN AIR SPRING AND THE VEHICLE IS ON THE GROUND, PRIOR TO AIRING THE SUSPENSION SYSTEM MAKE CERTAIN THE AIR SPRING LOCATOR IS INDEXED INTO THE UPPER AIR SPRING BRACKET PROPERLY, AND THE AIR SPRING IS FULLY SEATED ON THE SPRING TOP PAD. FAILURE TO FOLLOW THESE INSTRUCTIONS CAN RESULT IN PREMATURE AIR SPRING FAILURE, CAUSE PERSONAL INJURY, OR PROPERTY DAMAGE.

⚠ WARNING

PRIOR TO AND DURING DEFLATION AND INFLATION OF THE FRONT AIR SUSPENSION SYSTEM, ENSURE THAT ALL PERSONNEL AND EQUIPMENT ARE CLEAR FROM UNDER THE VEHICLE AND AROUND THE SERVICE AREA, FAILURE TO DO SO CAN CAUSE SERIOUS PERSONAL INJURY, DEATH, OR PROPERTY DAMAGE.

5. See additional Air Spring Cautions and Warnings in the Important Safety Notice Section of this publication prior to inflating or deflating the suspension system.
6. Remove the air from the air system by disconnecting the height control valve linkage(s) at the rubber grommet(s) and allowing the lever(s) to drop. This will exhaust air from the system.
7. If the air spring is damaged and the suspension is deflated, it will be necessary to raise the frame and support the vehicle with frame stands to obtain adequate clearance for air spring removal.
8. Disconnect the ¼" NPT air fitting from the air spring.
9. Remove the lower ½" air spring locknut from the piston stud to remove the air spring from the top pad, see Figure 9-9.

FIGURE 9-9



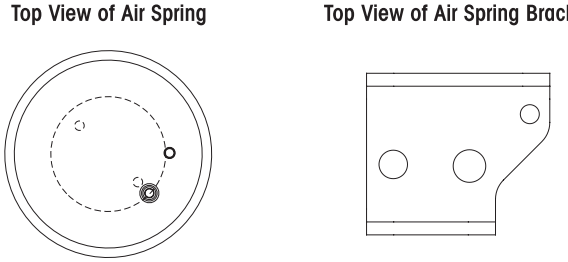
*Specification provided, controlled and subject to change by vehicle manufacturer.

10. Remove the ¾" upper air spring locknut from the air spring bracket.
11. Remove the air spring.

ASSEMBLY

1. Compress the air spring and slide into vertical position.
2. There is a locating ½" stud and ¾" threading stud on top of the air spring.
3. There are two studs on the bottom of the air spring. Guide studs through the air spring bracket and properly seat the lower air spring piston into the top axle pad. Secure the ½" locknut to the piston, see Figure 9-10.

FIGURE 9-10



4. Tighten the ¾" upper air spring locknuts to vehicle manufacturer's specifications and the lower ½" lower air spring locknuts to 20-30 foot pounds.

WARNING

WHEN SERVICING THE VEHICLE OR ATTACHING AN AIR SPRING AND THE VEHICLE IS ON THE GROUND, PRIOR TO AIRING THE SUSPENSION SYSTEM MAKE CERTAIN THE AIR SPRING LOCATOR IS INDEXED INTO THE UPPER AIR SPRING BRACKET PROPERLY, AND THE AIR SPRING IS FULLY SEATED ON THE SPRING TOP PAD. FAILURE TO FOLLOW THESE INSTRUCTIONS CAN RESULT IN PREMATURE AIR SPRING FAILURE, CAUSE PERSONAL INJURY, OR PROPERTY DAMAGE.

WARNING

PRIOR TO AND DURING DEFLATION AND INFLATION OF THE FRONT AIR SUSPENSION SYSTEM, ENSURE THAT ALL PERSONNEL AND EQUIPMENT ARE CLEAR FROM UNDER THE VEHICLE AND AROUND THE SERVICE AREA, FAILURE TO DO SO CAN CAUSE SERIOUS PERSONAL INJURY, DEATH, OR PROPERTY DAMAGE.

5. See additional Air Spring Cautions and Warnings in the Important Safety Notice Section of this publication prior to inflating or deflating the suspension system.
6. Install the air line into the air spring.
7. Air up the suspension.
8. Check the air spring for leaks.
9. Check the ride height and adjust if necessary. See Alignment & Adjustments Section of this publication for the proper ride height adjustment.
10. Remove the wheel chocks.

AIRTEK FRONT LEAF SPRING FRAME HANGER

DISASSEMBLY

1. Place the vehicle on level floor.
2. Chock the wheels.
3. Raise the frame.
4. Support the vehicle with frame stands.
5. Suspend the front axle from the shock absorbers.

⚠ WARNING

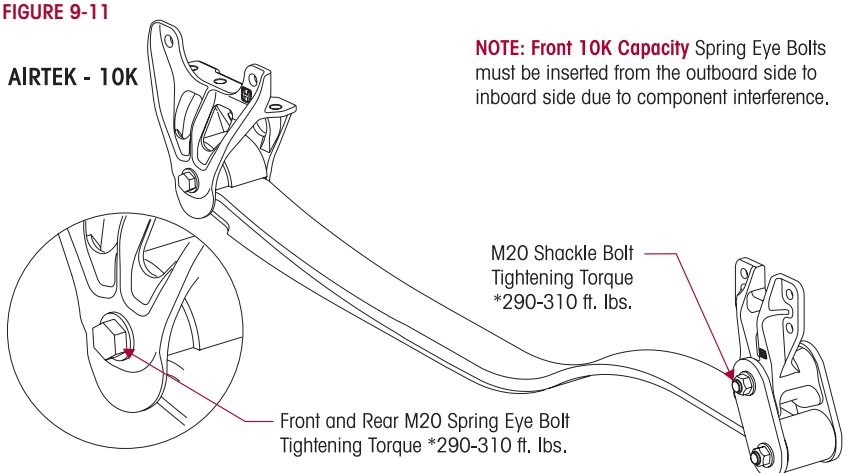
PRIOR TO AND DURING DEFLATION AND INFLATION OF THE FRONT AIR SUSPENSION SYSTEM, ENSURE THAT ALL PERSONNEL AND EQUIPMENT ARE CLEAR FROM UNDER THE VEHICLE AND AROUND THE SERVICE AREA, FAILURE TO DO SO CAN CAUSE SERIOUS PERSONAL INJURY, DEATH, OR PROPERTY DAMAGE.

6. See additional Air Spring Cautions and Warnings in the Important Safety Notice Section of this publication prior to inflating or deflating the suspension system.
7. Deflate the air springs by removing the height control valve linkage and lowering the leveling valve arm. This will exhaust the air pressure in the air springs.
8. Remove the air lines from air springs.
9. Remove the M20 spring eye bolt, washers and locknut.

SERVICE HINT A bottle jack may be required to raise the axle slightly to facilitate removal of the spring eye bolt.

10. Remove the frame mounting fasteners from the hanger. See manufacturer's guidelines.
11. Remove the hanger from the vehicle, see Figure 9-11.

FIGURE 9-11



*Specification provided, controlled and subject to change by vehicle manufacturer.

ASSEMBLY

1. Install the new hanger on the frame.
2. Install new frame fasteners. Follow manufacturer's guidelines.
3. Install the new M20 spring eye bolt from the outboard side of the hanger (see Figure 9-11), washers and locknut.
4. Remove the frame stands and lower frame.

WARNING

PRIOR TO AND DURING DEFLATION AND INFLATION OF THE FRONT AIR SUSPENSION SYSTEM, ENSURE THAT ALL PERSONNEL AND EQUIPMENT ARE CLEAR FROM UNDER THE VEHICLE AND AROUND THE SERVICE AREA, FAILURE TO DO SO CAN CAUSE SERIOUS PERSONAL INJURY, DEATH, OR PROPERTY DAMAGE.

5. See additional Air Spring Cautions and Warnings in the Important Safety Notice Section of this publication prior to inflating or deflating the suspension system.
6. Install the air lines into the air springs.
7. Install the height control valve linkage and inflate the suspension to normal operating pressure.
8. Tighten M20 locknut to vehicle manufacturer's specifications.
9. Remove the wheel chocks.

SOFTEK FRONT LEAF SPRING FRAME HANGER

DISASSEMBLY

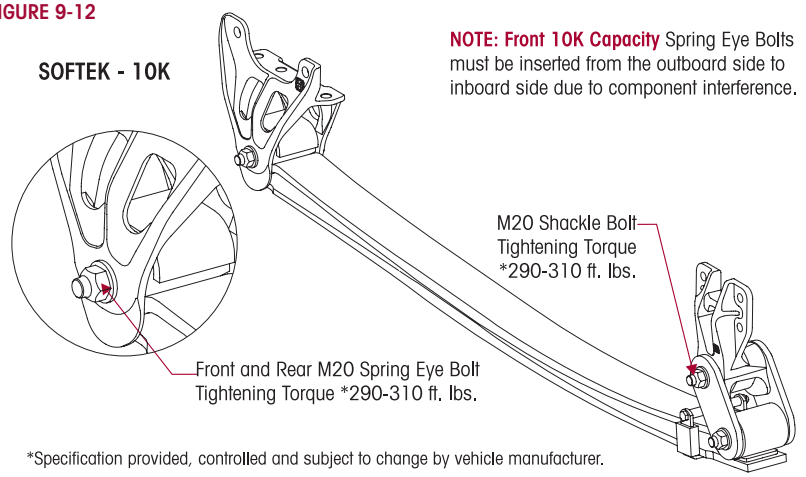
1. Place the vehicle on level floor.
2. Chock the wheels.
3. Raise the frame.
4. Support the vehicle with frame stands.
5. Suspend the front axle from the shocks.
6. Remove the M20 spring eye bolt, washers and locknut.

SERVICE HINT

A bottle jack may be required to raise the axle slightly to facilitate removal of the spring eye bolt.

7. Remove the frame mounting fasteners from the hanger. See manufacturer's guidelines.
8. Remove the hanger from the vehicle, see Figure 9-12.

FIGURE 9-12



*Specification provided, controlled and subject to change by vehicle manufacturer.

ASSEMBLY

1. Install the new hanger on the frame.
2. Install new frame fasteners. Follow manufacturer's guidelines.
3. Install the new M20 spring eye bolt from the outboard side of the hanger (see Figure 9-12), washers and locknut.

4. Remove the frame stands and lower frame.
5. Tighten M20 shackle locknut to vehicle manufacturer's specifications.
6. Remove the wheel chocks.

AIRTEK REAR SHACKLE FRAME BRACKET

DISASSEMBLY

1. Place the vehicle on level floor.
2. Chock the wheels.
3. Raise the frame.
4. Support the vehicle with frame stands.
5. Suspend the front axle from the shocks.

⚠ WARNING

PRIOR TO AND DURING DEFLATION AND INFLATION OF THE FRONT AIR SUSPENSION SYSTEM, ENSURE THAT ALL PERSONNEL AND EQUIPMENT ARE CLEAR FROM UNDER THE VEHICLE AND AROUND THE SERVICE AREA, FAILURE TO DO SO CAN CAUSE SERIOUS PERSONAL INJURY, DEATH, OR PROPERTY DAMAGE.

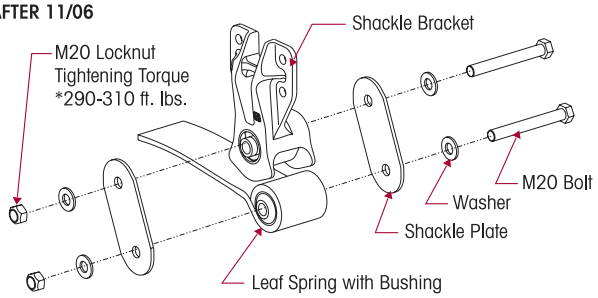
6. See additional Air Spring Cautions and Warnings in the Important Safety Notice Section of this publication prior to inflating or deflating the suspension system.
7. Deflate the air springs by removing the height control valve linkage and lowering the leveling valve arm. This will exhaust the air pressure in the air springs.
8. Remove the air lines from air springs.
9. Remove the rear M20 spring eye and shackle pivot bolts, washers and locknuts.

SERVICE HINT A bottle jack may be required to raise the axle slightly to facilitate removal of the rear spring eye bolt.

10. Remove the frame fasteners from the shackle bracket. See manufacturer's guidelines.
11. Remove the shackle bracket from the vehicle, see Figures 9-13 and 9-14.
12. Inspect the shackle assembly and both thrust washers (if equipped) for excessive wear or damage. See Thrust Washer Inspection in the Preventive Maintenance Section of this publication. Hendrickson recommends the thrust washers be replaced when this assembly is serviced.
13. If damaged or worn excessively, replace with Genuine Hendrickson Parts as detailed in the Component Replacement Section of this publication.

FIGURE 9-13

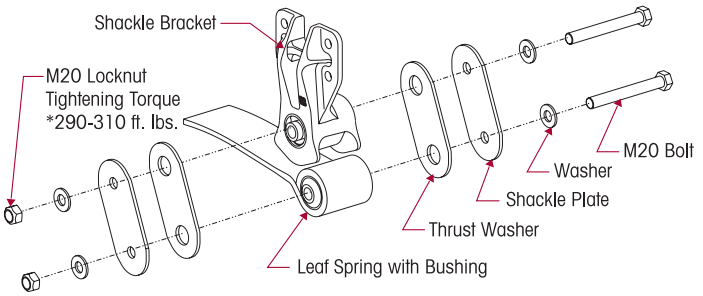
FOR VEHICLES BUILT AFTER 11/06



*Specification provided, controlled and subject to change by vehicle manufacturer.

FIGURE 9-14

FOR VEHICLES BUILT PRIOR TO 11/06



*Specification provided, controlled and subject to change by vehicle manufacturer.

ASSEMBLY

1. Install the shackle bracket on the frame.
2. Install new frame fasteners. Follow manufacturer's guidelines.
3. Install the thrust washers (if equipped) and shackle plates with the M20 bolts, washers and locknuts. Snug the shackle bolts. DO NOT tighten.
4. Remove the frame stands and lower frame.

⚠ WARNING

PRIOR TO AND DURING DEFLATION AND INFLATION OF THE FRONT AIR SUSPENSION SYSTEM, ENSURE THAT ALL PERSONNEL AND EQUIPMENT ARE CLEAR FROM UNDER THE VEHICLE AND AROUND THE SERVICE AREA, FAILURE TO DO SO CAN CAUSE SERIOUS PERSONAL INJURY, DEATH, OR PROPERTY DAMAGE.

5. See additional Air Spring Cautions and Warnings in the Important Safety Notice Section of this publication prior to inflating or deflating the suspension system.
6. Install the air lines into the air springs.
7. Install the height control valve linkage and inflate the suspension to normal ride height.
8. Tighten M20 shackle locknuts to vehicle manufacturer's specifications, see Figures 9-13 and 9-14.
9. Remove the wheel chocks.

SOFTEK REAR SHACKLE BRACKET

DISASSEMBLY

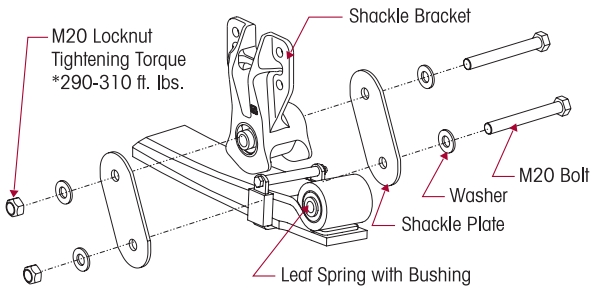
1. Place the vehicle on level floor.
2. Chock the wheels.
3. Raise the frame.
4. Support the vehicle with frame stands.
5. Suspend the front axle from the shocks.
6. Remove the rear M20 spring eye and shackle pivot bolts, washers and locknuts.

SERVICE HINT A bottle jack may be required to raise the axle slightly to facilitate removal of the rear spring eye bolt.

7. Remove the frame fasteners from the shackle bracket. See manufacturer's guidelines.
8. Remove the shackle bracket from the vehicle, see Figures 9-15 and 9-16.

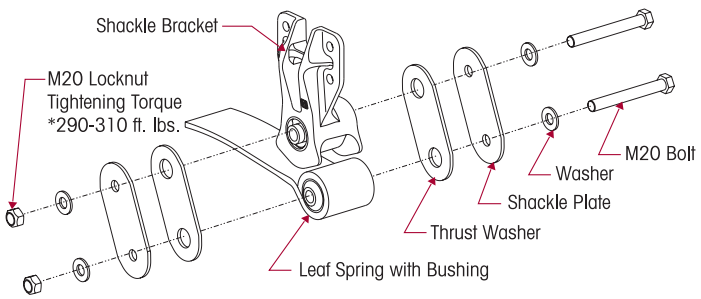
9. Inspect the shackle assembly and both thrust washers (if equipped) for excessive wear or damage. See Thrust Washer Inspection in the Preventive Maintenance Section of this publication. Hendrickson recommends the thrust washers be replaced when this assembly is serviced.
10. If damaged or worn excessively, replace with Genuine Hendrickson Parts as detailed in the Component Replacement Section of this publication.

FIGURE 9-15
FOR VEHICLES BUILT AFTER 11/06



*Specification provided, controlled and subject to change by vehicle manufacturer.

FIGURE 9-16
FOR VEHICLES BUILT PRIOR TO 11/06



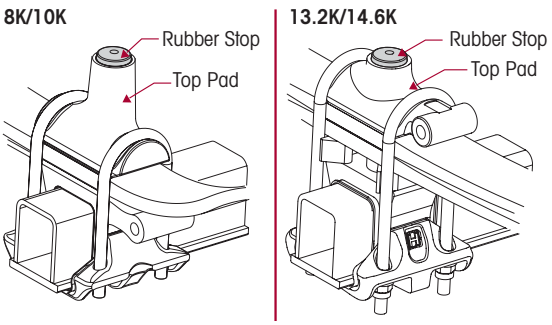
*Specification provided, controlled and subject to change by vehicle manufacturer.

ASSEMBLY

1. Install the shackle bracket on the frame.
2. Install new frame fasteners. Follow manufacturer's guidelines.
3. Install the thrust washers (if equipped) and shackle plates with the M20 bolts, washers and locknuts, see Figures 9-15 and 9-16.
4. Remove the frame stands and lower frame.
5. Tighten M20 locknuts to vehicle manufacturer's specifications.
6. Remove the wheel chocks.

SOFTEK RUBBER AXLE STOP

FIGURE 9-17



REMOVAL

1. Insert a small pry bar between the rubber stop and the inside of the top pad.
2. Apply downward force on the pry bar and pull the rubber stop out of the top pad, see Figure 9-17.
3. Inspect the top pad and frame rail flange for any contact damage.
4. Clean any debris from inside the top pad.

INSTALLATION

1. Lubricate the new rubber axle stop with soapy water.
2. Install the rubber axle stop in the top pad.
3. Apply downward force on the rubber axle stop until it is seated firmly in the top pad.

AIRTEK THRUST WASHERS (If Equipped)

DISASSEMBLY

1. Place the vehicle on level floor.
2. Chock the wheels.
3. Raise the frame.
4. Support the vehicle with frame stands.

⚠ WARNING

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5. See additional Air Spring Cautions and Warnings in the Important Safety Notice Section of this publication prior to inflating or deflating the suspension system.
6. Deflate the air springs by removing the height control valve linkage and lowering the leveling valve arm. This will exhaust the air pressure in the air springs.
7. Suspend the front axle from the shocks.
8. Remove the M20 spring eye and shackle pivot bolts, washers and locknuts.
9. Remove the shackle plates and thrust washers (if equipped).

ASSEMBLY

1. Install the NEW thrust washers (if equipped) and shackle plates with the M20 bolts, washers and locknuts, see Figure 9-14.
2. Remove frame stands and lower frame.

WARNING

PRIOR TO AND DURING DEFLATION AND INFLATION OF THE FRONT AIR SUSPENSION SYSTEM, ENSURE THAT ALL PERSONNEL AND EQUIPMENT ARE CLEAR FROM UNDER THE VEHICLE AND AROUND THE SERVICE AREA, FAILURE TO DO SO CAN CAUSE SERIOUS PERSONAL INJURY, DEATH, OR PROPERTY DAMAGE.

3. See additional Air Spring Cautions and Warnings in the Important Safety Notice Section of this publication prior to inflating or deflating the suspension system.
4. Install air lines into the air springs.
5. Install the height control valve linkage and inflate the suspension to normal ride height.
6. Tighten M20 locknuts to vehicle manufacturer's specifications.
7. Remove the wheel chocks.

SOFTEK THRUST WASHERS (If Equipped)

DISASSEMBLY

1. Place the vehicle on level floor.
2. Chock the wheels.
3. Raise the frame.
4. Support the vehicle with frame stands.
5. Suspend the front axle from the shocks.
6. Remove the M20 spring eye and shackle pivot bolts, washers and locknuts.
7. Remove the shackle plates and thrust washers (if equipped).

ASSEMBLY

1. Install the NEW thrust washers (if equipped) and shackle plates with the M20 bolts, washers and locknuts, see Figure 9-16.
2. Remove frame stands and lower frame.
3. Tighten M20 locknuts to vehicle manufacturer's specifications.
4. Remove the wheel chocks.

AIRTEK LEAF SPRING ASSEMBLY

DISASSEMBLY

1. Place the vehicle on a level floor.
2. Chock the wheels.
3. Raise the frame.
4. Support the vehicle with frame stands.

WARNING

PRIOR TO AND DURING DEFLATION AND INFLATION OF THE FRONT AIR SUSPENSION SYSTEM, ENSURE THAT ALL PERSONNEL AND EQUIPMENT ARE CLEAR FROM UNDER THE VEHICLE AND AROUND THE SERVICE AREA, FAILURE TO DO SO CAN CAUSE SERIOUS PERSONAL INJURY, DEATH, OR PROPERTY DAMAGE.

5. See additional Air Spring Cautions and Warnings in the Important Safety Notice Section of this publication prior to inflating or deflating the suspension system.
6. Deflate the air springs by removing the height control valve linkage and lowering the height control valve arm. This will exhaust the air pressure in the air springs.

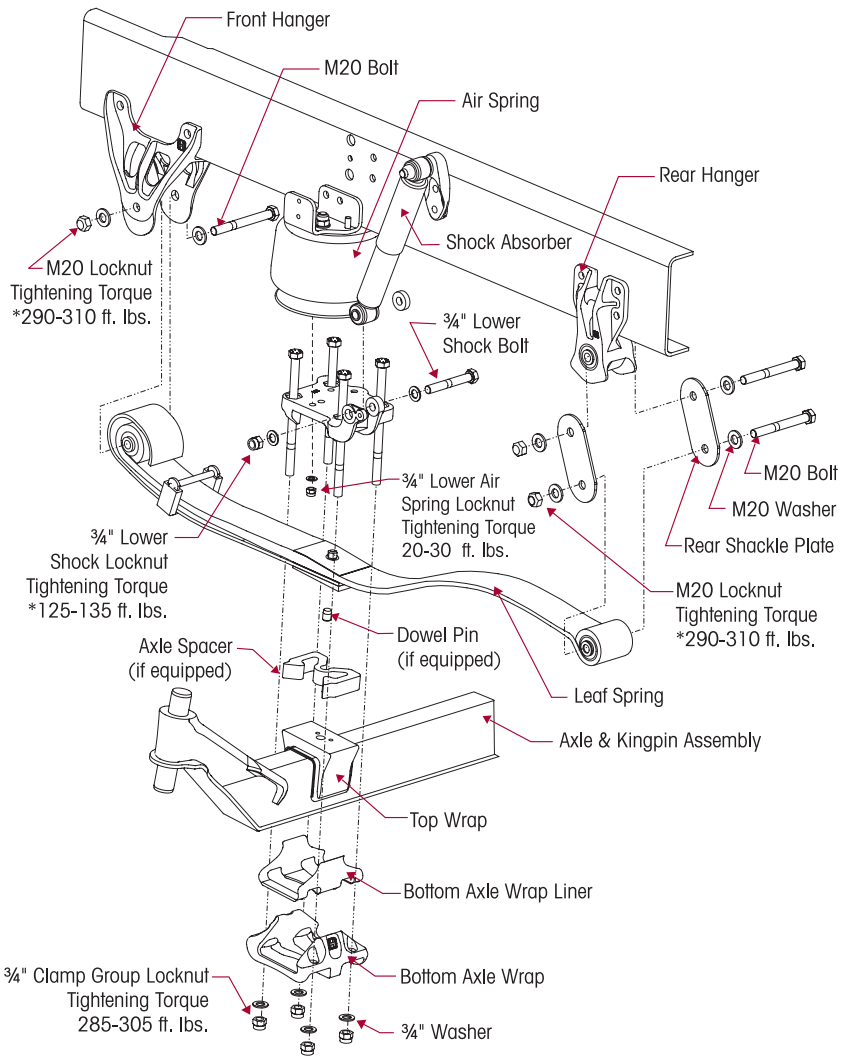
CAUTION

THE PUSH-TO-CONNECT FITTINGS ARE NON-SERVICEABLE. IT IS NECESSARY TO CLEAN THE DIRT AND DEBRIS AWAY FROM THE PUSH-TO-CONNECT FITTINGS AND THE AIR LINES TO HELP PREVENT ANY FOREIGN MATERIAL FROM ENTERING THE AIR SPRING, AIR SYSTEM OR DAMAGING THE PUSH-TO-CONNECT FITTINGS. CLEAN PUSH-TO-CONNECT FITTINGS USING SOAPY WATER AND A SOFT BRISTLED BRUSH AND DRY WITH COMPRESSED AIR.

7. Disconnect the air lines at the air springs.
8. Suspend the front axle to remove the load from leaf spring assembly.
9. Remove the air spring (see Air Spring disassembly in this section).
10. Remove the front and rear M20 spring eye bolts washer and locknuts. Loosen the M20 shackle pivot bolt.

SERVICE HINT To ease in the removal of the spring eye bolts, it may be necessary to raise the axle slightly.

FIGURE 9-18



*Specification provided, controlled and subject to change by vehicle manufacturer.

11. Remove the ¾" clamp group locknuts and discard.

WARNING

DO NOT USE A CUTTING TORCH TO REMOVE CLAMP GROUP BOLTS OR ATTACHING FASTENERS. THE USE OF SUCH HEAT ON SUSPENSION COMPONENTS CAN ADVERSELY AFFECT THE STRENGTH OF THESE PARTS. A COMPONENT DAMAGED IN THIS MANNER CAN RESULT IN THE LOSS OF VEHICLE CONTROL AND POSSIBLE PERSONAL INJURY OR PROPERTY DAMAGE.

SERVICE HINT

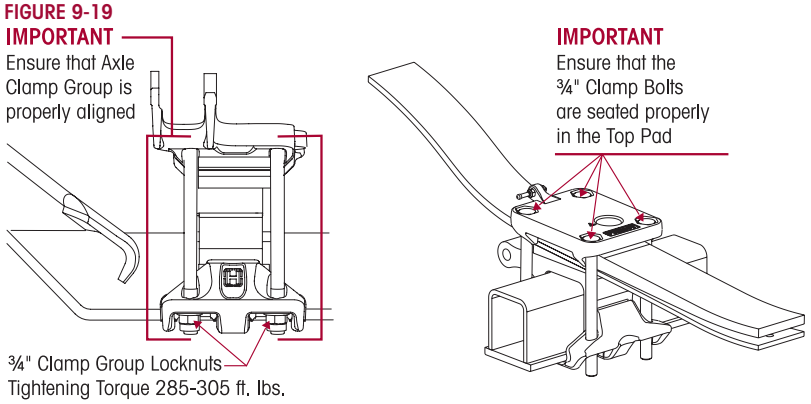
If a clamp group nut fails to come off bolt, cut half way through the bolt with an abrasive cut off wheel, taking care not to contact axle beam or other components. Using an impact wrench, spin the locknut to fracture the bolt and remove.

12. Remove the ¾" clamp group bolts, the top pad, galvanized liner and the bottom axle wrap and liner. Discard the clamp group bolts, see Figure 9-18.
13. Remove the spring assembly.

ASSEMBLY

1. Install the new spring and wrap leaf assembly on the axle. Verify the center bolt is located properly in the top axle wrap and spacer (if equipped), see Figure 9-18.
2. Install the new galvanized liner and the top pad onto the spring.
3. Remove and replace the bottom axle wrap liner located in bottom axle wrap.
4. Install the bottom axle wrap.
5. Install the new ¾" clamp group bolts, washers, and locknuts. New clamp group fasteners must be used when the clamp group is removed, to prevent premature bolt fatigue.
6. Snug the clamp group, DO NOT torque at this time.
7. Raise the axle and the spring assembly into the front hanger and rear shackle assembly.
8. Install the M20 spring eye bolts, washers and locknuts. Snug bolts. Do not tighten.
9. Ensure that the clamp group is properly aligned and the hex bolts are seated in the top pad, and the bottom axle wrap is centered with the top axle wrap, see Figure 9-19.

FIGURE 9-19



10. Tighten the clamp group locknuts evenly in 50 foot pounds increments to 285-305 foot pounds torque in the proper pattern to achieve uniform bolt tension, see Figure 9-20.

FIGURE 9-20

WARNING

PRIOR TO AND DURING DEFLATION AND INFLATION OF THE FRONT AIR SUSPENSION SYSTEM, ENSURE THAT ALL PERSONNEL AND EQUIPMENT ARE CLEAR FROM UNDER THE VEHICLE AND AROUND THE SERVICE AREA, FAILURE TO DO SO CAN CAUSE SERIOUS PERSONAL INJURY, DEATH, OR PROPERTY DAMAGE.

11. See additional Air Spring Cautions and Warnings in the Important Safety Notice Section of this publication prior to inflating or deflating the suspension system.
12. Install air spring.
13. Install air lines, and air up system.
14. Remove the frame supports and load the front axle with the vehicle weight.
15. Verify proper ride height. See Alignment & Adjustments Section of this publication.
16. Tighten the M20 spring eye bolt locknuts to vehicle manufacturer's specifications.

SOFTEK LEAF SPRING ASSEMBLY

DISASSEMBLY

1. Place the vehicle on a level floor.
2. Chock the wheels.
3. Raise the vehicle.
4. Support the vehicle with frame stands.
5. Suspend the front axle to remove the load from leaf spring assembly.
6. Remove the front and rear M20 spring eye bolts washer and locknuts. Loosen the M20 shackle pivot bolt.

SERVICE HINT To ease in the removal of the spring eye bolts, it may be necessary to raise the axle slightly.

7. Remove the ¾" clamp group U-bolts, washers and locknuts. Discard the fasteners.

WARNING

DO NOT USE A CUTTING TORCH TO REMOVE CLAMP GROUP BOLTS OR ATTACHING FASTENERS. THE USE OF SUCH HEAT ON SUSPENSION COMPONENTS CAN ADVERSELY AFFECT THE STRENGTH OF THESE PARTS. A COMPONENT DAMAGED IN THIS MANNER CAN RESULT IN THE LOSS OF VEHICLE CONTROL AND POSSIBLE PERSONAL INJURY OR PROPERTY DAMAGE.

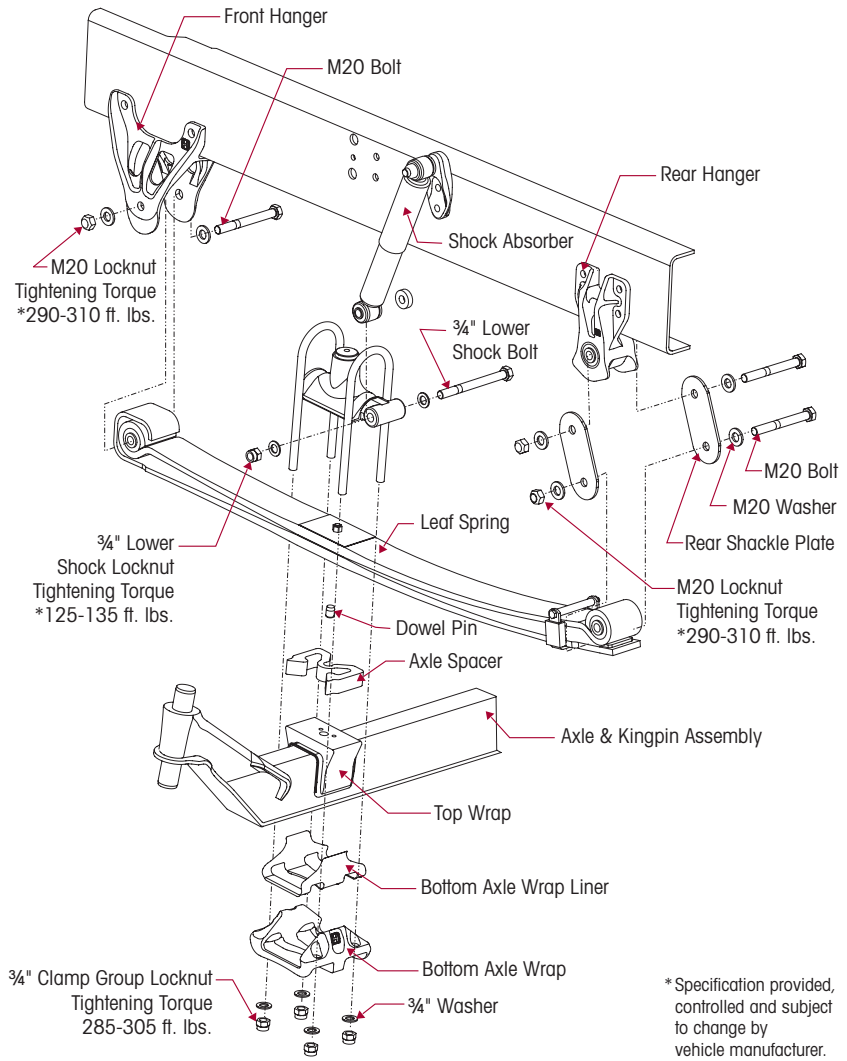
SERVICE HINT If a clamp group nut fails to come off bolt, cut half way through the bolt with an abrasive cut off wheel, taking care not to contact axle beam or other components. Using an impact wrench, spin the locknut to fracture the bolt and remove.

8. Remove the top pad, galvanized liner and the bottom axle wrap, see Figure 9-21.
9. Remove the spring assembly.

ASSEMBLY

1. Install the new spring and wrap leaf assembly on the axle. Verify that the center bolt is located properly in the top axle wrap and spacer (if equipped), see Figure 9-21.
2. Install the new galvanized liner and the top pad onto the spring.
3. Remove and replace the bottom axle wrap liner located in bottom axle wrap.
4. Install the bottom axle wrap.
5. Install the new ¾" clamp group U-bolts, washers, and locknuts. The locknuts must be replaced when the clamp group is removed, to prevent premature bolt fatigue.
6. Snug the clamp group, **DO NOT** torque at this time.

FIGURE 9-21



*Specification provided, controlled and subject to change by vehicle manufacturer.

7. Raise the axle and the spring and wrap leaf assembly into the front hanger and rear shackle assembly.
8. Install the M20 spring eye bolts, washers and locknuts. Snug bolts. Do not tighten.
9. Ensure that the clamp group is properly aligned and the U-bolts are seated in the top pad, and the bottom axle wrap is centered with the top axle wrap, see Figure 9-22.

FIGURE 9-22

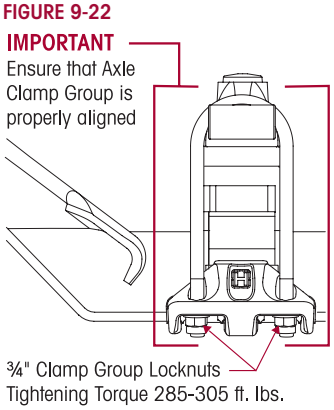
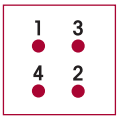


FIGURE 9-23



10. Tighten the clamp group locknuts evenly in 50 foot pounds increments to 285-305 foot pounds torque in the proper pattern to achieve uniform bolt tension, see Figure 9-23.
11. Remove the frame supports and load the front axle with the vehicle weight.
12. Tighten the M20 spring eye bolt locknuts to vehicle manufacturer's specifications.

FRONT LEAF SPRING EYE BUSHINGS

The spring eye bushings for the AIRTEK and SOFTEK spring and wrap leaf assemblies are designed to provide extended service life. If premature wear occurs careful consideration must be given to the contributing factor that caused the wear. This must be corrected in order to prevent the new bushing from wearing in the same manner. The front and rear bushings are permanently installed in the spring leaf and are not serviceable. If a bushing wears prematurely, the spring and wrap leaf assembly must be replaced. Follow the procedure for the Front Leaf Spring removal in the Component Replacement Section of this publication.

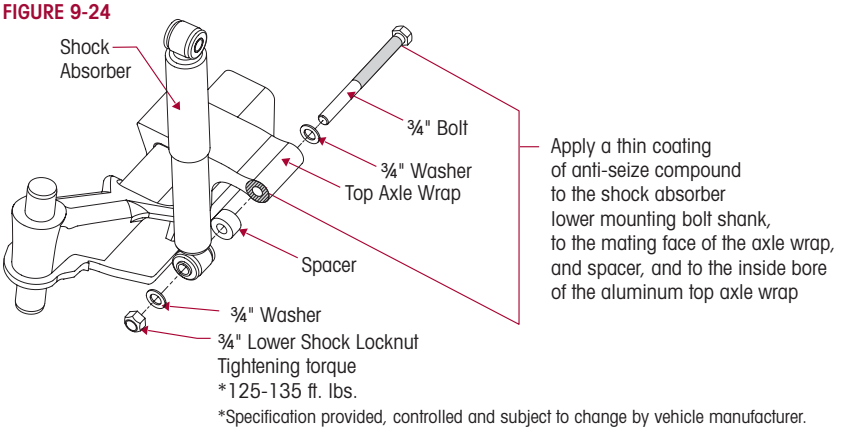
AIRTEK/SOFTEK SHOCK ABSORBER – VISION (8K/10K)

It is not necessary to replace shock absorbers in pairs if only one shock requires replacement.

DISASSEMBLY

1. Remove the ¾" lower mounting bolt, fasteners, and spacer.
2. Remove the ¾" upper mounting bolt and fasteners.
3. Slide the shock absorber out of the upper bracket and off of the lower mounting bolt.
4. Inspect the shock absorber mounting brackets and hardware for damage or wear, replace as necessary.

FIGURE 9-24



*Specification provided, controlled and subject to change by vehicle manufacturer.

ASSEMBLY

1. Install the shock absorber into the upper mounting bracket.
2. Install the upper ¾" shock mounting bolt, washers and locknut.

3. Apply a thin coating of anti-seize compound to the shock absorber lower mounting bolt shank, to the mating face of the axle wrap and spacer, and to the inside bore of the aluminum axle wrap. This is necessary to help prevent seizing of the bolt to the aluminum axle wrap.
4. Install the lower ¾" bolt from the inboard side to the outboard side of the top axle wrap and attach the spacer, washer, and locknut, see Figure 9-24.
5. Tighten both upper and lower ¾" locknuts to vehicle manufacturer's specifications, see Figure 9-24.

AIRTEK/SOFTEK SHOCK ABSORBER – ALL AMERICAN (13.2K/14.6K)

It is not necessary to replace shock absorbers in pairs if only one shock requires replacement.

DISASSEMBLY

1. Remove the ¾" lower mounting bolt, fasteners, and spacer.
2. Remove the ¾" upper mounting bolt and fasteners.
3. Slide the shock absorber out of the lower bracket and off of the lower mounting bolt.
4. Inspect the shock absorber mounting brackets and hardware for damage or wear, replace as necessary.

FIGURE 9-25
AIRTEK 14.6K

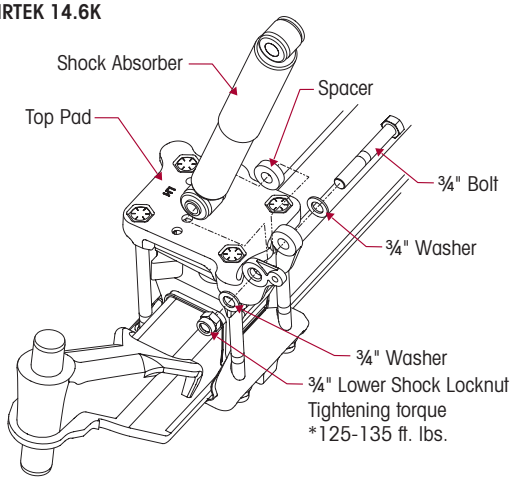
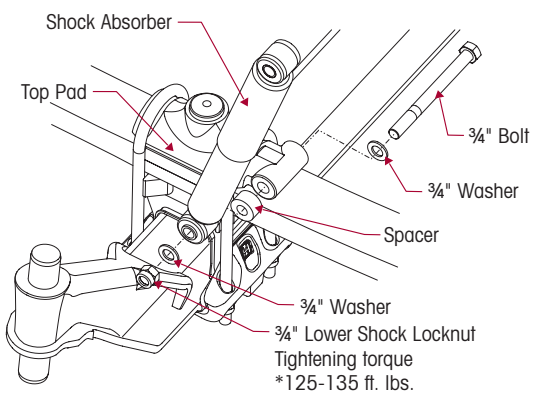


FIGURE 9-26
SOFTEK 13.2K/14.6K



*Specification provided, controlled and subject to change by vehicle manufacturer.

ASSEMBLY

1. Install the shock absorber into the upper mounting bracket.
2. Install the upper ¾" shock mounting bolt, washers and locknut.
3. Install the lower ¾" bolt from the inboard side to the outboard side of the top axle wrap and attach the spacer, washer, and locknut, see Figures 9-25 and 9-26.
4. Tighten both upper and lower ¾" locknuts to vehicle manufacturer's specifications, see Figures 9-25 and 9-26.

AIRTEK BOTTOM AXLE WRAP

DISASSEMBLY

1. Place the vehicle on level floor.
2. Chock the wheels.
3. Raise the frame.
4. Support the vehicle with frame stands.

WARNING

PRIOR TO AND DURING DEFLATION AND INFLATION OF THE FRONT AIR SUSPENSION SYSTEM, ENSURE THAT ALL PERSONNEL AND EQUIPMENT ARE CLEAR FROM UNDER THE VEHICLE AND AROUND THE SERVICE AREA, FAILURE TO DO SO CAN CAUSE SERIOUS PERSONAL INJURY, DEATH, OR PROPERTY DAMAGE.

5. See additional Air Spring Cautions and Warnings in the Important Safety Notice Section of this publication prior to inflating or deflating the suspension system.
6. Deflate the air springs by disconnecting the height control valve linkage and lowering the height control valve arm. This will exhaust the air pressure in the air springs.

WARNING

DO NOT USE A CUTTING TORCH TO REMOVE CLAMP GROUP BOLTS OR ATTACHING FASTENERS. THE USE OF SUCH HEAT ON SUSPENSION COMPONENTS CAN ADVERSELY AFFECT THE STRENGTH OF THESE PARTS. A COMPONENT DAMAGED IN THIS MANNER CAN RESULT IN THE LOSS OF VEHICLE CONTROL AND POSSIBLE PERSONAL INJURY OR PROPERTY DAMAGE.

SERVICE HINT

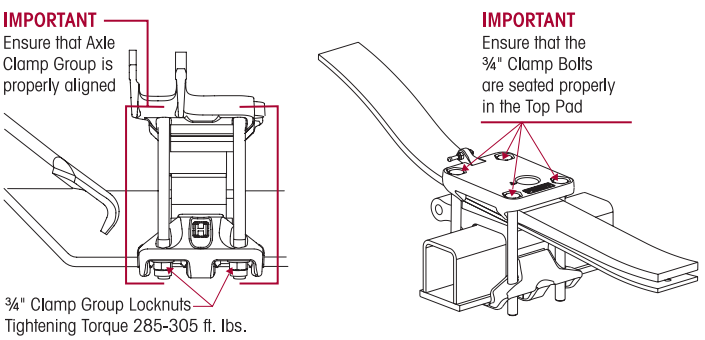
If a clamp group nut fails to come off bolt, cut half way through the bolt with an abrasive cut off wheel, taking care not to contact axle beam or other components. Using an impact wrench, spin the locknut to fracture the bolt and remove.

7. Remove ¾" hex bolts, washers and locknuts. Removal of the air spring will be required. See Air Spring Replacement instructions in this section. Discard fasteners.
8. Remove bottom axle wrap. It may be necessary to use a dead blow mallet to dislodge axle wrap.
9. Once removed inspect axle wrap for damage. Replace if necessary.
10. Discard used bottom axle wrap liner.

ASSEMBLY

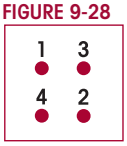
1. Install new bottom axle wrap liner into bottom axle wrap.
2. Install bottom axle wrap on axle.

FIGURE 9-27 AIRTEK



3. Install new ¾" clamp group bolts, washers and locknuts. Ensure that the clamp group is properly aligned and the hex bolts are seated in the top pad, and the bottom axle wrap is centered on the top axle wrap, see Figure 9-27.

FIGURE 9-28



4. Tighten locknuts evenly to 285-305 foot pounds torque, see Figure 9-28 for proper torque sequence.
5. Install Air spring. See Air Spring assembly in this section.
6. Remove the wheel chocks.

SOFTEK BOTTOM AXLE WRAP

DISASSEMBLY

1. Place the vehicle on level floor.
2. Chock the wheels.
3. Raise the frame.
4. Support the vehicle with frame stands.

WARNING

DO NOT USE A CUTTING TORCH TO REMOVE CLAMP GROUP BOLTS OR ATTACHING FASTENERS. THE USE OF SUCH HEAT ON SUSPENSION COMPONENTS CAN ADVERSELY AFFECT THE STRENGTH OF THESE PARTS. A COMPONENT DAMAGED IN THIS MANNER CAN RESULT IN THE LOSS OF VEHICLE CONTROL AND POSSIBLE PERSONAL INJURY OR PROPERTY DAMAGE.

SERVICE HINT

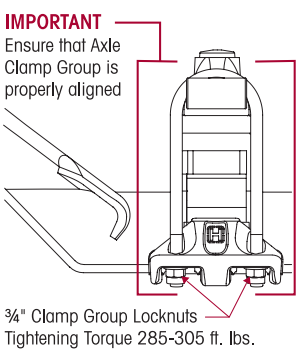
If a clamp group nut fails to come off bolt, cut half way through the bolt with an abrasive cut off wheel, taking care not to contact axle beam or other components. Using an impact wrench, spin the locknut to fracture the bolt and remove.

5. Remove ¾" U-bolts, washers and locknuts. Discard fasteners.
6. Remove bottom axle wrap. It may be necessary to use a dead blow mallet to dislodge axle wrap.
7. Once removed inspect axle wrap for damage. Replace if necessary.
8. Discard used bottom axle wrap liner.

ASSEMBLY

1. Install new bottom axle wrap liner into bottom axle wrap.
2. Install bottom axle wrap on axle.
3. Install new ¾" U-bolts, washers and locknuts. Ensure that the clamp group is properly aligned and the U-bolts are seated in the top pad, and the bottom axle wrap is centered with the top axle wrap, see Figure 9-29.
4. Tighten locknuts evenly to 285-305 foot pounds torque, see Figure 9-28 for proper torque sequence.
5. Remove the wheel chocks.

FIGURE 9-29 SOFTEK



AIRTEK TOP AXLE WRAP (In Chassis)

DISASSEMBLY

1. Place the vehicle on level floor.
2. Chock the wheels.
3. Raise the frame.
4. Support the vehicle with frame stands.
5. Suspend the front axle to remove the load from the spring and wrap leaf assembly.

⚠ WARNING

PRIOR TO AND DURING DEFLATION AND INFLATION OF THE FRONT AIR SUSPENSION SYSTEM, ENSURE THAT ALL PERSONNEL AND EQUIPMENT ARE CLEAR FROM UNDER THE VEHICLE AND AROUND THE SERVICE AREA, FAILURE TO DO SO CAN CAUSE SERIOUS PERSONAL INJURY, DEATH, OR PROPERTY DAMAGE.

6. See additional Air Spring Cautions and Warnings in the Important Safety Notice Section of this publication prior to inflating or deflating the suspension system.

⚠ DANGER

AIR SPRINGS MUST BE DEFLATED PRIOR TO LOOSENING ANY CLAMP GROUP HARDWARE. UNCONSTRAINED AIR SPRINGS CAN VIOLENTLY SHIFT, RESULTING IN POSSIBLE PERSONAL INJURY, DEATH OR PROPERTY DAMAGE.

7. Deflate the air springs by disconnecting the height control valve linkage and lowering the height control valve arm. This will exhaust the air pressure in the air springs.
8. Disconnect the air lines at the air springs.
9. Remove the air spring (See Air Spring disassembly in this section).
10. Support the axle with a jack.
11. Remove the front and rear M20 spring eye bolts, washers and locknuts.

SERVICE HINT A bottle jack may be required to raise the axle slightly in order to remove spring eye bolts.

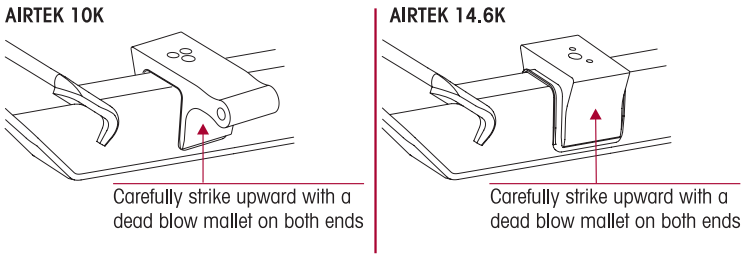
⚠ WARNING

DO NOT USE A CUTTING TORCH TO REMOVE CLAMP GROUP BOLTS OR ATTACHING FASTENERS. THE USE OF SUCH HEAT ON SUSPENSION COMPONENTS CAN ADVERSELY AFFECT THE STRENGTH OF THESE PARTS. A COMPONENT DAMAGED IN THIS MANNER CAN RESULT IN THE LOSS OF VEHICLE CONTROL AND POSSIBLE PERSONAL INJURY OR PROPERTY DAMAGE.

SERVICE HINT If a clamp group nut fails to come off bolt, cut half way through the bolt with an abrasive cut off wheel, taking care not to contact axle beam or other components. Using an impact wrench, spin the locknut to fracture the bolt and remove.

12. Remove the ¾" clamp group bolts, washers and locknuts. Discard fasteners.
13. Remove the top pad, the galvanized liner, and the bottom axle wrap.
14. Remove the lower shock mounting bolt.
15. Remove the spring and wrap leaf assembly
16. Strike the axle wrap with a dead blow mallet at the front and rear on the underside of the axle wrap to dislodge it from the axle, see Figure 9-30.
17. Clean and inspect the axle wrap and axle wrap line for cracks or damage, replace each if cracks or damage are present.

FIGURE 9-30

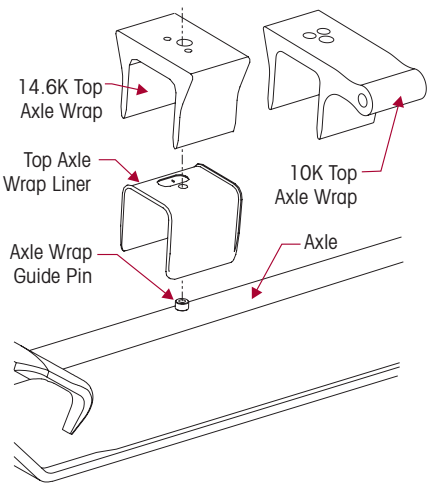


ASSEMBLY

1. Install the new axle wrap liner on the axle.
2. Spray the axle wrap liner and the axle wrap with a silicon lubricant.
3. Position the axle wrap on the axle, see Figure 9-31.

CAUTION DO NOT STRIKE THE TOP AXLE WRAP WITH A HAMMER. HENDRICKSON RECOMMENDS USING A PLASTIC DEAD BLOW MALLET WITH CARE WHEN INSTALLING THE AXLE WRAP.

FIGURE 9-31



4. Protect the top surface of the axle wrap with a block of wood, cardboard, or shop towels.
5. Install a bottle jack between the axle wrap and frame rail flange.
6. Jack the axle wrap down into position on the axle, using care to make sure the axle wrap bore indexes the locating bushing on the axle.

IMPORTANT NOTE For Flat Floor Models install the intermediate dowel pin into the axle wrap.

7. Install the spring and wrap leaf assembly on the axle wrap (indexing the dowel pin if equipped).
8. Install the galvanized liner and the top pad on the spring and wrap leaf assembly.
9. Remove and replace the bottom axle wrap liner.
10. Install the bottom axle wrap.
11. Install the new ¾" clamp group bolts, washers, and locknuts.
12. Snug the clamp group, **DO NOT** torque at this time.
13. Use a jack and raise the axle and spring assembly into the front spring hanger and shackle assembly.

SERVICE HINT A bottle jack may be required to raise the axle slightly in order to install the spring eye bolts.

14. Install the M20 spring eye bolts in the front spring hanger and rear shackle assembly.
15. Ensure that the clamp group is properly aligned and the hex bolts are seated in the top pad, and the bottom axle wrap is centered with the top axle wrap, see Figure 9-32.

FIGURE 9-32

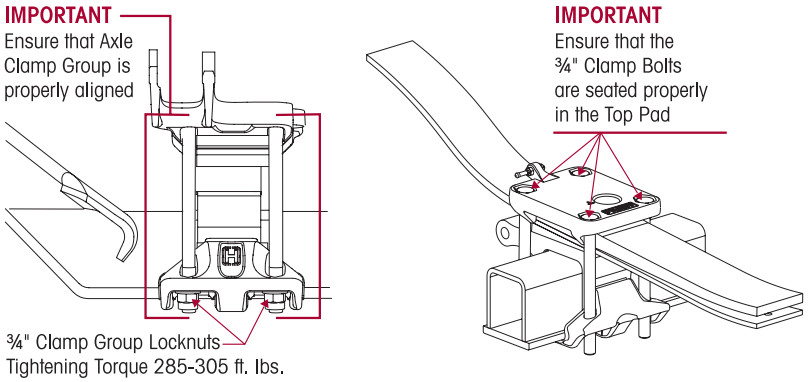
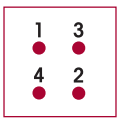


FIGURE 9-33



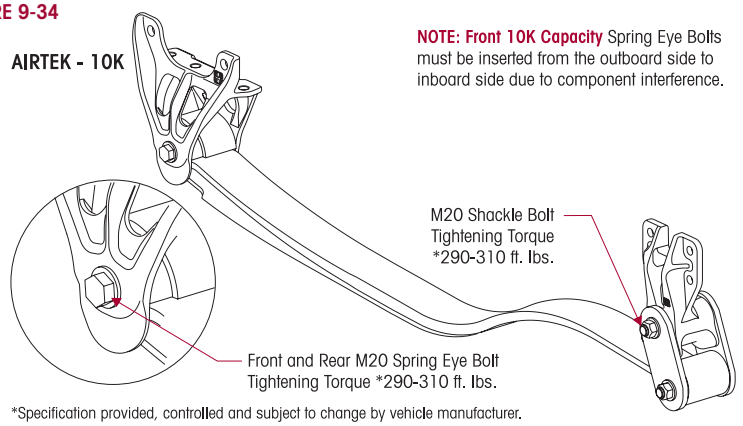
16. Tighten the ¾" clamp group locknuts evenly to 285-305 foot pounds torque in the proper sequence, see Figure 9-33.
17. Remove the jack from the axle.
18. Remove the frame stands.

WARNING

PRIOR TO AND DURING DEFLATION AND INFLATION OF THE FRONT AIR SUSPENSION SYSTEM, ENSURE THAT ALL PERSONNEL AND EQUIPMENT ARE CLEAR FROM UNDER THE VEHICLE AND AROUND THE SERVICE AREA, FAILURE TO DO SO CAN CAUSE SERIOUS PERSONAL INJURY, DEATH, OR PROPERTY DAMAGE.

19. See additional Air Spring Cautions and Warnings in the Important Safety Notice Section of this publication prior to inflating or deflating the suspension system.
20. Attach air lines to the air springs.
21. Install shocks. (See shock absorber assembly in this section)
22. Air up system to proper ride height. (See Ride Height Adjustment in the Alignment & Adjustments Section of this publication).
23. Tighten the M20 spring eye bolt locknuts to vehicle manufacturer's specifications, see Figure 9-34.
24. Remove the wheel chocks.

FIGURE 9-34



*Specification provided, controlled and subject to change by vehicle manufacturer.

SOFTEK TOP AXLE WRAP (In Chassis)

DISASSEMBLY

1. Place the vehicle on level floor.
2. Chock the wheels.
3. Raise the frame.
4. Support the vehicle with frame stands.
5. Suspend the front axle to remove the load from the spring and wrap leaf assembly.
6. Remove the front and rear M20 spring eye bolts, washers and locknuts. Loosen the M20 shackle pivot bolt.

SERVICE HINT A bottle jack may be required to raise the axle slightly in order to remove spring eye bolts.

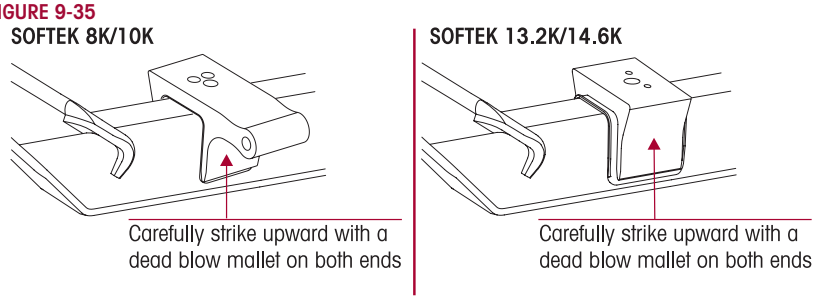
7. Support the axle with a jack.

⚠ WARNING DO NOT USE A CUTTING TORCH TO REMOVE CLAMP GROUP BOLTS OR ATTACHING FASTENERS. THE USE OF SUCH HEAT ON SUSPENSION COMPONENTS CAN ADVERSELY AFFECT THE STRENGTH OF THESE PARTS. A COMPONENT DAMAGED IN THIS MANNER CAN RESULT IN THE LOSS OF VEHICLE CONTROL AND POSSIBLE PERSONAL INJURY OR PROPERTY DAMAGE.

SERVICE HINT If a clamp group nut fails to come off bolt, cut half way through the bolt with an abrasive cut off wheel, taking care not to contact axle beam or other components. Using an impact wrench, spin the locknut to fracture the bolt and remove.

8. Remove the ¾" clamp group U-bolts, washers and locknuts. Discard fasteners.
9. Remove the top pad and the bottom axle wrap.
10. Remove the lower shock mounting bolt.
11. Remove the spring and wrap leaf assembly.
12. Strike the axle wrap with a dead blow mallet at the front and rear on the underside of the axle wrap to dislodge it from the axle, see Figure 9-35.
13. Clean and inspect the axle wrap and axle wrap liners for cracks or damage, replace each if cracks or damage are present.

FIGURE 9-35

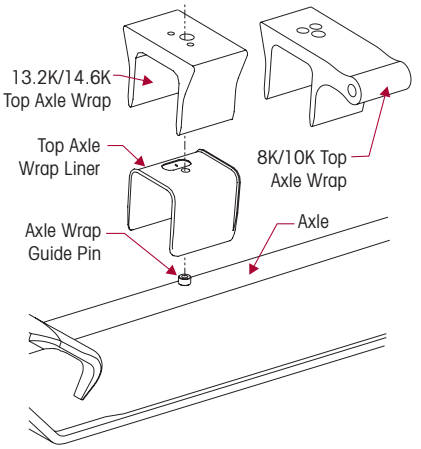


ASSEMBLY

1. Install the new axle wrap liner on the axle.
2. Spray the axle wrap liner and the axle wrap with a silicon lubricant.

3. Position the axle wrap on the axle, see Figure 9-36.

FIGURE 9-36

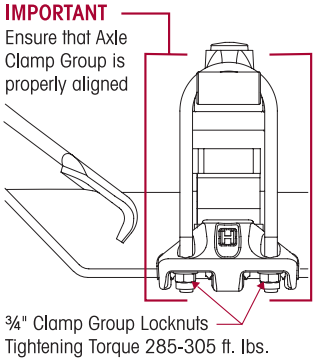


⚠ CAUTION

DO NOT STRIKE THE TOP AXLE WRAP WITH A HAMMER. HENDRICKSON RECOMMENDS USING A PLASTIC DEAD BLOW MALLET WITH CARE WHEN INSTALLING THE AXLE WRAP.

4. Protect the top surface of the axle wrap with a block of wood, cardboard, or shop towels.
5. Install a bottle jack between the axle wrap and frame rail flange.
6. Jack the axle wrap down into position on the axle, using care to make sure the axle wrap bore indexes the locating bushing on the axle.
7. Install the spring and wrap leaf assembly on the axle wrap indexing the center bolt in the locating hole.
8. Install the top pad on the spring and wrap leaf assembly.
9. Remove and replace the bottom axle wrap liner.
10. Install the bottom axle wrap.
11. Install the new ¾" clamp group U-bolts, washers, and locknuts.
12. Snug the clamp group, **DO NOT** torque at this time.

FIGURE 9-37 SOFTEK



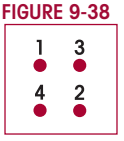
13. Use a jack and raise the axle and spring assembly into the front spring hanger and shackle assembly.

SERVICE HINT

A bottle jack may be required to raise the axle slightly in order to install the spring eye bolts.

14. Install the M20 spring eye bolts, washer and locknuts in the front spring hanger and rear shackle assembly.
15. Ensure that the clamp group is properly aligned and the U-bolts are seated in the top pad, and the bottom axle wrap is centered with the top axle wrap, see Figure 9-37.

FIGURE 9-38



16. Tighten the ¾" clamp group locknuts evenly to 285-305 foot pounds torque in the proper sequence, see Figure 9-38.
17. Apply a thin coating of anti-seize to the lower shock mounting bolt.
18. Install shocks. (See shock absorber assembly in this section)
19. Remove the jack from the axle.
20. Remove the frame stands.
21. Tighten the M20 spring eye bolt locknuts to vehicle manufacturer's specifications.
22. Remove the wheel chocks.

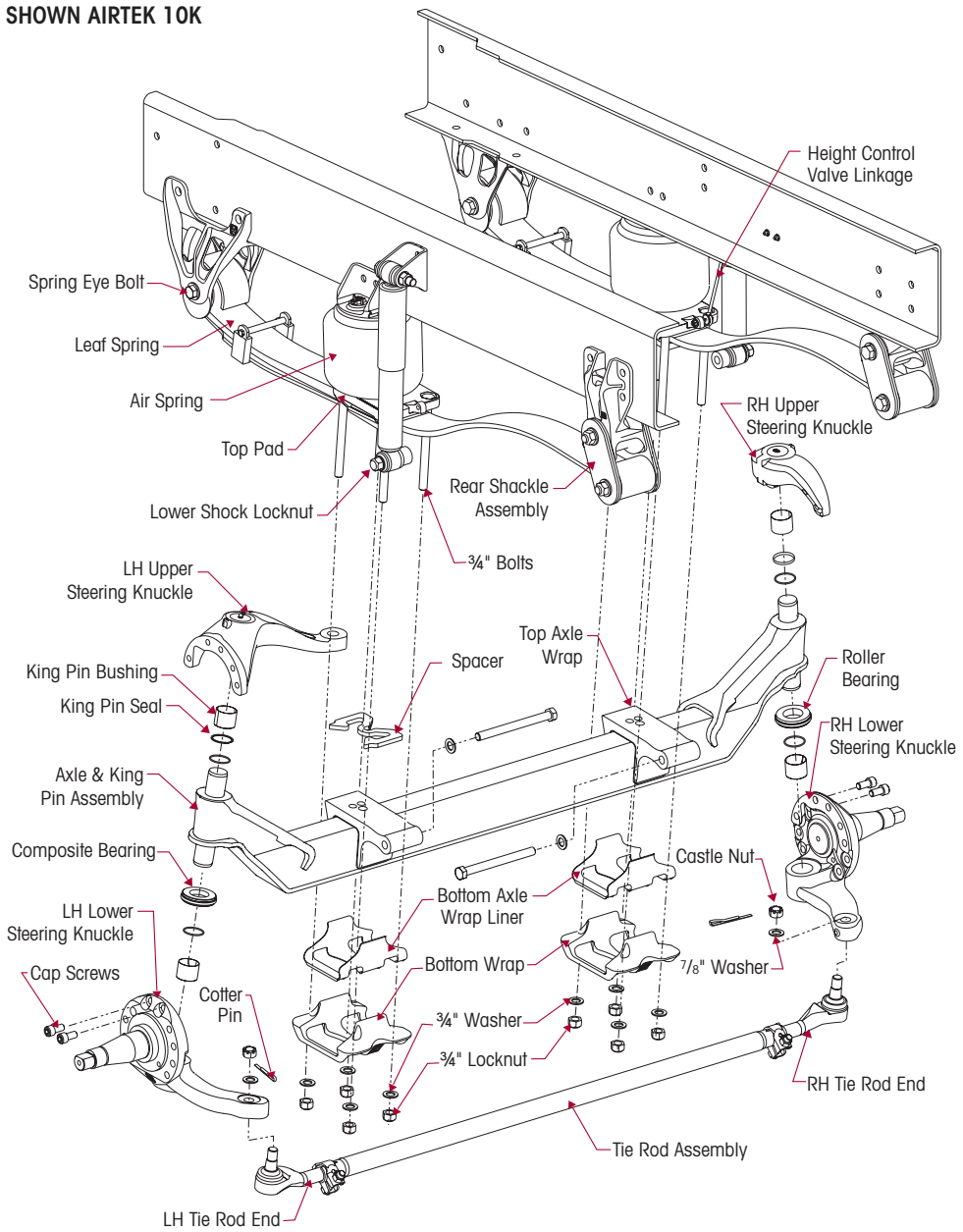
AIRTEK FRONT AXLE ASSEMBLY

STEERTEK AXLE CLAMP GROUP CONSIST OF THE FOLLOWING COMPONENTS:

- Top axle wrap
- Top axle wrap liner
- Top pad
- Bottom axle wrap
- Bottom axle wrap liner
- ¾" Bolts, washers and nylon locknuts

FIGURE 9-39

SHOWN AIRTEK 10K



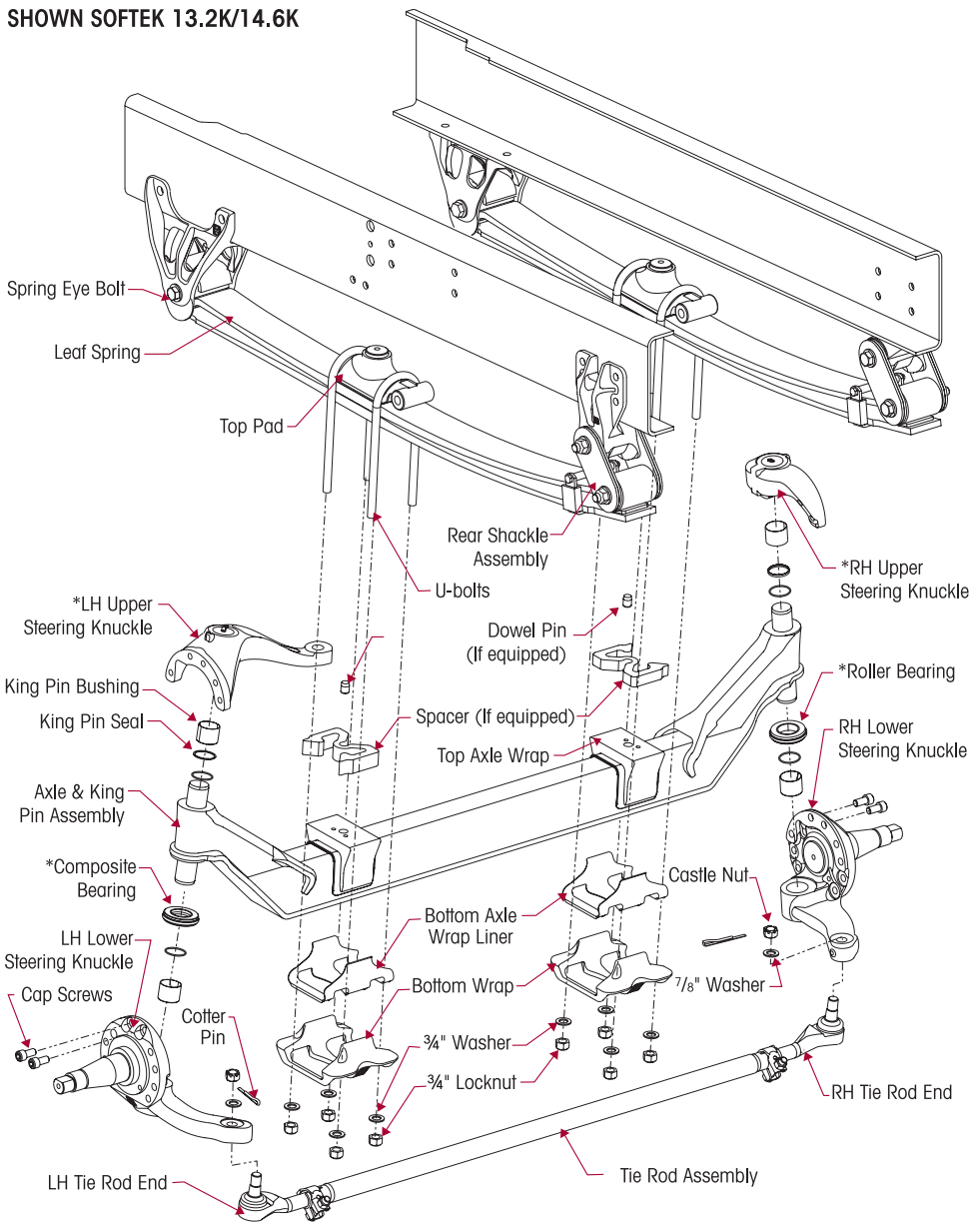
SOFTEK FRONT AXLE ASSEMBLY

STEERTEK AXLE CLAMP GROUP CONSIST OF THE FOLLOWING COMPONENTS:

- Top axle wrap
- Top axle wrap liner
- Top pad
- Bottom axle wrap
- Bottom axle wrap liner
- ¾" Bolts, washers and nylon locknuts

FIGURE 9-40

SHOWN SOFTEK 13.2K/14.6K



*For right hand drive axle configuration, see Parts List Section of this publication.

STEERTEK AXLE REMOVAL

Refer to Figures 9-39 and 9-40 when replacing the components of the STEERTEK axle.

WARNING

DO NOT USE A TORCH ON CLAMP GROUP BOLTS OR ANY OTHER PART OF THE AIRTEK SUSPENSION. IF THE CLAMP GROUP BOLTS WILL NOT COME LOOSE WITH AN IMPACT WRENCH, USE A CUT OFF WHEEL AND CUT THE SHANK OF THE BOLT. THE USE OF A TORCH CAN CAUSE DAMAGE TO CERTAIN AIRTEK COMPONENTS THAT CAN RESULT IN THE LOSS OF VEHICLE CONTROL AND POSSIBLE PERSONAL INJURY OR PROPERTY DAMAGE.

1. Place the vehicle on level floor.
2. Chock the wheels.
3. SOFTEK equipped vehicles — proceed to step 6.

WARNING

PRIOR TO AND DURING DEFLATION AND INFLATION OF THE FRONT AIR SUSPENSION SYSTEM, ENSURE THAT ALL PERSONNEL AND EQUIPMENT ARE CLEAR FROM UNDER THE VEHICLE AND AROUND THE SERVICE AREA, FAILURE TO DO SO CAN CAUSE SERIOUS PERSONAL INJURY, DEATH, OR PROPERTY DAMAGE.

4. See additional Air Spring Cautions and Warnings in the Important Safety Notice Section of this publication prior to inflating or deflating the suspension system.
5. AIRTEK equipped vehicles — Deflate the air springs by disconnecting the height control valve linkage and lowering the height control valve linkage arm. This will exhaust the air pressure in the air springs.
6. Raise the frame.
7. Support the vehicle with frame stands.
8. Suspend the front axle with the shocks attached.
9. Remove the front wheels, hubs, brake shoes and backing plate assembly.
10. Disconnect the drag link from the steering arm.
11. SOFTEK equipped vehicles — proceed to step 13.
12. AIRTEK equipped vehicles — Remove lower air spring mounting fasteners for both air springs at the axle top pad and unseat from the top pad.
13. Support the axle with a floor jack.

WARNING

THE REPAIR OR RECONDITIONING OF SUSPENSION OR AXLE COMPONENTS IS NOT ALLOWED. HENDRICKSON ADVISES REPLACING ALL COMPONENTS FOUND TO BE DAMAGED OR OUT OF SPECIFICATIONS. ALL MAJOR HENDRICKSON COMPONENTS ARE HEAT TREATED AND TEMPERED. AIRTEK COMPONENTS CANNOT BE BENT, WELDED, HEATED, OR REPAIRED WITHOUT REDUCING THE STRENGTH OR LIFE OF THE COMPONENT. FAILURE TO FOLLOW THESE GUIDELINES CAN CAUSE LOSS OF VEHICLE CONTROL, AND POSSIBLE PERSONAL INJURY OR DEATH OR PROPERTY DAMAGE AND WILL VOID APPLICABLE WARRANTIES.

14. If the vehicle is equipped with the shock absorbers attached to the top axle wrap, it will be necessary to remove the lower shock mounting locknuts and washers. Remove the shock absorbers from the lower mounting bolts and push clear of spring assembly.

SERVICE HINT

If a clamp group nut fails to come off bolt, cut half way through the bolt with an abrasive cut off wheel, taking care not to contact axle beam or other components. Using an impact wrench, spin the locknut to fracture the bolt and remove.

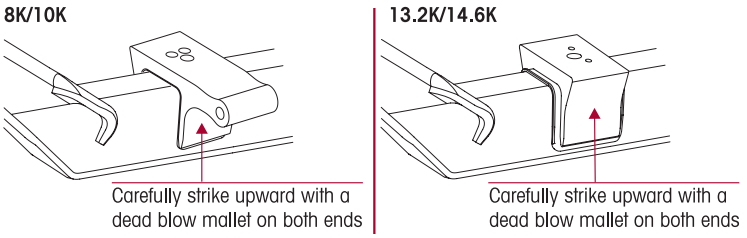
15. Remove the ¾" clamp group bolts, washers, and locknuts. Discard fasteners.
16. Lower the axle and remove from the vehicle.

STEERTEK AXLE (Removed from Chassis)

AXLE DISASSEMBLY

1. Remove the bottom axle wrap and liner from the axle.
2. Strike the top axle wrap with a dead blow mallet at the front and rear on the underside of the axle wrap to dislodge it from the axle, see Figure 9-41.

FIGURE 9-41



3. After removal of the top axle wrap from the axle inspect for cracks or fretting.
4. Remove the tie rod assembly. See Tie Rod disassembly in this section.

⚠ WARNING

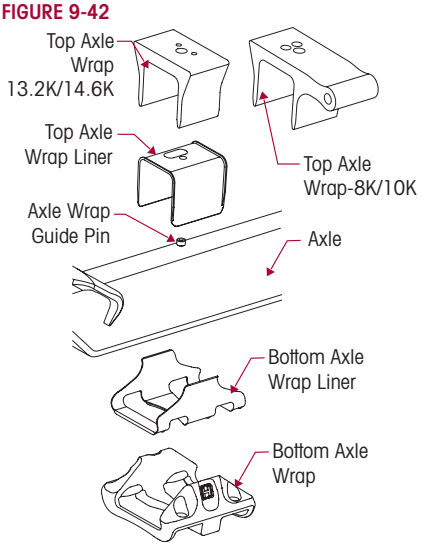
REMOVAL OF THE CAP SCREWS WILL ALLOW THE STEERING KNUCKLE TO SEPARATE FROM THE AXLE. THE BACKBONE MUST BE SUPPORTED BEFORE REMOVAL OF THESE TWO (2) CAP SCREWS. FAILURE TO DO SO CAN CAUSE COMPONENT DAMAGE OR PERSONAL INJURY.

5. Remove the two ⅝" socket head cap screws from the steering knuckle assembly.
6. Remove the steering knuckle, thrust bearing, and shims (if equipped).
7. After complete removal of the one side, repeat steps 1-6 for the opposite side of the axle.
8. Inspect the steering kingpin bushings for excessive wear. If worn, replace the kingpin bushings and seals. See the Kingpin Bushing replacement instructions in this section.

AXLE PRE-ASSEMBLY

1. Install the new upper axle wrap liner on the axle. Index the liner with the axle's guide pin, see Figure 9-42.

FIGURE 9-42



⚠ CAUTION

DO NOT STRIKE THE TOP AXLE WRAP WITH A HAMMER. DAMAGE TO THE ALUMINUM AXLE WRAP WILL OCCUR. USE A PLASTIC DEAD BLOW MALLET WITH CARE WHEN INSTALLING THE AXLE WRAP.

⚠ WARNING

SECURELY INSTALL THE TOP WRAP TO THE AXLE. FAILURE TO DO SO CAN CAUSE LOSS OF CONTROL OF THE VEHICLE, PERSONAL INJURY OR PROPERTY DAMAGE.

SERVICE HINT

Apply a lubricant (such as an aerosol silicone) to the outer surface of the plastic liner to aid in assembly of the top axle wrap.

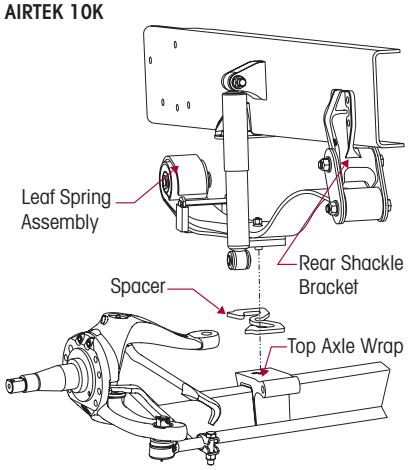
2. Install the top axle wrap, see Axle Wrap Assembly instructions located in this section. The axle wrap must be aligned with the guide pin on the axle.
3. At this point in the assembly, do not install anything further on the axle.

AXLE INSTALLATION

1. Place the new axle on the floor jack and position the axle under the vehicle.
2. Install the axle spacer (if equipped) on the top axle wrap prior to raising the axle into position.
3. Raise the axle into position, see Figures 9-43 and 9-44. Care must be taken at this point to ensure that the front leaf spring assemblies' center bolt is aligned correctly in the top axle wrap.

FIGURE 9-43

AIRTEK 10K



AIRTEK 14.6K

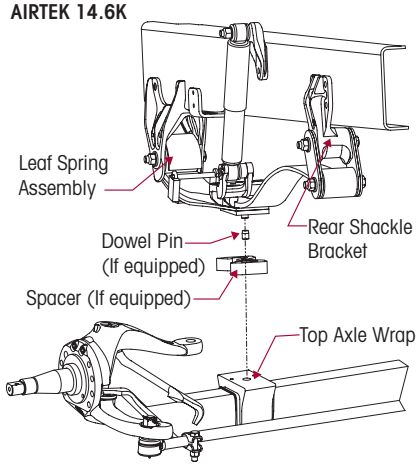
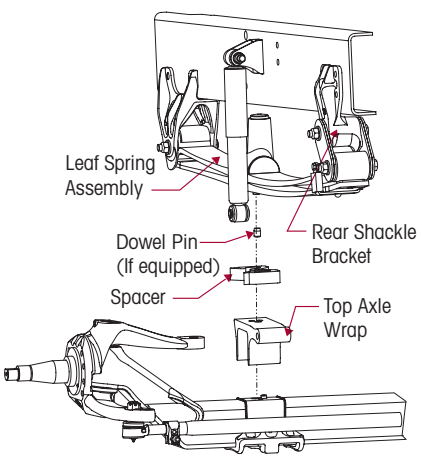
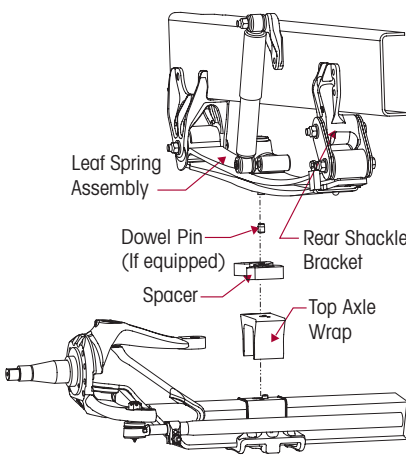


FIGURE 9-44

SOFTEK 8K/10K

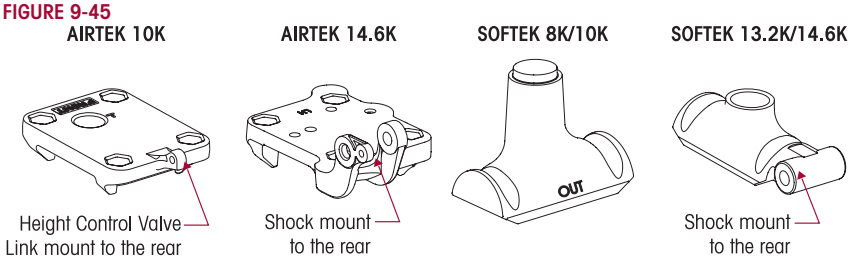


SOFTEK 13.2K/14.6K



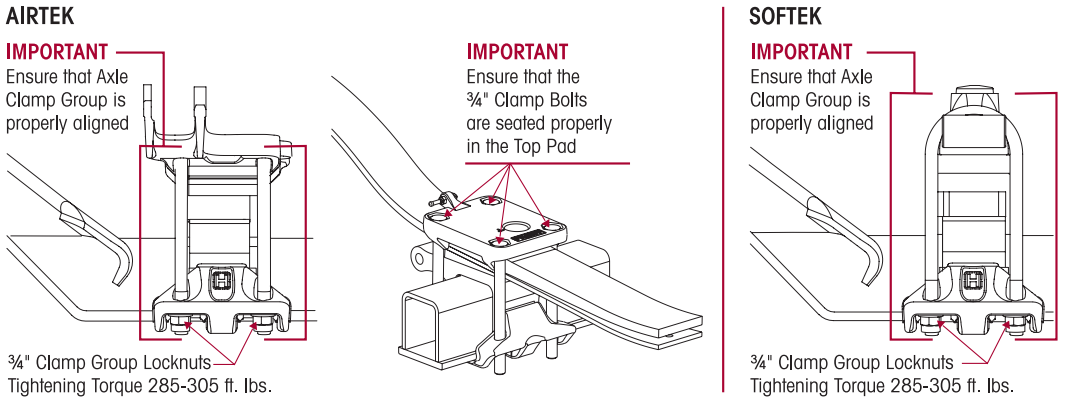
4. Verify that the galvanized liner is between the leaf springs and the top pad.
5 Install the new bottom axle wrap liners on the bottom axle wraps.
6. Install the bottom axle wraps on the axle.
7. Install the top pad with the directional identification facing correctly on the vehicle, see Figure 9-45.

FIGURE 9-45



8. Install the new ¾" clamp group bolts, washers and locknuts. Snug the bolts , **DO NOT** tighten to the specified torque at this time.
9. Ensure that the clamp groups are properly aligned and the bolts are seated in the top pad, and the bottom axle wraps are centered on the top axle wraps, see Figure 9-46.

FIGURE 9-46



10. SOFTEK equipped vehicles — proceed to step 13.

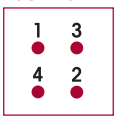
⚠ WARNING

PRIOR TO AND DURING DEFLATION AND INFLATION OF THE FRONT AIR SUSPENSION SYSTEM, ENSURE THAT ALL PERSONNEL AND EQUIPMENT ARE CLEAR FROM UNDER THE VEHICLE AND AROUND THE SERVICE AREA, FAILURE TO DO SO CAN CAUSE SERIOUS PERSONAL INJURY, DEATH, OR PROPERTY DAMAGE.

11. See additional Air Spring Cautions and Warnings in the Important Safety Notice Section of this publication prior to inflating or deflating the suspension system.
12. AIRTEK equipped vehicles:
    - Engage the 10K air springs into the top pad. The bottom of the air spring snaps into the top pad.
    - Engage the 14.6K air springs into the top pad. Install new lower air spring mounting fasteners and tighten to 20-30 foot pounds torque.
13. Install the lower shock absorber connection (if removed). Install the lower shock fasteners and tighten to vehicle manufacturer's specifications.
14. Install the steering knuckles as per the Steering Knuckle replacement instructions in this section.
15. Install the tie rod assembly.
16. Install the ⅞" hardened washers on the Ackermann arm and the castle nuts. Tighten the castle nuts to 185 foot pounds, then rotate until the first castle slot lines up with the cotter pin bore in the tie rod end. Do not back off the nut for cotter pin installation.

17. Install the tie rod end cotter pins.
18. Connect the drag link. Install the castle nut. Tighten the castle nut to 185 foot pounds, then rotate until the first castle slot lines up with the cotter pin bore in the drag link. Do not back off the nut for cotter pin installation.
19. Install the drag link cotter pin.
20. Install the brake backing plate assemblies.
21. Install the brakes, hubs, and wheels as per manufacturer's guidelines.
22. Fill the hubs with the proper lubricant (see manufacturer's guidelines for recommended lubrication specifications).
23. Raise the vehicle and remove the frame stands.
24. Lower the vehicle.
25. SOFTEK equipped vehicles — proceed to step number 27.
26 AIRTEK equipped vehicles — Reconnect the height control valve and air up the system.

FIGURE 9-47



27. Tighten the ¾" clamp group locknuts evenly in 50 foot pounds increments to 285-305 foot pounds torque in the proper sequence to achieve uniform bolt tension, see Figure 9-47.
28. SOFTEK equipped vehicles — proceed to step number 30.
29 AIRTEK equipped vehicles — Adjust ride height per instructions in the Alignment & Adjustments Section of this publication.
30. Grease the front steering components as per lubrication guidelines in the Preventive Maintenance Section of this publication.
31. Remove the wheel chocks.

STEERING KNUCKLE DISASSEMBLY

DISASSEMBLY

See tools needed to remove and install kingpin bushing under the Special Tools Section of this publication.

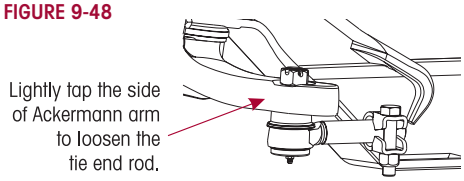
The steering knuckle disassembly and assembly includes the Kingpin Preparation and Measurement and Kingpin Bushing Removal process.

1. Place the vehicle on level floor.
2. Chock the wheels.
3. Raise the frame.
4. Support the vehicle with frame stands.
5. Remove the wheel and hub assembly.
6. Remove the brake components from steering knuckle.
7. Remove the tie rod assembly.

SERVICE HINT

Lightly tap the side of the Ackermann arm with a mallet to separate the tie rod end from the Ackermann arm, see Figure 9-48.

FIGURE 9-48

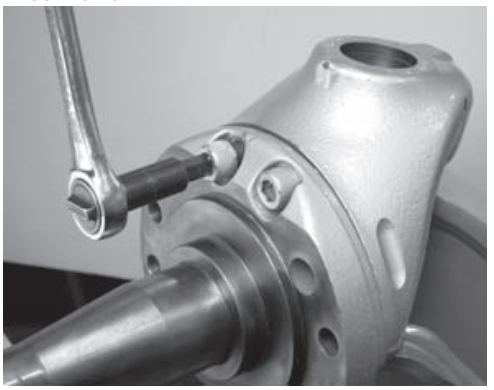


8. Remove the drag link from the knuckle if necessary.

WARNING

REMOVAL OF THE CAP SCREWS WILL ALLOW THE STEERING KNUCKLE TO SEPARATE FROM THE AXLE. THE STEERING KNUCKLE MUST BE SUPPORTED BEFORE REMOVAL OF THESE TWO (2) CAP SCREWS. FAILURE TO DO SO CAN CAUSE COMPONENT DAMAGE OR PERSONAL INJURY.

FIGURE 9-49



9. Remove the 2 socket head cap screws that connect upper kingpin connection to the steering knuckle, see Figure 9-49.
10. Remove the lower steering knuckle from the kingpin by sliding it down the kingpin.
11. Remove the upper steering knuckle by sliding it up off the kingpin.

KINGPIN PREPARATION AND MEASUREMENT

CLEANING GROUND AND POLISHED PARTS

- Use a cleaning solvent to clean ground or polished parts and surfaces. **DO NOT USE GASOLINE.**
- Do not clean ground or polished parts in a hot solution tank or with water, steam, or alkaline solutions. These solutions will cause corrosion of the parts.

DRYING THE CLEANED PARTS

- Parts must be dried immediately after cleaning. Dry the parts with clean paper towels, clean rags, or compressed air. Do not dry bearings by spinning with compressed air. Damage to the bearings will result.

PREVENTING CORROSION ON CLEANED PARTS

- Apply a light coating of oil to all cleaned and dried parts that are going to be reused. Do not apply oil to the brake lining or the brake drums. If parts are to be stored, apply an effective rust inhibitor to all surfaces.

WARNING

TO HELP PREVENT SERIOUS EYE INJURY, ALWAYS WEAR PROPER EYE PROTECTION WHEN YOU PERFORM VEHICLE MAINTENANCE OR SERVICE.

WARNING

SOLVENT CLEANERS CAN BE FLAMMABLE, POISONOUS AND CAUSE BURNS. TO HELP AVOID SERIOUS PERSONAL INJURY, CAREFULLY FOLLOW THE MANUFACTURER'S PRODUCT INSTRUCTIONS AND GUIDELINES AND THE FOLLOWING PROCEDURES:

- WEAR PROPER EYE PROTECTION.
- WEAR CLOTHING THAT PROTECTS YOUR SKIN.
- WORK IN A WELL VENTILATED AREA.
- DO NOT USE GASOLINE, SOLVENTS OR OTHER MATERIALS THAT CONTAIN GASOLINE THAT CAN EXPLODE.
- HOT SOLUTION TANKS OR ALKALINE SOLUTIONS MUST BE USED CORRECTLY. FOLLOW THE MANUFACTURER'S RECOMMENDED INSTRUCTIONS AND GUIDELINES CAREFULLY TO HELP PREVENT PERSONAL ACCIDENT OR INJURY.

CAUTION

DO NOT USE HOT SOLUTION TANKS OR WATER AND ALKALINE SOLUTIONS TO CLEAN GROUND OR POLISHED PARTS. DAMAGE TO THE PARTS WILL RESULT.

WARNING

THE STEERTEK HAS A UNIQUE AXLE. THE KINGPIN IS CRYOGENICALLY INSTALLED IN THE AXLE. THE KINGPIN IS A NON-REPLACEABLE COMPONENT OF THE AXLE ASSEMBLY. DO NOT TRY TO REMOVE THE KINGPIN. DOING SO WILL DAMAGE THE AXLE AND MAY CAUSE LOSS OF VEHICLE CONTROL, PERSONAL INJURY OR PROPERTY DAMAGE. IF THE KINGPIN SHOWS SIGNS OF MOVEMENT, CONTACT HENDRICKSON PRODUCT ENGINEERING - TECH SERVICES.

1. Prepare and polish the kingpin by removing all grease and excess debris using a fine grit (220 grit or higher) emery cloth and parts solvent, see Figures 9-50 through 9-53.

FIGURE 9-50

FIGURE 9-51

FIGURE 9-52 KINGPIN BEFORE CLEANING

FIGURE 9-53 KINGPIN AFTER CLEANING

2. Inspect the kingpin for wear or damage. Use a micrometer and measure the upper and lower kingpin in two locations. Positions must be 90° opposed from each other. If the kingpin has less than 1.802" diameter, replacement of the axle is necessary, see Figures 9-54 through 9-57.

   Kingpin minimum dimension is 1.802"

FIGURE 9-54

FIGURE 9-55

FIGURE 9-56

FIGURE 9-57

KINGPIN BUSHING REMOVAL

1. Remove the retaining ring for the grease cap.
2. A hydraulic shop press with a minimum forcing capacity of 2.5 tons (or use an arbor press) will be required.

⚠ WARNING

BEFORE APPLYING HYDRAULIC PRESSURE TO ANY TOOLING SET-UP, ALWAYS CHECK TO BE SURE THE PRESS PLATE, ADAPTERS, AND COMPONENTS BEING WORKED ON ARE POSITIONED PROPERLY, I.E. "IN LINE" WITH THE RAM. IMPROPER POSITIONING CAN CAUSE PERSONAL INJURY OR COMPONENT DAMAGE.

⚠ CAUTION

BEFORE APPLYING HYDRAULIC PRESSURE TO REMOVE OR INSTALL THE KINGPIN BUSHING, SUPPORT THE LOWER STEERING KNUCKLE AS SHOWN IN FIGURES 9-58 AND 9-59. IMPROPER SUPPORT TO THE STEERING KNUCKLES CAN CAUSE COMPONENT DAMAGE.

3. Use the grease cap to press out the kingpin bushing and seal. Remove the grease zerk in the grease cap or use a hollow driver, (see Figure 9-58) to press out the kingpin bushing.
4. Install the lower steering knuckle upside down in press. Be sure to support the lower steering knuckle assembly so that it sits in-line with the press, see Figure 9-59.
5. Use the same procedure to remove the kingpin bushing in the upper kingpin connection or the steering arm, see Figures 9-58 through 9-60.
6. Clean the parts and inspect for reassembly, see Figure 9-61.

FIGURE 9-58

FIGURE 9-59

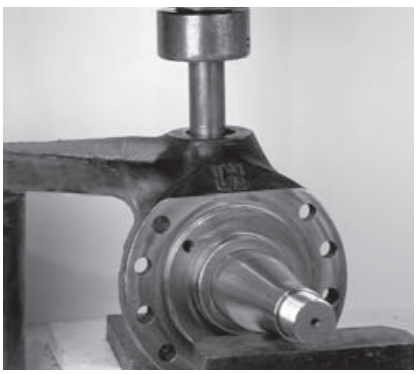


FIGURE 9-60

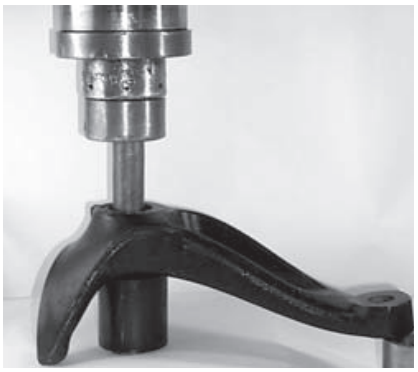
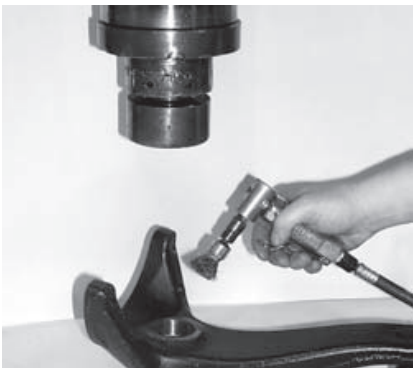


FIGURE 9-61



STEERING KNUCKLE BORE MEASUREMENT

Complete the following steering knuckle bore inspection and the measurement instructions prior to installing the kingpin bushing.

1. Measure the upper knuckle bore inside diameter at two locations. Always use an inside micrometer or a telescoping gauge when taking a knuckle bore measurement. Some out-of-roundness at the top and bottom of the bore edges is acceptable. Steering knuckle bore diameter is 1.938" ± 0.003"
2. Measure the upper and lower bore in two positions and at two locations. The two positions must be 90º opposed from each other, see Figures 9-62 through 9-64. If the average measurement is more than the knuckle bore maximum diameter specification, replace the knuckle.

FIGURE 9-62

FIGURE 9-63

FIGURE 9-64

KINGPIN BUSHING INSTALLATION

1. A hydraulic shop press with a minimum forcing capacity of 5 tons will be required.

⚠ WARNING

BEFORE APPLYING HYDRAULIC PRESSURE TO ANY TOOLING SET-UP, ALWAYS CHECK TO BE SURE THE PRESS PLATE, ADAPTERS, AND COMPONENTS BEING WORKED ON ARE POSITIONED PROPERLY, I.E. "IN LINE" WITH THE RAM. IMPROPER POSITIONING CAN CAUSE PERSONAL INJURY OR COMPONENT DAMAGE.

2. Install the lower or upper steering knuckle in the press.
3. Install the kingpin bushing from the machined side (axle side) of the lower steering knuckle using a bushing driver, (see driver specifications in the Special Tools Section of this publication). Press in bushing to a depth of no less than $^{15}/_{64}$" (0.236") or 6 millimeters and no more than $^{5}/_{16}$" (0.32") or 8 millimeters, see Figures 9-65 and 9-67.
4. Following this procedure it is necessary to ream the kingpin bushings to fit the kingpins, (see Kingpin Bushing Reaming Instructions).

FIGURE 9-65

FIGURE 9-66

FIGURE 9-67

KINGPIN BUSHING REAMING

CAUTION

REAM THE KINGPIN BUSHINGS WITH AN ADJUSTABLE STRAIGHT FLUTE REAMER. (SEE SPECIAL TOOLS SECTION OF THIS PUBLICATION) DO NOT HONE OR BURNISH THE KINGPIN BUSHINGS. HONING OR BURNISHING WILL DAMAGE THE BUSHINGS AND VOID WARRANTY.

WARNING

WHEN INSTALLING STEERING KNUCKLE COMPONENTS IN A VISE IT IS NECESSARY TO PROTECT THE MACHINED SURFACES FROM GOUGES OR MARRING BY USING BRASS JAWS. FAILURE TO DO SO CAN CAUSE PREMATURE PART DAMAGE, DAMAGE TO THE STEERING KNUCKLE COMPONENTS, LOSS OF WARRANTY, LOSS OF VEHICLE CONTROL, CAUSING PERSONAL INJURY OR PROPERTY DAMAGE.

1. Install the lower steering knuckle assembly in a vise with brass jaws.

SERVICE HINT

It is acceptable to mount the knuckle components in a vise either vertically or horizontally when performing the reaming procedure.

2. Install the reamer into the lower steering knuckle until the blades touch the kingpin bushing.
3. Rotate the reamer with light downward pressure. Rotate the reamer smoothly. Do not apply too much pressure, see Figures 9-68 and 9-69.

FIGURE 9-68 Lower Steering Knuckle in Vise

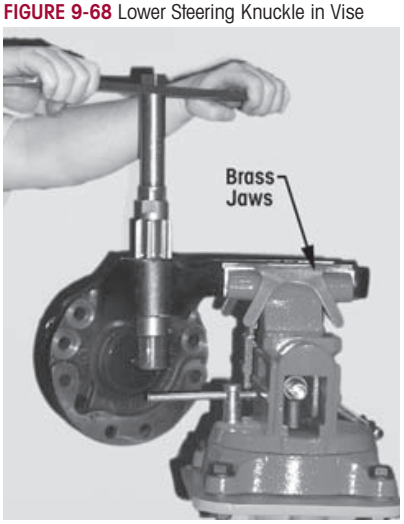
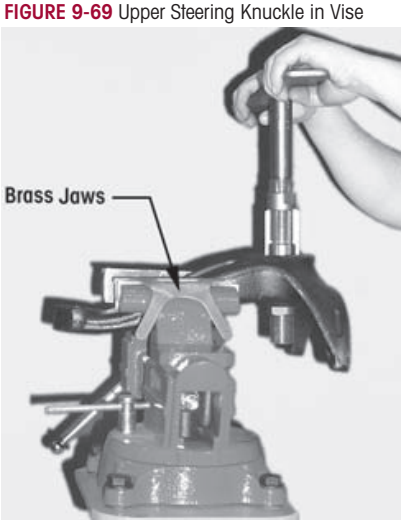


FIGURE 9-69 Upper Steering Knuckle in Vise



4. Slide the reamer out of the bottom of the steering knuckle assembly. If it is necessary to remove the reamer from the top, rotate the reamer opposite of cutting rotation.
5. Clean and remove all kingpin bushing material from the steering knuckle assembly. Take special attention to remove material from the grease channels and dimples.
6. Clean the 5/8" brake backing plate bolts with a wire wheel and run a tap through the threads of the lower steering knuckle assembly and then flush out with brake cleaner and dry with compressed air.

WARNING

PRIOR TO INSTALLATION ENSURE THAT ALL RESIDUAL LOCTITE® MATERIAL IS REMOVED FROM THE MOUNTING BOLTS AND THE THREAD BORES IN THE UPPER STEERING KNUCKLES, AND NEW LOCTITE 277 OR EQUIVALENT IS APPLIED TO HELP ENSURE THAT THE BOLTS SUSTAIN THE PROPER TORQUE REQUIREMENT. FAILURE TO DO SO CAN CAUSE LOSS OF VEHICLE CONTROL RESULTING IN PERSONAL INJURY OR PROPERTY DAMAGE.

NOTE The Hendrickson Genuine part, socket head cap screw comes with a pre-applied loctite compound.

7. Install the upper and lower steering knuckle on the kingpin.
8. Check for the proper fit by rotating the knuckle assembly back and forth to verify there is no binding on the kingpin, see Figures 9-70 and 9-71.
9. If the bushing is too tight repeat steps 1 through 8 until the proper clearance is achieved.

NOTE Bushing size is to be 0.001" larger than the kingpin size.

FIGURE 9-70

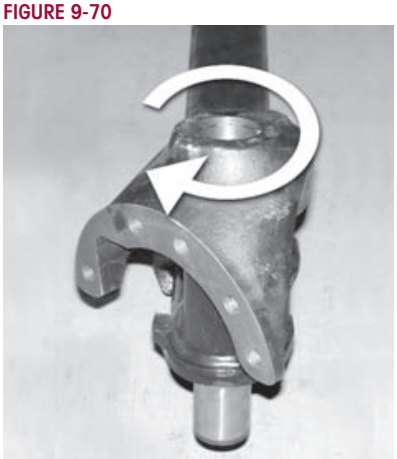
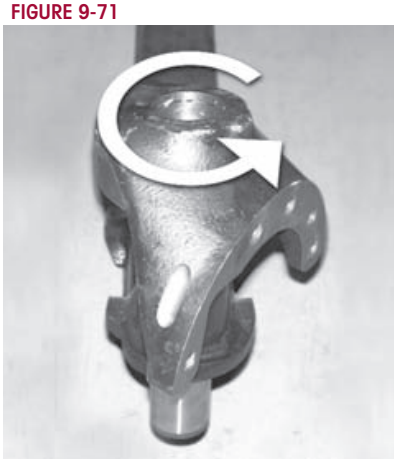


FIGURE 9-71



KINGPIN SEAL INSTALLATION

1. Place the steering knuckle assembly in a vise with brass jaws or place on a suitable workbench. The steering knuckle will have the machined surface facing up (axle side up).
2. Lay the kingpin seal into the bore of the steering knuckle. The seal lip should face outward or toward the axle.
3. Use a bushing driver tool and press seal firmly into the steering knuckle assembly.
4. Install the kingpin seal until it makes contact with the kingpin bushing, see Figures 9-72 and 9-73.

FIGURES 9-72 AND 9-73

STEERING KNUCKLE ASSEMBLY

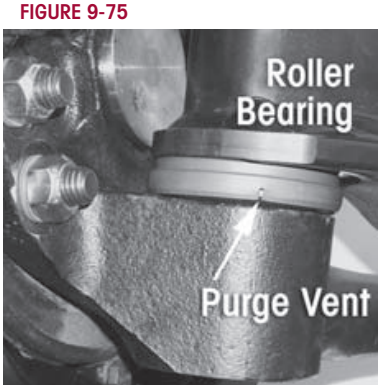
ASSEMBLY

After replacement of the kingpin bushings it is necessary to re-assemble the steering knuckle assemblies. The STEERTEK axle is equipped with two different thrust bearings installed. The composite thrust bearing is installed on the left side of the axle. The roller bearing is installed on the right side of the axle, see Figures 9-74 and 9-75, for right hand drive axle configuration the thrust bearings will be the opposite. Do not substitute aftermarket components when servicing.

1. Install the thrust bearing on the lower kingpin with the seal facing up toward axle (the black seal will designate the top side). The composite thrust bearing is installed on the left side of the axle. The roller bearing is installed on the right side of the axle, see Figures 9-74 and 9-75. For right hand drive axle configuration the thrust bearings will be the opposite.
2. Install the shim on the upper kingpin.
3. Pack the bushing dimples on the upper and lower steering knuckles with multi purpose Lithium based grease (NLGI Grade 2) before installation, see Figures 9-74 and 9-75.

FIGURE 9-74

FIGURE 9-75



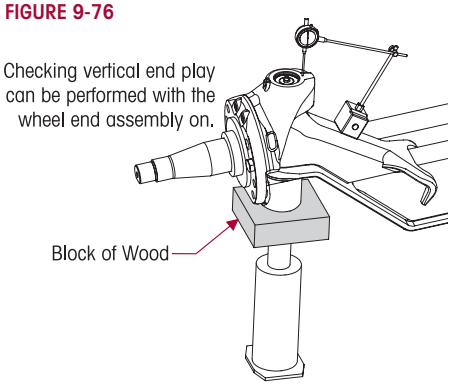
4. Install the upper steering knuckle on the upper arm kingpin.
5. Install the lower steering knuckle on the lower kingpin and install the old socket head cap screws loose into the top two threaded holes.

SERVICE HINT

The easiest way to achieve this is with the grease caps not installed in the knuckle assemblies. This eliminates back pressure. The assembly can then freely slide up and down on the kingpin. If the grease caps are still installed, remove the grease zerks to avoid creating back pressure. Grease zerks will be re-installed at the end of the procedure.

6. Install a bottle jack under the lower knuckle and slightly raise the knuckle until it is possible to thread in the (3) brake backing plate bolts by hand. These are for guide purposes only.
7. Snug the two socket head cap screws.
8. Lower the bottle jack so that all the vertical clearance is on the underside of the axle.
9. Affix a magnetic base dial indicator on the axle and place the tip of the dial indicator on top of the knuckle assembly, see Figure 9-76.
10. Zero the dial indicator.

FIGURE 9-76



11. Raise the bottle jack until there is no clearance between the knuckle assembly and the bottom of the axle, slightly lifting the axle.
12. Check the reading on the dial indicator. The specification for vertical travel on the steering knuckle during assembly is 0.008" to 0.011".
13. If the clearance is above 0.011", loosen the socket head cap screws and push down on the knuckle assembly until the proper vertical clearance is achieved. Add (0.005") shim if necessary.
14. If the clearance is below the 0.008", loosen the two socket head cap screws and pull up on the knuckle assembly until the proper vertical clearance is achieved. If the 0.008" minimum clearance is unattainable it may be necessary to remove a 0.005" shim.

NOTE

The Ⓗ Hendrickson Genuine part, socket head cap screw comes with a pre-applied loctite compound.

⚠ WARNING

PRIOR TO INSTALLATION ENSURE THAT ALL RESIDUAL LOCTITE MATERIAL IS REMOVED FROM THE MOUNTING BOLTS AND THE THREAD BORES IN THE UPPER STEERING KNUCKLE, AND NEW LOCTITE 277 OR EQUIVALENT IS APPLIED TO HELP ENSURE THAT THE BOLTS SUSTAIN THE PROPER TORQUE REQUIREMENT. FAILURE TO DO SO CAN CAUSE LOSS OF VEHICLE CONTROL RESULTING IN PERSONAL INJURY OR PROPERTY DAMAGE.

15. Remove one old socket head cap screw and replace with new socket head cap screw.
16. Remove second socket head cap screw and replace with new socket head cap screw. Tighten both socket head cap screws to 175-200 foot pounds torque.
17. Recheck the vertical clearance with the dial indicator or a 0.010" feeler gauge, see Figure 9-76.
18. Remove the brake spider bolts, they should thread out freely.
19. Remove the bottle jack and continue assembling the wheel ends.

IMPORTANT NOTE

Loctite applied to the three brake spider bolts is a critical procedure to ensure that these bolts sustain the torque requirement of Steering knuckle assembly.

20. Apply loctite to the three brake spider bolts prior to installation into the brake spider. Tighten bolts to 175-200 foot pounds torque.

WARNING

DO NOT GREASE KNUCKLES WITHOUT THE BRAKE SPIDER INSTALLED AND TIGHTENED TO PROPER TORQUE. FAILURE TO DO SO CAN CAUSE COMPONENT DAMAGE RESULTING IN FAILURE AND LOSS OF VEHICLE CONTROL, POSSIBLY CAUSING PERSONAL INJURY OR PROPERTY DAMAGE.

21. Install the tie rod end into the lower steering knuckle arm.
22. Tighten the castle nuts to 185 foot pounds torque then rotate the castle nut to the next castle slot and install cotter pin.
23. Install the drag link into the steering arm and tighten to the vehicle manufacturer's specifications.
24. Install new o-rings on the grease caps and lubricate o-rings with grease.
25. Install grease caps and new retaining rings.
26. Install brakes, drums, wheels and tires.
27. Remove jack and safety stands.
28. Grease steering knuckles with the vehicle on the floor.
29. Remove wheel chocks.

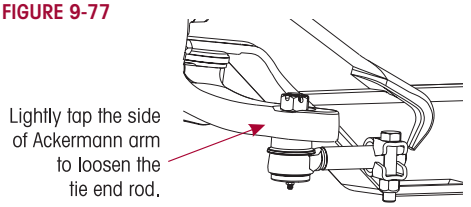
TIE ROD END AND CROSS TUBE

NOTE: Hendrickson supplies different tie rod configurations. Prior to ordering find the part number on the tie rod tube. For additional information see Technical Bulletin SEU-0223 or contact Hendrickson Sales Engineering.

DISASSEMBLY

1. Chock the wheels.
2. Position the steer axle tires straight ahead.
3. Remove the cotter pin and castle nut.
4. Lightly tap the side of the Ackermann arm to loosen the tie rod end from the Ackermann arm, see Figure 9-77.

FIGURE 9-77



5. Repeat to steps 3 and 4 to remove the other tie rod end.
6. Remove the cross tube and tie rod ends from the vehicle.
7. Mount the cross tube in a soft jaw vice.
8. Remove the hardware from the clamp on the cross tube.
9. Count the exposed threads on the tie rod end being replaced.
10. Remove the tie rod end from the cross tube.

WARNING

DO NOT HEAT THE CROSS TUBE WITH A TORCH TO FACILITATE THE REMOVAL OF THE TIE ROD END. THE USE OF SUCH HEAT CAN ADVERSELY AFFECT THE STRENGTH OF THE CROSS TUBE. A COMPONENT DAMAGED IN THIS MANNER WILL RESULT IN LOSS OF WARRANTY, AND CAN RESULT IN THE AND LOSS OF VEHICLE CONTROL, AND POSSIBLE PERSONAL INJURY OR PROPERTY DAMAGE.

11. If the opposing tie rod end is being replaced repeat steps 8 through 10.

12. Inspect the cross tube for dents, cracks, or thread damage. Replace the cross tube if needed.

ASSEMBLY

1. Lubricate the new tie rod end threads with Anti-Seize.

NOTE

When installing the cross tube the thread direction of the tie rod ends are as follows:

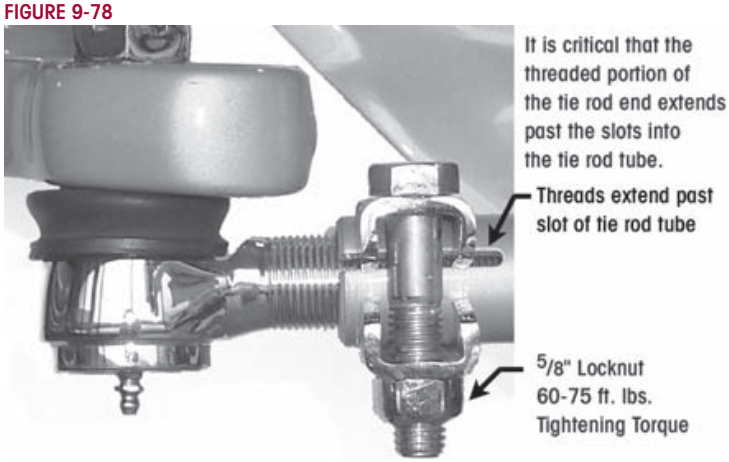
- A right hand threaded tie rod end will be installed into the right side Ackermann arm.
- A left hand threaded tie rod end will be installed into the left side Ackermann arm.

2. Install the new tie rod end into the cross tube, leaving the same amount of threads exposed that were counted on the failed tie rod end prior to removal.

⚠ WARNING

THE THREADED PORTION OF THE TIE ROD END MUST EXTEND PAST THE SLOTS INTO THE TIE ROD CROSS TUBE, SEE FIGURE 9-78. FAILURE TO DO SO CAN CAUSE COMPONENT DAMAGE, LOSS OF VEHICLE CONTROL AND POSSIBLE PERSONAL INJURY OR PROPERTY DAMAGE.

FIGURE 9-78



3. Replace the opposing tie rod end if necessary by repeating steps 2 and 3.
4. If replacing opposing tie rod end, it is critical that the cross tube will rotate in the opposing tie rod end.

⚠ WARNING

DO NOT HEAT THE CROSS TUBE WITH A TORCH TO ROTATE THE CROSS TUBE IN THE TIE ROD END. THE USE OF SUCH HEAT CAN ADVERSELY AFFECT THE STRENGTH OF THE CROSS TUBE. A COMPONENT DAMAGED IN THIS MANNER WILL RESULT IN LOSS OF WARRANTY, AND CAN RESULT IN THE LOSS OF VEHICLE CONTROL, AND POSSIBLE LOWER STEERING KNUCKLE PERSONAL INJURY OR PROPERTY DAMAGE.

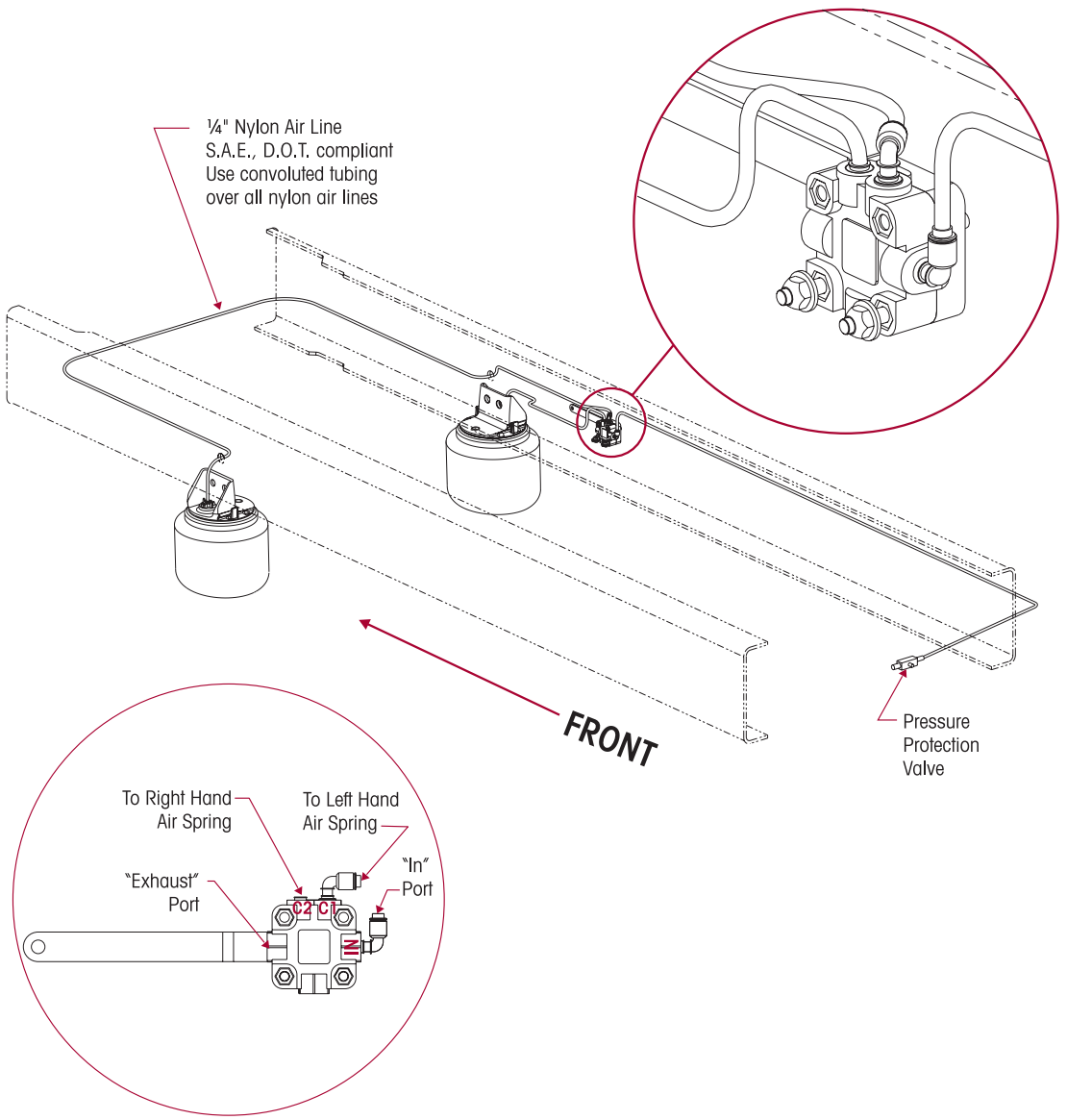
5. Install the cross tube into the Ackermann arms.
6. Tighten the castle nuts to 185 foot pounds torque then rotate the castle nut to the next castle slot and install cotter pin.
7. Grease tie rod ends, see Lubrication Chart for required lubricant in the Preventive Maintenance Section of this publication.
8. Set the toe, (see the Toe Adjustment Procedure in the Alignment & Adjustments Section of this publication).
9. Remove the wheel chocks.

SECTION 10

Plumbing Diagrams

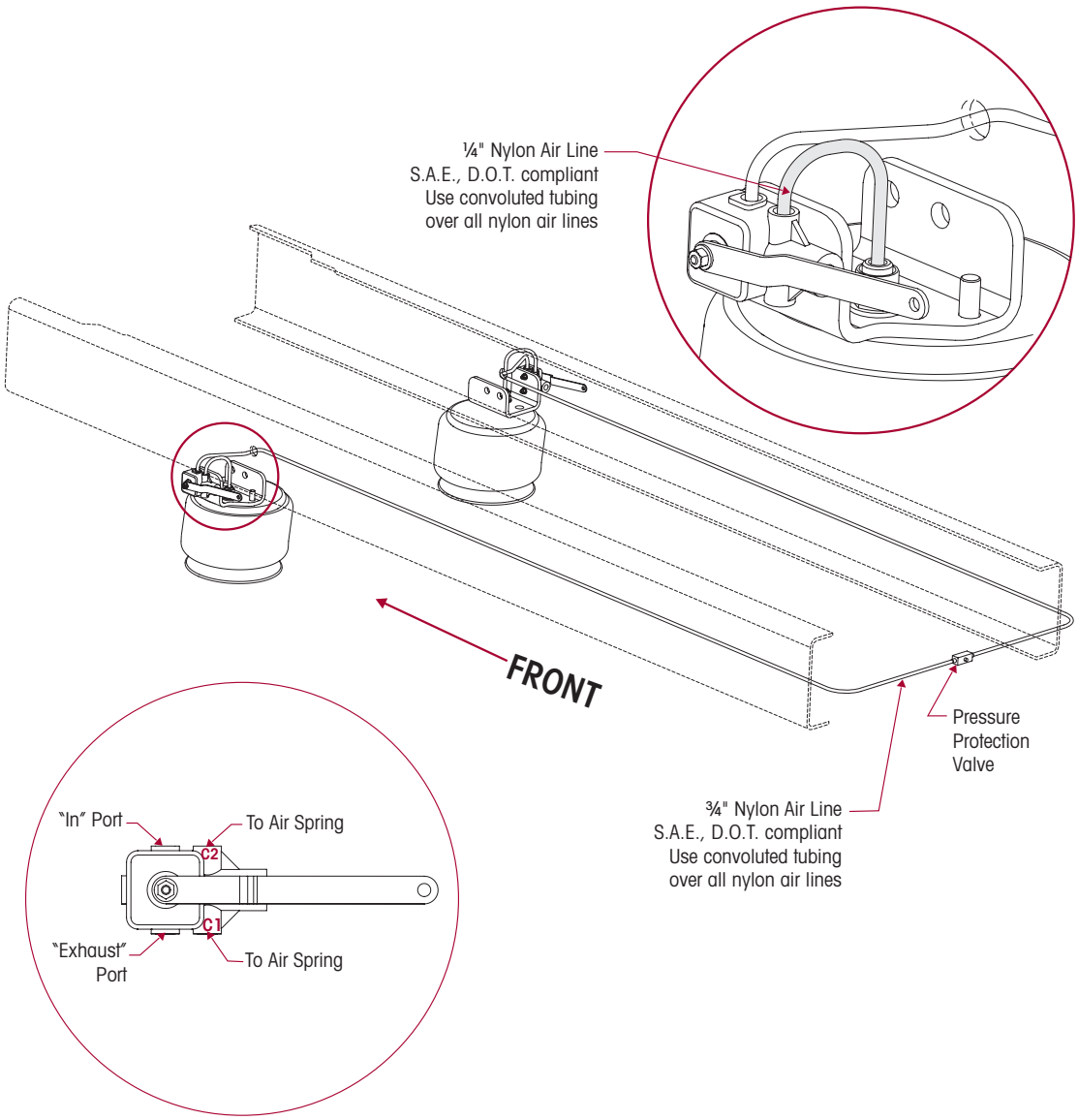
AIRTEK SINGLE HEIGHT CONTROL VALVE – 10K

When replacing or installing nylon air line tubing into quick-connect fittings it is critical that the end of the air line is cut square. Improper cut of the end of the air line tubing can cause the air line to seat improperly in the quick connect fitting causing air leakage.



AIRTEK DUAL HEIGHT CONTROL VALVES – 14.6K

When replacing or installing nylon air line tubing into quick-connect fittings it is critical that the end of the air line is cut square. Improper cut of the end of the air line tubing can cause the air line to seat improperly in the quick connect fitting causing air leakage.



Reference Material

This technical publication covers Hendrickson Truck Suspension's recommended procedures for our parts/products. Other components play a major role in overall performance and Hendrickson recommends you follow the specific vehicle manufacturer's recommendation for care and maintenance. Some recommended procedures have been developed by The Technology & Maintenance Council (TMC) and Hendrickson supports these recommendations. We have compiled a list of these below.

TMC

To obtain copies of the following RP's, video's, or charts, contact TMC at:

TMC/ATA
2200 Mill Road
Alexandria, VA 22314

Phone: 703-838-1763
website: tmc.truckline.com
online ordering: www.truckline.com/store

Important References

TMC RP 214B	Tire/Wheel End Balance and Runout
TMC RP 216	Radial Tire Conditions Analysis Guide
TMC RP 219A	Radial Tire Wear Conditions and Causes
TMC RP 222A	User's Guide To Wheels and Rims
TMC RP 230	Tire Test Procedures for Tread wear, Serviceability, and Fuel Economy
TMC RP 514	Pre-Alignment Inspection
TMC RP 618	Wheel Bearing Adjustment Procedure
TMC RP 620B	Front End Alignment Steering Geometry
TMC RP 708A	Trailer Axle Alignment
TMC RP 642	Guidelines For Total Vehicle Alignment
TMC RP 644	Wheel End Conditions Analysis Guide
TMC RP 645	Tie Rod End Inspection and Maintenance Procedure

Video's

TMC T0326	Wheel End Maintenance
TMC T0372	Tire Pre-Trip Inspection Guidelines

Other

TMC T0400	Wheel bearing Adjustment Procedure Wall Chart

AIRTEK/SOFTEK

TROUBLESHOOTING GUIDE

CONDITION	POSSIBLE CAUSE	CORRECTION
Worn or damaged kingpins and kingpin bushings	Dirt in system– contaminated lubricant	Polish and inspect kingpin, replace bushing and seals, then follow specified lubrication procedures
	Incorrect lubricant	Lubricate axle with specified lubricant
	Axle not lubricated at scheduled frequency	Lubricant axle at scheduled frequency
	Incorrect lubrication procedures	Use correct lubrication procedures
	Lubrication interval not compatible with operating conditions	Change lubrication interval to match operating conditions
	Worn or missing seals	Replace worn or missing seals
Vibration or shimmy of front axle during operation	Caster out of specification	Set proper ride height then adjust caster to specification
	Wheels and/or tires out of balance	Balance or replace wheels and/or tires
	Worn shock absorbers	Replace shock absorbers
	Worn thrust washers (if equipped) and rear hanger clamps	Replace thrust washers (if equipped) and rear hanger clamps
	Broken engine mount	Replace engine mount
	Wheel bearing adjustment	Adjust wheel bearing to the vehicle manufacturers specifications.
Excessive wear on tires or uneven tire tread wear	Tires have incorrect air pressure	Adjust tire pressure to manufacturer's specification.
	Tires out of balance	Balance or replace tires
	Incorrect tandem axle alignment	Align tandem axles
	Incorrect toe setting	Adjust toe-in to manufacturer's specification
	Incorrect steering arm geometry	Repair steering system as necessary
	Worn kingpin bushings	Replace kingpin bushings
	Excessive wheel bearing end play	Check specified wheel nut torque, replace worn or damaged wheel bearings
	Wheel bearing adjustment	Adjust wheel bearing to the vehicle manufacturers specifications.
Vehicle is hard to steer	Low pressure in the power steering system	Repair power steering system
	Steering linkage needs lubrication	Lubricate steering linkage
	Steering knuckles are binding	Check vertical clearance
	Incorrect steering ar geometry	Repair steering system as necessary
	Caster out of specification	Set proper ride height then adjust caster to specification
	Tie rod ends hard to move	Replace tie rod ends
	Worn thrust bearing	Replace thrust bearing
	Steering gear box internal problem	Perform steering gear trouble shooting procedures per steering gear manufacturing guidelines.

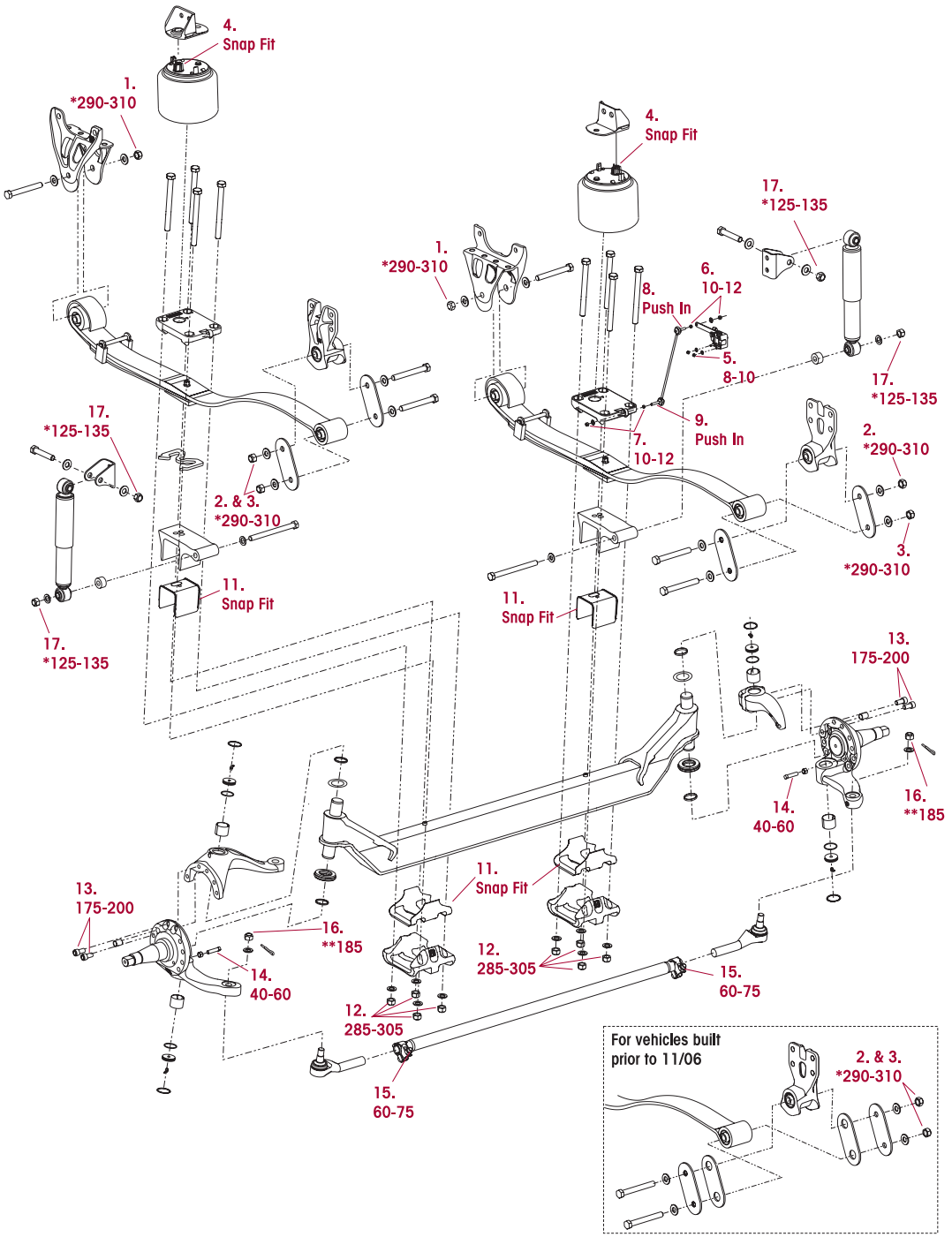
AIRTEK/SOFTEK

TROUBLESHOOTING GUIDE (CONTINUED)

CONDITION	POSSIBLE CAUSE	CORRECTION
Tie rod ends are worn and require replacement	Tie rod ends need lubrication	Lubricate tie rod end. Make sure lubrication schedule is followed.
	Severe operating conditions	Increase frequency of inspection and lubrication intervals
	Damaged boot on tie rod end	Replace tie rod end
Bent or broken cross tube, tie rod end ball stud or tie rod end NOTE: Damaged components require replacement	Pump/gear relief valve pressure setting exceeds system specifications	Adjust power steering system to manufacturer's specified pressure
	Steering gear poppets improperly set or malfunctioning	Check for proper operation or adjust poppets to OEM specifications
	Axle stops improperly set	Set axle stops to OEM specifications
	Severe duty cycle service	Increase frequency of inspection and lubrication intervals
Worn or broken steering ball stud	Drag link fasteners lightened past specified torque	Tighten drag link fasteners to the specified torque
	Lack of lubrication or incorrect lubricant	Lubricate linkage with specified lubricant
	Power steering stops out of adjustment	Adjust steering stops to OEM specifications
Suspension has harsh or bumpy ride	Air spring not inflated	Check air supply to air spring, repair as necessary
	Air spring ride height out of specification	Adjust ride height to proper specification
	Broken or worn leaf spring	Replace leaf spring
	Front suspension overloaded	Redistribute steer axle load
Restricted steering radius	Steering stops not adjusted correctly	Adjust steering stops to achieve correct wheel cut
Vehicle leans	Ride height incorrect	Adjust ride height to specification
	Air spring(s) are not inflated	Repair source of air pressure loss
	Suspension is not torqued correctly at installation	Perform spring eye re-torque procedure. See Torque Specification Section of this publication
	Leaf spring broken	Replace leaf spring
	Excessive weight bias	Contact the vehicle manufacturer or Hendrickson Tech Services
Vehicle wanders	Caster out of specifications	Set proper ride height then adjust caster to specification
	Incorrect toe setting	Adjust toe to specification
	Fifth wheel not greased	Grease fifth wheel
	Air in the power steering system	Remove air form the power steering systems
	Rear ride height out of adjustment	Adjust ride height to specification
	Front ride height out of adjustment	Adjust ride height to specification

AIRTEK for Blue Bird Vision Buses - 10K Capacity

Hendrickson Recommended Torque Values Provided in Foot Pounds



AIRTEK for Blue Bird Vision Buses – 10K

HENDRICKSON RECOMMENDED TORQUE SPECIFICATIONS

NO.	COMPONENT	QTY.	SIZE	TORQUE VALUE (in foot pounds)
1	Front Frame Hanger to Front Leaf Spring Eye	2	M20	*290-310
2	Rear Shackle Bracket to Shackle Plate	2	M20	*290-310
3	Rear Shackle Bracket to Spring Eye	2	M20	*290-310
4	Air Spring	2	Self-Locking	Snap Fit
5	Height Control Valve to Frame	2	¼"	8-10
6	HCV Linkage to HCV Arm	2	5/16"	10-12
7	HCV Linkage to Top Pad	2	5/16"	10-12
8	HCV Linkage Grommet to HCV Arm	1	Grommet	Push In
9	HCV Linkage Grommet to Top Pad	1	Grommet	Push In
10	Spring Center Aligning Dowel Pin (Flat Floor Bus)	2	¾"	***Loose Fit
11	Axle Wrap Liners for Clamp Group	2	Formed	Snap Fit
	⚠ WARNING DO NOT ASSEMBLE CLAMP GROUP WITHOUT AXLE WRAP LINERS. FAILURE TO DO SO CAN CAUSE LOSS OF VEHICLE CONTROL, PROPERTY DAMAGE OR PERSONAL INJURY.			
12	Clamp Group Hardware	8	¾"	285-305
	⚠ WARNING ENSURE CLAMP GROUP IS ALIGNED PROPERLY PRIOR TO TIGHTENING HARDWARE. FAILURE TO DO SO CAN CAUSE LOSS OF VEHICLE CONTROL, PROPERTY DAMAGE OR PERSONAL INJURY.			
13	Knuckle Attachment Bolt (Socket Head Cap Screw)	4	5/8"	175-200
14	Knuckle / Axle Wheel Stop Bolt	2	5/8" Jam Nut	40-60
15	Tie Rod Tube to Tie Rod Ends	2	5/8"	60-75
16	Tie Rod Ends to Lower Steering Knuckle	2	7/8" Castle Nut	**185
17	Shocks Eye Bolts	2	¾"	*125-135

• All hardware ¼" and greater is Grade 8 with no additional lubrication.
Frame mount hardware in most cases are Huck style fasteners supplied by the OEM.

NOTE:

* All hardware information in gray in the matrix denotes recommended torques for fasteners originally supplied by the vehicle manufacturer. If Hendrickson supplied fasteners are used, tighten to Hendrickson torque values, if non Hendrickson fasteners are used, follow torque specifications listed in the vehicle manufacturer's service manual. Hendrickson is not responsible for maintaining vehicle manufacturer's torque values.

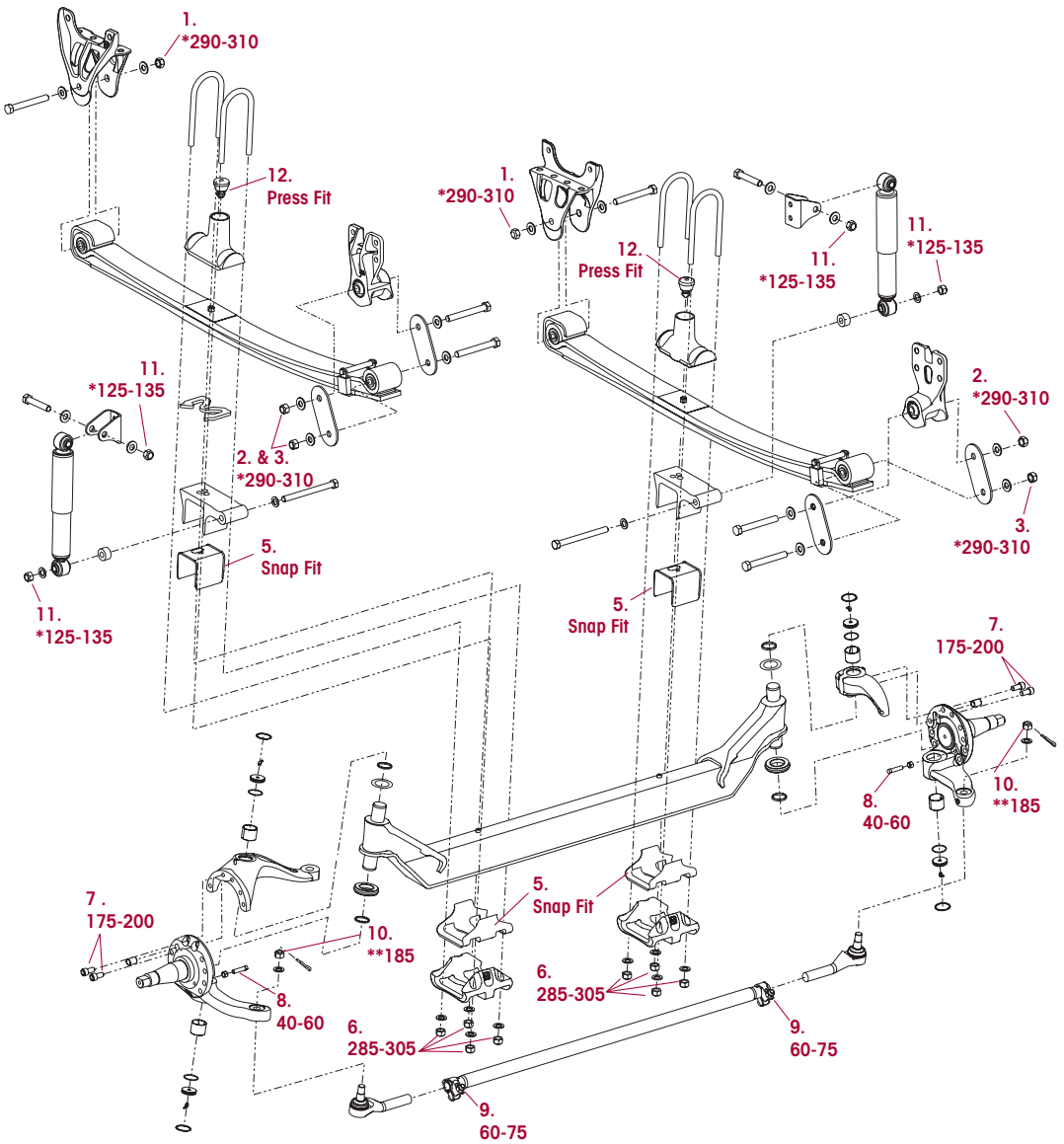
** Torque to 185 foot lbs., advance nut to next hex face to install cotter pin. Do not back off nut for cotter pin installation.

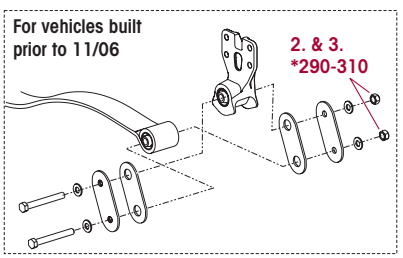
*** Denote items not shown on illustration.

MODEL	AIRTEK		COMFORT AIR	
Blue Bird	RIDE HEIGHT	SHOCK ABSORBER LENGTH	RIDE HEIGHT	SHOCK ABSORBER LENGTH
	From the bottom of the frame to the center of axle	At ride height with a tolerance of ¼"	From the bottom of the frame to the bottom of the main support member.	At ride height with a tolerance of ¼"
Vision 10K	12½"	18 9/16"	4 7/8"	22¾"

SOFTEK for Blue Bird Vision Buses - 8K/10K Capacity

Hendrickson Recommended Torque Values Provided in Foot Pounds





SOFTEK for Blue Bird Vision Buses – 8K/10K

HENDRICKSON RECOMMENDED TORQUE SPECIFICATIONS

NO.	COMPONENT	QTY.	SIZE	TORQUE VALUE (in foot pounds)
1	Front Frame Hanger to Front Leaf Spring Eye	2	M20	*290-310
2	Rear Shackle Bracket to Shackle Plate	2	M20	*290-310
3	Rear Shackle Bracket to Spring Eye	2	M20	*290-310
4	Spring Center Aligning Dowel Pin (Flat Floor Bus)	2	¾"	***Loose Fit
5	Axle Wrap Liners for Clamp Group	2	Formed	Snap Fit
	⚠ WARNING DO NOT ASSEMBLE CLAMP GROUP WITHOUT AXLE WRAP LINERS. FAILURE TO DO SO CAN CAUSE LOSS OF VEHICLE CONTROL, PROPERTY DAMAGE OR PERSONAL INJURY.			
6	Clamp Group Hardware	8	¾"	285-305
	⚠ WARNING ENSURE CLAMP GROUP IS ALIGNED PROPERLY PRIOR TO TIGHTENING HARDWARE. FAILURE TO DO SO CAN CAUSE LOSS OF VEHICLE CONTROL, PROPERTY DAMAGE OR PERSONAL INJURY.			
7	Knuckle Attachment Bolt (Socket Head Cap Screw)	4	⅝"	175-200
8	Knuckle / Axle Wheel Stop Bolt	2	⅝" Jam Nut	40-60
9	Tie Rod Tube to Tie Rod Ends	2	⅝"	60-75
10	Tie Rod Ends to Lower Steering Knuckle	2	⅞" Castle Nut	**185
11	Shocks Eye Bolts	4	¾"	*125-135
12	Rubber Axle Stop	2	—	Press Fit

• All hardware ¼" and greater is Grade 8 with no additional lubrication.
Frame mount hardware in most cases are Huck style fasteners supplied by the OEM.

NOTE:

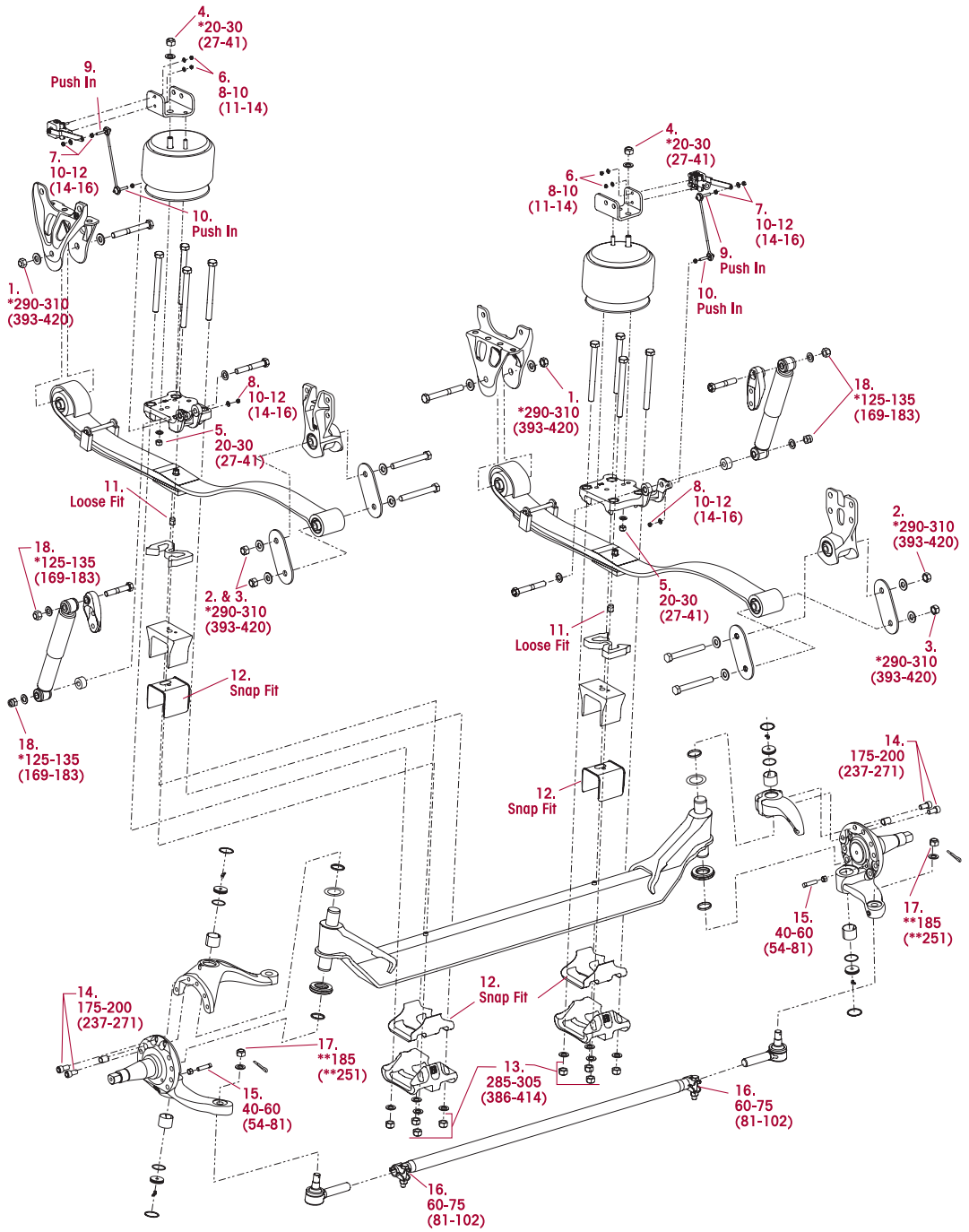
* All hardware information in gray in the matrix denotes recommended torques for fasteners originally supplied by the vehicle manufacturer. If Hendrickson supplied fasteners are used, tighten to Hendrickson torque values, if non Hendrickson fasteners are used, follow torque specifications listed in the vehicle manufacturer's service manual. Hendrickson is not responsible for maintaining vehicle manufacturer's torque values.

** Torque to 185 foot lbs., advance nut to next hex face to install cotter pin. Do not back off nut for cotter pin installation.

*** Denote items not shown on illustration.

AIRTEK for Blue Bird All American Buses - 14.6K Capacity

Hendrickson Recommended Torque Values Provided in Foot Pounds



AIRTEK for Blue Bird All American Buses – 14.6K

HENDRICKSON RECOMMENDED TORQUE SPECIFICATIONS

NO.	COMPONENT	QTY.	SIZE	TORQUE VALUE	
				(in foot pounds)	(in Nm)
1	Front Frame Hanger to Front Leaf Spring Eye	2	M20	*290-310	*393-420
2	Rear Shackle Bracket to Shackle Plate	2	M20	*290-310	*393-420
3	Rear Shackle Bracket to Spring Eye	2	M20	*290-310	*393-420
4	Air Spring to Air Spring Bracket	2	¾"	*20-30	*27-41
5	Air Spring to Top Pad	2	½"	20-30	27-41
6	Height Control Valve to Air Spring Bracket	2	¼"	8-10	11-14
7	HCV Linkage to HCV Arm	2	5/16"	10-12	14-16
8	HCV Linkage to Top Pad	2	5/16"	10-12	14-16
9	HCV Linkage Grommet to HCV Arm	1	Grommet	Push In	
10	HCV Linkage Grommet to Top Pad	1	Grommet	Push In	
11	Spring Center Aligning Dowel Pin (Flat Floor Bus)	2	¾"	Loose Fit	
12	Axle Wrap Liners for Clamp Group	2	Formed	Snap Fit	
	⚠ WARNING DO NOT ASSEMBLE CLAMP GROUP WITHOUT AXLE WRAP LINERS. FAILURE TO DO SO CAN CAUSE LOSS OF VEHICLE CONTROL, PROPERTY DAMAGE OR PERSONAL INJURY.				
13	Clamp Group Hardware	8	¾"	285-305	386-414
	⚠ WARNING ENSURE CLAMP GROUP IS ALIGNED PROPERLY PRIOR TO TIGHTENING HARDWARE. FAILURE TO DO SO CAN CAUSE LOSS OF VEHICLE CONTROL, PROPERTY DAMAGE OR PERSONAL INJURY.				
14	Knuckle Attachment Bolt (Socket Head Cap Screw)	4	5/8"	175-200	237-271
15	Knuckle / Axle Wheel Stop Bolt	2	5/8" Jam Nut	40-60	54-81
16	Tie Rod Tube to Tie Rod Ends	2	5/8"	60-75	81-102
17	Tie Rod Ends to Lower Steering Knuckle	2	7/8" Castle Nut	**185	**251
18	Shocks Eye Bolts	2	¾"	*125-135	*169-183

• All hardware ¼" and greater is Grade 8 with no additional lubrication.
Frame mount hardware in most cases are Huck style fasteners supplied by the OEM.

NOTE:

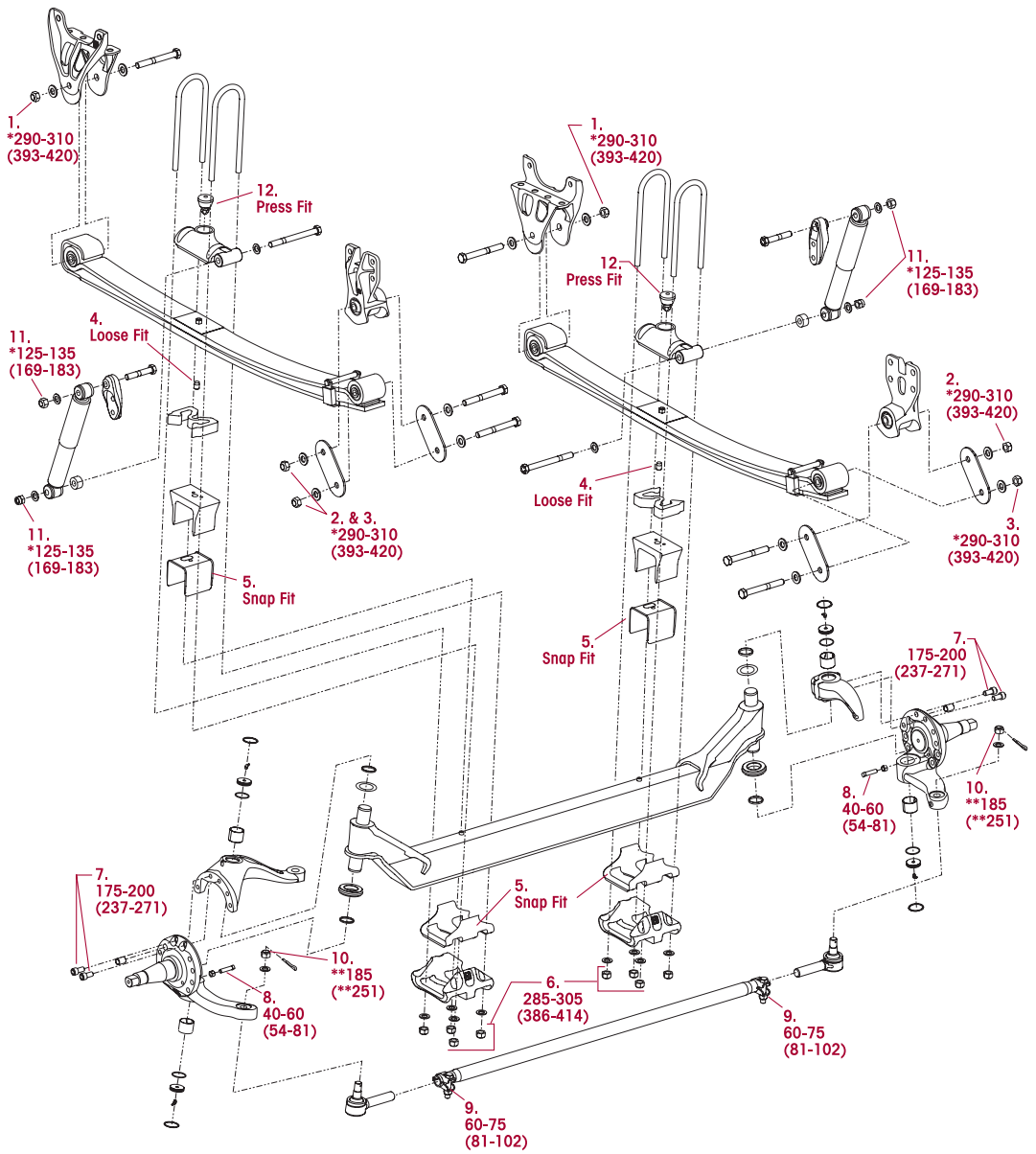
* All hardware information in gray in the matrix denotes recommended torques for fasteners originally supplied by the vehicle manufacturer. If Hendrickson supplied fasteners are used, tighten to Hendrickson torque values, if non Hendrickson fasteners are used, follow torque specifications listed in the vehicle manufacturer's service manual. Hendrickson is not responsible for maintaining vehicle manufacturer's torque values.

** Torque to 185 foot pounds (251 Nm), advance nut to next hex face to install cotter pin. Do not back off nut for cotter pin installation.

MODEL	AIRTEK		COMFORT AIR	
Blue Bird	RIDE HEIGHT	SHOCK ABSORBER LENGTH	RIDE HEIGHT	SHOCK ABSORBER LENGTH
	From the bottom of the frame to the center of axle	At ride height with a tolerance of ¼"	From the bottom of the frame to the bottom of the main support member.	At ride height with a tolerance of ¼"
All American Front Engine Model	14 7/8"	17 1/4"	4 7/8"	22 3/4"
All American Rear Engine Model	14 7/8"	17 15/32"		

SOFTEK for Blue Bird All American Buses - 13.2K/14.6K Capacity

Hendrickson Recommended Torque Values Provided in Foot Pounds



SOFTEK for Blue Bird All American Buses – 13.2K/14.6K

HENDRICKSON RECOMMENDED TORQUE SPECIFICATIONS

NO.	COMPONENT	QTY.	SIZE	TORQUE VALUE (in foot pounds)	TORQUE VALUE (in Nm)
1	Front Frame Hanger to Front Leaf Spring Eye	2	M20	*290-310	*393-420
2	Rear Shackle Bracket to Shackle Plate	2	M20	*290-310	*393-420
3	Rear Shackle Bracket to Spring Eye	2	M20	*290-310	*393-420
4	Spring Center Aligning Dowel Pin (Flat Floor Bus)	2	¾"	Loose Fit	
5	Axle Wrap Liners for Clamp Group	2	Formed	Snap Fit	
	⚠ WARNING DO NOT ASSEMBLE CLAMP GROUP WITHOUT AXLE WRAP LINERS. FAILURE TO DO SO CAN CAUSE LOSS OF VEHICLE CONTROL, PROPERTY DAMAGE OR PERSONAL INJURY.				
6	Clamp Group Hardware	8	¾"	285-305	386-414
	⚠ WARNING ENSURE CLAMP GROUP IS ALIGNED PROPERLY PRIOR TO TIGHTENING HARDWARE. FAILURE TO DO SO CAN CAUSE LOSS OF VEHICLE CONTROL, PROPERTY DAMAGE OR PERSONAL INJURY.				
7	Knuckle Attachment Bolt (Socket Head Cap Screw)	4	5/8"	175-200	237-271
8	Knuckle / Axle Wheel Stop Bolt	2	5/8" Jam Nut	40-60	54-81
9	Tie Rod Tube to Tie Rod Ends	2	5/8"	60-75	81-102
10	Tie Rod Ends to Lower Steering Knuckle	2	7/8" Castle Nut	**185	**251
11	Shocks Eye Bolts	4	¾"	*125-135	*169-183
12	Rubber Axle Stop	2	—	Press Fit	

• All hardware ¼" and greater is Grade 8 with no additional lubrication.
Frame mount hardware in most cases are Huck style fasteners supplied by the OEM.

NOTE:

* All hardware information in gray in the matrix denotes recommended torques for fasteners originally supplied by the vehicle manufacturer. If Hendrickson supplied fasteners are used, tighten to Hendrickson torque values, if non Hendrickson fasteners are used, follow torque specifications listed in the vehicle manufacturer's service manual. Hendrickson is not responsible for maintaining vehicle manufacturer's torque values.

** Torque to 185 foot pounds (251 Nm), advance nut to next hex face to install cotter pin. Do not back off nut for cotter pin installation.

AIRTEK for Blue Bird Buses

FRONT AIR MODULE SUSPENSION ALIGNMENT SPECIFICATION

CAMBER[1]	DESIGN SPECIFICATION	RANGE	
		MINIMUM	MAXIMUM
LEFT	0.00° ± 1.0°	-1.0°	+1.0°
RIGHT	- 0.25° ± 1.0°	-1.25°	+0.75°
CROSS	Max 2.0°	—	—

CAMBER NOTES:

[1] The camber angle is not adjustable. Do not bend axle or otherwise try to adjust camber. If found out of specification, notify Hendrickson Tech Services for further information.

CASTER[1,2]	DESIGN SPECIFICATION	RANGE			
		10K		14.6K	
		MINIMUM	MAXIMUM	MINIMUM	MAXIMUM
LEFT	4.1° ± 1°	+3.1°	+5.1°	+3.1°	+5.1°
RIGHT	4.1° ± 1°	+3.1°	+5.1°	+3.1°	+5.1°
CROSS[3]	Max 1.0°	—	—	—	—

CASTER NOTES:

[1] Caster is determined with the vehicle at specified ride height for air suspension or at rated load for mechanical suspension systems. It is critical that the vehicle front and rear ride height is within specifications prior to performing a caster measurement or adjustment. See Hendrickson ride height specifications and procedure.

[2] In most cases actual vehicle caster is defined with the frame rails at zero slope. Refer to the vehicle manufacturer's specifications for correct frame rail slope. (Both the alignment surface and the vehicle's frame rails should be level during execution of alignment procedures). For vehicles with a positive frame rake (higher in rear) add the frame slope (in degrees) to the caster reading to determine true vehicle caster.

[3] **The cross caster angle is not adjustable** – Do not bend axle or otherwise try to adjust cross caster. If found out of specifications notify Hendrickson Tech Services for further information. Changes to caster can be attained by using caster shims as provided by the vehicle manufacturer or chassis and body manufacturer. Caster shims must match, side to side, to reduce uneven loading to the suspension components. **The use of two different angle caster shims will not correct cross caster.**

[4] **Example of caster adjustment:** 2.5° RH/3° LH, would require one, 1.0 shim on each side to increase caster and achieve 3.5° RH/4.0° LH, which is in specification. Do not attempt to use uneven shims.

Hendrickson recommends following TMC[2] practices:

	DESIGN SPECIFICATION[1]	RANGE	
		MINIMUM	MAXIMUM
TOTAL TOE[2]	1/16" ± 1/32" (0.06" ± 0.03")	1/32" (0.03")	3/32" (0.09")

TOE-IN NOTES:

[1] Toe-in is to be set and adjusted in the normal vehicle unladen configuration. Actual vehicle curb weight on the ground. Toe should be checked at the tires front and rear tread center, at a distance above ground equal to the tire's rolling radius.

[2] In most instances total toe is set by the vehicle manufacturer or body builder. Consult the vehicle manufacturer for specifications.

SOFTEK for Blue Bird Buses

FRONT AIR MODULE SUSPENSION ALIGNMENT SPECIFICATION

CAMBER[1]	DESIGN SPECIFICATION	RANGE	
		MINIMUM	MAXIMUM
LEFT	0.00° ± 1.0°	-1.0°	+1.0°
RIGHT	- 0.25° ± 1.0°	-1.25°	+0.75°
CROSS	Max 2.0°	—	—

CAMBER NOTES:

[1] The camber angle is not adjustable. Do not bend axle or otherwise try to adjust camber. If found out of specification, notify Hendrickson Tech Services for further information.

CASTER[1,2]	DESIGN SPECIFICATION		RANGE			
			8K/10K		13.2K/14.6K	
	8K/10K	13.2K/14.6K	MINIMUM	MAXIMUM	MINIMUM	MAXIMUM
LEFT	4.5° ± 1°	4.5° ± 1.5°	+3.5°	+5.5°	+3.0°	+6.0°
RIGHT	4.5° ± 1°	4.5° ± 1.5°	+3.5°	+5.5°	+3.0°	+6.0°
CROSS[3]	Max 1.0°		—	—	—	—

CASTER NOTES:

[1] Caster is determined with the vehicle at specified ride height for air suspension or at rated load for mechanical suspension systems. It is critical that the vehicle front and rear ride height is within specifications prior to performing a caster measurement or adjustment. See Hendrickson ride height specifications and procedure.

[2] In most cases actual vehicle caster is defined with the frame rails at zero slope. Refer to the vehicle manufacturer's specifications for correct frame rail slope. (Both the alignment surface and the vehicle's frame rails should be level during execution of alignment procedures). For vehicles with a positive frame rake (higher in rear) add the frame slope (in degrees) to the caster reading to determine true vehicle caster.

[3] **The Cross caster angle is not adjustable** – Do not bend axle or otherwise try to adjust cross caster. If found out of specifications notify Hendrickson Tech Services for further information. Changes to caster can be attained by using caster shims as provided by the vehicle manufacturer or chassis and body manufacturer. Caster shims must match, side to side, to reduce uneven loading to the suspension components. **The use of two different angle caster shims will not correct cross caster.**

[4] **Example of caster adjustment:** 2.5° RH/3° LH, would require one, 1.0 shim on each side to increase caster and achieve 3.50° RH/4.00° LH, which is in specification. Do not attempt to use uneven shims.

Hendrickson recommends following TMC[2] practices:

	DESIGN SPECIFICATION[1]	RANGE	
		MINIMUM	MAXIMUM
TOTAL TOE[2]	1/16" ± 1/32" (0.06" ± 0.03")	1/32" (0.03")	3/32" (0.09")

TOE-IN NOTES:

[1] Toe-in is to be set and adjusted in the normal vehicle unladed configuration. Actual vehicle curb weight on the ground. Toe should be checked at the tires front and rear tread center, at a distance above ground equal to the tire's rolling radius.

[2] In most instances total toe is set by the vehicle manufacturer or body builder. Consult the vehicle manufacturer for specifications.

Technical Procedure Publication Quiz

1) What three items have the greatest influence on tire wear?
   a) Toe
   b) Air Pressure
   c) Camber
   d) Thrust Angle

2) Caster may be increased or decreased using shims or wedges.
   True or False

3) Cross caster may be changed using shims or wedges.
   True or False

4) You may bend a STEERTEK axle to correct for improper camber settings.
   True or False

5) In an unladen vehicle the correct toe setting for the STEERTEK axle is?
   a) 0 to negative 1/8"
   b) 0 to negative 1/16"
   c) 0 to positive 1/32"
   d) 1/16" ± 1/32"

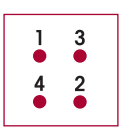
6) When reducing wheel cut on the STEERTEK axle it is necessary to check the steering gear box poppets.
   True or False

7) The torque requirement for the front and rear spring hanger eye bolts are the same.
   True or False

8) When servicing the clamp group a technician should always replace the following items.
   a) Hex bolts/U-bolts (Grade 8) and nylon locknuts (Grade C)
   b) Bottom axle wrap liner
   c) Upper axle wrap liner, if removed
   d) All of the above

9) What is the clamp group final torque?
   a) 500-550 foot pounds (678-746 Nm)
   b) 290-310 foot pounds (393-420 Nm)
   c) 285-305 foot pounds (386-414 Nm)
   d) 240-275 foot pounds (325-373 Nm)

10) What is the torque sequence for the clamp group? See Figure below.



   a) 1,3,2,4
   b) 1,4,2,3
   c) 1,2,3,4
   d) The torque sequence does not matter.

11) For a vehicle equipped with a STEERTEK axle it is an acceptable practice to tow using a tow chain wrapped around the axle.
   True or False

12) The front leaf spring eye bushing is non serviceable
   True or False

13) To remove the STEERTEK knuckle you must.
    a) Drive the kingpin out of the axle bore
    b) Remove the locking pins before driving the kingpin out
    c) Remove the two 5/8" socket head cap screws and separate the knuckle assembly
    d) None of the above

14) What is the maximum allowable specification for lateral movement of the steering knuckle?
    a) 0.001"
    b) 0.075"
    c) 0.030"
    d) 0.015"

15) When the AIRTEK ride height is checked, it is not necessary to cycle the leveling valve before check the ride height.
    True or False

16) Worn kingpins are easily removed and replaced.
    True or False

17) The lower shock eye bolt mounting torque per the vehicle manufacturer is:
    a) 125-135 foot pounds (169-183 Nm)
    b) 225-255 foot pounds (305-346 Nm)
    c) not critical
    d) none of the above

18) Although the AIRTEK/SOFTEK is low maintenance, it is recommended to do a visual inspection on the axle and suspension every _____ miles.
    a) 100,000 or 1 year
    b) 25,000 or 6 months
    c) Never

19) When replacing the rear spring ¾" length hanger bolts, the new bolts should be installed:
    a) From the outboard side to inboard side for AIRTEK 10K and SOFTEK 8K/10K
    b) It does not matter what direction the bolts are facing
    c) From the inboard side to outboard side for AIRTEK 14.6K and SOFTEK 13.2K/14.6K
    d) Both a and c

20) The STEERTEK axle combined with the clamp group and stiff front spring limb help to make the AIRTEK torsionally rigid and reduce body roll.
    True or False

21) How many grease points are there on the STEERTEK axle?
    a) 2
    b) 6
    c) 8
    d) None

22) It is acceptable to replace a failed shock absorber with any brand that will fit.
    True or False

23) A shock that is misting is classified as a leaking shock and should be replaced immediately.
    True or False

24) Wheel bearing adjustment has no impact on tire wear.
    True or False

25) Prior to performing a total vehicle alignment the following components must be inspected.
    a) Front and rear spring mounts
    b) Steer axle tires
    c) Ride height
    d) All of the above

26) When the clamp group is disassembled the use of a cutting torch is acceptable to help remove seized bolts and nuts.
    True or False

27) Prior to steering knuckle re-assembly it is critical that residual Loctite be removed and re-applied from the upper kingpin connection.
    True or False

28) AIRTEK is available exclusively with the STEERTEK axle.
    True or False

29) To heat test a shock absorber you should drive a vehicle at moderate speeds for fifteen minutes.
    True or False

30) If the kingpin bushing is worn, then both bushings on that knuckle need to be replaced.
    True or False

31) The unique packaging of the steering knuckle will allow up to _____ degrees of wheel cut on the STEERTEK axle.
    a) Maximum of 50°
    b) 32°
    c) 87°
    d) None of the above

32) A pre-alignment inspection reveals a tie rod end is worn out of specification. What is the correct action needed to complete the alignment.
    a) Fill the tie rod with grease to absorb excessive play
    b) Replace the tie rod and reset toe before alignment
    c) Perform alignment and then replace tie rod end and reset toe
    d) Align vehicle and do not repair tie rod end

33) The seal on the thrust bearings are installed facing down.
    a) True
    b) False
    c) Doesn't matter

34) When servicing tie rod ends it is not necessary to have the part number located on the tie rod tube to order tie rod service kits.
    True or False

CERTIFICATE

Hendrickson will provide a personalized AIRTEK/SOFTEK Technical Procedure Quiz Achievement Certificate to candidates scoring 80% or higher on the test. Simply complete the test and fill in the enclosed answer sheet or on a separate sheet with the return address, name, phone number, and company name as it will appear on the award to:

Hendrickson
ATTN: Truck Marketing Test Quiz Assessment
800 S. Frontage Road
Woodridge, Illinois 60517

Overview

Rear Suspension

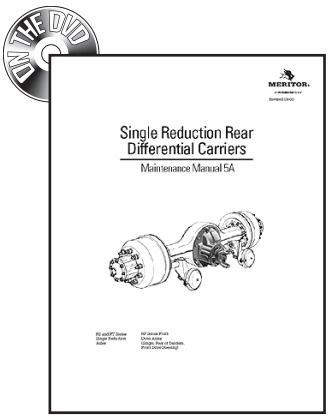
This chapter includes routine maintenance and a procedure for removal of the axle and suspension from the bus chassis. Manufacturer's documentation is provided in the appendixes and on the TechReference DVD for more involved servicing of the axle and suspenion components.

All Americans are equipped with one of three rear suspension systems:

Hendrickson™ Softek.™ The Softek rear suspension is a 14-leaf slipper spring configuration, and is standard equipment on the Rear Engine All American.

Hendrickson™ Comfort Air.™ The Comfort Air rear suspension is a trailing arm configuration with 2 heavy duty rolling lobe air springs mounted rearward of axle and steel springs forward of the axle. The system features a quick align dog tracking adjustment. A transverse track rod controls lateral motion. Vertical motion is controlled by two 1⅜" bore Sachs shock absorbers. A single height control valve maintains suspension height at varying loads.

Ridewell™ Model 227. The Ridewell 227 rear suspension is a 4-bag air spring suspension incorporating a parallelogram linkage, and is optional on Rear Engine All American only. Vertical motion is controlled by adjustable heavy duty Koni shock absorbers. Two leveling valves permit leveling side to side and front to rear. Axle dog tracking is adjustable via eccentric torque arm bolts.



Single Reduction Rear Differential Carriers

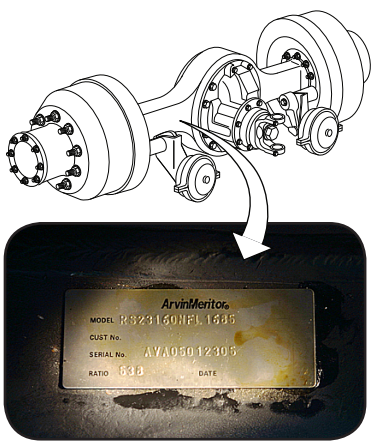
Meritor Publication Maintenance Manual 5A

Rear Engine Rear Axle

Meritor single reduction speed with synthetic lubed bearings. Standard model is RS21-145; 21,000 lbs. capacity; 5.38 to 1 ratio. All American RE may be equipped with optional models depending upon GVWR and reduction ratio, suspension, and/or brakes options:

Meritor Model	GAWR	Details
RS19-144	19,000 lbs	
RS21-145	21,000 lbs	Standard.
RC23-160	23,000 lbs	
RS23-160	23,000 lbs	

The wheel hub (with either an attached drum or rotor) is mounted to the axle spindles. Axle shafts pass through the center of the spindles and bolt to the outer flange of the wheel hub. Thus, the rear wheel bearings are lubricated by the axle oil. Synthetic axle lubricant is standard.



The specific axle model installed may be identified by refering to the axle data plate affixed to driveshaft side (front on Forward Engine, rear on Rear Engine) of the axle's housing.

CAUTION ***Towing the bus with the rear wheels on the road requires removal of the rear axle shafts in order to avoid potential damage to the automatic transmission. See* Jacking & Towing *in the* Specs & Maintenance *chapter for the required procedure.***

Appendixes In This Chapter

Appendix 1. Comfort Air Rear Suspension. Hendrickson Technical Procedure number 17730-246 covers maintenance, disassembly, adn troubleshooting for the Comfort Air rear suspension.

Appendix 2. Ridewell Air Rear Suspension. Ridewell publication covers maintenance, adjustment, and component replacement information on the Ridewell front and rear air suspension

On The TechReference DVD

Rear Axle. Arvin Meritor Maintenance Manual 5A includes thorough servicing information on the disassembly, inspection, and servicing of the rear axles, differential, and reduction gears. The axles used on Blue Bird All Americans are single-speed axles without Driver Controlled Main Differential Lock (DCDL).

Maintenance

Maintenance of the rear axle and suspension consists of periodic general inspection, checking tightness of fasteners, and axle lubrication fluid level check and/or replacement. Refer to the maintenance charts on the next page (also included in the **Specs & Maintenance** chapter) for intervals and lubricant specs.

Rear Axle & Suspension

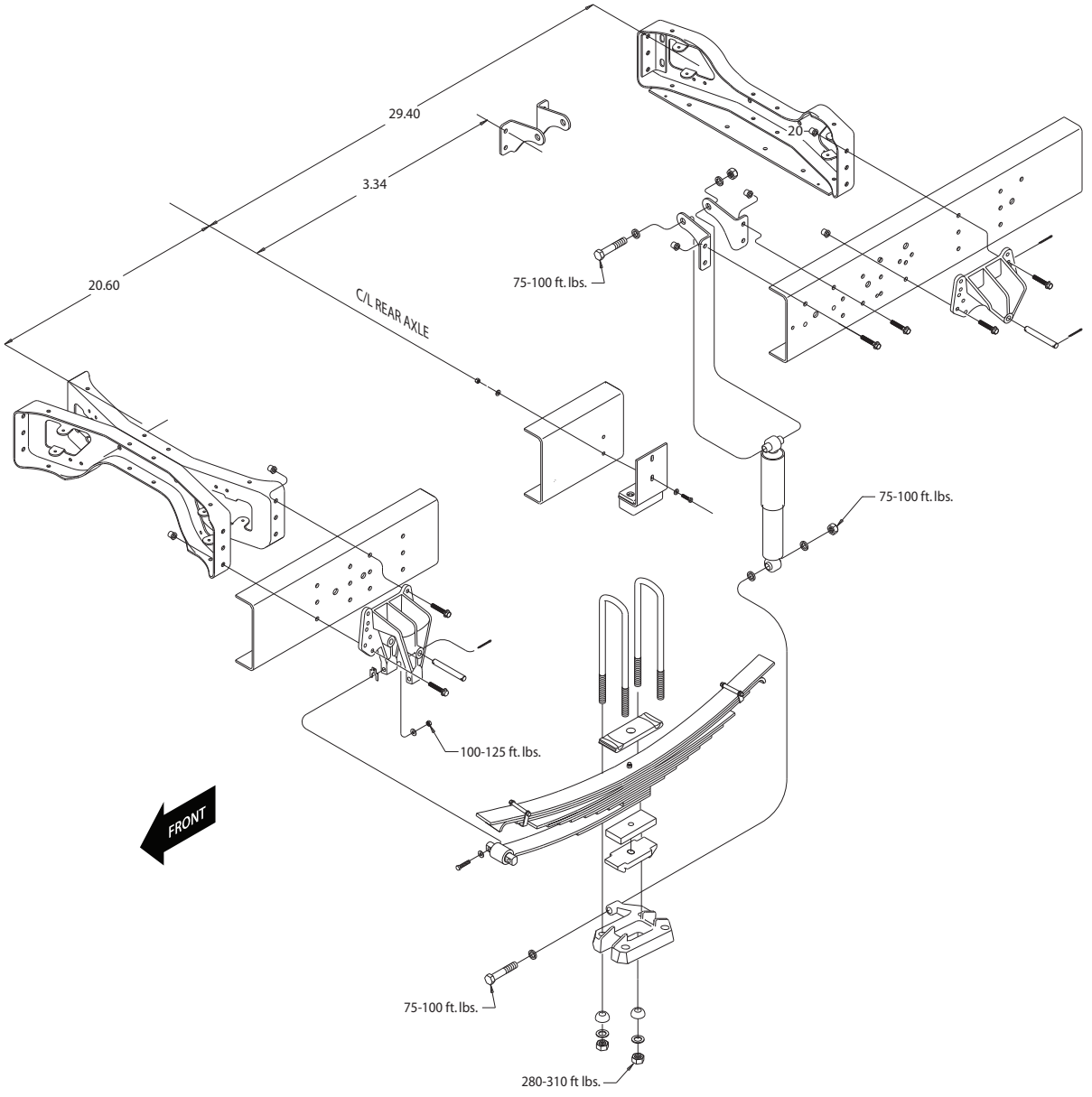
OPERATION	INTERVAL: MONTHS/1000 MILES whichever occurs first: first 1000 miles	1 / 10,000	6 / 6,000	6 / 10,000	12 / 12,000	12 / 24,000	12 / 50,000	12 / 100,000	NOTES
Rear Axle									
Check lubricant		•							*Hypoid Gear Oil. Capacity: 35 pints (16.9 litres). For viscosity recomendation, see Axle Lubricant chart, below.*
Change Lubricant, Petroleum Based						•	•		
Change Lubricant Synthetic								•	
Spring Suspension									
Inspect visually			•						
Check rebound pins					•				*Verify that cotter pins are installed.*
Torque spring radius fasteners					•				*TIghten locknuts to 100–125 ft·lb (11–14 Nm).*
Torque shock mounting bolts					•				*Tighten locknuts to 75–100 ft·lb (9-11 Nm).*
Torque U-bolt fasteners					•				*Torque U-bolts to 300–350 ft·lb (34–39 Nm).*
Air Suspension									
Inspect visually			•						*Check for wear, damage; loose or missing parts.*
Torque upper shock mount				•					*Tighten to 50–70 ft·lb (68–95 Nm)*
Torque lower shock mount				•					*Tighten to 150–180 ft·lb (203–244 Nm)*
Check ride height	•		•						*Shock length, eye to eye: 22.68" ± .25". (576 ± 6 mm)*
Check U-bolts 7/8-14 UNF 28	•			•					*Tighten to 400–450 ft·lb (542–610 Nm)*
Check U-bolts 3/4-16 UNF 28	•			•					*Tighten to 260–320 ft·lb (353–434 Nm)*
Torque lower shock mount to spring				•					*Tighten to 260–320 ft·lb (353–434 Nm)*
Torque air spring anchor bolts				•					*Tighten to 20–30 ft·lb (27–41 Nm)*
Torque quick align bolts				•					*Tighten to 525–575 ft·lb (712–800 Nm)*
Torque lever linkage locknut				•					*Tighten to 100–150 in. lbs. (11–17 Nm)*
Torque Leveling valve mount bolt				•					*Tighten to 60–85 in. lbs. (7–10 Nm)*

Rear Axle Viscosity /Temperature Chart

Meritor Lubricant Specification	Description	Cross Reference	Minimum Outside Temperature	Maximum Outside Temperature
0-76-A	Hypoid Gear Oil	GL-5, S.A.E. 85W/140	+10° F (-12.2° C)	*
0-76-B	Hypoid Gear Oil	GL-5, S.A.E. 80W/140	-15° F (-26.1° C)	*
0-76-D	Hypoid Gear Oil	GL-5, S.A.E. 80W/90	-15° F (-26.1° C)	*
0-76-E	Hypoid Gear Oil	GL-5, S.A.E. 75W/90	-40° F (-40° C)	*
0-76-J	Hypoid Gear Oil	GL-5, S.A.E. 75W	-40° F (-40° C)	+35° F (+1.6° C)
0-76-L	Hypoid Gear Oil	GL-5, S.A.E. 75W/140	-40° F (-40° C)	*

** No upper limit on these temperatures. However, axle sump temperature must never exceed + 250° F (121° C).*

Rear Spring Suspension



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Rear Spring & Axle Removal

WARNING ***Never work under a bus supported solely by hydraulic jacks. Always use jack stands or blocks to secure the vehicle. Ensure that the floor is firm enough to support the weight of the vehicle on the reduced footprint of the lifting/holding device.***

1. Raise the vehicle observing all appropriate safety precautions for working under the bus.
   - 1.1 Park the bus on a level surface.
   - 1.2 Apply the parking brakes.
   - 1.3 Chock the wheels opposite those being lifted.
   - 1.4 Using a jack or lift of sufficient strength, lift the bus to raise the wheels off the floor.
   - 1.5 Place jack stands of sufficient strength under the frame rails, forward of the front spring hanger brackets.
2. Remove rear wheels.
3. Disconnect the driveline at the differential by removing capscrews and u-joint straps.
4. Suspend the driveline safely out of the way.
5. Disconnect the wheel speed sensors.
6. If bus is equipped with air brakes, release the air pressure from the air tanks. Then disconnect the air lines at the chassis frame rail.
7. Remove Shock Absorber as follows:
   - 7.1 Lift the axle/suspension assembly enough to take the weight off the suspension hangers.
   - 7.2. Remove hexnut, flat washers, and bolt from the bottom end of the shock absorber.
   - 7.3. Remove hexnut, flat washers and bolt from the top end of the shock absorber. The shock absorber can now be removed.
8. Remove the stabilizer bar, if so equipped, by removing locknut, flat washers and bolt from each end of the axle.

9. To drop the axle, remove hex nuts, flat washer and spherical washer from 4 places, and lower the axle/wheels assembly.

CAUTION ***If working on only one end of the axle, it is possible to do so by dropping only one side. However, care must be taken to avoid twisting the suspension on the opposite side. Lower the end being worked on only enough to clear the location pins on the springs and axle. This will make location of components easier during reassembly.***

10. To remove the springs, remove and discard the cotter pin from the rebound pin at the forward spring hanger.

11. Remove the rebound pin.

12. Remove and discard the cotter pin from the rebound pin at the rearward spring hanger.

13. Remove the rebound pin.

CAUTION ***Carefully note the position of any shims in the next step. During reassembly, they must be replaced in the same positions.***

14. Remove hexnuts, flat washers, shims and bolt from 2 places at the rearmost spring hanger.

15. Loosely install the inner wheels onto axle ends.

16. Carefully lower the suspension/axle/wheels assembly and roll it out from under the vehicle.

WARNING ***If any frame members are to be removed, or any suspension hangers, they must be replaced in accordance with instructions in the Frame section of this service manual.***

Rear Spring & Axle Installation

Installation of the rear spring suspension is accomplished in the reverse order of the removal instructions above, and according to the torque values in the chart:

WARNING ***Always use new hardware in high-torque applications. Never re-use hardware in suspension applications.***

1. Position the axle saddle block over the location pin on the axle housing.
2. Position the spring assembly in the saddle block.
3. Position the U-bolt seat on the top of the spring.
4. Position a new U-bolt at the forward groove in the U-bolt seat.
5. Position a new U-bolt at the rearward groove of the U-bolt seat.
6. Position the lower U-bolt bracket over the ends of the U-bolts.
7. Install the spherical washers on the U-bolt.

CAUTION ***Flat washers must be hardened.***

8. Install the flat washers on the U-bolt.
9. Loosely (snugly enough to prevent movement) install hexnuts on U-bolt.

CAUTION ***To prevent distortion of the U-bolts, tighten hexnuts in a crisscross pattern after initial contact (snug).***

10. Temporarily install the inner wheels and position the axle assembly in the hanger brackets to ensure the springs are located properly. Then remove the wheels.
11. Position the rearward spring end in the rearward spring bracket.
12. Install the rebound pin in the aft mounting bracket.
13. Position the forward spring end in the forward mounting bracket.
14. Locate the spring radius leaf pin at the forward side of the bracket.
15. Install the rebound pin.
16. Install new bolts through the spring end assembly and the forward spring mounting bracket lugs.
17. Install new cotter pins.

CAUTION ***Ensure that any shim(s) removed during disassembly are replaced in the proper positions. Ensure that the bolts are oriented in the proper direction.***

18. Install shims between the head of the bolts and the lugs on the mounting bracket.

19. Install new cotter pins at rebound pins, front and rear.

20. Install flat washers on bolts.

21. Install hexnuts.

22. Make standard check for dog tracking adjustment.

23. When laser mark is within 1/4-inch of center (adjusted with shims in step 23 above), torque hexnuts to 100 – 125 ft lb (135 – 169 Nm).

24. Using a crisscross pattern, torque hexnuts to 300 – 350 ft lb (407 – 474 Nm) in 10 ft lb (13 Nm) increments.

25. Install flat washer on bolt.

26. Position the top end of the shock absorber between the shock absorber brackets on the frame rails. Ensure that the bolt is properly oriented with the head toward the front of the bus.

27. Install bolt and washer through the hanger brackets and the top end of the shock absorber.

28. Install the flat washer on bolt.

29. Install hexnut on bolt. Torque to 75 – 100 ft lb (102 – 135 Nm).

30. Position the lower end of the shock absorber at the lower shock mount. Ensure the bolt is properly oriented with the head toward the rear of the bus.

31. Install a flat washer on bolt.

32. Install bolt and flat washer through the lower end of the shock and install a flat washer on the bolt.

33. Position the lower end of the shock at the lower shock mounting bracket and install the bolt and washer assembly through the lower mounting bracket.

34. Install a flat washer and hexnut on bolt. Torque to 75 – 100 ft lb (102 – 135 Nm).

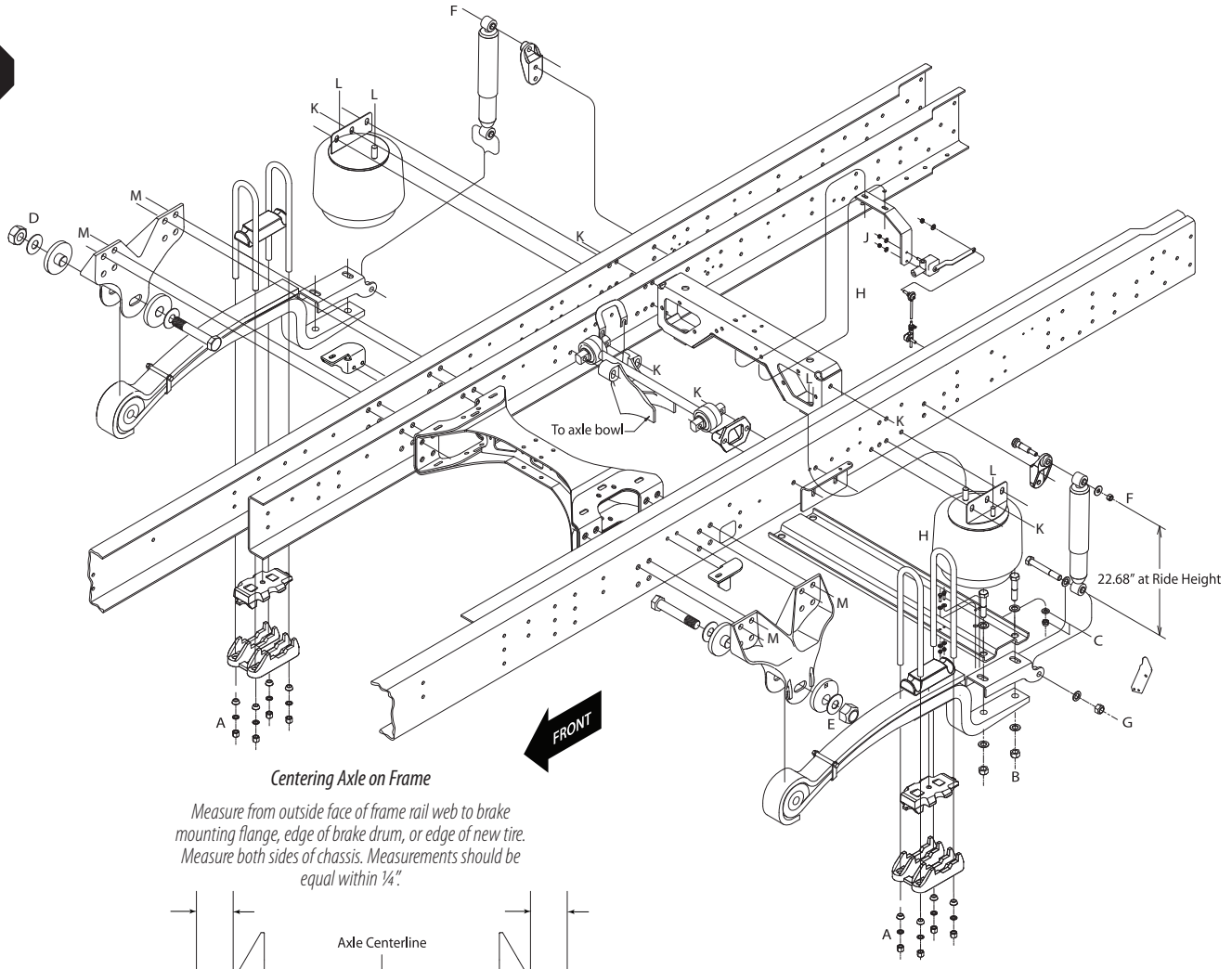
35. Install brake lines in accordance with instructions in the Brakes Section of this service manual.

36. Install speed sensors in accordance with instructions in the Brakes Section of this service manual.

37. Install wheels in accordance with instructions in the Brakes Section of this service manual.

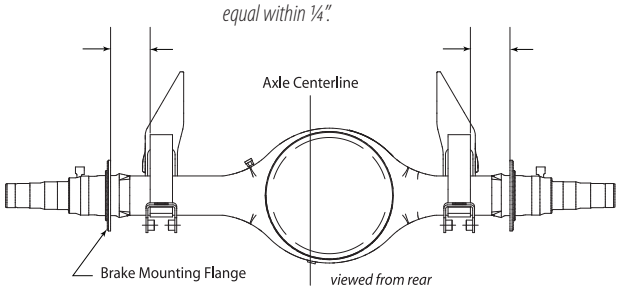
Rear Air Suspension

For servicing the Hendrickson Comfort Air™ rear suspension, see Appendix 1 of this chapter, Hendrickson publication number 17730-246.



Centering Axle on Frame

Measure from outside face of frame rail web to brake mounting flange, edge of brake drum, or edge of new tire. Measure both sides of chassis. Measurements should be equal within ¼".



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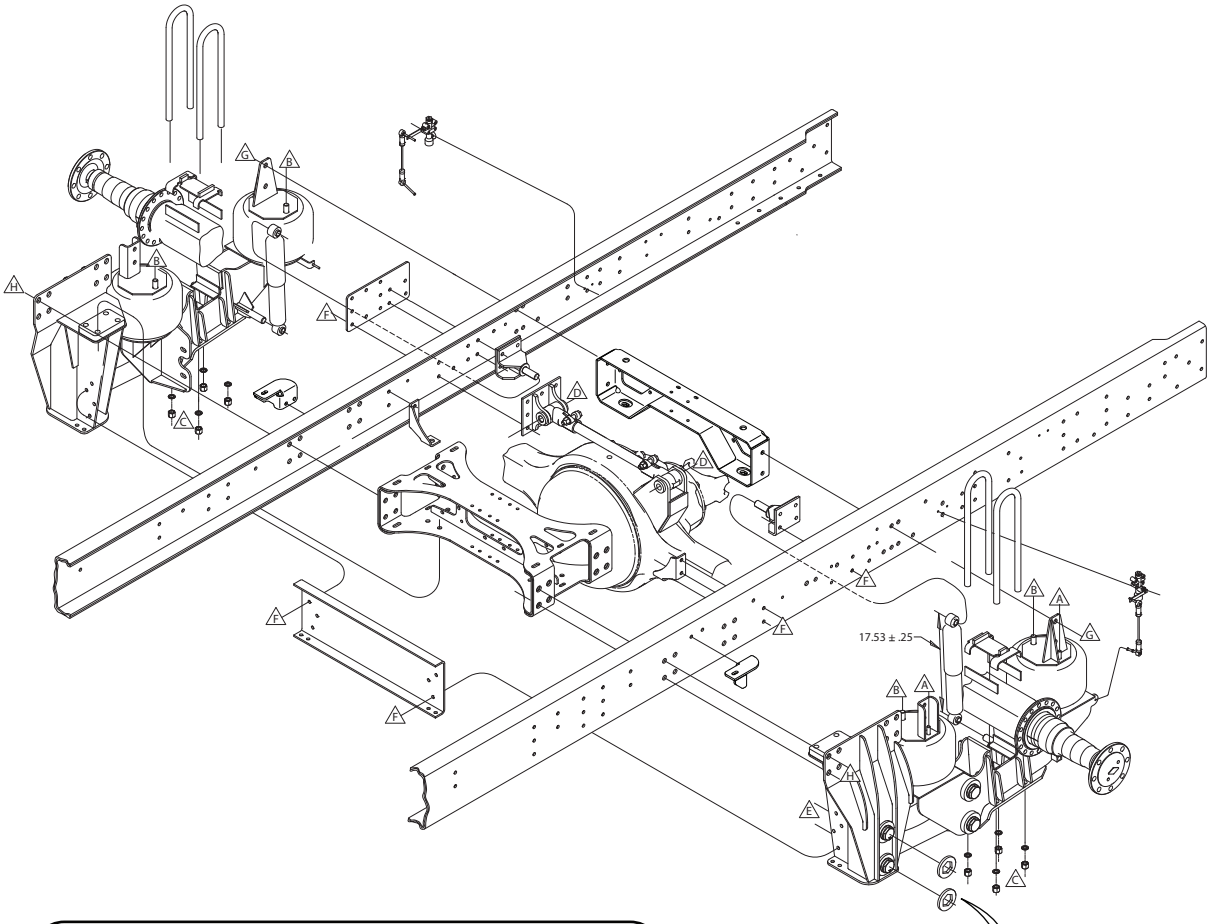
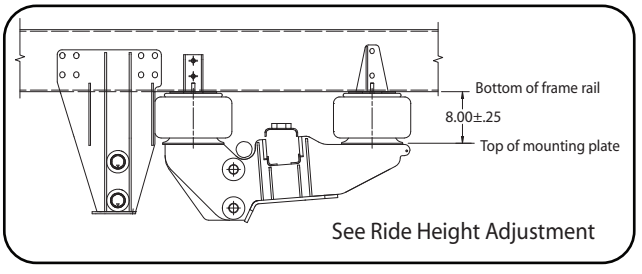
Rear Comfort Air Suspension

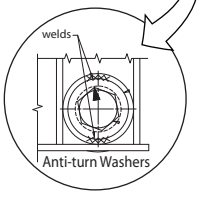
Torque Requirements

KEY	DESCRIPTION	TORQUE
A	U-bolt (High Locknut)	400-450 ft·lb
B	Cross Channel To Main Support Mbr	260-320 ft·lb
C	Air Spring To Cross Channel	20-30 ft·lb
D	Quick Align Joint Right Side Only	525-575 ft·lb
E	Quick Align Joint Left Side Only	525-575 ft·lb /(100 ft·lb during alignment)
F	Shock Absorber, Upper Shock	50-70 ft·lb
G	Shock Absorber, Lower Shock	160-180 ft·lb
H	Linkage Rod Assy Locknut	100-150 ft·lb
J	Leveling Valve Mounting	60-85 ft·lb
K	Capscrew, 5/8"-11, Gr8	90-122 Ft.lbs.
L	Air Spring Stud Nut, 3/4"-16	25 Ft.lbs.
M	Hanger Assembly Nut, 3/4"-10	155-210 Ft.lbs.

Rear Ridewell Suspension







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Torque Requirements

KEY	DESCRIPTION	TORQUE
A	Air Spring Stud Nut	25 ft·lb
B	Air Spring Stud Nut	50 ft·lb
C	U-Bolt Nuts	350 ft·lb
D	Sway Bar L'Nut	460 ft·lb
E	Hanger Beam L'Nut	1000 ft·lb
F	Hex Nut, 1/2"-13, Grd 8	56 ft·lb
G	Hex Nut, 5/8"-11, Grd 8	160-180 ft·lb
H	Suspension Hanger, Hex Nut, 3/4"-10, Grd 8	155-210 ft·lb

Ride height

Ride height is defined as the distance between the axle and the bottom of the frame rail, and may be verified by measuring either shock length or air spring height:

Shock length @ Ride Height

Hendrickson: **22.68"±0.25" (eye to eye)**

Ridewell: **17.53" ±0.25" (eye to eye)**

Air Spring Ride Height: **8.0±0.25"**

Ride Height Adjustment Air Suspension

1. Vehicle to be on level ground with 70-120 psi system air pressure maintained. Left and right rear height control valves to be adjusted independently.

2. Remove vertical rod from first valve horizontal arm & from lower stud. Rotate horizontal lever arm down to fully exhaust air springs.

3. Rotate horizontal lever up, filling air springs until affected side of vehicle is at specified ride height. Bring arm to neutral (horizontal) position when proper height is reached.

4. Place centering pins in valve to hold arm horizontal. Insert vertical link into upper connector, sliding up or down until lower grommet can be pushed onto lower mounting stud. Tighten hose clamp on upper connector and remove centering pins from valve.

5. Remove vertical link lower grommet from mounting stud and rotate horizontal link down to exhaust air.

6. Reinstall grommet on mounting stud and recheck ride height.

7. If adjustments are necessary, loosen hose clamp, slide connector up or down as required. Tighten clamp and repeat steps 5 & 6 until ride height measurement is within specifications.

8. Repeat steps 2-7 for 2nd valve.

Drive Axle Alignment—Ridewell Air Suspension

1. Center axle in chassis, as follows:

   1.1 With chassis at normal ride height,measure from outside face of frame rail web to drive axle brake-mounting flange,edge of brake drum, or edge of tire (w/new tires only). Do for both sides. If measurements are within 1/8" skip to step 4.

   1.2 Loosen track rod pinch bolts and with pipe wrench, rotate track rod shaft (item #18) to move frame laterally relative to axle.

   1.3 Repeat steps 1) and 2) until axle has been centered within 1/8".

   1.4 Retighten pinch bolts to 150 ft-lbs.

2. Axle Dog-Track Alignment

   2.1 Using beeline or other suitable equipment, make standard check for drive axle dog tracking. If laser mark is within 1/4" of center, no further drive axle alignment is required. Skip to step 3).

   2.2 If laser mark is greater than 1/4" from center, loosen nuts (item #28), Rotate eccentric bolts (item #27) on appropriate side to center laser mark. Rotate both upper and lower eccentric bolts equally. Rotating eccentric bolts on both sides of chassis (in opposite directions) may be required to center laser mark.

   2.3 Torque drive axle eccentric bolt nuts (item #28) to 1000 ft-lbs.

   2.4 Add anti-turn washers (item #26) over head of eccentric bolt (item #27) and weld to receiver ring.

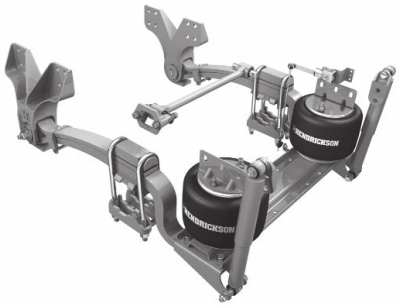
Adjusting of Koni Shocks

1. Remove the shock absorber from the vehicle. Place the lower eye attachment In a vise. Fully collapse shock absorber while turning dust cap to the left (counterclockwise) until it is felt that cams of internal adjusting nut engages in the recesses of the internal foot valve. While engaged, turning the dust cap fully counterclockwise puts the shock at its minimum dampening setting. Skip to step 3) if no damping increase is required.

2. Keeping shock absorber collapsed, turn dust cap to the right (clockwise) until a stop is felt. Stop turning and do not use any more force!! This Is the maximum dampening setting. To reduce dampening, turn counterclockwise.

3. Pull shock absorber out vertically without turning for at least 3/8" to disengage the adjusting mechanism. The dust cap may now be turned freely. Shock absorber can then be re-fitted to the vehicle. When reinstalling, tighten shock absorber upper & lower nut (item #23) until a dimensionof 1.75" between washers is attained, as shown.

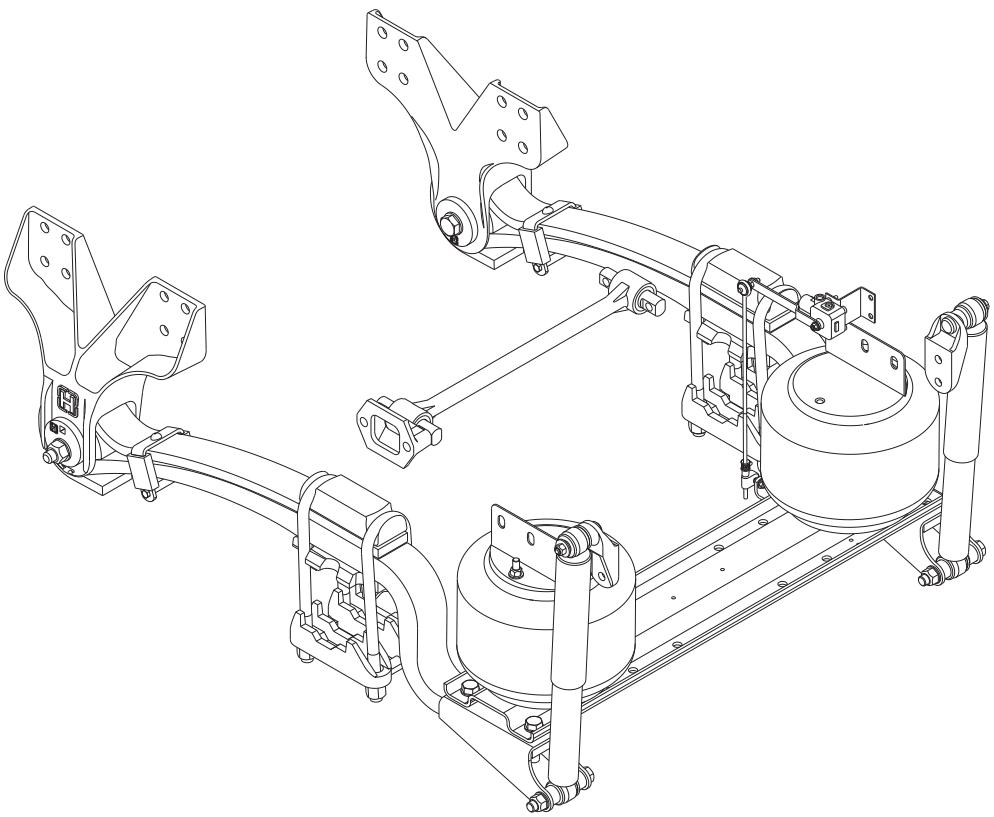
4. Make certain both left and right shocks are at equal settings. Repeat steps 1–3 as required.



TECHNICAL PROCEDURE

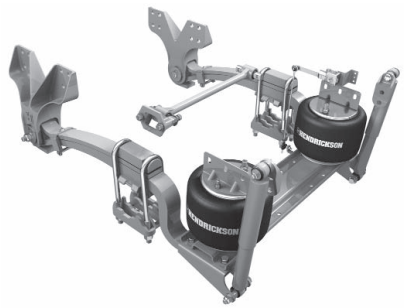
COMFORT AIR®

SUBJECT: Service Instructions
LIT NO: 17730-246
DATE: December 2007 REVISION: B



For The Road Ahead™

HENDRICKSON



TECHNICAL PROCEDURE

COMFORT AIR®

SUBJECT: Service Instructions
LIT NO: 17730-246
DATE: December 2007 **REVISION:** B

TABLE OF CONTENTS

For The Road Ahead™

HENDRICKSON

SECTION 1
Introduction

This publication is intended to acquaint and assist maintenance personnel in the preventive maintenance, service, repair and rebuild of the COMFORT AIR® suspension system.

NOTE Use only Genuine Hendrickson parts for servicing this suspension system.

It is important to read and understand the entire Technical Procedure publication prior to performing any maintenance, service, repair, or rebuild of this product. The information in this publication contains parts lists, safety information, product specifications, features, proper maintenance, service, repair and rebuild instructions for the COMFORT AIR Suspension.

Hendrickson reserves the right to make changes and improvements to its products and publications at any time. Contact Hendrickson Tech Services at 630-910-2800 or email techservices@hendrickson-intl.com for information on the latest version of this manual.

The latest revision of this publication is also available online at www.hendrickson-intl.com.

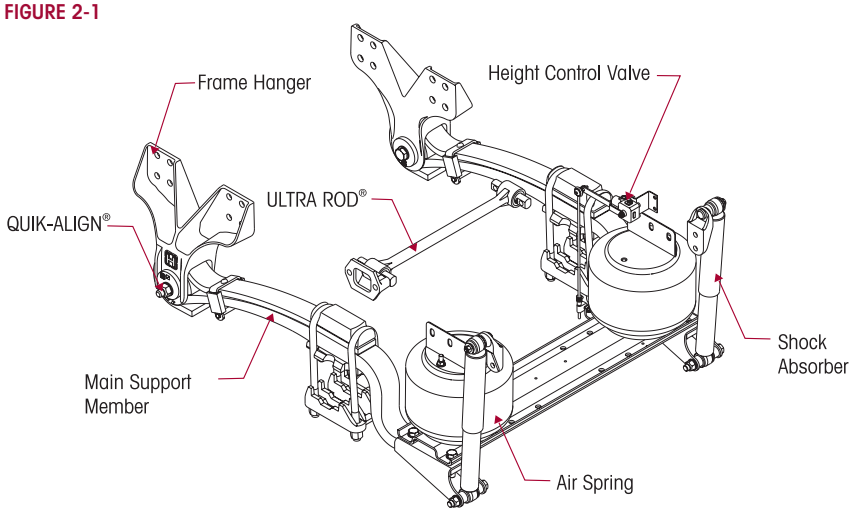
SECTION 2
Product Description

The COMFORT AIR rear suspension system, based on Hendrickson's proven HAS technology, is designed for the needs of buses, motor homes, and ambulances. The new system combines superior ride and handling with enhanced equipment protection.

- **Frame hanger** — Wide footprint distributes load over a larger area for reduced frame stress.
- **QUIK-ALIGN®** — Fast and easy alignment without shims, see Figure 2-1.
- **Main support member** — Extended-length generates lower spring rate for optimized roll stiffness providing a more comfortable and compliant ride. It also provides neutral roll steer for better handling.
- **Shock absorbers** — Tuned for optimum damping characteristics to provide maximum driving comfort.
- **Air springs** — Adjust to changing load conditions to deliver superior ride quality.
- **ULTRA ROD®** — Lightweight and durable torque rod. The ULTRA ROD is an integral component of the COMFORT AIR suspension that enhances handling during cornering and helps maintain lateral axle position.
- **Height control valve** — Maintains precise ride height control through changing road surfaces, load, and driving conditions.

COMFORT AIR is available in suspension capacities up to 23,000 pounds, and in ride heights of 8.5" and 10.5". The suspension weighs 487 pounds and includes the frame hanger brackets, main support member assembly, axle clamp group, air springs, shock absorbers, cross channel, upper and lower shock brackets, ULTRA ROD transverse torque rod and frame bracket, and height control system.

FIGURE 2-1



SECTION 3
Important Safety Notice

Proper maintenance, service and repair are important to the reliable operation of the suspension. The procedures recommended by Hendrickson and described in this technical publication are methods of performing such maintenance, service and repair.

The warnings and cautions should be read carefully to help prevent personal injury and to assure that proper methods are used. Improper maintenance, service or repair may damage the vehicle, cause personal injury, render the vehicle unsafe in operation, or void the manufacturer's warranty.

Failure to follow the safety precautions in this manual can result in personal injury and/or property damage. Carefully read and understand all safety related information within this publication, on all decals and in all such materials provided by the vehicle manufacturer before conducting any maintenance, service or repair.

EXPLANATION OF SIGNAL WORDS

Hazard "Signal Words" (Danger-Warning-Caution) appear in various locations throughout this publication. Information accented by one of these signal words must be observed to help minimize the risk of personal injury to service personnel, or possibility of improper service methods which may damage the vehicle or render it unsafe.

This is the safety alert symbol. It is used to alert you to potential personal injury hazards. Obey all safety messages that follow this symbol to avoid possible injury or death.

Additional 'Notes' or 'Service Hints' are utilized to emphasize areas of procedural importance and provide suggestions for ease of repair. The following definitions indicate the use of these signal words as they appear throughout the publication.

DANGER	INDICATES AN IMMINENTLY HAZARDOUS SITUATION, WHICH, IF NOT AVOIDED, WILL RESULT IN SERIOUS INJURY OR DEATH
WARNING	INDICATES A POTENTIAL HAZARDOUS SITUATION WHICH, IF NOT AVOIDED, CAN RESULT IN DEATH OR SERIOUS INJURY
CAUTION	INDICATES A POTENTIAL HAZARDOUS SITUATION WHICH, IF NOT AVOIDED, MAY RESULT IN MINOR OR MODERATE INJURY.
NOTE	An operating procedure, practice condition, etc. which is essential to emphasize.
SERVICE HINT	A helpful suggestion that will make the service being performed a little easier and/or faster.

Also note that particular service operations may require the use of special tools designed for specific purposes. These special tools can be found in the Special Tools Section of this publication.

SAFETY PRECAUTIONS

WARNING

FASTENERS

DISCARD USED FASTENERS. ALWAYS USE NEW FASTENERS TO COMPLETE A REPAIR. FAILURE TO DO SO COULD RESULT IN FAILURE OF THE PART OR MATING PARTS, LOSS OF VEHICLE CONTROL, PERSONAL INJURY, OR PROPERTY DAMAGE.

LOOSE OR OVER TORQUED FASTENERS CAN CAUSE COMPONENT DAMAGE, LOSS OF VEHICLE CONTROL, PROPERTY DAMAGE, OR SEVERE PERSONAL INJURY. MAINTAIN CORRECT TORQUE VALUE AT ALL TIMES. CHECK TORQUE VALUES ON A REGULAR BASIS AS SPECIFIED, USING A TORQUE WRENCH THAT IS REGULARLY CALIBRATED. TORQUE VALUES SPECIFIED IN THIS TECHNICAL PUBLICATION ARE FOR HENDRICKSON SUPPLIED FASTENERS ONLY. IF NON HENDRICKSON FASTENERS ARE USED, FOLLOW TORQUE SPECIFICATION LISTED IN THE VEHICLE MANUFACTURER'S SERVICE MANUAL.

WARNING

LOAD CAPACITY

ADHERE TO THE PUBLISHED CAPACITY RATINGS FOR THE SUSPENSION. ADD ON AXLE ATTACHMENTS AND OTHER LOAD TRANSFERRING DEVICES CAN INCREASE THE SUSPENSION LOAD ABOVE ITS RATED AND APPROVED CAPACITIES, WHICH CAN RESULT IN COMPONENT DAMAGE AND LOSS OF VEHICLE CONTROL, POSSIBLY CAUSING PERSONAL INJURY OR PROPERTY DAMAGE.

WARNING

MODIFYING COMPONENTS

DO NOT MODIFY OR REWORK PARTS WITHOUT AUTHORIZATION FROM HENDRICKSON. DO NOT SUBSTITUTE PARTS OF THE SUSPENSION. USE OF MODIFIED OR REPLACEMENT PARTS NOT AUTHORIZED BY HENDRICKSON MAY NOT MEET HENDRICKSON'S SPECIFICATIONS, AND CAN RESULT IN COMPONENT DAMAGE, LOSS OF VEHICLE CONTROL, AND POSSIBLE PERSONAL INJURY OR PROPERTY DAMAGE. USE ONLY HENDRICKSON AUTHORIZED REPLACEMENT PARTS.

WARNING

TORCH/WELDING

DO NOT USE A CUTTING TORCH TO REMOVE ANY ATTACHING FASTENERS. THE USE OF HEAT ON SUSPENSION COMPONENTS WILL ADVERSELY AFFECT THE STRENGTH OF THESE PARTS. EXERCISE EXTREME CARE WHEN HANDLING OR PERFORMING MAINTENANCE IN THE AREA OF THE MAIN SUPPORT MEMBER. DO NOT CONNECT ARC WELDING GROUND LINE TO THE MAIN SUPPORT MEMBER. DO NOT STRIKE AN ARC WITH THE ELECTRODE ON THE MAIN SUPPORT MEMBER ASSEMBLY AND AXLE. DO NOT USE HEAT NEAR THE MAIN SUPPORT MEMBER ASSEMBLY. DO NOT NICK OR GOUGE THE MAIN SUPPORT MEMBER ASSEMBLY. SUCH IMPROPER ACTIONS CAN CAUSE DAMAGE TO THE MAIN SUPPORT MEMBER ASSEMBLY COULD FAIL, AND CAUSE LOSS OF VEHICLE CONTROL AND POSSIBLE PERSONAL INJURY OR PROPERTY DAMAGE.

CAUTION

PROCEDURES AND TOOLS

A TECHNICIAN USING A SERVICE PROCEDURE OR TOOL WHICH HAS NOT BEEN RECOMMENDED BY HENDRICKSON MUST FIRST SATISFY HIMSELF THAT NEITHER HIS SAFETY NOR THE VEHICLE'S SAFETY WILL BE JEOPARDIZED BY THE METHOD OR TOOL SELECTED. INDIVIDUALS DEVIATING IN ANY MANNER FROM THE INSTRUCTIONS PROVIDED WILL ASSUME ALL RISKS OF CONSEQUENTIAL PERSONAL INJURY OR DAMAGE TO EQUIPMENT INVOLVED.

WARNING

DO NOT AT ANY TIME WORK AROUND OR UNDER A VEHICLE SUPPORTED ONLY ON LIFTING DEVICES. THE VEHICLE MUST BE SECURELY CHOCKED AND SUPPORTED ON RIGID STANDS OF SUFFICIENT STRENGTH BEFORE WORK MAY COMMENCE.

WARNING

AIR SPRING INFLATION AND DEFLATION

AIR SPRING ASSEMBLIES MUST BE DEFLATED PRIOR TO LOOSENING ANY CLAMP GROUP HARDWARE. UNRESTRICTED AIR SPRING ASSEMBLIES CAN VIOLENTLY SHIFT. DO NOT INFLATE AIR SPRING ASSEMBLIES WHEN THEY ARE UNRESTRICTED. AIR SPRING ASSEMBLIES MUST BE RESTRICTED BY SUSPENSION OR OTHER ADEQUATE STRUCTURE. DO NOT INFLATE BEYOND PRESSURES RECOMMENDED BY AIR SPRING MANUFACTURER, CONTACT HENDRICKSON TECHNICAL SERVICES FOR DETAILS. IMPROPER USE OR OVER INFLATION WILL CAUSE AIR SPRING ASSEMBLIES TO BURST, CAUSING PROPERTY DAMAGE AND/OR SEVERE PERSONAL INJURY.

WARNING

PRIOR TO AND DURING DEFLATION AND INFLATION OF THE AIR SUSPENSION SYSTEM, ENSURE THAT ALL PERSONNEL AND EQUIPMENT ARE CLEAR FROM UNDER THE VEHICLE AND AROUND THE SERVICE AREA, FAILURE TO DO SO CAN CAUSE SERIOUS PERSONAL INJURY, DEATH, OR PROPERTY DAMAGE.

CAUTION

AIR SPRING INFLATION

INFLATE THE SUSPENSION SLOWLY, ENSURE THAT THE RUBBER BLADDER OF THE AIR SPRING INFLATES UNIFORMLY AND IS NOT BINDING. FAILURE TO DO SO CAN CAUSE DAMAGE TO THE AIR SPRING AND/OR AIR SPRING MOUNTING BRACKETS VOIDING WARRANTY.

CAUTION

AIR SPRING DEFLATION

IF THE AIR SPRING IS BEING REMOVED, IT IS MANDATORY TO LUBRICATE THE LOWER AIR SPRING FASTENERS WITH PENETRATING OIL AND REMOVE WITH HAND TOOLS TO PREVENT DAMAGE TO THE LOWER AIR SPRING MOUNTING STUD. FAILURE TO DO SO CAN CAUSE COMPONENT DAMAGE AND VOID WARRANTY.

WARNING

PERSONAL PROTECTIVE EQUIPMENT

ALWAYS WEAR PROPER EYE PROTECTION AND OTHER REQUIRED PERSONAL PROTECTIVE EQUIPMENT TO HELP PREVENT PERSONAL INJURY WHEN PERFORMING VEHICLE MAINTENANCE, REPAIR OR SERVICE.

WARNING

PARTS CLEANING

SOLVENT CLEANERS CAN BE FLAMMABLE, POISONOUS, AND CAUSE BURNS. TO HELP AVOID SERIOUS PERSONAL INJURY, CAREFULLY FOLLOW THE MANUFACTURER'S PRODUCT INSTRUCTIONS AND GUIDELINES AND THE FOLLOWING PROCEDURES:

1. WEAR PROPER EYE PROTECTION.
2. WEAR CLOTHING THAT PROTECTS YOUR SKIN.
3. WORK IN A WELL-VENTILATED AREA.
4. DO NOT USE GASOLINE, OR SOLVENTS THAT CONTAIN GASOLINE. GASOLINE CAN EXPLODE.
5. HOT SOLUTION TANKS OR ALKALINE SOLUTIONS MUST BE USED CORRECTLY. FOLLOW THE MANUFACTURER'S RECOMMENDED INSTRUCTIONS AND GUIDELINES CAREFULLY TO HELP PREVENT PERSONAL ACCIDENT OR INJURY.

DO NOT USE HOT SOLUTION TANKS OR WATER AND ALKALINE SOLUTIONS TO CLEAN GROUND OR POLISHED PARTS. DOING SO WILL CAUSE DAMAGE TO THE PARTS AND VOID WARRANTY.

WARNING

QUIK-ALIGN FASTENERS

DO NOT ASSEMBLE QUIK-ALIGN JOINT WITHOUT PROPER FASTENERS. USE ONLY DACROMET PLUS XL PLATED FASTENERS TO SUSTAIN PROPER CLAMP FORCE. FAILURE TO DO SO CAN CAUSE LOSS OF VEHICLE CONTROL, PROPERTY DAMAGE OR PERSONAL INJURY.

ENSURE THAT QUIK-ALIGN FASTENERS TORQUE VALUE IS SUSTAINED AS RECOMMENDED IN THE TORQUE SPECIFICATIONS SECTION OF THIS PUBLICATION. FAILURE TO SO CAN CAUSE LOSS OF VEHICLE CONTROL RESULTING IN PERSONAL INJURY OR PROPERTY DAMAGE.

WARNING

U-BOLT CLAMP GROUP CONNECTION

IT IS IMPORTANT THAT THE U-BOLT CLAMP GROUP CONNECTION BE PROPERLY ALIGNED AND HAVE THE PROPER TIGHTENING TORQUE VALUES MAINTAINED. METAL SURFACES CAN WORK AND WEAR AGAINST OTHER RELATED CLAMP GROUP COMPONENTS IF NOT PROPERLY ALIGNED OR PROPERLY TIGHTENED TO MAINTAIN THE PROPER CLAMP FORCE. FAILURE TO DO SO CAN CAUSE PREMATURE COMPONENT WEAR, POSSIBLE SEPARATION OF THE CLAMP GROUP, CAUSING LOSS OF VEHICLE CONTROL, PROPERTY DAMAGE, OR PERSONAL INJURY.

WARNING

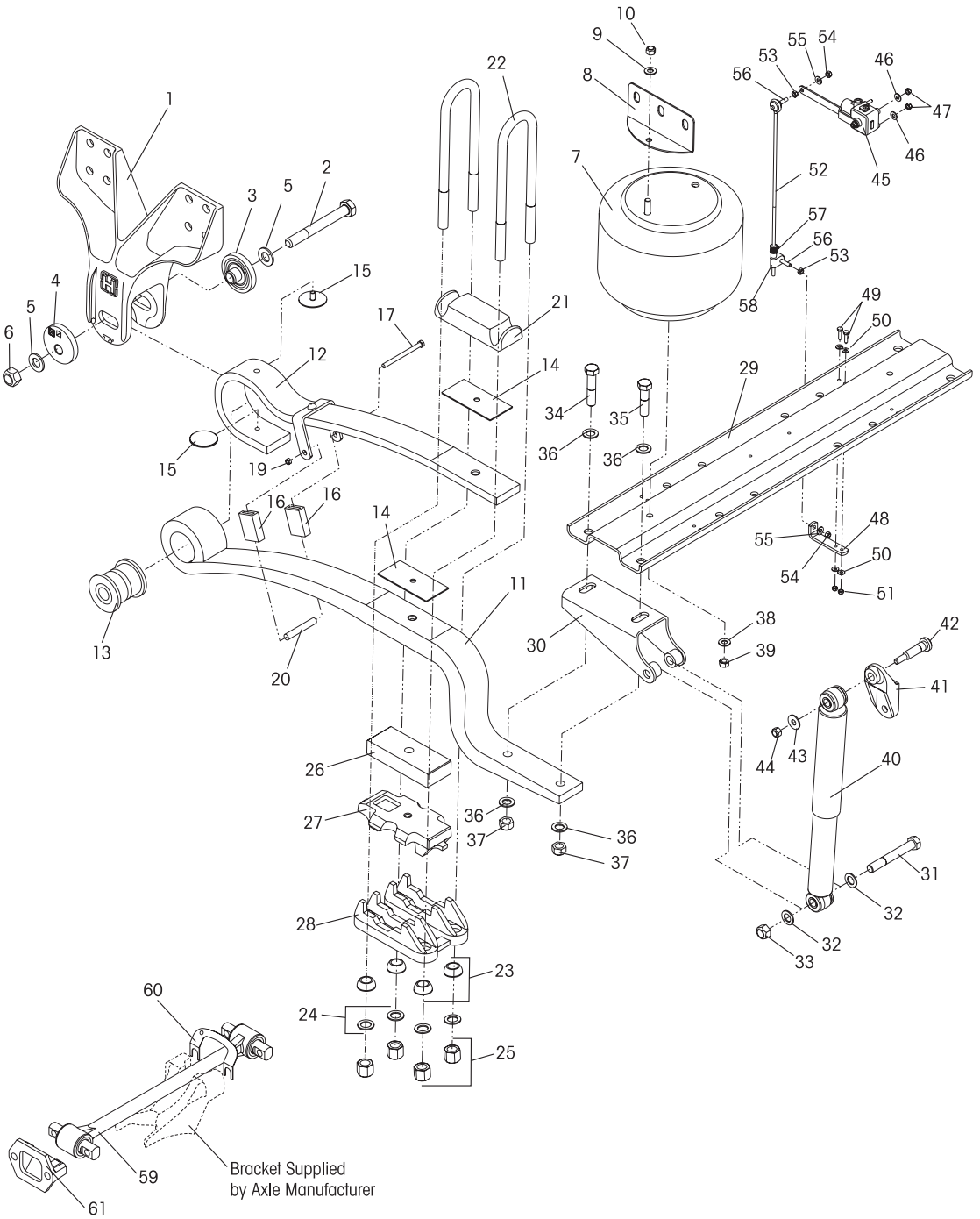
SHOCK ABSORBERS

THE SHOCK ABSORBERS ARE THE REBOUND TRAVEL STOPS FOR THE SUSPENSION. ANYTIME THE AXLE ON A COMFORT AIR SUSPENSION IS SUSPENDED IT IS MANDATORY THAT THE SHOCK ABSORBERS REMAIN CONNECTED. FAILURE TO DO SO CAN CAUSE THE AIR SPRINGS TO SEPARATE FROM THE PISTON AND RESULT IN PREMATURE AIR SPRING FAILURE.

SECTION 4

Parts List

COMFORT AIR®



COMFORT AIR®

KEY NO.	PART NO.	DESCRIPTION	NO.REQ.
1	60784-000	Frame Hanger	2
	60632-001	**QUIK-ALIGN® Service Kit,** Axle Set (Includes Key Nos. 2-6)	
	34013-103	**Pivot Bushing Service Kit,** One Side (Includes Key Nos. 2, 5-6, 13, 15)	
2	64107-000	1"-8 UNC Bolt 7.50"	2
3	64633-000	QUIK-ALIGN Concentric Collar	3
4	64632-000	QUIK-ALIGN Eccentric Collar	1
5	22962-035	1" Hardened Washer	4
6	64108-000	1"-8 UNC Locknut	2
	60925-002	Air Spring Assembly (Includes Key Nos. 7-10)	2
	60929-002	Air Spring Assembly Front Engine (Includes Key Nos. 7-10)	2
7		*Air Spring	2
8	57096-002	Air Spring Bracket	2
9	22962-014	½" Flat Washer	2
10	17700-010	½"-13UNC Nylocknut	2
	60779-000	Main Support Assembly (Includes Key Nos. 11-20)	2
11		*Main Support Member	2
12		*Secondary Leaf	2
13	58648-000	Pivot Bushing	2
14	37674-051	Liner	4
15	64817-000	Puck	4
	49175-026	**Spring Clip Fastener Service Kit,** Axle Set (Includes Key Nos.16-19)	
16	64272-000	Spring Clip Sleeve	4
17	37042-002	7/16"-14 UNC Bolt	2
18	22962-027	7/16" Washer (Not Shown)	
19	17700-007	7/16"-14 UNC Nut	2
20		*Clip Bolt Spacer	2
21	56805-000	Top Pad (All except 15,000 lb. capacity)	2
	57724-000	Top Pad (15,000 lb. capacity)	2
		U-bolt Service Kit, Axle Set	
	48718-	⅞" Specify Length,(Includes Key Nos. 22-25)	
	48718-104	¾"-15,000 lb. capacity, (Includes Key Nos. 22, 24-25)	
22	47417-	⅞"-14 UNF U-bolt - Specify Length	4
	49684-014	¾" 26 UNF U-bolt - 12.5" (15,000 lbs.Capacity)	4
23	48574-000	Spherical Washer	8
24	22962-002	⅞" Hardened Flat Washer	8
	22962-001	¾" Hardened Flat Washer (15,000 lb. Capacity)	8
25	50765-000	⅞" 14UNF U-Bolt Locknut	8
	49685-000	¾" 16UNF U-Bolt Locknut (15,000 lb. Capacity)	8
26	48531-014	Spacer 1.5" (As Required)	2
27		Spring Seat	2
		Meritor RS15-120	
	57022-010	4.5° Pinion Angle LH/RH	
		Meritor RS21-145, RS23-160	
	56501-006	4.5° Pinion Angle LH/RH	
	56501-019	0.0° Pinion Angle LH/RH	
	56501-020	4.5° Pinion Angle LH/RH	
	56501-021	0.0° Pinion Angle LH/RH	
		Meritor RC23-160	
	56501-020	Negative 4.5° Pinion Angle LH/RH	
28		Axle Bottom Cap	2
		Meritor RS15-120	
	57024-000	2-5.0° Pinion Angle LH/RH	
		Meritor RS21-145, RS23-160	
	50216-000	0-9.5° Pinion Angle LH/RH	
		Meritor RC23-160	
	50216-000	Negative 0-9.5° Angle LH/RH	
29		Cross Channel (Contact Hendrickson Tech Services for proper Cross Channel)	1
	57356-000	Lower Shock Bracket Assembly (Includes Key Nos. 30-33)	2
30		*Lower Shock Bracket	2
31	50764-002	¾"-10 UNC Bolt - 5.50"	2
32	22962-001	¾" Hardened Washer	4
33	49842-000	¾"-10 UNC Locknut	2
	50763-004	**Cross Channel Fastener Service Kit,** Axle Set (Includes Key Nos. 34-37)	
34	50764-003	¾"-10 UNC Bolt - 3.50"	2
35	50764-005	¾"-10 UNC Bolt - 3.00"	2
36	22962-001	¾" Hardened Washer	8
37	49842-000	¾"-10 UNC Locknut	4
	49177-006	**Air Spring Fastener Service Kit,** Axle Set (Includes Key Nos. 38-39)	
38	22962-014	½" Hardened Washer	2
39	17700-010	½"-13 UNC Nylocknut	2
40	60998-001	Shock Absorber	2
	57322-002	Upper Shock Bracket Assembly (Includes Key Nos. 41-44)	2
41		*Upper Shock Bracket	2
42	50368-000	½"-13 UNC Serrated Shank Bolt	2
43	22962-031	½" Hardened Washer	2
44	49846-000	½"-13 UNC Locknut	2
	59013-000	**Height Control Valve Service Kit,** Axle Set (Includes Key Nos. 45-47)	
45		*Height Control Valve	1
46		*¼" Hardened Washer	2
47		*¼"-20 UNC Locknut	2
		HCV Linkage Lower Bracket Service Kit (Includes Key Nos. 48-51)	
	57430-000	All Except Rear Engine	
	57430-003	Rear Engine Only	
48	56789-000	HCV Linkage Bracket	1
	58367-000	HCV Linkage Bracket (Rear Engine)	
49	56935-002	¼"-20 UNC Bolt - 1.00"	2
50	22962-028	¼" Hardened Washer	4
51	49983-000	¼"-20 UNC Locknut	2
	58994-	Height Control Valve Linkage Assembly, Specify Length (Includes Key Nos. 52-58)	1
52		*HCV Linkage Rod	1
53		*5/16"-18 UNC Jam Nut	2
54		*5/16"-18 UNC Locknut	2
55		*5/16" Hardened Washer	2
56		*5/16"-18 UNC Stud	2
57		*Valve Arm Clamp	1
58		*Adjustable Valve Arm Joint	1
59	62000-	Transverse Torque Rod Assembly, Specify Length	1
60	49689-000	Torque Rod Shim	As Req.
61	22186-000	Transverse Torque Rod Frame Bracket	1

NOTE

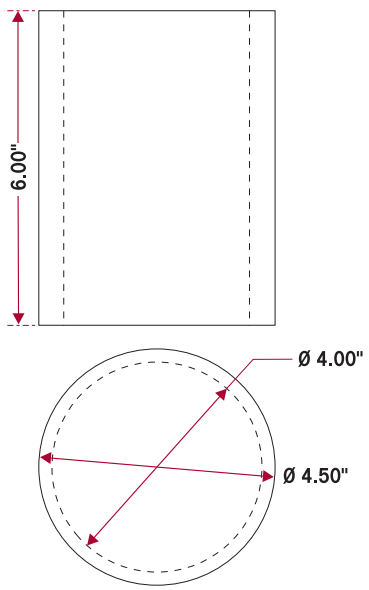
* Item included in assembly only, part not sold separately.

SECTION 5
Special Tools

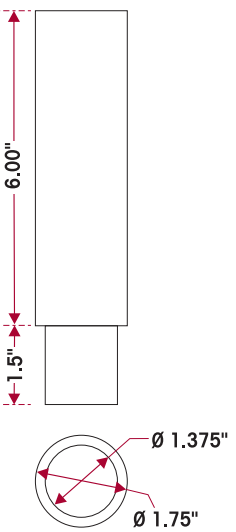
These shop made tools are designed to install and remove pivot bushing and torque rod bushing. Bushing tools are made from cold rolled steel or equivalent. Drawing is for reference only, Hendrickson does not supply this tools.

PIVOT BUSHING TOOLS

Pivot Bushing Receiving Tool

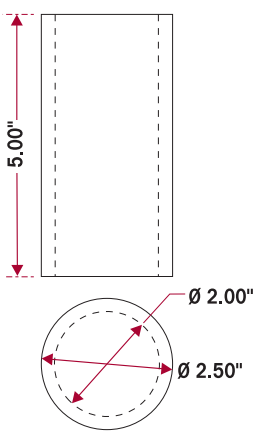


Pivot Bushing Push Out Tool



TRANSVERSE TORQUE ROD BUSHING TOOLS

Torque Rod Bushing Receiving Tool



SECTION 6

Preventive Maintenance

Following appropriate inspection procedures is important to help ensure the proper maintenance and operation of the COMFORT AIR suspension system and component parts function to their highest efficiency. Look for bent or cracked parts. Replace all worn or damaged parts.

HENDRICKSON RECOMMENDED PREVENTIVE MAINTENANCE INTERVALS

- Preparation for delivery
- The first 1,000 miles
- **On-highway** – every 20,000 miles or every 6 months, whichever comes first

COMPONENT INSPECTION

- **Air spring** — Visually inspect the outer surface of the air spring for chafing, uneven wear, cracks or any signs of component damage.
- **Clamp group** — Visually inspect for any loose or damaged fasteners. Verify the U-bolt locknuts have the proper torque values maintained. See the U-bolt Locknuts in this section.
- **Fasteners** — Look for any loose or damaged fasteners on the entire suspension. Make sure all fasteners are tightened to a torque value within the specified torque range. See Torque Specification Section of this publication for Hendrickson recommended torque requirements. Use a calibrated torque wrench to check torque in the tightening direction. As soon as the fastener starts to move, record the torque. Correct the torque if necessary.

NOTE Hendrickson recommends the use of Grade 8 bolts and Grade C locknuts for all suspension component attachments.

- **Frame hanger** — Inspect for any signs of loosening or damage. Check for cracks. Replace if necessary, see the Component Replacement Section of this publication.
- **Height control valve and air lines** — Check the suspension air system for air leaks. Check all air lines for proper routing. Check for chafing or pinched air lines. Check the height control valve linkage for damage or interference with peripheral components.
- **Transverse torque rods** — All torque rods must be inspected for looseness, torn or shredded rubber, bushing walk-out, and for proper fastener torque. If there is metal-to-metal contact in the bushing joint, this is a sign of excessive bushing wear and the bushing needs to be replaced. See Transverse Torque Rods in this section.
- **Shock absorbers** — Look for any signs of dents or leakage. Misting is not considered a leak. See Shock Absorber Inspection in this section.
- **Tire wear** — Inspect the tires for wear patterns that may indicate suspension damage or misalignment. Verify proper alignment and correct as necessary.
- **Top pad** — Look for cracks or damage. Replace if necessary, see the Component Replacement Section of this publication.
- **Wear and damage** — Inspect all parts of the suspension for wear and damage. Look for bent or cracked parts.

See vehicle manufacturer's applicable publications for other preventive maintenance requirements.

MAIN SUPPORT MEMBER ASSEMBLY BUSHINGS

Bushings should function satisfactorily during normal vehicle operation. However premature bushing wear can occur and will require replacement. The main support member assembly pivot bushing should be replaced if it exhibits excessive fore-aft movement or the vehicle is experiencing excessive tire wear on the rear axle. For instructions on bushing replacement, see the Component Replacement Section of this publication.

U-BOLT LOCKNUTS

1. U-bolt locknuts must be re-torqued at 1,000 miles or first service interval.
2. Thereafter, follow 6 months/20,000 mile inspection and re-torque interval.

NOTE

Hendrickson Truck Suspension Systems U-bolt clamp group hardware for the COMFORT AIR suspension are phosphate and oil coated ¾"-16 UNF Grade C high locknuts and ¾"-16 UNF Grade 8 U-bolts.

⚠ WARNING

IT IS IMPORTANT THAT THE U-BOLT CLAMP GROUP CONNECTION BE PROPERLY ALIGNED AND HAVE THE PROPER TIGHTENING TORQUE VALUES MAINTAINED. METAL SURFACES CAN WORK AND WEAR AGAINST OTHER RELATED CLAMP GROUP COMPONENTS IF NOT PROPERLY ALIGNED OR PROPERLY TIGHTENED TO MAINTAIN THE PROPER CLAMP FORCE. FAILURE TO DO SO CAN CAUSE PREMATURE COMPONENT WEAR, POSSIBLE SEPARATION OF THE CLAMP GROUP, CAUSING LOSS OF VEHICLE CONTROL, PROPERTY DAMAGE, OR PERSONAL INJURY.

FIGURE 6-1

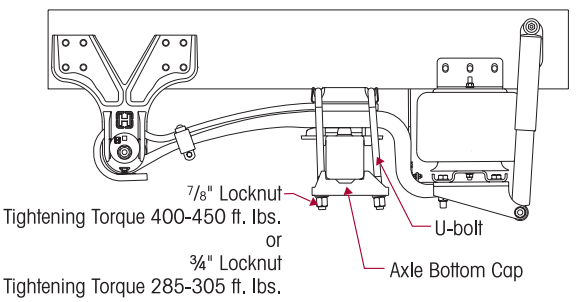
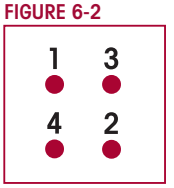


FIGURE 6-2



Tighten the U-bolt locknuts evenly in 50 foot pounds increments in the proper pattern to achieve uniform bolt tension, see Figure 6-2. **DO NOT** EXCEED SPECIFIED TORQUE ON U-BOLT LOCKNUTS.

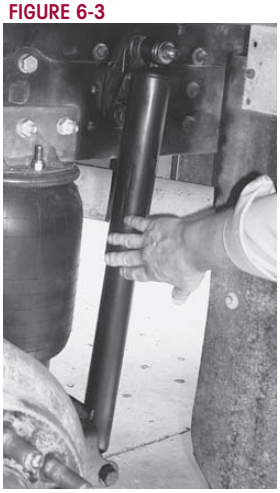
- 19,000 to 23,000 pound capacity equipped with ⅞" locknuts tighten to 400-450 foot pounds torque.
- 15,000 pound capacity equipped with ¾" locknuts tighten to 285-305 foot pounds torque.

SHOCK ABSORBER INSPECTION

Hendrickson uses a long service life, premium shock absorber on all COMFORT AIR suspensions. If shock absorber replacement is necessary, Hendrickson recommends that the shock absorbers be replaced with identical Hendrickson Genuine parts for servicing. Failure to do so will affect the suspension performance, durability, and will void the warranty.

Inspection of the shock absorber can be performed by doing a heat test, and a visual inspection. For instructions on shock absorber replacement see the Component Replacement Section of this publication. It is not necessary to replace shock absorbers in pairs if one shock absorber requires replacement.

FIGURE 6-3



HEAT TEST

1. Drive the vehicle at moderate speeds on rough road for a minimum of fifteen minutes.

WARNING

DO NOT GRAB THE SHOCK AS IT COULD POSSIBLY CAUSE PERSONAL INJURY.

2. Lightly touch the shock body carefully below the dust cover.
3. Touch the frame to get an ambient reference. A warm shock absorber is acceptable, a cold shock absorber should be replaced.
4. To inspect for an internal failure, remove and shake the suspected shock. Listen for the sound of metal parts rattling inside. Rattling of metal parts can indicate that the shock has an internal failure.

VISUAL INSPECTION

Look for these potential problems when doing a visual inspection. Inspect the shock absorbers fully extended. Replace as necessary.

FIGURE 6-4

Damaged upper or lower mount

Damaged upper or lower bushing

Damaged dust cover and/or shock body

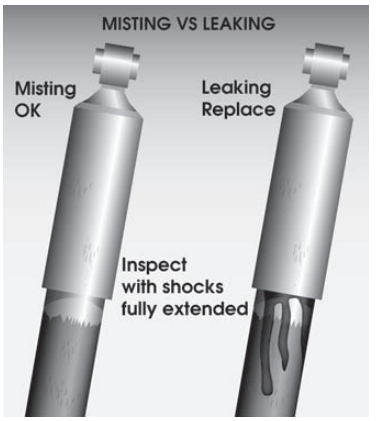
Bent or dented shock

Improper installation example: washers (if equipped) installed backwards.

LEAKING VS. MISTING SHOCK VISUAL INSPECTION

The inspection must not be conducted after driving in wet weather or a vehicle wash. Shocks needs to be free from water. Many shocks are often mis-diagnosed as failures. Misting is the process whereby very small amounts of shock fluid evaporate at a high operating temperature through the upper seal of the shock. When the "mist" reaches the cooler outside air, it condenses and forms a film on the outside of the shock body. Misting is perfectly normal and necessary function of the shock. The fluid which evaporates through the seal area helps to lubricate and prolong the life of the seal.

FIGURE 6-5



A shock that is truly leaking and needs to be replaced will show signs of fluid leaking in streams from the upper seal. These streams can easily be seen when the shock is fully extended, underneath the main body (dust cover) of the shock. Look for these potential problems when doing a visual inspection. Inspect the shock absorbers fully extended. Replace as necessary.

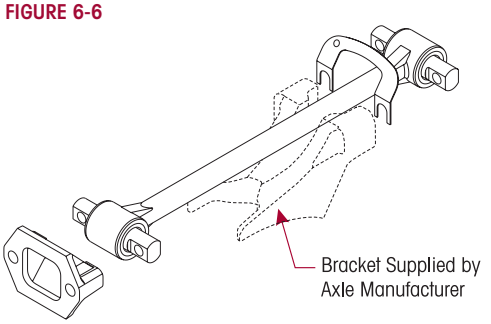
NOTE The COMFORT AIR suspension is equipped with a premium seal on the shock, however this seal will allow for misting to appear on the shock body (misting is not a leak and is considered acceptable).

If the shock is damaged install new shock absorber and replace as detailed in the Component Replacement Section of this publication.

TRANSVERSE TORQUE RODS

The length of the transverse torque rod is determined by the vehicle manufacturer in order to center the axles under the frame. The transverse torque rod maintains lateral axle position during cornering. See Figure 6-6. The mounting bracket at the axle end of the torque rod is furnished and welded into position on the axle housing by the axle or vehicle manufacturer.

FIGURE 6-6



Torque rod end attaching fasteners are furnished by the vehicle manufacturer. It is important that the torque of the nuts be checked during preventive maintenance service. Follow the vehicle manufacturer's specifications for torque values.

All torque rods should be inspected for looseness and torn or shredded rubber. With brakes applied, slowly rock an empty vehicle with power while a mechanic visually checks the action at both ends. Or with the vehicle shut down, a lever check can be made with a long pry bar placed under each rod end and pressure applied.

Torque Rod ends can be renewed by pressing out the worn end, and installing a replacement bushing. A two-piece torque rod is also available to cut and weld to the desired length, see Hendrickson publication no. 59310-001.

NOTE Hendrickson recommends the use of Grade 8 bolts and Grade C locknuts for all torque rod attachments.

SECTION 7

Alignment & Adjustments

RIDE HEIGHT SETTING

Proper ride height is essential for maximum ride quality and performance. Proper adjustment of the height control valve is described below. If the valve or linkage assembly becomes damaged they will require replacement. See the Component Replacement Section of this publication.

1. Place vehicle on level floor.
2. Free and center all suspension joints by slowly moving the vehicle back and forth without applying the brakes. When coming to a complete stop, make sure the parking brakes are released.
3. Chock front wheels of vehicle.
4. Loosen the clamp on the adjustable extension rod.
5. Remove the fasteners at height control valve leveling arm.
6. Verify that air system is at full operating pressure. Exhaust the air in the air springs to relax the suspension. Then refill the air springs to proper ride height.

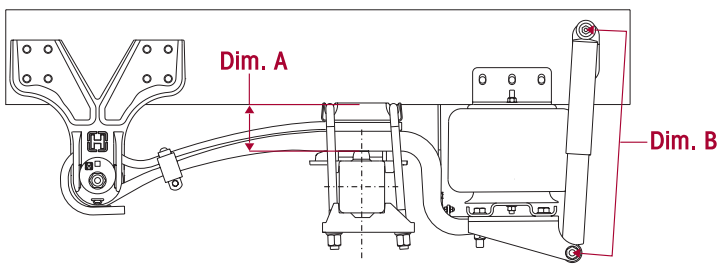
Dimension A

The ride height can be measured at the centerline of the main support member assembly as shown in Figure 7-1. The ride height is 4⅞" ± ¼" at the **A** dimension shown.

Dimension B

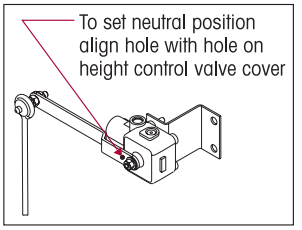
This option to measure the normal running length of the shock absorber will measure the ride height on the shock from center of eye to center of eye, see dimension **B** in Figure 7-1. The specific running length of the shock absorber varies per specific OEM applications as shown in the matrix.

FIGURE 7-1



	DIMENSION A	DIMENSION B
OEM AND MODEL	RIDE HEIGHT From Bottm Of Frame To Bottom Of Main Support Member	SHOCK ABSORBER LENGTH At Ride Height With A Tolerance Of ¼"
BLUE BIRD - RE/QBRE	4⅞"	22.75"
BLUE BIRD - TCFE/CSFE	4⅞"	22.75"
BLUE BIRD - TSFE/CIFE	4⅞"	23"
BLUE BIRD - TCFE FLAT FLOOR	4⅞"	22.75"
BLUE BIRD - A3FE/A3RE/BBCV	4⅞"	22.68"
BLUE BIRD - C4RE	4⅞"	22.75"

FIGURE 7-2



7. Use a ⅛" wooden dowel rod (golf tee) to set the neutral position for the height control valve by aligning hole in leveling arm with hole in control valve cover, as shown in Figure 7-2. **DO NOT** use a metal rod or nail as this may cause damage to the height control valve.
8. Reposition the extension rod in the rubber joint.
9. Attach washer and locknut and tighten to 80-90 inch pounds torque.
10. Tighten clamp on the rubber joint with a screwdriver until securely fastened.

NOTE During cycle operation of the height control valve it is normal to experience a limited amount of exhaust noise.

11. Remove wheel chocks.

ALIGNMENT

Proper alignment is essential for maximum ride quality, performance, and tire service life. The recommended alignment procedure is described below. This procedure should be performed if excessive or irregular tire wear is observed, or any time the Main Support Member Assembly is removed for service.

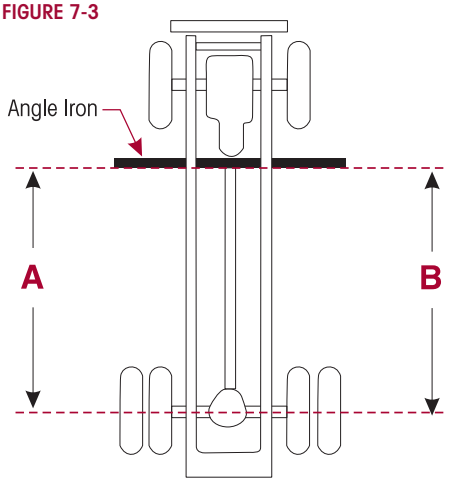
The following procedure should be performed after all repairs are completed.

NOTE It is important to have the QUIK-ALIGN locknut pre-torqued to 100 foot pounds on the left side of vehicle only. All other suspension fasteners tightened to their specified torque values. The total range of adjustment is 1.0".

NOTE Use a new QUIK-ALIGN kit Part No. 60632-001 for any axle alignment or disassembly of the QUIK-ALIGN connection. This ensures proper torque is applied to the connection.

1. Place vehicle on level floor.
2. Free and center all suspension joints by slowly moving the vehicle back and forth without applying the brakes. When coming to a complete stop make sure the parking brakes are released.
3. Chock front wheels of vehicle.

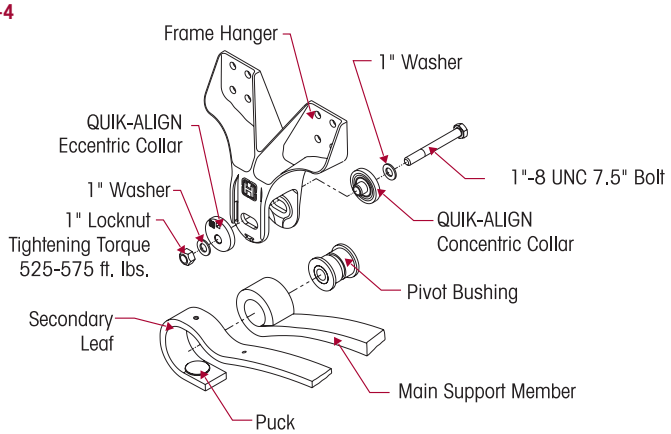
FIGURE 7-3



4. Verify proper ride height is set. For proper ride height setting see Ride Height Setting in this section.
5. Using "C" clamps, securely clamp a six foot piece of STRAIGHT bar stock or angle iron across the lower frame flange as shown in Figure 7-3. Select a location as far forward of the drive axle as possible where components will not interfere.
6. Accurately square straight edge to frame using a carpenter's square.

7. Using a measuring tape, measure from straight edge to forward face of drive axle arm at the centerline of the spring seat on both sides of vehicle as shown in Figure 7-3. If both sides measure within ⅛" of being equal, alignment of drive axle is acceptable. If **A** and **B** differ by more than ⅛" the following procedure must be followed.
   - Loosen the left pivot bolt locknut to snug (100 foot pounds), see Figure 7-4. This will hold the eccentric flanged washer in place against the hanger face, and within the adjustment guide, but loose enough to permit the eccentric flanged washer to rotate freely.
   - Using an alignment tool or ½" square drive breaker bar rotate the left eccentric alignment collar to align axle (Clockwise rotation moves axle forward, counter clockwise rotation moves axle rearward). A 90° rotation of the QUIK-ALIGN collar will move axle fore and aft ± ½" from center.

FIGURE 7-4



WARNING

DO NOT ASSEMBLE QUIK-ALIGN JOINT WITHOUT PROPER FASTENERS. USE ONLY DACROMET PLUS XL PLATED FASTENERS TO SUSTAIN PROPER CLAMP FORCE. FAILURE TO DO SO CAN CAUSE LOSS OF VEHICLE CONTROL, PROPERTY DAMAGE OR PERSONAL INJURY.

ENSURE THAT QUIK-ALIGN FASTENERS TORQUE VALUE IS SUSTAINED AS RECOMMENDED IN THE TORQUE SPECIFICATION SECTION OF THIS PUBLICATION. FAILURE TO SO CAN CAUSE LOSS OF VEHICLE CONTROL RESULTING IN PERSONAL INJURY OR PROPERTY DAMAGE.

- Measure from straight edge to forward face of axle arm to verify both sides of axle are equal and tighten the 1" QUIK-ALIGN locknuts to 525-575 foot pounds torque.

NOTE The Eccentric collar is located on the outside frame on the left side of chassis with the concentric collar on the inside. On the right side of chassis are (2) concentric collars located on the inside and outside of the frame hanger.

NOTE Axle adjustment is applied to LEFT side of vehicle only. If adjustment to the right side of vehicle is necessary, it will require replacement of the outside concentric collar with an eccentric collar (Hendrickson Part No. 64096-000) and repeat step 7 on the right side of vehicle.

8. Following alignment of axle, move vehicle back and forth several times prior to removing straight edge from frame, and recheck measurements to confirm adjustments.
9. Repeat steps 7 and 8 until alignment is achieved.
10. Remove wheel chocks.

SECTION 8
Component Replacement

FRAME HANGER

The frame hanger should function satisfactorily during normal vehicle operation. Replacement is required when the frame hanger is damaged or worn.

DISASSEMBLY

1. Chock wheels of axle.
2. Raise frame of vehicle to remove load from suspension.

⚠ WARNING

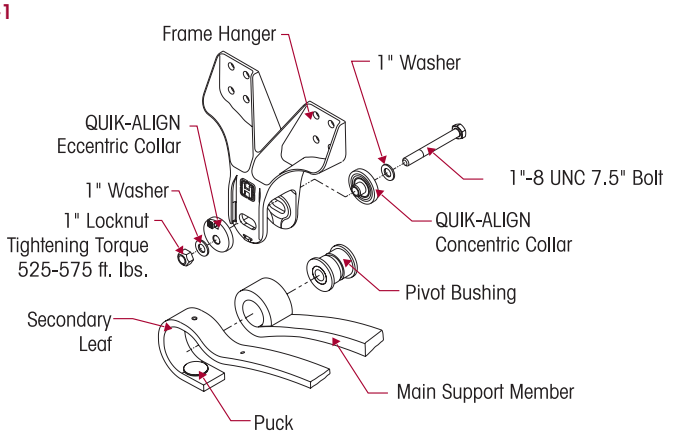
VEHICLE MUST BE FIRMLY SUPPORTED WITH JACK STANDS PRIOR TO SERVICING. FAILURE TO DO SO CAN RESULT IN PERSONAL INJURY OR PROPERTY DAMAGE.

⚠ WARNING

PRIOR TO AND DURING DEFLATION AND INFLATION OF THE AIR SUSPENSION SYSTEM, ENSURE THAT ALL PERSONNEL AND EQUIPMENT ARE CLEAR FROM UNDER THE VEHICLE AND AROUND THE SERVICE AREA, FAILURE TO DO SO CAN CAUSE SERIOUS PERSONAL INJURY, DEATH, OR PROPERTY DAMAGE.

3. See additional Air Spring Cautions and Warnings in the Important Safety Notice Section of this publication prior to deflating or inflating the air system.
4. Verify air is removed from the system.
5. Remove the dacromet locknut and washers, 1" pivot bolt, and QUIK-ALIGN® collars that connect main support member assembly to frame hanger, see Figure 8-1.
6. Remove the fasteners that attach the frame hanger to the vehicle per vehicle manufacturer specifications.
7. Remove frame hanger.

FIGURE 8-1



ASSEMBLY

1. Install new frame hanger by attaching fasteners per vehicle manufacturer specifications.
2. Install the new QUIK-ALIGN collars, new 1" dacromet pivot bolt, washers, and locknut that attach the main support member assembly to the frame hanger. Verify that the nose of each QUIK-ALIGN collar is installed into the pivot-bushing sleeve, and the flanged side is flat against the hanger face within the alignment guides.

NOTE The eccentric collar is located on the outside frame on the left side of chassis with the concentric collar on the inside. On the right side of chassis are (2) concentric collars located on the inside and outside of the frame hanger.

3. Snug the left pivot bolt to 100 foot pounds torque. Tighten the right pivot bolt to 525-575 foot pounds torque.
4. Remove jack stands and lower frame of vehicle.
5. Air up the system.
6. Align the rear axle (see alignment in the Alignment & Adjustments Section of this publication).
7. Remove wheel chocks.

MAIN SUPPORT MEMBER ASSEMBLY

The Main Support Member Assembly should function satisfactorily during normal vehicle operation. Replacement is only required when the Main Support Member Assembly is damaged or worn.

DISASSEMBLY

1. Chock wheels of axle.
2 Raise frame of vehicle to remove load from suspension.

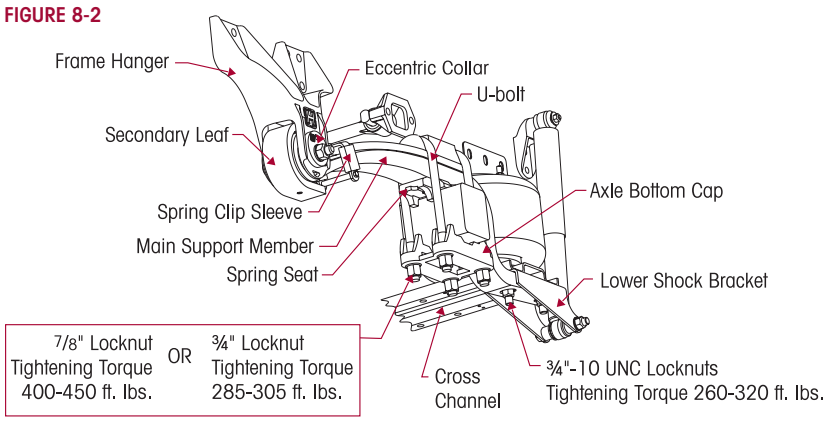
WARNING VEHICLE MUST BE FIRMLY SUPPORTED WITH JACK STANDS PRIOR TO SERVICING. FAILURE TO DO SO CAN RESULT IN PERSONAL INJURY OR PROPERTY DAMAGE.

WARNING PRIOR TO AND DURING DEFLATION AND INFLATION OF THE AIR SUSPENSION SYSTEM, ENSURE THAT ALL PERSONNEL AND EQUIPMENT ARE CLEAR FROM UNDER THE VEHICLE AND AROUND THE SERVICE AREA, FAILURE TO DO SO CAN CAUSE SERIOUS PERSONAL INJURY, DEATH, OR PROPERTY DAMAGE.

3. See additional Air Spring Cautions and Warnings in the Important Safety Notice Section of this publication prior to deflating or inflating the air system.
4. Verify air is removed from the system, and remove height control valve extension rod from valve by removing the fasteners.
5. Mark the position of QUIK-ALIGN collar on the frame hanger.

SERVICE HINT Marking the position will create a starting point for the alignment procedure following assembly.

FIGURE 8-2

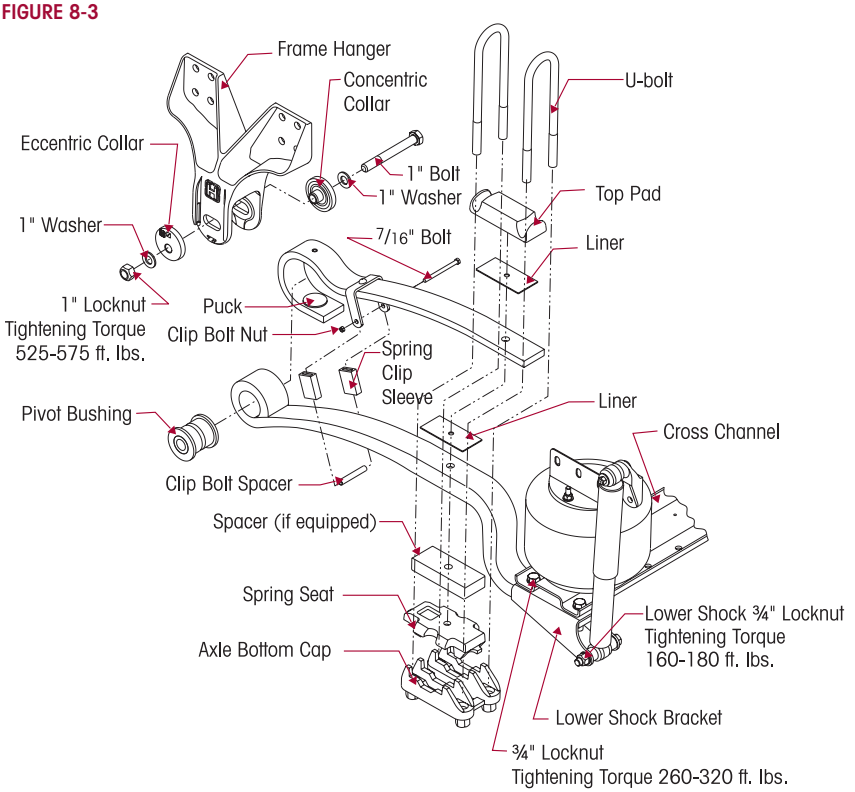


6. Remove the 1" pivot bolt, nut and QUIK-ALIGN collars that connect the main support member assembly to the frame hanger, see Figure 8-2.
7. Remove the U-bolts, locknuts and washers.
8. Remove the axle bottom cap and top pad.
9. Remove the ¾" fasteners that connect the cross channel to both main support assemblies.
10. Lift cross channel off of the main support assemblies with jacks.
11. Lift and rotate the shock absorber and lower mounting bracket away from the main support assembly to be replaced.
12. Remove the main support assembly.

ASSEMBLY

1. Position main support member assembly on spring seat, or on spacer plate (if equipped), with the main support member assembly center dowel pin piloting into hole in spring seat or spacer plate. Galvanized steel liner must be positioned on the topside of the main support member assembly.
2. Assemble the top pad, U-bolts, axle bottom cap, washers and locknuts. **DO NOT TIGHTEN** U-bolt locknuts at this time, see Figure 8-3.

FIGURE 8-3



⚠ WARNING

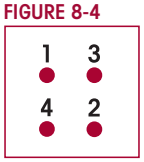
DO NOT ASSEMBLE QUIK-ALIGN JOINT WITHOUT PROPER FASTENERS. USE ONLY DACROMET PLUS XL PLATED FASTENERS TO SUSTAIN PROPER CLAMP FORCE. FAILURE TO DO SO CAN CAUSE LOSS OF VEHICLE CONTROL, PROPERTY DAMAGE OR PERSONAL INJURY.

3. Install NEW QUIK-ALIGN collars, NEW 1" dacromet pivot bolt, washers and locknut. Verify the nose of each QUIK-ALIGN collar is installed into the pivot-bushing sleeve, and the flanged collar is flat against the hanger face within the adjustment guides. **DO NOT TIGHTEN** at this time.

NOTE The eccentric collar is located on the outside frame on the left side of chassis with the concentric collar on the inside. On the right side of chassis are (2) concentric collars located on the inside and outside of the frame hanger.

4. Position shock absorber and lower mounting bracket assembly on main support assembly.
5. Position cross channel on main support assemblies. Install ¾" bolts, washers and locknuts. Tighten to 260-320 foot pounds torque.
6. Snug 1" NEW QUIK-ALIGN locknuts to 100 foot pounds torque.

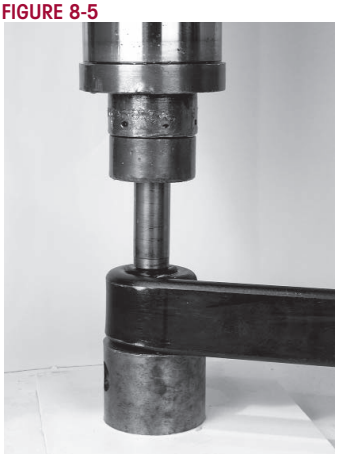
FIGURE 8-4



7. Tighten the U-bolt locknuts evenly in 50 foot pounds increments in proper pattern to achieve uniform bolt tension, see Figure 8-4.
8. Rap the top of U-bolts, and retighten to the proper torque. **DO NOT** EXCEED SPECIFIED TORQUE ON U-BOLT LOCKNUTS. Tighten locknuts to:
   - 19,000 to 23,000 pound capacity equipped with ⅞" locknuts tighten to 400-450 foot pounds torque.
   - 15,000 pound capacity equipped with ¾" locknuts to 285-305 foot pounds torque.
9. Remove jack stands and lower the frame of vehicle.
10. Install upper extension rod stud onto the height control valve arm. Tighten locknut to 80-90 inch pounds torque.
11. Air up the system.
12. Align rear axle (see alignment in the Alignment & Adjustments Section of this publication).
13. Remove wheel chocks.

MAIN SUPPORT MEMBER ASSEMBLY PIVOT BUSHING

FIGURE 8-5



DISASSEMBLY

You will need:

- A vertical shop press with a capacity of at least 10 tons
- A receiving tool and a push out tool, see Special Tools Section of this publication for more information.

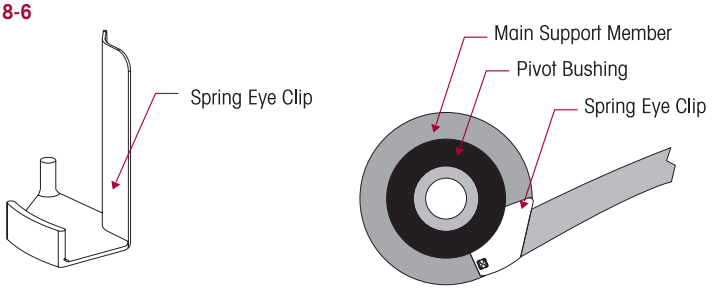
1. Remove the 7/16" bolt, clip bolt spacer and nut from the secondary leaf spring clip.
2. Cut the splicing tape that holds the liners to the center of the main support member assembly and rotate the secondary leaf to clear the spring clip from main support member.

3. Slide the secondary leaf off of the main support member eye.
4. Support the main support member on the receiving tool with the end hub centered on the tool. Be sure the main support member is squarely supported on the press bed, see Figure 8-5.

NOTE

At the time of manufacture, a spring eye clip was used to insert the pivot bushing into the spring eye of the the main support member, see Figure 8-6. If spring eye clip is equipped on the main support member you have the option to carefully press out the bushing from the opposite side of the spring eye (where the spring eye clip is NOT visible). If the spring eye clip is not damaged it can be used again to facilitate the pressing in of the pivot bushing into the spring eye. If clip is damaged use the tape option as shown in Figure 8-7.

FIGURE 8-6

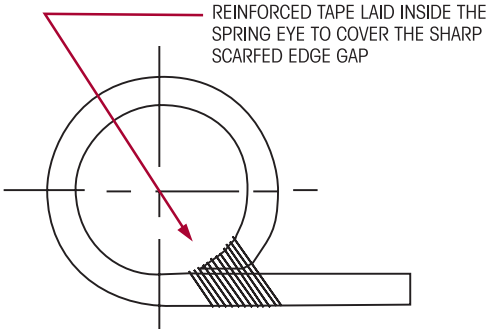


5. Center the push out tool on inner sleeve and press out the old bushing. (These bushings are not cartridge type bushings. They do not have outer metals).
6. Clean and inspect the I.D. of the main support member eye.

ASSEMBLY

1. Insert the spring eye clip (if equipped) into the gap of the main support member eye, (see note above). If spring eye clip is damaged or not present it is necessary to cut a strip of 3M Scotch #890T black fiber tape, or heavy bodied duct tape 1" x 6" long.
2. Feed the tape into the spring eye, adhesive side facing gap in the eye. Center the tape equally around each end.

FIGURE 8-7



3. Pull the tape tight, and wrap it around the outside of the eye. Additional tape may be required depending on gap size. Ensure that the gap is completely covered, see Figure 8-7.
4. Lubricate inner diameter of steel spring bore and the new rubber bushing with a vegetable base oil (cooking oil). **DO NOT** use petroleum or soap base lubricant, it can cause an adverse reaction with the bushing material, such as deterioration.
5. Support the main support member on the receiving tool with the end hub centered on the tool. Be sure the main support member is squarely supported on the press bed.

FIGURE 8-8

6. Locate the push out tool on inner sleeve, and press in the new bushing. Bushings must be centered within the spring eye. When pressing in the new bushings, over-shoot desired final position by 3/16" and press again from opposite side to center the bushing within the main support member assembly, see Figure 8-8.
7. Trim all protruding tape from the underside of the eye. Wipe off excess lubricant. Allow the lubricant four hours to dissipate before operating vehicle.
8. Replace the two nylon pucks inside the secondary leaf eye.
9. Slide secondary leaf around main support member eye and rotate into position.
10. Place one liner between the secondary leaf and the main support member. Place the second liner on top of the secondary leaf and tape the assembly together using two 1" x 12" long strips of splicing tape.

⚠ CAUTION

DO NOT WRAP EXCESSIVE TAPE AROUND THE ASSEMBLY AS THIS WOULD CREATE HIGH SPOTS IN THE CLAMP GROUP. DO NOT WRAP TAPE AROUND THE ASSEMBLY MORE THAN TWICE. FAILURE TO DO SO CAN CAUSE PREMATURE WEAR OR DAMAGE TO THE MAIN SUPPORT MEMBER.

11. Install the 7/16" bolt and nut into the spring clip and tighten to 30-34 foot pounds torque, see Figure 8-3.
12. Replace main support member assembly per instructions in this section.

SPRING SEAT

The spring seat is unlikely to require replacement. In normal use it should function satisfactorily throughout the life of the vehicle. Replacement is required when it is damaged.

DISASSEMBLY

1. Chock wheels of axle.
2. Raise frame of vehicle to remove load from suspension.

⚠ WARNING

VEHICLE MUST BE FIRMLY SUPPORTED WITH JACK STANDS PRIOR TO SERVICING. FAILURE TO DO SO CAN RESULT IN PERSONAL INJURY OR PROPERTY DAMAGE.

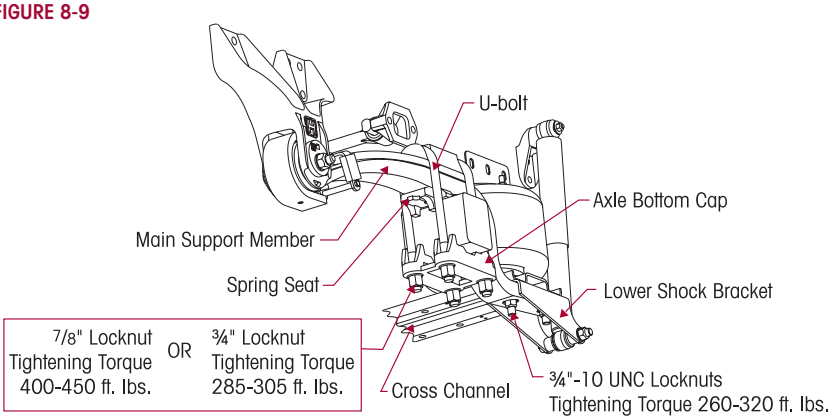
⚠ WARNING

PRIOR TO AND DURING DEFLATION AND INFLATION OF THE AIR SUSPENSION SYSTEM, ENSURE THAT ALL PERSONNEL AND EQUIPMENT ARE CLEAR FROM UNDER THE VEHICLE AND AROUND THE SERVICE AREA, FAILURE TO DO SO CAN CAUSE SERIOUS PERSONAL INJURY, DEATH, OR PROPERTY DAMAGE.

3. See additional Air Spring Cautions and Warnings in the Important Safety Notice Section of this publication prior to deflating or inflating the air system.
4. Verify air is removed from the system, and remove height control valve extension rod from valve by removing fasteners.
5. Remove the U-bolt locknuts and washers, see Figure 8-9.
6. Remove U-bolts, axle bottom cap and top pad.
7. Loosen the 3/4" fasteners that connect the cross channel to both main support assemblies.

8. Lift cross channel and the main support member assembly with a jack.
9. Remove spring seat.

FIGURE 8-9



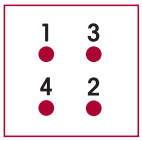
ASSEMBLY

1. Install spring seat on axle in proper direction.
2. Position main support assembly on spring seat, or on spacer plate if so equipped, with main support assembly center dowel pin piloting into hole in spring seat or spacer plate. Delrin liner must be positioned on the topside of the main support member assembly.
3. Assemble U-bolts, axle bottom cap, washers and locknuts. **DO NOT** TIGHTEN U-bolt locknuts at this time.
4. Tighten the ¾" bolts, washers and locknuts that connect the cross channel to the main support member assemblies to 260-320 foot pounds torque.

⚠ WARNING

IT IS IMPORTANT THAT THE U-BOLT CLAMP GROUP CONNECTION BE PROPERLY ALIGNED AND HAVE THE PROPER TIGHTENING TORQUE VALUES MAINTAINED. METAL SURFACES CAN WORK AND WEAR AGAINST OTHER RELATED CLAMP GROUP COMPONENTS IF NOT PROPERLY ALIGNED OR PROPERLY TIGHTENED TO MAINTAIN THE PROPER CLAMP FORCE. FAILURE TO DO SO CAN CAUSE PREMATURE COMPONENT WEAR, POSSIBLE SEPARATION OF THE CLAMP GROUP, CAUSING LOSS OF VEHICLE CONTROL, PROPERTY DAMAGE, OR PERSONAL INJURY.

FIGURE 8-10



5. Tighten the U-bolt locknuts evenly in 50 foot pounds increments in proper pattern to achieve uniform bolt tension, see Figure 8-10.
6. Rap the top of U-bolts, and retighten to the proper torque. **DO NOT** EXCEED SPECIFIED TORQUE ON U-BOLT LOCKNUTS. Tighten locknuts to:
   - 19,000 to 23,000 pound capacity equipped with ⅞" locknuts tighten to 400-450 foot pounds torque.
   - 15,000 pound capacity equipped with ¾" locknuts to 285-305 foot pounds torque.
7. Remove jack stands and lower the frame of vehicle.
8. Install height control valve link on control valve arm. Tighten 5/16" lockwasher and nut to 80-90 inch pounds torque.
9. Air up the system.
10. Remove wheel chocks.

BOTTOM CAP

The bottom cap is unlikely to require replacement. In normal use it should function satisfactorily throughout the life of the vehicle. Replacement is required when it is damaged.

DISASSEMBLY

1. Chock wheels of axle.
2. Raise frame of vehicle to remove load from suspension.

WARNING

VEHICLE MUST BE FIRMLY SUPPORTED WITH JACK STANDS PRIOR TO SERVICING. FAILURE TO DO SO CAN RESULT IN PERSONAL INJURY OR PROPERTY DAMAGE.

WARNING

PRIOR TO AND DURING DEFLATION AND INFLATION OF THE AIR SUSPENSION SYSTEM, ENSURE THAT ALL PERSONNEL AND EQUIPMENT ARE CLEAR FROM UNDER THE VEHICLE AND AROUND THE SERVICE AREA, FAILURE TO DO SO CAN CAUSE SERIOUS PERSONAL INJURY, DEATH, OR PROPERTY DAMAGE.

3. See additional Air Spring Cautions and Warnings in the Important Safety Notice Section of this publication prior to deflating or inflating the air system.
4. Verify air is removed from the system.
5. Remove the U-bolt locknuts and washers.
6. Remove axle bottom cap.

ASSEMBLY

1. Install axle bottom cap on axle in proper direction.
2. Assemble U-bolts, washers and locknuts.

WARNING

IT IS IMPORTANT THAT THE U-BOLT CLAMP GROUP CONNECTION BE PROPERLY ALIGNED AND HAVE THE PROPER TIGHTENING TORQUE VALUES MAINTAINED. METAL SURFACES CAN WORK AND WEAR AGAINST OTHER RELATED CLAMP GROUP COMPONENTS IF NOT PROPERLY ALIGNED OR PROPERLY TIGHTENED TO MAINTAIN THE PROPER CLAMP FORCE. FAILURE TO DO SO CAN CAUSE PREMATURE COMPONENT WEAR, POSSIBLE SEPARATION OF THE CLAMP GROUP, CAUSING LOSS OF VEHICLE CONTROL, PROPERTY DAMAGE, OR PERSONAL INJURY.

3. Tighten the U-bolt locknuts evenly in 50 foot pounds increments in proper pattern to achieve uniform bolt tension, see Figure 8-10.
4. Rap the top of U-bolts, and retighten to the proper torque. **DO NOT** EXCEED SPECIFIED TORQUE ON U-BOLT LOCKNUTS. Tighten locknuts to:
   - 19,000 to 23,000 pound capacity equipped with ⅞" locknuts tighten to 400-450 foot pounds torque.
   - 15,000 pound capacity equipped with ¾" locknuts to 285-305 foot pounds torque.
5. Remove jack stands and lower the frame of vehicle.
6. Air up the system.
7. Remove wheel chocks.

AIR SPRING

DISASSEMBLY

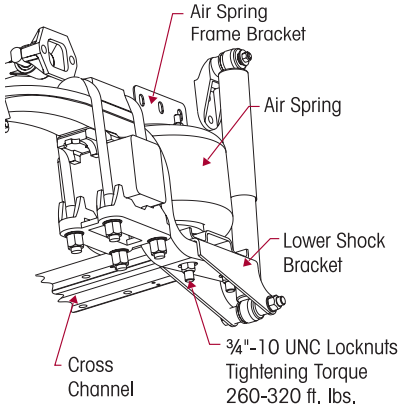
1. Chock wheels of axle.
2. Raise frame of vehicle to remove load from suspension.

WARNING VEHICLE MUST BE FIRMLY SUPPORTED WITH JACK STANDS PRIOR TO SERVICING. FAILURE TO DO SO CAN RESULT IN PERSONAL INJURY OR PROPERTY DAMAGE.

WARNING PRIOR TO AND DURING DEFLATION AND INFLATION OF THE AIR SUSPENSION SYSTEM, ENSURE THAT ALL PERSONNEL AND EQUIPMENT ARE CLEAR FROM UNDER THE VEHICLE AND AROUND THE SERVICE AREA, FAILURE TO DO SO CAN CAUSE SERIOUS PERSONAL INJURY, DEATH, OR PROPERTY DAMAGE.

3. See additional Air Spring Cautions and Warnings in the Important Safety Notice Section of this publication prior to deflating or inflating the air system.
4. Verify air is removed from the system.

FIGURE 8-11



5. Remove the ½" fasteners that connect air spring to the cross channel, see Figure 8-11.
6. Remove air line from air spring.
7. Remove brass fittings from air spring.
8. Remove the ½" fasteners that connect air spring to the upper air spring hanger.
9. Remove air spring.

ASSEMBLY

1. Install air spring in upper air spring hanger by inserting stud into hole and attach the ½" washer and locknut.
2. Install air spring in spring seat by inserting stud into hole and attach the ½" washer and locknut.
3. Tighten ½" locknuts to 20-30 foot pounds torque.
4. Install brass fitting in air spring using Teflon thread seal.
5. Connect air line to air spring.
6. Remove jack stands and lower frame of vehicle.
7. Air up system.
8. Remove wheel chocks.

CROSS CHANNEL

DISASSEMBLY

1. Chock wheels of axle.
2. Raise frame of vehicle to remove load from suspension.

WARNING VEHICLE MUST BE FIRMLY SUPPORTED WITH JACK STANDS PRIOR TO SERVICING. FAILURE TO DO SO CAN RESULT IN PERSONAL INJURY OR PROPERTY DAMAGE.

WARNING

PRIOR TO AND DURING DEFLATION AND INFLATION OF THE AIR SUSPENSION SYSTEM, ENSURE THAT ALL PERSONNEL AND EQUIPMENT ARE CLEAR FROM UNDER THE VEHICLE AND AROUND THE SERVICE AREA, FAILURE TO DO SO CAN CAUSE SERIOUS PERSONAL INJURY, DEATH, OR PROPERTY DAMAGE.

3. See additional Air Spring Cautions and Warnings in the Important Safety Notice Section of this publication prior to deflating or inflating the air system.
4. Verify air is removed from the system.
5. Remove the ½" fasteners that connect air springs to the cross channel, and push air springs out of cross channel.
6. Remove the ¼" fasteners that connect the lower linkage mounting bracket to the cross channel. See Parts Lists Section of this publication.
7. Remove the ¾" fasteners that connect the cross channel to the main support member assemblies.
8. Remove cross channel.

ASSEMBLY

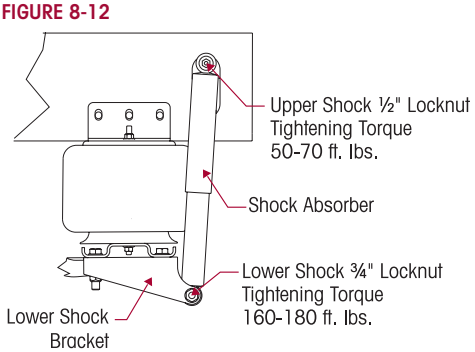
1. Install the cross channel to the lower shock brackets and main support member assemblies by attaching the ¾" bolts, washers and locknuts. Tighten to 260-320 foot pounds torque.
2. Install air springs in cross channel by inserting studs into appropriate holes and attach washers and locknuts. Tighten ½" locknuts to 20-30 foot pounds torque.
3. Install the lower linkage mounting bracket to the cross channel by attaching the ¼" bolts, washers and locknuts. Tighten ¼" locknuts to 40-50 inch pounds torque.
4. Remove jack stands and lower frame of vehicle.
5. Air up system.
6. Remove wheel chocks.

SHOCK ABSORBER

DISASSEMBLY

1. Remove the ½" fasteners, that connect shock absorber to frame hanger, see Figure 8-12.
2. Remove the ¾" fasteners that connect shock absorber to lower shock bracket.
3. Remove shock absorber.

FIGURE 8-12



ASSEMBLY

1. Install shock absorber to frame bracket stud by attaching ½" washers and locknut. Washers must be installed on each side of shock absorber bushing.
2. Install shock absorber to lower shock bracket by attaching the ¾" bolt, washers, and locknut.
3. Tighten ½" locknut to 50-70 foot pounds torque, and ¾" locknut to 160-180 foot pounds torque.

UPPER SHOCK BRACKET

DISASSEMBLY

1. Remove the ½" fasteners, that connect shock absorber to upper shock bracket.
2. Remove the ¾" fasteners that connect shock absorber to lower shock bracket.
3. Remove shock absorber.
4. Remove the fasteners that attach the upper shock frame bracket per vehicle manufacturer specifications.
5. Remove frame bracket.

ASSEMBLY

1. Install the upper shock bracket by attaching the fasteners per vehicle manufacturer specifications.
2. Install shock absorber to upper shock bracket stud by attaching ½" washers and locknut. Washers must be installed on each side of shock absorber bushing.
3. Install shock absorber to lower shock bracket by attaching the ¾" bolt, washers, and locknut.
4. Tighten ½" locknut to 50-70 foot pounds torque, and ¾" locknut to 160-180 foot pounds torque.

LOWER SHOCK BRACKET

DISASSEMBLY

1. Chock wheels of axle.
2. Raise frame of vehicle to remove load from suspension.

WARNING

VEHICLE MUST BE FIRMLY SUPPORTED WITH JACK STANDS PRIOR TO SERVICING. FAILURE TO DO SO CAN RESULT IN PERSONAL INJURY OR PROPERTY DAMAGE.

WARNING

PRIOR TO AND DURING DEFLATION AND INFLATION OF THE AIR SUSPENSION SYSTEM, ENSURE THAT ALL PERSONNEL AND EQUIPMENT ARE CLEAR FROM UNDER THE VEHICLE AND AROUND THE SERVICE AREA, FAILURE TO DO SO CAN CAUSE SERIOUS PERSONAL INJURY, DEATH, OR PROPERTY DAMAGE.

3. See additional Air Spring Cautions and Warnings in the Important Safety Notice Section of this publication prior to deflating or inflating the air system.
4. Verify air is removed from the system.
5. Remove the ½" fasteners that connect the shock absorber to the upper frame bracket.
6. Remove the ¾" fasteners that connect the shock absorber to the lower bracket, see Figure 8-12.
7. Remove the shock absorber.
8. Remove the ¾" fasteners that connect the cross channel and lower shock bracket to the main support member assembly on the affected side. Loosen the ¾" bolts, washers and locknuts on the opposite side.
9. Remove lower shock bracket.

ASSEMBLY

1. Install the lower shock bracket to the cross channel and main support member assembly by attaching the ¾" bolts, washers and locknuts. Tighten ¾" locknuts to 260-320 foot pounds torque.

2. Install shock absorber to frame bracket stud by attaching washers and ½" locknut. Washers must be installed on each side of shock absorber bushing.
3. Install shock absorber to lower shock bracket by attaching the ¾" bolt, washers, and locknut.
4. Tighten ½" locknut to 50-70 foot pounds torque, and ¾" locknut to 160-180 foot pounds torque.
5. Remove jack stands and lower frame of vehicle.
6. Air up system.
7. Remove wheel chocks.

HEIGHT CONTROL VALVE

DISASSEMBLY

1. Chock wheels of axle.
2. Raise frame of vehicle to remove load from suspension.

WARNING

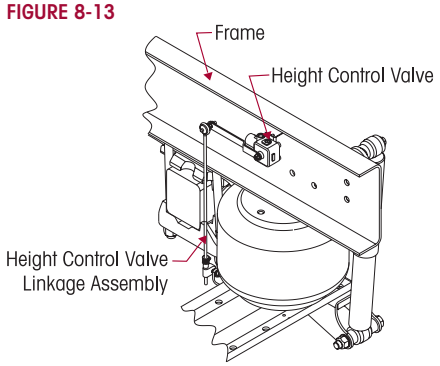
VEHICLE MUST BE FIRMLY SUPPORTED WITH JACK STANDS PRIOR TO SERVICING. FAILURE TO DO SO CAN RESULT IN PERSONAL INJURY OR PROPERTY DAMAGE.

WARNING

PRIOR TO AND DURING DEFLATION AND INFLATION OF THE AIR SUSPENSION SYSTEM, ENSURE THAT ALL PERSONNEL AND EQUIPMENT ARE CLEAR FROM UNDER THE VEHICLE AND AROUND THE SERVICE AREA, FAILURE TO DO SO CAN CAUSE SERIOUS PERSONAL INJURY, DEATH, OR PROPERTY DAMAGE.

3. See additional Air Spring Cautions and Warnings in the Important Safety Notice Section of this publication prior to deflating or inflating the air system.
4. Verify air is removed from the system.
5. Remove the 5/16" fasteners that attach the extension rod to the height control valve arm.
6. Remove the air lines from the height control valve.
7. Remove the brass fittings from the height control valve.
8. Remove the ¼" fasteners, that attach the height control valve to the frame mounting bracket.
9. Remove the height control valve, see Figure 8-13.

FIGURE 8-13



ASSEMBLY

1. Install the height control valve to the frame mounting bracket by attaching the 5/16" washers and locknuts. Tighten to 80-90 inch pounds torque.
2. Install brass fittings into height control valve using Teflon thread seal.
3. Install air lines to height control valve.
4. Install the height control valve link assembly to the height control valve arm by attaching the 5/16" washer and locknut. Tighten to 80-90 inch pounds torque.
5. Remove jack stands and lower frame of vehicle.
6. Air up system.

7. Verify proper ride height, (see Ride Height Setting in the Alignment & Adjustments Section of this publication).
8. Remove wheel chocks.

TRANSVERSE TORQUE ROD

DISASSEMBLY

1. Chock the wheels.
2 Remove the ⅝" fasteners that connect the transverse torque rod to the frame bracket and axle.
3. Remove transverse torque rod.

ASSEMBLY

NOTE Hendrickson requires the use of Grade 8 bolts and Grade C locknuts be used for all torque rod attachments.

1. Install transverse torque rod by attaching the ⅝" bolts, washers, and locknuts to the frame bracket and axle. See manufacturers for torque specifications.
2. Verify lateral axle alignment, and correct with drop in shims between the torque rod bar pin and the frame or axle bracket depending on the direction of alignment.
3. Remove wheel chocks.

TRANSVERSE TORQUE ROD BUSHING

DISASSEMBLY

You will need:

- A vertical press with a capacity of at least 10 tons
- A receiving tool, see Special Tools Section of this publication

⚠ CAUTION

DO NOT USE HEAT OR USE A CUTTING TORCH TO REMOVE THE BUSHINGS FROM THE TORQUE ROD. THE USE OF HEAT WILL ADVERSELY AFFECT THE STRENGTH OF THE TORQUE ROD, HEAT CAN CHANGE THE MATERIAL PROPERTIES. A COMPONENT DAMAGED IN THIS MANNER CAN RESULT IN THE LOSS OF VEHICLE CONTROL AND POSSIBLE PERSONAL INJURY OR PROPERTY DAMAGE.

1. Remove transverse torque rod as detailed in this section.
2. Support the torque rod end on the receiving tool with the end tube of torque rod centered on the tool. Be sure the torque rod is squarely supported on the press bed.
3. Push directly on the bushing straddle mount bar pin until top of the bushing is level to the top of torque rod end tube. Press until the bushing clears the torque rod end tube.
4. Clean and inspect the inner diameter of the torque rod ends, removing any nicks with an emery cloth or a rotary sander, see Figure 8-14.

ASSEMBLY

1. Lubricate the inner diameter of the torque rod ends and the new rubber bushings with a vegetable base oil (cooking oil), see Figure 8-15.

NOTE **DO NOT** use petroleum or soap base lubricant, it can cause and adverse reaction with the bushing, such as deterioration of the rubber.

5. Press in the new bushings. Support the torque rod end tube on the receiving tool with the end tube of torque rod centered on the receiving tool.

NOTE

The straddle mount bar pin bushings must have the mounting flats positioned at zero degrees to shank of the torque rod.

6. Press directly on the straddle mount bar pin of bushing. The rubber bushings of the bar pin must be centered within the torque rod end tubes.
7. When pressing in the new bushings, overshoot the desired final position by approximately 3/16", see Figure 8-16.
8. Press the bushing again from opposite side to center the bar pin within the torque rod end, see Figure 8-17.
9. Wipe off excess lubricant. Allow the lubricant four hours to dissipate before operating vehicle.

CAUTION

IF THE TORQUE ROD ASSEMBLY IS NOT ALLOWED THE ALLOTTED TIME FOR THE LUBRICANT TO DISSIPATE, THE BUSHING MAY SLIDE FROM THE TORQUE ROD END TUBE. THE BUSHING WILL THEN NEED TO BE REMOVED AND A NEW BUSHING RE-INSTALLED.

10. Replace torque rod assembly as detailed in this section.

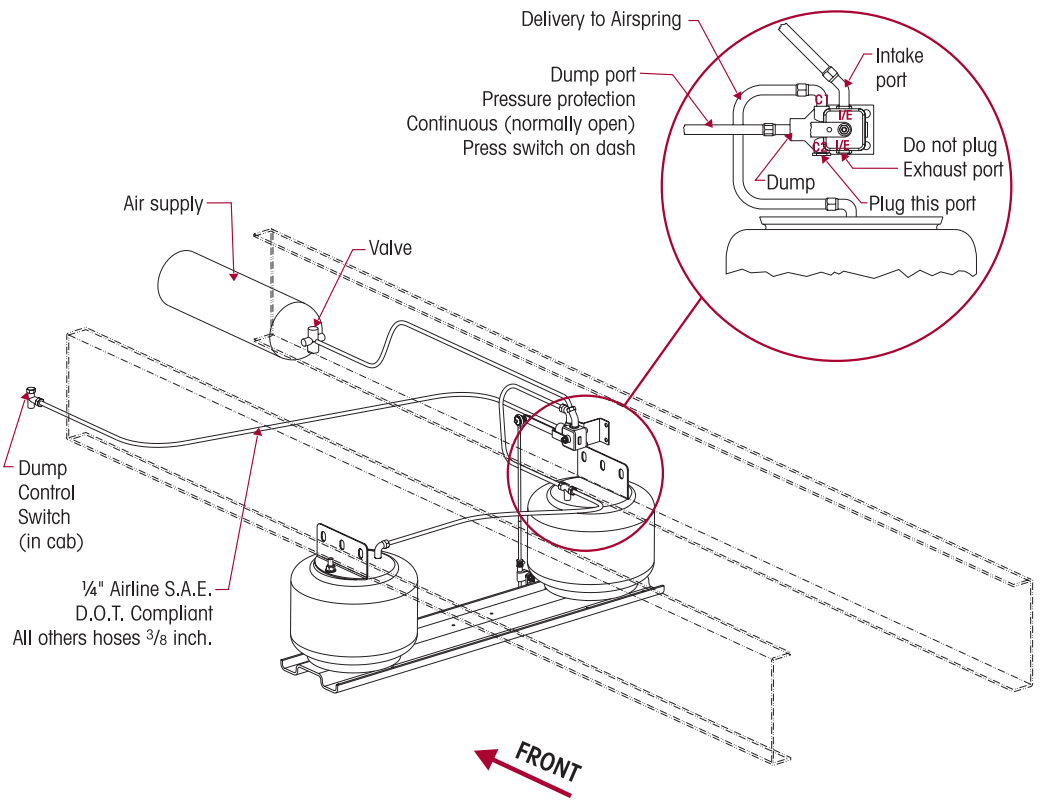
FIGURE 8-14

FIGURE 8-15

FIGURE 8-16

FIGURE 8-17

SECTION 9
Plumbing Diagram

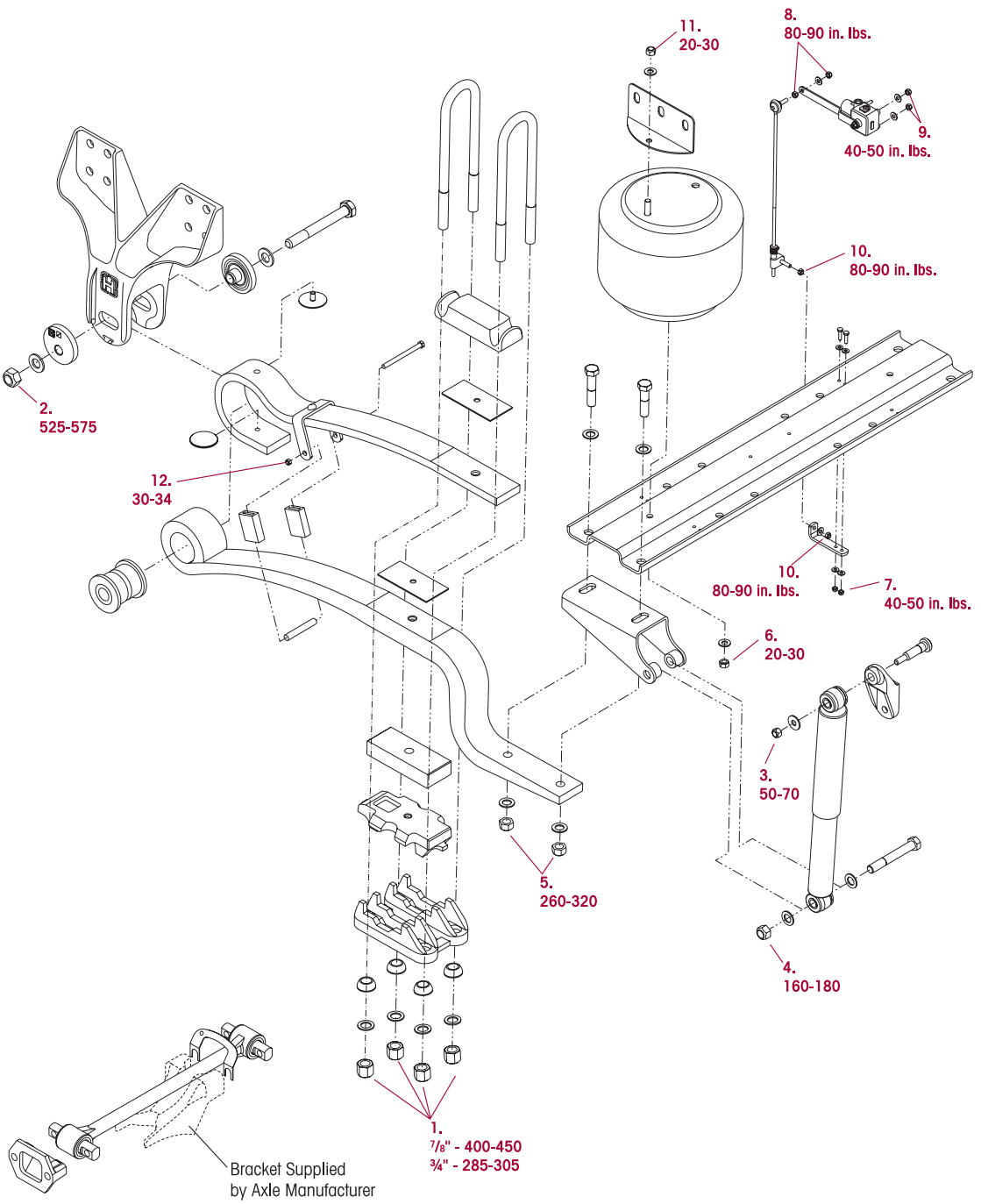


SECTION 10
Troubleshooting Guide

COMFORT AIR TROUBLESHOOTING GUIDE		
CONDITION	**POSSIBLE CAUSE**	**CORRECTION**
Vehicle bouncing excessively	Leaking shock absorber	Replace shock absorber
	Damaged shock absorber	Replace shock absorber
	Air spring(s) not inflated	Check air supply to air spring, repair as necessary
	Incorrect ride height	Adjust ride height to proper setting. See Ride Height Setting in the Alignment & Adjustments Section of this publication
Suspension has harsh or bumpy ride	Broken main support member assembly	Replace main support member assembly
	Damaged height control valve	Replace height control valve
Excessive driveline vibration	Incorrect ride height	Adjust ride height to proper setting. See Ride Height Setting in the Alignment & Adjustments Section of this publication
	Broken main support member assembly	Replace main support member assembly
	Air spring(s) not inflated	Check air supply to air spring, repair as necessary
Vehicle leans	Broken main support member assembly	Replace main support member assembly
	Axle connection not torqued correctly	Perform U-bolt retorque procedure. See Torque Specifications Section of this publication
	Worn pivot bushing	Replace pivot bushing
	Air spring(s) not inflated	Check air supply to air spring, repair as necessary
Suspension is noisy	Loose QUIK-ALIGN attachment	Replace QUIK-ALIGN connection and check suspension alignment. Check frame hanger for wear around QUIK-ALIGN plates and replace if necessary
	Loose U-bolts	Perform U-bolt retorque procedure. See Torque Specifications Section of this publication
	Worn main support member eye spacers	Replace worn main support member eye spacers (pucks)
	Worn main support member clip spacers	Replace worn main support member clip spacers (sleeves)
Irregular tire wear	Worn pivot bushing	Replace pivot bushing
	Loose QUIK-ALIGN attachment	Replace QUIK-ALIGN connection and check suspension alignment. Check frame hanger for wear around QUIK-ALIGN plates and replace if necessary

SECTION 11
Torque Specifications

RECOMMENDED TORQUE VALUES PROVIDED IN FOOT POUNDS



COMFORT AIR®

HENDRICKSON RECOMMENDED TORQUE SPECIFICATIONS				
NO	**COMPONENT**	**QUANTITY**	**SIZE**	**TORQUE VALUE (in foot pounds)**
	*Frame fasteners furnished and installed by truck manufacturer			
1	U-bolt (high locknut) 19,000 to 23,000 lb. Capacity	8	⅞"	400-450
	U-bolt (high locknut) 15,000 lb. Capacity	8	¾"	285-305
2	QUIK-ALIGN® Locknut	4	1"	525-575
	⚠ WARNING DO NOT ASSEMBLE QUIK-ALIGN JOINT WITHOUT PROPER FASTENERS. USE ONLY DACROMET PLUS XL PLATE FASTENERS TO MAINTAIN PROPER CLAMP FORCE. FAILURE TO DO SO CAN CAUSE LOSS OF VEHICLE CONTROL, PROPERTY DAMAGE OR PERSONAL INJURY.			
3	Shock Absorber to Upper Shock Bracket	2	½"	50-70
4	Shock Absorber to Lower Shock Bracket	2	¾"	160-180
5	Cross Channel to Main Support Member	4	¾"	260-320
6	Air Spring to Cross Channel	2	½"	20-30
7	HCV Linkage Bracket to Cross Channel	2	¼"	40-50 in. lbs.
8	HCV Linkage to Height Control Valve Arm	2	5/16"	80-90 in lbs.
9	Hight Control Valve to Frame Bracket	2	¼"	40-50 in. lbs.
10	HCV Linkage to HCV Linkage Bracket	2	5/16"	80-90 in. lbs.
11	Air Spring to Frame Bracket	2	½"	20-30
12	Main Support Member Spring Clip	2	7/16"	30-34

NOTE: * Torque values listed above apply only if Hendrickson supplied fasteners are used. If non-Hendrickson fastenres are used, follow torque specification listed in the vehicle manufacturer's service manual.

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Overview

The standard air brakes system on the Blue Bird All American Rear Engine utilizes Meritor cam-operated drum brakes, with captive spring brake chambers on the rear axle providing parking brake and safety backup functions. A gear driven Wabco, Bendix or Midland air compressors mounted on the engine operates whenever the engine is running. A governor monitors system air pressure and switches the compressor between load and unload modes to maintain a normal operating pressure range within the storage tanks.

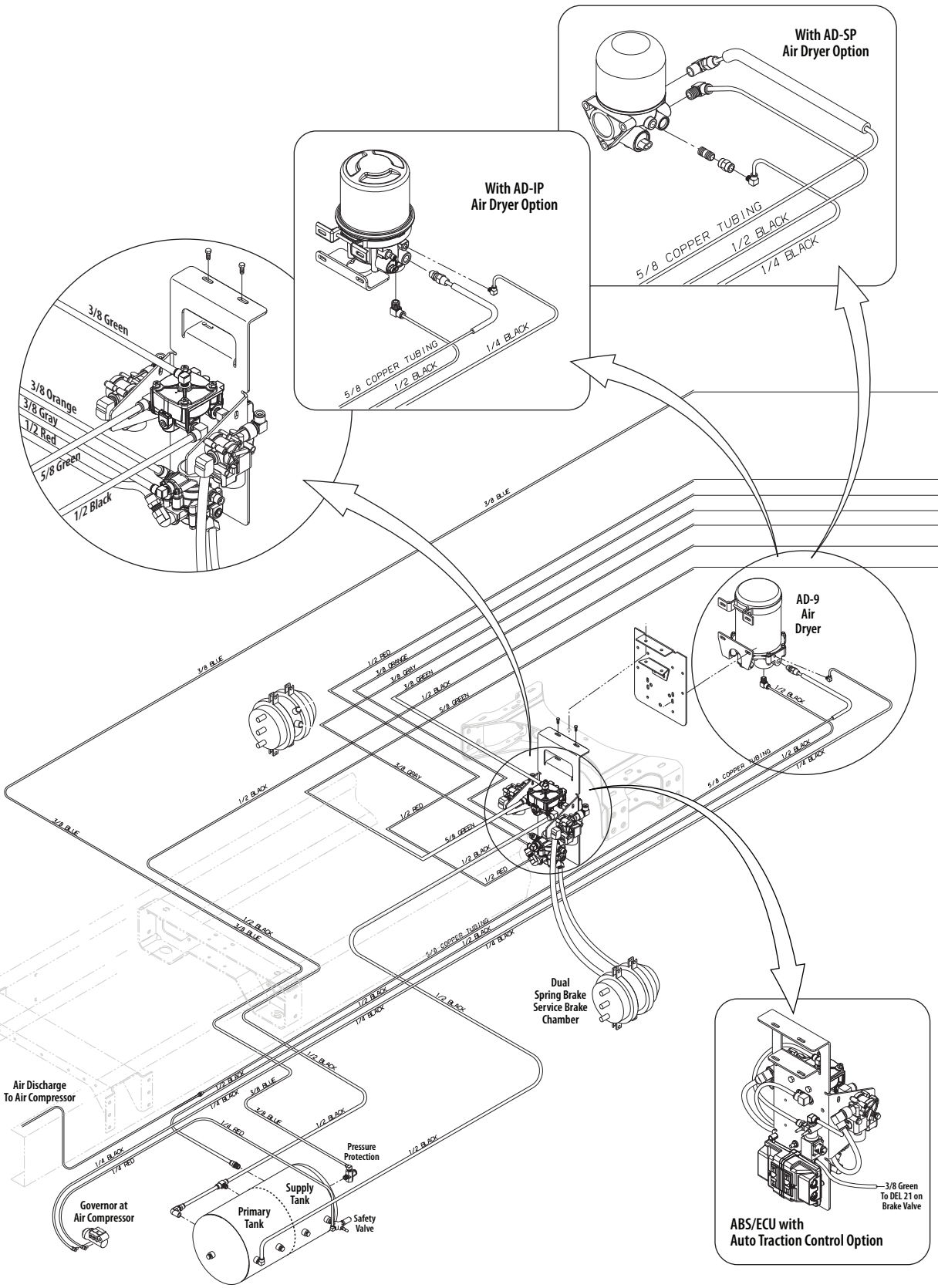
As air is compressed, moisture vapor tends to condense inside the storage tanks. The tanks are equipped with drain valves to allow removal of this built-up moisture. Some buses are equipped with an air dryer to assist collection and expulsion of the excess moisture. Air from the compressor passes through the air dryer before passing into the storage tank. The storage tanks are mounted under the bus, inboard the frame rails, and on buses equipped with an air dryer, the dryer is mounted inboard of the frame rails.

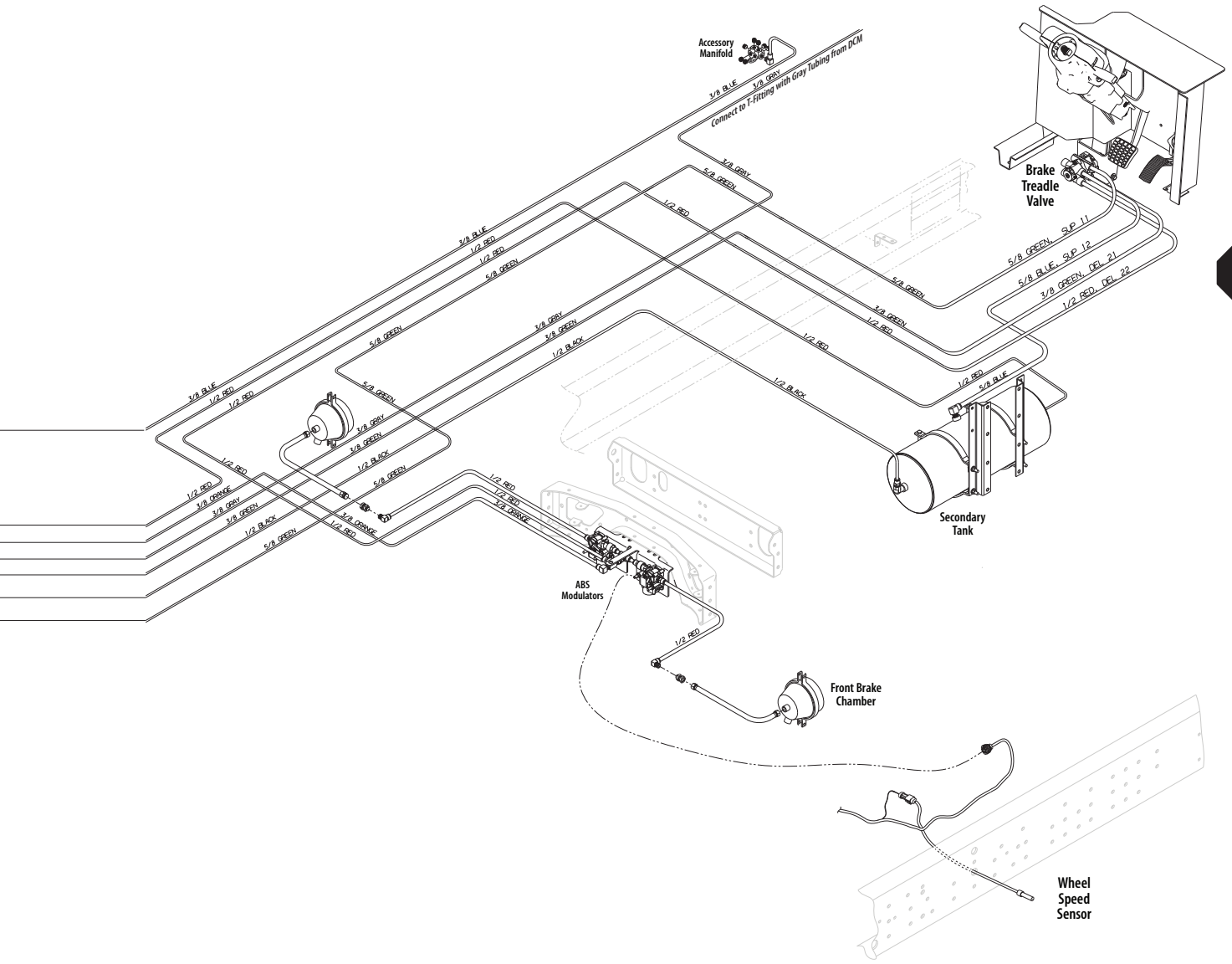
The system is divided into two separate circuits; one for rear brakes (primary) and one for front (secondary). The brake treadle valve receives pressure from both the primary and secondary tanks. The treadle valve directly controls the pressure and volume of air delivered to the front brakes. However, for the rear brakes, the treadle valve provides a signal only, which actuates a relay valve mounted to the frame crossmember just forward of the rear axle. The relay valve receives the pressure and volume of air needed to operate the rear brakes directly from the primary tank, and controls that supply in response to the signals it receives from the treadle valve.

At each wheel, air pressure is delivered to a closed brake chamber, which encases a diaphragm. The increased pressure behind the diaphragm results in an increased mechanical advantage to move a pushrod, which rotates the shaft of an S-cam situated between the ends of two brake shoes. As the S-cam rotates, it spreads the brake shoes, pushing their friction linings against the inner wall of the drum converting the kinetic energy of the bus into heat to slow or stop the wheel.

Over time, as the friction linings of the brake shoes wear, the push rods of the brake chambers must travel farther in order to actuate the brakes. To compensate for this normal wear of the brake shoes, the push rod of each brake chamber is connected to the S-cam by way of a slack adjuster; a ratcheting mechanism which incrementally and automatically takes up the linkage slack as the brake shoes wear.

An important concept in air brake systems is the matter of releasing air pressure in order to release the brake. Generally speaking, when brakes are applied, a valve is opened to allow air pressure to activate a brake chamber. However, simply closing the valve thereafter does not release the brakes, because the air pressure that activated them is still present in the chambers. A means must be provided to quickly release the captive pressure when the driver releases the brake pedal. On the secondary (front brake) circuit of the All American, this is accomplished through an exhaust port on the treadle valve. When the treadle is released that delivery port will open to the exhaust port allowing the brakes to release. On the rear, the relay valve performs the quick release function.


With AD-SP
Air Dryer Option
5/8 COPPER TUBING
1/2 BLACK
1/4 BLACK
With AD-IP
Air Dryer Option
5/8 COPPER TUBING
1/2 BLACK
1/4 BLACK
3/8 Green
3/8 Orange
3/8 Gray
1/2 Red
5/8 Green
1/2 Black
3/8 BLUE
AD-9
Air
Dryer
1/2 BLACK
5/8 COPPER TUBING
1/2 BLACK
1/4 BLACK
1/2 RED
3/8 ORANGE
3/8 GRAY
3/8 GREEN
1/2 BLACK
5/8 GREEN
5/8 GRAY
1/2 RED
5/8 GREEN
1/2 BLACK
1/2 RED
3/8 BLUE
1/2 BLACK
5/8 COPPER TUBING
1/2 BLACK
1/4 BLACK
1/2 BLACK
Dual
Spring Brake
Service Brake
Chamber
Air Discharge
To Air Compressor
1/2 BLACK
1/4 BLACK
3/8 BLUE
1/2 BLACK
1/4 RED
1/4 BLACK
1/4 RED
Pressure
Protection
1/2 BLACK
Governor at
Air Compressor
Supply
Tank
Primary
Tank
Safety
Valve
3/8 Green
To DEL 21 on
Brake Valve
ABS/ECU with
Auto Traction Control Option



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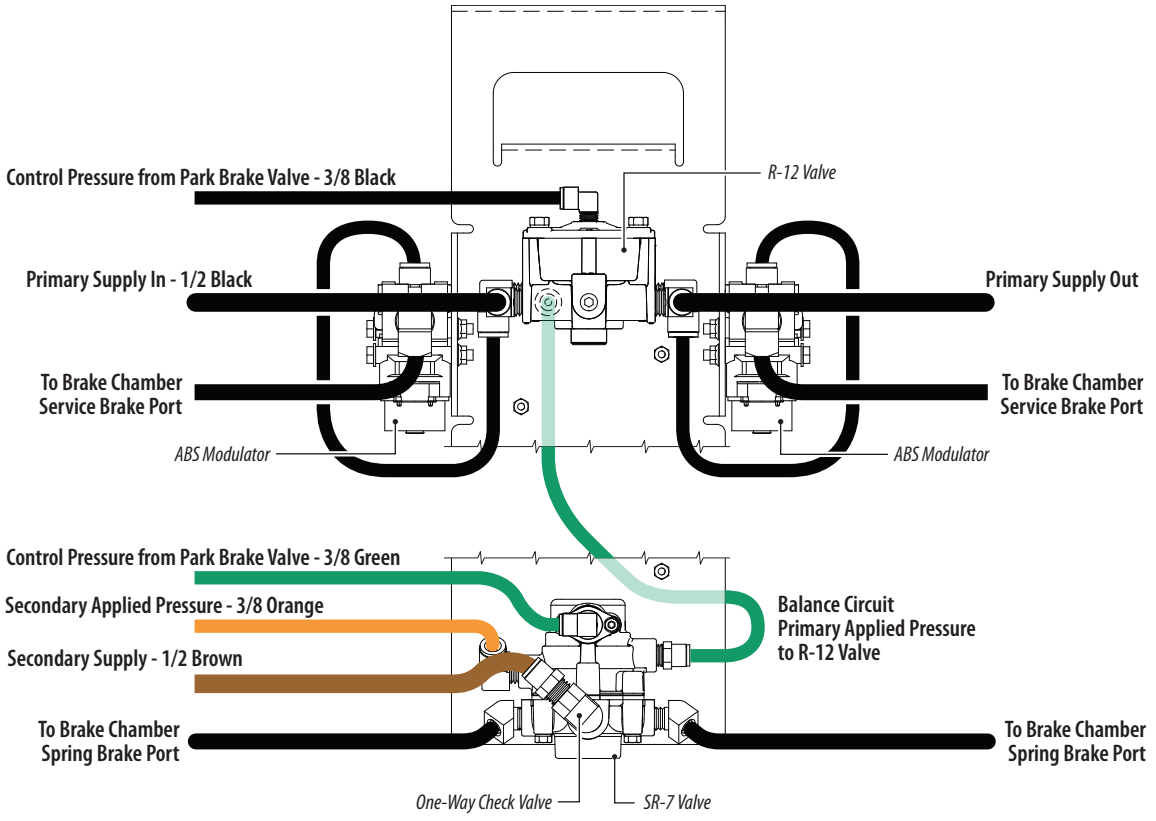
Sheet 1

See RE, SR-7 Detail, on Sheet 2

Air Brake Diagram



RE, SR-7 Detail, Rear View

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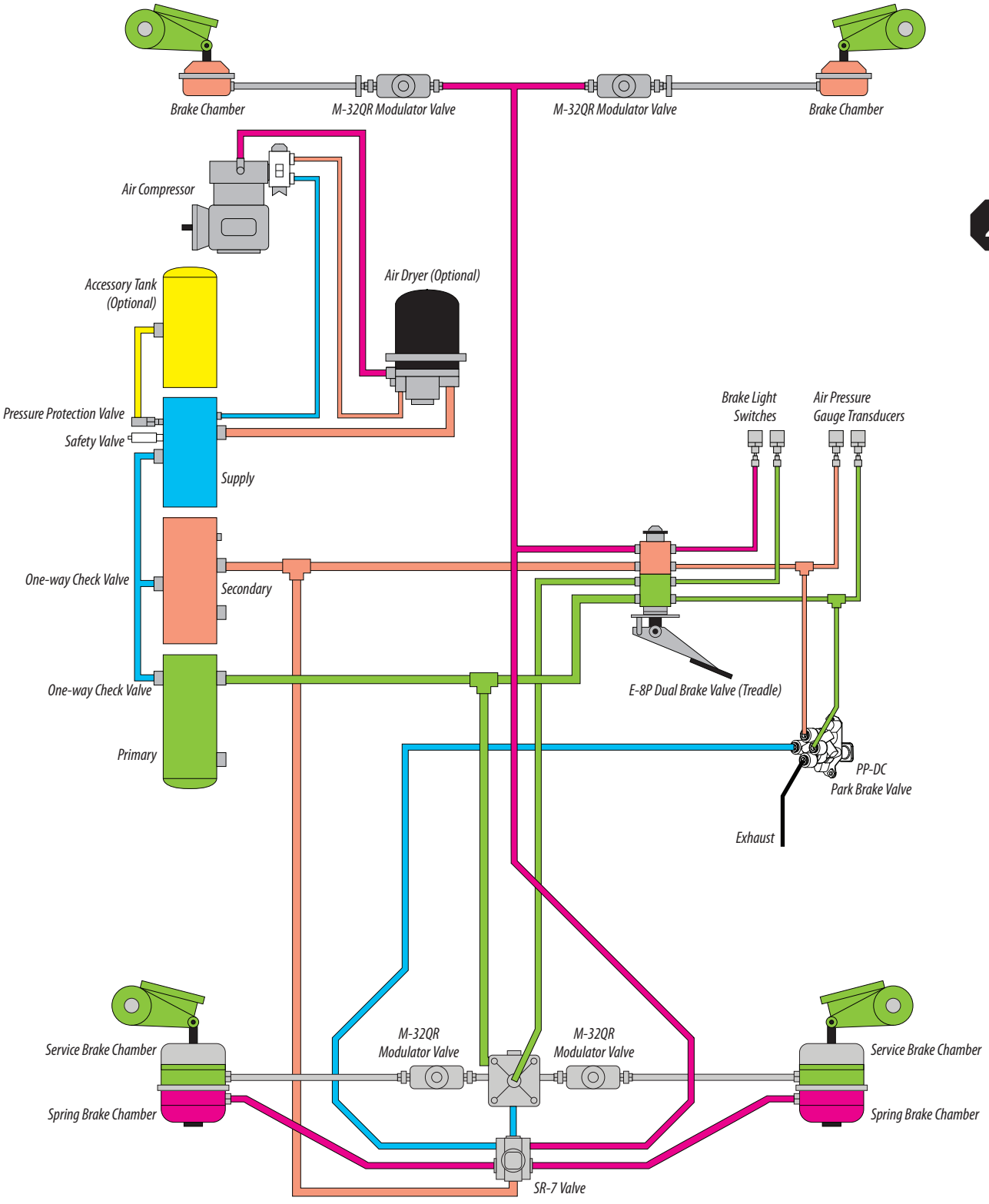
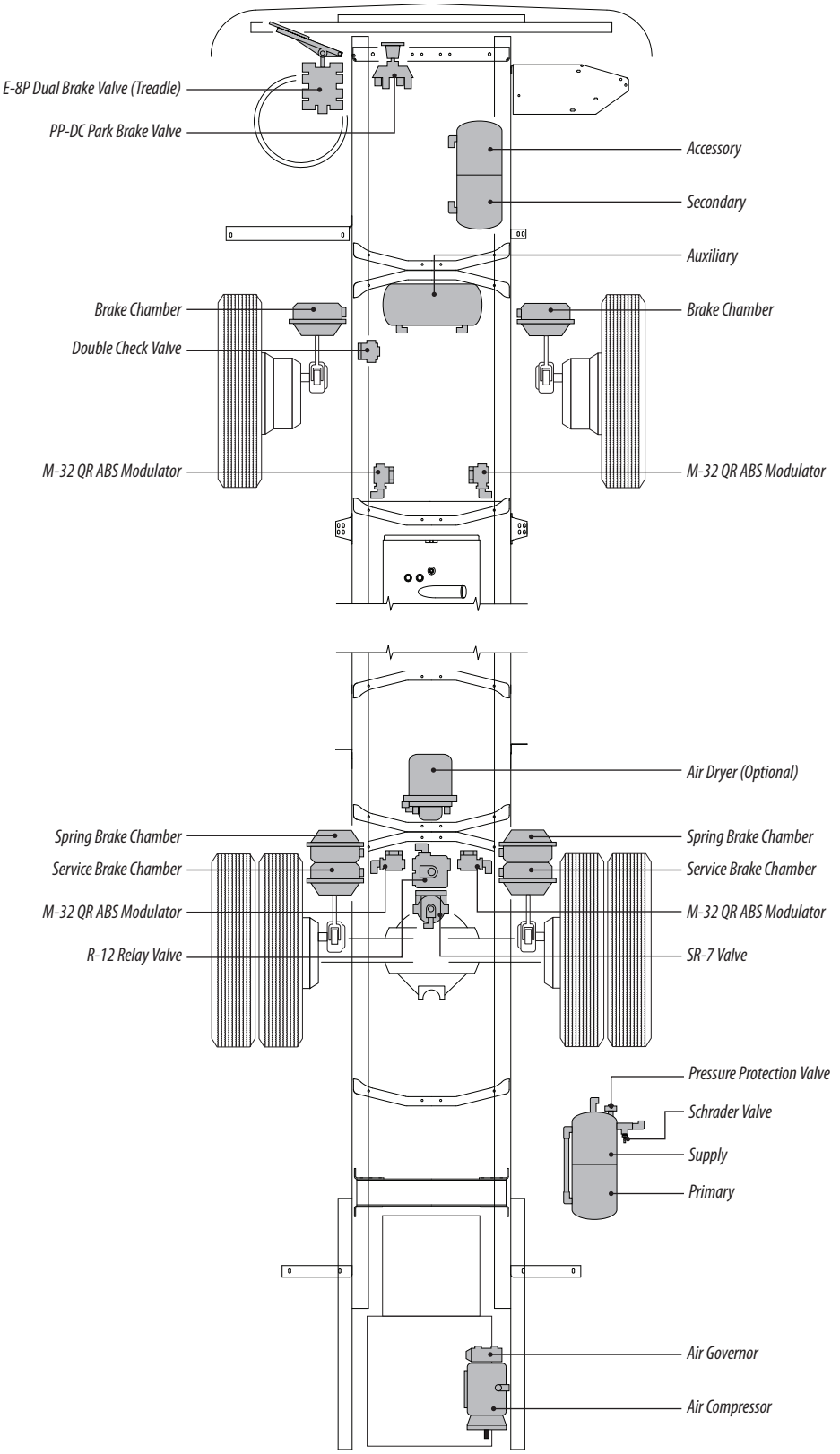
Sheet 2

See Air Brakes, RE, w/SR-7 Valve on Sheet 1



Air Brakes, Typical System



Air Brake Components

Before reaching the brake chambers at the front wheels, each of the two output lines connect to an ABS modulator valve mounted on the inboard side of the frame rails near the wheel. For the rear brakes, left and right modulator valves are mounted directly to the two output ports of the relay valve. Thus, there are four ABS modulator units, one for each wheel. Lines from the modulators then proceed to the chambers.

The modulator valves incorporate quick release valves of their own, which can aid in exhausting pressure from the brake chambers. But their primary function is to independently modulate braking pressure to each wheel in order to minimize wheel lock during braking.

The modulators receive electric signals from the ABS Electronic Control Unit (ECU) mounted on a crossmember forward of the rear axle. The ECU is a computer which monitors electric signals it receives from wheel speed sensors mounted at each wheel, and uses this information to determine when excessive wheel slip or wheel lock up (and, therefore, loss of traction) is about to occur. When the ECU makes such a determination, it signals the ABS modulator(s) for the affected wheel(s) to adjust the air pressure being applied to the wheel(s), using high frequency pulses. This helps maintain maximum traction by optimizing wheel slip between the tire and the road and minimizing wheel lock up.

Parking brake and emergency brake function is provided by the rear axle brake chambers (MGM Type 30). Unlike the front chambers (MGM Type 20L), each rear chamber incorporates two mechanisms by which to extend their pushrods; one powered by air pressure during normal driving as described above (service brakes) and the other powered by a heavy duty spring enclosed in the brake chamber (spring brakes). The spring brakes provide rear braking in the case of primary brake system failure, and also perform as normal parking brakes. Whenever system air pressure is within normal operating range and the parking brake control valve is pushed in, air pressure compresses the rear brake chamber springs, preventing them from actuating the rear brakes (the springs are "caged"). The park brake control valve receives it's supply from both the primary and secondary air supply. If primary or secondary pressure is absent, a double check valve incorporated inside the park brake valve (PP-DC) will direct the remaining system pressure to the park brake control valve thus the park brakes will remain caged. In the case of primary brake system failure, the spring brake valve dumps the pressure which cages the springs brakes in proportion to the amount of pressure the driver applies to the brake pedal.This condition is referred to as "spring brake modulation." A warning buzzer and light are activated in the driver's area.

When the driver pulls the dash-mounted Park Brake control valve (Bendix PP-DC), the delivery port in the PP-DC valve is open to the exhaust port fully dumping the air caging the spring brakes, thereby causing them to apply and serve as parking brakes. Sufficient prssure, approximately 60 psi, must be available from the PP-DC valve to cauge the spring brakes. This prevents the parking brakes from being released until system pressure is adequate for normal service brake operation.

Appendixes In This Chapter

Appendix 1. AD-9 Air Dryer. This Bendix Service Data Sheet describes in detail the function of the AD-9 Air Dryer, covers inspection and maintenance, and includes a troubleshooting chart.

Appendix 2. PP-DC Park Valve. This Bendix Service Data Sheet describes in detail the function of the PP-DC, and includes inspection and testing procedures. Blue Bird does not recommend rebuilding of damaged air brake system valves.

Appendix 3. SR-7 Spring Brake Valve. This Bendix Service Data Sheet describes in detail the SR-7, and includes inspection and testing procedures. Blue Bird does not recommend rebuilding of damaged air brake system valves.

Appendix 4. EC-60 ABS Controller Module. This Bendix Service Data Sheet describes in detail the EC-60, including blink code diagnostics and troubleshooting charts.

Appendix 5. Meritor Cam Brakes and Automatic Slack Adjusters. Meritor Maintenance Manual No. 4 describes function, inspection, and maintenance and adjustment of the cam brake assemblies and automatic slack adjusters.

On TechReference DVD

The TechReference DVD includes Bendix Service Data Sheets on the valves listed below. These documents provide detailed descriptions of the functioning of the valves, inspection proceedures, and troubleshooting. Note that Blue Bird does not recommend rebuilding of damaged air brake system valves.

- **E-8P Dual Brake Valve.**
- **R-12 Relay Valve.**
- **M-32QR Antilock Modulator Valve**
- **WS-24 Wheel Speed Sensor**
- **AD -IP Air Dryer**
- **Haldex Slack Adjuster**

Maintenance Overview

Wear and service life of brake system components varies according to the operating conditions of the vehicle. Regular inspections and attentiveness to any unusual pedal feel (abruptness or sponginess), or sounds (for example, unusual air releases) is especially important. Air brake system maintenance includes items in all these categories:

- Daily tasks such as purging the air tanks to remove moisture and in cold climates, inspecting the system purge valves for freezing.
- Regularly scheduled inspection of brake chamber push rod travel and automatic slack adjuster operation according to intervals in the Scheduled Maintenance section.
- Routine maintenance of consumables such as replacement of Air Dryer desiccant and/or filters. Service life will vary according to operating conditions.
- Replacement or renewal of normal wear parts such as brake shoes and rotors.
- Careful inspection of all air lines and fittings, checking for cracked, abraded, kinked, loose, or otherwise damaged lines.
- Inspection of components for proper operation. Blue Bird does not recommend disassembly or rebuilding of air brake valves and other components. When a component is found defective, replace it with a new or remanufactured unit.

WARNING ***Never attempt to disassemble a brake chambers, even when it contains no compressed air. The spring brake chambers enclose very powerful coil springs held under high mechanical compression. Any attempt to disassemble the brake chamber can result in injury or death.***

When working on the air brake system, always follow these precautions in addition to those in the Warnings and Cautions section:

- Park the vehicle on a level surface, stop the engine, and chock the wheels securely. Remember, during servicing, the brakes will not be available to prevent the bus from rolling.
- If wheel end components are to be serviced which require wheel removal, support the bus by proper jack stands under the frame rails. Do not rely upon a jack to support the bus during servicing.
- Fully drain all air tanks .before removing any air lines, fittings, or components. Never remove an air line which is under pressure. Never remove a component or plug unless you are certain all system pressure has been depleted.
- Disconnect the negative battery terminal. Some air brake system components have electrical connections.
- Never exceed recommended pressures and always wear safety glasses.
- Never re-use air lines, fittings, or connections which appear to be marginal, faulty, insecure, or leaking. When in doubt, replace the line and fitting.

Brake Interlock

As a safety feature, All Americans equipped with wheelchair lift doors incorporate an interlock system designed to automatically apply the rear service brakes and limit engine RPM to idle when the lift door is open. The main components of the interlock system include a pressure regulator valve, a double check valve and an air operated solenoid valve. The valves are mounted as one unite between the frame rails and between the front and rear axle.

The pressure regulator valve, supplied by the rear service brake tank, provides approximately 40 psi of air pressure to the normally-closed solenoid valve.

The solenoid valve's coil is electrically connected through a speed sensing switch to a switch located at the lift door. With the door in the open position a signal from the door switch will activate the normally-closed solenoid valve. The valve will open providing a signal pressure to the rear service brake R-12 relay valve thus applying the rear service brakes. The brakes will be applied as long as the left door is open and the override switch is off.

Air Compressor

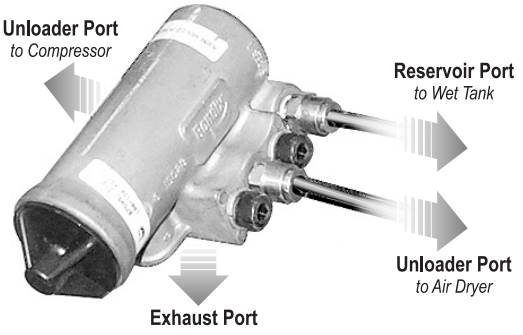
The Blue Bird All American's air compressor is a gear driven unit with turbocharged intake, and is mounted to the left side of the engine. Depending on engine application the air system will be equipped with a compressor selected by the engine manufacturer to best suite their engine.

Being directly gear driven by the engine, the air compressor turns continually while the engine is running. But the actual compression of air is cycled on (load mode) or off (unload mode) by an unloading valve in the compressor. This maintains a normal operating range of pressure within the system. The pressures at which the compressor switches between load and unload modes are set by the governor, mounted on the compressor or remote mounted close to the compressor with air lines connecting the governor to the compressor.

Servicing

As an integral part of the engine package, the compressor is installed by the engine manufacturd. For additional general information on the air compressor, refer to the engine manufactures manual supplied with your vehicle.

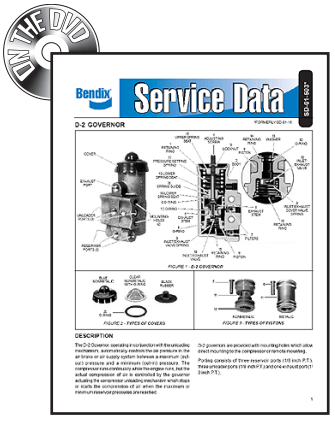
Air Compressor Governor (D-2)



The Bendix D-2 air compressor governor operates in conjunction with the unloading mechanism of the compressor to automatically keep the air pressure in the system between 100 and 120 psi.

The governor's porting includes a reservoir port, which connects to the wet tank; unloader ports which connect to the compressor's unloader mechanism and to the air dryer's control port; and an exhaust port which opens to the atmosphere.

Air pressure from the All American supply tank enters the D-2's reservoir ports and acts upon a piston in opposition to a pressure setting spring. When the pressure from the tanks is sufficient to overcome the tension of the spring, an inlet/exhaust valve integrated in the piston closes the exhaust and opens the inlet passage. Air pressure can then pass around the inlet valve, through the piston and out the unloader port to activate the unloader mechanism of the compressor. This unload pressure also travels to the air dryer to open the purge valve, allowing the air dryer to expel accumulated moisture and contaminates.



Bendix D-2 Governor

Bendix Publication SD-01-503

When the system reservoir pressure drops to the level insufficient to overcome the pressure setting spring, the spring moves the piston to close the inlet valve and open the exhaust. This allows air in the unloader line to escape back through the piston and out the exhaust port. The compressor goes into load mode and begins compressing air to raise the system pressure in the supply tank.

On the All American, the governor is set to maintain system pressure between 100 and 120 psi. When the system pressure drops to 100 psi, the governor de-activates the compressor's unloader mechanism. When system pressure rises to 120 psi, the governor activates the compressor's unloader mechanism.

Servicing

Bendix recommends performing operating and leakage tests on the D-2 governor every 6 months, 50,000 miles, or 1800 hours; whichever comes first. Instructions for leak and operating tests are provided in Air Brakes Appendix 1.

Troubleshooting

Conditions that may indicate problems with the D-2 governor include:

- Over pressure of the system. The compressor fails to go into unload mode when system pressure reaches 120 psi.
- Under pressure of the system. The compressor fails to go into load mode when system pressure drops to 100 psi.

Adjustment

The activation pressure of the D-2 governor is adjustable by means of an adjustment screw under the plastic cap in the end of the governor body. Note that adjustment affects both the cut-in and cut-out pressures. The pressure difference or range between cut-in and cut-out will remain constant and is not adjustable. Before deciding to adjust the governor pressure setting, be sure to check the system cut-in and cut-out pressures with an accurate test gauge. To adjust the D-2 governor:

1. Unscrew the top cover from the governor, exposing the adjusting screw. The adjusting screw is slotted on its outer end.

2. Loosen the adjusting screw locknut.

3. To raise the pressure setting, turn the adjusting screw counter-clockwise. To lower the pressure setting, turn the adjusting screw clockwise. Be careful not to overadjust. Each quarter turn of the adjusting screw raises or lowers the pressure setting approximately 4 psi.

4. When proper adjustment is obtained, tighten the adjusting screw locknut and replace the cover.

Removal

Some governors may be remote mounted with varying removal procedures. The D-2 governor is fastened to the compressor body by two Allen-head bolts, one on each side of the rear side unloader port. To remove:

1. Block and securely hold vehicle by means other than air brakes.

2. Drain the air brake system by opening the purge valve at the bottom of the air tank.

3. Disconnect the air tank line from the reservoir port.

4. Disconnect from the unloader port the line which leads to the air dryer.

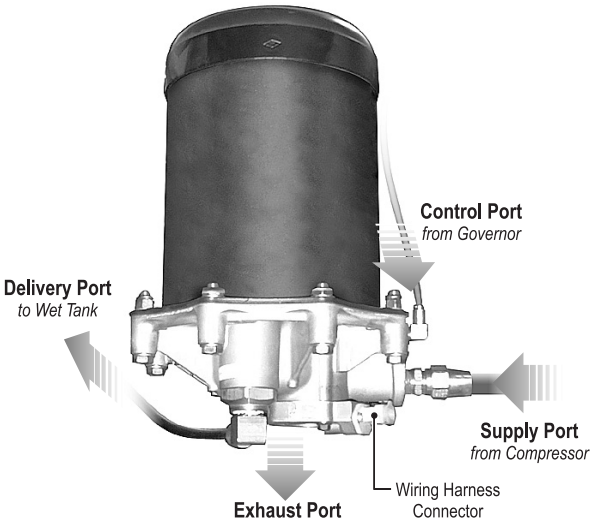
5. Remove the two Allen head bolts and carefully remove the governor, taking care not to damage the rubber gasket.

Installation

Reverse the removal steps. If the gasket was damaged during removal, replace it with a new gasket. Torque the mounting bolts to 18–20 ft. lbs. (24.4–27.1 Nm).

Air Dryer (Optional)

Your All American may be equipped with an air dryer. Two of Bendix air dryer models are the AD-SP integral purge dryer and the AD-9. The two dryers are similar in function. The main difference is that the AD-SP contains a desiccant cartridge which can be changed without removing the dryer assembly.



The air dryer operates in two modes, depending on whether the compressor is in load mode (compressing air) or unload mode (not compressing).

When the compressor is in load mode, the air dryer operates in its charge cycle. Air from the compressor enters the supply port of the air dryer. In the body of the air dryer, the air changes direction several times, reducing its temperature and causing contaminates to collect in the dryer's internal sump. The air continues its flow into a cartridge containing two filtering stages. The first stage is an oil separator, which removes water in liquid form as well as oil and solid contaminates. The second stage is a desiccant drying bed. Water vapor contained in the air flowing through the desiccant column is attracted to and condenses upon the surfaces of the desiccant particles.

Dry air exits the air dryer through a check valve and proceeds to the wet tank reservoir, ready for use by the system.

When system pressure reaches the cutout setting of the governor, the governor pressurizes its unloader ports, which signals the compressor to switch to unload mode (stop compressing) and signals the air dryer to switch to its purge cycle. Control pressure from the governor enters the air dryer's control port, causing a purge valve to open the air dryer's exhaust port and an initial audible burst of air is heard as moisture, oil, and contaminates are expelled. The purge valve remains open (after the audible burst) as long as the control pressure from the governor is present. A check valve in the delivery port prevents pressurized air from the supply tank from backing up into the dryer, but the air still inside the dryer reverses direction, flows back through the desiccant column, serving to remove most of the water adhering to the desiccant. Thus, the purge process effectively reactivates the desiccant. Generally 15–30 seconds are required for the entire purge volume to pass back through the desiccant drying bed. The purge valve assembly of the air dryer incorporates an electric heating element and thermostat to prevent freezing in cold climates.

Servicing & Inspection

Over time, the desiccant cartridge becomes less effective and eventually must be replaced. Actual service life is highly dependent upon operation conditions and climate. A noticeable increase of moisture in the air tanks may be an indication the desiccant may require replacement. Blue Bird recommends inspecting the air dryer every 3 months or 25,000 miles, whichever occurs first. Bendix lists three years as typical cartridge life and recommends replacement at intervals of 10,800 hours, 300,000 miles, or 36 months if conditions does not require replacement before this interval.

- Whenever purging the air tanks (see Scheduled Maintenance section), watch for unusual amounts of moisture accumulation. In climates and seasons in which ambient temperatures vary more than 30 degrees in a day, small amounts of moisture due to condensation inside the tanks should not be considered an indication that the dryer is not performing properly. Similarly, trace amounts of oil in the system may be normal and should not, in itself, be considered a reason to replace the desiccant; oil stained desiccant can function adequately, but excessive oil contamination of the desiccant would require replacement.
- In cold months, visually inspect the air dryer's exhaust port for signs of freezing, which may indicate improperly functioning heating of the purge valve.

Air Brakes appendix 1 (Bendix publications SD-08-2412 for AD-9) contain additional helpful information on testing, cleaning, and inspection.

Removal (AD-9)

The AD-9 dryer must be removed to replace its internal desiccant cartridge.

1. Park the bus on a level surface and apply the parking brake. Stop the engine. Chock wheels to prevent movement. Disconnect the negative terminal of the battery.

2. Open the wet tank purge valve to drain the air brake system to 0 psi.

3. Disconnect the heater/thermostat electric connector from the air dryer's purge valve assembly.

4. Identify and disconnect the air lines connected to the air dryer at the delivery port (leads to wet tank), control port (leads to governor), and supply port (leads to compressor).

5. Loosen the 5/16 horizontal bolt and nut securing the upper mounting strap to the upper mounting bracket. It is not necessary to completely remove the nut and bolt. The nut is a special nut with an extended threaded shank which inserts into the mounting hole, allowing the clamp to be loosened sufficiently.

6. Remove the two 3/8" bolts mounting the air dryer body to the lower mounting bracket. Mark the locations of these two bolts on the body of the air dryer to aid in orienting the dryer correctly on re-installation.

7. Remove the air dryer by pulling the bottom flange clear of the lower mounting bracket tabs and slipping the dryer downward from inside the upper mounting clamp.

Installation

1. Slide the upper body of the dryer up into the upper mounting clamp. Position the bottom flange on top of the tabs of the lower mounting bracket. The dryer should rest on top of the bracket's mounting tabs, not fasten below them.

2. Install the two lower mounting bolts, four special washers, and two lock nuts. Tighten to 270–385 in. lbs. (30.5–43.5 Nm).

3. Tighten the upper clamp's bolt and nut to 80–120 in. lbs. (9–13.5 Nm).

4. Connect the air lines connected to the air dryer at the delivery port (leads to wet tank), control port (leads to governor), and supply port (leads to compressor).

5. Connect the heater/thermostat electric connector to the air dryer's purge valve assembly.

6. Before returning the Blue Bird All American to service, perform the operation and leakage tests in Appendix 1.

Air Tanks

The supply (wet tank), primary (rear brake reservoir), and secondary (front brake reservoir) air tanks are separate air supplies with separate functionality.

The supply tank receives dry air from the delivery port of the air dryer (or from the compressor, if not equipped with an air dryer) through a fitting at the front end of the tank assembly. The secondary and primary tanks receive air from the supply tank through one-way check valves (90 degree elbow/check valve with arrow indicating air flow) located on the end of the tank assembly.

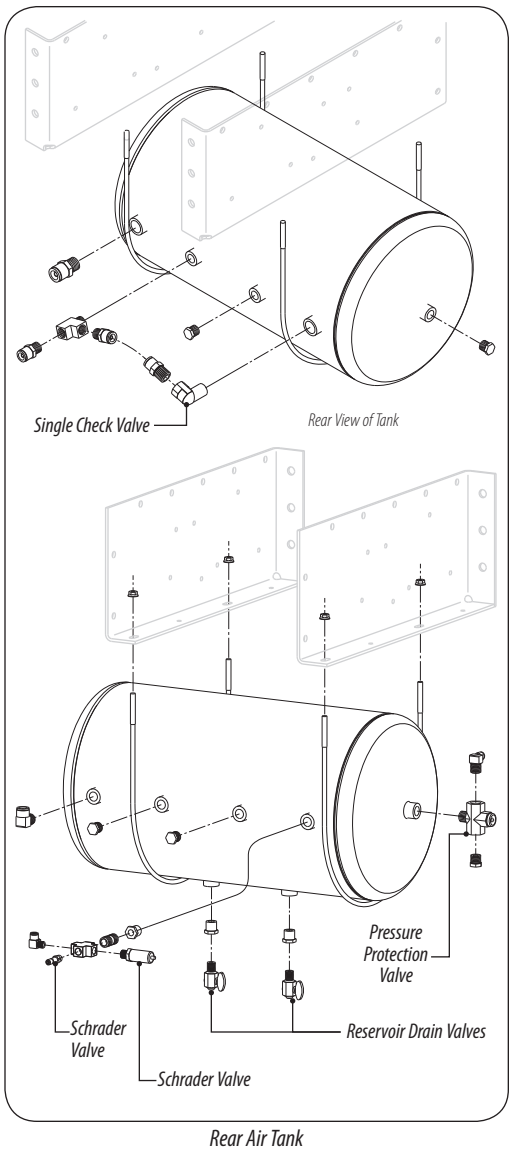
Each air tank (supply, primary, and secondary) has its own drain valve on the bottom side of the tank assembly for the purpose of manually expelling any moisture condensation that may have collected in the tanks. Optionally all drain valves can be located behind the front driver's side access panel. *Note: Air tank placement is determined by chassis option and wheelbase.*

The supply tank chamber has these fittings:

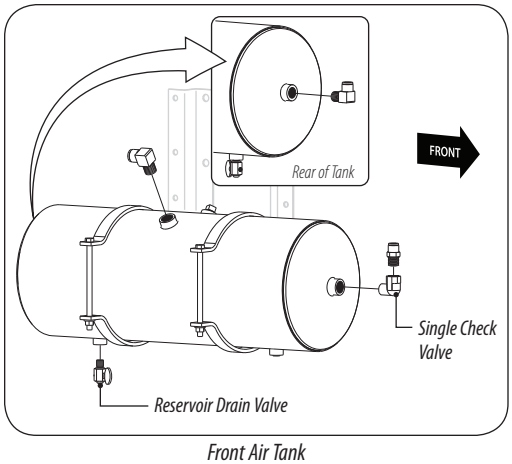
- A drain valve.
- A Schrader valve allows manual pressurization of the system for service or testing purposes by using a common air hose, without having to charge the system by running the engine and compressor.
- A pressure protection valve. This valve attaches to a line which leads to a pressure connection manifold under the left side of the bus for powering air-operated accessories. On units equipped with air suspensions, the supply line for the suspension is also connected at this fitting. The pressure protection valve closes when system pressure drops to 60 psi in order to preserve air pressure to the brakes in an abnormally low pressure situation.

The secondary tank has:

- A drain valve.
- A supply line from the supply tank
- A line leading to the supply side of the treadle valve, providing service pressure for the front brakes.
- A Line leading to the double check valve



Rear Air Tank



Front Air Tank

The primary tank chamber has these fittings:

- A drain valve.
- A 5/8" line leading to the supply side of the E-8P treadle valve, providing signal pressure which the treadle valves uses to activate the rear service brakes.
- A 5/8" line leading to the R-12 relay valve, providing service brake pressure for the rear brakes.
- A signal line leading to the spring brake valve
- A line leading to the double check valve

Removal

The air tank assembly is mounted to a bracket on the chassis frame. To remove the tank assembly:

1. Park the bus on a level surface. Stop the engine. Chock all wheels securely to prevent movement in either direction. Means other than air brakes must be used to prevent vehicle movement. Disconnect the negative terminal of the battery.

2. Open all drain valves to drain the all air tanks to 0 psi.

3. Disconnect all air lines connected to the air tank.

4. Support the air tank assembly from the bottom to prevent its dropping when the supports are removed.

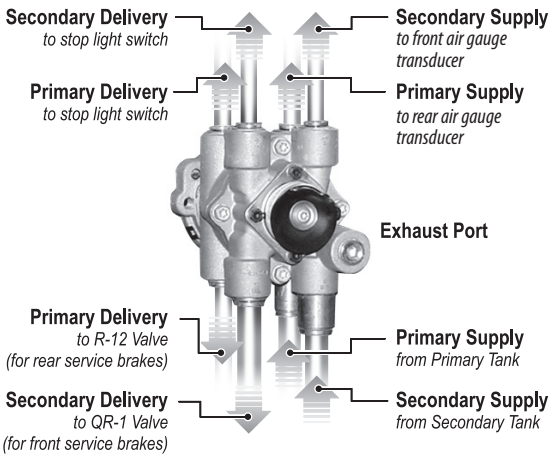
5. Remove the nuts and bolts from the supports.

Installation

Reverse the removal procedure to install the air tank assembly.

Treadle Valve (E-8P)

The E-8P dual brake valve is the unit directly acted upon when the driver presses the brake pedal, and which provides the driver a variable, graduated control for applying and releasing the brakes. The E-8P is a floor mounted control valve.



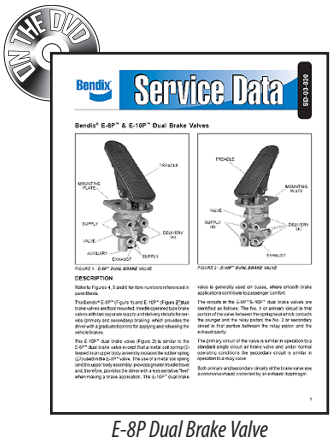
The E-8P is internally divided into two separate valves. The upper half of the valve controls the rear brakes (primary) and the lower half controls the front brakes (secondary). The upper half of the treadle has two identical primary supply ports (labeled Sup 11) and two identical delivery ports (labeled Del 21). The lower half of the valve has two secondary supply ports (labeled Sup 12) and two delivery ports (labeled Del 22).

Air pressure entering one of the two primary supply ports, provides air to operate the treadle valve and then continues on through the valve, out the other primary supply port, to provide a supply for the front air gauge. This feature of the treadle valve serves much like a tee fitting would in supplying air pressure to two different components. When the brakes are applied, air pressure exiting the treadle valve through one of the two primary delivery ports provides a signal to operate the rear brakes and air from the other primary delivery port provides a signal to the brake light switches to actuate the brake lights. The ports in the lower half of the treadle valve have similar functionality

An exhaust port, protected by a rubber diaphragm, is located on bottom of the valve and opens to the atmosphere to exhaust air from the delivery lines when the driver releases the pedal.

When the brake pedal is applied, air pressure from the primary supply tank is allowed to flow out the primary delivery port (labeled Del 21) in proportion to the distance the brake pedal is moved, to serve as a signal pressure to control the R-12V relay valve which in turn controls the delivery of pressure from the primary tank through the rear ABS modulators, and on to the rear brake chambers.

When the brake pedal is applied, air pressure form the secondary supply tank is allowed to flow out the secondary delivery port (labeled Del 22) in proportion to the distance the brake pedal is moved, through the modulators valves, and on to the front brake chambers.



E-8P Dual Brake Valve

Bendix Publication SD-03-830

Inspection & Maintenance

The TechReference DVD contains more information on the inner workings of the E-8P, as well as operational and leakage testing. Blue Bird does not recommend disassembling or rebuilding the E-8P. If testing determines the valve to be operating incorrectly, contact your Blue Bird Parts Dealer for a replacement.

Removal

The E-8P is fastened to a bracket under the drivers floor by three studs which pass through the bracket and are secured with 3 self-locking nuts To remove the E-8P valve:

1. Park the bus on a level surface. Stop the engine. Chock all wheels securely to prevent movement in either direction. Means other than air brakes must be used to prevent vehicle movement. Disconnect the negative terminal of the battery.

2. Open all tank drain valves to drain the air brake system to 0 psi.

3. Disconnect all 8 air lines connected to the E-8P valve.

4. Remove the three mounting nuts. Remove the E-8P valve.

Installation

Reverse the removal procedure to install the E-8P valve.

Relay Valve (R-12)

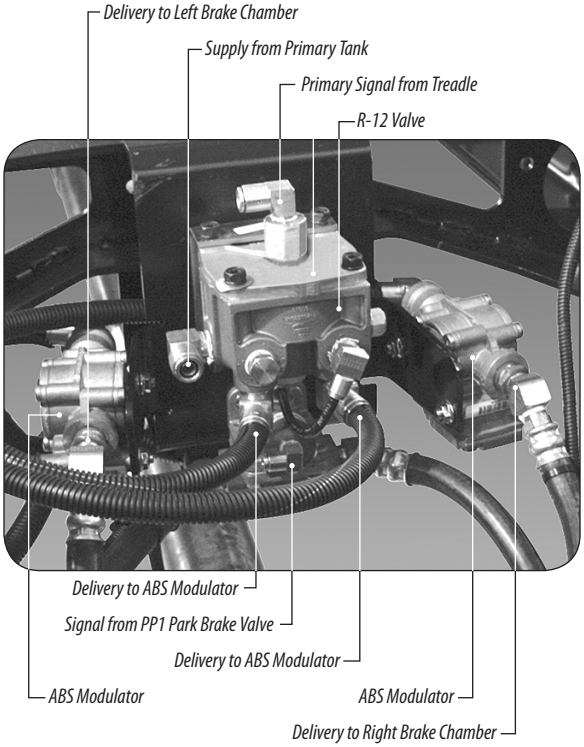
The Bendix R-12 relay valve is mounted to the rear-facing side of the double frame cross member just forward of the rear axle.

The valve operates as a remote controlled brake valve, which delivers or releases air to the rear brake chambers in response to the control air signal it receives from the E-8P treadle valve.

A port on the top of the R-12 receives the primary controlling signal air pressure from the E-8P treadle valve. A supply port on the side of the R-12 receives air directly from the primary air tank. Ports on each side of the R-12 connect to the ABS modulators to deliver service brake pressure to the left and right rear brakes. A balance line connects to a delivery port on the front side of the R-12 and leads to the secondary signal port of the SR-7 Spring Brake valve.

As the R-12's internal piston moves in response to control pressure from the E-8P treadle valve, it allows air from the primary tank to proportionally flow to the rear brake chambers through the ABS modulators.

When the driver releases the brakes, air in the lines between the treadle valve and the R12 valve will exhaust through the exhaust port on the bottom of the treadle valve and in turn air in the lines to the brake chambers is allowed to exhaust through the exhaust port on the bottom of the R-12.



Inspection & Maintenance

The Tech Reference DVD contains more information on the inner workings of the R-12, as well as operational and leakage testing. Blue Bird does not recommend disassembling or rebuilding the R-12. If testing determines the valve to be operating incorrectly, contact your Blue Bird Parts Dealer for a replacement.

R-12 Relay Valve

Bendix Publication SD-03-1064

Removal

1. Park the bus on a level surface. Stop the engine. Chock all wheels securely to prevent movement in either direction. Means other than air brakes must be used to prevent vehicle movement. Disconnect the negative terminal of the battery.

2. Open all three tank bleed valves to drain the air brake system to 0 psi.

3. Disconnect all air lines connected to the R-12 valve, and the outgoing air line connected to each of the rear ABS modulators.

4. Two threaded studs mount the R-12 to the bracket. Remove the two 3/8" self locking nuts on the inboard side of the bracket. The R-12 can now be removed.

Installation

Reverse the removal procedure to reassemble the R-12 valve to the two ABS modulators. Use nylon pipe thread tape on all four threaded parts of the male nipples between the valve units.

Park Brake Control Valve (PP-DC)

The PP-DC is a control panel mounted valve that the driver operates when applying the parking brake.

Two separate supply ports receive air from primary and secondary lines leading from the supply side of the E-8P treadle valve. When the PP-DC valve is pushed in to release the parking brake, primary and secondary air supply flows to an internal double check valve. Whichever of the two supply lines contains higher pressure at that moment will delivers pressure to the delivery port. From the delivery port, pressure signals the SR-7 spring brake modulating valve to cage the rear spring brakes, allowing normal service brake operation.

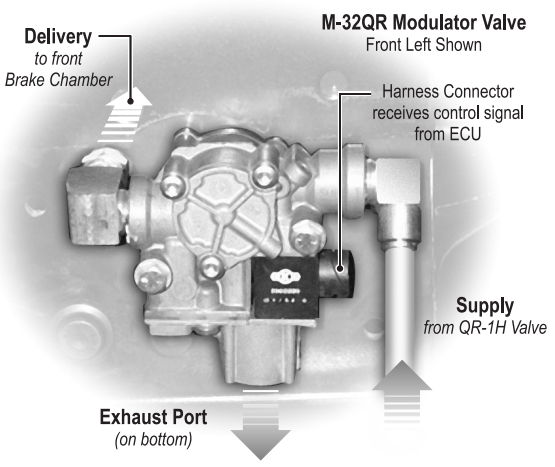
When the driver pulls outward on the PP-DC knob, the intake ports close, and the exhaust port opens, releasing the signal pressure going to the SR-7 causing the SR-7 to exhaust the pressure thereby allowing the spring to move the chamber shaft forward, applying spring pressure to the brakes as parking brakes.

The PP-DC valve is designed to automatically "pop out" and lock the parking brake if supply pressure drops below 20–30 psi. Thus, the parking brakes are automatically active whenever total system pressure is insufficient for normal service brake operation.

Inspection & Maintenance

TechReference on the DVD, contains more information on the inner workings of the PP-DC valve, as well as operational and leakage testing. Blue Bird does not recommend disassembling or rebuilding the PP-DC. If testing determines the valve to be operating incorrectly, contact your Blue Bird Parts Dealer for a replacement.

ABS Modulator Valves (M-32QR)



In air systems, a modulator valve is more effective when located a short distance from the brake chamber it controls. An All American equipped with air brakes uses four Bendix M-32QR modulator valves; one located near each wheel.

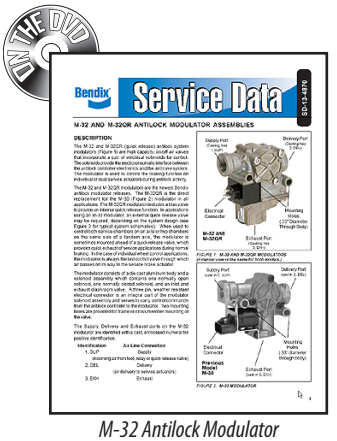
The front modulators are mounted on the inboard side of the frame rails, just over the front axle. The rear modulators are mounted on either side of the R-12 relay.

The modulators are the final valve assemblies though which air passes on its way to actuate the brake chambers.

Each M-32QR modulator has three ports: a supply port receiving air from the R-12 relay valve (rear) or treadle valve (front); a delivery port which sends air to the brake chamber; and an exhaust port on the bottom of the modulator body. The modulator incorporates two electric solenoids, which control supply and exhaust diaphragms inside the modulator, in response to signals received from the ABS EC-60 control unit during anti-skid braking situations.

Under most normal braking conditions, the modulators are passive, simply through-passing air pressure to the chambers. Similarly, when the brake pedal is released, air moves back through the modulator as it flowed during brake application, and is exhausted at the R-12 relay in the rear or the treadle valve in the front.

If a service brake application is made by the driver, and the ABS system detects an impending wheel lockup, the coils of the two solenoid valve in the affected wheel's modulator are independently energized or de-energized in a pre-programmed sequence by the E-60. This is similar in principle to the practice of "pumping the brakes" to prevent wheel skid; however, the ABS system is able to affect the brake application of each wheel independently, with much more accuracy and with a series of high-frequency pulses. The effect is better traction in a wide variety of braking conditions, and more controlled stops.



M-32 Antilock Modulator

Bendix Publication SD-13-4870

Inspection & Maintenance

The Tech Reference DVD contains more information on the inner workings of the modulator valves. Blue Bird does not recommend disassembling or rebuilding the M-32QR modulators. If testing determines the valve(s) to be operating incorrectly, contact your Blue Bird Parts Dealer for a replacement.

Removal, Front

Each front modulator is mounted directly to the frame rail by two 5/16" bolts which pass through the body of the modulator and through the frame rail, and are fastened with lock washers and flange nuts on the outboard side of the frame rails.

1. Park the bus on a level surface. Stop the engine. Chock all wheels securely to prevent movement in either direction. Means other than air brakes must be used to prevent vehicle movement. Disconnect the negative terminal of the battery.

2. Open all air tank drain valves to drain the air brake system to 0 psi.

3. Disconnect the brake hose at this fitting on the outboard side of the frame rail.

4. Remove the two nuts on the outboard side of the frame rail which secure the modulator.

5. Pull the modulator away from the frame rail to more easily access the air lines and electrical connector.

6. Remove the supply line connected to the push-in fitting. Remove the electrical connector. The modulator can now be removed.

Installation

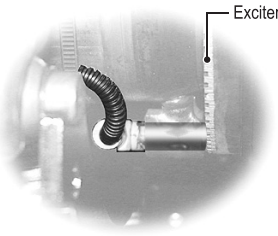
Reverse the removal procedure to install the front M-32QR modulator. Tighten the mounting bolts to 80–100 in. lbs. (9–13.5 Nm).

Removal & Installation, Rear

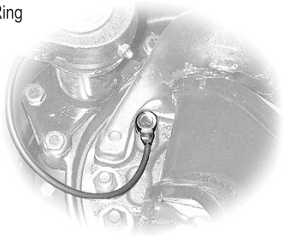
The rear M-32QR modulators are installed similar to the front modulators but mount on a frame crossemeber. See the section above on the R-12 valve for removal & installation procedure.

ABS Wheel Speed Sensors (WS-24)

The Bendix WS-24 Antilock wheel speed sensors are electro magnetic devices slip-fitted into mounting sockets on the inboard side of each wheel hub. A notched exciter ring formed with regularly spaced flats (teeth) rotates with the wheel drum in very close proximity to the sensor. As the flats pass through the sensor's magnetic field, an AC voltage is generated, the frequency of which is proportional to the speed of the turning wheel. This signal is conveyed electrically through the wiring harness to the ABS Electronic Control Unit.



ABS Wheel Speed Sensor, Rear
remove brake drum for access



ABS Wheel Speed Sensor, Front
accessible without wheel removal

Inspection

Inspect for any visible damage to the sensor, cable, connector, mounting block, and bushing. Replace any damaged components. The Tech Reference DVD contains more information on the WS-24 wheel speed sensors. Contact your Blue Bird Parts Dealer for a replacement.

WS-24 Wheel Speed Sensors
Bendix Publication SD-13-4754

Removal, Front

A front wheel speed sensor can be removed without removing the wheel.

1. Park the bus on a level surface. Turn the steering wheel in the direction of the side of the bus on which you want to remove the sensor. Stop the engine. Apply the parking brake. Disconnect the negative terminal of the battery.

2. Unlatch and raise the hood. Locate the wheel speed sensor by following its electrical lead

3. Disconnect the sensor lead from the wire harness. Remove the cable ties securing the lead. . Take note of the locations of the ties in order to replace with new ones.

4. Gently pry the sensor out of its socket using needle nose pliers and/or bladed screwdriver. The sensor location is tight, but it can be removed with care. The sensor is not threaded, but friction fitted, so twisting slightly can help removal. Be careful not to damage the wire leads, and do not pull on the leads.

5. The spring clip may remain in the socket, or may pull out with the sensor. Remove the spring clip.

Removal, Rear

Removing a rear wheel speed sensor requires removal of the wheel and brake drum.

1. Park the bus on a level surface with parking brake off. Block the other wheels to prevent the vehicle from moving in either direction.

2. Raise the wheel to be serviced and support the vehicle with safety stands under the frame rails.

3. Remove the tire and wheel assembly.

4. Remove the brake drum.

5. Locate the ABS sensor. Disconnect its electrical leads from the chassis wiring harness and remove the cable ties securing the leads. Take note of the locations of the ties in order to replace with new ones.

6. Gently pull the sensor straight back from its mounting bore. Remove the spring clip.

Installation

Reverse the removal procedures above to install the wheel speed sensors. When inserting the sensors:

1. Install a new spring bushing into the mounting block bore, with the retaining tabs toward the inside.

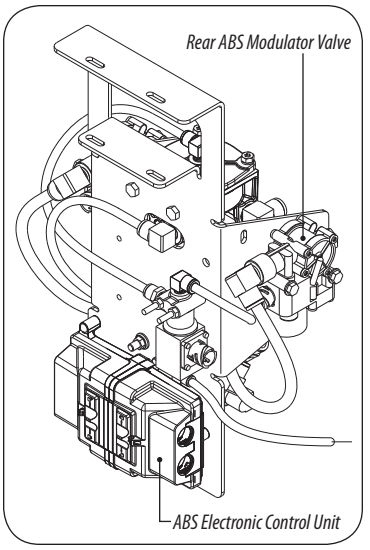
2. Gently push the sensor all the way into its mounting bore until it contacts the exciter ring. Do not strike the sensor to insert it.

3. Secure the cable leads with cable ties in the locations noted during removal. Inspect to assure that cable leads will not be abraded by contact with other components.

The friction fit of the WS-24 sensors allow them to slide back and forth under force, but retain their position when force is removed. Thus, the sensors self-adjust after being installed. When the sensor is inserted all the way into the mounting block, the hub exciter contacts the sensor, which pushes it back. Normal bearing play will "bump" the sensor away from the exciter. The combination of these two actions will establish a running clearance between the sensor and exciter.

WARNING ***It is important that the wheel bearings be adjusted correctly to ensure that the antilock function does not shut down as a result of excessive wheel endplay.***

ABS Controller (EC-60)



The ABS Controller is mounted on a frame crossmember just forward of the rear axle close to the R-12 Relay Valve and ABS Modulator Valves. The Controller is the "black box" encasing the computer circuitry, which controls the Antilock Braking System. The model used on a Blue Bird All American equipped with air brakes is the basic configuration Bendix EC-60.

The EC-60 continuously receives and monitors signals from the wheel speed sensors. It analyzes this information during braking to determine when a particular wheel is about to lock up, and thereby loose braking traction. When the EC-60 anticipates an impending wheel lock condition, it energizes the supply and/or exhaust diaphragm solenoids in the appropriate M-32QR modulator to "pulse" the brake pressure at that wheel. This maximizes traction and, in most cases, reduces braking distance. When performing ABS braking functions, the ECU also communicates via SAE J1939 serial communications link with the transmission to over-ride torque converter lock; necessary for wheel-independent ABS modulation to occur.

The EC-60 controls an ABS warning lamp on the driver's indicator light panel. On power-up, the light turns on for 2.5 seconds and then turns off. Also at start up, the EC-60 performs a modulator chuff test. With brake pressure applied, the EC-60 activates a chuff at each modulator in the following sequence: right front; left front; right rear; left rear. The chuff sequence is then repeated for a total of 8 chuffs.

Being a sealed electronic unit, the EC-60 is not repairable or rebuildable, but is re-settable; and the EC-60 is itself a diagnostic tool. When the EC-60 senses an erroneous system condition, it stores the fault code in memory, activates the appropriate warning lamp and disables all or part of the affected ABS function(s). Depressing an ABS diagnostic switch on the dash will cause the ECU to enter a diagnostic mode, revealing the stored code by blinking the ABS light on the instrument panel.

In most cases, the EC-60 will automatically reset the active fault code when the fault is corrected. However, repeated occurrences of a given fault will cause the fault code to latch. Once the fault code is latched, a manual reset is required. After repair, latched fault codes can be reset by the diagnostic switch.

For more detailed diagnostics, the EC-60 provides a J1939 data link to communicate with the vehicle systems (engine, transmission, IP)and a J1587 data link for various diagnostic tools via Blue Bird's All American diagnostic tool port located in the driver's area under the dash, to the left of the steering column.

More detailed information on troubleshooting and diagnosis of the EC-60 and the ABS system is contained in Appendix 4.

Removal

The EC-60 is through-bolted to the crossmember and bracket:

1. Park the bus on a level surface. Stop the engine. Apply the parking brake. Disconnect the negative terminal of the battery.

2. Remove the four screws which attach the shifter housing, and remove the housing. Disconnect the wiring harness from the EC-60.

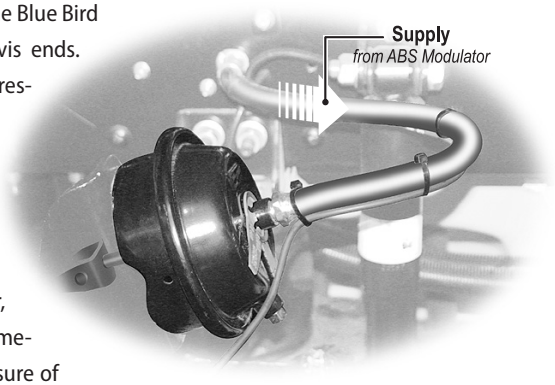
3. Remove the two mounting bolts. The EC-60 can now be removed.

Installation

Reverse the removal procedure.

Brake Chambers, Front

MGM service brake chambers are used on the front wheels of the Blue Bird All American. These are non-adjustable, with welded-on clevis ends. Each front brake chamber has one port on the top end of the pressure chamber housing. The hose connected to this fitting leads from the delivery port of the M32QR modulator mounted a short distance away inside the frame rail.



Air entering the chamber acts upon a diaphragm which is connected to a push rod, which extends from the chamber to actuate the brakes. The pressure delivered to the chamber, multiplied by the area of the diaphragm results in a significant mechanical advantage gain. Thus, for example, a supply line pressure of 30 psi results in a force of approximately 600 lbs. at the pushrod end.

Inspection

The brake chambers should be visually inspected whenever brake maintenance is scheduled, or at a minimum of every 50.000 miles (80,000 km):

- The brake rod shaft is marked by a bright orange band at its inboard end. With brakes applied, if this band is seen protruding from the brake chamber, it is an indication of excessive push rod extension. The automatic slack adjusters should be inspected for proper operation and/or the brake pads should be inspected for excessive wear.
- Check for any visible signs of cracks in the non-pressure chamber housing around mounting studs.
- Check actuator for leaks around the joint seam between the chamber halves. With brakes applied, spray leak detector solution around the seam.
- The chamber should be replaced if there are any signs of the diaphragm leaking or of compressor oil contamination reaching the diaphragm.

WARNING ***Blue Bird does not recommend disassembly or rebuilding of the brake chambers. If a chamber is found to be damaged or suspect, replace it with an identical OEM component.***

Removal

The front brake chambers are attached to the chamber bracket of the axle by two self-locking nuts with flat washers. The push rod attaches to the slack adjuster arm by two clevis pins. To remove:

1. Park the bus on a level surface. Stop the engine. Apply Parking Brake. Chock all wheels securely to prevent movement in either direction.

2. Open all three tank bleed valves to drain the air brake system to 0 psi.

3. Disconnect the supply hose at the end connected to the modulator. (This end has a swivel connector). Then disconnect the hose at the brake chamber end.

4. Remove the two cotter pins and clevis pins, which connect the pushrod to the actuator rod and body of the slack adjuster.

WARNING ***Do not re-use clevis pin retaining clips after removing them. Always replace used clevis pin retainer clips with new ones.***

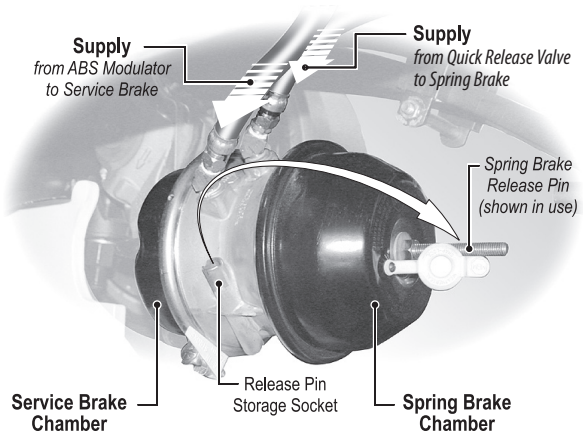
5. Remove the two self-locking nuts and flat washers which mount the brake chamber assembly to the axle bracket. The chamber can now be removed.

Installation

To reinstall the brake chamber when no other changes have been made (such as brake shoe replacement) reverse the removal procedure. Tighten the chamber mounting stud nuts to 100–115 ft. lbs. (135.5–156 Nm). Use new clevis pin retaining clips. Then check slack adjuster adjustment. (See Slack Adjusters section, below.)

Brake Chambers, Rear

MGM Type 30 brake chambers are used on the rear wheels of the Blue Bird All American. These are non-adjustable, with welded-on clevis ends. The Type 30 chamber assembly is a combination of two different kinds of brake chambers sharing a common center housing. The lower chamber, from which the pushrod protrudes, is the service brake chamber and operates similarly to the front brake chambers described above. The upper chamber is the spring brake chamber, and contains a powerful coil spring which actuates the brakes when parking brakes are applied, or while driving when primary circuit pressure is absent. Thus, the spring brakes serve two purposes: as normal parking brakes and as a mechanically actuated backup system for rear air brakes.



The service brake and spring brake chambers have separate supply ports. The service brake chamber receives air from the primary tank, as controlled by the R-12 valve and the M-32QR modulator valve. Air entering the service brake chamber acts upon a diaphragm connected to the push rod, which extends from the chamber to actuate the brakes. The pressure delivered to the chamber, multiplied by the area of the diaphragm results in a significant mechanical advantage gain.

The spring brake chamber also contains a diaphragm. However, its supply port receives pressure from the secondary air tank, as controlled by the quick release valve. Air entering the spring brake chamber is used not to extend the push rod; but to work against the tension of the coil spring. Whenever air pressure is absent (or released) from the spring brake chamber, the powerful spring tension is applied to the pushrod, actuating the brakes.

It is important to note that the spring brake does not gain mechanical advantage as does the air-powered service brake. Therefore, the captive coil spring is actually strong enough to apply the full force necessary to stop the bus. Even when expanded the full length of its chamber, the spring is still under tremendous compression.

WARNING ***Never attempt to disassemble a spring brake cylinder, even when it contains no compressed air. The spring brake cylinders enclose very powerful coil springs held under high mechanical compression. Any attempt to disassemble the brake chamber can result in injury or death.***

Under normal driving conditions, with the parking brake released and the air system fully charged, the system delivers air to the spring brake chambers, fully compressing (caging) the springs. The spring brakes are held in this disengaged position, and the service brakes perform braking functions.

Whenever the vehicle is stopped and the parking brake is applied, air is released from the spring brake chamber through the quick release valve, allowing the spring brakes to fully apply the rear brakes to stop the bus under adverse conditions.

If primary circuit pressure is abnormally low or absent, the spring brake valve varies the air being delivered to the spring brake chamber in response to the driver's operation of the brake pedal. This condition, called "spring brake modulation," allows the spring brakes to function as rear brakes while driving the bus.

If both primary and secondary system pressure fail (or if system pressure is not yet charged, as at the beginning of service), no pressure is available to cage the spring brakes. The spring brakes fully apply, preventing the vehicle from being driven until proper air brake operation is restored.

Manual Spring Brake Disengagement

Means are provided on the spring brake chambers by which to manually disengage the spring brakes so as to allow the bus to be towed for repair in an emergency situation; or to allow the rear brake components to be serviced without the air system being charged.

On each of the rear combination brake chambers, a special tool is carried in a storage socket cast into the body of the chamber. The tool consists of a release bolt with a specially formed end, a washer, and hex nut. To manually disengage the spring brakes for service:

1. Stop the engine. Chock all wheels to prevent movement in either direction. Use whatever means necessary to make absolutely certain the bus cannot roll when the spring brakes are released.

WARNING ***Do not manually disengage spring brakes if the vehicle is in an unstable roadside situation, or if the vehicle can roll when the spring brakes are released. Movement of the bus must be prevented by means other than brakes.***

2. Open all three tank bleed valves to drain the air brake system to 0 psi.

3. Remove the nut and washer from the end of the release bolt, and remove the tool from its storage socket.

4. Remove the rubber dust cap from the access hole in the upper end of the spring brake chamber.

5. Insert the toggle end of the release bolt into the access hole. Be sure that the formed end of the release bolt has entered the hole in the piston inside the chamber. Continue to insert the bolt until it bottoms out.

6. Turn the release bolt ¼ turn clockwise and pull outward on the bolt to lock the formed end into the piston.

7. Holding the bolt locked into the piston, install the flat washer and the release nut onto the end of the release bolt, and turn down the nut against the flat washer until finger tight.

8. Using a ¾" hand wrench (do not use an impact-type wrench), turn the release nut clockwise until the internal spring is fully caged.

9. Repeat this procedure for the spring brake chamber on the opposite side of the bus. The spring brakes are now released, having their springs compressed by the release bolts.

Inspection

The brake chambers should be visually inspected whenever brake maintenance is scheduled, or at a minimum of every 50.000 miles (80,000 km):

- The brake rod shaft is marked by a bright orange band at its inboard end. With brakes applied, if this band is seen protruding from the brake chamber, it is an indication of excessive push rod extension. The automatic slack adjusters should be inspected for proper operation and/or the brake pads should be inspected for excessive wear.
- Check for any visible signs of cracks in the non-pressure chamber housing around mounting studs.
- Check actuator for leaks around the joint seam between the chamber halves. With brakes applied, spray leak detector solution around the seam.
- The chamber should be replaced if there are any signs of the diaphragm leaking or of compressor oil contamination reaching the diaphragm.

WARNING ***Never attempt to disassemble or rebuild the rear brake chambers. If a chamber is found to be damaged or suspect, replace it with an identical OEM component.***

Removal

The rear combination brake chambers are attached to the chamber bracket of the axle by two self-locking nuts with flat washers. The push rod attaches to the slack adjuster arm by two clevis pins. To remove:

1. Park the bus on a level surface. Stop the engine. Chock all wheels securely to prevent movement in either direction. Means other than brakes must be used to prevent vehicle movement.

2. Open all three tank bleed valves to drain the air brake system to 0 psi.

3. Manually disengage the spring brake being removed as described above in Manual Spring Brake Disengagement.

4. Disconnect both supply hoses from the brake chamber supply ports.

5. Remove the two cotter pins and clevis pins which connect the pushrod to the actuator rod and body of the slack adjuster.

WARNING ***Do not re-use clevis pin retaining clips after removing them. Always replace used clevis pin retainer clips with new ones.***

6. Remove the two self-locking nuts and flat washers which mount the brake chamber assembly to the axle bracket. The chamber can now be removed.

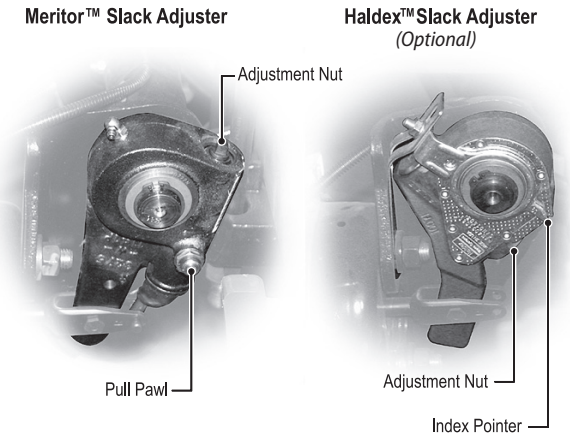
Installation

To reinstall the brake chamber when no other changes have been made (such as brake shoe replacement) reverse the removal procedure. Tighten the chamber mounting stud nuts to 100–115 ft. lbs. (135.5–156 Nm). Use new clevis pin retaining clips. Then check slack adjuster adjustment (See Slack Adjusters Appendix 5).

Slack Adjusters

At each wheel, the brake actuating push rod of the air brake chamber connects to an automatic slack adjuster mechanism, which acts as a lever to turn the brake assembly's S-cam shaft.

As the friction surfaces of the brake shoes wear, they grow thinner, and the clearance between the brake shoes and drum increases. If this situation were left uncorrected, the brake chamber push rod would have to travel an ever-increasing distance in order to actuate the brakes and frequent manual adjustment would be necessary to remove this excess travel. The role of the automatic slack adjuster is to compensate for the brake shoe wear by acting as a ratcheting mechanism, much like a ratchet wrench, keeping the linkage travel within normal tolerance.

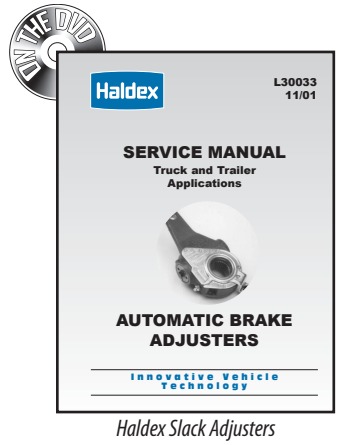


Meritor slack adjusters are standard on the Blue Bird All American. Haldex adjusters are on some units as an option. The two types perform the same function, but by somewhat different internal mechanisms.

In Meritor slack adjustors, the ratcheting function is performed by a pawl which engages the notches of a toothed adjusting sleeve which rotates as brake lining wear occurs. The spring-loaded pawl can be manually released by pulling a button on the outside of the slack adjuster body.

On Haldex adjusters, the internal ratcheting action is performed by a one-way clutch on the shaft of a worm drive gear which rotates as brake lining wear occurs.

Appendix 5 contains more detailed information on the Meritor automatic slack adjusters. The Tech Reference DVD contains more detailed information on the Haldex automatic slack adjusters.



Haldex Slack Adjusters

Haldex Publication L30033

Adjustment

The slack adjusters on the Blue Bird All American are designed to be self-adjusting. The only times at which manual adjustment should be necessary is when initially setting the adjusters after reassembling the brakes following service procedures such as shoe replacement. If brake travel is found to be out of range, always be sure to find the root cause. Making manual adjustments of the slack adjusters is probably only affecting a symptom, and not correcting the actual cause of a problem.

Thorough instructions for making the initial slack adjuster settings after servicing the brakes are contained in the two appendixes mentioned above.

Removal of Meritor Slack Adjusters

Meritor slack adjusters are mounted on the splined shaft of the S-cam, and secured by an outer diameter circlip. The end of the actuating arm is connected to the brake chamber push rod clevis by two clevis pins and clevis pin retainer clips. To remove:

1. Park the bus on a level surface. Stop the engine. Chock all wheels securely to prevent movement in either direction. Means other than brakes must be used to prevent vehicle movement.

2. If the bus is equipped with air suspension, support the frame rail securely with safety stands.

3. Open all three tank bleed valves to drain the air brake system to 0 psi.

4. Manually disengage the spring brake as described above in Manual Spring Brake Disengagement.

5. Remove the two cotter pins and clevis pins that connect the pushrod to the slack adjuster.

WARNING ***Do not re-use clevis pin retaining clips after removing them. Always replace used clevis pin retainer clips with new ones.***

6. Pry the spring-loaded pawl button outward to release the ratchet mechanism of the slack adjuster. While holding the pawl outward, use a wrench to turn the adjusting hex head on the bottom of the adjuster clockwise. This will cause the slack adjuster to rotate. Turn the nut until the slack adjuster arm is clear of the pushrod clevis.

7. Use outer circlip pliers to remove the circlip securing the adjuster assembly to the S-cam shaft. Note the number and assembly order of spacing washers on either side of the adjuster as you remove the adjuster from the shaft.

Installation

Reinstall the Meritor slack adjuster by reversing the removal procedure. After installing, make the initial setting of the slack adjuster by following the instructions in Appendix 5.

Removal of Haldex Slack Adjusters

Haldex slack adjusters are mounted on the splined shaft of the S-cam, and secured by an outer diameter circlip. The end of the actuating arm is connected to the brake chamber push rod clevis by one clevis pin and a clevis pin retainer clip. The adjuster's control arm is fastened to a slotted hole in the anchor bracket. To remove:

1. Park the bus on a level surface. Stop the engine. Chock all wheels securely to prevent movement in either direction. Means other than brakes must be used to prevent vehicle movement.

2. If the bus is equipped with air suspension, support the frame rail securely with safety stands.

3. Open all three tank bleed valves to drain the air brake system to 0 psi.

4. Manually disengage the spring brake as described above in Manual Spring Brake Disengagement.

5. Remove the clevis pin retainer clip and clevis pin which connect the pushrod to the slack adjuster.

WARNING ***Do not re-use clevis pin retaining clips after removing them. Always replace used clevis pin retainer clips with new ones.***

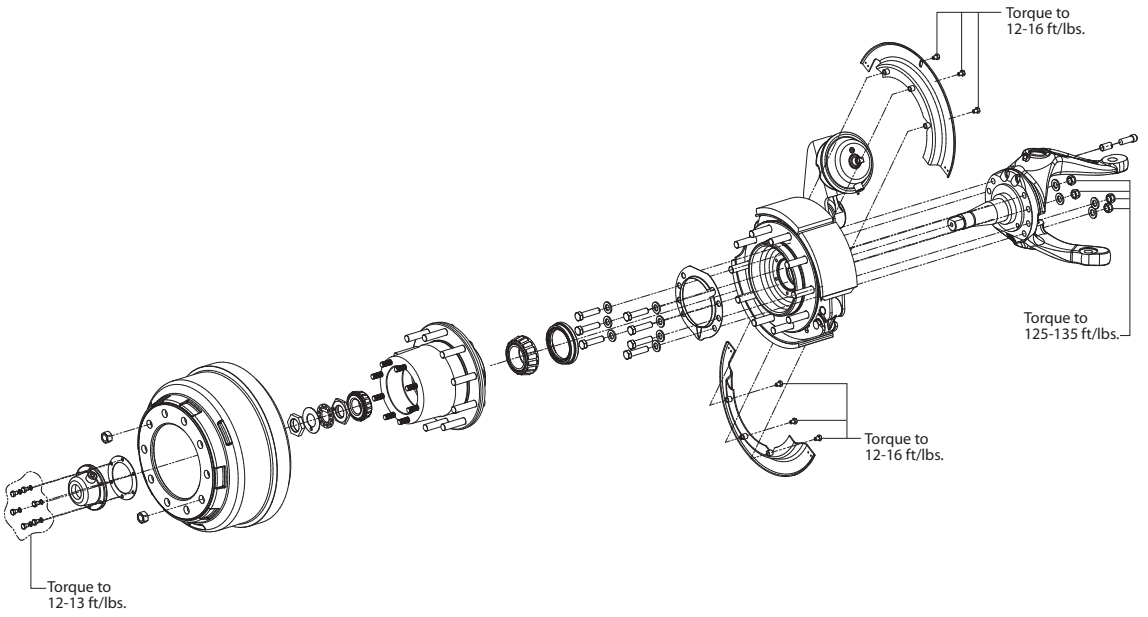
6. Use a wrench to turn the adjusting hex head on the bottom of the adjuster clockwise. This will cause the slack adjuster to rotate. Turn the nut until the slack adjuster arm is clear of the pushrod clevis.

7. Use outer circlip pliers to remove the circlip securing the adjuster assembly to the S-cam shaft. Note the number and assembly order of spacing washers on either side of the adjuster as you remove the adjuster from the shaft.

Installation

Reinstall the Haldex slack adjuster by reversing the removal procedure. After installing, make the initial setting of the slack adjuster by following the instructions found in the Air Brakes Haldex Appendix on the TechReference DVD.

Air Brakes Wheel Ends, Front



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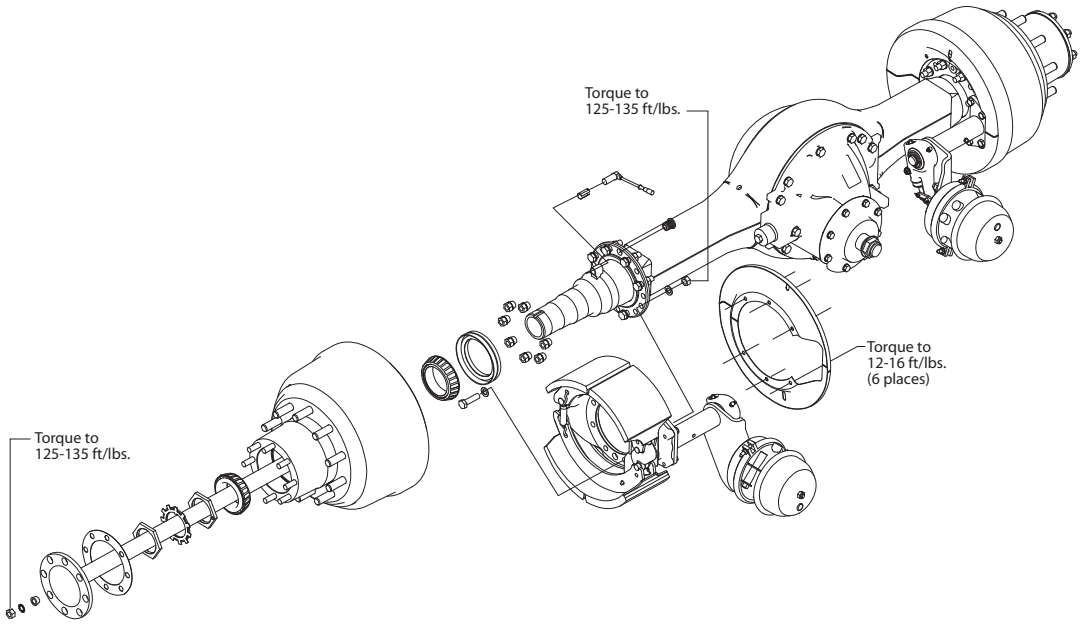
Air Brakes Wheel Ends, Rear



Brake Shoes & Drums

The Blue Bird All American uses Meritor Q-Plus model S-cam brakes and drums. The front brakes are 16.5" diameter, 5" wide models with cast spiders. Rear brakes are 16.5" diameter, 7" wide with cast spiders.

The brake shoes are mounted on individual pivots at their rear-most end, as mounted on the Blue Bird All American. Half-round notches on the pivot ends of the shoes engage the shouldered ends of individual anchor pins that pass through the casting of the spider plate. The pivoting ends of the shoes and are held in place by a heavy-duty spring connecting to both shoes.

The opposite ends of the brake shoes are supported by cam rollers, which ride in the round notches of an S-shaped cam situated between the two shoes. Wire retaining clips hold the cam rollers in the ends of the shoes, and heavy-duty springs again provide pressure to retain the shoes in their position.

When brakes are applied, the slack adjuster rotates the shaft of the S-cam. The S-shape of the cam forces the forward ends of the brake shoes to spread, pressing the shoe linings against the walls of the brake drum.

Maintenance

Brake shoe service life will vary according to operating conditions. The thickness of the brake shoe friction linings can be viewed from the inboard side of the wheel, and should be measured regularly. The brake shoes should be replaced when lining thickness is .25 in. (6.3mm) at the thinnest point. Springs, rollers, cam bushings, and anchor pins should be replaced when replacing brake shoes.

Do not re-bore brake drums. Doing so decreases the strength and heat capacity of the drum.

Appendix 5 contains detailed information on inspection, disassembly and reassembly of the Q Plus brakes used on the Blue Bird All American.

Removal, Front Drums

The same mounting stud nuts that retain the front wheel also retain the front brake drum.

1. Park the bus on a level surface. Stop the engine. Chock all wheels securely to prevent movement in either direction. Means other than brakes must be used to prevent vehicle movement.

2. Open all three tank bleed valves to drain the air brake system to 0 psi.

3. Raise the bus with an appropriate jack and support it with safety stands under the frame rails.

4. Disconnect the automatic slack adjuster to allow the brake shoes to fully retract from the drum. The extra clearance will be required when reassembling with new brake shoes. Refer to the instructions above for kind of slack adjuster (Meritor or Haldex) installed.

5. Remove the wheel nuts. Remove the front wheel. The brake drum can now be removed for access to the brake shoes and other components.

Refer to Appendix 5 for instructions on disassembling, inspecting and reassembling the brake shoes and related components.

Installation, Front Drums

After reinstalling the brake components according to instructions in Air Brakes Appendix5:

1. Install the brake drum, wheel, and wheel mounting nuts. Draw up the wheel nuts evenly, rotating the wheel a few turns to be sure to remove all free play in the mounting nuts. Then use a calibrated torque wrench to gradually tighten the wheel nuts to 450–500 ft. lbs. (610–678 Nm), working back and forth across the center of the wheel as in the pattern shown:

2. Reconnect the automatic slack adjuster using new clevis pin retainer clips. Adjust the slack adjuster according to instructions in Air Brakes Appendix 5 (for Meritor slack adjusters) or Air Brakes Haldex Appendix on the DVD (for Haldex slack adjusters).

Removal, Rear Drums

The same mounting stud nuts which retain the rear wheel also retain the rear brake drum.

1. Park the bus on a level surface. Stop the engine. Chock all wheels securely to prevent movement in either direction. Means other than brakes must be used to prevent vehicle movement.

2. Open all three tank bleed valves to drain the air brake system to 0 psi.

3. Raise the bus with an appropriate jack and support it with safety stands under the frame rails.

4. Manually disengage the spring brake as described above in Manual Spring Brake Disengagement.

5. Disconnect the automatic slack adjuster to allow the brake shoes to fully retract from the drum. The extra clearance will be required when reassembling with new brake shoes. Refer to the instructions above for kind of slack adjuster (Meritor or Haldex) installed.

6. Remove the wheel nuts. Remove the rear wheels. The brake drum can now be removed for access to the brake shoes and other components.

Refer to Appendix 5 for instructions on disassembling, inspecting and reassembling the brake shoes and related components.

Installation, Rear Drums

After reinstalling the brake components according to instructions in Appendix 5:

1. Install the brake drum, wheel, and wheel mounting nuts. Draw up the wheel nuts evenly, rotating the wheel a few turns to be sure to remove all free play in the mounting nuts. Then use a calibrated torque wrench to gradually tighten the wheel nuts to 450–500 ft. lbs. (610–678 Nm), working back and forth across the center of the wheel as in the pattern shown:

2. Reconnect the automatic slack adjuster using new clevis pin retainer clips. Adjust the slack adjuster according to instructions in Air Brakes Appendix 5 (for Meritor slack adjusters) or Air Brakes Haldex Appendix on the DVD (for Haldex slack adjusters).

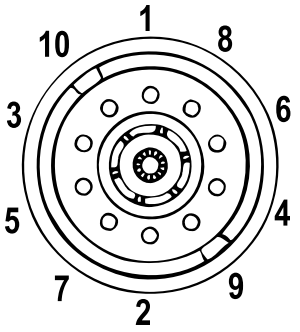
3. Remove the manual release tool from the spring brake chamber to engage the air spring. Reinstall the tool in its storage socket.

Front Brake Assembly

1. Clean mating surfaces of both the axle brake flange and the brake assembly.

2. If dustshields are required, install them.

3. Brake assemblies are RH & LH and must be installed on the correct side. Front brake assemblies should be positioned with brake chambers toward the front and on top of the axle and slack adjusters toward the front of the vehicle. Position oil slinger (if required) with the lip turned out and the oil basin pointng down over the axle spindles. Torque mounting hardware in an "x" or crossing sequence.



Wheel Bearing Lubrication

Wheel bearings are precision components which must be kept clean and adequately but not excessively lubricated.

1. Lay out bearings to be used on a clean area.

2. Dip clean bearings in the appropriate SAE 50 gear oil until thoroughly saturated.

Inner Bearing And Seal

1. Seat smaller O.D. Of seal in recess of tool.

2. Insert centering plug of tool in bore of inner bearing. Plug insures proper alignment of seal.

3. Insert tool with bearing and seal in the vehcile center end of hub and rotor assembly.

4. Hold tool and handle firmly and strike until sound of impact changes to indicate seal has bottomed in hub seal recess.

5. After seal is bottomed in the bore recess, inspect the face of seal for dents or deformity and check the rubber lip for a smooth even surface. Check for freedom of movement by manually moving interior rubber componts of seal back and forward. A slight movement indicates damage free installation.

Hub And Rotor Assembly

1. Clean spindles before installing wheel end components.

2. Clean the threads on the spindles with a wire brush.

3. Coat the lip of the rubber seal with a thin layer of wheel bearing lubricant.

4. Carefully slide the hub and rotor assembly straight onto the spindle to prevent damage to the seal.

5. Install the outer wheel bearing. Make sure bearing is properly lubricated.

6. After the hub and bearings are assembled in place on the spindle, install the bearing adjusting nut on the spindle against the outer bearing. The nut must be installed so that the nipple faces outward toward the hubcap. Tighten finger tight.

7. Torque the bearing adjusting nut to 150 ft lb while rotating the hub to seat the bearings. Back off the adjusting nut until loose. Re-torque nut to 50 ft lb while rotating hub. Back off nut 1/4 turn to achieve an end play of 0.001" to 0.005".

8. Install the pierced lock ring so that the inner tab locks into the spindle keyway and the adjusting nut nipple engages the through holes on the lock ring. Nut may be loosened slightly to install lock.

9. Install the lock washer onto the spindle so that the nipple engages one of the through holes on the lock ring.

10. Install the outer nut. Tighten to 240-260 ft lb. Rotate wheel in both directions. Wheel must rotate freely without binding.

11. Bend two opposed lock washer tabs over the outer wheel nut to lock it in position.

12. Install the axle flange gasket.

13. Install hubcap.

14. Remove plug in hub cap and fill with proper oil. Use the sight glass indicator to fill to proper level. Do not overfill!

ABS Installation

1. Firmly install the abs sensor clip in the hole supplied on the steering knuckle. The clip is designed to seat in the proper position in the hole.

2. Snap the abs sensor into the clip just installed. The clip is designed to hold the sensor at the proper distance from the tone ring on the hub.

3. Rotate hub assembly to ensure sensor is not contacting the tone ring in any area.

4. Route wire from wheel area to brake ECU. Only tie wrap cable to brake flanges, axle houses or other secure objects. Do not tie to cam shafts.

Rear Brake Assembly

1. Clean mating surfaces of both the axle brake flange and the brake assembly.

2. If dustshields are required, install them.

3. Brake assemblies are RH & LH and must be installed on the correct side. The brake assemblies should be positioned with brake chambers toward the front on the bottom of the axle and rotated such that the chamber is angled horizontal to slightly upward. Torque mounting hardware in a crossing sequence.

Wheel Bearing Lubrication

Wheel bearings are precision components which must be kept clean and adequately but not excessively lubricated.

1. Lay out bearings to be used on a clean area.

2. Dip clean bearings in the appropriate petroleum or synthetic oil until thoroughly saturated.

Inner Bearing And Seal

1. Seat the seal in the appropriate tool.

2. Insert centering plug of tool in bore of inner bearing. Plug insures proper alignment of seal.

3. Insert tool with bearing and seal in the vehcile center end of hub and rotor assembly.

4. Hold tool and handle firmly and strike until sound of impact changes to indicate seal has bottomed in hub seal recess.

5. After seal is bottomed in the bore recess, inspect the face of seal for dents or deformity and check the rubber lip for a smooth even surface. Check for freedom of movement by manually moving interior rubber componts of seal back and forward. A slight movement indicates damage free installation.

6. Install the inner wheel bearing on top of the seal.

Hub And Rotor Assembly

1. Clean spindles before installing wheel end components.

2. Clean the threads on the spindles with a wire brush.

3. Coat the lip of the rubber seal with a thin layer of wheel bearing lubricant.

4. Carefully slide the hub and rotor assembly straight onto the spindle to prevent damage to the seal.

5. Install the outer wheel bearing. Make sure bearing is properly lubricated.

6. After the hub and bearings are assembled in place on the spindle, install the bearing adjusting nut on the spindle against the outer bearing. The nut must be installed so that the nipple faces outward. Tighten finger tight.

7. Torque the bearing adjusting nut to 100 ft lb while rotating the hub to seat the bearings. Back off the adjusting nut one turn. Re-torque nut to 50 ft lb while rotating hub back and forth. Back off nut 1/3 turn to achieve an end play of 0.001" to 0.005".

8. Install the pierced lock ring so that the inner tab locks into the spindle key-way and the adjusting nut nipple engages the through holes on the lock ring. Nut may be loosened slightly to install lock.

9. Install the lock washer onto the spindle so that the nipple engages one of the through holes on the lock ring.

10. Install the outer nut. Tighten to 240-250 ft lb. Rotate wheel in both directions. Wheel must rotate freely without binding.

11. Bend two opposed lock washer tabs over the outer wheel nut to lock it in position.

12. Install the axle shaft gasket.

13. Install the axle shafts that came with the axle into the axle housing making sure the correct length shaft is on the correct side.

14. Install the tapered dowels, star washers and nuts. Torque to 160-185 ft lb in an "x" or crossing pattern.

15. Remove the breather from the top of the bowl and the plug from the back-side of the bowl and fill with the proper oil. Add the oil throuth the breather hole until the oil level is even with the bottom of the hole on the backside of the bowl. If petroleum oil is used, reinstall the plug supplied with the axle on the backside of the bowl. If synthetic oil is used, replace with the new plug as shown. Reinstall the breather on top side of bowl making sure breather cap operates freely.

ABS Installation

1. Firmly install the ABS sensor spring clip in the mounting block welded to the spindle. The clip is designed to seat in the proper position in the hole.

2. Push the ABS sensor all the way into the spring clip just installed. The clip will allow the sensor to adjust to the proper distance from the tone ring on the hub (self gapping) after installation.

3. Rotate hub assembly to ensure there is no binding.

4. Route wire from wheel area to brake ECU. Only tie wrap cable to brake flang-es, axle houses or other secure objects. Do not tie to cam shafts.

Wheel Bearing Adjustment

Proper Wheel bearing adjustment is critical to the performance and life of the wheel end components. Improper wheel bearing adjustment can affect wheel bearing and wheel seal life as well as having and adverse effect to the ABS wheel sensing system. The following wheel bearing adjustment recommendation follows Blue Bird Engineering and Technology & Maintenance Council TCM RP618 guidelines.

1. Lubricate the wheel bearing with clean lubricant of the same type used in the axle sump or hub assembly.

2. Install the wheel/ hub and bearing onto the spindle and tighten the adjusting nut to a torque of 200 ft-lbs (272 N-m) while rotating the hub/wheel. This will purge the lubricant and seat the bearing.

3. Back the adjusting nut off one full turn.

4. Re-torque the adjusting nut to 50 ft-lbs (68 N-m) while rotating the wheel.

5. Back off the adjusting nut ¼ turn.

6. Install the wheel bearing adjusting washer and lock washer onto the spindle so that the nipple engages one of the holes on the lock ring. The adjusting nut may be loosened slightly to install the lock.

7. Install the outer jam nut. Tighten to 240-260 ft-lbs (326–353 N-m).

8. Check the bearing end play with a dial indicator by attaching its magnetic base to the hub or brake drum. Adjust the dial indicator so that its plunger is against the end of the spindle with its line of action parallel to the axis of the spindle.

9. Grasp the wheel or hub assembly at the 3 o'clock and 9 o'clock positions. Push and pull the wheel end assembly in and out while oscillating it to seat the bearings. Read the bearing end play as the total indicator movement. Acceptable end play is .001" - .0005" (.025-.127 mm).

10. If the end play is too loose, remove the jam nut and pull the washer away from the adjusting nut. Tighten the adjusting nut to the next alignment hole of the washer. Re-assemble the washer and re-tighten the jam nut to 240-260 ft-lbs. Verify End Play with a dial indicator.

11. If end play is not present, remove the jam nut and pull the washer away from the adjusting nut. Loosen the adjusting nut to the next alignment hole of the washer. Re-assemble the washer and re-tighten the jam nut to 240-260 ft-lbs. Verify End Play with a dial indicator.

Bendix

Service Data

SD-08-2412

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Bendix® AD-9® Air Dryer

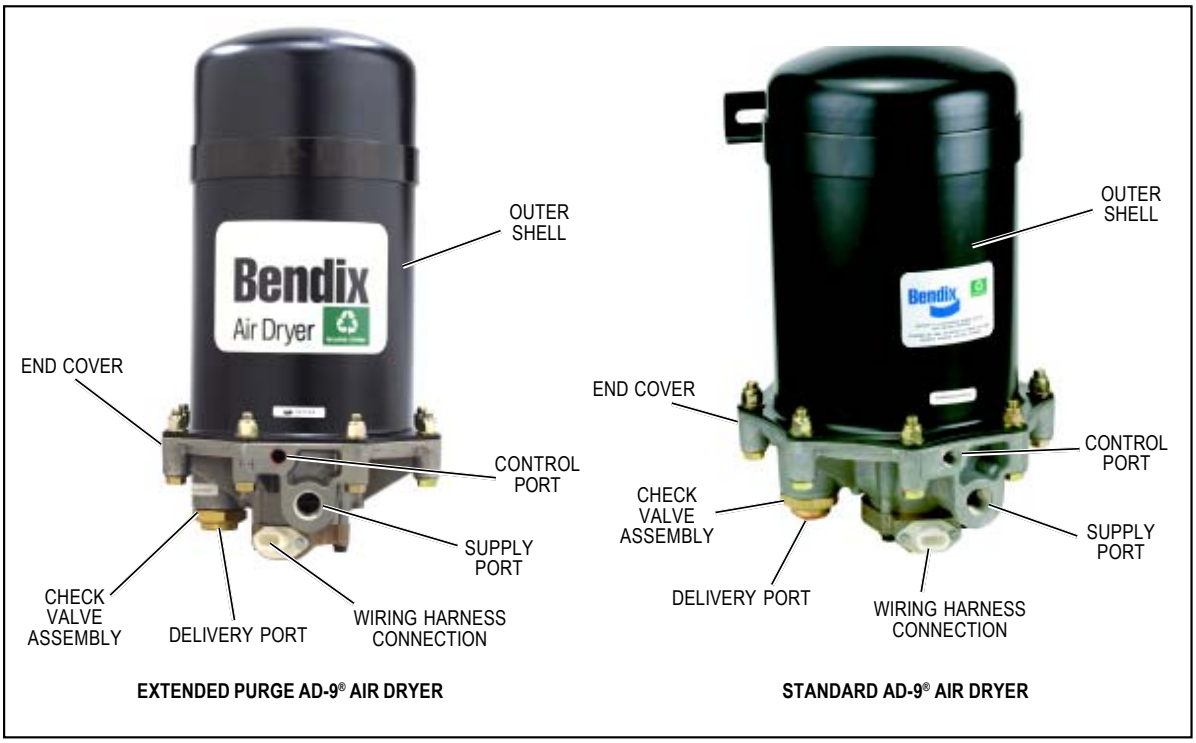


*FIGURE 1 - **AD-9® AIR DRYER MODELS***

DESCRIPTION

The function of the AD-9® air dryer is to collect and remove air system contaminants in solid, liquid and vapor form before they enter the brake system. It provides clean, dry air to the components of the brake system which increases the life of the system and reduces maintenance costs. Daily manual draining of the reservoirs is eliminated.

The AD-9® air dryer consists of a desiccant cartridge and a die cast aluminum end cover secured to a cylindrical steel outer shell with eight cap screws and nuts. The end cover contains a check valve assembly, a safety valve, three threaded air connections and the purge valve housing assembly. The removable purge valve housing assembly incorporates a purge valve mechanism and a turbo charger cut-off feature that is designed to prevent loss of engine "turbo" boost pressure during the purge cycle of the AD-9® air dryer. For ease of serviceability, the desiccant cartridge and discharge check valve assembly are screw in type. The purge valve housing assembly, which includes the heater and thermostat assembly, and the discharge check valve assembly, is serviceable from the exterior of the air dryer, while servicing the screw-in desiccant cartridge requires removal of the air dryer assembly from the vehicle.

The AD-9® air dryer has three female pipe thread air connections and each is identified as follows:

Port I.D.	Function/Connection
CON 4	Control Port (purge valve control and turbo cut-off).
SUP 11	Supply Port (air in).
DEL 2	Delivery Port (air out).

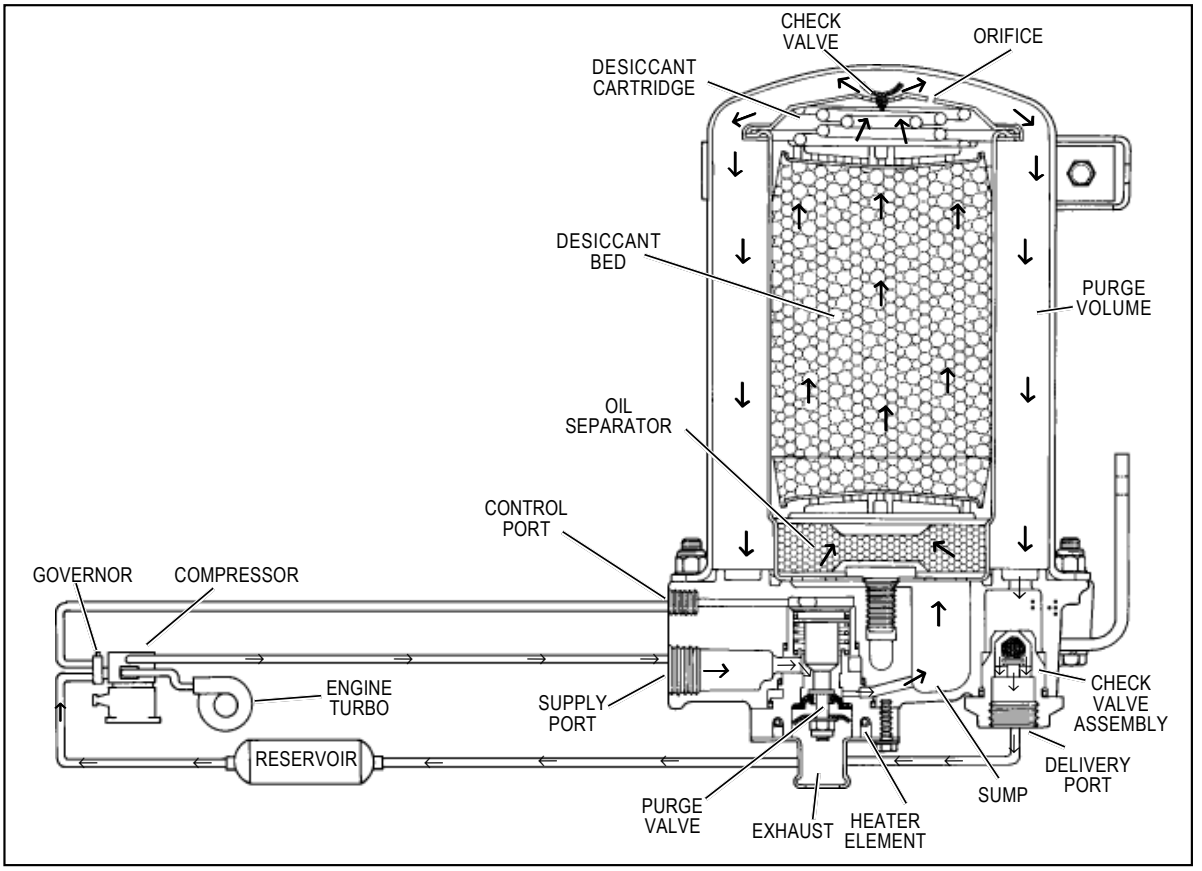


FIGURE 2 - ***AD-9® AIR DRYER CHARGE CYCLE***

OPERATION OF THE AD-9® AIR DRYER

The AD-9® air dryer alternates between two operational modes or "cycles" during operation: the *charge cycle* and the *purge cycle*. The following description of operation is separated into these "cycles" of operation.

CHARGE CYCLE (refer to Figure 2)

When the compressor is loaded (compressing air) compressed air, along with oil, oil vapor, water and water vapor flows through the compressor discharge line to the supply port of the air dryer end cover. As air travels through the end cover assembly, its direction of flow changes several times, reducing the temperature, causing contaminants to condense and drop to the bottom or sump of the air dryer end cover.

After exiting the end cover, the air flows into the desiccant cartridge. Once in the desiccant cartridge air first flows through an oil separator which removes water in liquid form as well as oil and solid contaminants.

Air exits the oil separator and enters the desiccant drying bed. Air flowing through the column of desiccant becomes progressively drier as water vapor adheres to the desiccant material in a process known as *"adsorption"*. The desiccant cartridge using the adsorption process typically removes 95% of the water vapor from the pressurized air.

The majority of dry air exits the desiccant cartridge through its integral single check valve to fill the purge volume between the desiccant cartridge and outer shell. Some air will also exit the desiccant cartridge through the purge orifice adjacent to the check valve.

Dry air flows out of the purge volume through the single check valve assembly and out the delivery port to the first (supply) reservoir of the air system.

The air dryer will remain in the charge cycle until air brake system pressure builds to the governor cutout setting.

PURGE CYCLE (refer to Figure 3)

When air brake system pressure reaches the cutout setting of the governor, the compressor unloads (air compression stopped) and the purge cycle of the air dryer begins. When the governor unloads the compressor, it pressurizes the compressor unloader mechanism and line connecting the

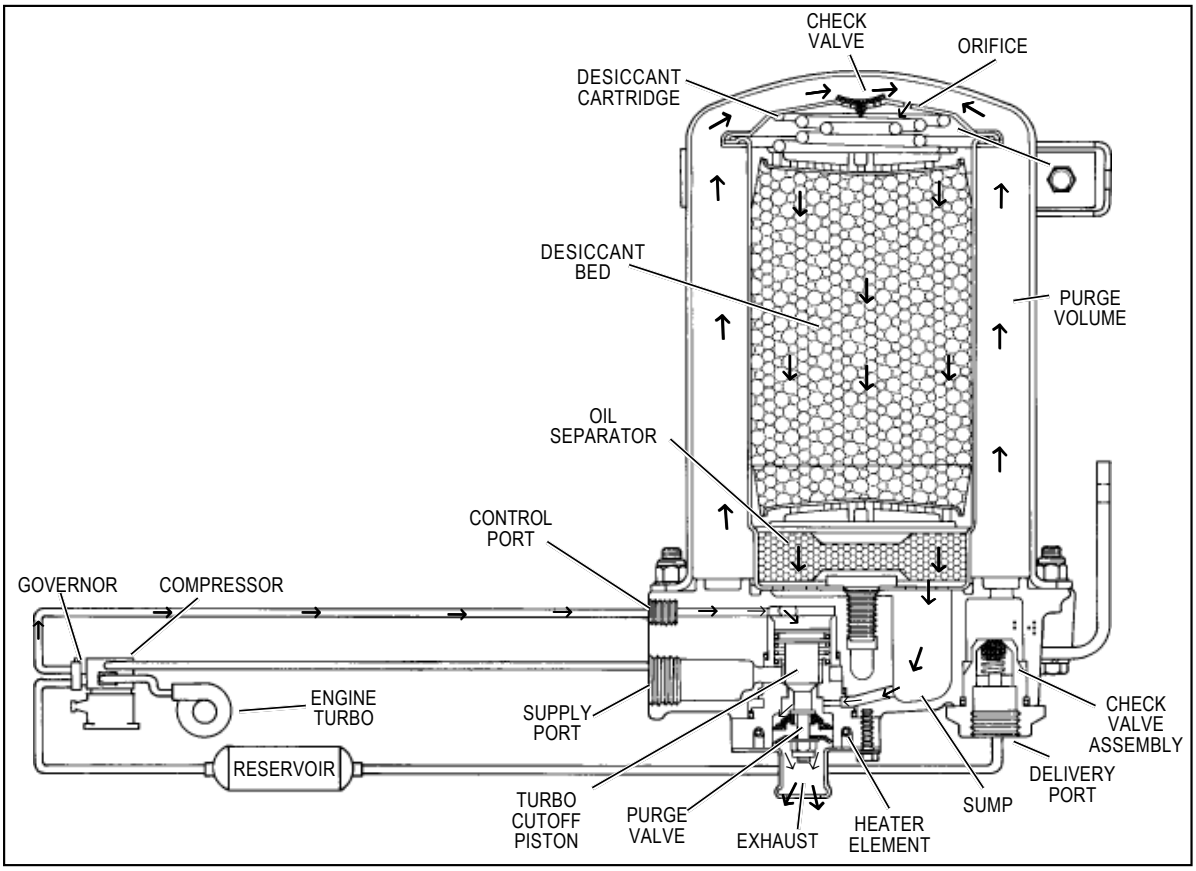


FIGURE 3 - ***AD-9® AIR DRYER PURGE CYCLE***

governor unloader port to the AD-9® air dryer end cover control port. The purge piston moves in response to air pressure causing the purge valve to open to atmosphere and (partially) closing off the supply of air from the compressor, this will be further discussed in the section covering the turbo cut-off feature. Contaminants in the end cover sump are expelled immediately when the purge valve opens. Also, air which was flowing through the desiccant cartridge changes direction and begins to flow toward the open purge valve. Oil and solid contaminants collected by the oil separator are removed by air flowing from the desiccant drying bed to the open purge valve.

The initial purge and desiccant cartridge decompression lasts only a few seconds and is evidenced by an audible burst of air at the AD-9® air dryer exhaust.

The actual reactivation of the desiccant drying bed begins as dry air flows from the purge volume through the desiccant cartridge purge orifice and into the desiccant drying bed. Pressurized air from the purge volume expands after passing through the purge orifice; its pressure is lowered and its volume increased. The flow of dry air through the drying bed reactivates the desiccant material by removing the water vapor adhering to it. Generally 15-30 seconds are required for the entire purge volume of a standard AD-9® air dryer to flow through the desiccant drying bed.

The end cover single check valve assembly prevents air pressure in the brake system from returning to the air dryer during the purge cycle. After the 30 second purge cycle is complete, the air dryer is ready for the next charge cycle to begin.

The purge valve will remain open after the purge cycle is complete and will not close until air brake system pressure is reduced and the governor signals the compressor to charge.

TURBO CUT-OFF FEATURE (Refer to Figure 4)

The primary function of the turbo cut-off valve is to prevent loss of engine turbocharger air pressure through the AD-9® air dryer in systems where the compressor intake is connected to the engine turbocharger. The turbo cut-off valve also reduces the “puffing” of air out the open exhaust when a naturally aspirated, single cylinder compressor equipped with an inlet check valve is in use.

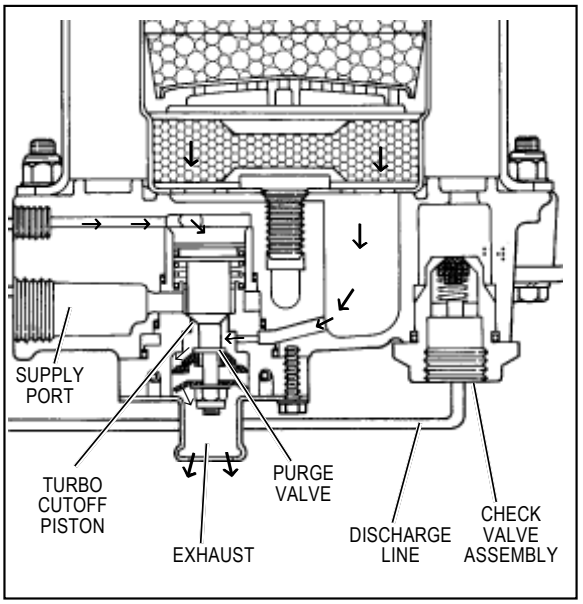


*FIGURE 4 - **AD-9® AIR DRYER TURBO CUTOFF***

At the onset of the purge cycle, the downward travel of the purge piston is stopped when the turbo cut-off valve (tapered portion of purge piston) contacts its mating metal seat in the purge valve housing. With the turbo cut-off valve seated (closed position), air in the discharge line and AD-9® air dryer inlet port is restricted from entering the air dryer. While the turbo cut-off effectively prevents loss of turbo charger boost pressure to the engine, some "seepage" of air may be detected under certain conditions of compressor engine and turbo charger operation, even so there will always be low pressure trapped in the discharge line.

PREVENTIVE MAINTENANCE

Important: Review the warranty policy before performing any intrusive maintenance procedures. An extended warranty may be voided if intrusive maintenance is performed during this period. Note: It is acceptable for the purge valve to be maintained as necessary, i.e., the installation of a purge valve maintenance kit, without voiding the warranty.

Because no two vehicles operate under identical conditions, maintenance and maintenance intervals will vary. Experience is a valuable guide in determining the best maintenance interval for any one particular operation.

Every 900 operating hours or 25,000 miles or every three (3) months:

1. Check for moisture in the air brake system by opening reservoirs, drain cocks, or valves and checking for presence of water. If moisture is present, the desiccant may require replacement; however, the following conditions can also cause water accumulation and should be considered before replacing the desiccant:

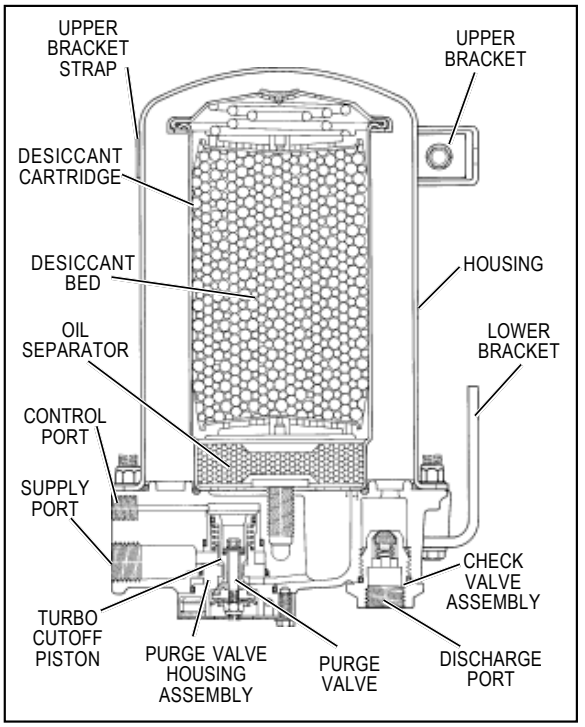


*FIGURE 5 - **AD-9® AIR DRYER SECTIONAL VIEW***

A. An outside air source has been used to charge the system. This air did not pass through the drying bed.

B. Air usage is exceptionally high and not normal for a highway vehicle. This may be due to accessory air demands or some unusual air requirement that does not allow the compressor to load and unload (compressing and non-compressing cycle) in a normal fashion. Check for high air system leakage. If the vehicle vocation has changed it may be necessary to upgrade the compressor size. Refer to Appendix A, Table A and the column entitled Vehicle Vocation.

C. The air dryer has been installed in a system that has been previously used without an air dryer. This type of system will be saturated with moisture and several weeks of operation may be required to dry it out.

D. Location of the air dryer is too close to the air compressor. Refer to *Locating AD-9® Air Dryer On Vehicle* section and Appendix A, Table A, column 2 for discharge line length.

E. In areas where more than a 30 degree range of temperature occurs in one day, small amounts of water can accumulate in the air brake system due to condensation. Under these conditions, the presence of small amounts of moisture is normal

and should not be considered as an indication that the dryer is not performing properly.

Note: A small amount of oil in the system may be normal and should not, in itself, be considered a reason to replace the desiccant; oil stained desiccant can function adequately.

2. Check mounting bolts for tightness. Retorque to 270-385 inch pounds.
3. Perform the *Operation & Leakage Tests* listed in this publication.

Every 10,800 hours; 300,000 miles or 36 months:

1. Rebuild the air dryer including the desiccant cartridge.

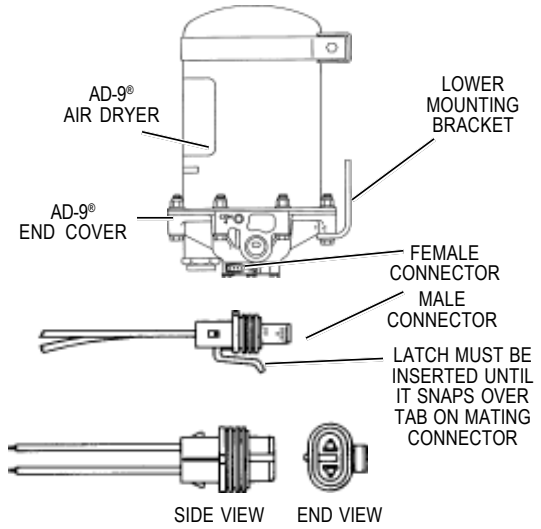
Note: The desiccant change interval may vary from vehicle to vehicle. Although typical desiccant cartridge life is three years, many will perform adequately for a longer period of time. In order to take maximum advantage of desiccant life and assure that replacement occurs only when necessary, it is important that *Operation & Leakage Tests* be performed.

WARNING!

This air dryer is intended to remove moisture and other contaminants normally found in the air brake system. Do not inject alcohol, anti-freeze, or other de-icing substances into or upstream of the air dryer. Alcohol is removed by the dryer, but reduces the effectiveness of the device to dry air. Use of other substances can damage the air dryer and may void the warranty.

OPERATION & LEAKAGE TESTS

1. Test the outlet port check valve assembly by building the air system to governor cut-out and observing a test air gauge installed in the #1 reservoir. A rapid loss of pressure could indicate a failed outlet port check valve. This can be confirmed by bleeding the system down, removing the check valve assembly from the end cover, subject air pressure to the unit and apply a soap solution to the check valve side. Leakage should not exceed a 1" bubble in 1 second.
2. Check for excessive leakage around the purge valve. With the compressor in loaded mode (compressing air), apply a soap solution to the purge valve housing assembly exhaust port and observe that leakage does not exceed a 1" bubble in 1 second. If the leakage exceeds the maximum specified, service the purge valve housing assembly.
3. Close all reservoir drain cocks. Build up system pressure to governor cut-out and note that AD-9® air dryer purges with an audible escape of air. "Fan" the service brakes to reduce system air pressure to governor cut-in. Note that the system once again builds to full pressure and is followed by an AD-9® air dryer purge.



A two lead, 12 inch, wire harness with attached weather resistant connector is supplied with all retrofit and replacement AD-9® air dryers. Connect one of the two leads of the wire harness to the engine kill or ignition switch. The remaining lead of the wire harness must be connected to a good vehicle ground. A fuse should be installed in the power carrying wire; install a 10 amp fuse for 12 volt heaters and a 5 amp fuse for a 24 volt heater. Use 14 AWG wire if it is necessary to lengthen the wire harness provided.
Make certain all wire splices are waterproofed.
Tie wrap or support all electrical wire leading to the AD-9® air dryer.

FIGURE 6 - ***HEATER AND THERMOSTAT CONNECTOR***

4. Check the operation of the safety valve by pulling the exposed stem while the compressor is loaded (compressing air). There must be an exhaust of air while the stem is held and the valve should re-seat when the stem is released.
5. Check all lines and fittings leading to and from the air dryer for leakage and integrity.
6. Check the operation of the end cover heater and thermostat assembly during cold weather operation as follows:
   A. Electric Power to the Dryer

      With the ignition or engine kill switch in the ON position, check for voltage to the heater and thermostat assembly using a voltmeter or test light. Unplug the electrical connector at the air dryer and place the test leads on each of the pins of the male connector. If there is no voltage, look for a blown fuse, broken wires, or corrosion in the vehicle wiring harness. Check to see if a good ground path exists.

B. Thermostat and Heater Operation

Turn off the ignition switch and cool the end cover assembly to below 40 degrees Fahrenheit. Using an ohmmeter, check the resistance between the electrical pins in the female connector. The resistance should be 1.5 to 3.0 ohms for the 12 volt heater assembly and 6.8 to 9.0 ohms for the 24 volt heater assembly. **Note**: *Some early models of the AD-9® air dryer will have resistance readings of 1.0 to 2.5 ohms for the 12 volt heater assembly and 4.8 to 7.2 ohms for the 24 volt heater assembly. If the resistance is higher than the maximum stated, replace the purge valve housing assembly, which includes the heater and thermostat assembly.*

Warm the end cover assembly to over 90 degrees Fahrenheit and again check the resistance. The resistance should exceed 1000 ohms. If the resistance values obtained are within the stated limits, the thermostat and heater assembly is operating properly. If the resistance values obtained are outside the stated limits, replace the purge valve housing assembly, which includes the heater and thermostat assembly.

REBUILDING THE AD-9® AIR DRYER

GENERAL

If, after completing the routine operation and leakage tests, it has been determined that one or more components of the air dryer requires replacement or maintenance, refer to the following list to find the appropriate kit(s).

When rebuilding or replacing components of the air dryer use only genuine Bendix parts. For ease in servicing the AD-9® air dryer desiccant cartridge assembly, it is recommended that the air dryer be removed from the vehicle.

MAINTENANCE KITS AVAILABLE:

5005037 Hard Seat Purge Valve Housing Maintenance Kit

5005893 Soft Seat Purge Valve Housing Maintenance Kit

These kits contain the parts necessary to rebuild the air portion of the purge valve housing and do not include the heater and thermostat.

107796 Remanufactured Desiccant Cartridge Replacement Kit

This kit contains the parts necessary to change the desiccant cartridge only.

107794 Desiccant Cartridge Replacement Kit

This kit contains the parts necessary to change the desiccant cartridge only.

107799 End Cover Check Valve Assembly Replacement 3/4 inch thread size.

107800 End Cover Check Valve Assembly Replacement 1/2 inch thread size.

800405 Service New Purge Valve Housing Assembly - Soft Seat (w/heater and thermo.) 12 volt system.

5004341 Remanufactured Exchange Purge Valve Housing Assembly - Soft Seat (w/heater and thermo.) 12 volt system.

5004479 Service New Purge Valve Housing Assembly - Hard Seat (w/heater and thermo.) 12 volt system.

5004339 Service New Purge Valve Housing Assembly - DLU (w/heater and thermo.) 12 volt system.

5004338 Service New Purge Valve Housing Assembly - Soft Seat (w/heater and thermo.) 24 volt system.

5004342 Remanufactured Exchange Purge Valve Housing Assembly - Soft Seat (w/heater and thermo.) 24 volt system.

5004480 Service New Valve Housing Assembly - Hard Seat (w/heater and thermo.) 24 volt system.

5004340 Service New Purge Valve Housing Assembly - DLU (w/heater and thermo.) 24 volt system.

107695 Complete Mounting Bracket Kit

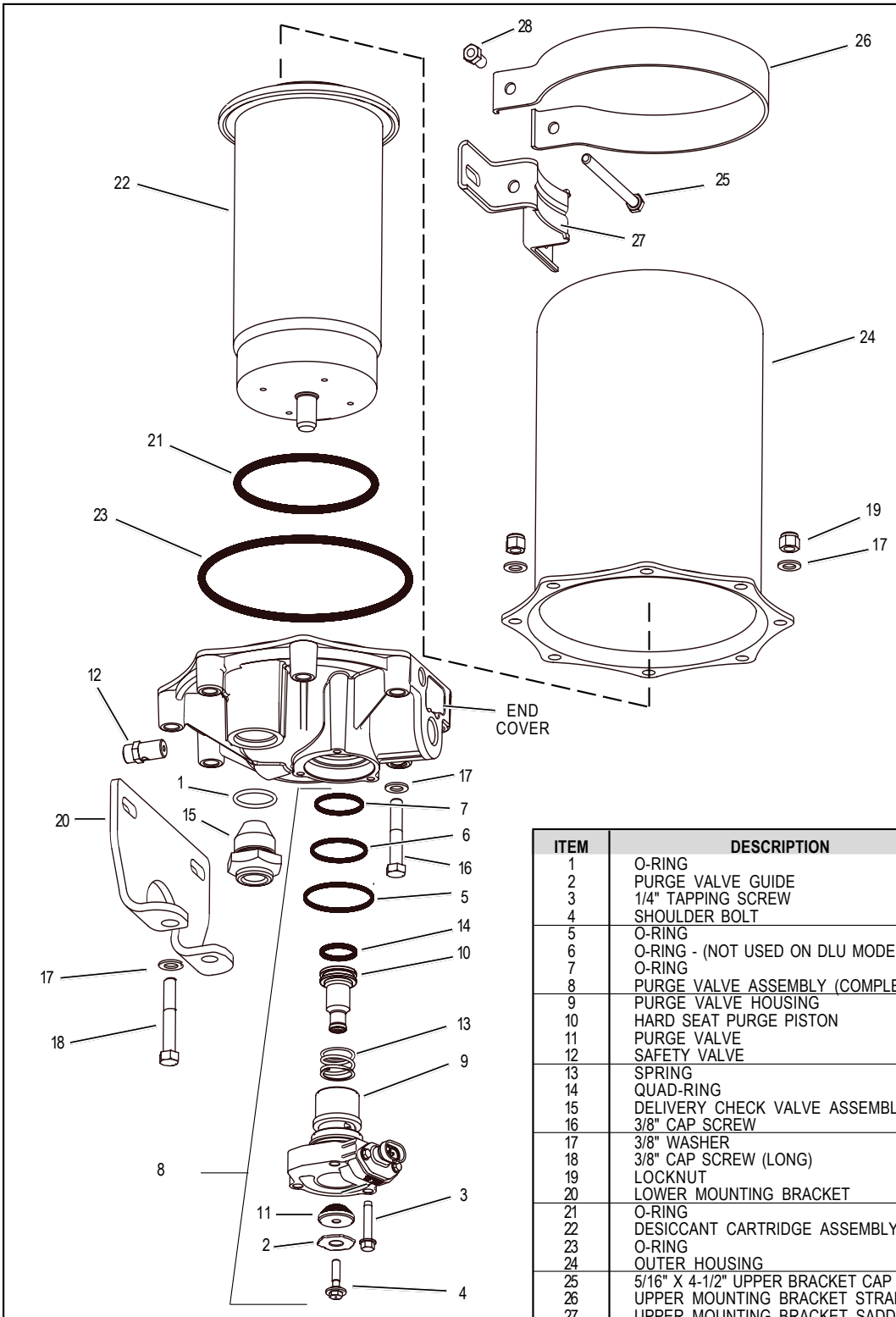
This kit contains the upper and lower brackets as well as the necessary hardware items to mount them.

GENERAL SAFETY GUIDELINES

WARNING! PLEASE READ AND FOLLOW THESE INSTRUCTIONS TO AVOID PERSONAL INJURY OR DEATH:

When working on or around a vehicle, the following general precautions should be observed at all times.

1. **Park the vehicle on a level surface, apply the parking brakes, and always block the wheels. Always wear safety glasses.**
2. **Stop the engine and remove ignition key when working under or around the vehicle. When working in the engine compartment, the engine should be shut off and the ignition key should be removed. Where circumstances require that the engine be in operation, EXTREME CAUTION should be used to prevent personal injury resulting from contact with moving, rotating, leaking, heated or electrically charged components.**
3. **Do not attempt to install, remove, disassemble or assemble a component until you have read and thoroughly understand the recommended procedures. Use only the proper tools and observe all precautions pertaining to use of those tools.**
4. **If the work is being performed on the vehicle's air brake system, or any auxiliary pressurized air systems, make certain to drain the air pressure from all reservoirs before beginning ANY work on the vehicle. If the vehicle is equipped with an AD-IS® air dryer system or a dryer reservoir module, be sure to drain the purge reservoir.**



ITEM	DESCRIPTION
1	O-RING
2	PURGE VALVE GUIDE
3	1/4" TAPPING SCREW
4	SHOULDER BOLT
5	O-RING
6	O-RING - (NOT USED ON DLU MODELS)
7	O-RING
8	PURGE VALVE ASSEMBLY (COMPLETE)
9	PURGE VALVE HOUSING
10	HARD SEAT PURGE PISTON
11	PURGE VALVE
12	SAFETY VALVE
13	SPRING
14	QUAD-RING
15	DELIVERY CHECK VALVE ASSEMBLY
16	3/8" CAP SCREW
17	3/8" WASHER
18	3/8" CAP SCREW (LONG)
19	LOCKNUT
20	LOWER MOUNTING BRACKET
21	O-RING
22	DESICCANT CARTRIDGE ASSEMBLY (COMPLETE)
23	O-RING
24	OUTER HOUSING
25	5/16" X 4-1/2" UPPER BRACKET CAP SCREW
26	UPPER MOUNTING BRACKET STRAP
27	UPPER MOUNTING BRACKET SADDLE
28	SLEEVE NUT

*FIGURE 7 - **AD-9® AIR DRYER ASSEMBLY***

5. **Following the vehicle manufacturer's recommended procedures, deactivate the electrical system in a manner that safely removes all electrical power from the vehicle.**
6. **Never exceed manufacturer's recommended pressures.**
7. **Never connect or disconnect a hose or line containing pressure; it may whip. Never remove a component or plug unless you are certain all system pressure has been depleted.**
8. **Use only genuine Bendix® replacement parts, components and kits. Replacement hardware, tubing, hose, fittings, etc. must be of equivalent size, type and strength as original equipment and be designed specifically for such applications and systems.**
9. **Components with stripped threads or damaged parts should be replaced rather than repaired. Do not attempt repairs requiring machining or welding unless specifically stated and approved by the vehicle and component manufacturer.**
10. **Prior to returning the vehicle to service, make certain all components and systems are restored to their proper operating condition.**
11. **For vehicles with Antilock Traction Control (ATC), the ATC function must be disabled (ATC indicator lamp should be ON) prior to performing any vehicle maintenance where one or more wheels on a drive axle are lifted off the ground and moving.**

AD-9® AIR DRYER REMOVAL

1. Park the vehicle on a level surface and prevent movement by means other than the brakes.
2. Drain all reservoirs to 0 p.s.i. (0 kPa).— Caution: Compressor discharge line may still contain residual pressure.
3. Identify and disconnect the three air lines from the end cover and note the position of end cover ports relative to the vehicle.
4. Unplug the vehicle wiring harness from the heater and thermostat assembly connector on the purge valve housing assembly.
5. Loosen the 5/16" X 4-1/2" hex cap screw (25) securing the upper mounting strap (26).
6. Remove, retain and mark the two 3/8" end cover cap screws (18), lock nuts (19) and four special washers (17) that retain the lower mounting bracket (20) to the end cover, also mark these two holes of the end cover. (These bolts are longer than the other 6 bolts.)
7. Remove the AD-9® air dryer from its mounting brackets on the vehicle.

DISASSEMBLY

The following disassembly and assembly procedure is presented for reference purposes and presupposes that a major rebuild of the AD-9® air dryer is being undertaken. Several replacement parts and maintenance kits are available which do not require full disassembly. The instructions provided with these parts and kits should be followed in lieu of the instructions presented here. Refer to Figure 7 during disassembly.

Caution: While performing service on the AD-9® air dryer, it is <u>not</u> recommended that a clamping device (vise, C-clamp, etc.) be used to hold any die cast aluminum component as damage may result. To hold the end cover, install a pipe nipple in the supply port and clamp the nipple into a vise.

1. Using an adjustable wrench or an 1-3/4" socket, remove the delivery check valve assembly (15) and o-ring (1). Remove the o-ring (1) from the check valve assembly.
2. Remove the three 1/4" self tapping screws (3) that secure the purge valve housing assembly to the end cover assembly. Pull the purge valve housing assembly (8) out of the end cover assembly. Remove the o-rings (5, 6 & 7) from the exterior of the purge valve housing assembly. (O-ring item 6 is not included in DLU models.) **Note:** the o-rings may be lodged in the end cover bores, if so, they must be removed.
3. Purge Valve (8) Disassembly:

   Note: Removal of the piston from the purge valve housing assembly requires a tool to hold the head of the purge piston while unscrewing the purge valve shoulder bolt (4). If an extended type exhaust cover is in use to accommodate the attachment of an exhaust hose, the exhaust cover must be carefully peeled off of the purge valve housing (9). **Use a thin flat blade to pry the exhaust cover off, taking care not to damage the potting material (RTV sealant) under the cover.** To remove the piston (10) from the purge valve housing assembly (9)(9) use a twelve point 1/4" socket to hold the head of the shoulder bolt (4).

   A. Remove the shoulder bolt (4) from the bottom of the purge valve housing assembly (8) while securing the top of the purge piston (10) using the two opposing cast indentations and a tool. Remove the purge guide (2) and purge valve (11) from the purge valve housing.

   B. Remove the purge piston (10) and return spring (13) from the opposite end of the purge valve housing. Remove the quad ring (14) from the purge piston (10).

   C. Heater and Thermostat Assembly Replacement. **Caution:** Do not attempt to remove this assembly, as it will be damaged during the removal process and is **not available as a service part**. If the heater and thermostat are defective, replace the entire purge valve housing assembly which includes these items.

4. Remove the remaining six 3/8" cap screws (16), lock nuts (19) and twelve special washers (17) that secure the end cover to the housing (24). Separate the end cover and desiccant cartridge (22) from the housing (24).
5. Remove the end cover to outer housing o-ring (23).
6. Do not remove the safety valve (12) from the end cover unless it has been proven defective. If replacement is required, apply thread sealant or Teflon® tape on the threads of the replacement valve and torque to 120-400 in. lbs.
7. Place a strap or chain wrench around the desiccant cartridge (22) so that it is approximately 2-3 inches away from the end cover. Rotate the cartridge counterclockwise until it completely separates from the end cover. **Note:** *A substantial torque (up to 50 lb. ft.) may be required to perform this disassembly.*
8. Remove the desiccant cartridge o-ring (21) from the end cover.

CLEANING & INSPECTION

1. Using mineral spirits or an equivalent solvent, clean and thoroughly dry all metal parts.
2. Inspect the interior and exterior of all metal parts that will be reused for severe corrosion, pitting and cracks. Superficial corrosion and/or pitting on the exterior portion of the upper and lower body halves is acceptable.
3. Inspect the bores of both the end cover and the purge valve housing for deep scuffing or gouges.
4. Make certain that all purge valve housing and end cover passages are open and free of obstructions.
5. Inspect the pipe threads in the end cover. Make certain they are clean and free of thread sealant.
6. Inspect the purge valve housing bore and seats for excessive wear and scuffing.
7. Inspect the purge valve piston seat for excessive wear.
8. Inspect all air line fittings for corrosion. Clean all old thread sealant from the pipe threads.
9. All o-rings removed should be discarded and replaced with new o-rings provided in appropriate kit(s).

Any component exhibiting a condition described in step 1 to 8 should be replaced.

ASSEMBLY

Prior to assembly, coat all o-rings, o-ring grooves, and bores with a generous amount of the lubricant included in the maintenance kit. Refer to Figure 7 during assembly unless otherwise advised.

1. Purge Valve Housing Assembly
   A. Install the quad-ring (14) in its groove on the O.D. of the purge piston (10). Place the return spring (13) in the bore of the purge valve housing. Insert the purge piston (10) into the I.D. of the return spring. Place the purge valve guide (2) onto the shoulder bolt (4) followed by the purge valve (11). Using a ratchet or wrench, screw the purge valve, purge valve guide and shoulder bolt into the purge housing until it bottoms. This will require a tool to hold the top of the purge piston from rotating as the shoulder bolt is screwed into the bottom of the purge piston to complete the purge valve assembly (8). Torque the shoulder bolt to 60-90 in. lbs.
   B. Install the o-rings (5, 6 and 7) on the purge valve housing placing each in its appropriate location. Note o-ring (6) is not used on DLU models. If the exhaust cover was removed during disassembly, install it on the purge valve housing assembly (8) making certain the “bubble” portion is positioned over the thermostat. Install the assembled purge valve housing (8) in the end cover making certain to orient both parts such that the connector is approximately 10 degrees clockwise from the supply port, while making certain the purge valve housing is fully seated against the end cover. Secure the purge valve housing to the end cover using the three 1/4" self-tapping screws (3). Start all three screws by hand then torque to 50-80 in. lbs.
2. Install the o-ring (1) on the check valve assembly (15), then install the assembly in the end cover.

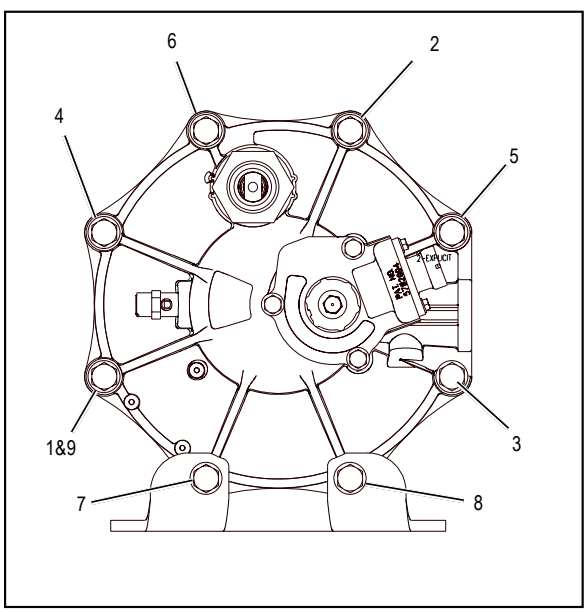


FIGURE 8 - ***END COVER TO HOUSING TORQUE PATTERN***

3. Install the desiccant cartridge o-ring (21) in its groove in the end cover. Using a light coat of lubricant (included in kit), lubricate the bottom of the desiccant cartridge in the area that will contact the o-ring (21) and end cover. Screw the desiccant cartridge into the end cover until contact is made between it and the o-ring. Using a strap or chain wrench positioned 2-3" from the bottom of the cartridge, turn the desiccant cartridge clockwise 180-225 degrees beyond the position where initial contact was made between the cartridge and end cover o-ring. Torque should not exceed 50 ft. lbs.
4. Install the end cover outer housing o-ring (23) on the shoulder in the end cover. Place the housing (24) over the desiccant cartridge and align the holes. Install the six 3/8" cap screws (16), lock nuts (19) and twelve special washers (17) making certain they are in the proper position as marked during disassembly. The two longer 3/8" cap screws (18) will be used to secure the AD-9® air dryer to its mounting bracket. Tighten the six cap screws and nuts in a star pattern in a fashion similar to Figure 8; depending on lower bracket location. Torque to 270-385 in. lbs. (Refer to Fig. 8.) **Note:** The two remaining bolt holes in the end cover and two 3/8" cap screws must be the ones marked during disassembly to assure proper orientation of the ports and adequate length of the cap screws.

INSTALLATION

1. Install the assembled AD-9® air dryer back onto the vehicle by slipping it into the upper mounting bracket. Align the two unused holes in the end cover with the bottom mounting bracket such that the bottom bracket supports the air dryer. The AD-9® air dryer end cover should rest on the bracket. Using the remaining two 3/8" cap screws (18), four special washers (17), and two lock nuts (19), secure the air dryer to the lower bracket. Tighten, then torque the two remaining cap screws to 270-385 in. lbs.
2. Tighten the 5/16" X 4-1/2" hex cap screw (25) and nut (28) on the upper mounting bracket saddle (27) and strap (26). Torque to 80-120 in. lbs.
3. Reconnect the three air lines to the proper ports on the end cover (identified during disassembly).
4. Reconnect the vehicle wiring harness to the AD-9® air dryer heater and thermostat assembly connector by plugging it into the air dryer connector until its lock tab snaps in place.
5. Before placing vehicle back into service, perform the *Operation and Leakage Tests* stated elsewhere in this manual.

RETROFITTING THE AD-9® AIR DRYER

GENERAL

The following retrofit instructions are presented for reference purposes only since Bendix aftermarket retrofit and replacement air dryers are packaged with the most up-to-date installation instructions. The instructions packaged with the AD-9® air dryer should be followed in lieu of those presented here.

The preceding portion of this manual deals with "in-service" repair and/or replacement of the AD-9® air dryer. The portion of the manual that follows is concerned with installing an AD-9® air dryer on a vehicle not previously equipped with one.

VEHICLE APPLICATION REQUIREMENTS

The basic application requirements presented here apply to a standard air dryer installation. The majority of highway vehicles in use today will meet these basic requirements however, some may not. Examples of vehicles that may not meet the requirements include, bulk trailer unloading operations and other high air consumption/continuous flow systems. While the AD-9® air dryer can be used on these vehicles the standard installation procedure presented in this manual may require modification to assure proper operation and service life. Consult your local authorized Bendix parts outlet or sales representative for additional information.

1. Charge Cycle Time - The AD-9® air dryer is designed to provide clean, dry air for the brake system. When a vehicle's air system is used to operate non-brake air accessories it is necessary to determine that during normal, daily operation the compressor should recover from governor "cut-in" to governor "cut-out" (usually 100 psi to 120 psi) in 90 seconds or less at engine RPMs commensurate with the vehicle vocation. If the recovery time consistently exceeds this limit, it may be necessary to "bypass" the air accessory responsible for the high air usage. Consult your local authorized Bendix parts outlet or sales representative for additional information.
2. Purge Cycle Time - During normal vehicle operation, the air compressor **must remain unloaded for a minimum of 20 seconds for the standard AD-9® air dryer or 30 seconds for the Extended Purge model.** These minimum purge times are required to ensure complete regeneration of the desiccant material. If the purge time is occasionally shorter than the times specified, no permanent ill effect should be expected, however, if the purge time is consistently less than the minimum, an accessory by-pass system must be installed.
3. European Air Brake Systems - Brake systems that incorporate compressors without integral unloading

mechanisms and/or utilize a compressor discharge line unloader valve have special AD-9® air dryer installation requirements. Consult your local authorized Bendix parts outlet or sales representative for additional information.

4. Air Compressor Size - Although the AD-9® air dryer can be used in conjunction with larger compressors, it was designed primarily for units rated for up to 17 CFM. It is recommended that when using the AD-9® air dryer with a compressor which has a rated displacement exceeding 17 CFM that an authorized Bendix parts outlet or Bendix marketing representative be contacted for assistance.
5. Holset "E or QE" Type Air Compressors - In order for the AD-9® air dryer to function properly when installed with the Holset Type "E or QE" compressor, several specialized Holset components are required. Consult your local authorized Holset parts outlet or sales representative for additional information.
6. Use of Standard or Extended Purge AD-9® Air Dryer - Use the following guidelines:

Total Vehicle Reservoir Volume	Requirement
Less than 9,000 cu. in.	Standard AD-9® Air Dryer
9,000 - 12,500 cu. in.	Extended Purge AD-9® Air Dryer
Greater than 12,500 cu. in.	Contact Bendix Rep. or Bendix Engineering

VEHICLE PREPARATION

1. Park the vehicle on a level surface and prevent movement by means other than the brakes.
2. Drain all reservoirs to 0 p.s.i. (0 kPa).

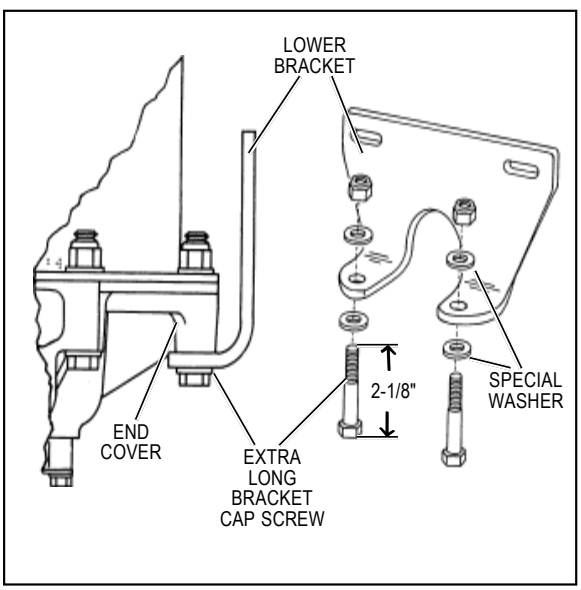


FIGURE 9 - ***LOWER BRACKET INSTALLATION***

LOCATING AD-9® AIR DRYER ON VEHICLE

1. The AD-9® air dryer must be mounted vertically (purge exhaust toward road surface) outside the engine compartment in an area of air flow while the vehicle is in motion. The AD-9® air dryer must not be exposed to direct wheel splash (located behind axle mud flap is acceptable).
2. Locate the AD-9® air dryer as close to the first (supply) reservoir as possible.
3. Do not locate the AD-9® air dryer near heat producing components such as the vehicle exhaust and make certain adequate clearance from moving components (e.g. drive shaft, suspension, pitman arm, etc.) is provided.
4. Locate the AD-9® air dryer on vehicle so that a minimum of 11 inches (28 cm) clearance below the end cover is available to allow servicing. Alternatively, provide access to the bracket bolts so the unit may be removed for servicing.
5. When choosing the mounting location for the AD-9® air dryer, note the discharge line length requirements stated under the heading *Connecting the Air Lines*, elsewhere in this instruction sheet.

   Important Note: Under normal operating conditions, the maximum inlet air temperature for the AD-9® air dryer is 160 degrees Fahrenheit.

MOUNTING THE AD-9® AIR DRYER

1. To install the lower mounting bracket on the AD-9® air dryer, it will be necessary to remove and discard two of the end cover bolts and lock nuts. To determine which end cover bolts to utilize to attach the lower bracket, take into consideration the piping connections required to install the AD-9® air dryer and use those that will best

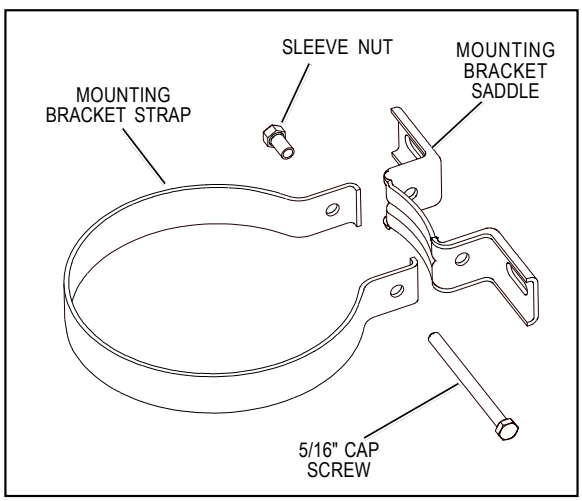


FIGURE 10 - ***UPPER MOUNTING BRACKET AND STRAP***

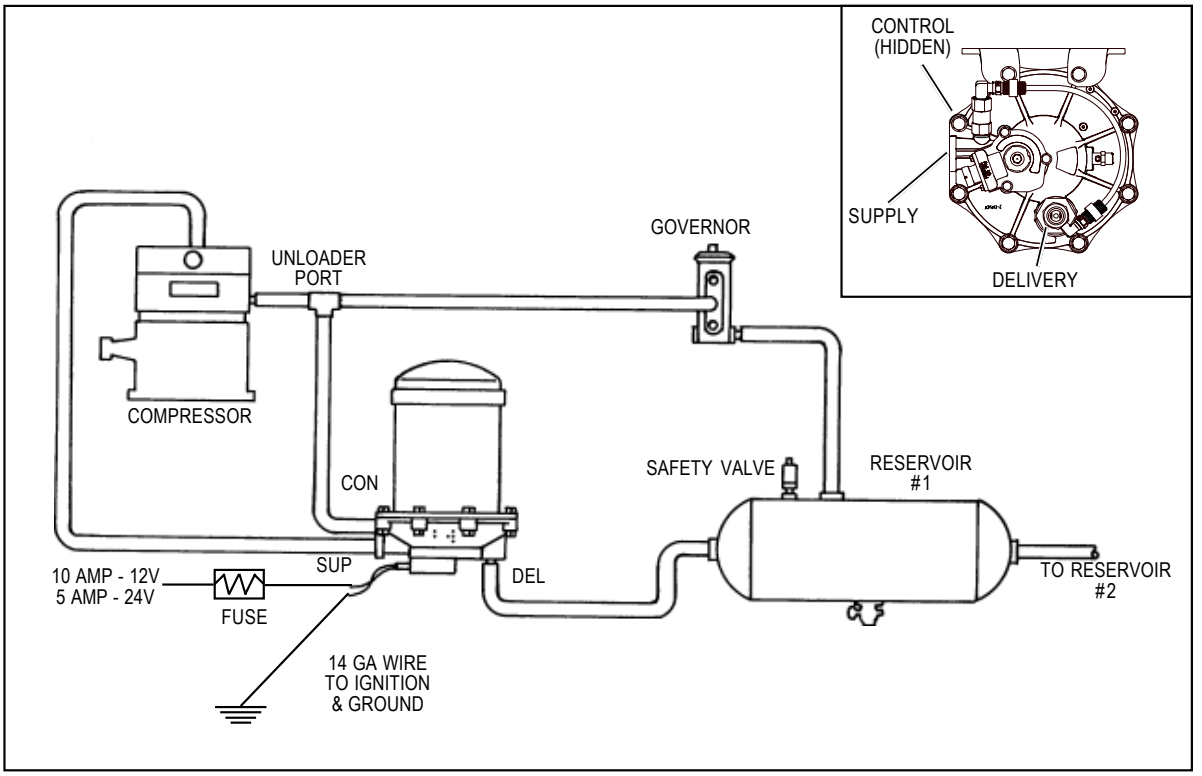


FIGURE 11 - ***AD-9® AIR DRYER CHARGE CYCLE***

position the unit for ease of installation. Locate the bracket such that it cradles the end cover as shown in Figure 9. Utilizing the two 2-3/8" long cap screws, lock nuts and special washers provided with the AD-9® air dryer retrofit unit, attach the lower mounting bracket and torque to 270-385 in. lbs.

2. Assemble the mounting strap and upper mounting bracket as illustrated in Figure 10, by utilizing the 5/16" cap screw (25) and sleeve nut (28).
3. Place the upper bracket assembly onto the shell of the AD-9® air dryer and orient it so that it bears entirely on the cylindrical surface and does not extend onto the domed top. The slot spacing between the upper and lower bracket should be a minimum of 5.5 inches apart. Do not tighten strap onto the shell at this time.
4. Mount the AD-9® air dryer on the vehicle using 3/8" bolts (grade 5 min.) and washers. Torque to 25 ft. lbs. (300 inch pounds.) After positioning and mounting the upper bracket assembly according to the installation requirements, torque the 5/16" nut to 80-120 in. lbs. to tighten strap onto the shell.

CONNECTING THE AIR LINES

PURGE CONTROL LINE

1. Install a purge control air line having a minimum inside diameter of 3/16 inches between the AD-9® air dryer end cover control port and an unused unloader port on the governor. The control line must be plumbed direct to the governor and not in series with automatic drain valves, lubrication systems, etc.
2. The control line should slope downward to the end cover without forming potential water traps.

DISCHARGE LINE

General:

Refer to Appendix A, Table A for recommended discharge line lengths and sizes for various vehicle applications and vocations.

PURGE EXHAUST LINE

1. If it is necessary to direct AD-9® air dryer discharge contaminants away from vehicle components it may be necessary to purchase a special exhaust cover for the AD-9® air dryer (Pc. No. 5003838). A one inch (25.4 mm) I.D. hose can be clamped on the special AD-9® air dryer exhaust cover.

WIRING THE HEATER/THERMOSTAT

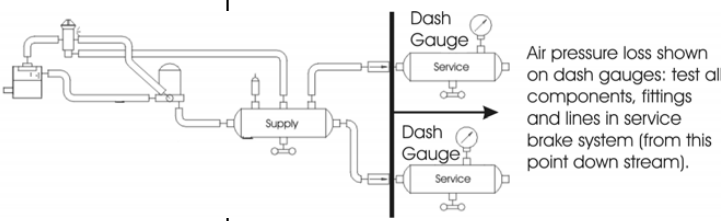
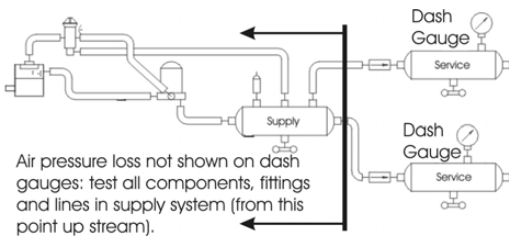
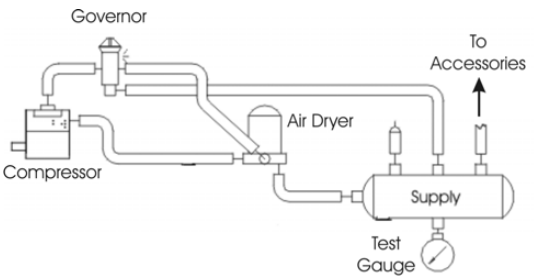
1. Determine the vehicle's electrical system voltage and make certain that the AD-9® air dryer that is to be installed contains the same voltage heater. Use the AD-9® air dryer part number to confirm the proper voltage. The AD-9® air dryer is available with either a 12 or 24 volt heater which uses 75 watts of power.
2. A two lead, 12 inch, wire harness with attached weather resistant connector is supplied with all retrofit and replacement AD-9® air dryers. Connect one of the two leads of the wire harness to the engine kill or ignition switch. The remaining lead of the wire harness must be connected to a good vehicle ground (not to the air dryer or its mounting bracket). A fuse should be installed in the power carrying wire; install a 10 amp fuse for 12 volt heaters and a 5 amp fuse for a 24 volt heater.
3. Use 14 GA wire if it is necessary to lengthen the wire harness provided with the AD-9® air dryer. Make certain all wire splices are waterproofed.
4. Tie wrap or support all electrical wire leading to the AD-9® air dryer at 6 - 8 inch intervals. **Note:** Wires should have sufficient slack and not completely taught.

TESTING THE AD-9® AIR DRYER

Before placing the vehicle in service, perform the following tests:

1. Close all reservoir drain cocks.
2. Build up system pressure to governor cut-out and note that the AD-9® air dryer purges with an audible escape of air.
3. "Fan" the service brakes to reduce system air pressure to governor cut-in. Note that the system once again builds to full pressure and is followed by a purge at the AD-9® air dryer exhaust.
4. It is recommended that the following items be tested for leakage to assure that the AD-9® air dryer will not cycle excessively.
   (A) Total air system leakage (See Bendix publication BW-5057 "Air Brake Handbook").
   (B) Compressor unloader mechanism.
   (C) Governor.
   (D) Drain cock and safety valve in first (supply) reservoir.
   (E) All air connections leading to and from the first (supply) reservoir.

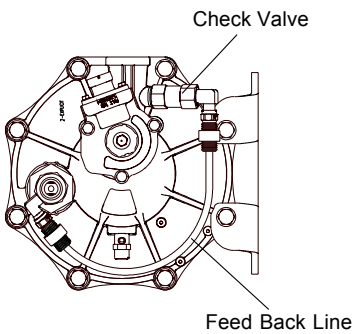
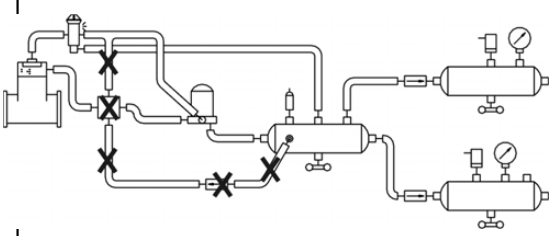
AD-9® AIR DRYER TROUBLESHOOTING CHART

SYMPTOMS	CAUSE	REMEDY
1. Dryer is constantly "cycling" or purging. Dryer purges frequently (every 4 minutes or less while vehicle is idling).	A. Excessive system leakage. IMPORTANT: Note whether air pressure loss is shown on dash gauge(s). Pressure loss shown on gauges is caused by service brake system or component leakage. Pressure loss NOT SHOWN on gauges is caused by supply system or component leakage.	A. If leakage IS SHOWN on gauges test for excessive service brake system leakage. Allowable leakage: Pre-121 vehicles, single vehicles - 2 psi/ minute. Tractor trailer - 3 psi/minute. 121 vehicles, single vehicle - 1 psi/minute per service reservoir. Tractor trailer - 3 psi/minute per service reservoir. Repair and retest as required.  If leakage is NOT SHOWN on gauges test for excessive supply system leakage.  Remove drain cock or valve in supply reservoir (wet tank) and install air gauge. Build system pressure, allow air dryer to purge and observe air gauge in supply reservoir. Pressure drop should not exceed 1 psi per minute. Perform tests 1 to 6 in the order presented. 

AD-9® AIR DRYER TROUBLESHOOTING CHART

SYMPTOMS	CAUSE	REMEDY
		1. **Test fittings, hoses, lines and connections.** Apply soap solution to detect excessive leakage. Tighten or replace as needed then repeat the air dryer charge-purge cycle and observe the gauge installed in the supply reservoir. If leakage is within limits remove gauge from reservoir and replace drain cock or valve. If excessive leakage is detected, continue testing. 2. **Test accessories connected to supply reservoir.** Drain all air pressure from system, disconnect all air lines leading to accessories (fan clutch, wipers, air seats, etc.) and plug the reservoir at disconnection point. Build air system pressure until air dryer purges and observe supply reservoir gauge. If leakage is no longer excessive, repair or replace leaking accessory. If excessive leakage is detected, continue testing. 3. **Test governor leakage.** Build system pressure to governor cut-out turn off engine and apply soap solution to governor exhaust port and around cap. Leakage should not exceed a 1" bubble in 5 seconds. Reduce system pressure to 80 psi or less, and reapply soap solution. Leakage should not exceed a 1" bubble in 5 seconds. If excessive leakage is detected in either test, repair or replace governor. 4. **Test compressor unloader leakage.** Drain all air pressure from system and remove the governor from the compressor. Temporarily plug the governor unloader port or air line that mated with, or connected to, the compressor. Build air system pressure until air dryer purges then IMMEDIATELY SHUT OFF THE ENGINE. Observe the air gauge in the supply reservoir. If leakage is within limits, replace the compressor unloaders. Reconnect the governor to the compressor (after removing plug installed in governor) and retest while observing supply reservoir gauge. If excessive leakage is detected, continue testing. 5. **Test air dryer purge valve and outlet (delivery) check valve.** Drain all air pressure from system, remove the control line connection at the air dryer and plug the end of the air line leading to the governor (not the air dryer control port). Build system pressure to governor cut-out and observe air gauge. If little or no pressure drop is observed replace the air dryer check valve. If pressure drop continues apply soap

AD-9® AIR DRYER TROUBLESHOOTING CHART

SYMPTOMS	CAUSE	REMEDY
		solution to air dryer purge exhaust and purge control port (where the control line was removed). Leakage should not exceed a 1" bubble in 5 seconds. If leakage is excessive repair or replace purge valve assembly. 6. With gauge installed at RES port of governor, pressure should not drop below "Cut-In" pressure at the onset of the compressor "Unloaded" cycle. If pressure drops, check for "kinks" or restrictions in line connected to RES port. Line connected to RES port on governor must be same diameter, or preferably larger than, lines connected to UNL port(s) on governor.
	B. Leaking purge valve housing assembly and/or o-rings in AD-9® air dryer end cover.	B. With the supply port open to atmosphere, apply 120 psi at the control port. Apply a soap solution to the supply port and exhaust port (purge valve seat area). Permissible leakage - 1" bubble in 5 seconds.
	C. Holset "E" type compressor.	C. Test the Holset E Compressor unloader system with feedback line and check valve for proper operation. Make certain Holset ECON is not in use with the drop-in version of the air dryer, if so, remove and retest.  Typical Drop-In Air Dryer End Cover When installing a Bendix Drop-In air dryer in a system equipped with a Holset E or QE compressor, remove the Holset ECON valve along with its feed back and governor control line. 

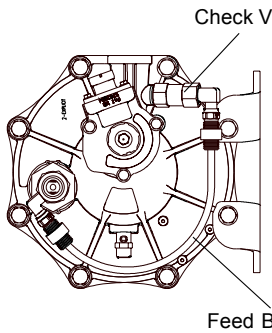
AD-9® AIR DRYER TROUBLESHOOTING CHART

SYMPTOMS	CAUSE	REMEDY
2. Water in vehicle reservoir.	A. Desiccant requires replacement - excessive contaminants in desiccant cartridge assembly.	A. Replace desiccant cartridge.
	B. Improper discharge line length or improper line material. Maximum air dryer inlet temperature is exceeded.	B. Refer to section entitled "Connecting the Air Lines" as well as Appendix A, Table A columns 1 & 2 then check line size and length.
	C. Air system charged from outside air source (outside air not passing through air dryer).	C. If system must have outside air fill provision, outside air should pass through air dryer. This practice should be minimized.
	D. Air dryer not purging (see Symptom #5).	D. See Symptom #5.
	E. Purge (air exhaust) time insufficient due to excessive system leakage (see causes for Symptom #1).	E. Check causes and remedies for Symptom #1.
	F. Excessive air usage, duty cycle too high - Air dryer not compatible with vehicle air system requirement (Improper air dryer/vehicle application). **NOTE: Duty Cycle** is the ratio of time the compressor spends building air to total engine running time. Air compressors are designed to build air (run "loaded") up to 25% of the time. Higher duty cycles cause conditions that affect air brake charging system performance which may require additional maintenance. Factors that add to the duty cycle are: air suspension, additional air accessories, use of an undersized compressor, frequent stops, excessive leakage from fittings, connections, lines, chambers or valves, etc.	F. See Appendix A, Table A, column 1, for recommended compressor sizes. If the compressor is "too small" for the vehicle vocation (for example, where a vehicle's vocation has changed or service conditions exceed the original vehicle or engine OE spec's) then upgrade the compressor. Note: The costs incurred (e.g. installing a larger capacity compressor, etc.) are not covered under original compressor warranty. Charge Cycle Time - The AD-9® air dryer is designed to provide clean, dry air for the brake system. When a vehicle's air system is used to operate non-brake air accessories it is necessary to determine that during normal, daily operation the compressor should recover from governor "cut-in" to governor "cut-out" (usually 100 psi to 120 psi) in 90 seconds or less at engine RPM's commensurate with the vehicle vocation. If the recovery time consistently exceeds this limit, it may be necessary to "bypass" the air accessory responsible for the high air usage. An example of where a by-pass system would be required is when the compressor is used to pressurize a tank trailer for purposes of off-loading product. Consult your local authorized Bendix parts outlet or sales representative for additional information.

AD-9® AIR DRYER TROUBLESHOOTING CHART

SYMPTOMS	CAUSE	REMEDY
		Purge Cycle Time - During normal vehicle operation, the air compressor **must remain unloaded for a minimum of 20 seconds for the standard AD-9® air dryer or 30 seconds for the Extended Purge Model.** These minimum purge times are required to ensure complete regeneration of the desiccant material. If the purge time is consistently less than the minimum, an accessory by-pass system must be installed. Consult your local authorized Bendix parts outlet or sales representative for additional information. European Air Brake Systems - Brake systems that incorporate compressors without integral unloading mechanisms and/or utilize a compressor discharge line unloader valve have special air dryer installation requirements. Consult your local authorized Bendix parts outlet or sales representative for additional information. Air Compressor Size - Although the AD-9® air dryer can be used in conjunction with larger compressors, it was designed primarily for units rated for up to 17 CFM. It is recommended that when using the AD-9® air dryer with a compressor which has a rated displacement exceeding 17 CFM that an authorized Bendix parts outlet or Bendix marketing representative be contacted for assistance.
	G. Air compressor discharge and/or air dryer inlet temperature too high.	G. **Restricted discharge line.** See Appendix A, Table A, column 1 & 2 for recommended sizes. If discharge line is restricted or more than 1/16" carbon build up is found, replace the discharge line. Replace as necessary. **Discharge Line Freeze-Up.** The discharge line must maintain a **constant slope** down from the compressor to the air dryer inlet fitting to avoid low points where ice may form and block the flow. If, instead, ice blockages occur at the air dryer inlet, insulation may be added here, or if the inlet fitting is a typical 90 degree fitting, it may be changed to a straight or 45 degree fitting. For more information on how to help prevent discharge line freeze-ups, see Bendix Bulletins TCH-08-21 and TCH-08-22. Shorter discharge line lengths or insulation may be required in cold climates. **Insufficient coolant flow through compressor.** Inspect coolant line. Replace as necessary (I.D. is 1/2" min.). Inspect the coolant lines for kinks and restrictions and fittings for restrictions. Replace as necessary. Verify coolant lines go from engine block to compressor and back to the water pump. Repair as necessary.

AD-9® AIR DRYER TROUBLESHOOTING CHART

SYMPTOMS	CAUSE	REMEDY
		Restricted air inlet (not enough air to compressor). Check compressor air inlet line for restrictions, brittleness, soft or sagging hose conditions, etc. Repair as necessary. Inlet line size is 3/4 ID. Maximum restriction requirement for compressors is 25 inches of water. Check the engine air filter and service if necessary (if possible, check the air filter usage indicator). **Poorly filtered inlet air (poor air quality to compressor).** Check for leaking, damaged or malfunctioning compressor air inlet components (e.g. induction line, fittings, gaskets, filter bodies, etc.). Repair inlet components as needed. Note: Dirt ingestion will damage compressor and is not covered under warranty. If you found excessive oil present in the service reservoir and you did not find any issues above, the compressor may be passing oil. Replace compressor. If still under warranty, follow normal warranty process.
	H. Compressor malfunction.	H. If you found excessive oil present in the service reservoir and you did not find any issues above, the compressor may be passing oil. Test the compressor using the BASIC cup method as described in the Bendix compressor service manual and referred to in Appendix A, Table A, column 5. Replace compressor. If still under warranty, follow normal warranty process.
	I. Air by-passes desiccant cartridge assembly.	I. If vehicle uses Holset compressor, inspect feedback check valve for proper installation and operation. When replacing the desiccant cartridge, make sure desiccant cartridge assembly is properly installed and sealing rings are in place on mounting surface of desiccant cartridge.  Typical Drop-In Air Dryer End Cover

AD-9® AIR DRYER TROUBLESHOOTING CHART

SYMPTOMS	CAUSE	REMEDY
	J. Desiccant requires replacement.	J. Replace desiccant cartridge assembly. Refer to Appendix A, Table A columns 3 & 4 for recommended intervals.
3. Oil present at air dryer purge exhaust or cartridge during maintenance.	A. Air brake charging system is functioning normally.	A. Air dryers remove water and oil from the air brake charging system. A small amount of oil is normal. Check that regular maintenance is being performed and that the amount of oil in the air tanks (reservoirs) is within the acceptable range shown on the BASIC cup (see also column 5 of Appendix A, Table A.) Replace the air dryer cartridge as needed and return the vehicle to service.
4. Safety valve on air dryer "popping off" or exhausting air.	A. Restriction between air dryer and supply (first) reservoir.	A. Check to determine if air is reaching supply reservoir. Inspect for kinked tubing or hose. Check for undrilled or restricted hose or tubing fittings and repair or replace as needed.
	B. Air dryer safety valve malfunction.	B. Verify relief pressure is at vehicle or component manufacturer specifications. Replace if malfunctioning.
	C. Desiccant cartridge maintenance required.	C. Refer to Appendix A Table A and column 3. Check compressor for excessive oil passing and/or correct compressor installation. Repair or replace as necessary. Replace desiccant cartridge.
	D. Malfunctioning defective discharge check valve in end cover of the AD-9® air dryer.	D. Test to determine if air is passing through check valve. Repair or replace.
	E. Excessive pressure pulsations from compressor. (Typical single cylinder type).	E. Increase volume in discharge line by increasing length or diameter. Add a ping tank (small reservoir).
	F. Governor malfunction. Missing or restricted governor control line installation.	F. Test governor operation and/or inspect the control line leading from the governor UNL (unloader) port to the air dryer control port.
5. Constant exhaust of air at air dryer purge valve exhaust. (Charge mode.)	A. Air dryer purge valve leaking excessively.	A. With compressor loaded, apply soap solution on purge valve exhaust, to test for excessive leakage. Repair purge valve as necessary.
	B. Compressor fails to unload (stop compressing air) and air dryer purge exhaust makes "sputtering" or "popping" sound.	B. Confirm failure to unload by increasing & decreasing engine RPM and noting change in the rate of leakage and intensity of accompanying leakage sound. Repair/replace compressor unloaders.

AD-9® AIR DRYER TROUBLESHOOTING CHART (Continued)

SYMPTOMS	CAUSE	REMEDY
	C. Purge control line connected to reservoir or exhaust port of governor.	C. Purge control line must be connected to unloader port of governor.
	D. Purge valve frozen open - malfunctioning heater and thermostat, wiring, blown fuse.	D. Test heater and thermostat as described in Preventative Maintenance Section.
	E. Excessive system leakage.	E. See Symptom #1.
	F. Purge valve stays open - supply air leaks to control side.	F. Repair purge valve and housing.
6. Can not build system air pressure.	A. Inlet and outlet air connections reversed.	A. Connect compressor discharge to air dryer supply port. Reconnect lines properly.
	B. Check valve between air dryer and first reservoir.	B. Test check valve for proper operation. Repair or replace as necessary.
	C. Kinked or blocked (plugged) discharge line.	C. Check to determine if air passes through discharge line. Check for kinks, bends, excessive carbon deposits, or ice blockage.
	D. Excessive bends in discharge line (water collects and freezes).	D. Discharge line should be constantly sloping from compressor to air dryer with as few bends as possible.
	E. Refer to Symptom 4, Causes E & F.	E. Refer to Symptom #4, Remedies E & F.
7. Air dryer does not purge or exhaust air.	A. Missing, broken, kinked, frozen, plugged or disconnected purge control line.	A. Inspect control line from governor UNL (unloader) port to control port of air dryer. Test to determine air flows through purge control line when compressor unloaded. Check for undrilled fittings. (See Symptom #4, Remedy C.)
	B. Faulty air dryer purge valve.	B. After determining air reaches purge valve (Remedy A above), repair purge valve.
	C. See Causes B, E, G for Symptom #4.	C. See Causes, B, E, G for Symptom #4.
8. Desiccant material being expelled from air dryer purge valve exhaust (may look like whitish liquid or paste or small beads.) - OR - Unsatisfactory desiccant life.	A. This symptom is almost always accompanied by one or more of Symptoms 1, 2, 3, 4 and 5. See related causes for these Symptoms above.	A. See Causes and Remedies for Symptoms 1, 2, 3, 4 and 5.
	B. Air dryer not securely mounted. (Excessive vibration.)	B. Vibration should be held to minimum. Add bracket supports or change air dryer mounting location if necessary.
	C. Malfunctioning or saturated desiccant cartridge.	C. Replace desiccant cartridge assembly.
	D. Compressor passing excessive oil.	D. Check for proper compressor installation; if symptoms persist, replace compressor.

AD-9® AIR DRYER TROUBLESHOOTING CHART (Continued)

SYMPTOMS	CAUSE	REMEDY
	E. Desiccant cartridge not assembled properly to end cover. (Loose attachment)	E. Check the torque on the desiccant cartridge to end cover attachment. Refer to assembly section of this service data sheet.
9. "Pinging" noise excessive during compressor loaded cycle.	A. Defective check valve assembly in AD-9® air dryer end cover.	A. Refer to Remedy C, Symptom #1.
	B. Leaking Turbo Cutoff valve.	B. Repair or replace purge valve assembly.
	C. Leaking purge valve control piston o-ring.	C. Repair or replace purge valve assembly.
10. Constant seepage of air at air dryer purge valve exhaust (non-charging mode.)	A. Defective check valve assembly in AD-9® air dryer end cover.	A. Refer to Remedy C, Symptom #1.
	B. Leaking Turbo Cutoff valve.	B. Repair or replace purge valve assembly.
	C. Leaking purge valve control piston o-ring.	C. Repair or replace purge valve assembly.
11. The air dryer purge piston cycles rapidly in the compressor unloaded (non-compressing) mode.	A. Compressor fails to "unload".	A. Faulty governor installation; no air line from governor to compressor or line is kinked or restricted. Install or repair air line.

Appendix A

Table A: Maintenance Schedule and Usage Guidelines

Regularly scheduled maintenance is the single most important factor in maintaining the air brake charging system.

Vehicle Used for:	No. of Axles	Column 1: Typical Compressors Spec'd	Column 2: Discharge Line I.D.	Column 2: Discharge Line Length	Column 3: Recommended Air Dryer Cartridge Replacement[1]	Column 4: Recommended Reservoir Drain Schedule[2]	Column 5: Acceptable Reservoir Oil Contents[3] at Regular Drain Interval
Low Air Use							
Compressor with less than 15% duty cycle e.g. Line haul single trailer w/o air suspension, air over hydraulic brakes.	5 or less	Bendix® Tu-Flo® 750 air compressor; Bendix® BA-921® air compressor; Bendix® Tu-Flo® 550 air compressor; Bendix® BA-922®, or DuraFlo™ 596 air compressor	1/2 in.	6 ft.	Every 3 Years	Recommended Every Month - Max of every 90 days	BASIC test acceptable range: 3 oil units per month. See appendix A.
			For oil carry-over control[4] suggested upgrades: 5/8 in.	9 ft.			
Compressor with up to 25% duty cycle e.g. Line haul single trailer with air suspension, RV, school bus.	5 or less		1/2 in.	9 ft.			
			For oil carry-over control[4] suggested upgrades: 5/8 in.	12 ft.			
High Air Use							*For the BASIC Test Kit: Order Bendix P/N 5013711*
Compressor with up to 25% duty cycle e.g. Double/triple trailer, open highway coach, (most) pick-up & delivery, yard or terminal jockey, off-highway, construction, loggers, concrete mixer, dump truck, fire truck.	8 or less		1/2 in.	12 ft.	Every 2 Years	Every Month	BASIC test acceptable range: 5 oil units per month. See appendix A.
			For oil carry-over control[4] suggested upgrades: 5/8 in.	15 ft.			
Compressor with up to 25% duty cycle e.g. City transit bus, refuse, bulk unloaders, low boys, urban region coach, central tire inflation.	12 or less		5/8 in.	12 ft.	Every Year		
			For oil carry-over control[4] suggested upgrades: 3/4 in.	15 ft.			

Footnotes:

1 With increased air demand the air dryer cartridge needs to be replaced more often.

2 Use the drain valves to slowly drain all reservoirs to zero psi.

3 Allow the oil/water mixture to fully settle before measuring oil quantity.

4 To counter above normal temperatures at the air dryer inlet, (and resultant oil-vapor passing upstream in the air system) replace the discharge line with one of a larger diameter and/or longer length. This helps reduce the air's temperature. If sufficient cooling occurs, the oil-vapor condenses and can be removed by the air dryer. Discharge line upgrades are not covered under warranty. Note: To help prevent discharge line freeze-ups, shorter discharge line lengths or insulation may be required in cold climates. (See Bendix Bulletins TCH-08-21 and TCH-08-22.)

5 For certain vehicles/applications, where turbo-charged inlet air is used, a smaller size compressor may be permissible.

Note: Compressor and/or air dryer upgrades are recommended in cases where duty cycle is greater than the normal range (for the examples above).

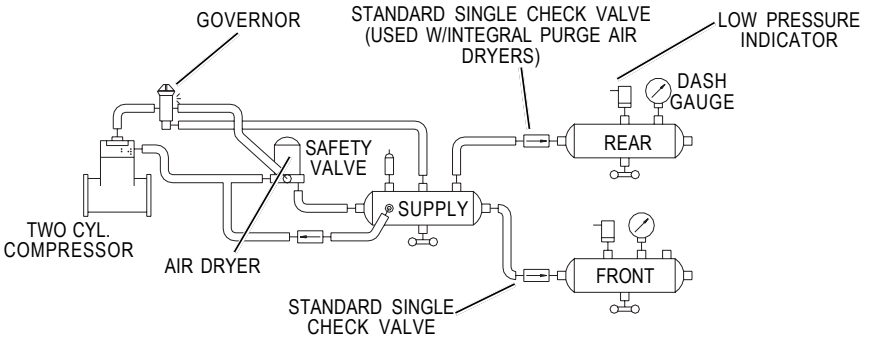
For Bendix® Tu-Flo® 550 and 750 compressors, unloader service is recommended every 250,000 miles.

Appendix B

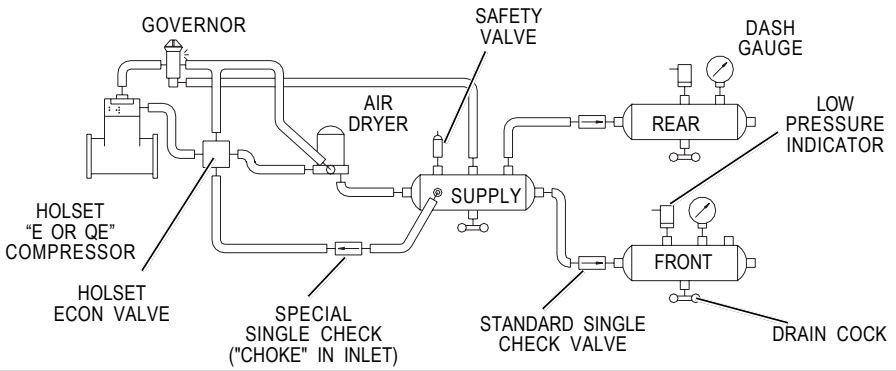
Additional Troubleshooting Information

The troubleshooting procedure presented on the following pages has been excerpted from a troubleshooting card entitled: Troubleshooting Charging and Air Supply Systems. The complete card can be obtained from authorized Bendix parts outlets under literature number BW1779. It is presented here because of the air dryers connection to the supply air system and for convenience. The procedure is not all inclusive but rather represents the most commonly encountered complaints.

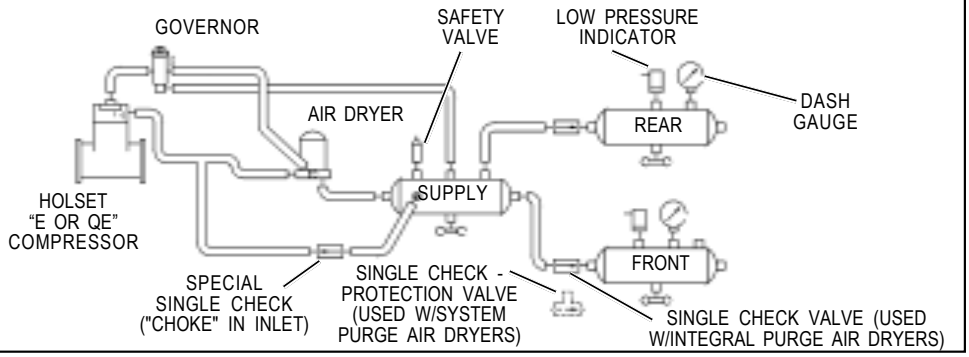
CONVENTIONAL SUPPLY SYSTEM & INTEGRAL PURGE AIR DRYER



HOLSET TYPE "E & QE" COMPRESSOR WITH ECON VALVE



HOLSET TYPE "E & QE" COMPRESSOR W/O ECON VALVE



Bendix® Service Data

SD-03-3619

Bendix® PP-DC™ Park Control Valve

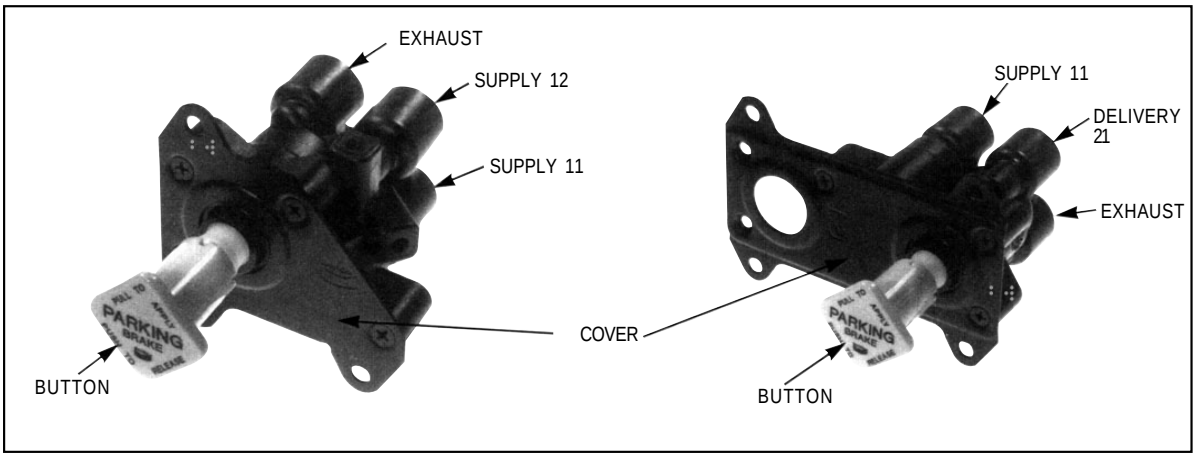


FIGURE 1 - PP-DC™ PARK CONTROL VALVE

DESCRIPTION

The Bendix® PP-DC™ park control valve is a push-pull, manually operable on/off valve. It is dash board-mounted and provides in-cab control of truck or bus parking brakes.

The valve is pressure sensitive – it automatically moves from the applied to the exhaust position if total system pressure drops below 20 to 30 psi. Also, manually pulling the button will apply the parking brakes.

The PP-DC™ valve body is made of non-metallic, non-corrosive material, and the cover is available in two mounting variations (see Figure 1). The valve is designed to accept 1/4" P.T. fittings or push-to-connect fittings that use SAE J844D non-metallic air brake tubing.

Ports:

Port	Embossed I.D.
Primary Reservoir Supply	Supply 11
Secondary Reservoir Supply	Supply 12
Delivery	Delivery 21
Exhaust	Exhaust 3

Operating pressure: 150 psi max.

Operating temperature: -40° to 200°F

Basic valve weight: Approximately .8 lbs.

OPERATION

GENERAL

The PP-DC™ valve receives its supply of air from the primary service reservoir or the secondary service reservoir, whichever is at the higher pressure. When the button is pushed in, the valve delivers air to the spring brake chambers (usually through a spring brake valve such as the Bendix® SR-1™ valve and a relay or quick release valve). The air releases the spring brakes for normal vehicle operation.

To apply the parking brakes, the button is pulled out, which exhausts the PP-DC™ valve delivery and releases air from the spring brake chambers.

If total system pressure drops below 20 to 30 psi, the valve will automatically “pop out,” which removes the hold-off air in the chambers and applies the spring brakes.

PARKING BRAKES RELEASED

To release the parking brakes, the push-pull button is pushed in. The PP-DC™ valve plunger moves, closing the exhaust port with the exhaust seal and allowing the plunger o-ring to move past the guide spool. Supply air then travels out the delivery port to release the brakes.

Note that Figure 3 shows the primary service reservoir supplying the PP-DC™ valve. The double check valve diaphragm has sealed the secondary reservoir supply port and allows air to pass from the primary reservoir into the PP-DC™ valve.

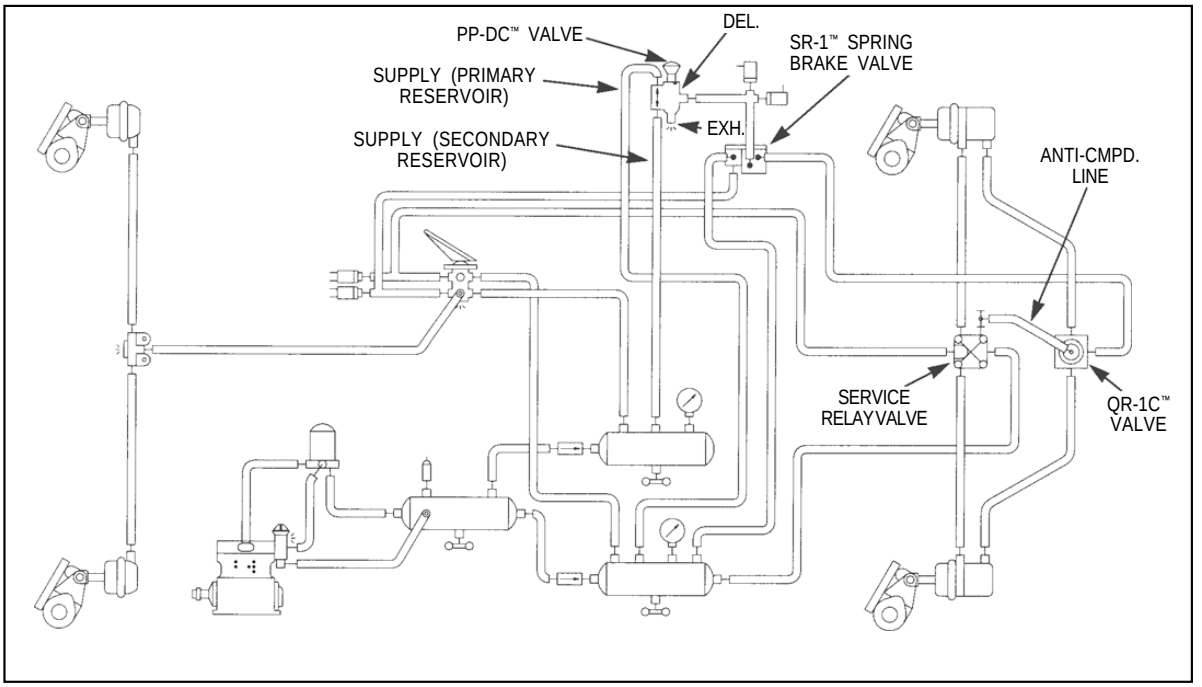


FIGURE 2 - TYPICAL 4 X 2 TRUCK SCHEMATIC WITH PP-DC™ PARK CONTROL VALVE

If primary service reservoir pressure drops below secondary service reservoir pressure, the double check valve reacts as shown in Figure 4. It seals the primary service reservoir supply port and supplies the PP-DC™ valve with air from the secondary service reservoir. As is shown, the push-pull button remains in and the spring brakes remain released.

PARKING BRAKES APPLIED

Figure 5 shows the PP-DC™ valve in the parking-brakes-applied position. This will occur if the driver manually pulls out the push-pull button or if total system pressure drops to below 20 to 30 psi.

When the button "pops out," the exhaust seal moves to open the exhaust port to atmosphere, allowing delivery line pressure to exhaust. The plunger o-ring moves to seal off supply pressure. Spring brake hold-off air is exhausted through the spring brake relay valve.

WARNING! PLEASE READ AND FOLLOW THESE INSTRUCTIONS TO AVOID PERSONAL INJURY OR DEATH:

When working on or around a vehicle, the following general precautions should be observed at all times.

1. **Park the vehicle on a level surface, apply the parking brakes, and always block the wheels. Always wear safety glasses.**
2. **Stop the engine and remove ignition key when working under or around the vehicle. When working in the engine compartment, the engine should be shut off and the ignition key should be removed. Where circumstances require that the engine be in operation, EXTREME CAUTION should be used to prevent personal injury resulting from contact with moving, rotating, leaking, heated or electrically charged components.**
3. **Do not attempt to install, remove, disassemble or assemble a component until you have read and thoroughly understand the recommended procedures. Use only the proper tools and observe all precautions pertaining to use of those tools.**
4. **If the work is being performed on the vehicle's air brake system, or any auxiliary pressurized air systems, make certain to drain the air pressure from all reservoirs before beginning ANY work on the vehicle. If the vehicle is equipped with an AD-IS® air dryer system or a dryer reservoir module, be sure to drain the purge reservoir.**
5. **Following the vehicle manufacturer's recommended procedures, deactivate the electrical system in a manner that safely removes all electrical power from the vehicle.**
6. **Never exceed manufacturer's recommended pressures.**
7. **Never connect or disconnect a hose or line containing pressure; it may whip. Never remove a component or plug unless you are certain all system pressure has been depleted.**
8. **Use only genuine Bendix® replacement parts, components and kits. Replacement hardware, tubing, hose, fittings, etc. must be of equivalent size, type and strength as original equipment and be designed specifically for such applications and systems.**

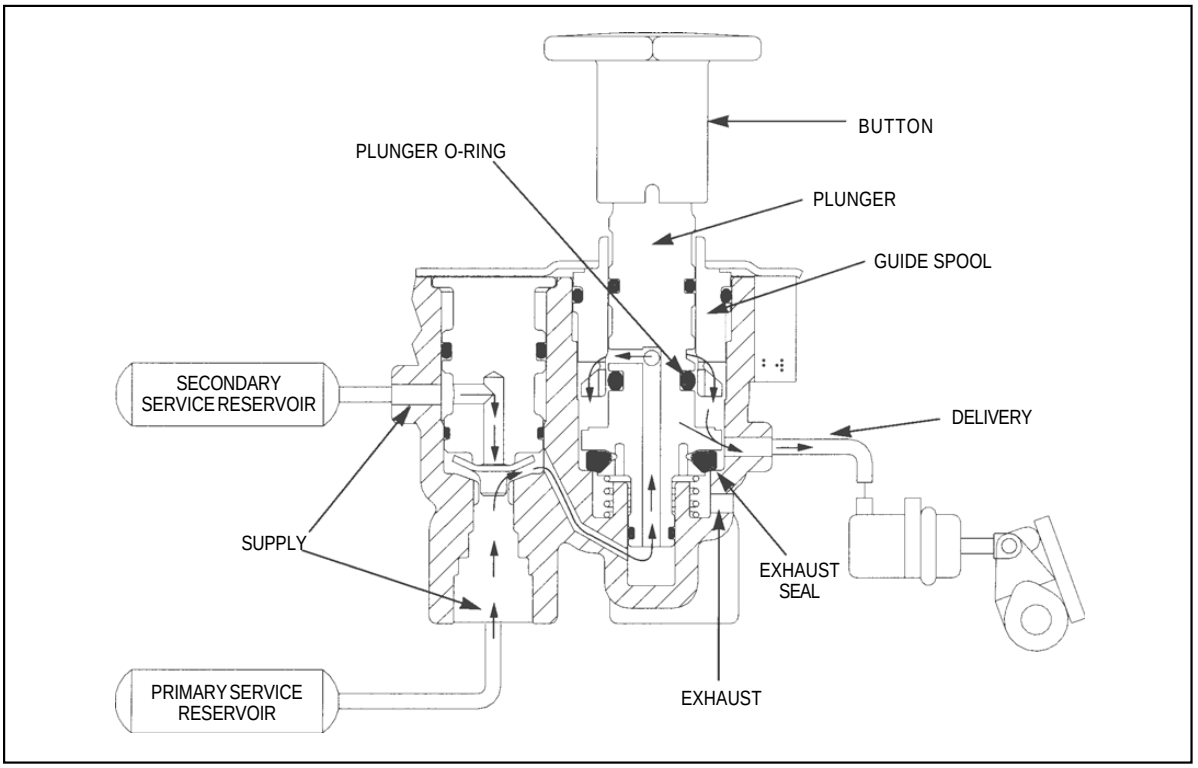


FIGURE 3 - SPRING BRAKES RELEASED (PRIMARY RESERVOIR SUPPLY)

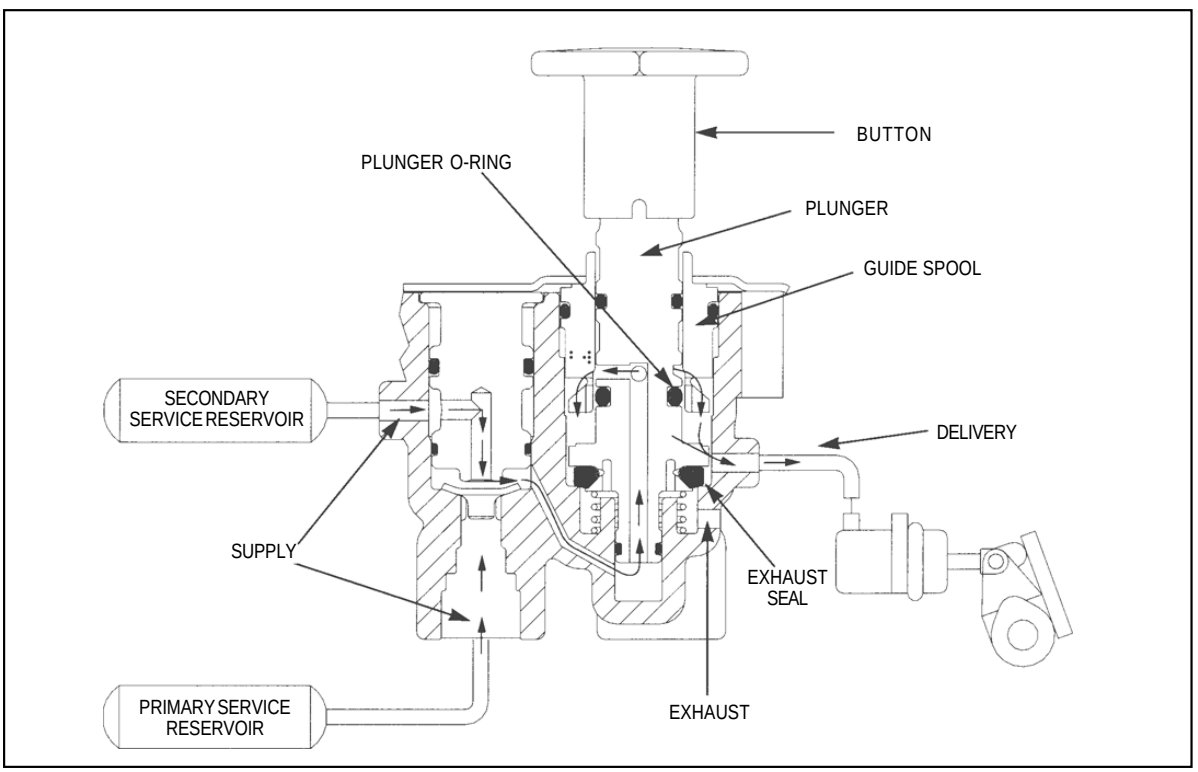


FIGURE 4 - SPRING BRAKES RELEASED (SECONDARY RESERVOIR SUPPLY)

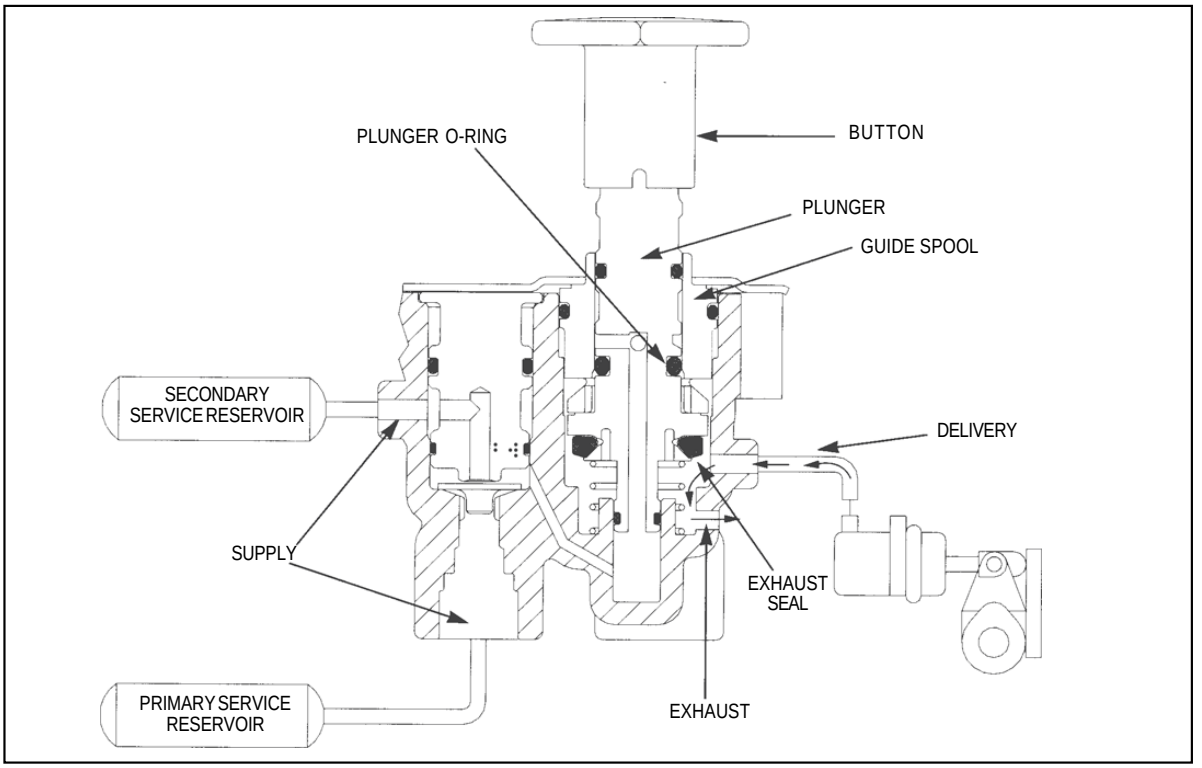


FIGURE 5 - PARKING BRAKES APPLIED

9. **Components with stripped threads or damaged parts should be replaced rather than repaired. Do not attempt repairs requiring machining or welding unless specifically stated and approved by the vehicle and component manufacturer.**
10. **Prior to returning the vehicle to service, make certain all components and systems are restored to their proper operating condition.**
11. **For vehicles with Antilock Traction Control (ATC), the ATC function must be disabled (ATC indicator lamp should be ON) prior to performing any vehicle maintenance where one or more wheels on a drive axle are lifted off the ground and moving.**

PREVENTIVE MAINTENANCE

Important: Review the Bendix Warranty Policy before performing any intrusive maintenance procedures. A warranty may be voided if intrusive maintenance is performed during the warranty period.

No two vehicles operate under identical conditions, as a result, maintenance intervals may vary. Experience is a valuable guide in determining the best maintenance interval for air brake system components. At a minimum, the PP-DC™ valve should be inspected every 6 months or 1500 operating hours, whichever comes first, for proper operation. Should the PP-DC™ valve not meet the elements of the operational tests noted in this document, further investigation and service of the valve may be required.

SERVICE CHECKS

1. Remove any accumulated contaminants. Visually inspect the valve's exterior for excessive wear or physical damage. Repair/replace as necessary.
2. Inspect all air lines connected to the valve for signs of wear or physical damage. Repair/replace as necessary.
3. Test air line fittings for excessive leakage. Repair/replace as necessary.

LEAKAGE AND OPERATIONAL TESTS

To perform the following tests, connect two separate 120 psi air sources to the PP-DC™ valve supply ports. Tee an accurate test gauge into the supply lines, and provide for a means to control supply line pressure. Connect a small volume with a gauge to the delivery port.

LEAKAGE TEST

1. Supply the valve with 120 psi from the primary reservoir supply port. With the button out, coat the exhaust port and the plunger stem with a soap solution. Leakage should not exceed a 1" bubble in 5 seconds. There should be no leakage from the secondary reservoir supply port.
2. With the button out, supply the valve with 120 psi from the secondary reservoir supply port. There should be no leakage from the primary reservoir supply port.

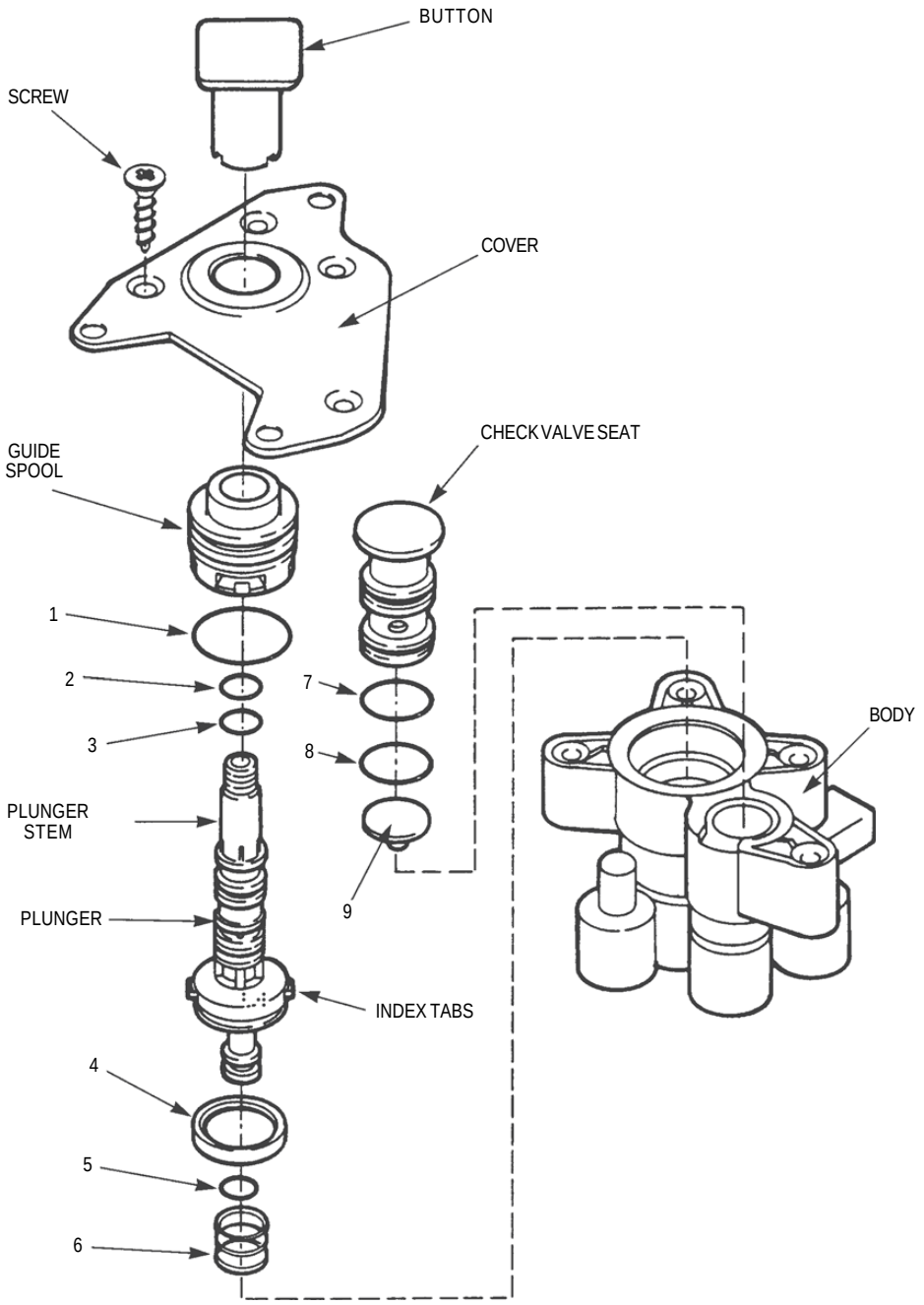


FIGURE 6 - EXPLODED VIEW

3. With the button in, coat the exhaust port and the plunger stem with a soap solution. Leakage at both areas should not exceed a 1" bubble in 3 seconds.

OPERATIONAL TEST

1. With the button out, supply either supply port with 120 psi of air. Then push the button in. Air pressure should rise in the delivery volume equivalent to supply pressure.
2. Pull the button out. Delivery pressure should exhaust to 0 psi.
3. Build each supply source to 120 psi. Decrease supply pressure at the secondary service reservoir supply port at a rate of 10 psi per second. Primary supply pressure and delivery pressure should not drop below 100 psi. Repeat the test for decreasing primary service reservoir pressure.
4. Build each supply source to 120 psi. Then decrease both supply pressures to below 20 to 30 psi. The button should automatically "pop" out when pressure drops within that range.

If the PP-DC™ valve fails to function as described, or if leakage is excessive, repair the valve or replace it at the nearest authorized Bendix Commercial Vehicle Systems parts outlet.

REMOVAL

1. Identify and mark or label all air lines and their connections on the valve.
2. Remove the PP-DC™ valve from the vehicle and save the mounting hardware.

INSTALLATION

1. Install the PP-DC™ valve in its location on the dashboard. Using the mounting hardware saved in "REMOVAL," secure the valve to the vehicle.
2. Reconnect all air lines to the valve using the identification made in "REMOVAL."
3. Perform "OPERATIONAL AND LEAKAGE TESTS" before placing the vehicle back in service.

DISASSEMBLY

The following disassembly and assembly procedures are for reference only. Always have the appropriate maintenance kit on hand and use its instructions in lieu of those presented here. Refer to Figure 6 throughout the procedure.

1. Turn the button counterclockwise to remove it from the plunger stem.
2. Remove the four screws that secure the cover to the body, and remove the cover.
3. Pull the plunger stem to remove the plunger and the guide spool from the body.
4. Remove plunger spring(6) and discard.
5. If necessary, use a screwdriver to carefully remove the check valve seat from the body. Be sure not to damage the check valve seat or the body.
6. Remove and discard check valve seat o-rings(7) and (8).
7. Turn the body upside down and gently tap it on a flat surface to remove check valve(9). Discard the check valve.
8. Remove the guide spool from the plunger. Remove and discard o-ring(1) from the guide spool.
9. Remove and discard o-rings(2), (3) and (5) from the plunger. Also remove and discard exhaust seal(4).

CLEANING & INSPECTION

1. Wash all metal parts in mineral spirits and thoroughly dry.
2. Inspect all re-usable parts for excessive wear or damage. Inspect the body for gouges or deep scuffing. Replace key numbers 1-9 (and any parts not determined usable) with genuine Bendix replacements.

ASSEMBLY

Before assembly, lubricate all o-rings, o-ring grooves, rubbing surfaces and bores with Bendix silicone lubricant (Pc. No. 291126) or equivalent.

1. Place check valve(9) into its seat in the body with its flat surface facing upward. If necessary, reach into the body to make sure the valve is seated evenly in the bore.
2. Install o-rings(7) and (8) on the check valve seat and install the check valve seat into the body. Make sure the seat is fully seated-its surface should be even with the body's surface.
3. Install plunger spring(6) into the body. Make sure it stands upright and is seated properly in the body bore. (It should surround the protrusion or "lip" at the bottom of the body bore.)
4. Install o-rings(2), (3), (5) and exhaust seal(4) onto the plunger. Then install the plunger into the body. Line up the plunger's index tabs with the spaces in the body bore for ease of installation.
5. Install o-ring(1) onto the guide spool. Then install the guide spool over the plunger and into the body. Press the guide spool into place firmly.
6. Place the cover onto the body and secure with its four screws. Torque to 35 in. lbs.
7. Thread the button clockwise onto the plunger stem. It should take approximately 3 full button revolutions to install it on the plunger. The protrusions on the side of the plunger should line up with the button grooves. Push on the button a number of times to make sure the plunger moves freely throughout its range of motion.

NOTE: BEFORE PLACING THE VEHICLE BACK INTO SERVICE, PERFORM THE "LEAKAGE AND OPERATIONAL TESTS" IN THIS MANUAL.

Bendix

Service Data

SD-03-9043

291

SR-7 SPRING BRAKE MODULATING VALVE

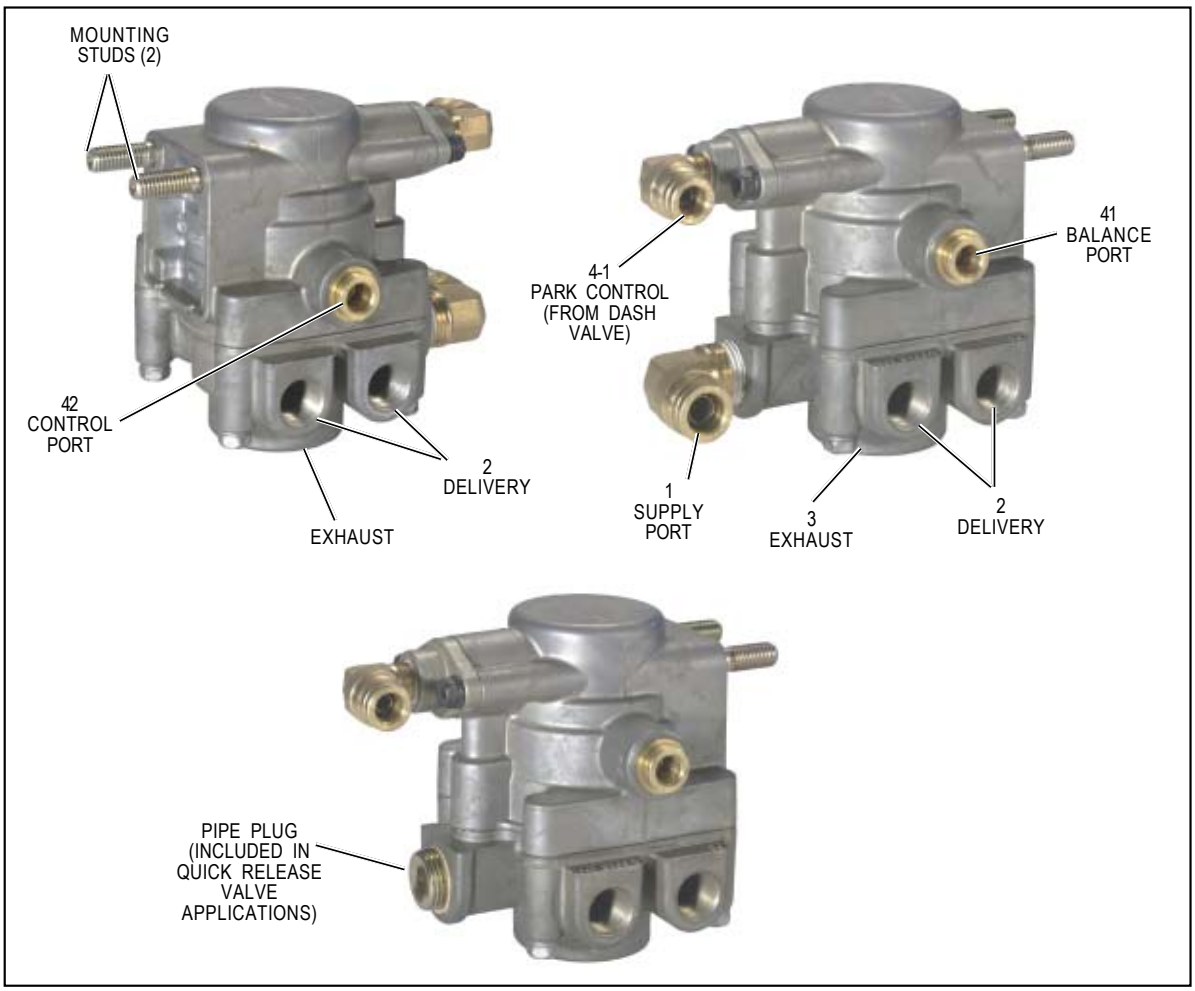


FIGURE 1 - EXTERIOR VIEW

DESCRIPTION

The SR-7 Spring Brake Modulating Valve is used in conjunction with a dual air brake system and spring brake actuator and performs the following functions:

1. Provides a rapid application of the spring brake actuator when parking.
2. Modulates the spring brake actuator application using the dual brake valve should a primary failure occur in the service brake system.
3. Prevents compounding of service and spring forces.

The valve has one park control, one service control, one supply, one balance, four delivery NPTF ports, and an exhaust port protected by an exhaust diaphragm. The valve incorporates two mounting studs for mounting the valve to the frame rail or cross member (where applicable).

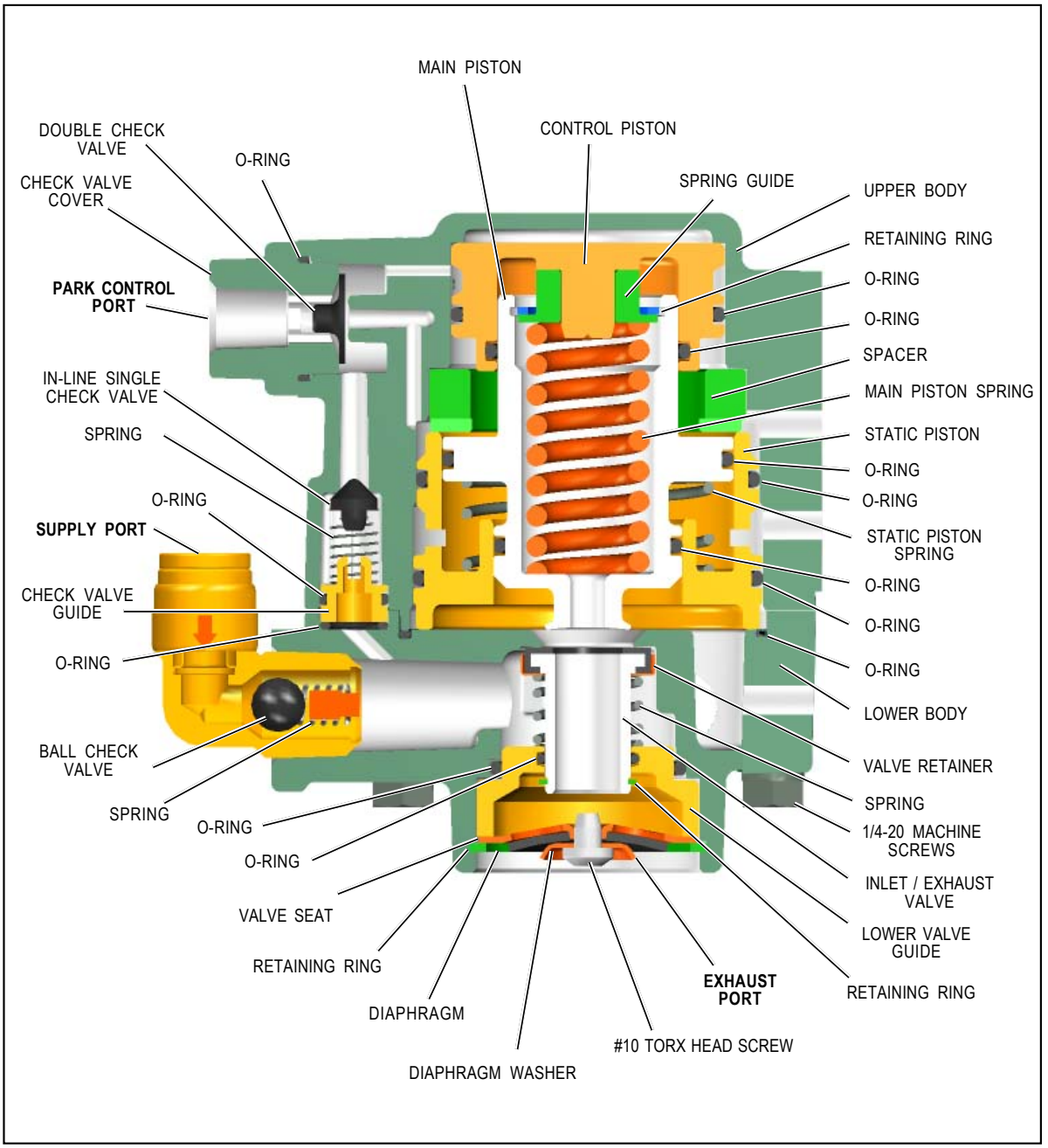


FIGURE 2 - SECTIONAL VIEW OF SR-7 USED IN RELAY VALVE APPLICATIONS

OPERATION

The operation guidelines shown in this manual represent the relay valve based SR-7 (refer to system schematic shown in figure 3). A quick release based valve functions similarly to the relay valve based version with the exception that all air delivered to spring brakes passes through the park control port through the in-line single check valve. The quick release style SR-7 can be easily identified by the pipe plug in the supply port of the valve.

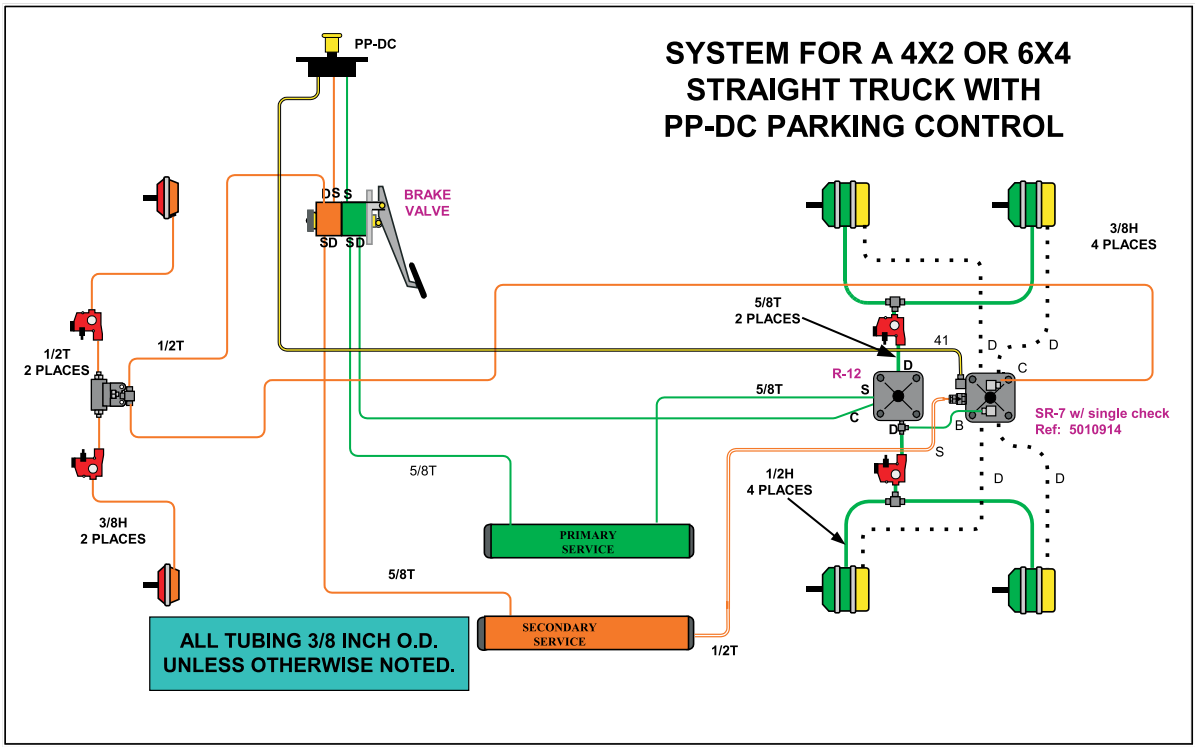


FIGURE 3 - SYSTEM SCHEMATIC WITH PP-DC PARK CONTROL

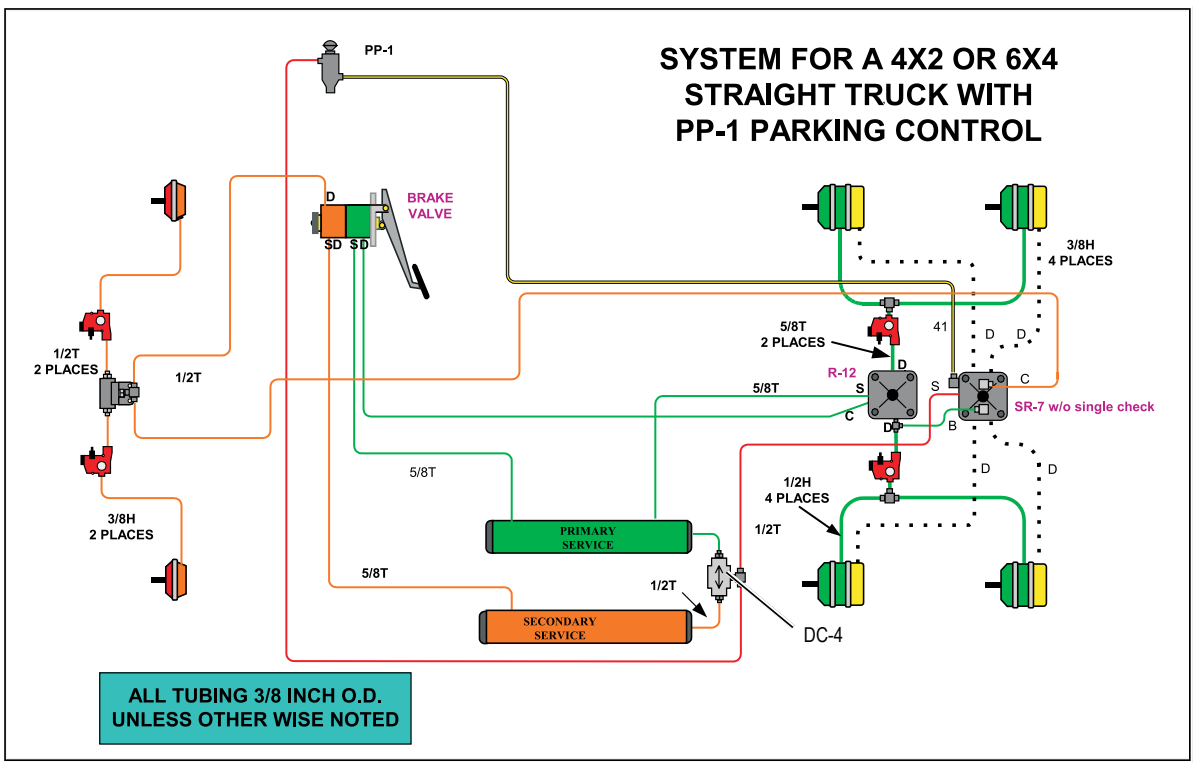


FIGURE 4 - SYSTEM SCHEMATIC WITH PP-1 PARK CONTROL AND DC-4 DOUBLE CHECK VALVE

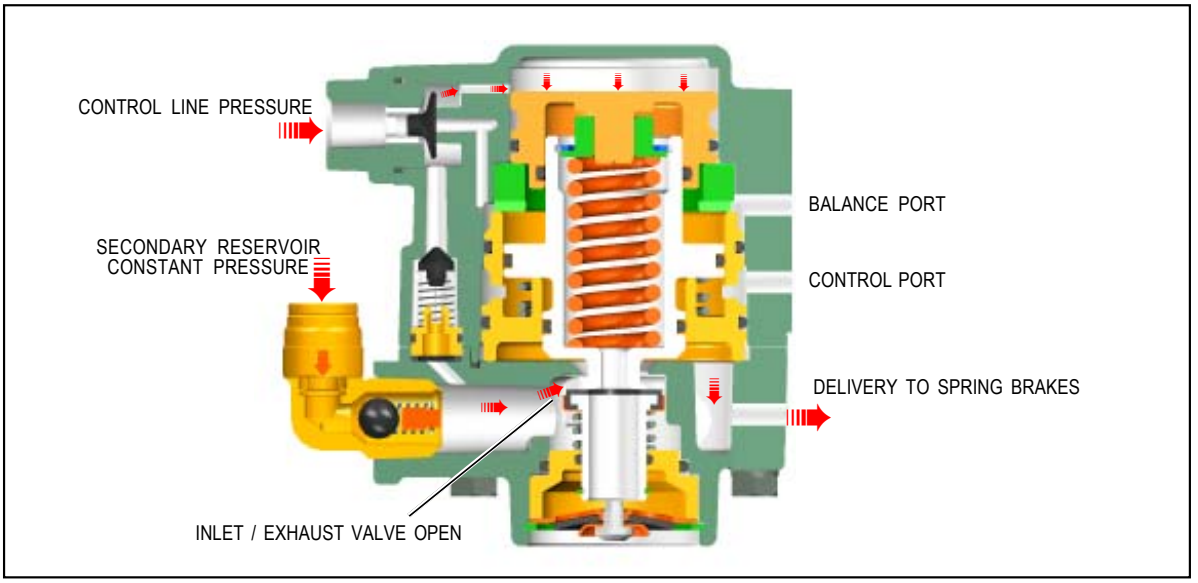


FIGURE 5 - CHARGING LESS THAN 107 PSI

CHARGING SPRING BRAKE ACTUATORS BELOW 107 PSI (FIGURE 5)

With the air brake system charged and the parking brakes released (by pushing the dash valve button in), air enters the park control port. This opens the SR-7 to supply air pressure to the spring brake chambers. As illustrated, air pressure in the chambers is below 107 psi (nominally).

CHARGING SPRING BRAKE ACTUATORS ABOVE 107 PSI (FIGURE 6)

Once the SR-7 valve delivery pressure reaches 107 psi (nominal), the inlet and exhaust are closed (valve lap position). This maintains the spring brake hold-off pressure at 107 psi (nominal).

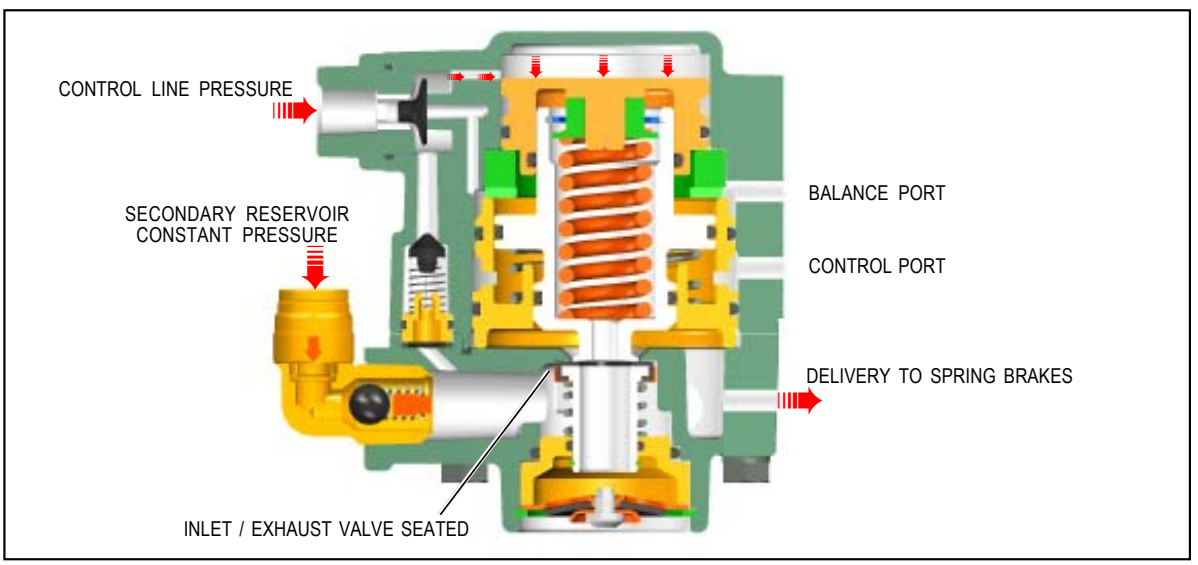


FIGURE 6 - CHARGING GREATER THAN 107 PSI

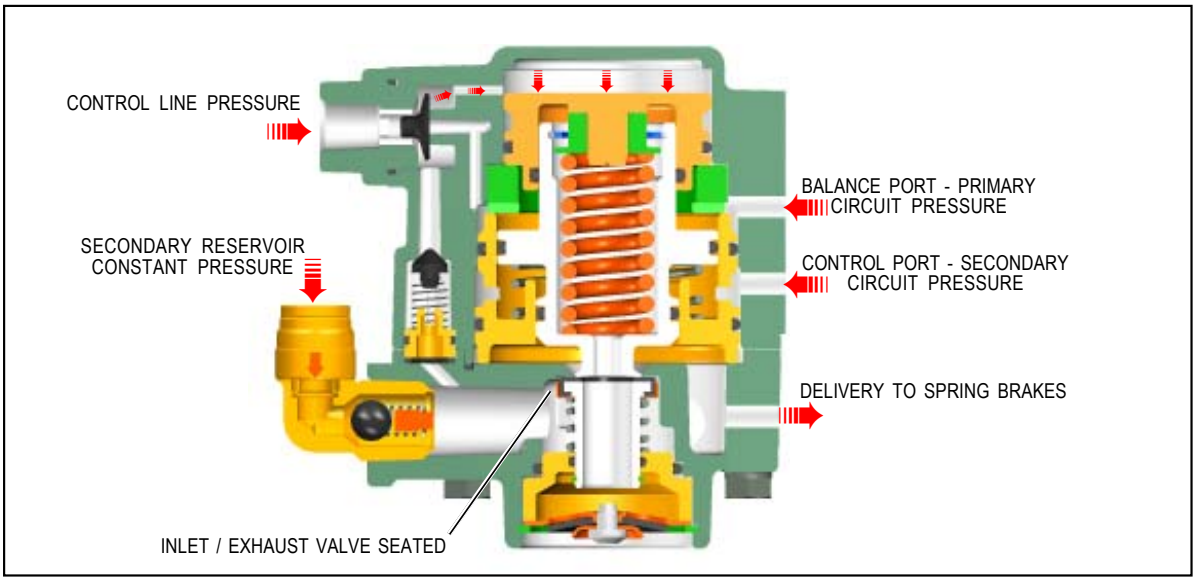


FIGURE 7 - NORMAL SERVICE APPLICATION

NORMAL SERVICE APPLICATION (FIGURE 7)

During a service brake application, the valve remains in the lap position. The SR-7 valve monitors the presence of air pressure in both primary and secondary delivery circuits.

PARKING (FIGURE 8)

Actuating the park brakes (by pulling the dash valve button out) exhausts spring brake air pressure through the SR-7 exhaust port.

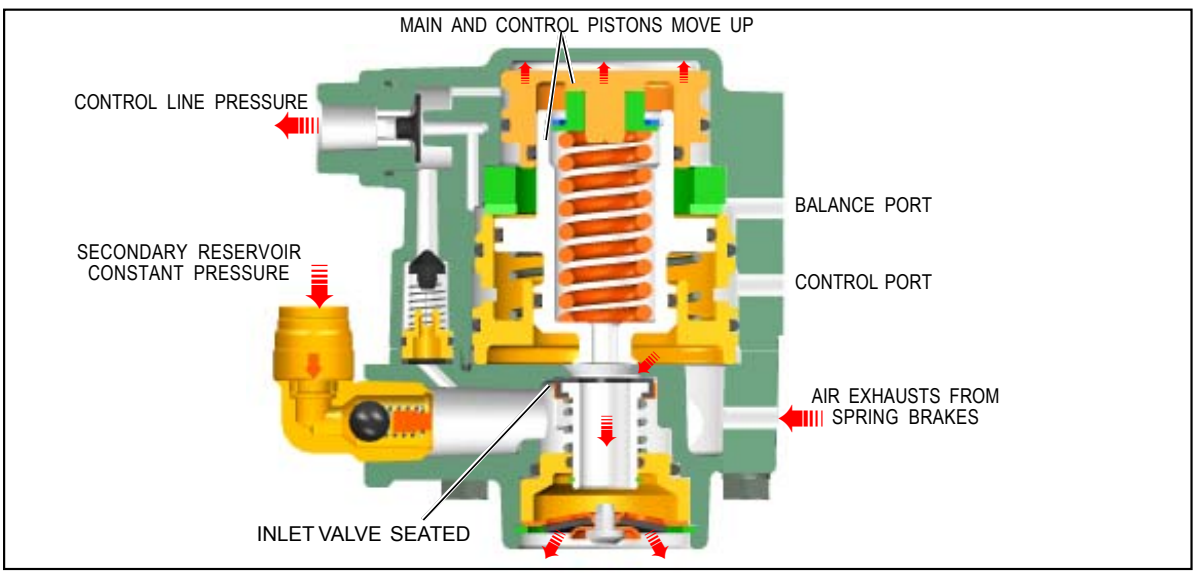


FIGURE 8 - PARKING

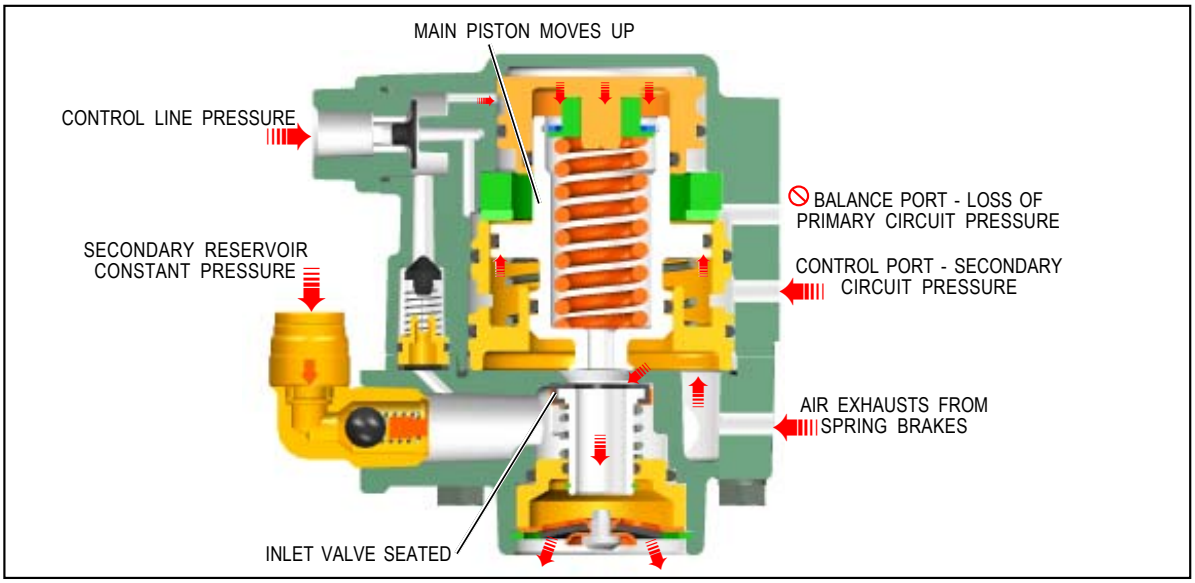


FIGURE 9 - SERVICE APPLICATION LOSS OF PRIMARY CIRCUIT

SERVICE APPLICATION WITH LOSS OF AIR IN PRIMARY CIRCUIT (FIGURE 9)

With the parking brakes released (dash valve button in) and the absence of air in the primary circuit delivery, a service brake application from the secondary circuit causes the pressure in the spring brakes to be exhausted proportionally to this application. This is known as spring brake modulation. A 30 psi service brake application will exhaust the spring brake pressure to approximately 60 psi.

SERVICE APPLICATION WITH LOSS OF AIR IN SECONDARY CIRCUIT (FIGURE 10)

With the parking brakes released (dash valve button in) and the absence of air in the secondary circuit reservoir, the external single check valve in the supply port seals to prevent air leakage to atmosphere from the SR-7 valve. The dash valve delivery air flows through the in-line single check valve and becomes SR-7 supply air. This air is delivered to maintain at least 107 psi (nominal) in the spring brake chambers.

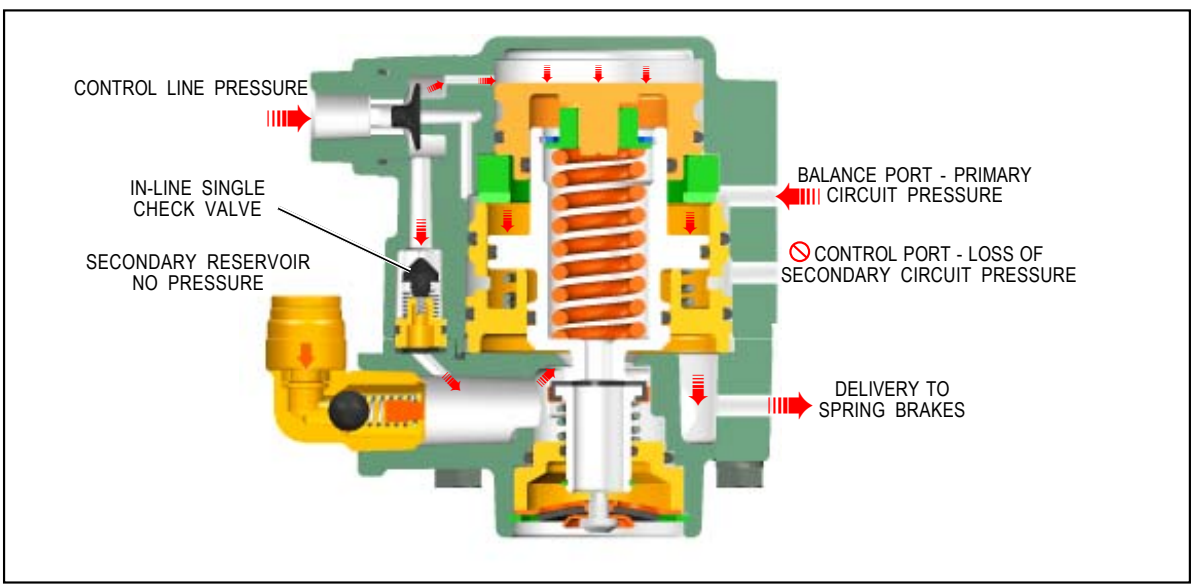


FIGURE 10 - SERVICE APPLICATION LOSS OF SECONDARY CIRCUIT

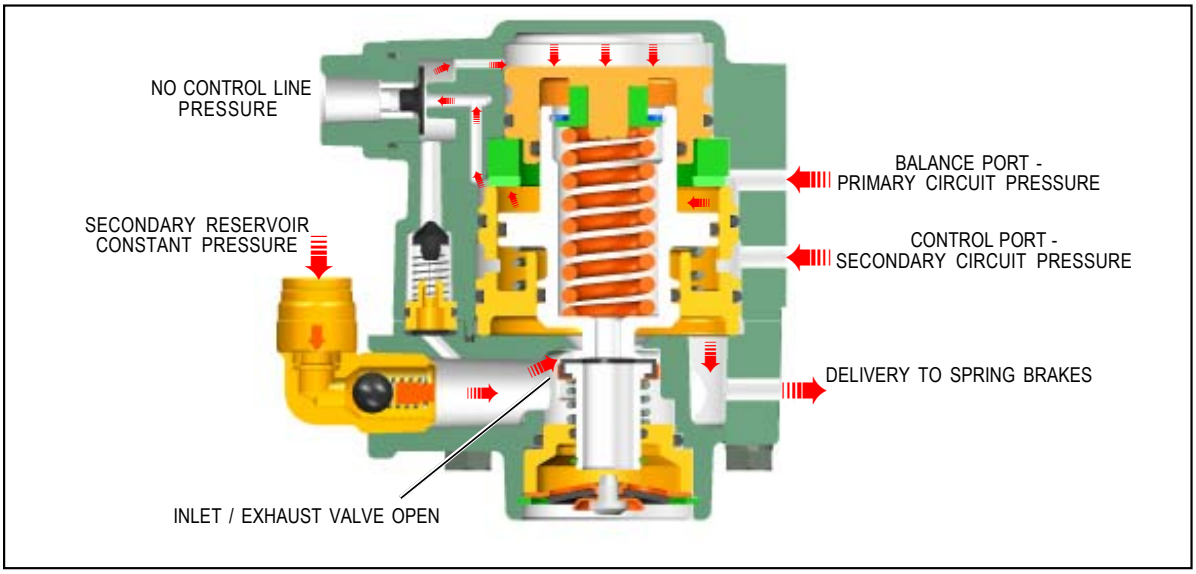


FIGURE 11 - ANTI-COMPOUNDING

ANTI COMPOUNDING (FIGURE 11)

The SR-7 provides anti-compounding of the service and spring brake forces. When the park brakes are actuated (by pulling the dash valve button out), a service brake application will cause the SR-7 to deliver air pressure to the spring brake chambers. Thus the vehicle is held stationary using a service brake application. When the service brake application is released, the delivery pressure is exhausted from the spring brake chambers and the vehicle remains parked using the spring brake actuators.

PREVENTIVE MAINTENANCE

Important: Review the warranty policy before performing any intrusive maintenance procedures. An extended warranty may be voided if intrusive maintenance is performed during this period.

Because no two vehicles operate under identical conditions, maintenance intervals will vary. Experience is a valuable guide in determining the best maintenance interval for a vehicle.

OPERATING TEST

Block vehicle and hold by means other than vehicle brakes. Charge air brake system to governor cut-out pressure.

1. Place parking control valve in “park” position. Observe that spring brake actuators apply promptly. Remove one line from delivery port of the SR-7 valve and install test gauge known to be accurate. Place parking control valve in “release” position. Observe that spring brake actuators release fully.
2. With parking control valve in “release” position, note gauge pressure reading. (Correct spring brake actuator hold-off pressure is 107 psi nominally.)
3. Place parking control valve in “park” position - gauge reading should drop to zero promptly. A lag (more than 3 seconds) in drop of pressure would indicate faulty operation.
4. With the parking control valve in the “park” position, gradually apply foot brake valve and note a pressure reading increase on the gauge installed in the SR-7 delivery port.
5. Place parking control valve in “release” position.
6. Drain the reservoir, which supplies the rear service brake circuit, apply the foot brake valve several times and note that pressure reading on gauge decreases each time foot brake valve is applied (spring brake modulation). After the foot brake valve has been applied several times, pressure on gauge will drop to the point where release of the spring brake actuators will no longer occur.

LEAKAGE TEST

Place the park control valve in the “release” position; using a soap solution, coat all ports including the exhaust port. A 1 inch bubble in three seconds is permitted.

If the valve does not function as described, or if leakage is excessive, it is recommended that it be replaced with a new or remanufactured unit available from a Bendix parts outlet. **DO NOT ATTEMPT TO DISASSEMBLE THE SR-7. THE VALVE CONTAINS HIGH SPRING FORCES THAT COULD RESULT IN PERSONAL INJURY IF DISASSEMBLY IS ATTEMPTED!**

SERVICING THE SR-7

IMPORTANT! PLEASE READ AND FOLLOW THESE INSTRUCTIONS TO AVOID PERSONAL INJURY OR DEATH.

When working on or around a vehicle, the following general precautions should be observed at all times:

1. **Park the vehicle on a level surface, apply the parking brakes, and always block the wheels.**
2. **Stop the engine when working around the vehicle.**
3. **If the vehicle is equipped with air brakes, make certain to drain the air pressure from all reservoirs before beginning ANY work on the vehicle.**
4. **Following the vehicle manufacturer's recommended procedures, deactivate the electrical system in a manner that removes all electrical power from the vehicle.**
5. **When working in the engine compartment the engine should be shut off. Where circumstances require that the engine be in operation, EXTREME CAUTION should be used to prevent personal injury resulting from contact with moving, rotating, leaking, heated, or electrically charged components.**
6. **Never connect or disconnect a hose or line containing pressure; it may whip. Never remove a component or plug unless you are certain all system pressure has been depleted.**
7. **Never exceed recommended pressures and always wear safety glasses.**
8. **Do not attempt to install, remove, disassemble or assemble a component until you have read and thoroughly understand the recommended procedures. Use only the proper tools and observe all precautions pertaining to use of those tools.**
9. **Use only genuine Bendix replacement parts, components, and kits. Replacement hardware, tubing, hose, fittings, etc. should be of equivalent size, type, and strength as original equipment and be designed specifically for such applications and systems.**
10. **Components with stripped threads or damaged parts should be replaced rather than repaired. Repairs requiring machining or welding should not be attempted unless specifically approved and stated by the vehicle or component manufacturer.**
11. **Prior to returning the vehicle to service, make certain all components and systems are restored to their proper operating condition.**

VALVE REMOVAL

1. Prior to removing the SR-7 apply the parking brakes and drain all the vehicle reservoirs.
2. Identify all air lines before disconnecting.
3. Remove the two mounting nuts that secure the valve to the frame rail and remove the valve.

VALVE INSTALLATION

1. Align the mounting studs with the mounting holes on the vehicle frame rail. Tighten the mounting nuts to 180-220 in. lbs.
2. Install the valve onto the vehicle ensuring all ports are connected as marked during disassembly.

TESTING THE REPLACEMENT SR-7 SPRING BRAKE MODULATING VALVE

Perform operating and leakage tests as outlined in "Operating Tests" section.

Bendix

Service Data

SD-13-4863

299

Bendix® EC-60™ ABS / ATC Controllers (Standard & Premium Models)

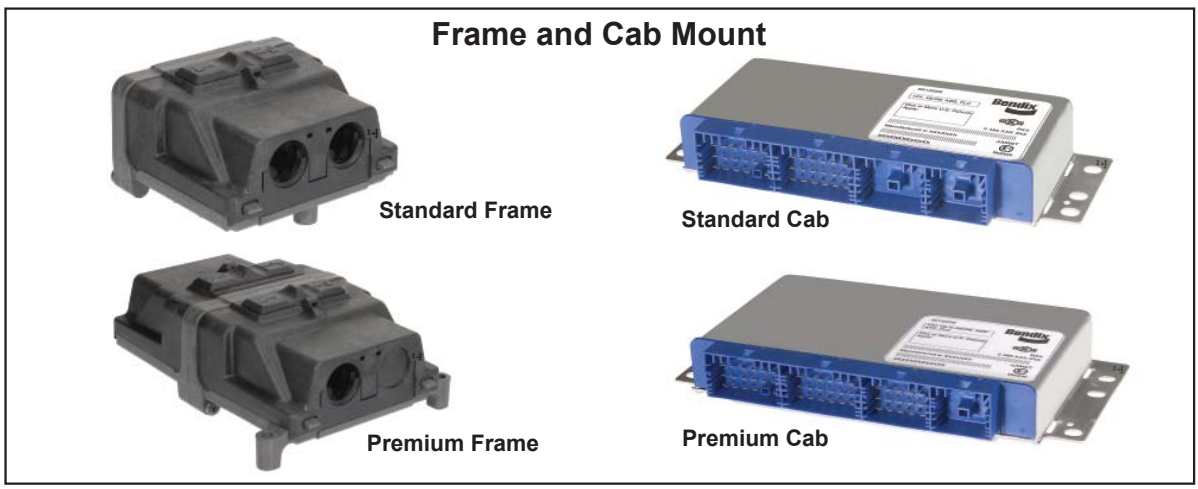


FIGURE 1 - EC-60™ CONTROLLERS

INTRODUCTION

Bendix® EC-60™ controllers are members of a family of electronic **Antilock Braking System (ABS)** devices designed to help improve the braking characteristics of air braked vehicles - including heavy and medium duty buses, trucks, and tractors. ABS controllers are also known as **Electronic Control Units (ECUs)**.

Bendix ABS uses wheel speed sensors, ABS modulator valves, and an ECU to control either four or six wheels of a vehicle. By monitoring individual wheel turning motion during braking, and adjusting or pulsing the brake pressure at each wheel, the EC-60™ controller is able to optimize slip between the tire and the road surface. When excessive wheel slip, or wheel lock-up, is detected, the EC-60™ controller will activate the Pressure Modulator Valves to simulate a driver pumping the brakes. However, the EC-60™ controller is able to pump the brakes on individual wheels (or pairs of wheels), independently, and with greater speed and accuracy than a driver.

In addition to the ABS function, premium models of the EC-60™ controller provide an **Automatic Traction Control (ATC)** feature. Bendix ATC can improve vehicle traction during acceleration, and lateral stability while driving through curves. ATC utilizes **Engine Torque Limiting (ETL)** where the ECU communicates with the engine's controller and/or **Differential Braking (DB)** where individual wheel brake applications are used to improve vehicle traction.

Premium EC-60™ controllers have a drag torque control feature which reduces driven-axle wheel slip (due to driveline inertia) by communicating with the engine's controller and increasing the engine torque.

TABLE OF CONTENTS PAGE

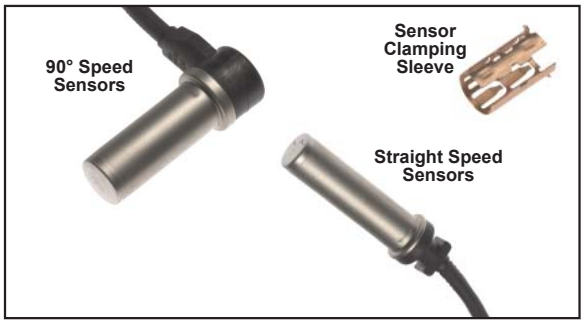


FIGURE 2 - BENDIX® WS-24™ WHEEL SPEED SENSORS

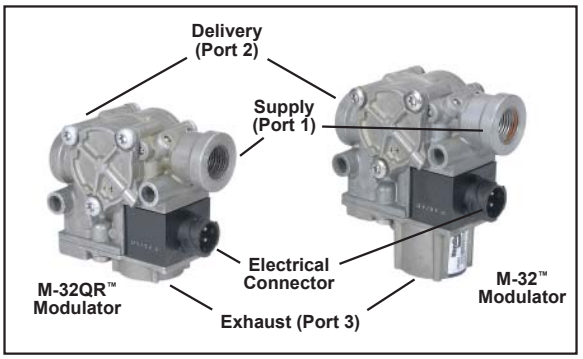


FIGURE 3 - M-32™ AND M-32QR™ MODULATORS

COMPONENTS

The EC-60™ controller's ABS function utilizes the following components:

- Bendix® WS-24™ wheel speed sensors (4 or 6, depending on ECU model and configuration). Each sensor is installed with a Bendix Sensor Clamping Sleeve
- Bendix® M-32™ or M-32QR™ Pressure Modulator Valves (4, 5, or 6 depending on ECU model and configuration)
- Dash-mounted tractor ABS Indicator Lamp
- Service brake relay valve
- Dash-mounted trailer ABS Indicator Lamp (used on all towing vehicles manufactured after March 1, 2001)
- Optional blink code activation switch
- Optional ABS off-road switch. (Off-road feature is not available on all models - See Chart 1.)

The EC-60™ controller ATC function utilizes the following additional components:

- Traction control valve (may be integral to the service brake relay valve or a stand-alone device)
- Dash-mounted ATC status/indicator lamp
- J1939 serial communication to engine control module
- Stop lamp switch input (may be provided using the ECU hardware input or J1939)
- Optional ATC off-road switch

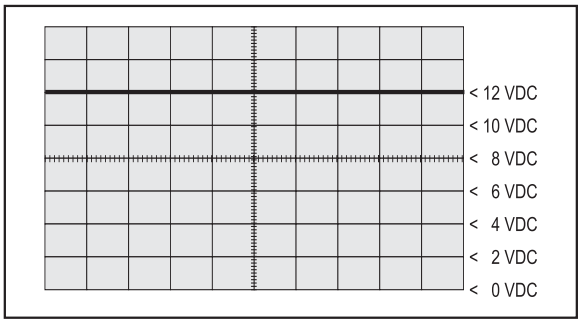


FIGURE 4 - POWER LINE WITHOUT PLC SIGNAL

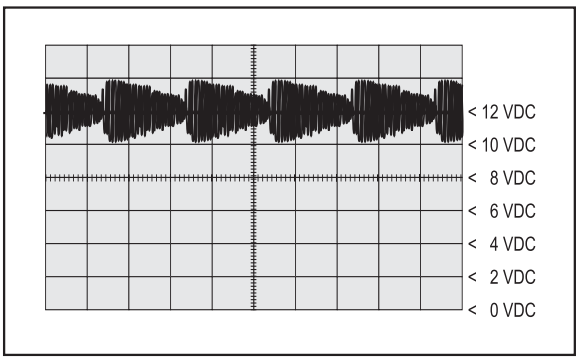


FIGURE 5 - POWER LINE WITH PLC SIGNAL

ECU MOUNTING

Cab ECUs

Cab-mounted EC-60™ controllers are not protected against moisture, and must be mounted in an environmentally protected area.

All wire harness connectors must be properly seated. The use of secondary locks is strongly recommended.

CAUTION: All unused ECU connectors must be covered and receive any necessary protection from moisture, etc.

Cab ECUs utilize connectors from the AMP MCP 2.8 product family.

Frame ECUs

Frame-mounted EC-60™ controllers may be mounted on the vehicle frame, but only in locations where they will not be subjected to direct tire spray. ECU mounting bolts must be torqued to 7.5 to 9 Nm.

CAUTION: The frame wire harness connectors must be properly seated with the seals intact (undamaged). All unused connector terminals must be plugged with the appropriate sealing plugs. Failure to properly seat or seal the connectors could result in moisture or corrosion damage to the connector terminals. ECUs damaged by moisture and/or corrosion are not covered under the Bendix warranty.

Frame ECUs utilize Deutsch connectors.

ECU Model	Mounting	Input Voltage	Sensors	PMVs	ATC	Blink Codes	Serial Communication		PLC	ABS Off-Road	ATC Off-Road	Retarder Relay
							J1587	J1939				
Standard	Cab Frame	12	4	4		✔	✔	✔				✔
Standard PLC	Cab Frame	12	4	4		✔	✔	✔	✔			✔
Premium	Cab Frame	12	4/6	4/5/6	✔	✔	✔	✔	✔	✔	✔	✔
Premium	Cab	24	4/6	4/5/6	✔	✔	✔	✔		✔	✔	✔

CHART 1 - EC-60™ CONTROLLERS AVAILABLE

HARDWARE CONFIGURATIONS

Standard Models

Standard model EC-60™ controllers support four sensor/four modulator (4S/4M) applications. Certain models support Power Line Carrier (PLC) communications, with all models supporting 12 volt installations. *See Chart 1 for more details.*

Premium Models

Premium model EC-60™ controllers support applications up to six sensor/six modulator (6S/6M) installations with ATC and drag torque control. All 12 volt models support PLC. 24 volt models do not support PLC. *See Chart 1 for more details.*

EC-60™ CONTROLLERS WITH PLC

Since March 1, 2001, all towing vehicles must have an in-cab trailer ABS Indicator Lamp. Trailers transmit the status of the trailer ABS over the power line (the blue wire of the J560 connector) to the tractor using a Power Line Carrier (PLC) signal. See Figures 4 and 5. Typically the signal is broadcast by the trailer ABS ECU. The application of PLC technology for the heavy vehicle industry is known as "PLC4Trucks." The Standard PLC EC-60™ controller and the Premium EC-60™ controller (12 volt versions) support PLC communications in accordance with SAE J2497.

Identifying an EC-60™ Controller with PLC

Refer to the information panel on the ECU label to see if the controller provides PLC.

An oscilloscope can be used to measure or identify the presence of a PLC signal on the power line. The PLC signal is an amplitude and frequency modulated signal. Depending on the filtering and load on the power line, the PLC signal amplitude can range from 5.0 mVp-p to 7.0 Vp-p. Suggested oscilloscope settings are AC coupling, 1 volt/div, 100 µsec/div. The signal should be measured at the ignition power input of the EC-60™ controller.

Note: An ABS trailer equipped with PLC, or a PLC diagnostic tool, must be connected to the vehicle in order to generate a PLC signal on the power line.

Alternatively, the part number shown on the ECU label can be identified as a PLC or non-PLC model by calling the Bendix TechTeam at 1-800-AIR-BRAKE (1-800-247-2725).

EC-60™ CONTROLLER INPUTS

Battery and Ignition Inputs

The ECU operates at a nominal supply voltage of 12 or 24 volts, depending on the model of the ECU. The battery input is connected through a 30 amp fuse directly to the battery.

The ignition input is applied by the ignition switch through a 5 amp fuse.

Ground Input

The EC-60™ controller supports one ground input. See pages 35 to 40 for system schematics.

ABS Indicator Lamp Ground Input (Cab ECUs Only)

EC-60™ cab ECUs require a second ground input (X1-12) for the ABS indicator lamp. The X1 wire harness connector contains an ABS indicator lamp interlock (X1-15), which shorts the ABS indicator lamp circuit (X1-18) to ground if the connector is removed from the ECU.

Bendix® WS-24™ Wheel Speed Sensors

Wheel speed data is provided to the EC-60™ controller from the WS-24™ wheel speed sensor (see Figure 2). Vehicles have an exciter ring (or "tone ring") as part of the wheel assembly, and as the wheel turns, the teeth of the exciter ring pass the wheel speed sensor, generating an AC signal. The EC-60™ controller receives the AC signal, which varies in voltage and frequency as the wheel speed changes.

Vehicle axle configurations and ATC features determine the number of WS-24™ wheel speed sensors that must be used. A vehicle with a single rear axle requires four wheel speed sensors. Vehicles with two rear axles can utilize six wheel speed sensors for optimal ABS and ATC performance.

Diagnostic Blink Code Switch

A momentary switch that grounds the ABS Indicator Lamp output is used to place the ECU into the diagnostic blink code mode and is typically located on the vehicle's dash panel.

ABS Off-Road Switch and Indicator Lamp Operation

WARNING: The ABS off-road mode should not be used on normal, paved road surfaces because vehicle stability and steerability may be affected. When the ECU is placed in the ABS off-road mode, the ABS Indicator Lamp will flash constantly to notify the vehicle operator that the off-road mode is active.

Premium EC-60™ controllers use a dash-mounted switch to place the ECU into the ABS off-road mode. In some cases, ECUs may also be put into the ABS off-road mode by one of the other vehicle control modules, using a J1939 message to the EC-60™ controller.

(If you need to know if your EC-60™ controller uses a J1939 message to operate the lamp, e-mail ABS@bendix.com, specifying the ECU part number, or call 1-800-AIR-BRAKE and speak to the Bendix TechTeam.)

Stop Lamp Switch (SLS)

The Premium EC-60™ controller monitors the vehicle stop lamp status. Certain vehicle functions, such as ATC and All-Wheel Drive (AWD), use the status of the stop lamp to know the driver's intention. This can be provided to the ECU via J1939 communications, or hardware input.

EC-60™ CONTROLLER OUTPUTS

Bendix® M-32™ and M-32QR™ Pressure Modulator Valves (PMV)

The Bendix® M-32™ and M-32QR™ pressure modulator valves (PMV) are operated by the EC-60™ controller to modify driver applied air pressure to the service brakes during ABS or ATC activation (See pages 6-8). The PMV is an electro-pneumatic control valve and is the last valve that air passes through on its way to the brake chamber. The modulator hold and release solenoids are activated to precisely modify the brake pressure during an antilock braking event. The hold solenoid is normally open and the release solenoid is normally closed.

Traction Control Valve (TCV)

Premium EC-60™ controllers will activate the TCV during differential braking ATC events. The TCV may be a separate valve or integrated into the rear axle relay valve.

ABS Indicator Lamp Control with Optional Diagnostic Blink Code Switch (Cab and Frame ECUs)

Cab and frame-mount EC-60™ controllers have internal circuitry to control the ABS Indicator Lamp on the dash panel.

The ABS Lamp Illuminates:

1. During power up (e.g. when the vehicle is started) and turns off after the self test is completed, providing no **Diagnostic Trouble Codes (DTCs)** are present on the tractor.
2. If the ECU is unplugged or has no power.
3. When the ECU is placed into the ABS off-road mode (the lamp flashes rapidly).
4. To display blink codes for diagnostic purposes after the external diagnostic switch is activated.

Certain models of the EC-60™ controller communicate with other vehicle control modules to operate the ABS Indicator Lamp using serial communications. (If you need to know if your EC-60™ controller uses serial communications to operate the lamp, e-mail ABS@bendix.com, specifying the ECU part number, or call 1-800-AIR-BRAKE and speak to the Bendix TechTeam.)

Indicator Lamp Control Using Serial Communications Links

As mentioned above, depending on the vehicle manufacturer, the dash indicator lamps (ABS, ATC, and trailer ABS) may be controlled using serial communications links. In these cases, the EC-60™ controller will send a serial communications message over the J1939 or J1587 links indicating the required status of the lamp(s). Another vehicle control module receives the message and controls the indicator lamp(s).

Retarder Relay Disable Output

The retarder relay disable output may be used to control a retarder disable relay.

When configured to use this output, the ECU will energize the retarder disable relay and inhibit the use of the retarder as needed.

SAE J1939 Serial Communications

A Controller Area Network (CAN) data link (SAE J1939) is provided for communication. This link is used for various functions, such as:

- To disable retarding devices during ABS operation
- To request torque converter lock-up during ABS operation
- To share information such as wheel speed and ECU status with other vehicle control modules

Premium EC-60™ controllers utilize the J1939 data link for ATC and drag torque control functions.

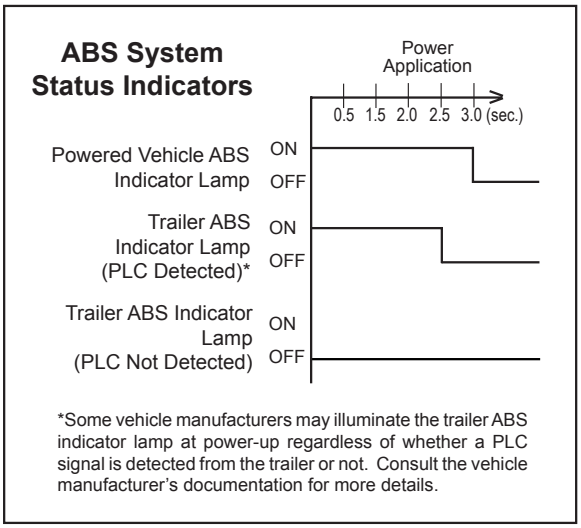


FIGURE 6 - ABS DASH LAMP START UP SEQUENCE

Trailer ABS Indicator Lamp Control

Certain models of the EC-60™ controller activate a trailer ABS Indicator Lamp (located on the dash panel) that indicates the status of the trailer ABS unit on one, or more trailers, or dollies. Typically, the EC-60™ controller directly controls the trailer ABS Indicator Lamp based on the information it receives from the trailer ABS.

Alternatively, some vehicles require the EC-60™ controller to activate the trailer ABS Indicator Lamp by communicating with other vehicle controllers using serial communications. (If you need to know if your EC-60™ controller uses a serial communications message to operate the lamp, e-mail ABS@bendix.com, specifying the ECU part number, or call 1-800-AIR-BRAKE and speak to the Bendix TechTeam.)

SAE J1708/J1587 Serial Communications

An SAE J1708 data link, implemented according to SAE J1587 recommended practice, is available for diagnostic purposes, as well as ECU status messages.

ATC Lamp Output/ATC Off-Road Switch Input

Premium ECUs control the ATC dash lamp.

The ATC Lamp Illuminates:

1. During power up (e.g. when the vehicle is started) and turns off after the self test is completed, providing no diagnostic trouble codes are present.
2. When ATC is disabled for any reason.
3. During an ATC event (the lamp will flash rapidly).
4. When the ECU is placed in the ATC off-road mode (the lamp will flash slowly at a rate of 1.0 seconds on, 1.5 seconds off). This notifies the vehicle operator that the off-road mode is active.

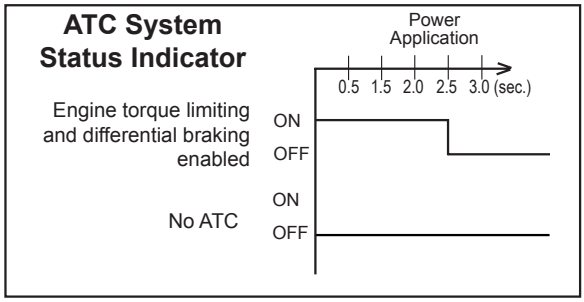


FIGURE 7 - ATC INDICATOR LAMP START UP SEQUENCE

Interaxle Differential Lock Control (AWD Transfer Case) Premium ECUs can control the interaxle differential lock (AWD transfer case). This is recommended on AWD vehicles, but the ECU must be specially configured to provide this feature. E-mail ABS@bendix.com for more details.

POWER-UP SEQUENCE

WARNING: The vehicle operator should verify proper operation of all installed indicator lamps (ABS, ATC, and trailer ABS) when applying ignition power and during vehicle operation.

Lamps that do not illuminate as required when ignition power is applied, or remain illuminated after ignition power is applied, indicate the need for maintenance.

ABS Indicator Lamp Operation

The ECU will illuminate the ABS Indicator Lamp for approximately three seconds when ignition power is applied, after which the lamp will extinguish if no diagnostic trouble codes are detected.

The ECU will illuminate the ABS Indicator Lamp whenever full ABS operation is not available due to a diagnostic trouble code. In most cases, partial ABS is still available.

ATC Status/Indicator Lamp Operation

The ECU will illuminate the ATC lamp for approximately 2.5 seconds when ignition power is applied, after which the lamp will extinguish, if no diagnostic trouble codes are detected.

The ECU will illuminate the ATC Indicator Lamp whenever ATC is disabled due to a diagnostic trouble code.

Trailer ABS Indicator Lamp Operation

Certain models of the ECU will control the Trailer ABS Indicator Lamp when a PLC signal (SAE J2497) from a trailer ABS ECU is detected.

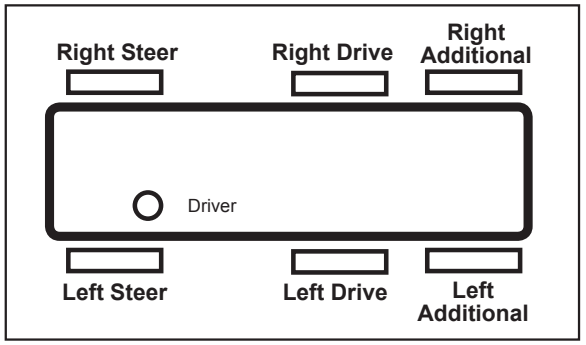


FIGURE 8 - VEHICLE ORIENTATION (TYPICAL)

ECU Configuration Test

Within two seconds of the application of ignition power, the ECU will perform a test to detect system configuration with regards to the number of wheel speed sensors and PMVs. This can be audibly detected by a rapid cycling of the PMVs. (Note: The ECU will not perform the configuration test when wheel speed sensors show that the vehicle is in motion.)

Pressure Modulator Valve Chuff Test

After the performance of the configuration test, the EC-60™ controller will perform a Bendix-patented PMV Chuff Test. The Chuff Test is an electrical and pneumatic PMV test that can assist maintenance personnel in verifying proper PMV wiring and installation.

With brake pressure applied, a properly installed PMV will perform one sharp audible exhaust of air by activating the hold solenoid twice and the release solenoid once. If the PMV is wired incorrectly, it will produce two exhausts of air or none at all.

The EC-60™ controller will perform a PMV chuff test on all installed modulators in the following order:

- Steer Axle Right PMV
- Steer Axle Left PMV
- Drive Axle Right PMV
- Drive Axle Left PMV
- Additional Axle Right PMV
- Additional Axle Left PMV

The pattern will then repeat itself.

The ECU will not perform the PMV Chuff Test when wheel speed sensors show that the vehicle is in motion.

ABS OPERATION

Bendix ABS uses wheel speed sensors, ABS modulator valves, and an ECU to control either four or six wheels of a vehicle. By monitoring individual wheel turning motion during braking, and adjusting or pulsing the brake pressure at each wheel, the EC-60™ controller is able to optimize slip between the tire and the road surface. When excessive wheel slip, or wheel lock-up, is detected, the EC-60™ controller will activate the Pressure Modulator Valves to simulate a driver pumping the brakes. However, the EC-60™ controller is able to pump the brakes on individual wheels (or pairs of wheels), independently, and with greater speed and accuracy than a driver.

Steer Axle Control

Although both wheels of the steer axle have their own wheel speed sensor and pressure modulator valve, the EC-60™ controller blends the applied braking force between the two steering axle brakes. This Bendix patented brake application control, called Modified Individual Regulation (MIR), is designed to help reduce steering wheel pull during an ABS event on road surfaces with poor traction (or areas of poor traction, e.g., asphalt road surfaces with patches of ice).

Single Drive Axle Control (4x2 Vehicle)

For vehicles with a single rear drive axle (4x2), the brakes are operated independently by the EC-60™ controller, based on the individual wheel behavior.

Dual Drive Axle Control (4S/4M Configuration)

For vehicles with dual drive axles (6x4) using a 4S/4M configuration, one ABS modulator controls both right-side rear wheels and the other modulator controls both left-side rear wheels. Both wheels on each side receive equal brake pressure during an ABS stop. The rear wheel speed sensors must be installed on the axle with the lightest load.

Dual Rear Axle Control (6S/6M Configuration)

For vehicles with dual rear axles (6x4, 6x2) using a 6S/6M configuration, the rear wheels are controlled independently. Therefore, brake application pressure at each wheel is adjusted according to the individual wheel behavior on the road surface.

6x2 Vehicles with 6S/5M Configuration

6x2 vehicles can utilize a 6S/5M configuration, with the additional axle (a non-driven rear axle) having two sensors, but only one Pressure Modulator Valve. In this case, the PMV controls both wheels on the additional axle. The additional axle wheels would receive equal brake pressure, based on the wheel that is currently experiencing the most wheel slip.

Normal Braking

During normal braking, brake pressure is delivered through the ABS PMV and into the brake chamber. If the ECU does not detect excessive wheel slip, it will not activate ABS control, and the vehicle stops with normal braking.

Retarder Brake System Control

On surfaces with low traction, application of the retarder can lead to high levels of wheel slip at the drive axle wheels, which can adversely affect vehicle stability.

To avoid this, the EC-60™ controller switches off the retarder as soon as a lock-up is detected at one (or more) of the drive axle wheels.

When the ECU is placed in the ABS off-road mode, it will switch off the retarder only when ABS is active on a steer axle wheel and a drive axle wheel.

Optional ABS Off-Road Mode

On some road conditions, particularly when the driving surface is soft, the stopping distance with ABS may be longer than without ABS. This can occur when a locked wheel on soft ground plows up the road surface in front of the tire, changing the rolling friction value. Although vehicle stopping distance with a locked wheel may be shorter than corresponding stopping distance with ABS control, vehicle steerability and stability is reduced.

Premium EC-60™ controllers have an optional control mode that more effectively accommodates these soft road conditions to shorten stopping distance while maintaining optimal vehicle steerability and stability.

WARNING: The ABS off-road mode should not be used on normal, paved road surfaces because vehicle stability and steerability may be reduced. The flashing ABS Indicator Lamp communicates the status of this mode to the driver.

The vehicle manufacturer should provide the optional ABS off-road function only for vehicles that operate on unpaved surfaces or that are used in off-road applications, and is responsible for ensuring that vehicles equipped with the ABS off-road function meet all FMVSS-121 requirements and have adequate operator indicators and instructions.

The vehicle operator activates the off-road function with a switch on the dash panel. A flashing ABS Indicator Lamp indicates to the driver that the ABS off-road function is engaged. To exit the ABS off-road mode, depress and release the switch.

All-Wheel Drive (AWD) Vehicles

AWD vehicles with an engaged interaxle differential (steer axle to rear axle)/AWD transfer case may have negative effects on ABS performance. Optimum ABS performance is achieved when the lockable differentials are disengaged, allowing individual wheel control.

Premium EC-60™ controllers can be programmed specifically for this configuration to control the differential lock/unlock solenoid in the AWD transfer case. When programmed to do so, the ECU will disengage the locked interaxle/AWD transfer case during an ABS event and reengage it once the ABS event has ended.

ATC OPERATION

ATC Functional Overview

Just as ABS improves vehicle stability during braking, ATC improves vehicle stability and traction during vehicle acceleration. The EC-60™ controller ATC function uses the same wheel speed information and modulator control as the ABS function. The EC-60™ controller detects excessive drive wheel speed, compares the speed of the front, non-driven wheels, and reacts to help bring the wheel spin under control. The EC-60™ controller can be configured to use engine torque limiting and/or differential braking to control wheel spin. For optimal ATC performance, both methods are recommended.

ATC Lamp Operation

The ATC Lamp Illuminates:

1. During power up (e.g. when the vehicle is started) and turns off after the self test is completed, providing no diagnostic trouble codes are present.
2. When ATC is disabled for any reason.
3. During an ATC event (the lamp will flash rapidly). When ATC is no longer active, the ATC active/indicator lamp turns off.
4. When the ECU is placed in the ATC off-road mode (the lamp will flash at a rate of 1.0 seconds on, 1.5 seconds off). This notifies the vehicle operator that the off-road mode is active.

Differential Braking

Differential braking is automatically activated when drive wheel(s) on one side of the vehicle are spinning, which typically occur on asphalt road surfaces with patches of ice. The traction system will then lightly apply the brake to the drive wheel(s) that are spinning. The vehicle differential will then drive the wheels on the other side of the vehicle.

Differential braking is available at vehicle speeds up to 25 MPH.

Disabling ATC Differential Braking

ATC differential braking is disabled under the following conditions:

1. During power up (e.g. when the vehicle is started), until the ECU detects a service brake application.
2. If the ECU receives a J1939 message indicating that the vehicle is parked.
3. When the dynamometer test mode is active. The dynamometer test mode is entered using the diagnostic blink code switch or by using a diagnostic tool (such as Bendix® ACom™ Diagnostics).

4. In response to a serial communications request from a diagnostic tool.
5. During brake torque limiting to avoid overheating of the brakes.
6. When certain diagnostic trouble code conditions are detected.

Engine Torque Limiting (ETL) with *Smart ATC*™ Traction Control

The EC-60™ controller uses Engine Torque Limiting to control drive axle wheel slip. This is communicated to the engine control module (using J1939), and is available at all vehicle speeds.

Bendix® *Smart ATC*™ Traction Control

The EC-60™ controller has an additional feature known as *Smart ATC*™ traction control. *Smart ATC*™ traction control monitors the accelerator pedal position (using J1939) to help provide optimum traction and vehicle stability. By knowing the driver's intention and adapting the target slip of the drive wheels to the driving situation, the *Smart ATC*™ traction control allows higher wheel slip when the accelerator pedal is applied above a preset level.

The target wheel slip is decreased when driving through a curve for improved stability.

Disabling ATC Engine Control and *Smart ATC*™ Traction Control

ATC Engine Control and *Smart ATC*™ traction control will be disabled under the following conditions:

1. In response to a serial communications request from an off-board tool.
2. At power-up until the ECU detects a service brake application.
3. If the ECU receives a J1939 message indicating that the vehicle is parked.
4. If the dynamometer test mode is active. This may be accomplished via an off-board tool or the diagnostic blink code switch.
5. When certain diagnostic trouble code conditions are detected.

Optional ATC Off-Road Mode

In some road conditions, the vehicle operator may desire additional drive wheel slip when ATC is active. The Premium EC-60™ controller has an optional control mode to permit this desired performance.

The vehicle operator can activate the off-road function with a switch on the dash panel. Alternately, a J1939 message may be used to place the vehicle in this mode. The ATC Indicator Lamp will flash continually to confirm that the off-road ATC function is engaged.

To exit the ATC off-road mode, depress and release the ATC off-road switch.

Drag Torque Control Functional Overview

Premium EC-60™ controllers have a feature referred to as drag torque control which reduces wheel slip on a driven axle due to driveline inertia. This condition is addressed by increasing the engine torque to overcome the inertia.

Drag torque control increases vehicle stability on low-traction road surfaces during down-shifting or retarder braking.

Dynamometer Test Mode

WARNING: ATC must be disabled prior to conducting any dynamometer testing. When the Dynamometer Test Mode is enabled, ATC brake control and engine control along with drag torque control are turned off. This test mode is used to avoid torque reduction or torque increase and brake control activation when the vehicle is operated on a dynamometer for testing purpose.

The Dynamometer Test Mode may be activated by pressing and releasing the diagnostic blink code switch five times or by using a hand-held or PC-based diagnostic tool.

The Dynamometer Test Mode will remain active even if power to the ECU is removed and re-applied. Press and release the blink code switch three times, or use a hand-held or PC-based diagnostic tool to exit the test mode.

Automatic Tire Size Calibration

The ECU requires a precise rolling circumference ratio between steer axle and drive axle tires in order for ABS and ATC to perform in an optimal manner. For this reason, a learning process continuously takes place in which the precise ratio is calculated. This calculated value is stored in the ECU memory provided the following conditions are met:

1. Rolling-circumference ratio is within the permissible range.
2. Vehicle speed is greater than approximately 12 MPH.
3. No acceleration or deceleration is taking place.
4. There are no active speed sensor diagnostic trouble codes.

The ECU is provided with a ratio value of 1.00 as a default setting. If the automatic tire size alignment calculates a different value, this is used to overwrite the original figure in the memory. This process adapts the ABS and ATC function to the vehicle.

Acceptable Tire Sizes

The speed calculation for an exciter ring with 100 teeth is based on a default tire size of 510 revolutions per mile. This figure is based on the actual rolling circumference of the tires, which varies with tire size, tire wear, tire pressure, vehicle loading, etc.

The ABS response sensitivity is reduced when the actual rolling circumference is excessive on all wheels. For a 100 tooth exciter ring, the minimum number of tire revolutions per mile is 426, and the maximum is 567. The ECU will set diagnostic trouble codes if the number of revolutions are out of this range.

In addition, the size of the steer axle tires compared to the drive axle tires also has to be within the ABS system design. To avoid diagnostic trouble codes, the ratio of the effective rolling circumference of the steer axle, divided by the effective rolling circumference of the drive axle, must be between 0.85 to 1.15.

ABS PARTIAL SHUTDOWN

Depending which component the trouble code is detected on, the ABS and ATC functions may be fully or partially disabled. Even with the ABS indicator lamp on, the EC-60™ controller may still provide ABS function on wheels that are not affected. The EC-60™ controller should be serviced as soon as possible.

Steer Axle ABS Modulator Diagnostic Trouble Code

ABS on the affected wheel is disabled. ABS and ATC on all other wheels remains active.

Drive Axle/Additional Axle ABS Modulator Diagnostic Trouble Code

ATC is disabled. ABS on the affected wheel is disabled. ABS on all other wheels remains active.

Steer Axle Wheel Speed Sensor Diagnostic Trouble Code

The wheel with the diagnostic trouble code is still controlled by using input from the remaining wheel speed sensor on the front axle. ABS remains active on the rear wheels. ATC is disabled.

Drive Axle/Additional Axle Wheel Speed Sensor Diagnostic Trouble Code

ATC is disabled. In a four sensor system, ABS on the affected wheel is disabled, but ABS on all other wheels remains active.

In a six sensor system, ABS remains active by using input from the remaining rear wheel speed sensor on the same side.

ATC Modulator Diagnostic Trouble Code

ATC is disabled. ABS remains active.

J1939 Communication Diagnostic Trouble Code

ATC is disabled. ABS remains active.

ECU Diagnostic Trouble Code

ABS and ATC are disabled. The system reverts to normal braking.

Voltage Diagnostic Trouble Code

While voltage is out of range, ABS and ATC are disabled. The system reverts to normal braking. When the correct voltage level is restored, full ABS and ATC function is available. Operating voltage range is 9.0 to 17.0 VDC.

Reconfiguring EC-60™ Controllers

SYSTEM CONFIGURATION

The EC-60™ controller is designed to allow the technician to change the default system settings (chosen by the vehicle OEM) to provide additional or customized features. When replacing an ECU, be sure to use an equivalent Bendix replacement part number so that the standard default settings are provided.

Depending on the model, the customizable features include ABS control settings, engine module communication etc. Many of these settings can be reconfigured using a hand-held or PC-based software, such as the Bendix® ACom™ Diagnostics program.

ECU RECONFIGURATION

Reconfiguring Standard ECUs

Reconfiguring an EC-60™ controller may be carried out by using the Blink Code Switch or by using a hand-held or PC-based diagnostic tool.

Note: During the reconfiguration process, and independently from any reconfiguration being carried out by the technician, standard ECUs automatically check the J1939 serial link and communicate with other vehicle modules. In particular, if the serial link shows that the vehicle has a retarder device present, the ECU will configure itself to communicate with the retarder device for improved ABS performance. For example, if the ECU detects the presence of a retarder disable relay during a reconfiguration, it will configure itself to control the relay to disable the retarding device as needed.

Reconfiguring Premium ECUs

As with standard ECUs, the Premium EC-60™ controller also carries out, independently from any reconfiguration being carried out by the technician, an automatic check of the J1939 serial link and communicates with other vehicle modules. This includes checking for ATC and retarder disable relay operation. In addition, premium EC-60™ controllers will determine the number of wheel speed sensors and PMVs installed and configure itself accordingly.

6S/5M Configuration

Premium EC-60™ controllers will configure for 6S/5M operation when a reconfiguration event is initiated and the ECU detects that an additional axle PMV is wired as follows:

PMV Connector	ECU Connector
Hold	Right Additional Axle Hold
Release	Left Additional Axle Release
Common	Right Additional Axle Common

See 6S/5M System Schematics (pages 37 & 40) for details.

Reconfiguration Using the Blink Code Switch

The reconfiguration event is the same for both Standard and Premium ECUs. With ignition power removed from the EC-60™ controller, depress the blink code switch. After the ignition power is activated, depress and release the switch seven times to initiate a reconfiguration event.

Diagnostic Tool

A reconfiguration event may be initiated using a hand-held or PC-based diagnostic tool to communicate with the ECU over the SAE J1587 diagnostic link.

Troubleshooting: General

SAFE MAINTENANCE PRACTICES

WARNING! PLEASE READ AND FOLLOW THESE INSTRUCTIONS TO AVOID PERSONAL INJURY OR DEATH:

When working on or around a vehicle, the following general precautions should be observed at all times:

1. **Park the vehicle on a level surface, apply the parking brakes, and always block the wheels. Always wear safety glasses.**
2. **Stop the engine and remove ignition key when working under or around the vehicle. When working in the engine compartment, the engine should be shut off and the ignition key should be removed. Where circumstances require that the engine be in operation, EXTREME CAUTION should be used to prevent personal injury resulting from contact with moving, rotating, leaking, heated or electrically charged components.**
3. **Do not attempt to install, remove, disassemble or assemble a component until you have read and thoroughly understand the recommended procedures. Use only the proper tools and observe all precautions pertaining to use of those tools.**
4. **If the work is being performed on the vehicle's air brake system, or any auxiliary pressurized air systems, make certain to drain the air pressure from all reservoirs before beginning ANY work on the vehicle. If the vehicle is equipped with an AD-IS® air dryer system or a dryer reservoir module, be sure to drain the purge reservoir.**
5. **Following the vehicle manufacturer's recommended procedures, deactivate the electrical system in a manner that safely removes all electrical power from the vehicle.**
6. **Never exceed manufacturer's recommended pressures.**
7. **Never connect or disconnect a hose or line containing pressure; it may whip. Never remove a component or plug unless you are certain all system pressure has been depleted.**
8. **Use only genuine Bendix® replacement parts, components and kits. Replacement hardware, tubing, hose, fittings, etc. must be of equivalent size, type and strength as original equipment and be designed specifically for such applications and systems.**
9. **Components with stripped threads or damaged parts should be replaced rather than repaired. Do not attempt repairs requiring machining or welding unless specifically stated and approved by the vehicle and component manufacturer.**
10. **Prior to returning the vehicle to service, make certain all components and systems are restored to their proper operating condition.**
11. **For vehicles with Antilock Traction Control (ATC), the ATC function must be disabled (ATC indicator lamp should be ON) prior to performing any vehicle maintenance where one or more wheels on a drive axle are lifted off the ground and moving.**

REMOVING THE EC-60™ CONTROLLER ASSEMBLY

1. Turn vehicle ignition off.
2. Remove as much contamination as possible prior to disconnecting air lines and electrical connections.
3. Note the EC-60™ controller assembly mounting position on the vehicle.
4. Disconnect the electrical connectors from the EC-60™ controller.
5. Remove and retain the mounting bolts that secure the EC-60™ controller.

INSTALLING A NEW EC-60™ CONTROLLER

CAUTION! When replacing the EC-60™ controller, verify that the unit you are installing has the correct default settings. Failure to do so could result in a loss of features, such as ATC and PLC, or noncompliance with U.S. regulations such as FMVSS 121. It is recommended to use only the correct replacement part number. However, most configuration settings can be altered using the Bendix ACom™ ABS Diagnostic Software program.

Verify correct operation of the EC-60™ controller system and indicator lamps prior to putting the vehicle back into service. Towing vehicles manufactured after March 1, 2001 must support the trailer ABS indicator lamp located on the dash.

For further information, contact either the vehicle manufacturer, Bendix or your local authorized Bendix dealer.

1. Position and secure the EC-60™ controller in the original mounting orientation using the mounting bolts retained during removal. On frame-mount ECUs, torque the mounting bolts to 7.5 to 9 NM (66-80 in. lbs). For cab-mount units use no more torque than is necessary to firmly secure the ECU into position. Over-tightening the mounting hardware can cause damage to the EC-60™ controller.
2. Reconnect the electrical connectors to the EC-60™ controller.
3. Apply power and monitor the EC-60™ controller power-up sequence to verify proper system operation.

See Troubleshooting: Wiring section beginning on page 32 for more information on wiring harnesses.

Troubleshooting: Blink Codes and Diagnostic Modes

ECU DIAGNOSTICS

The EC-60™ controller contains self-testing diagnostic circuitry that continuously checks for the normal operation of internal components and circuitry, as well as external ABS components and wiring.

Active Diagnostic Trouble Codes

When an erroneous system condition is detected, the EC-60™ controller:

1. Illuminates the appropriate indicator lamp(s) and disengages part or all of the ABS and ATC functions. (See page 9.)
2. Places the appropriate trouble code information in the ECU memory.
3. Communicates the appropriate trouble code information over the serial communications diagnostic link as required. Hand-held or PC-based diagnostic tools attach to the vehicle diagnostic connector, typically located on or under the dash (see Figure 9).

FIGURE 9 - TYPICAL VEHICLE DIAGNOSTIC CONNECTOR LOCATIONS (J1708/J1587, J1939)

BLINK CODES

Blink codes allow a technician to troubleshoot ABS problems without using a hand-held or PC-based diagnostic tool. Instead, information about the ABS system is communicated by the ECU using the ABS indicator lamp to display sequences of blinks.

Note: The ECU will not enter the diagnostic blink code mode if the wheel speed sensors show that the vehicle is in motion. If the ECU is in the diagnostic blink code mode and then detects vehicle motion, it will exit the blink code mode.

In addition, by operating the blink code switch as described below, one of several diagnostic modes can be entered. See Diagnostic Modes below.

Blink Code Switch Activation

When activating the blink code switch:

1. Wait at least two seconds after "ignition on." (Except when entering Reconfiguration Mode - see Reconfiguration section on page 10)
2. For the ECU to recognize that the switch is activated "on," the technician must press for at least 0.1 seconds, but less than 5 seconds. (If the switch is held for more than 5 seconds, the ECU will register a malfunctioning switch.)
3. Pauses between pressing the switch when a sequence is required, (e.g. when changing mode) must not be longer than 2 seconds.
4. After a pause of 3.5 seconds, the ECU will begin responding with output information blinks. See Figure 10 for an example.

Blink Code Timing

The ECU responds with a sequence of blink codes. The overall blink code response from the ECU is called a "message." Each message includes, depending on the

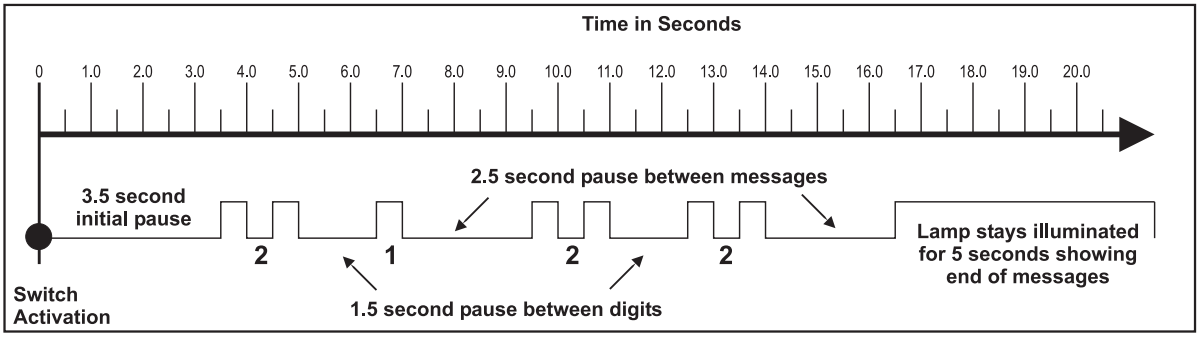


FIGURE 10 - EXAMPLE OF BLINK CODE MESSAGE

mode selected by the technician, a sequence of one or more groups of blinks. Simply record the number of blinks for each sequence and then use the troubleshooting index on page 17 for active or inactive trouble codes and you will be directed to the page that provides troubleshooting information.

NOTE:

1. Sequences of blinks illuminate the ABS indicator lamp for half a second, with half-second pauses between them.
2. Pauses between blink code digits are 1.5 seconds.
3. Pauses between blink code messages are 2.5 seconds.
4. The lamp remains on for 5 seconds at the end of messages.

Once the ABS indicator lamp begins displaying a sequence of codes, it continues until all blink code messages have been displayed and then returns to the normal operating mode. During this time, the ECU will ignore any additional blink code switch activation.

All trouble codes, with the exception of voltage and J1939 trouble codes, will remain in an active state for the remainder of the power cycle.

Voltage trouble codes will clear automatically when the voltage returns within the required limits. All ABS functions will be re-engaged.

J1939 trouble codes will clear automatically when communications are re-established.

DIAGNOSTIC MODES

In order to communicate with the ECU, the controller has several modes that the technician can select, allowing information to be retrieved, or other ECU functions to be accessed.

Diagnostic Modes

To enter the various diagnostic modes:

No. of Times to Press the Blink Code Switch	System Mode Entered
1	Active diagnostic trouble code retrieval
2	Inactive diagnostic trouble code retrieval
3	Clear active diagnostic trouble codes
4	System configuration check
5	Dynamometer Test Mode
7*	Reconfigure ECU

***** To enter the Reconfiguration Mode, the switch must be held in before the application of ignition power. Once the power is supplied, the switch is released and then pressed seven times.

CHART 2 - DIAGNOSTIC MODES

Active Diagnostic Trouble Code Mode

For troubleshooting, typically the Active and Inactive Diagnostic Trouble Retrieval Modes are used. The technician presses the blink code switch once and the ABS indicator lamp flashes a first group of two codes, and if there are more trouble codes recorded, this is followed by a second set of codes, etc. (See page 17 for a directory of these codes.) All active trouble codes may also be retrieved using a hand-held or PC-based diagnostic tool, such as the Bendix® ACom™ Diagnostics software.

To clear active diagnostic trouble codes (as problems are fixed), simply clear (or “self-heal”) by removing and re-applying ignition power. The only exception is for wheel speed sensor trouble codes, which clear when power is removed, re-applied, and the ECU detects valid wheel speed from all wheel speed sensors. Alternately, codes may be cleared by pressing the diagnostic blink code switch 3 times (to enter the Clear Active Diagnostic Trouble Code Mode) or by using a hand-held or PC-based diagnostic tool. Hand-held or PC-based diagnostic tools are able to clear wheel speed sensor trouble codes without the vehicle being driven.

Inactive Diagnostic Trouble Code Mode

The ECU stores past trouble codes and comments (such as configuration changes) in its memory. This record is commonly referred to as “event history.” When an active trouble code is cleared, the ECU stores it in the event history memory as an inactive trouble code.

Using blink codes, the technician may review all inactive trouble codes stored on the ECU. The ABS indicator lamp will display inactive diagnostic blink codes when the diagnostic blink code switch is depressed and released two times. See page 17 for the index showing trouble codes and the troubleshooting guide page to read for help.

Inactive trouble codes, and event history, may be retrieved and cleared by using a hand-held or PC-based diagnostic tool, such as the Bendix® ACom™ Diagnostics software.

Clearing Active Diagnostic Trouble Codes

The ECU will clear active trouble codes when the diagnostic blink code switch is depressed and released three times.

System Configuration Check Mode

The ABS indicator lamp will display system configuration information when the diagnostic blink code switch is depressed and released four times. The lamp will blink out configuration information codes using the following patterns. (See Chart 3). In this mode the ECU tells the technician, by means of a series of six blink codes, the type of ABS system that the ECU has been set up to expect. For example, if the fourth blink code is a three, the technician knows that a 6S/5M sensor/modulator configuration has been set.

Dynamometer Test Mode

The Dynamometer Test Mode is used to disable ATC when needed (e.g. when performing any vehicle maintenance where the wheels are lifted off the ground and moving, including dyno testing). This mode is not reset by power off, power on, cycling. Instead a hand-held or PC-based diagnostic tool must be used to change the setting. Alternatively, depressing and releasing the blink code switch three times will cause the ECU to exit the blink code mode.

Reconfigure ECU Mode

Vehicle reconfiguration is carried out by using the Reconfigure ECU Mode. (See page 10.) Note: To enter the Reconfiguration Mode, the blink code switch must be held in before the application of ignition power. Once the power is supplied, the switch is released and then pressed seven times.

1st Number	System Power
1	12 Volts
2	24 Volts
2nd Number	**Wheel Speed Sensors**
4	4 Sensors
6	6 Sensors
3rd Number	**Pressure Modulator Valves**
4	4 Modulators
5	5 Modulators
6	6 Modulators
4th Number	**ABS Configuration**
1	4S/4M or 6S/6M
2	6S/4M
3	6S/5M
5th Number	**Traction Control Configuration**
2	No ATC
3	ATC Engine Control Only
4	ATC Brake Control Only
5	Full ATC (Engine Control & Brake Control)
6th Number	**Retarder Configuration**
1	No Retarder
2	J1939 Retarder
3	Retarder Relay
4	J1939 Retarder, Retarder Relay

CHART 3 - SYSTEM CONFIGURATION CHECK

Troubleshooting: Using Hand-Held or PC-Based Diagnostic Tools

USING HAND-HELD OR PC-BASED DIAGNOSTICS

Troubleshooting and diagnostic trouble code clearing (as well as reconfiguration) may also be carried out using hand-held or PC-based diagnostic tools such as the Bendix® Remote Diagnostic Unit (RDU™), Bendix® ACom™ Diagnostics software, or the ProLink tool.

LED lights illuminate Diagnostic Trouble Codes (10 locations in total)

FIGURE 11 - *THE BENDIX® REMOTE DIAGNOSTIC UNIT*

Bendix® RDU™ (Remote Diagnostic Unit)

The Bendix® RDU™ tool provides the technician with a visual indication of Antilock Braking System (ABS) component **Diagnostic Trouble Code (DTC)** information. The RDU™ tool is specifically designed for use with Bendix® ABS systems and Bendix makes no claims for its operation and/or usability with other brands of ABS systems.

Features of the Bendix® RDU™ Tool

The RDU™ tool attaches to the 9 pin diagnostic connector in the cab of the vehicle. An adapter cable (Bendix part number 5012793) is available to connect the RDU to vehicles with a 6-pin diagnostic connector. (See Figure 11.)

The RDU™ tool allows the technician to:

- Troubleshoot ABS system component problems using Diagnostic Trouble Code reporting via LEDs.
- Reset Diagnostic Trouble Codes on Bendix® ABS ECUs by holding a magnet over the reset in the center of the RDU™ tool for less than 6 seconds.
- Enter the Self-Configuration Mode used by Bendix® ABS ECUs by holding a magnet over the reset area for greater than 6 seconds but less than 30 seconds.

How the Bendix® RDU™ Operates

See Figure 9 for typical vehicle connector locations.

When the RDU™ tool is plugged into the diagnostic connector, all the LEDs will illuminate, and the green LED will flash 4 times to indicate communications have been established.

If the ABS ECU has no active Diagnostic Trouble Codes, only the green LED will remain illuminated.

If the ABS ECU has at least one active Diagnostic Trouble Code the RDU™ tool displays the first diagnostic trouble code by illuminating the red LEDs, indicating the malfunctioning ABS component and its location on the vehicle. (See Figure 11.) If there are multiple diagnostic trouble codes on the ABS system, the RDU™ tool will display one diagnostic trouble code first, then once that Diagnostic Trouble Code has been repaired and cleared, the next code will be displayed.

Typical Combination Diagnostic Trouble Codes are:

- Right steer sensor
- Left steer sensor
- Right drive sensor
- Left drive sensor
- Right additional sensor
- Left additional sensor
- Right steer modulator
- Left steer modulator
- Right drive modulator
- Left drive modulator
- Right additional modulator
- Left additional modulator
- Traction modulator
- ECU
- Engine serial communication
- MOD red LED illuminated, shows the “Common” connection of one or more modulators is shorted to battery or ground
- VLT (Flashing indicates either over- or under-voltage condition)

To pinpoint the root cause and to ensure the system diagnostic trouble code is properly corrected the first time, additional troubleshooting may be necessary.

Bendix® RDU™ Reset Function

The magnetic reset switch is located in the center top of the RDU™ tool. Activation requires a magnet with 30 gauss minimum.

The reset operations are:

1. If the magnet is held over the switch for less than 6 seconds the “clear diagnostic trouble codes” command is sent.
2. If the magnet is held over the switch for more than 6 seconds, but less than 30 seconds, the Bendix® ABS “self-configuration command” is sent.

Additionally, it is recommended at the end of any inspection that the user switches off and restores the power to the ABS ECU, then check the ABS Indicator Lamp operation and RDU™ tool to see if they indicate any remaining Diagnostic Trouble Codes.

LED Diagnostic Trouble Codes

LFT -	Left	ECU -	ABS Controller
RHT -	Right	SEN -	Wheel Speed Sensor
DRV -	Drive Axle		
ADD -	Additional	MOD -	Pressure Modulator Valve
STR -	Steer Axle		
VLT -	Power	TRC -	Traction Control

Example: If the Diagnostic Trouble Code is "Right Steer Axle Sensor", the RDU™ unit will display one green and three red LEDs

LEDs
Green
VLT
Red
SEN
STR
RHT

FIGURE 12 - DIAGNOSTIC TROUBLE CODES

Bendix® RDU™ Communication Problems

If the ABS ECU does not respond to the RDU™ tool's request for diagnostic trouble codes, the RDU™ tool will illuminate each red LED in a clockwise pattern. This pattern indicates the loss of communication and will continue until the ABS ECU responds and communication has been re-established.

Possible sources of communication problems are:

1. A problem with the J1587 link at the in-cab off-board diagnostic connector (9 or 6 Pin).
2. The ECU does not support PID194.
3. No power is being supplied to the ECU and/or the diagnostic connector.
4. The J1587 bus is overloaded with information and the RDU can not arbitrate access.
5. A malfunctioning RDU™ tool.

Nexiq Bendix Application Card

Nexiq provides a Bendix application card for use with the ProLink tool. It can also be used to diagnose the EC-30™, EC-17™, Gen 4™ and Gen 5™, and MC-30™ ABS Controllers. For more information on the Bendix application card visit www.bendix.com, Nexiq at www.nexiq.com, or your local authorized Bendix parts outlet.

Pro-Link

Heavy Duty
Multi Protocol
Cartridge

PC Card MPSI
Part Number
805013

FIGURE 13 - NEXIQ (MPSI) PRO-LINK TOOL

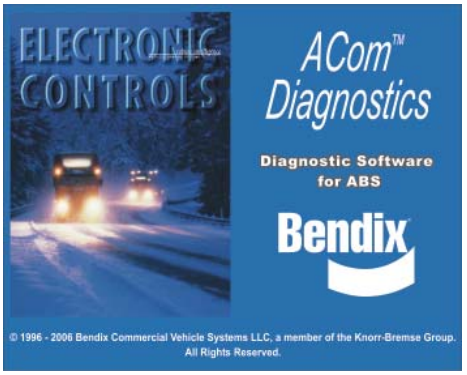


FIGURE 14 - BENDIX® ACOM™ DIAGNOSTICS

Bendix® ACom™ Diagnostics Software

Bendix® ACom™ Diagnostics is a PC-based software program and is designed to meet RP-1210 industry standards. This software provides the technician with access to all the available ECU diagnostic information and configuration capability, including:

- ECU information
- Diagnostic trouble codes and repair information
- Configuration (ABS, ATC, and more)
- Wheel speed information
- Perform component tests
- Save and print information

When using ACom™ Diagnostics software to diagnose the EC-60 ABS ECU, the computer's serial or parallel port needs to be connected to the vehicle's diagnostic connector.

For more information on ACom™ Diagnostics software or RP1210 compliant tools, go to www.bendix.com or visit your local authorized Bendix parts outlet.

See Page 42 for Appendix A: J1587 SID and FMI codes and their Bendix blink code equivalents.

www.bendix.com

Visit Bendix online for the latest information, and ways to find the Bendix contacts you need. Contact technical support, service engineers, Bendix account managers, and more — www.bendix.com is your complete Bendix resource.

Bendix Technical Assistance Team

For direct telephone technical support, call the Bendix technical assistance team at:

1-800-AIR-BRAKE (1-800-247-2725),

Monday through Friday, 8:00 A.M. to 6:00 P.M. EST, and follow the instructions in the recorded message.

Or, you may e-mail the Bendix technical assistance team at: techteam@bendix.com.

Active or Inactive Diagnostic Trouble Codes:

INDEX

How to interpret the first digit of messages received when Active or Inactive Diagnostic Trouble Code Mode is entered.

1st Blink Code Number	Go Here for Troubleshooting Tests
1	No faults (1,1)
2	Wheel Speed Sensors - page 18
3	Wheel Speed Sensors - page 18
4	Wheel Speed Sensors - page 18
5	Wheel Speed Sensors - page 18
6	Power Supply - page 23
7	Pressure Modulator Valves - page 20
8	Pressure Modulator Valves - page 20
9	Pressure Modulator Valves - page 20
10	Pressure Modulator Valves - page 20
11	J1939 - page 24
12	Miscellaneous - page 26
13	ECU - page 25
14	Wheel Speed Sensors - page 18
15	Wheel Speed Sensors - page 18
16	Pressure Modulator Valves - page 20
17	Pressure Modulator Valves - page 20
18	Traction Control Valve - page 22

Example: For a message sequence of:

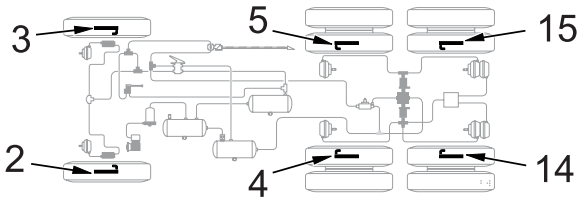
3, 2 12, 4

For the first sequence go to page 18 and
for the second sequence go to page 26.

See Page 42 for Appendix A: J1587 SID and FMI Codes and their Bendix Blink Code Equivalents

Troubleshooting Diagnostic Trouble Codes: Wheel Speed Sensors

1st. Blink Code	Location
2	Left Steer Axle Sensor
3	Right Steer Axle Sensor
4	Left Drive Axle Sensor
5	Right Drive Axle Sensor
14	Left Additional Axle Sensor
15	Right Additional Axle Sensor



2nd. Blink Code	Diagnostic Trouble Code Description	Repair Information
1	Excessive Air Gap	Adjust sensor to contact exciter ring. Rotate wheel and verify a minimum of 0.25 VAC sensor output at ~ 0.5 RPS. Verify condition of sensor head. Verify mounting of exciter ring and condition of teeth. Verify proper bearing endplay. Verify condition and retention of clamping sleeve. Verify sensor lead routing and clamping.
2	Output Low at Drive-off	Adjust sensor to contact exciter ring. Rotate wheel and verify a minimum of 0.25 VAC sensor output at ~ 0.5 RPS. Verify condition of sensor head. Verify mounting of exciter ring and condition of teeth. Verify proper bearing end-play. Verify condition and retention of clamping sleeve. Verify sensor lead routing and clamping.
3	Open or Shorted	Verify 1500 – 2500 ohms across sensor leads. Verify no continuity between sensor leads and ground or voltage. Verify no continuity between sensor leads and other sensors. Check for corroded/damaged wiring or connectors between the ECU and the wheel speed sensor.
4	Loss of Sensor Signal	Adjust sensor to contact exciter ring. Rotate wheel and verify a minimum of 0.25 VAC sensor output at ~ 0.5 RPS. Verify condition of sensor head. Verify mounting of exciter ring and condition of teeth. Verify proper bearing end-play. Verify condition and retention of clamping sleeve. Verify sensor lead routing and clamping. Check for corroded/damaged wiring or connectors between the ECU and the wheel speed sensor.
5	Wheel End	Verify mounting of exciter ring and condition of teeth. Verify proper bearing end-play. Verify condition and retention of clamping sleeve. Verify sensor lead routing and clamping. Check mechanical function of brake. Check for kinked or restricted air lines.
6	Erratic Sensor Signal	Adjust sensor to contact exciter ring. Rotate wheel and verify a minimum of 0.25 VAC sensor output at ~ 0.5 RPS. Verify condition of sensor head. Verify mounting of exciter ring and condition of teeth. Verify proper bearing end-play. Verify condition and retention of clamping sleeve. Verify sensor lead routing and clamping. Check for corroded/damaged wiring or connectors between the ECU and the wheel speed sensor.
7	Tire Size Calibration	Verify correct tire size as desired. Verify proper tire inflation. Verify correct number of exciter ring teeth.
10	Configuration Error	ECU is configured for four sensors, but has detected the presence of additional sensors. Verify sensor wiring and ECU configuration.

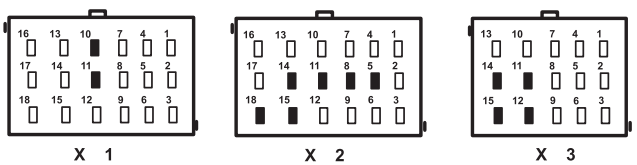
Speed Sensor Repair Tests:

1. Take all measurements at ECU harness connector pins in order to check wire harness and sensor. Probe the connector carefully so that the terminals are not damaged.
2. Wheel speed sensor measurements should read:

Location	Measurement
Sensor	1500 - 2500 Ohms
Sensor to voltage or ground	Open Circuit (no continuity)
Sensor output voltage	>0.25 of VAC sensor output at ~ 0.5 revs/sec.

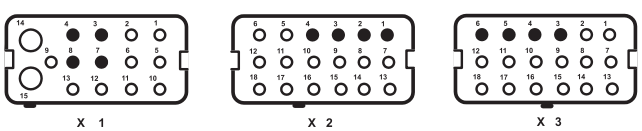
3. Clear DTC after issue is corrected. The sensor DTC will remain until the power is cycled to the ABS ECU and vehicle is driven above 15 MPH or DTC was cleared using either the diagnostic blink code switch or diagnostic tool.

Cab-mount ECU: Looking into wire harness connector



Connector	Pin	Wheel Speed Sensor Location
X1	10	Right Drive Axle (+)
18 Way	11	Right Drive Axle (-)
	5	Left Steer Axle (+)
X2	8	Left Steer Axle (-)
18 Way	11	Right Steer Axle (+)
	14	Right Steer Axle (-)
	15	Left Drive Axle (+)
	18	Left Drive Axle (-)
X3	11	Left Additional Axle (+)
15 Way (if Premium	14	Left Additional Axle (-)
ECU is configured	12	Right Additional Axle (+)
for 6 sensors)	15	Right Additional Axle (-)

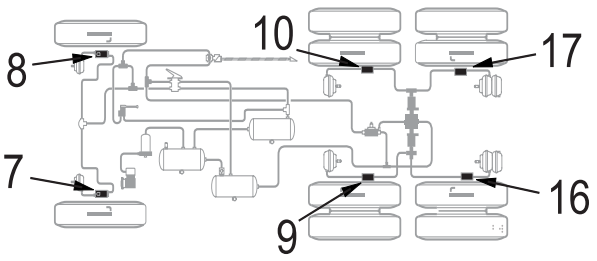
Frame-mount ECU: Looking into wire harness connector



Connector	Pin	Wheel Speed Sensor Location
	3	Left Steer Axle (+)
X1	7	Left Steer Axle (-)
15 Way	4	Right Steer Axle (+)
	8	Right Steer Axle (-)
	1	Left Drive Axle (+)
X2	2	Left Drive Axle (-)
18 Way	3	Right Drive Axle (+)
	4	Right Drive Axle (-)
X3	3	Left Additional Axle (+)
18 Way (if Premium	4	Left Additional Axle (-)
ECU is configured	5	Right Additional Axle (+)
for 6 sensors)	6	Right Additional Axle (-)

Troubleshooting Diagnostic Trouble Codes: Pressure Modulator Valves

1st. Blink Code	Location
7	Left Steer Axle
8	Right Steer Axle
9	Left Drive Axle
10	Right Drive Axle
16	Left Additional Axle
17	Right Additional Axle



2nd. Blink Code	Diagnostic Trouble Code Description	Repair Information
1	Release Solenoid Shorted to Ground	Verify no continuity between PMV leads and ground. Verify 4.9 to 5.5 ohms from REL to CMN & HLD to CMN, and 9.8 to 11 ohms from REL to HLD. Check for corroded/damaged wiring or connectors between ECU and PMV.
2	Release Solenoid Shorted to Voltage	Verify no continuity between PMV leads and voltage. Verify 4.9 to 5.5 ohms from REL to CMN & HLD to CMN, and 9.8 to 11 ohms from REL to HLD. Check for corroded/damaged wiring or connectors between ECU and PMV.
3	Release Solenoid Open Circuit	Verify 4.9 to 5.5 ohms from REL to CMN & HLD to CMN, and 9.8 to 11 ohms from REL to HLD. Check for corroded/damaged wiring or connectors between ECU and PMV.
4	Hold Solenoid Shorted to Ground	Verify no continuity between PMV leads and ground. Verify 4.9 to 5.5 ohms from REL to CMN & HLD to CMN, and 9.8 to 11 ohms from REL to HLD. Check for corroded/damaged wiring or connectors between ECU and PMV.
5	Hold Solenoid Shorted to Voltage	Verify no continuity between PMV leads and voltage. Verify 4.9 to 5.5 ohms from REL to CMN & HLD CMN, and 9.8 to 11 ohms from REL to HLD. Check for corroded/damaged wiring or connectors between ECU and PMV.
6	Hold Solenoid Open Circuit	Verify 4.9 to 5.5 ohms from REL to CMN & HLD to CMN, and 9.8 to 11 ohms from REL to HLD. Check for corroded/damaged wiring or connectors between the ECU and PMV.
7	CMN Open Circuit	Verify 4.9 to 5.5 ohms from REL to CMN & HLD to CMN, and 9.8 to 11 ohms from REL to HLD. Check for corroded/damaged wiring or connectors between the ECU and PMV.
8	Configuration Error	A mis-match exists between the ECU configuration and the modulator installation and wiring. Verify PMV wiring and installation. Verify ECU configuration.

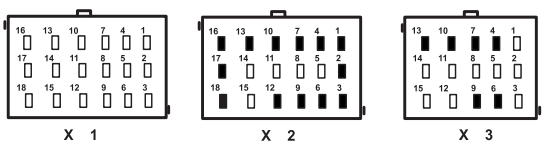
Pressure Modulator Valve Repair Tests:

1. Take all measurements at ECU harness connector pins in order to check wire harness and PMV. Probe the connector carefully so that the terminals are not damaged.
2. Pressure modulator resistance should read:

Location	Measurement
Release to Common	4.9 to 5.5 Ohms
Hold to Common	4.9 to 5.5 Ohms
Release to Hold	9.8 to 11.0 Ohms
Release, Hold, Common to Voltage or Ground	Open Circuit (no continuity)

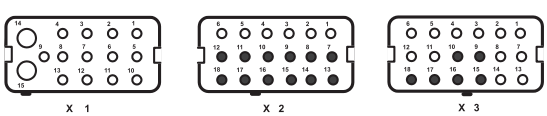
Caution: When troubleshooting modulator trouble codes, check inactive trouble codes and event history for over-voltage or excessive noise trouble codes. If one of these is found, troubleshoot these trouble codes first before the PMV.

Cab-mount ECU: Looking into wire harness connector



Connector	Pin	PMV Location
X2 18 Way	1	Left Steer Axle Hold
	2	Left Steer Axle Release
	3	Left Steer Axle Common
	4	Right Steer Axle Hold
	6	Right Steer Axle Common
	7	Right Steer Axle Release
	9	Right Drive Axle Common
	10	Right Drive Axle Hold
	13	Right Drive Axle Release
	12	Left Drive Axle Common
	16	Left Drive Axle Hold
	17	Left Drive Axle Release
X3 15 Way (if Premium ECU is configured for 6 sensors)	4	Left Additional Axle Hold
	6	Left Additional Axle Common
	7	Left Additional Axle Release
	9	Right Additional Axle Common
	10	Right Additional Axle Hold
	13	Right Additional Axle Release

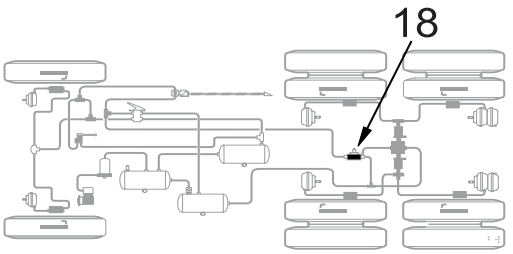
Frame-mount ECU: Looking into wire harness connector



Connector	Pin	PMV Location
X2 18 Way	7	Left Steer Axle Hold
	8	Left Steer Axle Release
	13	Left Steer Axle Common
	9	Right Steer Axle Hold
	10	Right Steer Axle Release
	14	Right Steer Axle Common
	11	Left Drive Axle Hold
	12	Left Drive Axle Release
	15	Left Drive Axle Common
	16	Right Drive Axle Common
	17	Right Drive Axle Hold
	18	Right Drive Axle Release
X3 15 Way (if Premium ECU is configured for 6 sensors)	9	Left Additional Axle Hold
	10	Left Additional Axle Release
	15	Left Additional Axle Common
	16	Right Additional Axle Common
	17	Right Additional Axle Hold
	18	Right Additional Axle Release

Troubleshooting Diagnostic Trouble Codes: Traction Control Valves

1st. Blink Code	Location
18	Traction Control Valve



2nd. Blink Code	Diagnostic Trouble Code Description	Repair Information
1	TCV Solenoid Shorted to Ground	Verify 7 to 19 ohms between TCV and TCV common. Verify no continuity between TCV leads and ground. Check for corroded/damaged wiring or connectors between ECU and TCV.
2	TCV Solenoid Shorted to Voltage	Verify 7 to 19 ohms between TCV and TCV common. Verify no continuity between TCV leads and voltage. Check for corroded/damaged wiring or connectors between ECU and TCV.
3	TCV Solenoid Open Circuit	Verify 7 to 19 ohms between TCV and TCV common. Check for corroded/damaged wiring or connectors between ECU and TCV.
4	TCV Configuration Error	The ECU is not configured for ATC, but has detected the presence of a TCV. Verify TCV wiring. Inspect for the presence of a TCV. Verify ECU configuration.

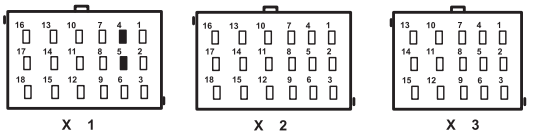
Traction Control Valve Repair Tests:

1. Take all measurements at ECU harness connector pins in order to check wire harness and traction control valve. Probe the connector carefully so that the terminals are not damaged.
2. Tractor Control Valve resistance measurements should read:

Location	Measurement
TCV to TCV Common	7 to 19 Ohms
Release, Hold, Common to Voltage or Ground	Open Circuit (no continuity)

Cab-mount ECU:

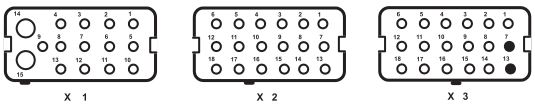
Looking into wire harness connector



Connector	Pin	Traction Control Test
X1	4	Traction Control Valve Common
18 Way	5	Traction Control Valve

Frame-mount ECU:

Looking into wire harness connector



Connector	Pin	Traction Control Test
X3	7	Traction Control Valve
18 Way	13	Traction Control Valve Common

Troubleshooting Diagnostic Trouble Codes: Power Supply

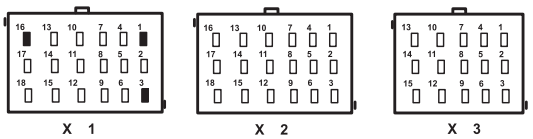
1st. Blink Code	Location
6	Power Supply

2nd. Blink Code	Diagnostic Trouble Code Description	Repair Information
1	Battery Voltage Too Low	Measure battery voltage under load. Check vehicle battery and associated components. Check for damaged wiring. Check for damaged or corroded connectors and connections.
2	Battery Voltage Too High	Measure battery voltage under load. Ensure that battery voltage is correct for the model of ECU. Check vehicle battery and associated components. Check for damaged wiring. Check for damaged or corroded connectors and connections.
3	Battery Voltage Too Low During ABS	Measure battery voltage under load. Check vehicle battery and associated components. Check for damaged wiring. Check for damaged or corroded connectors and connections.
4	Battery Voltage Open Circuit	Measure battery voltage under load. Check condition of fuse. Check vehicle battery and associated components. Check for damaged wiring. Check for damaged or corroded connectors and connections.
5	Ignition Voltage Too Low	Measure ignition voltage under load. Check vehicle battery and associated components. Check for damaged wiring. Check for damaged or corroded connectors and connections. Check condition of fuse.
6	Ignition Voltage Too High	Measure ignition voltage. Ensure that ignition voltage is correct for the model of ECU. Check vehicle battery and associated components. Check for damaged wiring. Check for damaged or corroded connectors and connections.
7	Ignition Voltage Too Low During ABS	Measure ignition voltage under load. Check vehicle battery and associated components. Check for damaged wiring. Check for damaged or corroded connectors and connections.
8	Input Voltage Has Excessive Noise (Temporary)	Check alternator output for excessive noise. Check for other devices causing excessive noise.
9	Input Voltage Has Excessive Noise	Check alternator output for excessive noise. Check for other devices causing excessive noise.

Power Supply Tests:

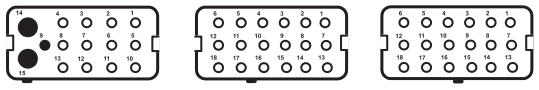
1. Take all measurements at ECU harness connector.
2. Place a load (e.g. an 1157 stop lamp) across battery or ignition and ground connection, measure ignition and battery voltage with the load. Ignition to Ground should measure between 9 to 17 VDC. Battery to Ground should also measure between 9 to 17 VDC.
3. Check for damaged wiring, damaged or corroded connectors and connections.
4. Check condition of vehicle battery and associated components, ground connection good and tight.
5. Check alternator output for excessive noise.

Cab-mount ECU:
Looking into wire harness connector



Connector	Pin	Power Supply Test
X1 18 Way	1	Ground
	3	Ignition
	16	Battery

Frame-mount ECU:
Looking into wire harness connector



Connector	Pin	Power Supply Test
X1 15 Way	9	Ignition
	14	Battery
	15	Ground

Troubleshooting Diagnostic Trouble Codes: J1939 Serial Communications

1st. Blink Code	Location
11	J1939

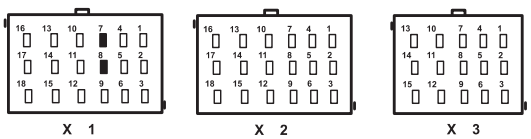
2nd. Blink Code	Diagnostic Trouble Code Description	Repair Information
1	J1939 Serial Link	Loss of communications between the EC-60™ controller and other devices connected to the J1939 link. Check for damaged or reversed J1939 wiring. Check for corroded or damaged connectors. Verify ECU Configuration. Check for other devices inhibiting J1939 communications.
2	J1939 Retarder	Loss of communications between the EC-60™ controller and other devices connected to the J1939 link. Check for damaged or reversed J1939 wiring. Check for corroded or damaged connectors. Verify presence of retarder on the J1939 link. Verify ECU Configuration. Check for other devices inhibiting J1939 communications.
3	J1939 Engine Communications	Loss of communications between the EC-60™ controller and the engine ECU over the J1939 link. Check for damaged or reversed J1939 wiring. Check for corroded or damaged connectors. Verify presence of engine ECU on the J1939 link. Verify ECU Configuration. Check for other devices inhibiting J1939 communications.

J1939 Troubleshooting Tests:

1. Take all measurements at ECU harness connector
2. Check for damaged or reversed J1939 wiring
3. Check for corroded or damaged wiring connector problems such as (opens or shorts to voltage or ground)
4. Check for other J1939 devices which may be loading down (inhibiting) J1939 communication

Cab-mount ECU:

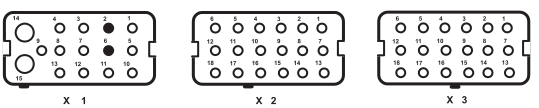
Looking into wire harness connector



Connector	Pin	J1939
X1	7	J1939 Low
18 Way	8	J1939 High

Frame-mount ECU:

Looking into wire harness connector



Connector	Pin	J1939
X1	2	J1939 Low
18 Way	6	J1939 High

Troubleshooting Diagnostic Trouble Codes: ECU

1st. Blink Code	Location
13	ECU

2nd. Blink Code	Diagnostic Trouble Code Description	Repair Information
2	ECU (10)	ALL: Check for damaged or corroded connectors. Check for damaged wiring. Clear trouble codes. If diagnostic trouble codes return, replace the ECU.
3	ECU (11)	
4	ECU (12)	
5	ECU (13)	
6	ECU (14)	
7	ECU (15)	
8	ECU (16)	
9	ECU (17)	
10	ECU (18)	
11	ECU (1A)	
12	ECU (1B)	
13	ECU (80)	

Troubleshooting Diagnostic Trouble Codes: Miscellaneous

1st. Blink Code	Location
12	Miscellaneous

2nd. Blink Code	Diagnostic Trouble Code Description	Repair Information
1	Stop Lamp Switch Not Detected	ECU has not detected the presence of the stop lamp switch since ignition power was applied (note that stop lamp switch input may be applied to the EC-60™ controller using either hardwire input or J1939). Apply and release service brake. Check for brake switch input into ECU (see system wiring schematic). With service brake released, check for presence of the stop lamp bulb. With service brake applied, verify system voltage is now present at the stop lamp switch input to the ECU. Check for damaged wiring between ECU, stop lamp switch and bulb. Check for corroded or damaged connectors. Check for damaged or reversed J1939 wiring. Check for corroded or damaged connectors on J1939 link. Verify presence of engine ECU on the J1939 link. Verify ECU configuration.
2	Stop Lamp Switch Defective	Apply and release service brake. Check for brake switch input into ECU (see system wiring schematic). With service brake released, check for presence of the stop lamp bulb. With service brake applied, verify system voltage is now present at the stop lamp switch input to the ECU. Check for damaged wiring between ECU, stop lamp switch and bulb. Check for corroded or damaged connectors. Check for damaged or reversed J1939 wiring. Check for corroded or damaged connectors on J1939 link. Verify presence of engine ECU on the J1939 link. Verify ECU configuration.
3	ATC Disabled or Dynamometer Test Mode Active	ECU has been placed in the Dynamometer Test Mode by either the diagnostic blink code switch or a hand-held or PC-based diagnostic tool. ATC is disabled.
4	Retarder Relay Open Circuit or Shorted to Ground	Verify vehicle contains a retarder relay. Verify ECU configuration. Check wiring between ECU and retarder relay. Verify no continuity between retarder disable output of EC-60™ controller and ground. Verify condition and wiring of the retarder relay.
5	Retarder Relay Circuit Shorted to Voltage	Check wiring between ECU and retarder relay. Verify no continuity between retarder disable output of EC-60™ controller and voltage. Verify condition and wiring of the retarder relay.
6	ABS Indicator Lamp Circuit Fault	Check operation of diagnostic blink code switch. Check wiring of diagnostic blink code switch, ABS WL, and ABS WL relay (frame ECUs only). Verify ABS WL ground input (cab ECUs only).
7	PMV Common Shorted to Ground	Verify no continuity between the CMN of all PMVs, TCV, and Diff Lock Solenoid and ground. Check for corroded/damaged wiring or connectors between the ECU and CMN of all PMVs, TCV, and Diff Lock Solenoid.
8	PMV Common Shorted to Voltage	Verify no continuity between the CMN of all PMVs, TCV, and Diff Lock Solenoid and voltage. Check for corroded/damaged wiring or connectors between the ECU and CMN of all PMVs, TCV, and Diff Lock Solenoid.
9	ATC Disabled to Prevent Brake Fade	ATC is temporarily disabled to prevent excessive heating of the foundation brakes.
10	Tire Size Out of Range (Front to Rear)	Verify correct tire size as desired. Verify proper tire inflation. Verify correct number of exciter ring teeth. Verify that the ECU has the proper tire size settings.
11	Wheel Speed Sensors Reversed on an Axle	Sensors are reversed (left to right) on one of the axles. Verify proper installation, connection, and wiring of the sensors.
12	Diff. Lock Solenoid Shorted to Ground or Open Circuit	Verify no continuity between the Diff Lock Solenoid and ground. Check for corroded/damaged wiring or connectors between the ECU and Diff Lock Solenoid.
13	Diff. Lock Solenoid Shorted to Voltage	Verify no continuity between the Diff Lock Solenoid and voltage. Check for corroded/damaged wiring or connectors between the ECU and Diff Lock Solenoid.
23	I/O 2 or I/O 3 Shorted High	Check for short circuit condition between voltage and the I/O 2 and I/O 3 circuits

Miscellaneous Troubleshooting

For all tests below, take all measurements at ECU harness connector pins in order to check wire harness and sensor. Probe the connector carefully so that the terminals are not damaged.

Stop Lamp Switch Test

1. With the service brake applied, measure the system voltage (9 to 17 VDC) stop lamp switch input to ECU.

Test	Measurement
Stop Lamp Switch to Ground	9 to 17 VDC

2. Apply and release service brake, does lamp extinguish?
3. Verify brake lamp switch is connected to ECU via hard wire or J1939.
4. With service brake released, check for presence of stop lamp bulb.

Dynamometer Test Mode (ATC Indicator Lamp Continuously Illuminated)

1. Clear the dynamometer test mode by depressing and releasing the blink code switch three times (or use an off-board diagnostic tool).

ABS Indicator Lamp

1. Verify diagnostic blink code switch is open when not activated.

Retarder Relay

1. Measure resistance between retarder disable output of EC-60™ controller and voltage / ground.

Test	Measurement
Retarder disable to Voltage or Ground	Open Circuit (no continuity)

2. Verify vehicle has retarder relay.
3. Verify proper wiring from ECU to retarder relay.

PMV Commons

1. Measure resistance between any common (PMV, TCV, and Diff.) and voltage or ground.

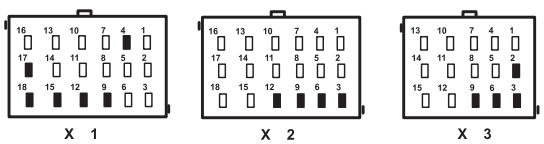
Test	Measurement
Any PMV, TCV, or Diff. Common to Voltage or Ground	Open Circuit (no continuity)

Differential Lock Solenoid

1. Measure resistance between Diff lock solenoid and voltage or ground.

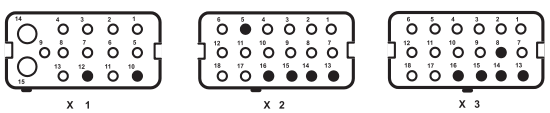
Test	Measurement
Diff. Lock Solenoid to Voltage or Ground	Open Circuit (no continuity)

Cab-mount ECU: Looking into wire harness connector



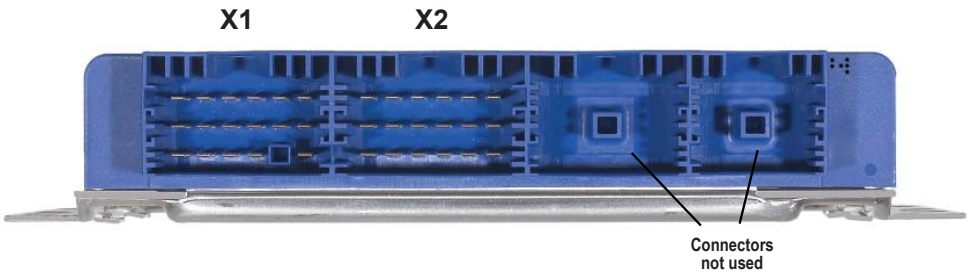
Connector	Pin	PMV Location
X1 18 Way	4	TCV Common
	9	Stop Lamp Switch
	12	ABS WL Ground
	15	ABS WL Interlock
	17	Retarder
	18	ABS WL
X2 18 Way	3	PMV Left Steer Axle Common
	6	PMV Right Steer Axle Common
	9	PMV Right Drive Axle Common
	12	PMV Left Drive Axle Common
X3 15 Way	2	Diff Lock Solenoid
	3	Diff Lock Solenoid Common
	6	PMV Left Additional Axle Common
	9	PMV Right Additional Axle Common

Frame-mount ECU: Looking into wire harness connector



Connector	Pin	PMV Location
X1 18 Way	10	Retarder
	12	ABS WL
X2 18 Way	5	Stop Lamp Switch
	13	PMV Left Steer Axle Common
	14	PMV Right Steer Axle Common
	15	PMV Left Drive Axle Common
	16	PMV Right Drive Axle Common
X3 15 Way	8	Diff. Lock Solenoid
	13	TCV Common
	14	Diff. Lock Solenoid Common
	15	PMV Left Additional Axle Common
	16	PMV Right Additional Axle Common

EC-60™ Controller Wire Harness Connector Part Numbers and Pin Assignments: STANDARD CAB



Standard Cab EC-60™ Controller

Standard cab models utilize two AMP connectors for wire harness connections.

Connector Designation	Number of Contacts	AMP Part Number
X1	17	1718091-1
X2	18	8-968974-1

Standard Cab X1 Connector Pin Assignments

Pin	Designation	Pin	Designation	Pin	Designation
1	Ground	7	J1939 Low	13	J1587 (B)
2	Trailer ABS WL	8	J1939 High	14	J1587 (A)
3	Ignition	**9**	**Not Used**	15	ABS WL Interlock
4	**Not Used**	10	WSS DA Right (+)	16	Battery
5	**Not Used**	11	WSS DA Right (-)	17	Retarder
6	**Not Used**	12	ABS WL Ground	18	ABS WL

Standard Cab X2 Connector Pin Assignments

Pin	Designation	Pin	Designation	Pin	Designation
1	PMV SA Left HLD	7	PMV SA Right REL	13	PMV DA Right REL
2	PMV SA Left REL	8	WSS SA Left (-)	14	WSS SA Right (-)
3	PMV SA Left CMN	9	PMV DA Right CMN	15	WSS DA Left (+)
4	PMV SA Right HLD	10	PMV DA Right HLD	16	PMV DA Left HLD
5	WSS SA Left (+)	11	WSS SA Right (+)	17	PMV DA Left REL
6	PMV SA Right CMN	12	PMV DA Left CMN	18	WSS DA Left (-)

EC-60™ Controller Wire Harness Connector Part Numbers and Pin Assignments: STANDARD FRAME

Standard Frame EC-60™ Controller

Standard frame models utilize two Deutsch connectors for wire harness connections.

Connector Designation	Number of Contacts	Deutsch Part Number
X1	15	DT16-15SA-K003
X2	18	DT16-18SB-K004

Standard Frame X1 Connector Pin Assignments

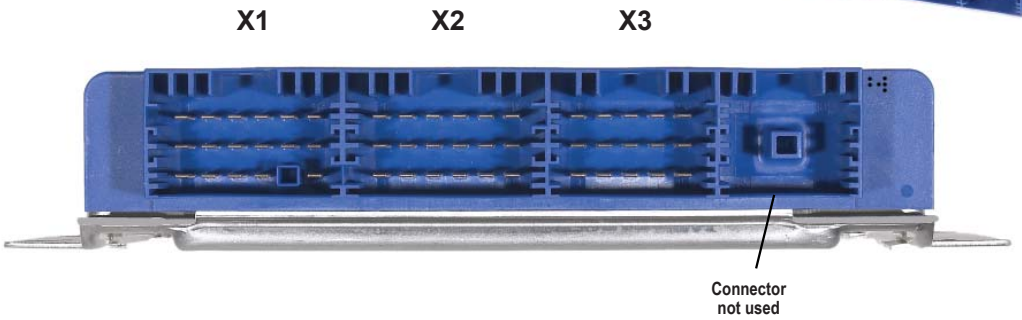
Pin	Designation	Pin	Designation	Pin	Designation
1	J1587 (B)	6	J1939 High	11	Trailer ABS WL
2	J1939 Low	7	WSS SA Left (-)	12	ABS WL
3	WSS SA Left (+)	8	WSS SA Right (-)	**13**	**Not Used**
4	WSS SA Right (+)	9	Ignition	14	Battery
5	J1587 (A)	10	Retarder	15	Ground

Standard Frame X2 Connector Pin Assignments

Pin	Designation	Pin	Designation	Pin	Designation
1	WSS DA Left (+)	7	PMV SA Left HLD	13	PMV SA Left CMN
2	WSS DA Left (-)	8	PMV SA Left REL	14	PMV SA Right CMN
3	WSS DA Right (+)	9	PMV SA Right HLD	15	PMV DA Left CMN
4	WSS DA Right (-)	10	PMV SA Right REL	16	PMV DA Right CMN
5	**Not Used**	11	PMV DA Left HLD	17	PMV DA Right HLD
6	**Not Used**	12	PMV DA Left REL	18	PMV DA Right REL

EC-60™ Controller Wire Harness Connector Part Numbers and Pin Assignments:

PREMIUM CAB



Premium Cab Model EC-60™ Controller

Premium cab models utilize three AMP connectors for wire harness connections.

Connector Designation	Number of Contacts	AMP Part Number
X1	17	1718091-1
X2	18	8-968974-1
X3	15	8-968973-1

Premium Cab X1 Connector Pin Assignments

Pin	Designation	Pin	Designation	Pin	Designation
1	Ground	7	J1939 Low	13	J1587 (B)
2	Trailer ABS WL	8	J1939 High	14	J1587 (A)
3	Ignition	9	SLS	15	ABS WL Interlock
4	TCV CMN	10	WSS DA Right (+)	16	Battery
5	TCV	11	WSS DA Right (-)	17	Retarder
6	ATC Lamp/ATC ORS	12	ABS WL Ground	18	ABS WL

Premium Cab X2 Connector Pin Assignments

Pin	Designation	Pin	Designation	Pin	Designation
1	PMV SA Left HLD	7	PMV SA Right REL	13	PMV DA Right REL
2	PMV SA Left REL	8	WSS SA Left (-)	14	WSS SA Right (-)
3	PMV SA Left CMN	9	PMV DA Right CMN	15	WSS DA Left (+)
4	PMV SA Right HLD	10	PMV DA Right HLD	16	PMV DA Left HLD
5	WSS SA Left (+)	11	WSS SA Right (+)	17	PMV DA Left REL
6	PMV SA Right CMN	12	PMV DA Left CMN	18	WSS DA Left (-)

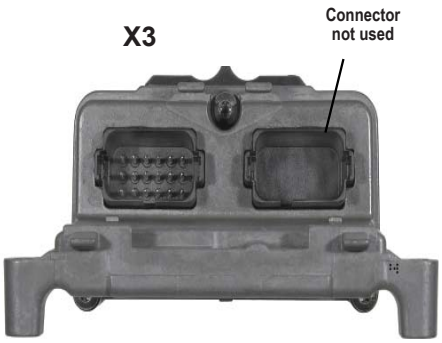
Premium Cab X3 Connector Pin Assignments

Pin	Designation	Pin	Designation	Pin	Designation
1	ABS ORS	6	PMV AA Left CMN	11	WSS AA Left (+)
2	Diff. Lock SOL[1]	7	PMV AA Left REL	12	WSS AA Right (+)
3	Diff. Lock SOL CMN[1]	8	Input/Output 3	13	PMV AA Right REL
4	PMV AA Left HLD	9	PMV AA Right CMN	14	WSS AA Left (-)
5	Input/Output 2	10	PMV AA Right HLD	15	WSS AA Right (-)

[1]AWD vehicles only. (AWD Transfer Case)

EC-60™ Controller Wire Harness Connector Part Numbers and Pin Assignments:

PREMIUM FRAME



Premium Frame Model EC-60™ Controller

Premium frame models utilize three Deutsch connectors for wire harness connections.

Connector Designation	Number of Contacts	Deutsch Part Number
X1	15	DT16-15SA-K003
X2	18	DT16-18SB-K004
X3	18	DT16-18SC-K004

Premium Frame X1 Connector Pin Assignments

Pin	Designation	Pin	Designation	Pin	Designation
1	J1587 (B)	6	J1939 High	11	Trailer ABS WL
2	J1939 Low	7	WSS SA Left (-)	12	ABS WL
3	WSS SA Left (+)	8	WSS SA Right (-)	13	ATC Lamp/ATC ORS
4	WSS SA Right (+)	9	Ignition	14	Battery
5	J1587 (A)	10	Retarder	15	Ground

Premium Frame X2 Connector Pin Assignments

Pin	Designation	Pin	Designation	Pin	Designation
1	WSS DA Left (+)	7	PMV SA Left HLD	13	PMV SA Left CMN
2	WSS DA Left (-)	8	PMV SA Left REL	14	PMV SA Right CMN
3	WSS DA Right (+)	9	PMV SA Right HLD	15	PMV DA Left CMN
4	WSS DA Right (-)	10	PMV SA Right REL	16	PMV DA Right CMN
5	SLS	11	PMV DA Left HLD	17	PMV DA Right HLD
6	ABS ORS	12	PMV DA Left REL	18	PMV DA Right REL

Premium Frame X3 Connector Pin Assignments

Pin	Designation	Pin	Designation	Pin	Designation
1	Input/Output 4	7	TCV	13	TCV CMN
2	Not Used	8	Diff. Lock SOL[1]	14	Diff. Lock SOL CMN[1]
3	WSS AA Left (+)	9	PMV AA Left HLD	15	PMV AA Left CMN
4	WSS AA Left (-)	10	PMV AA Left REL	16	PMV AA Right CMN
5	WSS AA Right (+)	11	Input/Output 2	17	PMV AA Right HLD
6	WSS AA Right (-)	12	Input/Output 3	18	PMV AA Right REL

[1]AWD vehicles only. (AWD Transfer Case)

Troubleshooting: Wiring

ABS/ATC WIRING

CAB ECU Wiring Harness Connectors

The in-cab EC-60™ controllers are designed to interface with AMP MCP 2.8 connectors as referenced in Chart 4. Follow all AMP requirements for the repair of wire harnesses.

All wire harness connectors must be properly seated. The use of secondary locks is strongly advised.

CAUTION: All unused ECU connectors must be covered and receive proper environmental protection.

Frame ECU Wiring Harness Connectors

Frame-mount EC-60™ controllers are designed to interface with Deutsch connectors as referenced in Chart 4.

CAUTION: The frame wire harness connectors must be properly seated with the seals intact (undamaged). All unused connector terminals must be plugged with the appropriate sealing plugs. Failure to properly seat or seal the connectors could result in moisture or corrosion damage to the connector terminals. ECUs damaged by moisture and/or corrosion are not covered under the Bendix warranty. Secondary locks must be snapped securely in place.

Follow all Deutsch requirements for the repair of wire harnesses.

CAUTION: All unused connector terminals must be plugged with the appropriate sealing plugs.

Frame ECU Connector Covers

Frame ECUs are provided with covers that must be removed to permit connection of the vehicle wiring harness. The cover can be removed by sliding the slide lock mechanism to the unlock position.

The covers provide strain relief and connector protection of the vehicle wire harness and will accept round convoluted conduit with an I.D. of 19 mm.

ABS Wiring Requirements

As a matter of good practice and to ensure maximum system robustness, always use the maximum size wire supported by the wire harness connectors for battery, ignition, ground, PMV, TCV, Interaxle Differential Lock and indicator lamp circuits.

All sensor and serial communications circuits (J1587 and J1939) must use twisted pair wiring (one to two twists per inch). See the appropriate SAE document for additional details.

WARNING: All wires must be carefully routed to avoid contact with rotating elements. Wiring must be properly secured approximately every 6 to 12 inches using UV stabilized, non-metallic hose clamps or bow-tie cable ties to prevent pinching, binding or fraying.

It is recommended that wires be routed straight out of a connector for a minimum of three inches before the wire is allowed to bend.

Battery and ground wires should be kept to a minimum length.

If convoluted tubing is used, its I.D. must match the size of the wire bundle as closely as possible.

CAUTION: Wire harness lengths must be carefully selected for the vehicle. Harnesses that are too long increase the possibility of electrical interference and wire damage. Excess lengths of wire are **not** to be wound to form coils, instead re-route, repair or replace wire harness. Do not attempt to stretch harnesses that are too short, since mechanical strain can result in wire breakage.

ABS Component	Connector	Wire Terminal	Wire Seal/ Plug	Terminal Lock	Terminal Crimp Tool
In-Cab Controller Harness 17-Way AMP MCP 2.8 (X1)	 1718091-1	 927768-9 1 - 2.5 mm² X1-12 & 18	N/A	 967634	 539723-2
In-Cab Controller Harness 18-Way AMP MCP 2.8 (X2)	 8-968974-1	 968874 2.5 - 4 mm²	N/A	N/A	
In-Cab Controller Harness 15-Way AMP MCP 2.8 (X3)	 8-968973-1	 968873 1.0 - 2.5 mm²	N/A	N/A	
Frame Controller Harness 15-Way Deutsch (X1)	 DT16-15SA-K003	 0462-203-12XX (Solid) (or alternatively use 1062-12-01) 12 AWG X1- 14 & 15	N/A	N/A	 HDT-48-00
Frame Controller Harness 18-Way Deutsch (X2)	 DT16-18SB-K004	 0462-201-16XX (Solid) (or alternatively use a stamped and formed version: 1062-16-06) 16-18 AWG	N/A	N/A	
Frame Controller Harness 18-Way Deutsch (X3)	 DT16-18SC-K004		N/A	N/A	
ABS Modulator Harness AMP Twist-Lock (Bayonet)	 1-967325-2	 929975-1	N/A	N/A	 539635-1
ATC Modulator Harness AMP Twist-Lock (Bayonet)	 1-967325-3	 929975-1	N/A	N/A	
ABS Modulator Harness 3-pin Packard Metri-Pack 280 Series	 12040977	 12077411	 12015323	 12034145	 12155975

WS-24™ Wheel Speed Sensor Connectors


Packard GT 150 series


Packard Metripack 150.2 series


Deutsch DTM06 series


Packard Metripack 280 series (female)


Packard Metripack 280 series (male)


Deutsch DT04 series


Standard round two pin

CHART 4 - EC-60™ CONTROLLER COMPONENT CONNECTORS

Troubleshooting: Wiring (Continued)

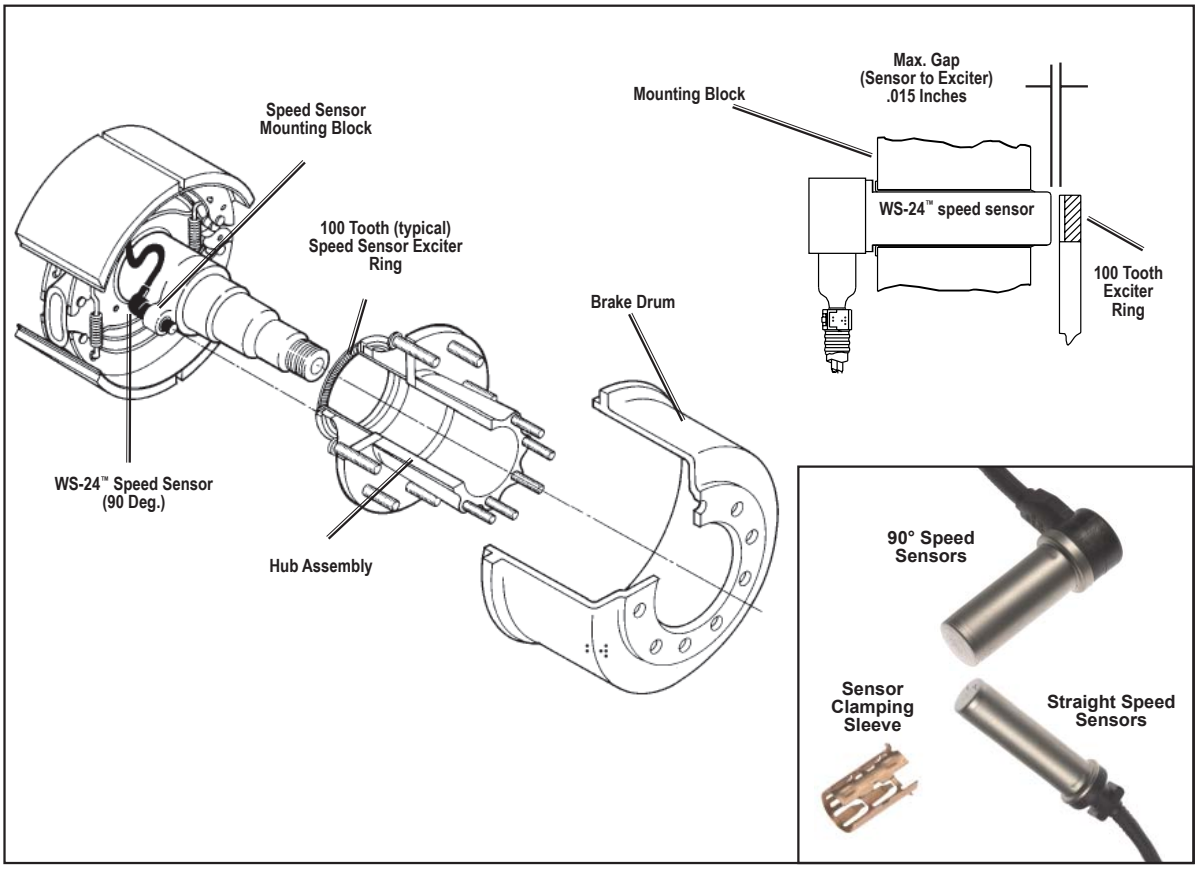


*FIGURE 15 - **WS-24™ WHEEL SPEED SENSOR INSTALLATION***

Wheel Speed Sensor Wiring

Route sensor wiring coming out of the wheel ends away from moving brake components. Sensor wiring needs to be secured to the axle to prevent excess cable length and wiring damage. It is required that cable ties be installed to the sensor wire within 3 inches (76.2 mm) of the sensor head to provide strain relief.

Following the axle, the sensor wires must be attached along the length of the service brake hoses using cable ties with ultraviolet protection and secured every 6 to 8 inches (152 to 203 mm). Sufficient – but not excessive – cable length must be provided to permit full suspension travel and steering axle movement. Install wires so that they cannot touch rotating elements such as wheels, brake discs or drive shafts. Radiation protection may be necessary in the area of brake discs.

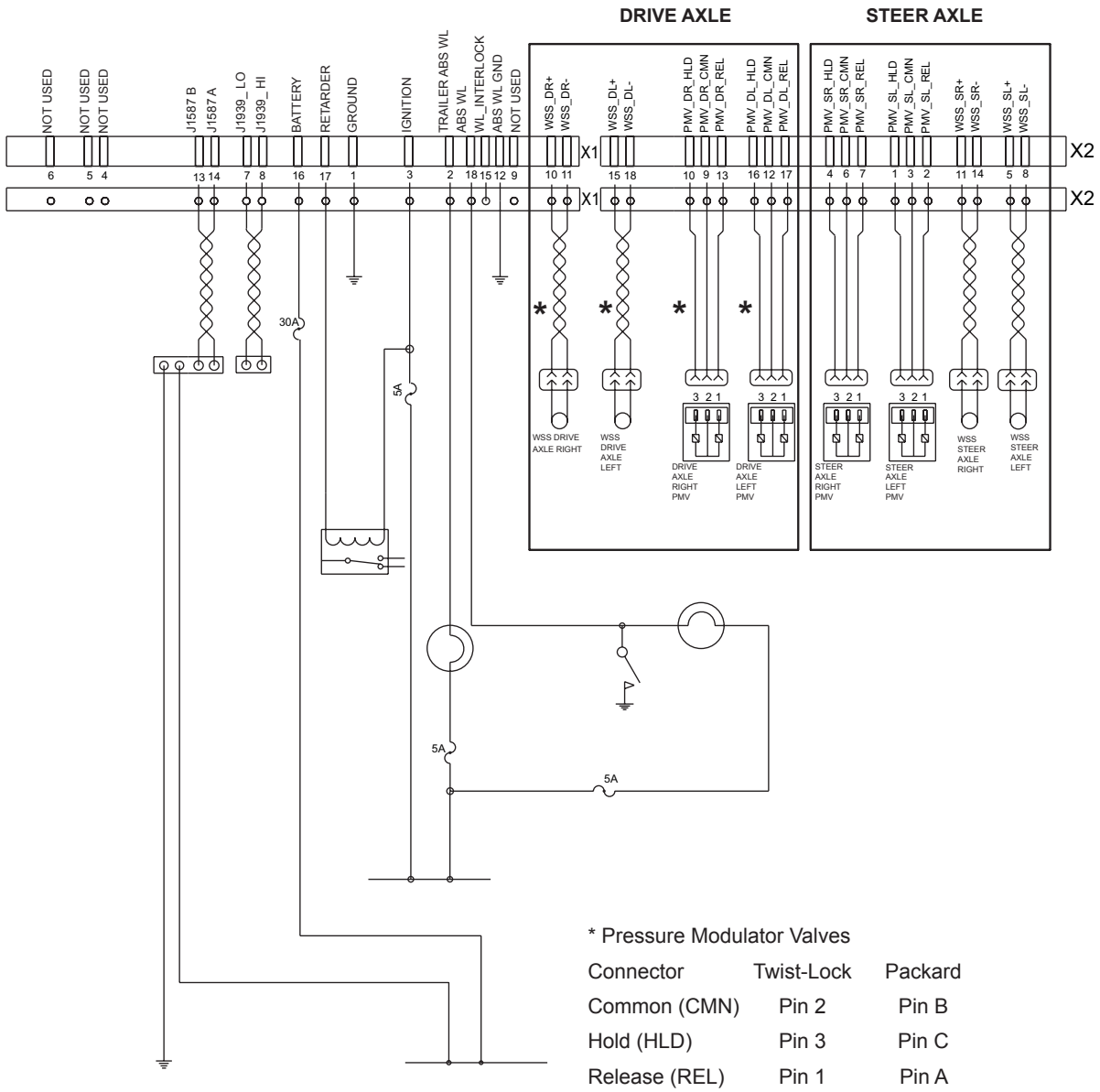
Bendix does not recommend using standard tie-wraps to secure wiring harnesses directly to rubber air lines. This may cause premature wiring failure from the pressure exerted on the wiring when air pressure is applied through the air line. Non-metallic hose clamps or bow-tie tie-wraps are preferred.

The use of grommets or other suitable protection is required whenever the cable must pass through metallic frame members.

All sensor wiring must utilize twisted pair wire, with approximately one to two twists per inch.

It is recommended that wires be routed straight out of a connector for a minimum of three inches before the wire is allowed to bend.

Troubleshooting: Standard Cab Wiring Schematic (4S/4M)



* Pressure Modulator Valves

Connector	Twist-Lock	Packard
Common (CMN)	Pin 2	Pin B
Hold (HLD)	Pin 3	Pin C
Release (REL)	Pin 1	Pin A

FIGURE 16 - STANDARD CAB WIRING SCHEMATIC (4S/4M)

Troubleshooting: Premium Cab Wiring Schematic (6S/6M)

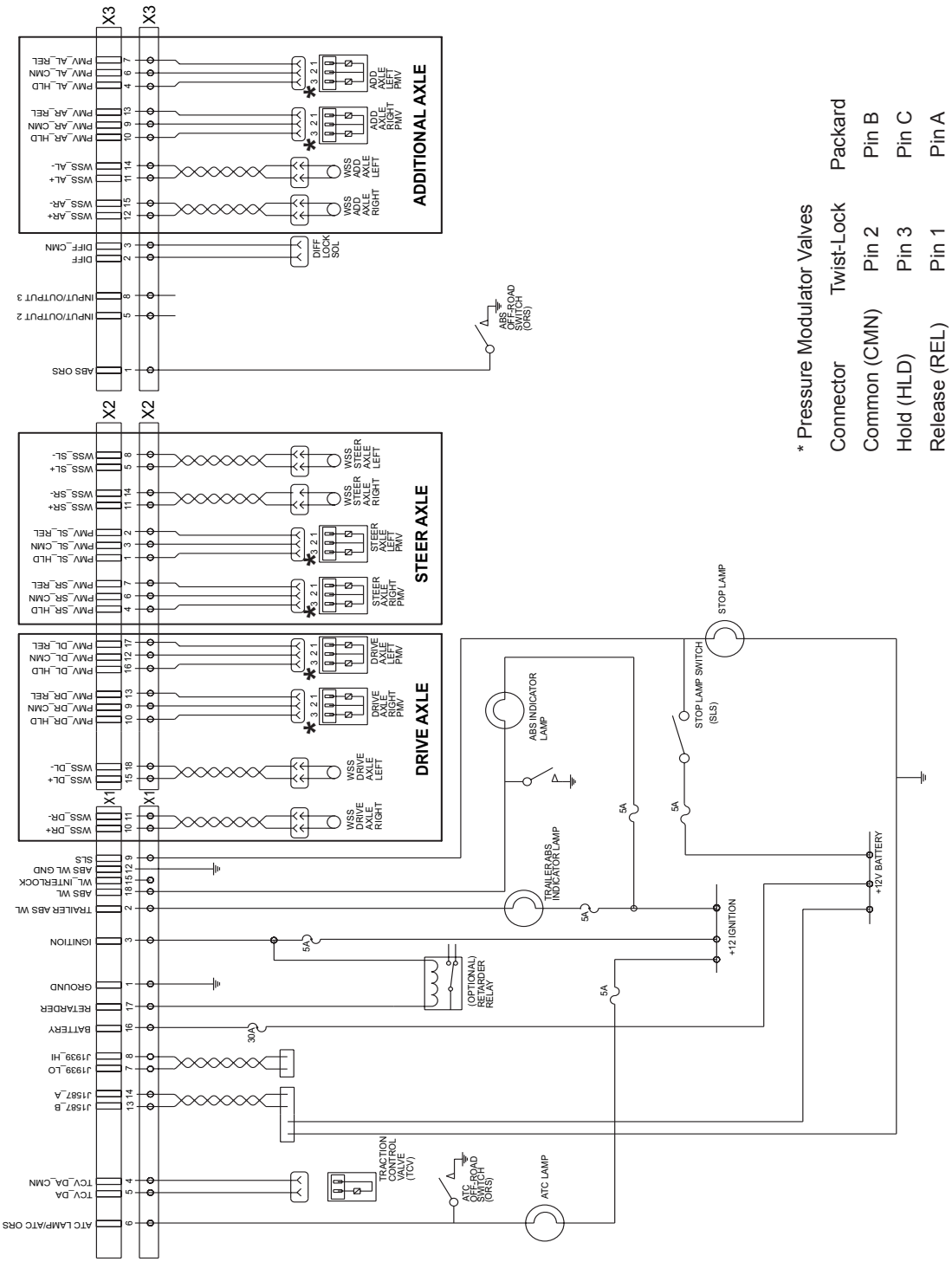


FIGURE 17 - PREMIUM CAB WIRING SCHEMATIC (6S/6M)
36

Troubleshooting: Premium Cab Wiring Schematic (6S/5M)

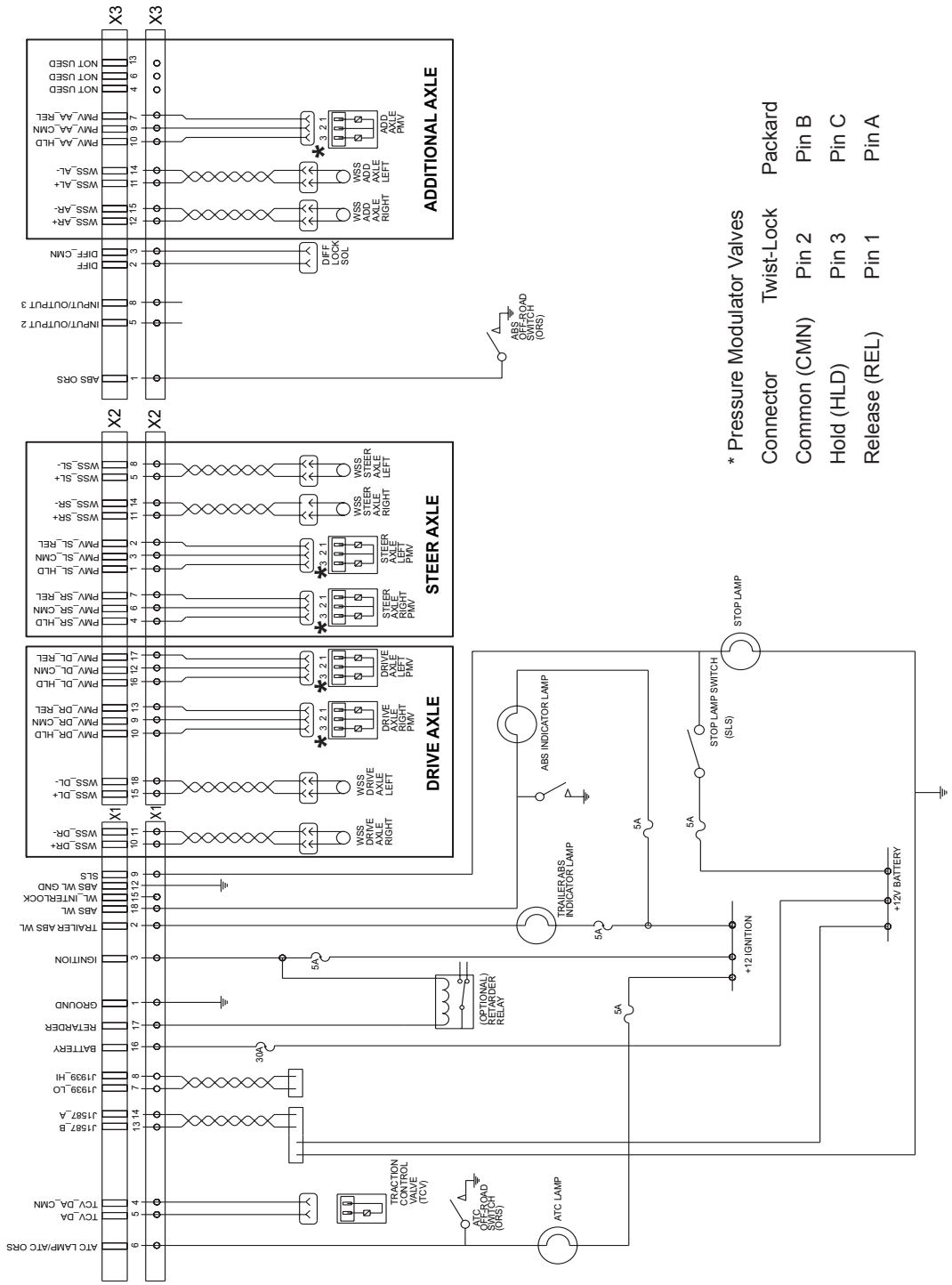
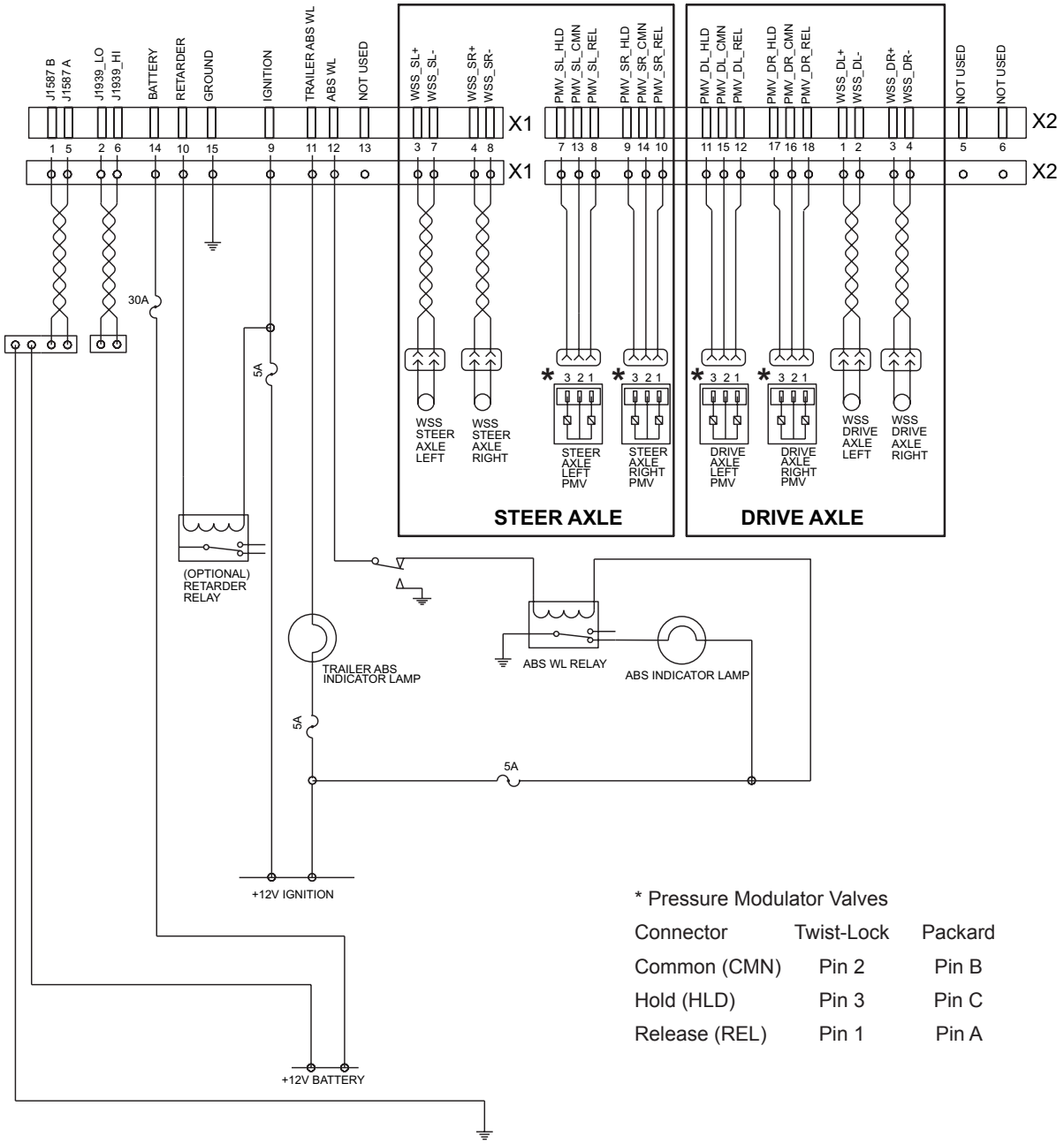


FIGURE 18 - PREMIUM CAB WIRING SCHEMATIC (6S/5M)

Troubleshooting: Standard Frame Wiring Schematic (4S/4M)



* Pressure Modulator Valves

Connector	Twist-Lock	Packard
Common (CMN)	Pin 2	Pin B
Hold (HLD)	Pin 3	Pin C
Release (REL)	Pin 1	Pin A

FIGURE 19 - STANDARD FRAME WIRING SCHEMATIC (4S/4M)
38

Troubleshooting: Premium Frame Wiring Schematic (6S/6M)

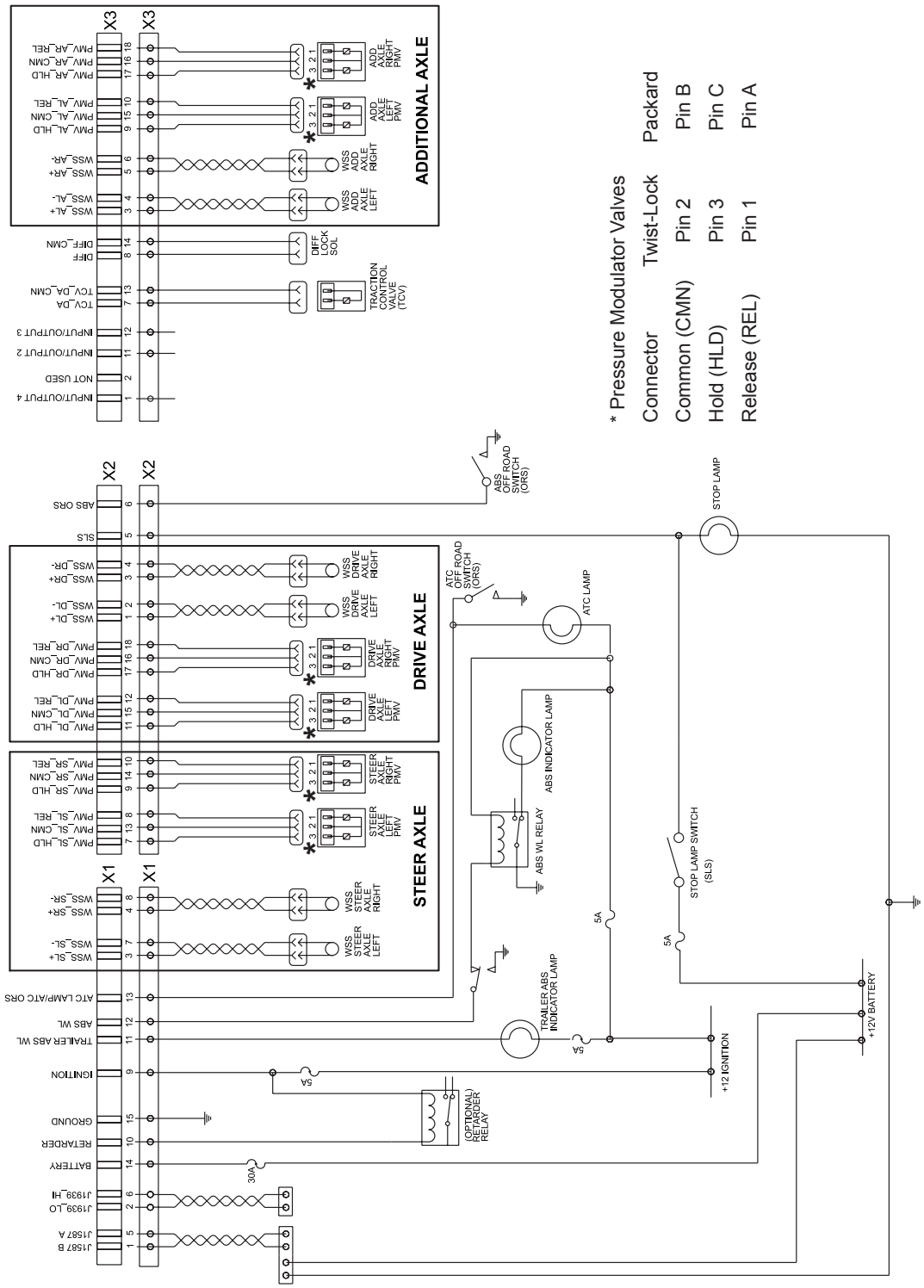


FIGURE 20 - PREMIUM FRAME WIRING SCHEMATIC (6S/6M)

Troubleshooting: Premium Frame Wiring Schematic (6S/5M)

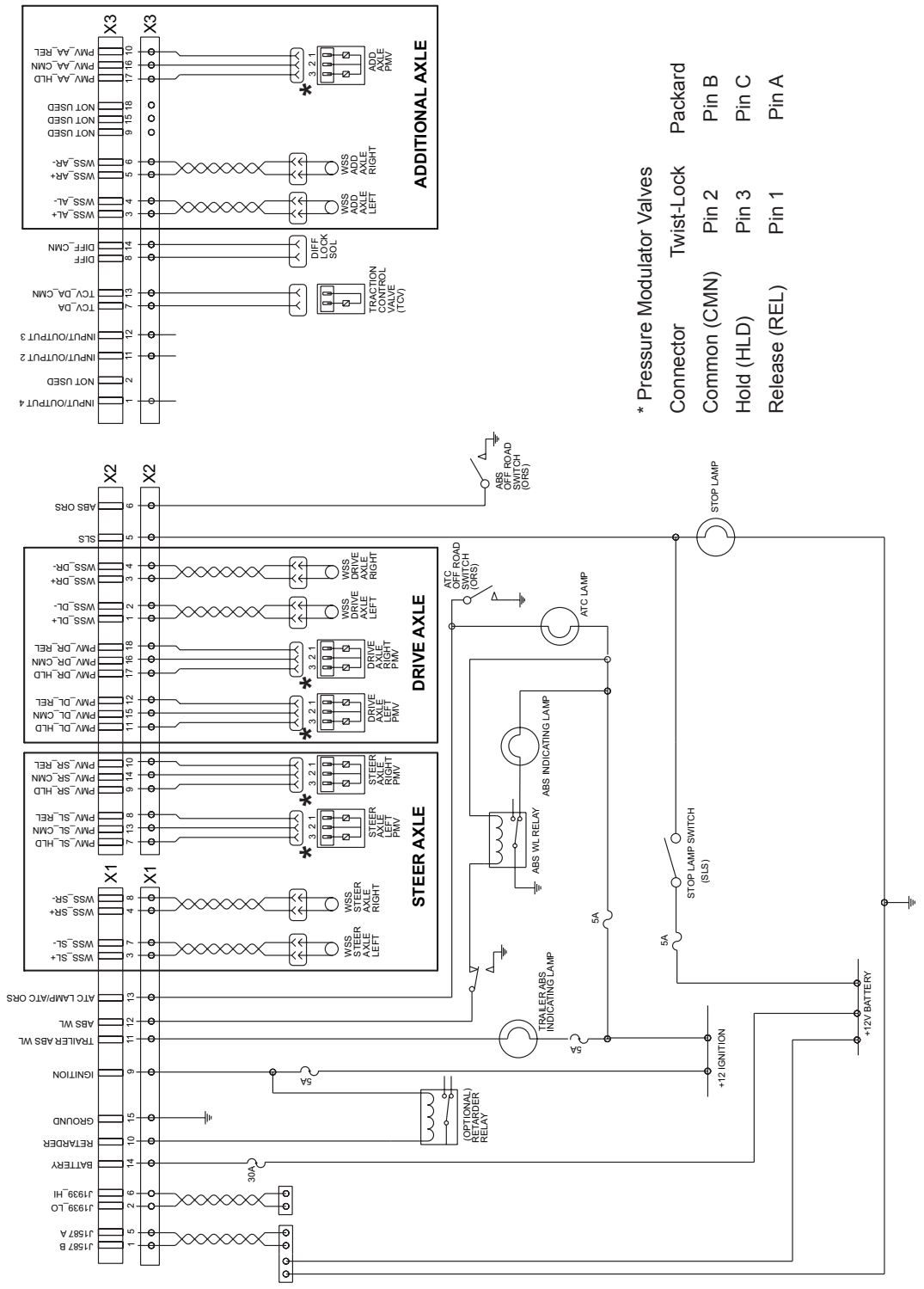


FIGURE 21 - PREMIUM FRAME WIRING SCHEMATIC (6S/5M)
40

Glossary

ABS — Antilock Brake System.

ABS Event — Impending wheel lock situation that causes the ABS controller to activate the modulator valve(s).

ABS Indicator Lamp — An amber lamp which indicates the operating status of an antilock system. When the indicator lamp is on, ABS is disabled and the vehicle reverts to normal brake operation.

Air Gap — Distance between the Sensor and tone ring.

ASR — Automatic Slip Regulation. Another name for traction control.

ATC — Automatic Traction Control. An additional ABS function in which engine torque is controlled and brakes are applied differentially to enhance vehicle traction.

ATC Light — A light that indicates when traction control is operating.

Channel — A controlled wheel site.

CAN — Controller Area Network. J1939 is an SAE version of the CAN link.

Clear Codes — System to erase historical diagnostic trouble codes from the ECU, from either the Diagnostic Switch or from a hand-held diagnostic tool (only repaired diagnostic trouble codes may be cleared).

Configuration — The primary objective is to identify a "normal" set of sensors and modulators for the Electronic Control Unit, so that it will identify future missing sensors and modulators.

Diagnostic Connector — Diagnostic receptacle in vehicle cab for connection of J1587 hand-held or PC based test equipment. The tester can initiate test sequences, and can also read system parameters.

Diagnostic Switch — A switch used to activate blinks codes.

Differential Braking — Application of brake force to a spinning wheel so that torque can be applied to wheels which are not slipping.

ECU — Electronic Control Unit.

Diagnostic Trouble Code — A condition that interferes with the generation or transmission of response or control signals in the vehicle's ABS system that could lead to the functionality of the ABS system becoming inoperable in whole or in part.

FMVSS-121 — Federal Motor Vehicle Safety Standard which regulates air brake systems.

IR — Independent Regulation. A control method in which a wheel is controlled at optimum slip, a point where retardation and stability are maximized. The brake pressure that is best for the wheel in question is directed individually into each brake chamber.

J1587 — The SAE heavy duty standard diagnostic data link.

J1708 — An SAE standard which defines the hardware and software protocol for implementing 9600 baud heavy vehicle data links. J1587 version of a J1708 data link.

J1939 — A high speed 250,000 baud data link used for communications between the ABS ECU engine, transmission and retarders.

MIR — Modified Independent Regulation. A method of controlling the opposite sides of a steer axle during ABS operation so that torque steer and stopping distance are minimized.

PLC — Power Line Carrier. The serial communication protocol used to communicate with the trailer over the blue full time power wire.

PMV — Pressure Modulator Valve. An air valve which is used to vent or block air to the brake chambers to limit or reduce brake torque.

QR — Quick Release. Quick release valves allow faster release of air from the brake chamber after a brake application. To balance the system, quick release valves have hold off springs that produce higher crack pressures (when the valves open).

Relay Valve — Increases the application speed of the service brake. Installed near brakes with larger air chambers (type 24 or 30). The treadle valve activates the relay valve with an air signal. The relay valve then connects its supply port to its delivery ports. Equal length air hose must connect the delivery ports of the relay valve to the brake chambers.

Retarder Relay — A relay which is used to disable a retarder when ABS is triggered.

Sensor Clamping Sleeve — A beryllium copper sleeve which has fingers cut into it. It is pressed between an ABS sensor and mounting hole to hold the sensor in place.

Stored Diagnostic Trouble Codes — A diagnostic trouble code that occurred.

TCS — Traction Control System, another name for ATC or ASR.

Tone Ring — A ring that is usually pressed into a wheel hub that has a series of teeth (usually 100) and provides actuation for the speed sensor. Note maximum run out is .008.

Appendix A: J1587 SID and FMI Codes and Their Bendix Blink Code Equivalents

SID (J1587)	FMI (J1587)	General	Bendix Blink Code Equivalent(s) (1st Digit)	(2nd Digit)	Diagnostic Trouble Code Description
1	1	Wheel Speed Sensor	2	1	SA Left WSS Excessive Air Gap
1	2	Wheel Speed Sensor	2	3	SA Left WSS Open or Shorted
1	7	Wheel Speed Sensor	2	5	SA Left WSS Wheel End
1	8	Wheel Speed Sensor	2	6	SA Left WSS Erratic Sensor Signal
1	10	Wheel Speed Sensor	2	4	SA Left WSS Loss of Sensor Signal
1	13	Wheel Speed Sensor	2	7	SA Left WSS Tire Size Calibration
1	14	Wheel Speed Sensor	2	2	SA Left WSS Output Low @ Drive-Off
2	1	Wheel Speed Sensor	3	1	SA Right WSS Excessive Air Gap
2	2	Wheel Speed Sensor	3	3	SA Right WSS Open or Shorted
2	7	Wheel Speed Sensor	3	5	SA Right WSS Wheel End
2	8	Wheel Speed Sensor	3	6	SA Right WSS Erratic Sensor Signal
2	10	Wheel Speed Sensor	3	4	SA Right WSS Loss of Sensor Signal
2	13	Wheel Speed Sensor	3	7	SA Right WSS Tire Size Calibration
2	14	Wheel Speed Sensor	3	2	SA Right WSS Output Low @ Drive-Off
3	1	Wheel Speed Sensor	4	1	DA Left WSS Excessive Air Gap
3	2	Wheel Speed Sensor	4	3	DA Left WSS Open or Shorted
3	7	Wheel Speed Sensor	4	5	DA Left WSS Wheel End
3	8	Wheel Speed Sensor	4	6	DA Left WSS Erratic Sensor Signal
3	10	Wheel Speed Sensor	4	4	DA Left WSS Loss of Sensor Signal
3	13	Wheel Speed Sensor	4	7	DA Left WSS Tire Size Calibration
3	14	Wheel Speed Sensor	4	2	DA Left WSS Output Low @ Drive-Off
4	1	Wheel Speed Sensor	5	1	DA Right WSS Excessive Air Gap
4	2	Wheel Speed Sensor	5	3	DA Right WSS Open or Shorted
4	7	Wheel Speed Sensor	5	5	DA Right WSS Wheel End
4	8	Wheel Speed Sensor	5	6	DA Right WSS Erratic Sensor Signal
4	10	Wheel Speed Sensor	5	4	DA Right WSS Loss of Sensor Signal
4	13	Wheel Speed Sensor	5	7	DA Right WSS Tire Size Calibration
4	14	Wheel Speed Sensor	5	2	DA Right WSS Output Low @ Drive-Off
5	1	Wheel Speed Sensor	14	1	AA Left WSS Excessive Air Gap
5	2	Wheel Speed Sensor	14	3	AA Left WSS Open or Shorted
5	7	Wheel Speed Sensor	14	5	AA Left WSS Wheel End
5	8	Wheel Speed Sensor	14	6	AA Left WSS Erratic Sensor Signal
5	10	Wheel Speed Sensor	14	4	AA Left WSS Loss of Sensor Signal
5	13	Wheel Speed Sensor	14	7	AA Left WSS Tire Size Calibration
5	13	Wheel Speed Sensor	14	10	AA Left WSS Configuration Error
5	14	Wheel Speed Sensor	14	2	AA Left WSS Output Low @ Drive-Off
6	1	Wheel Speed Sensor	15	1	AA Right WSS Excessive Air Gap
6	2	Wheel Speed Sensor	15	3	AA Right WSS Open or Shorted
6	7	Wheel Speed Sensor	15	5	AA Right WSS Wheel End
6	8	Wheel Speed Sensor	15	6	AA Right WSS Erratic Sensor Signal
6	10	Wheel Speed Sensor	15	4	AA Right WSS Loss of Sensor Signal
6	13	Wheel Speed Sensor	15	7	AA Right WSS Tire Size Calibration
6	13	Wheel Speed Sensor	15	10	AA Right WSS Configuration Error
6	14	Wheel Speed Sensor	15	2	AA Right WSS Output Low @ Drive-Off
7	5	Pressure Modulator Valve	7	7	SA Left PMV CMN Open Circuit
7	13	Pressure Modulator Valve	7	8	SA Left PMV Configuration Error
8	5	Pressure Modulator Valve	8	7	SA Right PMV CMN Open Circuit
8	13	Pressure Modulator Valve	8	8	SA Right PMV Configuration Error
9	5	Pressure Modulator Valve	9	7	DA Left PMV CMN Open Circuit
9	13	Pressure Modulator Valve	9	8	DA Left PMV Configuration Error
10	5	Pressure Modulator Valve	10	7	DA Right PMV CMN Open Circuit
10	13	Pressure Modulator Valve	10	8	DA Right PMV Configuration Error
11	5	Pressure Modulator Valve	16	7	AA Left PMV CMN Open Circuit
11	13	Pressure Modulator Valve	16	8	AA Left PMV Configuration Error
12	5	Pressure Modulator Valve	17	7	AA Right PMV CMN Open Circuit
12	13	Pressure Modulator Valve	17	8	AA Right PMV Configuration Error
13	2	Miscellaneous	12	4	Retarder Relay Open Circuit or Shorted to Ground
13	3	Miscellaneous	12	5	Retarder Relay Circuit Shorted to Voltage
17	14	Miscellaneous	12	3	ATC Disabled or Dynamometer Test Mode Active
17	14	Miscellaneous	12	9	ATC Disabled to Prevent Brake Fade
18	13	TCV	18	4	TCV Configuration Error
18	3	TCV	18	2	TCV Solenoid Shorted to Voltage
18	4	TCV	18	1	TCV Solenoid Shorted to Ground
18	5	TCV	18	3	TCV Solenoid Open Circuit
22	7	Miscellaneous	12	11	Wheel Speed Sensors Reversed on an Axle
23	2	Miscellaneous	12	6	ABS Warning Lamp Circuit

SID (J1587)	FMI (J1587)	General	Bendix Blink Code Equivalent(s) (1st Digit)	(2nd Digit)	Diagnostic Trouble Code Description
42	3	Pressure Modulator Valve	7	5	SA Left PMV HLD Solenoid Shorted to Voltage
42	4	Pressure Modulator Valve	7	4	SA Left PMV HLD Solenoid Shorted to Ground
42	5	Pressure Modulator Valve	7	6	SA Left PMV HLD Solenoid Open Circuit
43	3	Pressure Modulator Valve	8	5	SA Right PMV HLD Solenoid Shorted to Voltage
43	4	Pressure Modulator Valve	8	4	SA Right PMV HLD Solenoid Shorted to Ground
43	5	Pressure Modulator Valve	8	6	SA Right PMV HLD Solenoid Open Circuit
44	3	Pressure Modulator Valve	9	5	DA Left PMV HLD Solenoid Shorted to Voltage
44	4	Pressure Modulator Valve	9	4	DA Left PMV HLD Solenoid Shorted to Ground
44	5	Pressure Modulator Valve	9	6	DA Left PMV HLD Solenoid Open Circuit
45	3	Pressure Modulator Valve	10	5	DA Right PMV HLD Solenoid Shorted to Voltage
45	4	Pressure Modulator Valve	10	4	DA Right PMV HLD Solenoid Shorted to Ground
45	5	Pressure Modulator Valve	10	6	DA Right PMV HLD Solenoid Open Circuit
46	3	Pressure Modulator Valve	16	5	AA Left PMV HLD Solenoid Shorted to Voltage
46	4	Pressure Modulator Valve	16	4	AA Left PMV HLD Solenoid Shorted to Ground
46	5	Pressure Modulator Valve	16	6	AA Left PMV HLD Solenoid Open Circuit
47	3	Pressure Modulator Valve	17	5	AA Right PMV HLD Solenoid Shorted to Voltage
47	4	Pressure Modulator Valve	17	4	AA Right PMV HLD Solenoid Shorted to Ground
47	5	Pressure Modulator Valve	17	6	AA Right PMV HLD Solenoid Open Circuit
48	3	Pressure Modulator Valve	7	2	SA Left PMV REL Solenoid Shorted to Voltage
48	4	Pressure Modulator Valve	7	1	SA Left PMV REL Solenoid Shorted to Ground
48	5	Pressure Modulator Valve	7	3	SA Left PMV REL Solenoid Open Circuit
49	3	Pressure Modulator Valve	8	2	SA Right PMV REL Solenoid Shorted to Voltage
49	4	Pressure Modulator Valve	8	1	SA Right PMV REL Solenoid Shorted to Ground
49	5	Pressure Modulator Valve	8	3	SA Right PMV REL Solenoid Open Circuit
50	3	Pressure Modulator Valve	9	2	DA Left PMV REL Solenoid Shorted to Voltage
50	4	Pressure Modulator Valve	9	1	DA Left PMV REL Solenoid Shorted to Ground
50	5	Pressure Modulator Valve	9	3	DA Left PMV REL Solenoid Open Circuit
51	3	Pressure Modulator Valve	10	2	DA Right PMV REL Solenoid Shorted to Voltage
51	4	Pressure Modulator Valve	10	1	DA Right PMV REL Solenoid Shorted to Ground
51	5	Pressure Modulator Valve	10	3	DA Right PMV REL Solenoid Open Circuit
52	3	Pressure Modulator Valve	16	2	AA Left PMV REL Solenoid Shorted to Voltage
52	4	Pressure Modulator Valve	16	1	AA Left PMV REL Solenoid Shorted to Ground
52	5	Pressure Modulator Valve	16	3	AA Left PMV REL Solenoid Open Circuit
53	3	Pressure Modulator Valve	17	2	AA Right PMV REL Solenoid Shorted to Voltage
53	4	Pressure Modulator Valve	17	1	AA Right PMV REL Solenoid Shorted to Ground
53	5	Pressure Modulator Valve	17	3	AA Right PMV REL Solenoid Open Circuit
55	2	Miscellaneous	12	2	Stop Lamp Switch Defective
55	7	Miscellaneous	12	1	Stop Lamp Switch Not Detected
79	13	Miscellaneous	12	10	Tire Size Out of Range (Front to Rear)
93	3	Miscellaneous	12	8	PMV/TCV/Diff Lock Common Shorted to Voltage
93	4	Miscellaneous	12	7	PMV/TCV/Diff Lock Common Shorted to Ground
102	3	Miscellaneous	12	13	Diff Lock Solenoid Shorted to Voltage
102	5	Miscellaneous	12	12	Diff Lock Solenoid Shorted to Ground or Open Circuit
154	13	Miscellaneous	12	23	I/O 2 or I/O 3 Shorted High
231	2	J1939	11	3	J1939 Engine Communications
231	12	J1939	11	1	J1939 Serial Link
231	14	J1939	11	2	J1939 Retarder
251	2	Power Supply	6	8	Input Voltage Has Excessive Noise (Temp)
251	3	Power Supply	6	2	Battery Voltage Too High
251	3	Power Supply	6	6	Ignition Voltage Too High
251	4	Power Supply	6	1	Battery Voltage Too Low
251	4	Power Supply	6	3	Battery Voltage Too Low During ABS
251	4	Power Supply	6	5	Ignition Voltage Too Low
251	4	Power Supply	6	7	Ignition Voltage Too Low During ABS
251	5	Power Supply	6	4	Battery Voltage Input Open Circuit
251	14	Power Supply	6	9	Input Voltage Has Excessive Noise
254	2	ECU	13	4	ECU (12)
254	2	ECU	13	5	ECU (13)
254	2	ECU	13	7	ECU (15)
254	12	ECU	13	2	ECU (10)
254	12	ECU	13	3	ECU (11)
254	12	ECU	13	6	ECU (14)
254	12	ECU	13	10	ECU (18)
254	12	ECU	13	11	ECU (1A)
254	12	ECU	13	12	ECU (1B)
254	12	ECU	13	13	ECU (80)
254	13	ECU	13	8	ECU (16)
254	13	ECU	13	9	ECU (17)

Bendix®

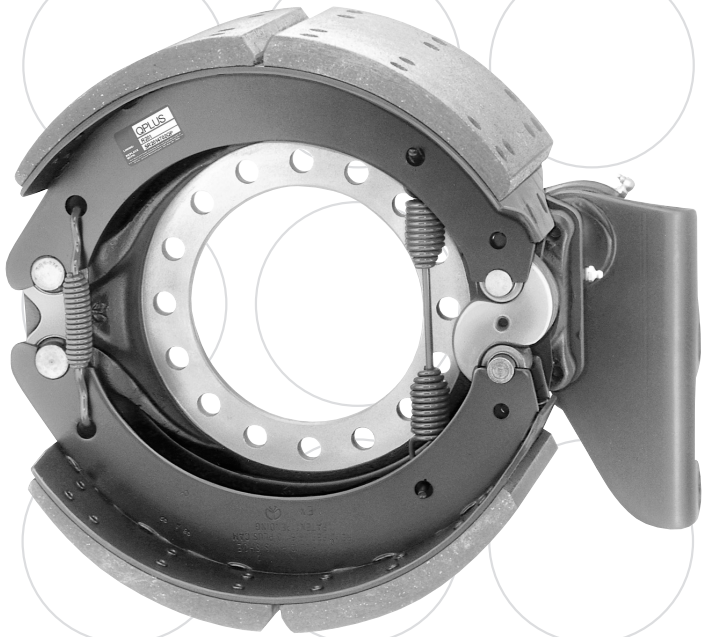
MERITOR®

Maintenance Manual 4

Cam Brakes and Automatic Slack Adjusters

Supersedes Maintenance Manual 4B, Automatic Slack Adjusters

Revised 07-06



Service Notes

About This Manual

This manual provides maintenance and service information for Meritor cam brakes and automatic slack adjuster.

Before You Begin

1. Read and understand all instructions and procedures before you begin to service components.
2. Read and observe all Warning and Caution hazard alert messages in this publication. They provide information that can help prevent serious personal injury, damage to components, or both.
3. Follow your company's maintenance and service, installation, and diagnostics guidelines.
4. Use special tools when required to help avoid serious personal injury and damage to components.

Important Information

Meritor automatic slack adjusters (ASAs) should not need to be manually adjusted in service. ASAs should not have to be adjusted to correct excessive push rod stroke. The excessive stroke may be an indication that a problem exists with the foundation brake, ASA, brake actuator or other system components.

Meritor recommends troubleshooting the problem, replacing suspect components and then confirming proper brake operation prior to returning the vehicle into service.

In the event that a manual adjustment must be made (although not a common practice), a service appointment and full foundation brake, ASA, and other system component inspection should be conducted as soon as possible to ensure integrity of the overall brake system.

For Meritor brake adjustment, refer to the brake adjustment tables in this manual. For non-Meritor brake adjusters, refer to the brake manufacturer's service procedures.

Hazard Alert Messages and Torque Symbols

⚠ WARNING

A Warning alerts you to an instruction or procedure that you must follow exactly to avoid serious personal injury and damage to components.

⚠ CAUTION

A Caution alerts you to an instruction or procedure that you must follow exactly to avoid damage to components.

This symbol alerts you to tighten fasteners to a specified torque value.

How to Obtain Product and Service Information

On the Web

Visit Literature on Demand at meritorhvs.com to access product, service, aftermarket, and warranty literature for ArvinMeritor's truck, trailer and specialty vehicle components.

ArvinMeritor's Customer Service Center

Call ArvinMeritor's Customer Service Center at 800-535-5560.

Technical Electronic Library DVD

The DriveTrain Plus™ by ArvinMeritor Technical Electronic Library DVD contains product and service information for most Meritor and Meritor WABCO products. Specify TP-9853.

How to Obtain Tools, Supplies and Brake Service Kits

Call ArvinMeritor's Commercial Vehicle Aftermarket at 888-725-9355 to obtain Meritor tools and supplies.

Contents

Contents

Asbestos and Non-Asbestos Fibers

⚠ ASBESTOS FIBERS WARNING

The following procedures for servicing brakes are recommended to reduce exposure to asbestos fiber dust, a cancer and lung disease hazard. Material Safety Data Sheets are available from ArvinMeritor.

Hazard Summary

Because some brake linings contain asbestos, workers who service brakes must understand the potential hazards of asbestos and precautions for reducing risks. Exposure to airborne asbestos dust can cause serious and possibly fatal diseases, including asbestosis (a chronic lung disease) and cancer, principally lung cancer and mesothelioma (a cancer of the lining of the chest or abdominal cavities). Some studies show that the risk of lung cancer among persons who smoke and who are exposed to asbestos is much greater than the risk for non-smokers. Symptoms of these diseases may not become apparent for 15, 20 or more years after the first exposure to asbestos.

Accordingly, workers must use caution to avoid creating and breathing dust when servicing brakes. Specific recommended work practices for reducing exposure to asbestos dust follow. Consult your employer for more details.

Recommended Work Practices

1. Separate Work Areas. Whenever feasible, service brakes in a separate area away from other operations to reduce risks to unprotected persons. OSHA has set a maximum allowable level of exposure for asbestos of 0.1 f/cc as an 8-hour time-weighted average and 1.0 f/cc averaged over a 30-minute period. Scientists disagree, however, to what extent adherence to the maximum allowable exposure levels will eliminate the risk of disease that can result from inhaling asbestos dust. OSHA requires that the following sign be posted at the entrance to areas where exposures exceed either of the maximum allowable levels:

DANGER: ASBESTOS
CANCER AND LUNG DISEASE HAZARD
AUTHORIZED PERSONNEL ONLY
RESPIRATORS AND PROTECTIVE CLOTHING
ARE REQUIRED IN THIS AREA.

2. Respiratory Protection. Wear a respirator equipped with a high-efficiency (HEPA) filter approved by NIOSH or MSHA for use with asbestos at all times when servicing brakes, beginning with the removal of the wheels.

3. Procedures for Servicing Brakes.

a. Enclose the brake assembly within a negative pressure enclosure. The enclosure should be equipped with a HEPA vacuum and worker arm sleeves. With the enclosure in place, use the HEPA vacuum to loosen and vacuum residue from the brake parts.

b. As an alternative procedure, use a catch basin with water and a biodegradable, non-phosphate, water-based detergent to wash the brake drum or rotor and other brake parts. The solution should be applied with low pressure to prevent dust from becoming airborne. Allow the solution to flow between the brake drum and the brake support or the brake rotor and caliper. The wheel hub and brake assembly components should be thoroughly wetted to suppress dust before the brake shoes or brake pads are removed. Wipe the brake parts clean with a cloth.

c. If an enclosed vacuum system or brake washing equipment is not available, employers may adopt their own written procedures for servicing brakes, provided that the exposure levels associated with the employer's procedures do not exceed the levels associated with the enclosed vacuum system or brake washing equipment. Consult OSHA regulations for more details.

d. Wear a respirator equipped with a HEPA filter approved by NIOSH or MSHA for use with asbestos when grinding or machining brake linings. In addition, do such work in an area with a local exhaust ventilation system equipped with a HEPA filter.

e. **NEVER** use compressed air by itself, dry brushing, or a vacuum not equipped with a HEPA filter when cleaning brake parts or assemblies. **NEVER** use carcinogenic solvents, flammable solvents, or solvents that can damage brake components as wetting agents.

4. Cleaning Work Areas. Clean work areas with a vacuum equipped with a HEPA filter or by wet wiping. **NEVER** use compressed air or dry sweeping to clean work areas. When you empty vacuum cleaners and handle used rags, wear a respirator equipped with a HEPA filter approved by NIOSH or MSHA for use with asbestos. When you replace a HEPA filter, wet the filter with a fine mist of water and dispose of the used filter with care.

5. Worker Clean-Up**.** After servicing brakes, wash your hands before you eat, drink or smoke. Shower after work. Do not wear work clothes home. Use a vacuum equipped with a HEPA filter to vacuum work clothes after they are worn. Launder them separately. Do not shake or use compressed air to remove dust from work clothes.

6. Waste Disposal. Dispose of discarded linings, used rags, cloths and HEPA filters with care, such as in sealed plastic bags. Consult applicable EPA, state and local regulations on waste disposal.

Regulatory Guidance

References to OSHA, NIOSH, MSHA, and EPA, which are regulatory agencies in the United States, are made to provide further guidance to employers and workers employed within the United States. Employers and workers employed outside of the United States should consult the regulations that apply to them for further guidance.

⚠ NON-ASBESTOS FIBERS WARNING

The following procedures for servicing brakes are recommended to reduce exposure to non-asbestos fiber dust, a cancer and lung disease hazard. Material Safety Data Sheets are available from ArvinMeritor.

Hazard Summary

Most recently manufactured brake linings do not contain asbestos fibers. These brake linings may contain one or more of a variety of ingredients, including glass fibers, mineral wool, aramid fibers, ceramic fibers and silica that can present health risks if inhaled. Scientists disagree on the extent of the risks from exposure to these substances. Nonetheless, exposure to silica dust can cause silicosis, a non-cancerous lung disease. Silicosis gradually reduces lung capacity and efficiency and can result in serious breathing difficulty. Some scientists believe other types of non-asbestos fibers, when inhaled, can cause similar diseases of the lung. In addition, silica dust and ceramic fiber dust are known to the State of California to cause lung cancer. U.S. and international agencies have also determined that dust from mineral wool, ceramic fibers and silica are potential causes of cancer.

Accordingly, workers must use caution to avoid creating and breathing dust when servicing brakes. Specific recommended work practices for reducing exposure to non-asbestos dust follow. Consult your employer for more details.

Recommended Work Practices

1. Separate Work Areas. Whenever feasible, service brakes in a separate area away from other operations to reduce risks to unprotected persons.

2. Respiratory Protection. OSHA has set a maximum allowable level of exposure for silica of 0.1 mg/m^3 as an 8-hour time-weighted average. Some manufacturers of non-asbestos brake linings recommend that exposures to other ingredients found in non-asbestos brake linings be kept below 1.0 f/cc as an 8-hour time-weighted average. Scientists disagree, however, to what extent adherence to these maximum allowable exposure levels will eliminate the risk of disease that can result from inhaling non-asbestos dust.

Therefore, wear respiratory protection at all times during brake servicing, beginning with the removal of the wheels. Wear a respirator equipped with a high-efficiency (HEPA) filter approved by NIOSH or MSHA, if the exposure levels may exceed OSHA or manufacturers' recommended maximum levels. Even when exposures are expected to be within the maximum allowable levels, wearing such a respirator at all times during brake servicing will help minimize exposure.

3. Procedures for Servicing Brakes.

a. Enclose the brake assembly within a negative pressure enclosure. The enclosure should be equipped with a HEPA vacuum and worker arm sleeves. With the enclosure in place, use the HEPA vacuum to loosen and vacuum residue from the brake parts.

b. As an alternative procedure, use a catch basin with water and a biodegradable, non-phosphate, water-based detergent to wash the brake drum or rotor and other brake parts. The solution should be applied with low pressure to prevent dust from becoming airborne. Allow the solution to flow between the brake drum and the brake support or the brake rotor and caliper. The wheel hub and brake assembly components should be thoroughly wetted to suppress dust before the brake shoes or brake pads are removed. Wipe the brake parts clean with a cloth.

c. If an enclosed vacuum system or brake washing equipment is not available, carefully clean the brake parts in the open air. Wet the parts with a solution applied with a pump-spray bottle that creates a fine mist. Use a solution containing water, and, if available, a biodegradable, non-phosphate, water-based detergent. The wheel hub and brake assembly components should be thoroughly wetted to suppress dust before the brake shoes or brake pads are removed. Wipe the brake parts clean with a cloth.

d. Wear a respirator equipped with a HEPA filter approved by NIOSH or MSHA when grinding or machining brake linings. In addition, do such work in an area with a local exhaust ventilation system equipped with a HEPA filter.

e. **NEVER** use compressed air by itself, dry brushing, or a vacuum not equipped with a HEPA filter when cleaning brake parts or assemblies. **NEVER** use carcinogenic solvents, flammable solvents, or solvents that can damage brake components as wetting agents.

4. Cleaning Work Areas. Clean work areas with a vacuum equipped with a HEPA filter or by wet wiping. **NEVER** use compressed air or dry sweeping to clean work areas. When you empty vacuum cleaners and handle used rags, wear a respirator equipped with a HEPA filter approved by NIOSH or MSHA, to minimize exposure. When you replace a HEPA filter, wet the filter with a fine mist of water and dispose of the used filter with care.

5. Worker Clean-Up. After servicing brakes, wash your hands before you eat, drink or smoke. Shower after work. Do not wear work clothes home. Use a vacuum equipped with a HEPA filter to vacuum work clothes after they are worn. Launder them separately. Do not shake or use compressed air to remove dust from work clothes.

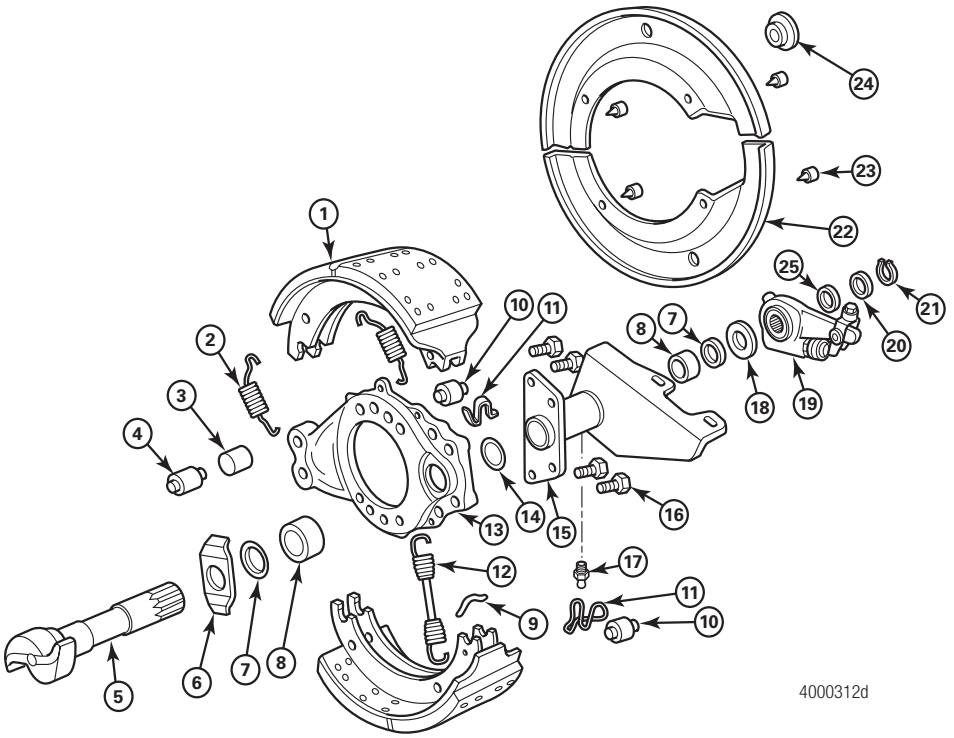
6. Waste Disposal**.** Dispose of discarded linings, used rags, cloths and HEPA filters with care, such as in sealed plastic bags. Consult applicable EPA, state and local regulations on waste disposal.

Regulatory Guidance

References to OSHA, NIOSH, MSHA, and EPA, which are regulatory agencies in the United States, are made to provide further guidance to employers and workers employed within the United States. Employers and workers employed outside of the United States should consult the regulations that apply to them for further guidance.

1 Exploded Views

15- and 16.5-Inch Q Plus™ and Q Series Cam Brakes with Cast Spiders

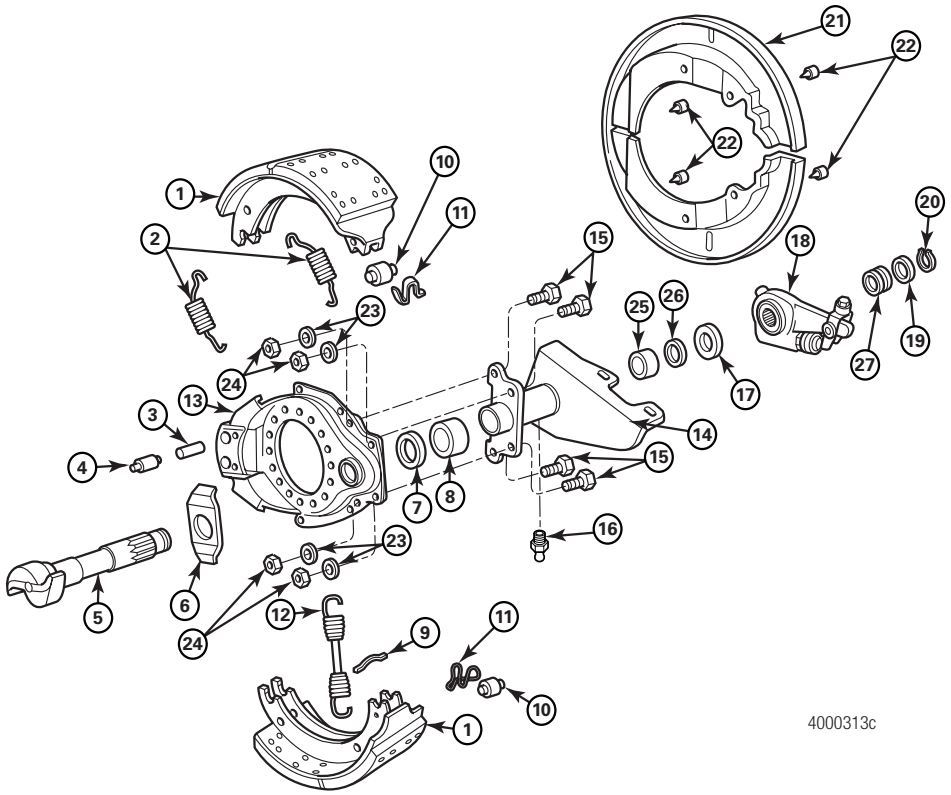


Item	Description
1	Shoe and Lining Assembly
2	Shoe Retaining Spring
3	Anchor Pin Bushing
4	Brake Shoe Anchor Pin
5	"S" Head Camshaft
6	Cam Head Washer
7	Camshaft Grease Seal
8	Camshaft Bushing
9	Return Spring Pin
10	Brake Shoe Roller
11	Shoe Roller Retainer
12	Brake Shoe Return Spring
13	Cast Brake Spider
14	Chamber Bracket Seal
15	Camshaft and Chamber Bracket

Item	Description
16	Chamber Bracket Capscrew
17	Grease Fitting
18	Thick Camshaft Thrust Washer
19	Automatic Slack Adjuster
20	Thick Camshaft Spacing Washer
21	Camshaft Snap Ring
22	Dust Shield
23	Dust Shield Capscrew
24	Plug
25	Thin Camshaft Spacing Washer

1 Exploded Views

16.5-Inch Q Plus™ Cam Brake with Stamped Spiders

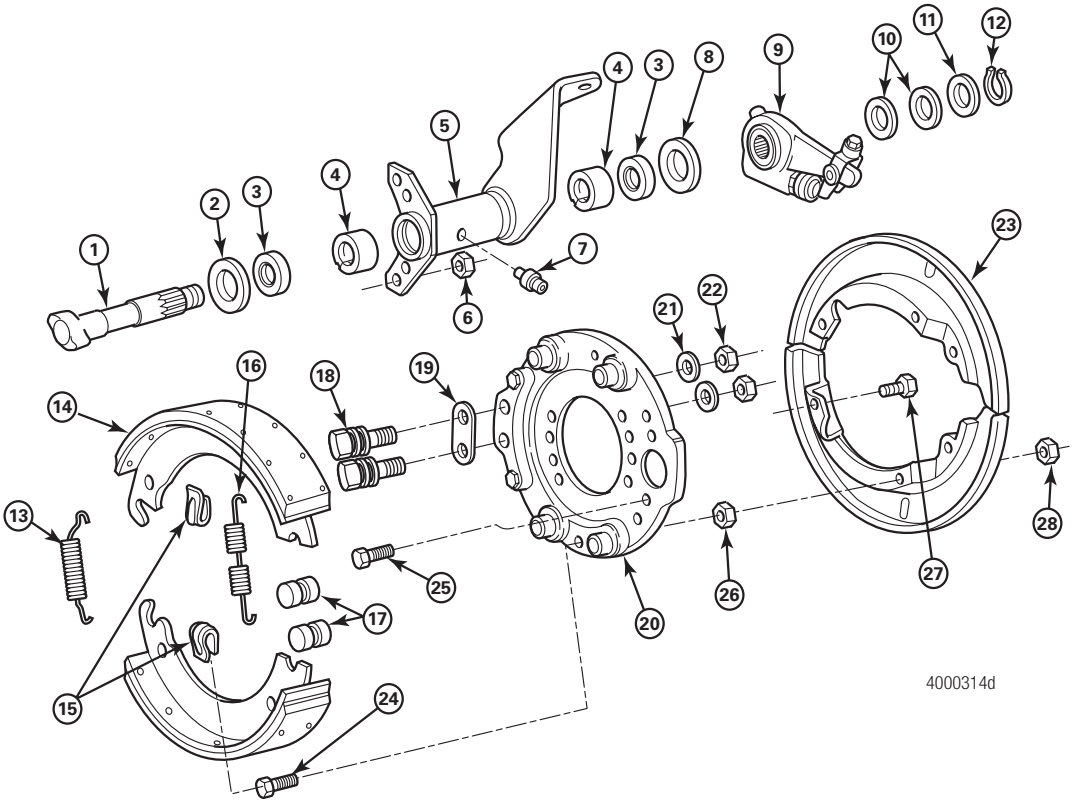


Item	Description
1	Shoe and Lining Assembly
2	Shoe Retaining Spring
3	Anchor Pin Bushing
4	Brake Shoe Anchor Pin
5	"S" Head Camshaft
6	Cam Head Washer
7	Camshaft Seal
8	Camshaft Bushing
9	Return Spring Pin
10	Brake Shoe Roller
11	Shoe Roller Retainer
12	Brake Shoe Return Spring
13	Stamped Brake Spider
14	Camshaft and Chamber Bracket

Item	Description
15	Grade 8 Capscrew
16	Grease Fitting
17	Thick Camshaft Thrust Washer
18	Automatic Slack Adjuster
19	Thick Camshaft Spacing Washer
20	Camshaft Snap Ring
21	Dust Shield
22	Dust Shield Capscrew
23	Hard Washer (4)
24	Grade 8 Nut (4)
25	Camshaft Bushing
26	Camshaft Seal
27	Thin Camshaft Spacing Washer

1 Exploded Views

15-Inch Q Series Cam Brakes

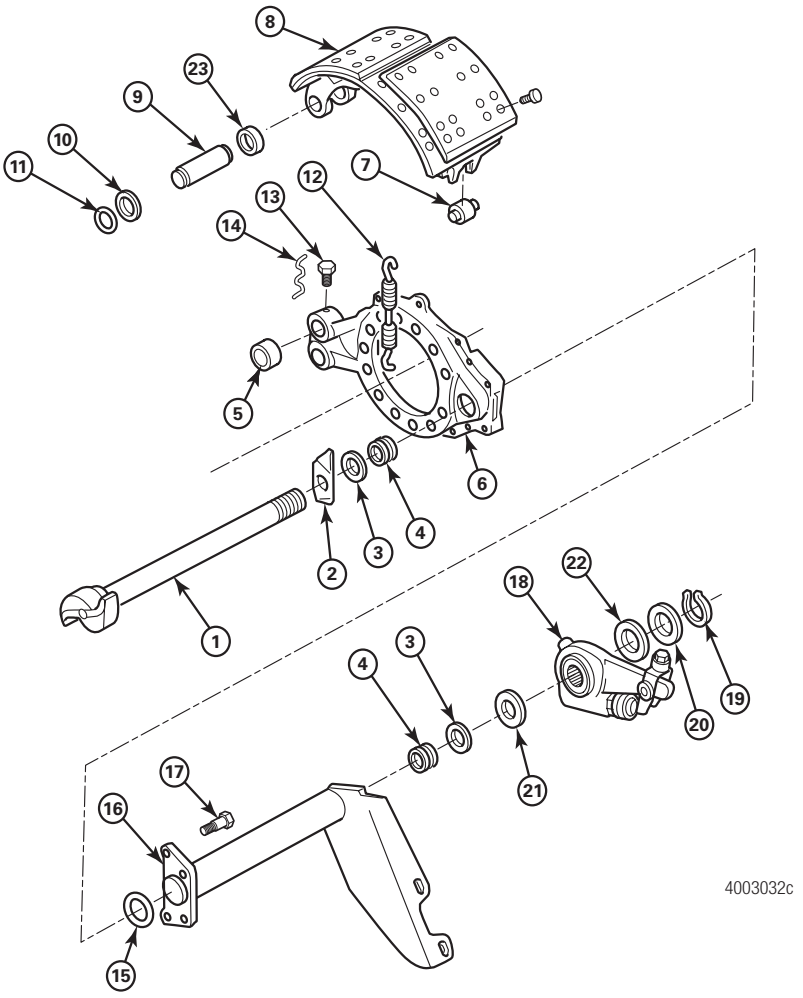


1 Exploded Views

Item	Description
1	Camshaft
2	Cam Head Washer
3	Camshaft Grease Seal
4	Camshaft Bushing
5	Camshaft and Chamber Bracket
6	Camshaft Bracket Nut
7	Grease Fitting
8	Thick Camshaft Thrust Washer
9	Automatic Slack Adjuster
10	Thin Camshaft Spacers
11	Thick Hardened Washer
12	Camshaft Snap Ring
13	Shoe Retaining Spring
14	Shoe and Lining Assembly
15	Anti-Rattle Clips
16	Shoe Return Spring
17	Brake Shoe Rollers
18	Brake Shoe Anchor Pins
19	Support Plate
20	Backing Plate
21	Anchor Pin Washer
22	Anchor Pin Nut
23	Dust Shield
24	Shoe Clip Bolt
25	Camshaft Bracket Bolt
26	Clip-to-Backing Plate Nut
27	Dust Shield Capscrew
28	Dust Shield Nut

1 Exploded Views

Cast Plus™ Cam Brake

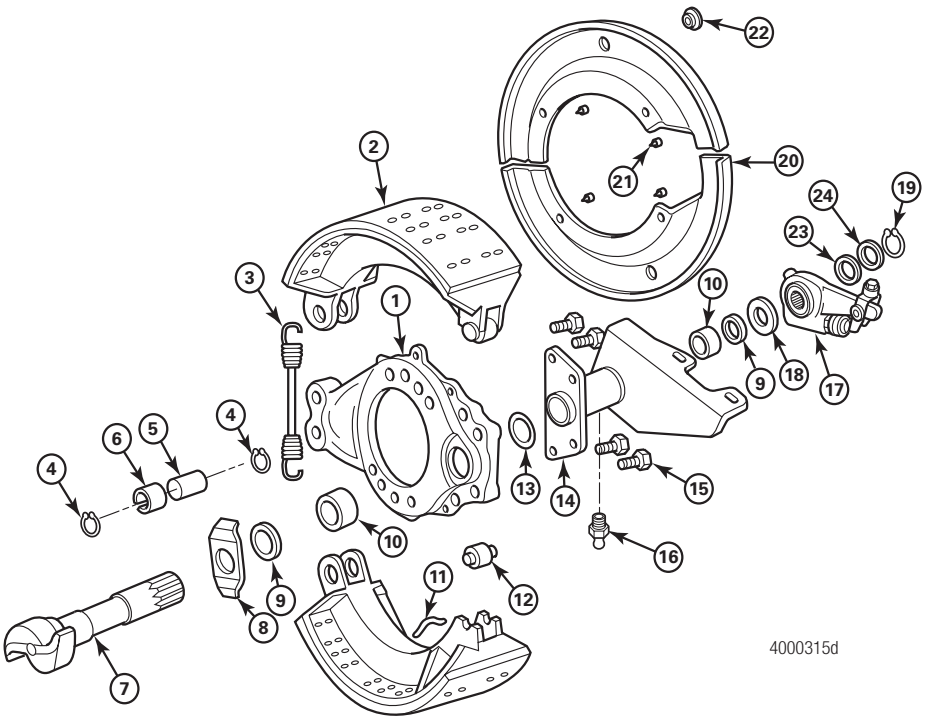


1 Exploded Views

Item	Description
1	Camshaft
2	Cam Head Washer
3	Camshaft Seal
4	Camshaft Bushing
5	Anchor Pin Bushing
6	Brake Spider
7	Brake Shoe Roller
8	Brake Shoe and Lining Assembly
9	Anchor Pin
10	Anchor Pin Washer
11	Anchor Pin Snap Ring
12	Brake Shoe Return Spring
13	Anchor Pin Set Screw
14	Anchor Pin Set Screw Lock Wire
15	Chamber Bracket Seal
16	Chamber Bracket
17	Chamber Bracket Capscrew
18	Slack Adjuster
19	Snap Ring
20	Thick Camshaft Spacing Washer
21	Thick Camshaft Thrust Washer
22	Thin Camshaft Spacing Washer
23	Shoe Bushing

1 Exploded Views

16.5-Inch P Series Cam Brakes

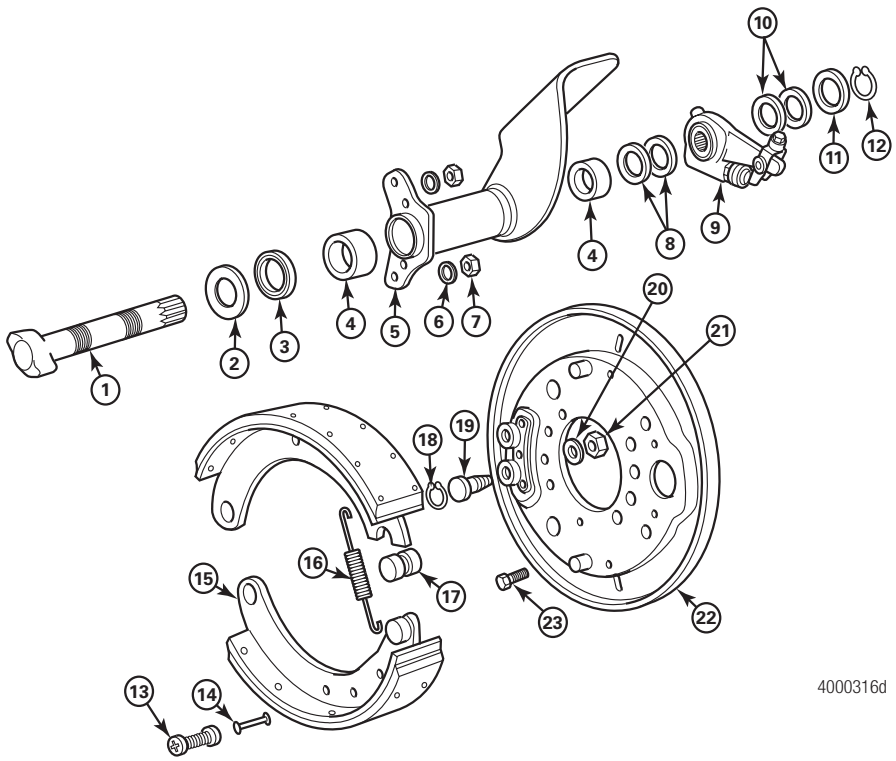


Item	Description
1	Brake Spider
2	Shoe and Lining Assembly
3	Brake Shoe Return Spring
4	Anchor Pin Snap Ring
5	Brake Shoe Anchor Pin
6	Anchor Pin Bushing
7	"S" Head Camshaft
8	Cam Head Washer
9	Camshaft Grease Seal
10	Camshaft Bushing
11	Return Spring Pin
12	Cam Roller
13	Camshaft Bracket Seal
14	Camshaft and Chamber Bracket

Item	Description
15	Camshaft Bracket Capscrew
16	Grease Fitting
17	Automatic Slack Adjuster
18	Thick Camshaft Thrust Washer
19	Camshaft Snap Ring
20	Dust Shield
21	Dust Shield Capscrew
22	Plug
23	Thin Camshaft Spacing Washer
24	Thick Camshaft Spacing Washer

1 Exploded Views

15-Inch T Series Cam Brakes



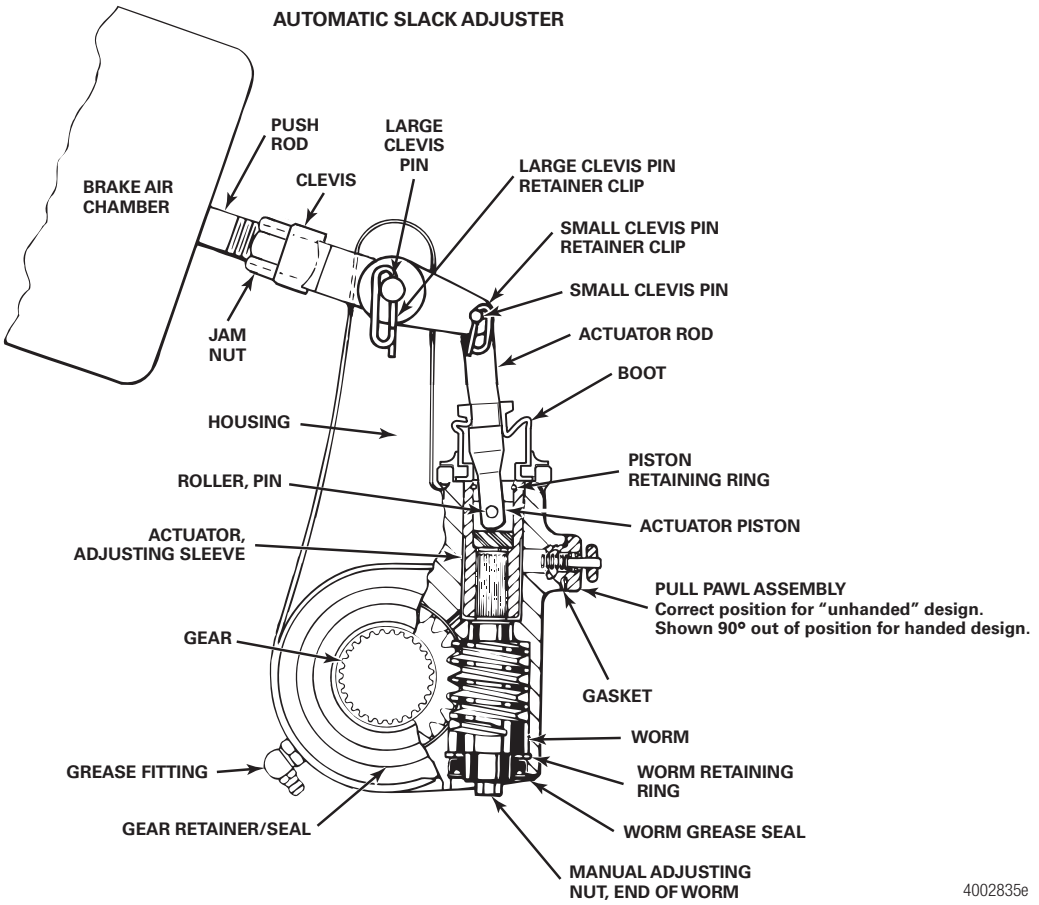
Item	Description
1	Camshaft
2	Cam Head Washer
3	Camshaft Grease Seal
4	Bushing
5	Camshaft and Chamber Bracket
6	Bracket Lock Washer
7	Bracket Nut
8	Thick Camshaft Thrust Washers
9	Automatic Slack Adjuster
10	Thin Camshaft Spacer Washer
11	Thick Camshaft Hardened Washer
12	Camshaft Snap Ring
13	Anti-Rattle Spring Retainer Assembly

Item	Description
14	Anti-Rattle Rod
15	Shoe and Lining Assembly
16	Shoe Return Spring
17	Brake Shoe Roller
18	Anchor Pin Snap Ring
19	Brake Shoe Anchor Pin
20	Anchor Pin Washer
21	Anchor Pin Nut
22	Backing Plate
23	Camshaft Bracket Capscrew

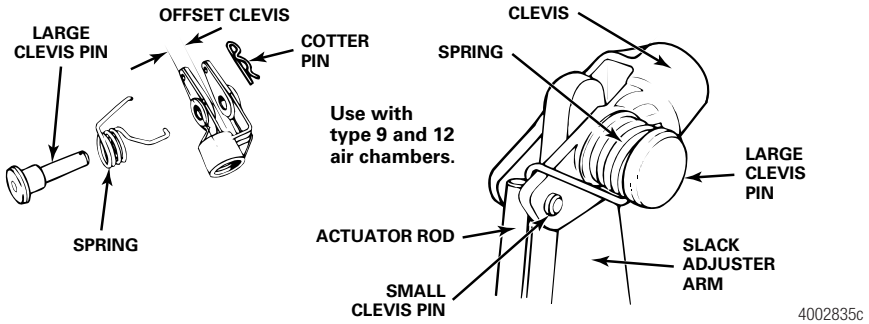
1 Exploded Views

Automatic Slack Adjusters

Cutaway View



Offset Clevis with Helper Spring



Components and Operation

Cam Brakes

Cam brakes are air-operated brakes — and the type of brake that is most commonly used in the commercial vehicle market. A cam brake consists of an air brake chamber and bracket, automatic slack adjuster, S-camshaft, brake hardware, shoes and linings, spider and brake drum.

At brake actuation, the S-cam rotates and pushes rollers located on the brake shoes against the brake drum. When a brake shoe is forced into the drum, friction slows the movement of the drum to stop the vehicle.

Air Brake Chambers

The vehicle supplies air to the brake system. When you push the brake pedal, a valve activates that uses compressed air to apply the brakes through the air brake chamber at each wheel end. Air brake chambers are specified by size for a particular brake and axle load. For example, a lightly-loaded steering axle might use a small chamber, while a heavily-loaded drive axle would use a larger chamber.

An air chamber also has a limited stroke movement, which is why maintaining cam brake adjustment is critical. The commercial vehicle industry uses two types of air brake chambers: the standard-stroke chamber and the long-stroke chamber.

Automatic Slack Adjusters

To adjust the brake as it wears, and help ensure the air brake chamber can produce enough actuation force, an automatic slack adjuster adjusts the amount of slack, or free play, in the brake. This adjustment is critical in air brakes, because with too little slack, the brake may drag and overheat. If there is too much slack, the brake may not generate enough braking effort to safely stop the vehicle.

Spring Brake Chambers

An air brake system requires parking brakes and emergency braking if the air system malfunctions; for example, if an air line ruptures. When the spring brake activates, air pressure is released from the spring brake chamber, which uses mechanical spring pressure as a braking force. The spring brake can be actuated automatically by low pressure, or it can be controlled mechanically to use as a parking brake.

Cam Brake Models

Q Plus™ Cam Brakes

Q Plus™ cam brakes are designed with an S-camshaft, heavy-duty return springs and thicker linings. Q Plus™ brakes are compatible with Meritor Q Series brakes on tractors and trailers. Figure 2.1.

Figure 2.1

Q Plus™ LX500 and MX500 Cam Brakes

Q Plus™ LX500 cam brakes include an Extended Lube Feature to help reduce wear and maintenance. Q Plus™ MX500 cam brakes include a Long Life package that requires no lubrication or lining maintenance. Both brakes include factory-installed automatic slack adjusters. Figure 2.2.

For complete maintenance and service information for Q Plus™ LX500 and MX500 cam brakes, refer to Maintenance Manual MM-96173, Q Plus™ LX500 and MX500 Cam Brakes. To obtain this publication, refer to the Service Notes page on the front inside cover of this manual.

Figure 2.2

2 Introduction

Cast Plus™ Cam Brakes

Cast Plus™ cam brakes use single-piece cast shoes and thicker linings, which provide resistance to heat-related wear in heavy-duty coach and off-road applications. Figure 2.3.

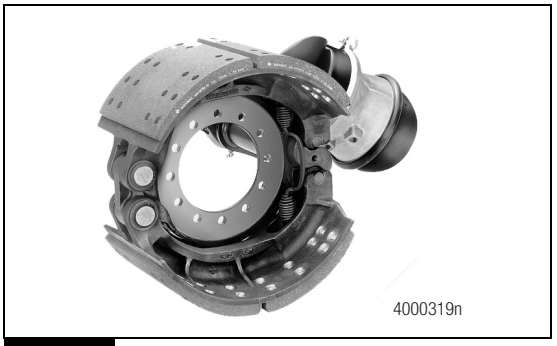


Figure 2.3

Q Series Cam Brakes

Q Series cam brakes are equipped with open anchor pins for quick change service. Q Series brakes are compatible with Meritor Q Plus™ brakes on tractors and trailers. Figure 2.4.

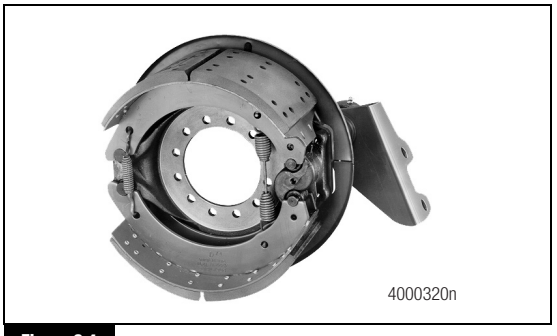


Figure 2.4

P Series

P Series cam brakes are available in 16.5- and 18-inch diameters, with 7-inch wide cast shoes and 0.75-inch tapered brake linings. Figure 2.5.

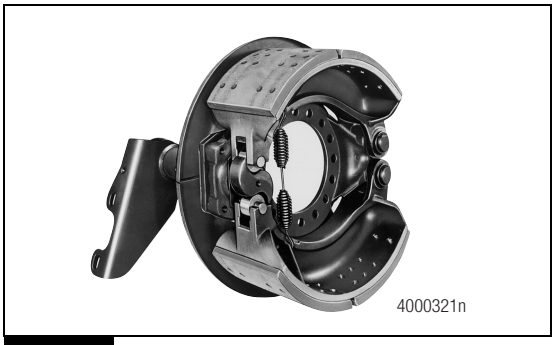


Figure 2.5

Converting 16.5-Inch Q Series Brakes to the Q Plus™ Brake Design

Meritor replaced the Q camshaft with the Q Plus™ camshaft in all 16.5-inch Q Series brakes manufactured since 1994. You can convert 16.5-inch Q Series brakes manufactured before 1994 to the Q Plus™ brake design by changing the shoe and lining assembly, the shoe return spring and the camshaft. Meritor recommends you install a new camshaft bushing whenever you replace a camshaft.

However, major design differences — brake offset, single-web versus double-web shoes, a backing plate versus a brake spider, differences in camshaft diameters and splines — will not allow you to convert 15-inch Q Series brakes to the Q Plus™ design by replacing individual parts. Also refer to Figure 2.6.

In addition, replacing an entire 15-inch Q Series brake assembly with a 15-inch Q Plus™ brake assembly also could require a different drum, depending on the original equipment manufacturer (OEM) and the brand of drum installed with the Q Series brakes.

How to Identify Q Plus™ and Q Series Cam Brakes

Differences Between the Brakes

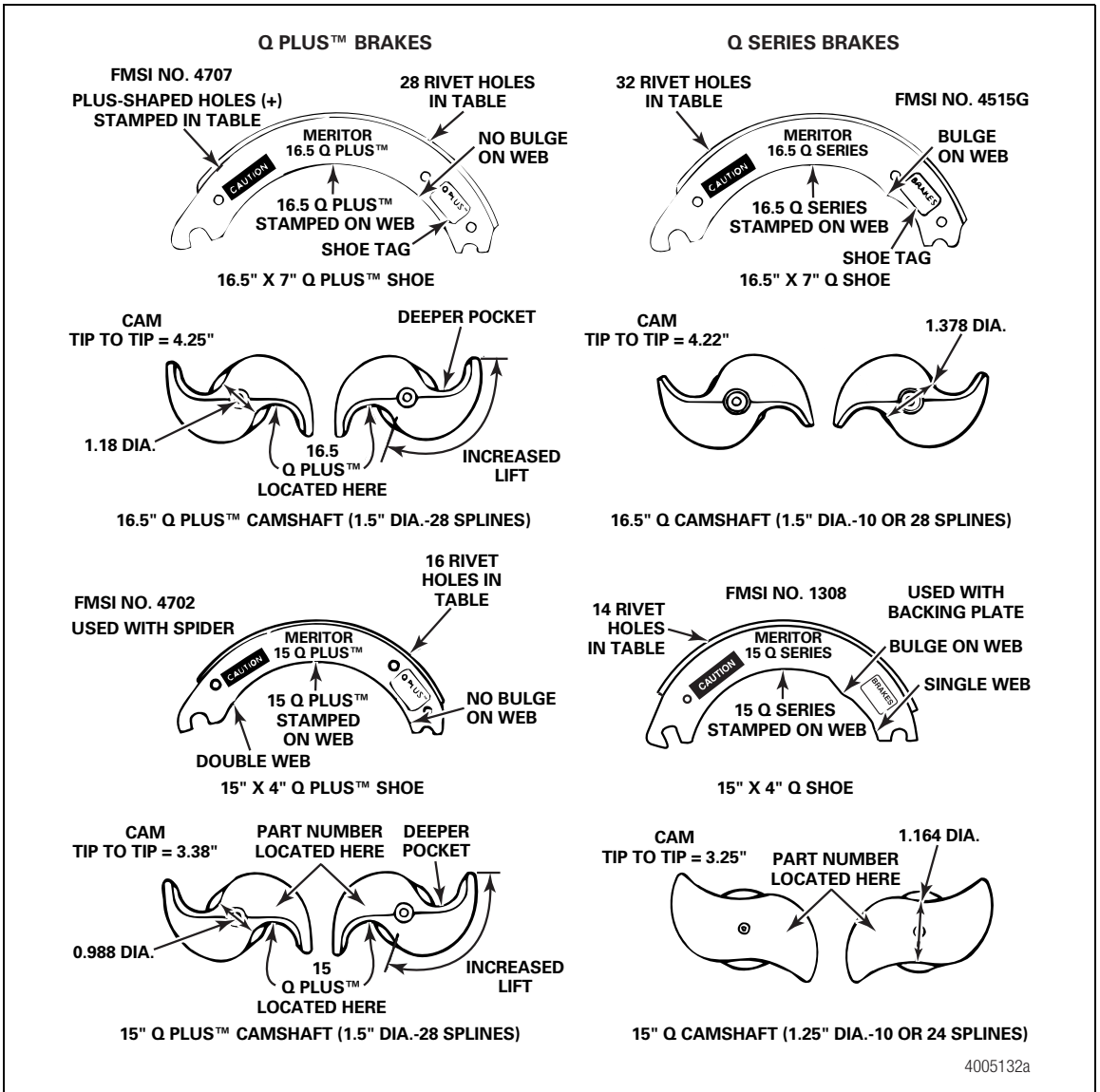


Figure 2.6

2 Introduction

Important Information

Meritor automatic slack adjusters (ASAs) should not need to be manually adjusted in service. ASAs should not have to be adjusted to correct excessive push rod stroke. The excessive stroke may be an indication that a problem exists with the foundation brake, ASA, brake actuator or other system components.

360

Meritor recommends troubleshooting the problem, replacing suspect components and then confirming proper brake operation prior to returning the vehicle into service.

In the event that a manual adjustment must be made (although not a common practice), a service appointment and full foundation brake, ASA, and other system component inspection should be conducted as soon as possible to ensure integrity of the overall brake system.

For Meritor brake adjustment, refer to the brake adjustment tables in this manual. For non-Meritor brake adjusters, refer to the brake manufacturer's service procedures.

Automatic Slack Adjusters

Since January 1993, some parts of Meritor automatic slack adjusters are not serviceable or interchangeable with parts from earlier models. Refer to Section 1 for more information.

Never mix automatic slack adjusters on the same axle. Always use replacement parts that were originally designed for the brake system to help ensure maximum brake performance.

How an Automatic Slack Adjuster Works

When you install an automatic slack adjuster, you set the brake chamber stroke measurement, which is the correct shoe-to-drum clearance. Figure 2.7. When linings wear, this clearance increases, and the air chamber push rod must travel farther to apply the brakes.

When this happens, the slack adjuster will automatically adjust during the return stroke to maintain the correct shoe-to-drum clearance. If the air brake chamber push rod stroke is within limits during operation, no adjustment occurs.

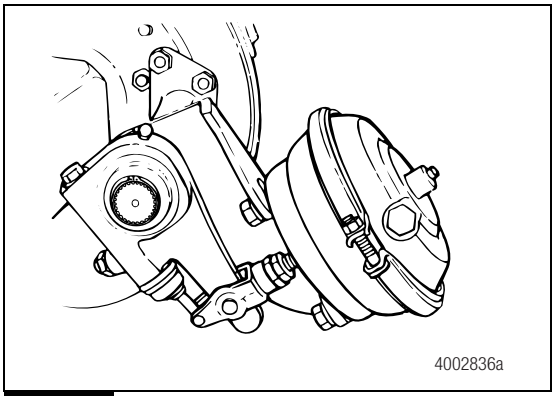


Figure 2.7

Factory-Installed Automatic Slack Adjusters on Q Plus™ LX500 and MX500 Cam Brake Packages

Q Plus™ LX500 and MX500 brake packages include factory-installed automatic slack adjusters that do not have grease fittings, and lubrication intervals differ from conventional slack adjusters. Refer to Maintenance Manual MM-96173, Q Plus™ LX500 and MX500 Cam Brakes, for complete information. To obtain this publication, refer to the Service Notes page on the front inside cover of this manual.

Handed and Unhanded Slack Adjusters

There are two automatic slack adjuster designs: handed and unhanded. Handing refers only to the location of the pawl, which is used for clearance issues on the vehicle. For most applications, install a handed automatic slack adjuster so that the pawl faces INBOARD on the vehicle.

The pawl can be on either side or on the front of the slack adjuster housing. Figure 2.8.

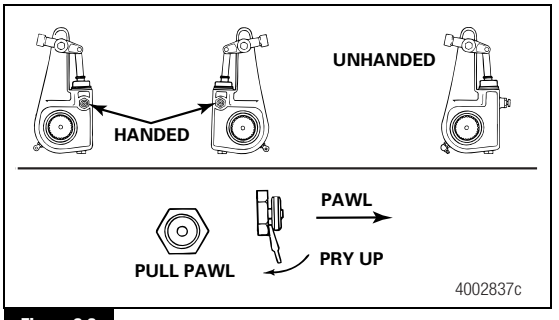


Figure 2.8

Pull Pawls

Pull pawls are spring loaded. Pry the pull pawl at least 1/32-inch to disengage the teeth. Figure 2.8. When you remove the pry bar, the pull pawl will re-engage automatically.

Clevis Types and Thread Sizes

A one-piece, threaded clevis is standard equipment on most Meritor automatic slack adjusters, including factory-installed slack adjusters on Q Plus™ LX500 and MX500 cam brakes, and all service replacement parts.

Meritor automatic slack adjusters and clevises are designed to be used as a system. Always use genuine Meritor replacement parts. Although parts from other manufacturers can look the same, differences can exist that will affect brake system performance.

The threaded-type clevis is available in two different pin spacings, 1.30-inches (33 mm) and 1.38-inches (35 mm). Figure 2.9.

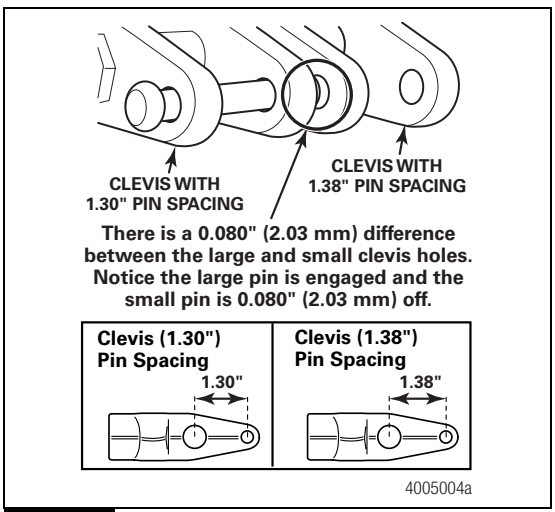


Figure 2.9

The initial slack adjuster set-up is unique for each pin spacing. Refer to Table E for correct installation.

Threaded Clevis for Straight or Offset Applications

A threaded clevis can be either straight or offset. If service replacement is required, replace a straight clevis with a straight clevis and an offset clevis with an offset clevis to maintain the correct brake design and set up. Figure 2.10.

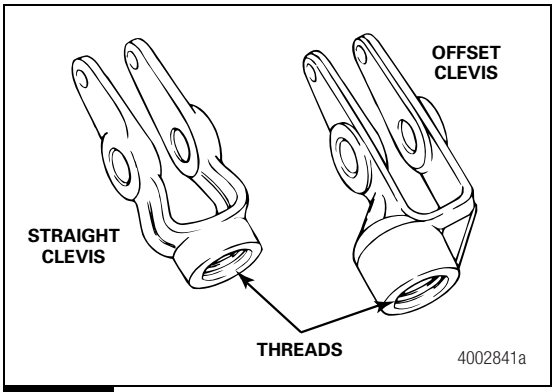


Figure 2.10

Thread Sizes

Straight and offset clevis designs are available in two common thread sizes to match push rod threads.

Table A: Thread Sizes

Chambers	Thread Sizes
9, 12, 16	1/2"-20 UNF
20, 24, 30, 36	5/8"-18 UNF

Meritor Automatic Slack Adjusters are Color-Coded to Brake Type and Air Chamber Size

Meritor uses either black, red, yellow, green or blue to color-code an automatic slack adjuster's internal actuator piston according to brake type and air chamber size.

Meritor uses a mylar tag on the body of the current-design slack adjuster to identify the color of the internal actuator piston.

Mylar Tag — Current Design

A mylar tag is attached to the current-design slack adjuster with a press-in boot. The color of the actuator piston is printed on the mylar tag. Figure 2.11.

2 Introduction

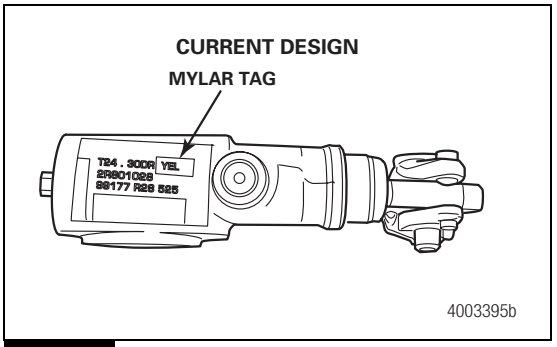


Figure 2.11

Color-Coded Tie Wrap — Previous Design

On previous-design slack adjusters, a color-coded tie wrap attaches the boot to the slack adjuster body. The tie wrap color matches the color of the actuator piston. Figure 2.11.

Important Note

While in service, it is possible that the boot's tie wrap might have been replaced with a tie wrap of a different color than originally installed at manufacture. If this happens, the tie wrap will not correctly identify the brake type and air chamber size.

Meritor recommends that you remove the boot from the slack adjuster to determine the color of the actuator piston, which identifies the brake type and air chamber size.

For a complete color-coding list, refer to Parts Catalog PB-8857, Brake, Trailer Axle and Wheel Attaching Parts. To obtain this publication, refer to the Service Notes page on the front inside cover of this manual.

When You Replace an Automatic Slack Adjuster

The original equipment manufacturer paints the chassis and slack adjusters, which includes the mylar tag or tie wrap, depending on the slack adjuster model.

When you replace an automatic slack adjuster, the color of the actuator piston on the new slack adjuster must match the color of the actuator piston on the in-service slack adjuster you'll replace.

Check the mylar tag or color-coded tie wrap, or remove the boot as described below, to identify the color of the actuator piston. To ensure a correct installation, this color must match the color of the actuator piston on the in-service slack adjuster you'll replace.

- **If you are unsure of the color of the actuator piston on the in-service slack adjuster:** Remove the piston boot to see the color of the actuator piston to ensure a correct installation. The color must be the same as the new slack adjuster you'll install.

For a complete color-coding list, refer to Parts Catalog PB-8857, Brake, Trailer Axle and Wheel Attaching Parts. To obtain this publication, refer to the Service Notes page on the front inside cover of this manual.

Hazard Alert Messages

Read and observe all Warning and Caution hazard alert messages in this publication. They provide information that can help prevent serious personal injury, damage to components, or both.

⚠ WARNING

To prevent serious eye injury, always wear safe eye protection when you perform vehicle maintenance and service.

⚠ ASBESTOS AND NON-ASBESTOS FIBERS WARNING

Some brake linings contain asbestos fibers, a cancer and lung disease hazard. Some brake linings contain non-asbestos fibers, whose long-term effects to health are unknown. You must use caution when you handle both asbestos and non-asbestos materials.

Removal

Wheel Components

⚠ WARNING

Park the vehicle on a level surface. Block the wheels to prevent the vehicle from moving. Support the vehicle with safety stands. Do not work under a vehicle supported only by jacks. Jacks can slip or fall over. Serious personal injury and damage to components can result.

1. Park the vehicle on a level surface. Block the wheels to prevent the vehicle from moving.
2. Use a jack to raise the vehicle so that the wheels to be serviced are off the ground. Support the vehicle with safety stands.

⚠ WARNING

Before you service a spring chamber, carefully follow the manufacturer's instructions to compress and lock the spring to completely release the brake. Verify that no air pressure remains in the service chamber before you proceed. Sudden release of compressed air can cause serious personal injury and damage to components.

3. If the brake has spring chambers, carefully cage and lock the spring, so that it can't actuate during assembly. Follow the chamber manufacturer's instructions to completely release the brake.
4. Verify that no air pressure remains in the service chamber. Sudden release of pressurized air can cause serious personal injury and damage to components.

Automatic Slack Adjuster

The Slack Adjuster Was Not Manufactured by Meritor

Refer to the slack adjuster manufacturer's service procedures.

The Slack Adjuster Was Manufactured by Meritor

⚠ CAUTION

You must disengage a pull pawl before rotating the manual adjusting nut, or you will damage the pawl teeth. A damaged pawl will not allow the slack adjuster to automatically adjust brake clearance. Replace damaged pawls before putting the vehicle in service.

1. Disengage the pull pawl. Use a screwdriver or equivalent tool to pry the pull pawl at least 1/32-inch (0.8 mm) to disengage the teeth from the actuator. Figure 3.1.

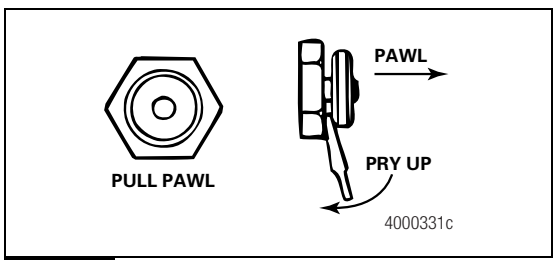


Figure 3.1

2. Use a wrench to turn the manual adjusting nut CLOCKWISE until the brake shoes are fully retracted, and the lining clears the drum. Figure 3.2.

3 Removal and Disassembly

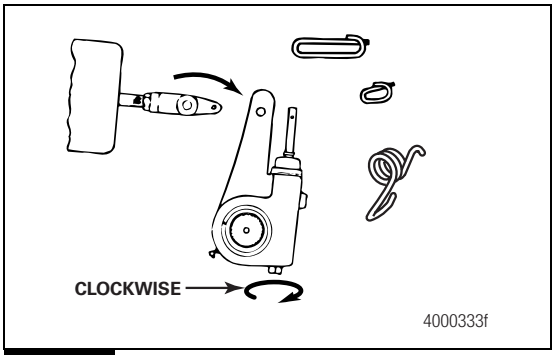


Figure 3.2

⚠ WARNING

When you remove a clevis pin that has a spring, hold the spring with pliers. The spring can disengage from the clevis with enough force to cause serious personal injury.

⚠ CAUTION

Always replace used clevis pin retainer clips with new ones when you service an automatic slack adjuster or air chamber. Do not reuse retainer clips. When you remove a retainer clip, it can bend out of shape and lose retention. Damage to components can result.

3. Remove both clevis pins, and retainer clips or cotter pins. Move the slack adjuster away from the clevis. Discard the retainer clips and cotter pins and replace them with new ones.
4. Follow the manufacturer's instructions to remove the wheel and drum from the axle.

Brake Shoes

All Q Plus™ and Q Series 15-Inch and 16.5-Inch Brakes

1. Push DOWN on the bottom brake shoe. Pull on the brake shoe roller retainer clip to remove the bottom roller. Figure 3.3.

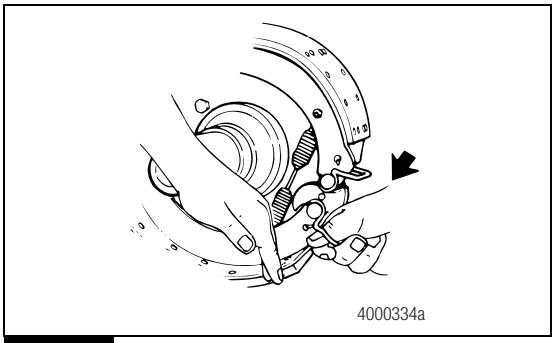


Figure 3.3

2. Lift the top brake shoe and pull on the brake shoe roller retainer clip to remove the top roller.
3. Lift the bottom shoe to release the tension on the brake shoe return spring. Figure 3.4.

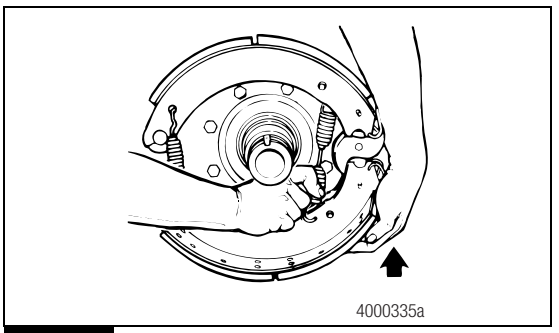


Figure 3.4

4. Rotate the bottom shoe to release the tension on the brake shoe retainer springs. Figure 3.5.

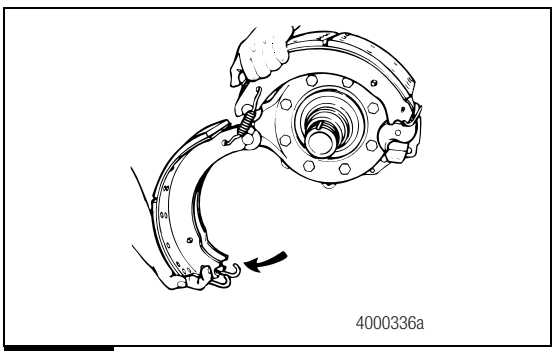


Figure 3.5

5. Remove the shoe retainer springs and the brake shoes.
6. Use the correct bushing driver tool to remove the anchor pin bushings from the spider.

P Series and Cast Plus™ Brakes

Some trailer axle P Series brakes have anchor pins that are secured with lock pins. Use a steel rod to make a tool to drive out the lock pins. Figure 3.6. The current anchor pin arrangement is shown in Figure 3.7. Earlier P Series brakes can include additional parts.

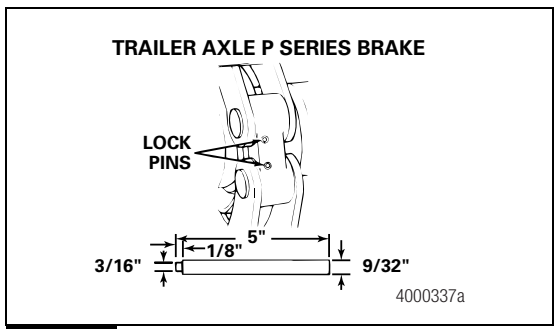


Figure 3.6

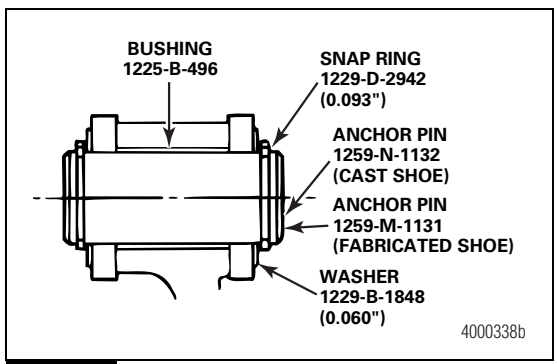


Figure 3.7

1. Remove the anchor pin snap ring, washer, retainer, felts, seals or capscrews as required.

⚠ WARNING

Use a brass or synthetic mallet for assembly and disassembly procedures. Do not hit steel parts with a steel hammer. Pieces of a part can break off. Serious personal injury and damage to components can result.

2. Use a brass drift to remove the top anchor pin. Figure 3.8.

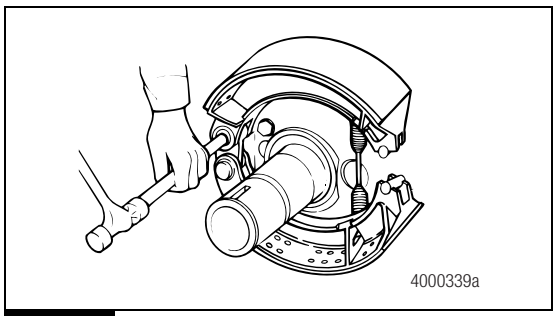


Figure 3.8

3. Rotate the top shoe to release the tension on the brake shoe return spring. Remove the shoe. Figure 3.9.

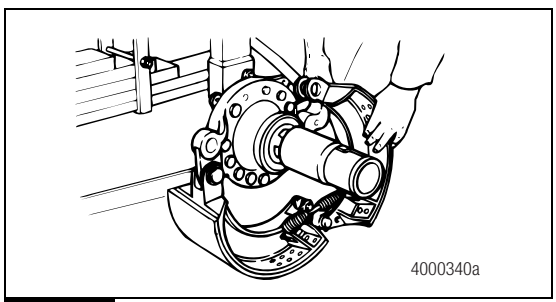


Figure 3.9

4. Use a brass drift to remove the bottom anchor pin. Remove the bottom shoe. If necessary, remove the rollers. Figure 3.10.

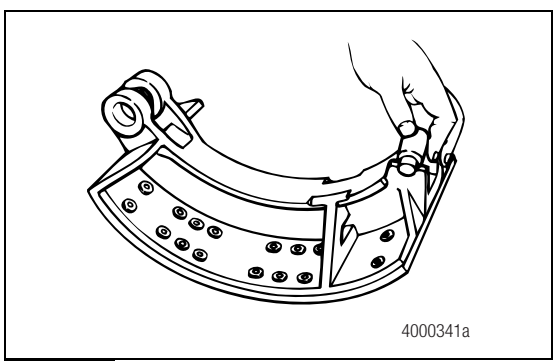


Figure 3.10

3 Removal and Disassembly

T Series Cam Brakes

1. Remove the anti-rattle spring retainer and spring from the anti-rattle rod.
2. Push DOWN on the bottom brake shoe to provide enough clearance to remove the bottom brake shoe roller. Remove the roller.
3. Lift the top brake shoe. Remove the top brake shoe roller. Remove the anchor pin snap ring and the anchor pin.
4. Rotate the bottom shoe to release the tension on the brake shoe retainer springs. Remove the shoe retainer springs and the brake shoes.

Check the Camshaft Bushing for Wear

Verify That Cam-to-Bushing Free Play is Within Specification

1. Before you remove the automatic slack adjuster and camshaft, verify that cam-to-bushing radial free play is within specification. Figure 3.11. Because the bushing wears in one direction, it is important to rotate the camshaft in all directions when you check for radial free play.

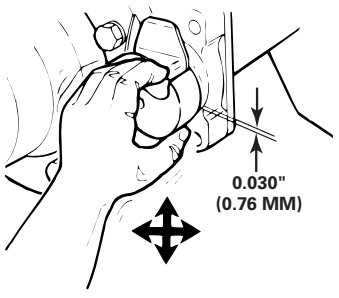


Figure 3.11

2. Use a dial indicator to verify that cam-to-bushing free play is 0.030-inch (0.76 mm) or less.
   - **If radial free play is less than 0.030-inch (0.76 mm):** Do not replace the bushings and seals.
   - **If radial free play is more than 0.030-inch (0.76 mm):** Replace the bushings and seals.

Removal

Automatic Slack Adjuster from the Camshaft

1. Remove the snap ring, washers and spacers from the camshaft.
2. Remove the slack adjuster from the camshaft.
3. Remove the camshaft from the spider.
   - **If the camshaft bushings and seals are replaced:** Use the following procedure.
   A. Use a seal removal tool to remove the inner and outer camshaft seals.
   B. Use the correct bushing puller tool to remove the inner and outer camshaft bushings.

⚠ CAUTION

You must turn the adjusting nut COUNTERCLOCKWISE when you check gear torque on an automatic slack adjuster. If you turn the adjusting nut incorrectly, you will damage the pawl teeth. A damaged pawl will prevent the slack adjuster from automatically adjusting the clearance between the linings and drum. Damage to components can result.

4. Check the slack adjuster gear torque. Use a lb-in torque wrench and turn the adjusting nut COUNTERCLOCKWISE (Figure 3.12) to rotate the gear 360 degrees, or 22 turns of the wrench, as you read the torque scale on the wrench. The value should be less than 45 lb-in (5 N•m) as you rotate the gear.
   - **If the torque value is less than 45 lb-in (5 N•m) as you rotate the gear:** The slack adjuster is operating correctly.
   - **If the torque value exceeds 45 lb-in (5 N•m) as you rotate the gear:** Replace the slack adjuster.

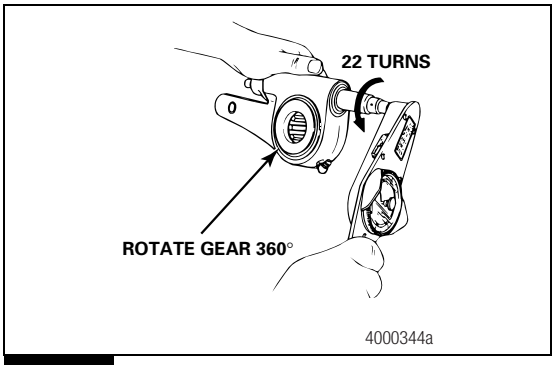


Figure 3.12

Disassembly

Automatic Slack Adjuster

1. Use a punch and hammer to tap the metal boot retaining ring from the slack adjuster housing.
2. Remove the boot from the housing. Pull the actuator assembly from the housing. Figure 3.13. Discard the boot, and install a new boot when you assemble the slack adjuster.

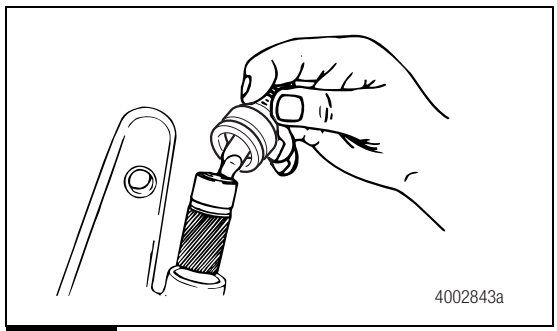


Figure 3.13

3. Use a small screwdriver to push down on one side of the piston retaining ring to force the ring out of the groove. Figure 3.14.

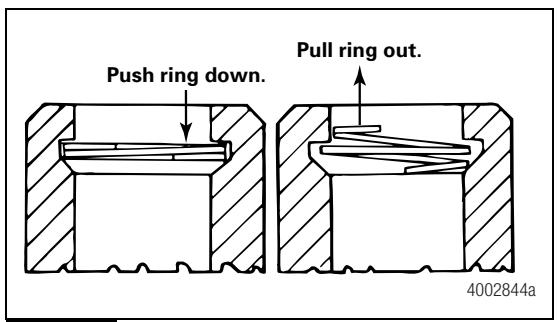


Figure 3.14

4. Extend the coils of the ring. Use pliers to unwind the ring and pull it out of the groove. Use a new ring when you assemble the slack adjuster. Figure 3.14.
5. Pull the actuator rod, piston and pin from the actuator.
6. Remove the pin from the rod and piston, if necessary. Figure 3.15.

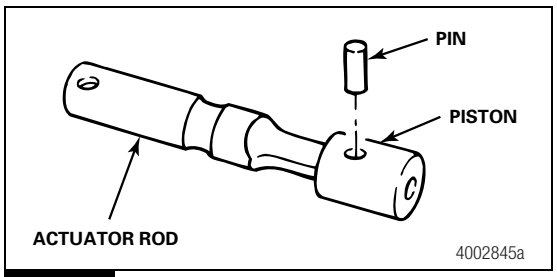


Figure 3.15

7. Inspect the clevis bushing in the slack adjuster arm for wear or damage. Replace a worn or damaged bushing. Check the bushing's diameter to ensure it does not exceed 0.531-inch (13.5 mm). Figure 3.16.
   - **If the bushing's diameter exceeds 0.531-inch (13.5 mm):** Replace the bushing.

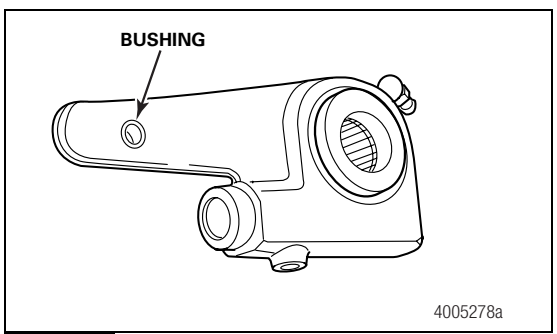


Figure 3.16

8. Use a small screwdriver to remove the grease seal from around the worm bore. Figure 3.17. Discard the seal. Install a new seal when you assemble the slack adjuster.

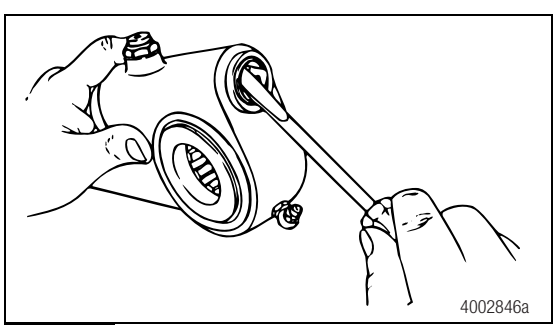


Figure 3.17

4 Prepare Parts for Assembly

Hazard Alert Messages

Read and observe all Warning and Caution hazard alert messages in this publication. They provide information that can help prevent serious personal injury, damage to components, or both.

⚠ WARNING

To prevent serious eye injury, always wear safe eye protection when you perform vehicle maintenance or service.

⚠ ASBESTOS AND NON-ASBESTOS FIBERS WARNING

Some brake linings contain asbestos fibers, a cancer and lung disease hazard. Some brake linings contain non-asbestos fibers, whose long-term effects to health are unknown. You must use caution when you handle both asbestos and non-asbestos materials.

Clean, Dry and Inspect Parts

⚠ WARNING

Solvent cleaners can be flammable, poisonous and cause burns. Examples of solvent cleaners are carbon tetrachloride, and emulsion-type and petroleum-base cleaners. Read the manufacturer's instructions before using a solvent cleaner, then carefully follow the instructions. Also follow the procedures below.

- **Wear safe eye protection.**
- **Wear clothing that protects your skin.**
- **Work in a well-ventilated area.**
- **Do not use gasoline, or solvents that contain gasoline. Gasoline can explode.**
- **You must use hot solution tanks or alkaline solutions correctly. Read the manufacturer's instructions before using hot solution tanks and alkaline solutions. Then carefully follow the instructions.**

⚠ CAUTION

Do not use hot solution tanks or water and alkaline solutions to clean ground or polished parts. Damage to parts can result.

Use soap and water to clean non-metal parts.

Dry parts immediately after cleaning with soft, clean paper or cloth, or compressed air.

Corrosion Protection

If you assemble the parts immediately after you clean them, lubricate the parts with grease to prevent corrosion. Parts must be clean and dry before you lubricate them.

If you store the parts after you clean them, apply a corrosion-preventive material. Store the parts in a special paper or other material that prevents corrosion.

Inspect Parts

Brakes

Check the spider for expanded anchor pin holes and for cracks. Replace damaged spiders and anchor pin bushings.

Check the camshaft bracket for broken welds, cracks and correct alignment. Replace damaged brackets.

Check the anchor pins for corrosion and wear. Replace worn or damaged anchor pins.

Check the brake shoes for rust, expanded rivet holes, broken welds and correct alignment. Replace a shoe with any of the above conditions.

1. For 16.5-inch brake shoes only, anchor pin holes must not exceed 1.009-inches (25.63 mm) in diameter. The distance from the center of the anchor pin hole to the center of the roller hole must not exceed 12.779-inches (32.46 cm). Replace brake shoes with measurements that do not meet specifications. Figure 4.1.
2. For 15-inch brake shoes only, anchor pin holes must not exceed 1.009-inches (25.63 mm) in diameter. The distance from the center of the anchor pin hole to the center of the roller hole must not exceed 11.685-inches (29.68 cm). Replace brake shoes with measurements that do not meet specifications. Figure 4.1.

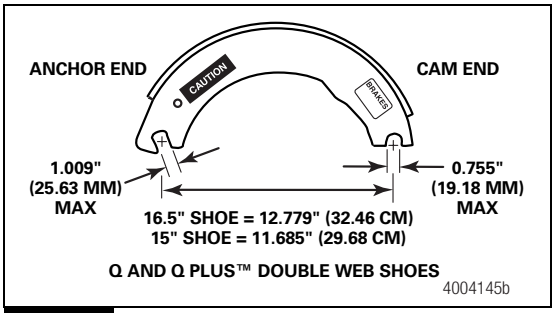


Figure 4.1

4 Prepare Parts for Assembly

Brake Drums

⚠ WARNING

Do not operate the vehicle with the brake drum worn or machined beyond the discard dimension indicated on the drum. The brake system may not operate correctly. Damage to components and serious personal injury can result.

⚠ CAUTION

Replace the brake drum if it is out-of-round. Do not turn or rebore a brake drum, which decreases the strength and capacity of the drum. Damage to components can result.

Check the brake drums for cracks, severe heat checking, heat spotting, scoring, pitting and distortion. Replace drums as required. Do not turn or rebore brake drums, which decreases the strength and heat capacity of the drum. Refer to Maintenance Manual MM-99100, Wheel Equipment, Disc Wheel Hubs, Brake Drum Failure Analysis. To obtain this publication, refer to the Service Notes page on the front inside cover of this manual.

Measure the inside diameter of the drum in several locations with a drum caliper or internal micrometer. Figure 4.2.

- **If the diameter exceeds the specifications supplied by the drum manufacturer:** Replace the drum.

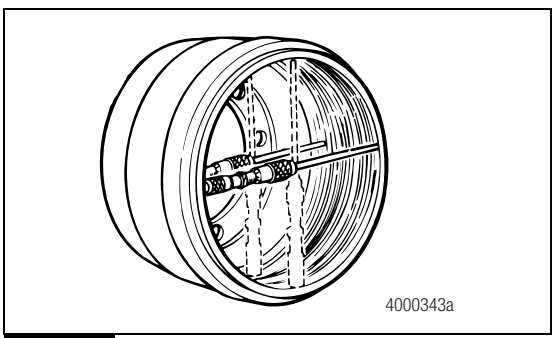


Figure 4.2

Check the dust shields for wear and damage. Repair or replace worn or damaged parts as necessary.

Automatic Slack Adjuster

Inspect the large and small clevis pins and retainer clips for wear and damage. Replace worn or damaged parts.

⚠ CAUTION

You must turn the adjusting nut COUNTERCLOCKWISE when you check gear torque on an automatic slack adjuster. If you turn the adjusting nut incorrectly, you will damage the pawl teeth. A damaged pawl will prevent the slack adjuster from automatically adjusting the clearance between the linings and drum. Damage to components can result.

1. Use a lb-in torque wrench and turn the adjusting nut COUNTERCLOCKWISE (Figure 4.3) to rotate the gear 360 degrees, or 22 turns of the wrench, as you read the torque scale on the wrench. The value should be less than 45 lb-in (5 N•m) as you rotate the gear.
   - **If the torque value is less than 45 lb-in (5 N•m) as you rotate the gear:** The slack adjuster is operating correctly.
   - **If the torque value exceeds 45 lb-in (5 N•m) as you rotate the gear:** Replace the slack adjuster.

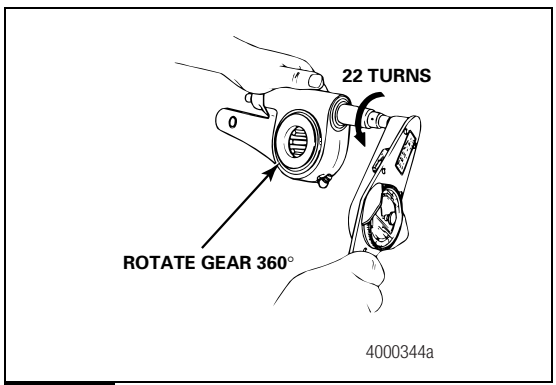


Figure 4.3

⚠ CAUTION

Always replace used clevis pin retainer clips with new ones when you service an automatic slack adjuster or chamber. Do not reuse retainer clips. Discard used clips. When you remove a retainer clip, it can bend or "gap apart" and lose retention. Damage to components can result.

2. Inspect the clevis pin retainer clips for wear and damage. Replace worn or damaged parts. Do not reuse clevis pin retainer clips.
3. Inspect the clevis pins and slack adjuster arm bushing. Replace clevis pins if they are worn or bent. Replace the bushing if its diameter exceeds 0.531-inch (13.5 mm).

4 Prepare Parts for Assembly

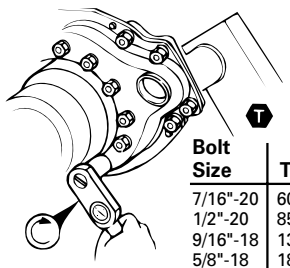
4. Inspect the boot assembly. If it is cracked, cut or torn, remove the pull pawl and inspect the areas around the actuator. If you find dirt, solid lubricant or corrosion, replace the slack adjuster. Otherwise, only replace the boot assembly.
5. Use a grease gun to apply Meritor specification O-692 or O-645 lubricant to the slack adjuster grease fitting, until grease flows from around the camshaft splines and pawl assembly. If necessary, install a camshaft into the slack adjuster gear to minimize grease flow through the gear holes.

Camshaft

Check the camshaft for cracks, wear and corrosion. Check the cam head, bearing journals and splines. Replace worn or damaged camshafts.

Install new camshaft bushings and seals whenever you install a new camshaft.

1. Tighten all spider bolts to the correct torque. Figure 4.4. T



Bolt Size	Torque	
7/16"-20	60-75 lb-ft	81-102 N•m
1/2"-20	85-115 lb-ft	115-156 N•m
9/16"-18	130-165 lb-ft	176-224 N•m
5/8"-18	180-230 lb-ft	244-312 N•m
7/8"-9	440-580 lb-ft	598-789 N•m

4000345a

Figure 4.4

2. Use a seal driver to install new camshaft seals and new bushings into the cast spider and camshaft bracket. Figure 4.5.
   - **If the brake has a stamped spider:** Install both bushings into the bracket. Install the seals with the seal lips toward the slack adjuster to ensure grease purges at the slack end. Figure 4.6.

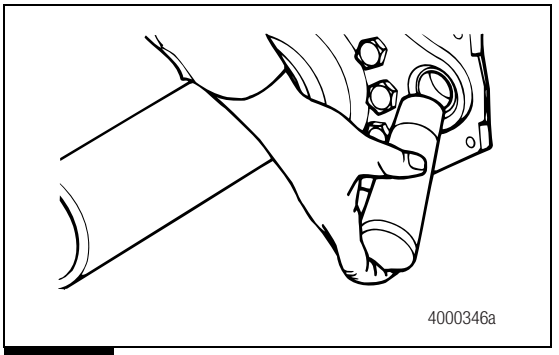


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Figure 4.5

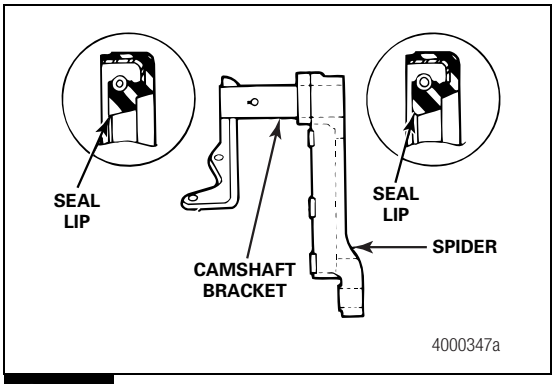

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Figure 4.6

3. If the camshaft bracket has been removed, install the chamber bracket seal and bracket onto the spider. Tighten the capscrews to the correct torque. Figure 4.4. T

Hazard Alert Messages

Read and observe all Warning and Caution hazard alert messages in this publication. They provide information that can help prevent serious personal injury, damage to components, or both.

⚠ WARNING

To prevent serious eye injury, always wear safe eye protection when you perform vehicle maintenance or service.

Use the correct shoe return spring with the Q Plus™ camshaft. An incorrect shoe spring can interfere with the camshaft and affect braking performance. Serious personal injury and damage to components can result.

⚠ ASBESTOS AND NON-ASBESTOS FIBERS WARNING

Some brake linings contain asbestos fibers, a cancer and lung disease hazard. Some brake linings contain non-asbestos fibers, whose long-term effects to health are unknown. You must use caution when you handle both asbestos and non-asbestos materials.

⚠ CAUTION

Only install a Q Plus™ camshaft in a Q Plus™ brake. A Q Series hammerclaw camshaft will not provide enough clearance between the brake shoe and the brake drum. Brake drag and damage to components can result.

To install a new brake drum so that it fits correctly over a Q Plus™ brake shoe, you must install a Q Plus™ camshaft to prevent damage to components.

Assembly

Automatic Slack Adjuster

Since January 1993, some parts of Meritor automatic slack adjusters are not serviceable or interchangeable with parts from earlier models. Refer to Section 1 for more information.

Never mix automatic slack adjusters on the same axle. Always use replacement parts that were originally designed for the brake system to help ensure maximum brake performance.

1. Remove any corrosion-preventive material that may have been applied to the parts you will assemble.
2. Use grease to lubricate the gear bore in the housing.
3. Lubricate the worm gear seal with grease that meets Meritor specifications. Press the seal into its groove. Push the gear into the housing.

⚠ CAUTION

Install the seal with the lips outside of the bore and the metal retainer inside of the bore to prevent contaminants from entering the slack adjuster housing. Damage to components can result.

4. Place the seal directly over the worm bore with the seal lips outside of the bore and the metal retainer inside of the bore. Figure 5.1. Use a hammer and 1-3/16-inch (30.2 mm) diameter seal driver to install the seal straight into the bore. Figure 5.2. Do not hit the seal after it reaches the bottom of the bore. Damage to the seal will result.

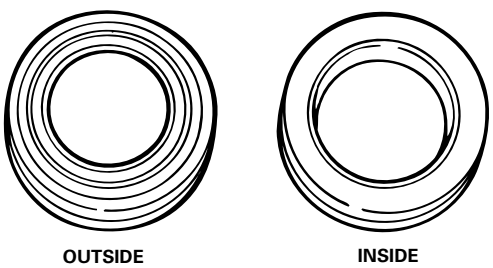


Figure 5.1

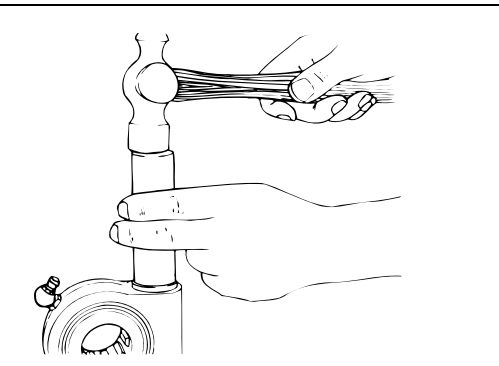


Figure 5.2

5 Assembly and Installation

5. If you removed the pin, install it into the rod and piston. Figure 5.3.

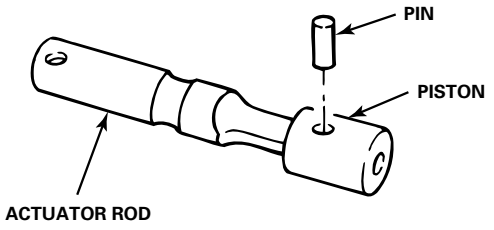


Figure 5.3

6. Apply a small amount of grease to the actuator piston and install the actuator rod and piston assembly into the actuator adjusting sleeve.
7. Slide the piston retaining ring over the rod.
8. Extend the coils of the ring.
9. Use a small screwdriver to press one end of the ring into the groove. Figure 5.4.

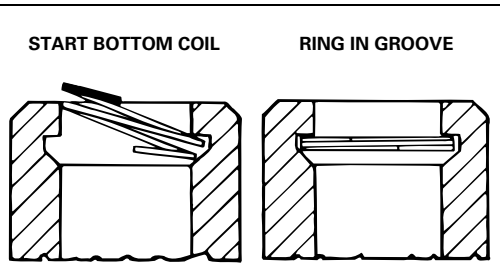


Figure 5.4

10. Keep the coil extended. Press on the ring and work around the groove until the ring is in the groove completely.
11. Check to ensure that the ring is installed correctly in the groove. You cannot pull the piston out of the actuator if the retaining ring is installed correctly.
12. Disengage the pull pawl. Use a screwdriver or equivalent tool to pry the pull pawl at least 1/32-inch (0.8 mm) to disengage the teeth from the actuator.
13. Make certain the pull pawl is disengaged, and install the actuator assembly into the housing so that the actuator slides along the worm splines.
14. Fill the boot with grease and slip it over the actuator rod. Do not seal the boot to the tapered part of the actuator rod. The top of the boot must fit into the groove.
15. Press the boot metal ring into the slack adjuster housing.
16. Remove the screwdriver or equivalent tool from the pull pawl. The pull pawl will re-engage automatically.
17. Use a grease gun to lubricate the slack adjuster through the grease fitting. If necessary, install a camshaft into the slack adjuster gear to minimize the grease flow through the gear holes.
18. Apply lubrication that meets Meritor specifications until new grease purges from around the camshaft splines and from the pawl assembly. Refer to Section 7.

Installation

Camshaft

1. Install the cam head thrust washer onto the camshaft. Apply Meritor specification O-617-A or O-617-B grease to the camshaft bushings and journals, and seal lips.
2. Install the camshaft through the spider and bracket so that the camshaft turns freely by hand. Figure 5.5.

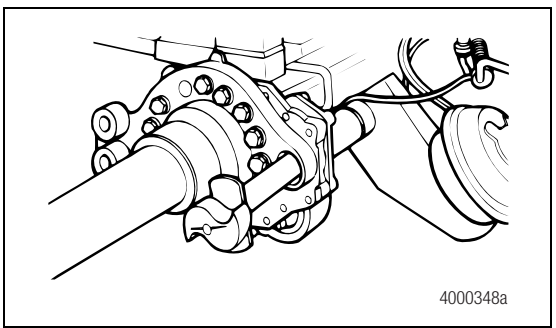


Figure 5.5

Replace a Q Series or P Series Camshaft with a Q Plus™ Camshaft

For all front and drive axle 16.5-Inch Q Series, 16.5-Inch and 18-Inch P Series brakes, when you replace a Q Series or P Series camshaft with a Q Plus™ camshaft, continue to follow maintenance and service procedures for a Q Series or P Series brake and a Q Plus™ camshaft.

The Q Plus™ S-cam replaced the Q Series and P Series S-cam. Because of the larger lift requirements and deeper pockets on the Q Plus™ S-cam, the P Series cast shoe roller does not fully seat in the pocket. Figure 5.6. This cam profile does not affect the performance of the cast shoe brake.

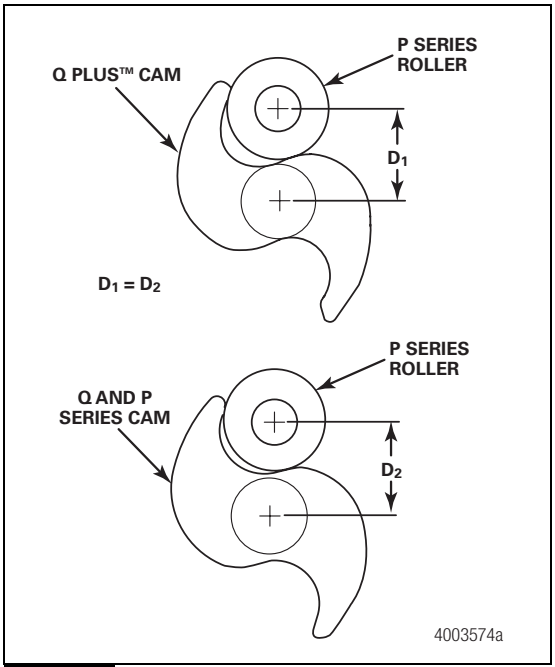


Figure 5.6

Replace a Hammerclaw Camshaft with a Standard Q Plus™ Camshaft

Follow Steps 1-2 under Q Plus™ and Q Series 16.5-Inch Brakes in this section to replace a Q Series hammerclaw camshaft with a standard Q Plus™ camshaft. Continue to follow service and maintenance procedures for a Q Plus™ camshaft and Q Series brake.

For front axles only, a standard Q Plus™ camshaft and a shoe return spring with an offset center bar replaces the hammerclaw Q Series camshaft and shoe return spring with a straight center bar on the 16.5 x 5-inch and 6-inch Q Series cam brake. Figure 5.7 and Figure 5.8.

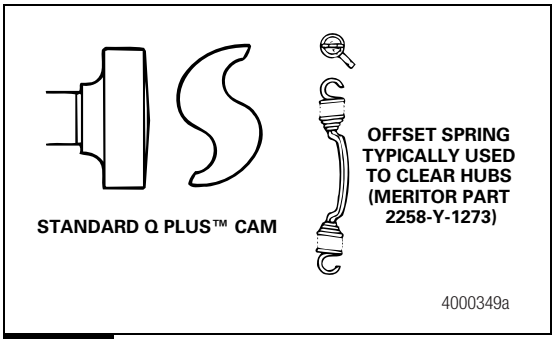


Figure 5.7

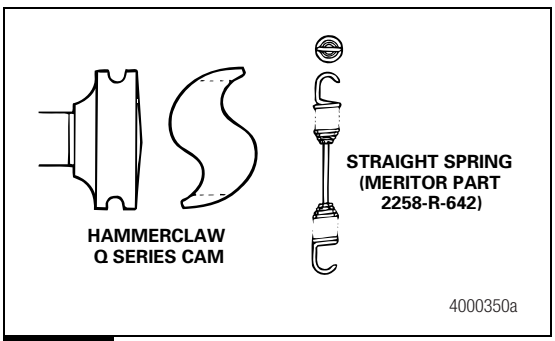


Figure 5.8

A Q Plus™ camshaft has deeper roller pockets than a Q Series camshaft and has “Q Plus” forged into one of the pockets. You may notice a larger gap between the brake lining and the drum after you assemble the brake shoe and shoe return spring with an offset center bar. Figure 5.9. The excess gap will be eliminated when you correctly adjust the brake.

5 Assembly and Installation

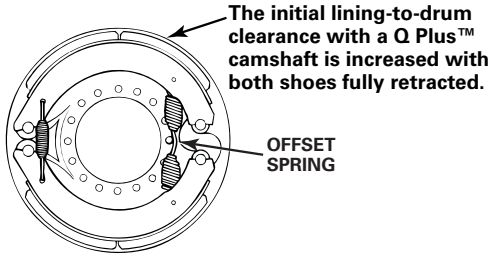


Figure 5.9

Shoe Return Spring

Install the new offset shoe return spring with the open end of the spring hooks toward the camshaft. Figure 5.10.

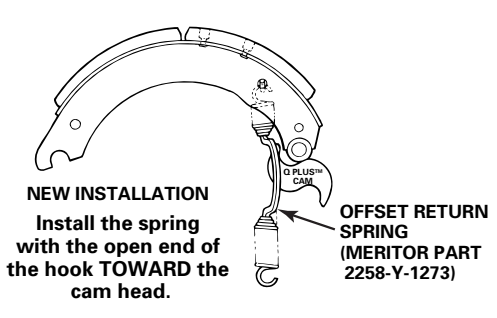


Figure 5.10

Automatic Slack Adjuster onto the Camshaft

NOTE: If the slack adjuster is not a Meritor automatic slack adjuster, refer to the manufacturer's literature for the correct service procedures.

While in service, it is possible that the boot's tie wrap might have been replaced with a tie wrap of a different color than originally installed at manufacture. If this happens, the tie wrap will not correctly identify the brake type and air chamber size.

Meritor recommends that you remove the boot from the slack adjuster to determine the color of the actuator piston, which identifies the brake type and air chamber size.

When You Replace an Automatic Slack Adjuster

The original equipment manufacturer paints the chassis and slack adjusters, which includes the mylar tag or tie wrap, depending on the slack adjuster model.

When you replace an automatic slack adjuster, the color of the actuator piston on the new slack adjuster must match the color of the actuator piston on the in-service slack adjuster you'll replace.

Check the mylar tag or color-coded tie wrap, or remove the boot as described below to identify the color of the actuator piston. To ensure a correct installation, this color must match the color of the actuator piston on the in-service slack adjuster you'll replace.

- **If you are unsure of the color of the actuator piston on the in-service slack adjuster:** Remove the piston boot to see the color of the actuator piston to ensure a correct installation. The color must be the same as the new slack adjuster you'll install.

For a complete color-coding list, refer to Parts Catalog PB-8857, Brake, Trailer Axle and Wheel Attaching Parts. To obtain this publication, refer to the Service Notes page on the front inside cover of this manual.

1. Check the camshaft and bushings and seals for wear and corrosion. Turn the camshaft by hand to check for smooth operation. Repair or replace parts as required.
2. Apply the service brake and spring brake several times. Check that the chamber return spring retracts the push rod quickly and completely. If necessary, replace the return spring or the air chamber.
3. Verify that the new automatic slack adjuster is the same length as the one you are replacing. Refer to Table B.

Table B: Chamber and Automatic Slack Adjuster Sizes

Length of Slack Adjuster (Inches)	Size of Chamber (Square Inches)
5	9, 12, 16, 20, 24, 30*
5-1/2	9, 12, 16, 20, 24, 30, 36*
6	24, 30, 36
6-1/2	30, 36

* Use an auxiliary spring on slack adjusters used with size 9 and 12 chambers. A size 9 or 12 chamber return spring cannot supply enough spring tension to completely retract the slack adjuster.

5 Assembly and Installation

⚠ WARNING

Before you service a spring chamber, carefully follow the manufacturer's instructions to compress and lock the spring to completely release the brake. Verify that no air pressure remains in the service chamber before you proceed. Sudden release of compressed air can cause serious personal injury and damage to components.

4. If the vehicle has spring brakes, follow the chamber manufacturer's instructions to compress and lock the springs to completely release the brakes. Verify that no air pressure remains in the service chambers.

⚠ CAUTION

Most Meritor automatic slack adjusters manufactured after January 1990 have lubrication holes in the gear splines. Do not operate the actuator rod before you install the slack adjuster. Lubricant can pump through the holes and onto the splines. Damage to components can result.

5. If the automatic slack adjuster gear has a 10-tooth spline, apply Meritor specification 0-637, part number 2297-U-4571, anti-seize compound, or equivalent. This anti-seize compound is a corrosion-control grease. Do not mix this grease with other greases.

NOTE: Install the slack adjuster so that you can remove a conventional pawl or disengage a pull pawl when you adjust the brake.

6. Add the thick camshaft thrust washer. Install the slack adjuster onto the camshaft. Position the slack adjuster so that you can access the pawl when you adjust the brake.
7. Add thin camshaft spacing washers, followed by a thick camshaft spacing washer (thick spacing washer must be next to the snap ring). Install the snap ring.
8. Verify that camshaft axial end play on trucks and tractors is 0.005-0.060-inch (0.127-1.52 mm). On trailers, no end play adjustment is required. End play is controlled by the snap ring near the cam head end of the camshaft.
   - **If axial end play is not 0.005-0.060-inch (0.127-1.52 mm):** Remove the snap ring. Add or remove the appropriate number of spacing washers to achieve the correct specification.
9. If the assembly has a "bolt-on" type camshaft, refer to Assembly of the Slack Adjuster for a Bolted Camshaft in this section.
10. Install the clevis onto the push rod.

⚠ CAUTION

You must disengage a pull pawl or remove a conventional pawl before rotating the manual adjusting nut, or you will damage the pawl teeth. A damaged pawl will not allow the slack adjuster to automatically adjust brake clearance. Replace damaged pawls before putting the vehicle in service.

11. Disengage the pull pawl. Turn the manual adjusting nut to align the holes in the slack adjuster arm and clevis. Figure 5.11.

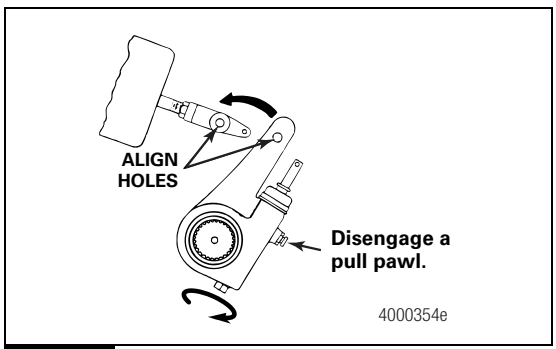


Figure 5.11

Assembly of the Slack Adjuster for a Bolted Camshaft

Refer to Figure 5.12 for measurement location and component description.

Place bracket washer (1229H4090) between slack and bracket. Place the slack on the camshaft and check in this order.

1. Alignment of slack arm to chamber centerline, maximum 0.100″ mismatch.
2. Slack body to wing bracket clearance during slack actuation.
   - **If slack interferes with bracket:** Shim between slack and bracket washer with the following washers and repeat Step 1.

Part Number	Nominal Thickness
1229-H-4090	0.104″
1229-W-2935	0.030″
1229-X-2936	0.054″

5 Assembly and Installation

3. Use hardened camshaft step washer and spacer washers to set up end play and slack between 0.005″ and 0.060″. Add spacer washers between the slack body and the hardened camshaft step washer.

Hardened Camshaft Step Washer Part Number	Nominal Step Thickness
1229-L-5030	0.260″
1229-M-5031	0.405″

Spacer Washer Part Number	Nominal Thickness
1229-W-1505	0.090″
1229-D-5022	0.054″

Table C: Typical End Play Washer Requirements

Measured Distance from End of Camshaft to Edge of Slack	Hardened Camshaft Step Washer Thickness	Spacer Washer Thickness
0.200″ to 0.255″	0.260″	None
0.256″ to 0.309″	0.260″	0.504″
0.310″ to 0.345″	0.260″	0.090″
0.346″ to 0.400″	0.405″	None
0.401″ to 0.454″	0.405″	0.054″
0.455″ to 0.490″	0.405″	0.090″
0.491″ to 0.539″	0.405″	0.054″ and 0.090″

4. Install lock washer (WA-18) and bolt (S-2812–2, 0.50″-13 thread x 1.50″ long), then torque bolt to 85-115 lb-ft (115-155 N•m).
5. Verify end play between 0.005″ and 0.060″.
6. Brake assembly check: Actuate brake by pulling on slack to assure cam and roller move freely and that shoes retract when slack is released.

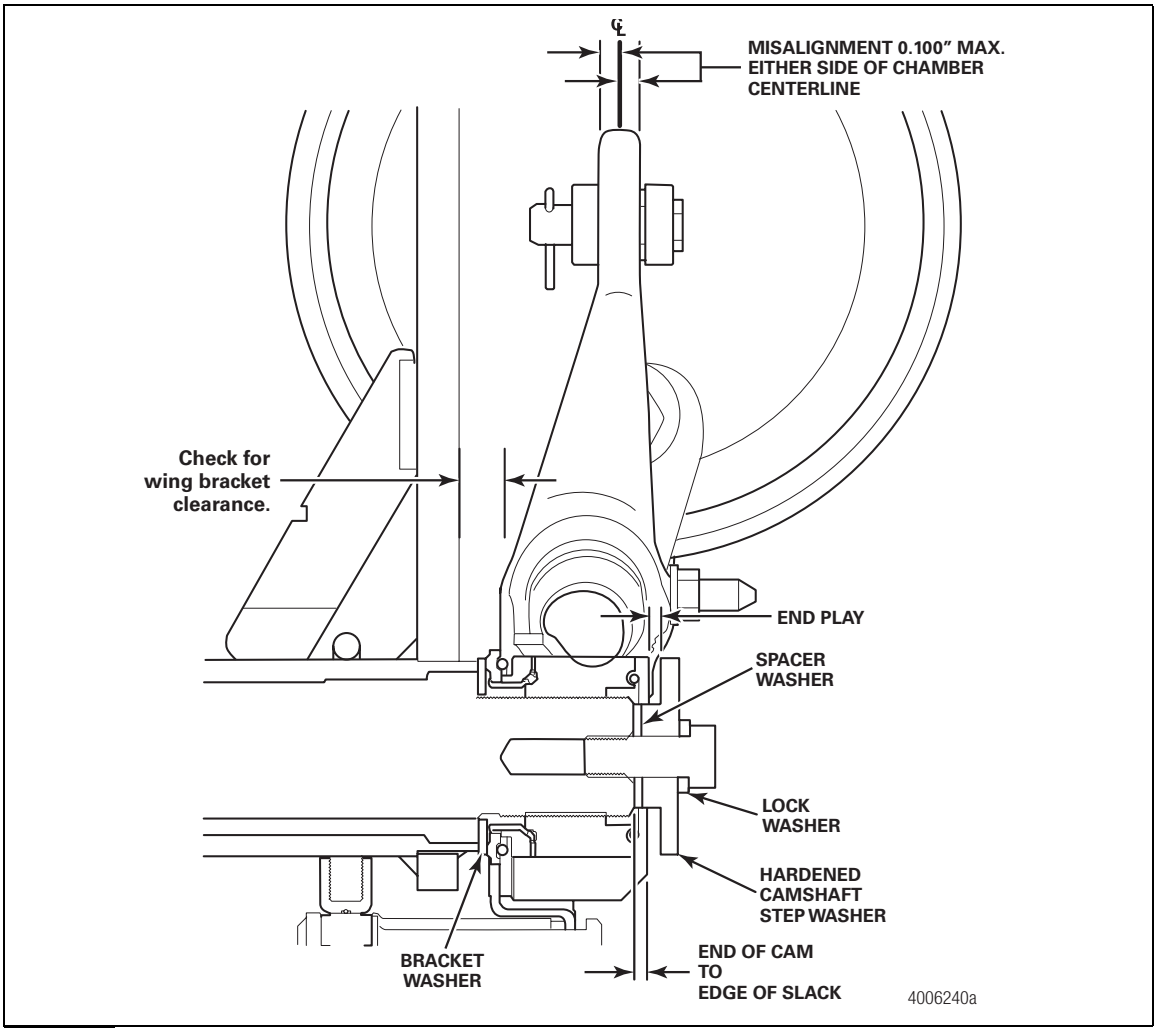

℄
MISALIGNMENT 0.100" MAX.
EITHER SIDE OF CHAMBER
CENTERLINE
Check for
wing bracket
clearance.
END PLAY
SPACER
WASHER
LOCK
WASHER
HARDENED
CAMSHAFT
STEP WASHER
BRACKET
WASHER
END OF CAM
TO
EDGE OF SLACK
4006240a

Figure 5.12

5 Assembly and Installation

Welded Clevis

1. Check the clevis position using the brake slack adjuster position (BSAP) method. Refer to Table E. Apply Meritor specification O-637, part number 2297-U-4571, anti-seize compound or equivalent to the large and small clevis pins. This anti-seize compound is a corrosion-control grease. Do not mix this grease with other greases.

⚠ CAUTION

Always replace used clevis pin retainer clips with new ones when you service an automatic slack adjuster or chamber. Do not reuse retainer clips. Discard used clips. When you remove a retainer clip, it can bend or "gap apart" and lose retention. Damage to components can result.

2. Install new clevis pin retainer clips or cotter pins to secure the clevis pins. Retainer clips must be fully installed and positioned around the side of the clevis pin. Figure 5.13.

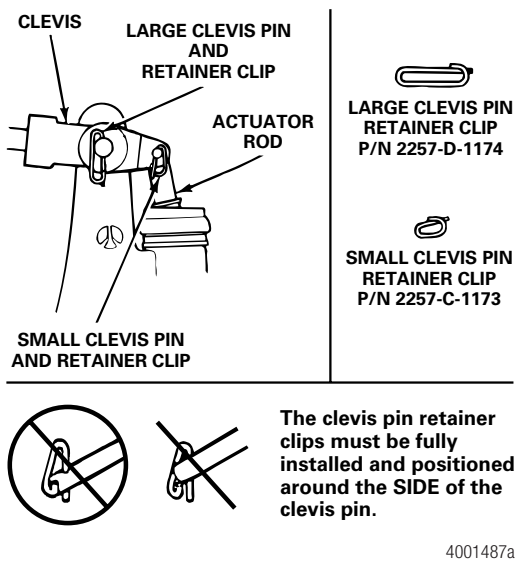


Figure 5.13

Threaded Clevis

The threaded-type clevis is available in two different pin spacings, 1.30-inches (33 mm) and 1.38-inches (35 mm). Figure 5.14.

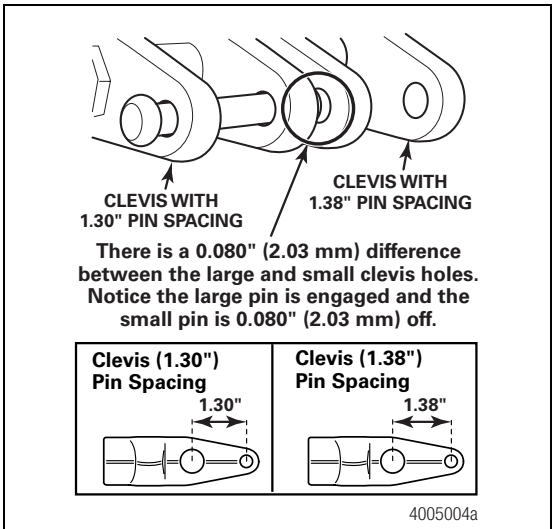


Figure 5.14

Based on your pin spacing, install the threaded clevis to the correct position using the template or brake slack adjuster position (BSAP) method. Refer to Table E.

Verify That the Slack Adjuster Angle is Correct

There are two methods for determining the correct geometry for the slack adjuster.

A. Brake Slack Adjuster Position (BSAP)

B. Template

Trucks and Tractors Equipped with Long-Stroke Chambers

Because of concerns regarding slack adjuster-to-axle clearances at the end of longer strokes, Meritor has revised instructions to use the BSAP method *only*. Trailers are not affected by this change. Refer to Brake Slack Adjuster Position (BSAP) Method and Table E in this section.

Trucks and Tractors Equipped with Standard-Stroke Chambers; Trailers Equipped with Standard- or Long-Stroke Chambers

You can use either the Brake Slack Adjuster Position (BSAP) method or the template method to verify that slack adjuster angles are correct on trucks and tractors with standard-stroke brake chambers and trailers with standard- and long-stroke brake chambers. Refer to Table E.

To obtain the correct slack adjuster template, refer to the Service Notes page on the front inside cover of this manual.

Template Method

⚠ CAUTION

There are three different installation templates for Meritor automatic slack adjusters. The templates are not interchangeable. You must use the correct template and clevis pin spacing and you must adjust the clevis position as described below. If you use the wrong combination and install the clevis in the wrong position, the slack adjuster will not adjust the brake correctly. If the slack adjuster underadjusts, then stopping distances are increased. If the slack adjuster overadjusts, then the linings may drag and damage the brake.

1. Use the correct Meritor automatic slack adjuster template to measure the length of the slack adjuster. The marks by the holes in the small end of the template indicate the length of the slack adjuster. Refer to Table E.
2. Install the large clevis pin through the large holes in the template and the clevis.
3. Select the hole in the template that matches the length of the slack adjuster. Hold that hole on the center of the camshaft.
4. Look through the slot in the template to see if the small clevis hole completely aligns within the slot.
   - **If the small clevis hole doesn't align within the slot:** Adjust the clevis until you can see the small clevis pin hole within the slot. Figure 5.15.

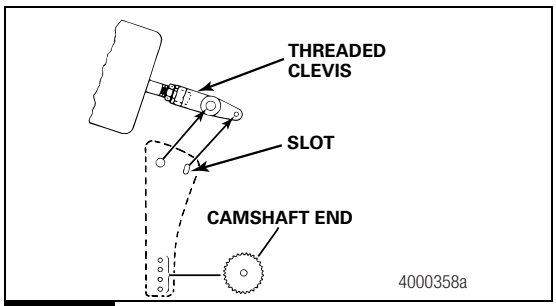


Figure 5.15

5. Verify that the thread engagement between the clevis and push rod is 0.5-0.625-inch (12.7-15.9 mm). Figure 5.16.

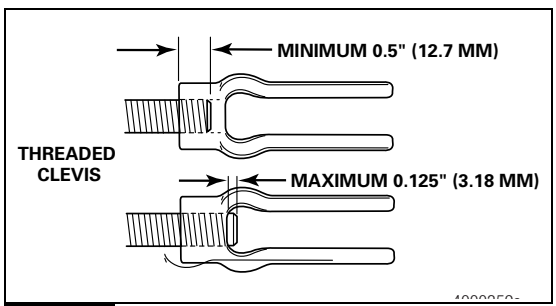


Figure 5.16

6. Verify that the push rod does not extend through the clevis more than 0.125-inch (12.7 mm).
   - **If the push rod extends through the clevis more than 0.125-inch (12.7 mm):** Cut the push rod or install a new air chamber and push rod.
7. Tighten the jam nut against the clevis to the torque specification in Table D. ❶

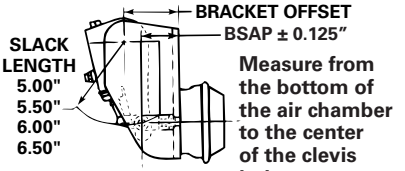
Table D: Jam Nut Torque Specifications

Threads	Torque
1/2-20	20-30 lb-ft (27-41 N•m)
5/8-18	35-50 lb-ft (48-68 N•m)

8. Use the following steps to install the automatic slack adjuster.
   A. Determine the clevis pin spacing.
   B. Determine the brake offset.
   C. Refer to Table E for the recommended installation.

5 Assembly and Installation

Table E: Meritor Automatic Slack Adjuster Installation Instructions



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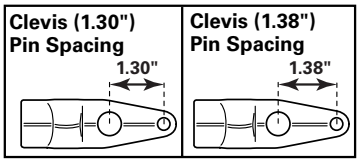
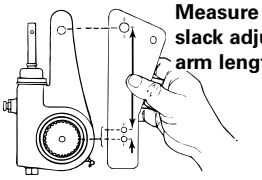


VIEW B 4005444a



VIEW C 4005446a

1.30″ Clevis Pin Spacing

Slack Length	Bracket Offset Refer to View A.	Clevis Pin Spacing Refer to View B.	± 0.125″ BSAP Installation	Clevis Type	Chamber Type	Optional Template Method Refer to View C. Template Color	Template Part Number	Vehicle Application
5.00″ 5.50″ 6.00″ 6.50″	3.75″ and 3.81″	1.30″	2.25″	Threaded or Welded	Standard Stroke or Long Stroke	Not Available		Truck or Tractor Drum Brake

1.38″ Clevis Pin Spacing								
Slack Length	Bracket Offset Refer to View A.	Clevis Pin Spacing Refer to View B.	± 0.125″ BSAP Installation	Clevis Type	Chamber Type	Optional Template Method Refer to View C. Template Color	Template Part Number	Vehicle Application
5.00″ 5.50″ 6.00″	3.75″ and 3.81″	1.38″	2.75″	Threaded	Standard Stroke	Dark Brown	TP-4786	Truck or Tractor Drum Brake/ Straight or Offset Clevis
						White	TP-4781	Coach Drum Brake
6.50″			2.62″			Dark Brown	TP-4786	Truck or Tractor Drum Brake/ Straight or Offset Clevis
						White	TP-4781	Coach Drum Brake
1.38″ Clevis Pin Spacing Must Be Used with Other Bracket Offsets								
Slack Length	Bracket Offset	Clevis Pin Spacing	± 0.125″ BSAP Installation	Clevis Type	Chamber Type	Optional Template Method Refer to View C. Template Color	Template Part Number	Vehicle Application
5.00″ 5.50″ 6.00″ 6.50″	Other	1.38″	Not Applicable. Use Template Method.	Threaded	Standard Stroke or Long Stroke	Dark Brown	TP-4786	Truck or Tractor Drum Brake/ Straight or Offset Clevis
						Tan	TP-4787	Trailer Drum Brake
						White	TP-4781	Coach Drum Brake

If your combination is not shown, please call ArvinMeritor's Customer Service Center at 800-535-5560.

Brake Slack Adjuster Position (BSAP) Method

Use this method to ensure the correct position of welded or threaded clevises on standard- or long-stroke brake chambers.

When you install the slack adjuster, verify that the BSAP chamber dimension matches the dimension shown in Table E.

Brake Shoes

When the brake is disassembled, or when necessary, lubricate the anchor pins and rollers where these parts touch the brake shoes. Do not allow grease to contact the area of the camshaft roller that touches the camshaft head. Meritor recommends that you replace the springs, rollers, anchor pins and cam bushings at each reline.

Q Plus™ 15- and 16.5-Inch Brakes and Q Series 16.5-Inch Brakes

1. Use Meritor specification O-617-A or O-617-B grease to lubricate the brake shoe roller pin and anchor pin. Figure 5.17.

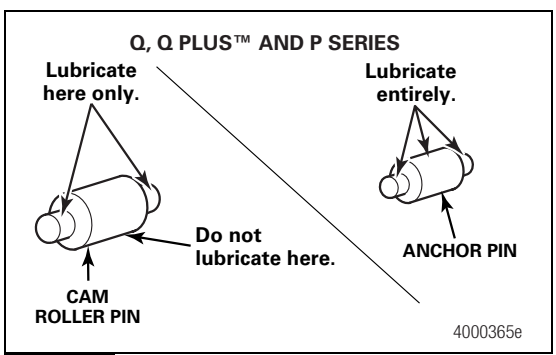


Figure 5.17

5 Assembly and Installation

2. Place the upper brake shoe into position on the top anchor pin. Hold the lower brake shoe on the bottom anchor pin. Install two new brake shoe retaining springs. Figure 5.18.

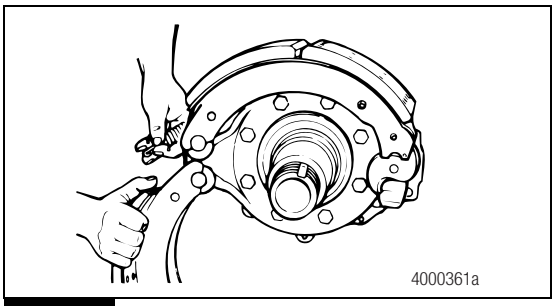


Figure 5.18

3. Rotate the lower brake shoe forward. Install a new brake shoe return spring with the open end of the spring hooks toward the camshaft. Figure 5.19.

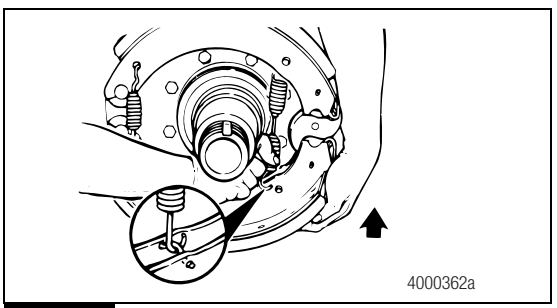


Figure 5.19

4. Pull each brake shoe away from the camshaft to enable you to install the brake shoe roller and roller retainer. Press the retainer ears to fit into the retainer between the brake shoe webs. Figure 5.20.

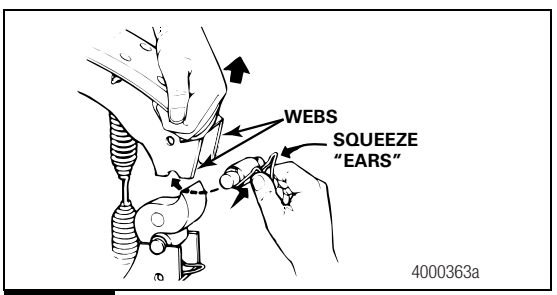


Figure 5.20

5. Push the brake shoe roller retainer into the brake shoe until the ears lock into the shoe web holes. Figure 5.21.

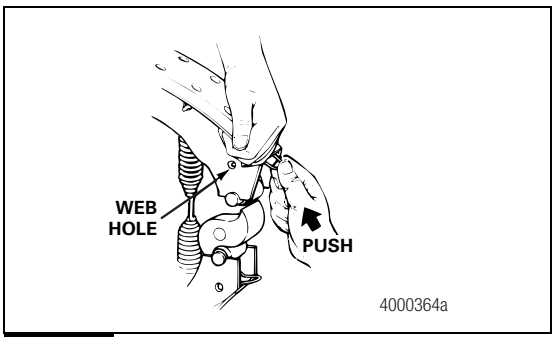


Figure 5.21

Q Series 15-Inch Cam Brake

1. Use Meritor specification 0-617-A or 0-617-B grease to lubricate the roller pin and anchor pin. Figure 5.22.

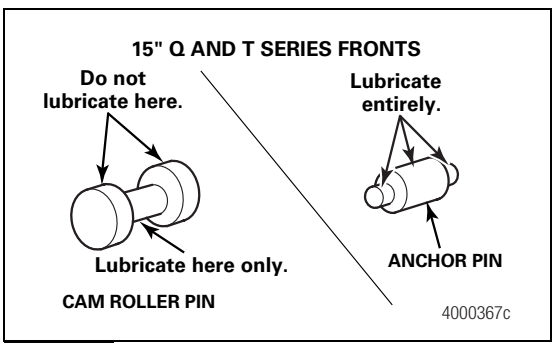


Figure 5.22

2. Install the anchor pins, washers and nuts to the spider if you removed these parts previously. Tighten the anchor pin nuts to 325-375 lb-ft (441-509 N•m).

3. Install a new brake shoe return spring with the open end of the spring hooks toward the camshaft. Install the brake shoes onto the anchor pins. Figure 5.23.

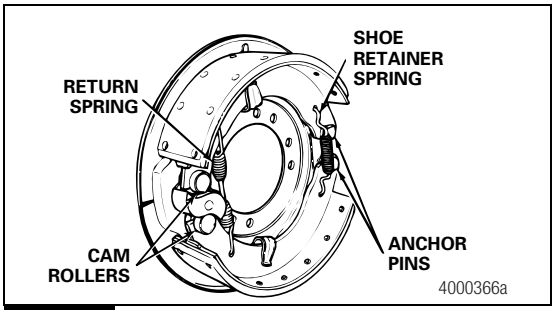


Figure 5.23

4. Hold the bottom brake shoe in position. Install the shoe return spring. Pull the brake shoe away from the camshaft to enable you to install the roller and roller retainer.

P Series and Cast Plus™ Cam Brakes

1. Lubricate the camshaft roller pin and anchor pin with Meritor specification O-617-A or O-617-B grease. Figure 5.17.
2. Install the anchor pin bushings. If necessary, align the holes in the bushings with the holes in the spider.
3. Install a new cam roller and cam roller retainers.
4. Install the lower brake shoe in position on the spider.
5. Use a hammer and brass drift to install the anchor pin. If necessary, align the groove on the anchor pin with the holes in the spider and bushing.
6. Install the anchor pin washers, felts, seals, retainers and snap rings, if required. Install lock pins or lock screws, if required. Tighten the screws to 10-15 lb-ft (13.6-20.3 N•m).
7. Install a new shoe return spring onto the brake shoe. Figure 5.24. Place the upper brake shoe into position over the spider. Repeat Steps 4-5.

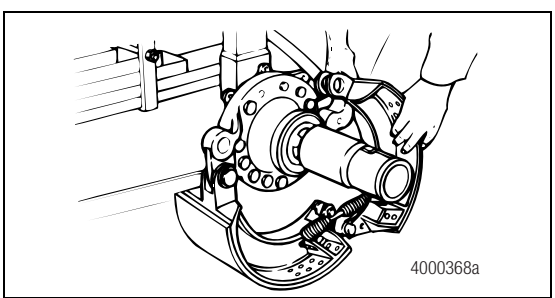


Figure 5.24

T Series Cam Brake

1. Lubricate the roller pin and anchor pin with Meritor specification O-617-A or O-617-B grease. Figure 5.22.
2. Install the anchor pins, washers and nuts onto the backing plate if you removed these parts previously. Tighten the anchor pin nuts to 185-350 lb-ft (251-475 N•m).
3. Install the anti-rattle rod. Install the brake shoe onto the anchor pins and anti-rattle rod.
4. Install the anchor pin snap rings, anti-rattle spring and anti-rattle retainer spring onto the anti-rattle rod.
5. Pull the brake shoe away from the camshaft to enable you to install the brake shoe roller. Install a new brake shoe return spring onto the brake shoe.

Drum and Wheel

Follow the manufacturer's instructions to install the drum and wheel onto the axle.

6 Adjustment

Hazard Alert Messages

Read and observe all Warning and Caution hazard alert messages in this publication. They provide information that can help prevent serious personal injury, damage to components, or both.

⚠ WARNING

To prevent serious eye injury, always wear safe eye protection when you perform vehicle maintenance or service.

⚠ ASBESTOS AND NON-ASBESTOS FIBERS WARNING

Some brake linings contain asbestos fibers, a cancer and lung disease hazard. Some brake linings contain non-asbestos fibers, whose long-term effects to health are unknown. You must use caution when you handle both asbestos and non-asbestos materials.

Important Information

Meritor automatic slack adjusters (ASAs) should not need to be manually adjusted in service. ASAs should not have to be adjusted to correct excessive push rod stroke. The excessive stroke may be an indication that a problem exists with the foundation brake, ASA, brake actuator or other system components.

Meritor recommends troubleshooting the problem, replacing suspect components and then confirming proper brake operation prior to returning the vehicle into service.

In the event that a manual adjustment must be made (although not a common practice), a service appointment and full foundation brake, ASA, and other system component inspection should be conducted as soon as possible to ensure integrity of the overall brake system.

For Meritor brake adjustment, refer to the brake adjustment tables in this manual. For non-Meritor brake adjusters, refer to the brake manufacturer's service procedures.

Adjust the Brakes

Measure Free Stroke

When you perform preventive maintenance procedures on an in-service brake, check both the free stroke and adjusted chamber stroke. Refer to the procedures in this section.

Free stroke sets the clearance between the linings and drum. The in-service free stroke may be slightly longer than 0.5-0.625-inch (12.7-15.9 mm) specified in this procedure. This is acceptable if the adjusted chamber stroke is within the limits shown in Table F and Table G.

⚠ CAUTION

You must disengage a pull pawl before rotating the manual adjusting nut, or you will damage the pawl teeth. A damaged pawl will not allow the slack adjuster to automatically adjust brake clearance. Replace damaged pawls before putting the vehicle in service.

1. Disengage a pull pawl. Use a screwdriver or equivalent tool to pry the pull pawl at least 1/32-inch (0.8 mm) to disengage the teeth.
2. Use a wrench to turn the adjusting nut COUNTERCLOCKWISE until the brake shoes contact the drum. Figure 6.1. Then back off the adjusting nut in the opposite direction 1/2 turn for drum brakes or 3/4 turn for disc brakes.

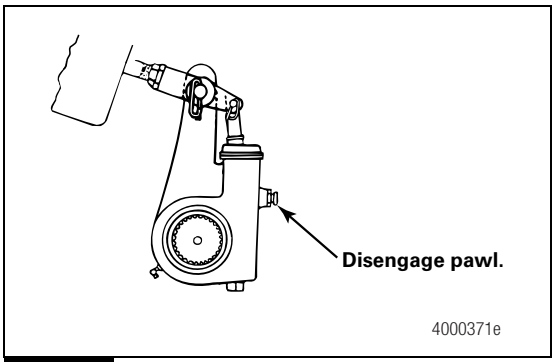


Figure 6.1

3. Measure the distance from the center of the large clevis pin to the bottom of the air chamber while the brake is released. The measurement you obtain is X in Figure 6.2.

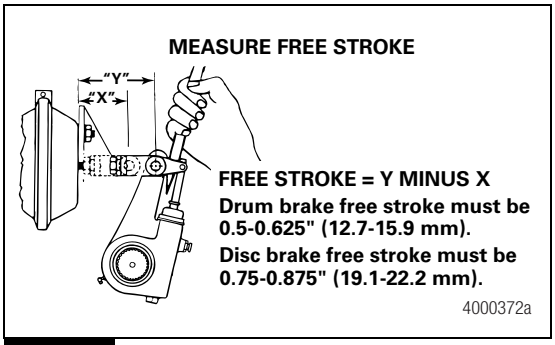


Figure 6.2

4. Use a pry bar to move the slack adjuster and position the linings against the drum, brakes applied. Measure the same distance again while the brakes are applied. The measurement you obtain is Y in Figure 6.2.

⚠ CAUTION

Do not set free stroke shorter than 0.5-0.625-inch (12.7-15.9 mm) for drum brakes. If the measurement is too short, linings can drag. Damage to components can result.

5. Subtract X from Y to obtain the in-service free stroke. The measurement must be 0.5-0.625-inch (12.7-15.9 mm) for drum brakes. Figure 6.2.

   - **If the free stroke measurement is not within specification:** Turn the adjusting nut 1/8 turn in the direction shown in Figure 6.3 and check the free stroke again. Continue to measure and adjust the stroke until the measurement is within specification.

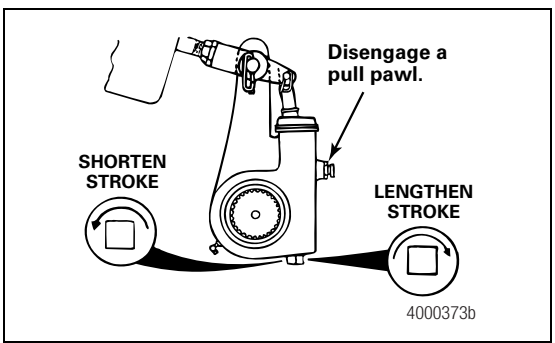


Figure 6.3

6. Re-engage the pull pawl by removing the screwdriver or equivalent tool. The pull pawl will re-engage automatically.
7. If the brakes have spring chambers, carefully release the springs. Test the vehicle before you return it to service.

Important Information

Meritor automatic slack adjusters (ASAs) should not need to be manually adjusted in service. ASAs should not have to be adjusted to correct excessive push rod stroke. The excessive stroke may be an indication that a problem exists with the foundation brake, ASA, brake actuator or other system components.

Meritor recommends troubleshooting the problem, replacing suspect components and then confirming proper brake operation prior to returning the vehicle into service.

In the event that a manual adjustment must be made (although not a common practice), a service appointment and full foundation brake, ASA, and other system component inspection should be conducted as soon as possible to ensure integrity of the overall brake system.

For Meritor brake adjustment, refer to the brake adjustment tables in this manual. For non-Meritor brake adjusters, refer to the brake manufacturer's service procedures.

Commercial Vehicle Safety Alliance (CVSA) Guidelines

Measure Push Rod Travel or Adjusted Chamber Stroke

Use the following procedure to check in-service push rod travel or adjusted chamber stroke on truck and tractor brakes.

⚠ WARNING

Before you service a spring chamber, carefully follow the manufacturer's instructions to compress and lock the spring to completely release the brake. Verify that no air pressure remains in the service chamber before you proceed. Sudden release of compressed air can cause serious personal injury and damage to components.

1. The engine must be OFF. If the brake has a spring chamber, follow the manufacturer's instructions to release the spring. Verify that no air pressure remains in the service section of the chamber.

6 Adjustment

2. Verify that pressure is 100 psi (689 kPa) in the air tanks. Determine the size and type of brake chambers on the vehicle.
3. With the brakes released, mark the push rod where it exits the chamber. Measure and record the distance. Have another person apply and hold the brakes on full application. Figure 6.4. Hold the ruler parallel to the push rod and measure as carefully as possible. A measurement error can affect CVSA re-adjustment limits. CVSA states that "any brake 1/4-inch or more past the re-adjustment limit, or any two brakes less than 1/4-inch beyond the re-adjustment limit, will be cause for rejection."

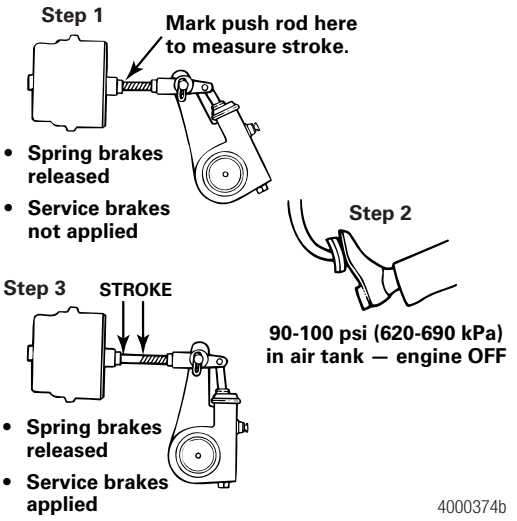


Figure 6.4

4. Measure the push rod travel or adjusted chamber stroke from where the push rod exits the brake chamber to your mark on the push rod. Measure and record the distance. Figure 6.4.
5. Subtract the measurement you recorded in Step 3 from the measurement you recorded in Step 4. The difference is the push rod travel or adjusted chamber stroke.
6. Refer to Table F or Table G to verify that the stroke length is correct for the size and type of air chambers on the vehicle.
   - **If the adjusted chamber stroke is greater than the maximum stroke shown in Table F or Table G:** Diagnose and correct the problem.

Table F: Standard-Stroke Clamp-Type Brake Chamber Data

Type	Outside Diameter (inches)	Brake Adjustment Limit (inches)
6	4-1/2	1-1/4
9	5-1/4	1-3/8
12	5-4/16	1-3/8
16	6-3/8	1-3/4
20	6-25/32	1-3/4
24	7-7/32	1-3/4
30	8-3/32	2
36	9	2-1/4

Table G: Long-Stroke Clamp-Type Brake Chamber Data

Type	Outside Diameter (inches)	Brake Adjustment Limit (inches)
16	6-3/8	2.0
20	6-25/32	2.0
24	7-7/32	2.0
24*	7-7/32	2.5
30	8-3/32	2.5

* For 3" maximum stroke type 24 chambers.

Alternate Method to Measure Push Rod Travel or Adjusted Chamber Stroke

Use the CVSA procedure, except in Steps 3 and 4, measure the distance from the bottom of the air chamber to the center of the large clevis pin on each of the brakes.

CVSA North American Out-of-Service Criteria Reference Tables

Information contained in Table F and Table G is for reference only. Consult the CVSA Out-of-Service Criteria Handbook for North American Standards, Appendix A. Visit their website at http://64.35.82.7/ to obtain the handbook.

Hazard Alert Messages

Read and observe all Warning and Caution hazard alert messages in this publication. They provide information that can help prevent serious personal injury, damage to components, or both.

⚠ WARNING

To prevent serious eye injury, always wear safe eye protection when you perform vehicle maintenance or service.

During lubrication procedures, if grease flows from the seal near the camshaft head, replace the seal. Remove all grease or oil from the camshaft head, rollers and brake linings. Always replace linings contaminated with grease or oil, which can increase stopping distances. Serious personal injury and damage to components can result.

⚠ ASBESTOS AND NON-ASBESTOS FIBERS WARNING

Some brake linings contain asbestos fibers, a cancer and lung disease hazard. Some brake linings contain non-asbestos fibers, whose long-term effects to health are unknown. You must use caution when you handle both asbestos and non-asbestos materials.

Lubrication

Cam Brakes

Refer to Table H for grease specifications.

Table H: Cam Brake Grease Specifications

Components	Meritor Specification	NLGI Grade	Grease Type	Outside Temperature
Retainer Clips	0-617-A	1	Lithium 12-Hydroxy Stearate or Lithium Complex	Refer to the grease manufacturer's specifications for the temperature service limits.
Anchor Pins	0-617-B	2		
Rollers, Journals Only				
Camshaft Bushings	0-645	2	Synthetic Oil, Clay Base	Down to –65°F (–54°C)
	0-692	1 and 2	Lithium Base	Down to –40°F (–40°C)
	0-701	2	Synthetic Oil, Calcium Base	Down to –65°F (–54°C)
	0-703	2	Synthetic Oil, Calcium Base	Down to –65°F (–54°C)
Camshaft Splines	Any of above	Refer to above	Refer to above	Refer to above
	0-637*	1-1/2	Calcium Base	Refer to the grease manufacturer's specifications for the temperature service limits.
	0-641	—	Anti-Seize	
	0-702	1-1/2	Calcium Base	

* Do not mix Meritor specification 0-637 grease, part number 2297-U-4571, a calcium-base, rust-preventive grease, with other greases.

Camshaft Bushings

Meritor recommends that you install new camshaft bushings whenever you install a new camshaft.

Lubricate through the fitting on the bracket or spider until new grease flows from the inboard seal.

Long-life trailer cam brake bushings require correct lubrication for maximum performance and bushing life. Although you do not have to replace spider cam bushings on trailer axles as frequently, Meritor recommends that you lubricate the bushings at least four times during the life of your brake lining.

7 Maintenance

Rollers and Anchor Pins

When you disassemble the brake, or when necessary, lubricate the anchor pins and rollers where these parts touch the brake shoes.

Do not allow grease to contact the area of the roller that touches the camshaft head. To avoid flat spots, lubricate a cam roller directly in the web roller pocket and not at the cam-to-roller contact area. Flat spots can affect brake adjustment and result in premature brake wear or reduced braking performance. Figure 7.1 and Figure 7.2.

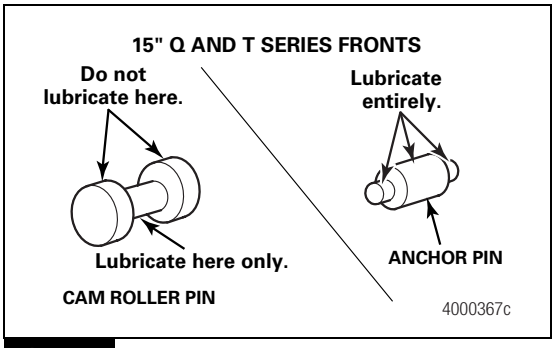


Figure 7.1

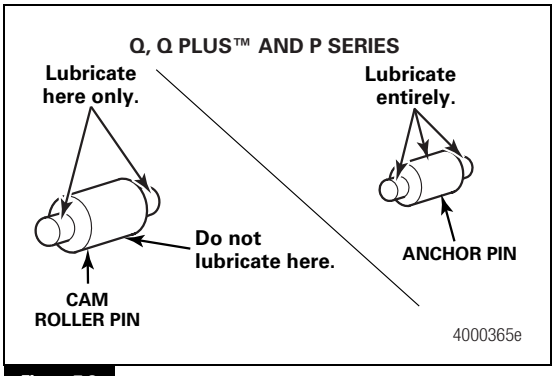


Figure 7.2

Important Information

Meritor automatic slack adjusters (ASAs) should not need to be manually adjusted in service. ASAs should not have to be adjusted to correct excessive push rod stroke. The excessive stroke may be an indication that a problem exists with the foundation brake, ASA, brake actuator or other system components.

Meritor recommends troubleshooting the problem, replacing suspect components and then confirming proper brake operation prior to returning the vehicle into service.

In the event that a manual adjustment must be made (although not a common practice), a service appointment and full foundation brake, ASA, and other system component inspection should be conducted as soon as possible to ensure integrity of the overall brake system.

For Meritor brake adjustment, refer to the brake adjustment tables in this manual. For non-Meritor brake adjusters, refer to the brake manufacturer's service procedures.

Automatic Slack Adjusters

Automatic does not mean maintenance-free. Correctly installed and lubricated automatic slack adjusters help to ensure maximum brake system performance.

Inspect and lubricate the automatic slack adjuster according to one of the schedules below. Use the schedule that requires the most frequent inspection and lubrication, and whenever you reline the brakes. Refer to Table I and Table J for grease specifications.

- Vehicle manufacturer's schedule
- Fleet's schedule
- Every six months
- A minimum of four times during the life of the linings

Adjust the Brakes

Adjust the wheel bearings before you adjust the brakes.

Clean, inspect and adjust the brakes each time you remove a hub. Check for correct lining-to-drum clearance, push rod travel and brake balance.

At Brake Reline

1. Before you perform brake maintenance, check the free stroke and the adjusted chamber stroke.
2. If the free stroke is not correct, refer to Section 8 to correct the stroke before you adjust the chamber stroke.
3. Inspect the boot for cuts or other damage. If the boot is cut or damaged, remove the pawl and inspect the grease.
4. If the grease is in good condition, replace the damaged boot with a new boot.
5. Use a grease gun to lubricate the slack adjuster through the grease fitting. If necessary, install a camshaft into the slack adjuster gear to minimize grease flow through the gear holes.
6. Lubricate until new grease purges from around the inboard camshaft splines and from the pawl assembly.

Slack Adjusters Manufactured Before 1993

Remove and replace the slack adjuster when the following conditions are apparent.

- The grease is dry or contaminated.
- The pawl or actuator is worn.

Grease Specifications

Table I: Automatic Slack Adjuster Grease Specifications

Components	Meritor Specification	NLGI Grade	Grease Type	Outside Temperature
Automatic Slack Adjuster	O-616-A	1	Clay Base	Down to –40°F (–40°C)
	O-645	2	Synthetic Oil, Clay Base	Down to –65°F (–54°C)
	O-692	1 and 2	Lithium Base	Down to –40°F (–40°C)
	O-701	2	Synthetic Oil Calcium Base	Down to –65°F (–54°C)
Clevis Pins	Any of Above	Refer to Above	Refer to Above	Refer to Above
	O-637*	1-1/2	Calcium Base	Refer to the grease manufacturer's specifications for the temperature service limits.
	O-641	—	Anti-Seize	

* Do not mix Meritor specification O-637 grease, part number 2297-U-4571, a calcium-base, rust-preventive grease, with other greases.

Table J: Automatic Slack Adjuster Lubricant Specifications

Operating Temperature	
Down to –40°F (–40°C)	**Down to –65°F (–54°C)**
Clay-Base Greases	Synthetic Greases
Meritor Specification O-616-A, Part Number A-1779-W-283	Meritor Specification O-645, Part Number 2297-X-4574
Shell Darina Number 1	Mobilgrease 28 (Military)
Texaco Thermatex EP-1	Mobiltemp SHC 32 (Industrial)
Texaco Hytherm EP-1	Tribolube-12 Grade 1
Aralub 3837	

Anti-Seize Compound

Use anti-seize compound, Meritor specification O-637 grease, part number 2297-U-4571, on the clevis pins of all automatic slack adjusters.

For a conventional automatic slack adjuster, use anti-seize compound on the slack adjuster and camshaft splines if the slack adjuster gear does not have a grease groove and holes around its inner diameter.

7 Maintenance

Factory-Installed Automatic Slack Adjusters on Q Plus™ LX500 and MX500 Cam Brake Packages

Q Plus™ LX500 and MX500 cam brake packages include factory-installed automatic slack adjusters that do not have grease fittings. Also, lubrication intervals are different than intervals for conventional slack adjusters.

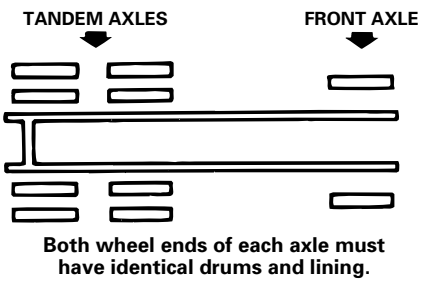
For complete maintenance and service information on the Meritor LX500 and MX500 cam brakes, refer to Maintenance Manual MM-96173, Q Plus™ LX500 and MX500 Cam Brakes. To obtain this publication, refer to the Service Notes page on the front inside cover of this manual.

Inspection and Maintenance Intervals

Application	Interval
Linehaul and General Service Vehicles	Q Plus™, Cast Plus™ and Q Series brakes at every 100,000 miles (160 000 km); or every six months, whichever comes first. P Series brakes at every 50,000 miles (80 000 km); or every six months, whichever comes first.
General Service and Heavy Service Vehicles	At least every four months, when you replace the seals and reline the brakes. Every two weeks during the first four-month period, inspect for hardened or contaminated grease, and for the absence of grease, to help determine lubrication intervals. Lubricate more often for severe-duty applications.
Restricted Service Vehicles	Lubricate every six months, at each reline, or at every 10,000 miles (16 000 km), whichever comes first.

Reline the Brakes

Reline the brakes when the lining thickness is 0.25-inch (6.3 mm) at the thinnest point. The rivets or bolts must not touch the drum. Damage to components will result. Meritor recommends that you replace the springs, rollers, camshaft bushings and anchor pins at each reline. Reline the brakes when the lining thickness is 0.25-inch (6.3 mm) at the thinnest point. Replace shoe retainer springs, check the drum, and perform a major inspection when you reline the brakes.



Both wheel ends of each axle must have identical drums and lining.

4000376a

Figure 7.3

Important Information on Linings and Primary Shoe Locations

Use the Correct Lining Material

Use the lining material specified by the vehicle manufacturer. This will help to ensure that the brakes perform correctly and meet Department of Transportation (DOT) performance regulations.

Also note that the drums and linings on a front axle can be different than drums and linings on a rear axle. Figure 7.3.

Single Axles

Always reline both wheels of a single axle at the same time. Always install the same type linings and drums on both wheels of a single axle.

Tandem Axles

Always reline all four wheels of a tandem axle at the same time. Always install the same type linings and drums on all four wheels of a tandem axle.

Combination Friction Linings

When you install combination friction linings, you must install the **primary** lining on the **primary** brake shoe. If you install combination friction linings incorrectly, damage to components will result. Carefully follow instructions included with the replacement linings. You can combine brake linings, which means that the linings you install on the primary shoe will have a different friction rating than the linings you install on the secondary shoe. However, you must install the primary lining on the primary shoe. Carefully follow the instructions included with the replacement combination linings.

Primary Shoe Locations

The first shoe past the camshaft in the direction of wheel rotation is the primary shoe. Figure 7.4. The primary shoe can be either at the top or bottom position, depending on the location of the camshaft. If the camshaft is behind the axle, the top shoe is the primary shoe. If the cam is in front of the axle, the top shoe is the primary shoe.

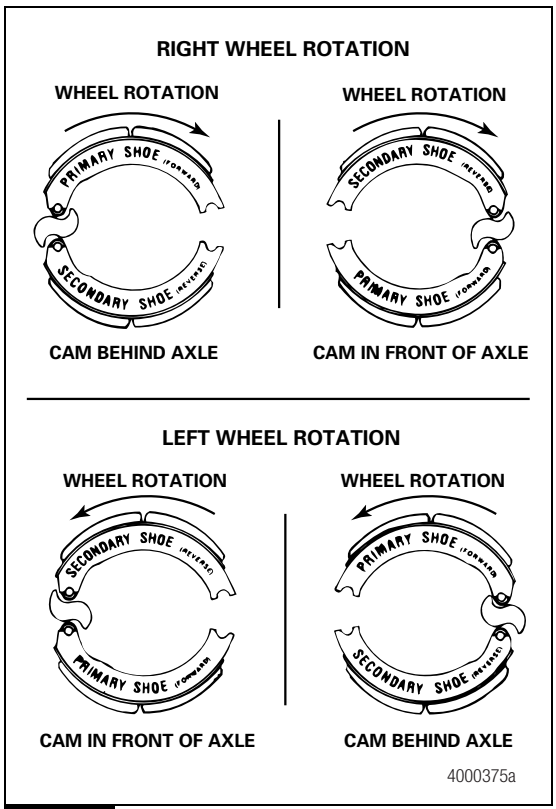


Figure 7.4

Major Overhaul

Perform a major overhaul at every second reline, or as necessary. Replace the shoe return springs. Replace the damaged or worn parts with genuine Meritor parts. Check the components for the following conditions.

- Spiders for distortion and loose bolts
- Anchor pins for wear and correct alignment
- Brake shoes for wear at anchor pin holes or roller slots
- Camshafts and camshaft bushings for wear
- Brake linings for grease on the lining, wear and loose rivets or bolts
- Drums for cracks, deep scratches or other damage

7 Maintenance

Inspection

Before You Return the Vehicle to Service

⚠ WARNING

To prevent serious eye injury, always wear safe eye protection when you perform vehicle maintenance or service.

1. Check the complete air system for worn hoses and connectors. With the air pressure at 100 psi (689 kPa), the brakes released and the engine off, tractor air pressure loss must not exceed two psi (13.8 kPa) per minute. Total tractor and trailer loss must not exceed three psi (20.7 kPa) per minute.
2. Verify that the air compressor drive belt is tight. Air system pressure must rise to approximately 100 psi (689 kPa) in two minutes.
3. The governor must be checked and set to the specifications supplied by the vehicle manufacturer.
4. Both the tractor and trailer air systems must match the specifications supplied by the vehicle manufacturer.
5. Both wheel ends of each axle must have the same linings and drums. All four wheel ends of tandem axles also must have the same linings and drums. It is not necessary for the front axle brakes to be the same as the rear drive axle brakes. Figure 7.5.

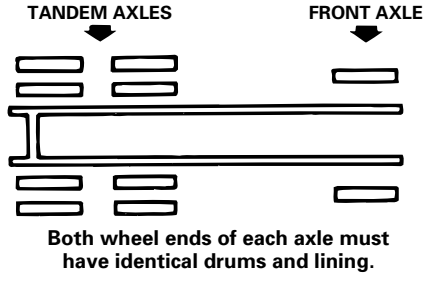


Figure 7.5

6. Always follow the specifications supplied by the vehicle manufacturer for the correct lining to be used. Vehicle brake systems must have the correct friction material and these requirements can change from vehicle to vehicle.
7. The return springs must retract the shoes completely when the brakes are released. Replace the return springs each time the brakes are relined. The spring brakes must retract completely when they are released.
8. The air chamber area multiplied by the length of the automatic slack adjuster is called the AL factor. This number must be equal for both ends of a single axle and all four ends of a tandem axle. Figure 7.6.

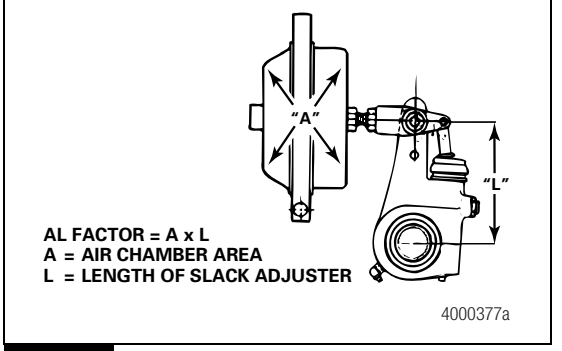


Figure 7.6

Important Information

Meritor automatic slack adjusters (ASAs) should not need to be manually adjusted in service. ASAs should not have to be adjusted to correct excessive push rod stroke. The excessive stroke may be an indication that a problem exists with the foundation brake, ASA, brake actuator or other system components.

Meritor recommends troubleshooting the problem, replacing suspect components and then confirming proper brake operation prior to returning the vehicle into service.

In the event that a manual adjustment must be made (although not a common practice), a service appointment and full foundation brake, ASA, and other system component inspection should be conducted as soon as possible to ensure integrity of the overall brake system.

For Meritor brake adjustment, refer to the brake adjustment tables in this manual. For non-Meritor brake adjusters, refer to the brake manufacturer's service procedures.

Troubleshooting

⚠ WARNING

To prevent serious eye injury, always wear safe eye protection when you perform vehicle maintenance and service.

Table K: Cam Brakes, All Models

Symptoms	Possible Causes	Corrective Actions
The adjusted stroke is too long.	The slack adjuster part number is incorrect.	Check with the warehouse distributor or original equipment manufacturer.
No adjustment occurs.	The clevis is installed at the wrong angle (BSAP or template).	Use the correct template or BSAP setting to install the clevis correctly.
	Wear between the clevis and collar is excessive, more than 0.060-inch (1.52 mm), (Quick Connect clevis).	Replace with a threaded clevis.
	The jam nut at the clevis is loose.	Tighten to specification.
	The clevis pin bushing in the slack arm is worn. The inside diameter of the bushing is larger than 0.53-inch (13.46 mm).	Replace the bushing.
	The return spring in the air chamber is weak or broken. Spring force must be at least 32 lb (142.4 N) at the first push rod movement.	Replace the return spring or air chamber.
	The spring brake does not retract fully.	Repair or replace the spring brake.
	The teeth on the pawl or actuator are worn or stripped.	Replace the slack adjuster.

8 Diagnostics

Table K: Cam Brakes, All Models

Symptoms	Possible Causes	Corrective Actions
The adjusted stroke is too long.	High torque is required to rotate the worm when the slack is removed from the vehicle.	Replace the slack adjuster.
No adjustment occurs	• In service slack, maximum worm torque: 45 lb-in (5.09 N•m) • New or rebuilt slack, maximum worm torque: 25 lb-in (2.83 N•m)	
	Looseness between the camshaft splines and automatic slack adjuster gear is excessive.	Replace the powershaft, gear or automatic slack adjuster as needed.
	Components, such as the cam bushing, are worn.	Replace the components.
	The non-original equipment manufacturer replacement linings may have excessive swell or growth.	Use Meritor-approved linings.
The adjusted stroke is too short.	The slack adjuster part number is incorrect.	Check with the warehouse distributor or original equipment manufacturer.
The linings drag.	The clevis is installed at the incorrect angle.	Use the correct template to install the clevis correctly.
	The jam nut at the clevis is loose.	Tighten to specification.
	The spring brake does not retract fully.	Repair or replace the spring brake.
	The manual adjustment is incorrect.	Adjust the brake.
	There is poor contact between the linings and the drum, or the drum is out-of-round.	Repair or replace the drums or linings.
	There is a brake temperature imbalance.	Correct the brake balance.
	The non-original equipment manufacturer replacement linings may have excessive swell or growth.	Use Meritor-approved linings.
	Insufficient air system pressure —causing parking spring to apply.	Check the air system pressure.

Torque Specifications

Cam Brakes

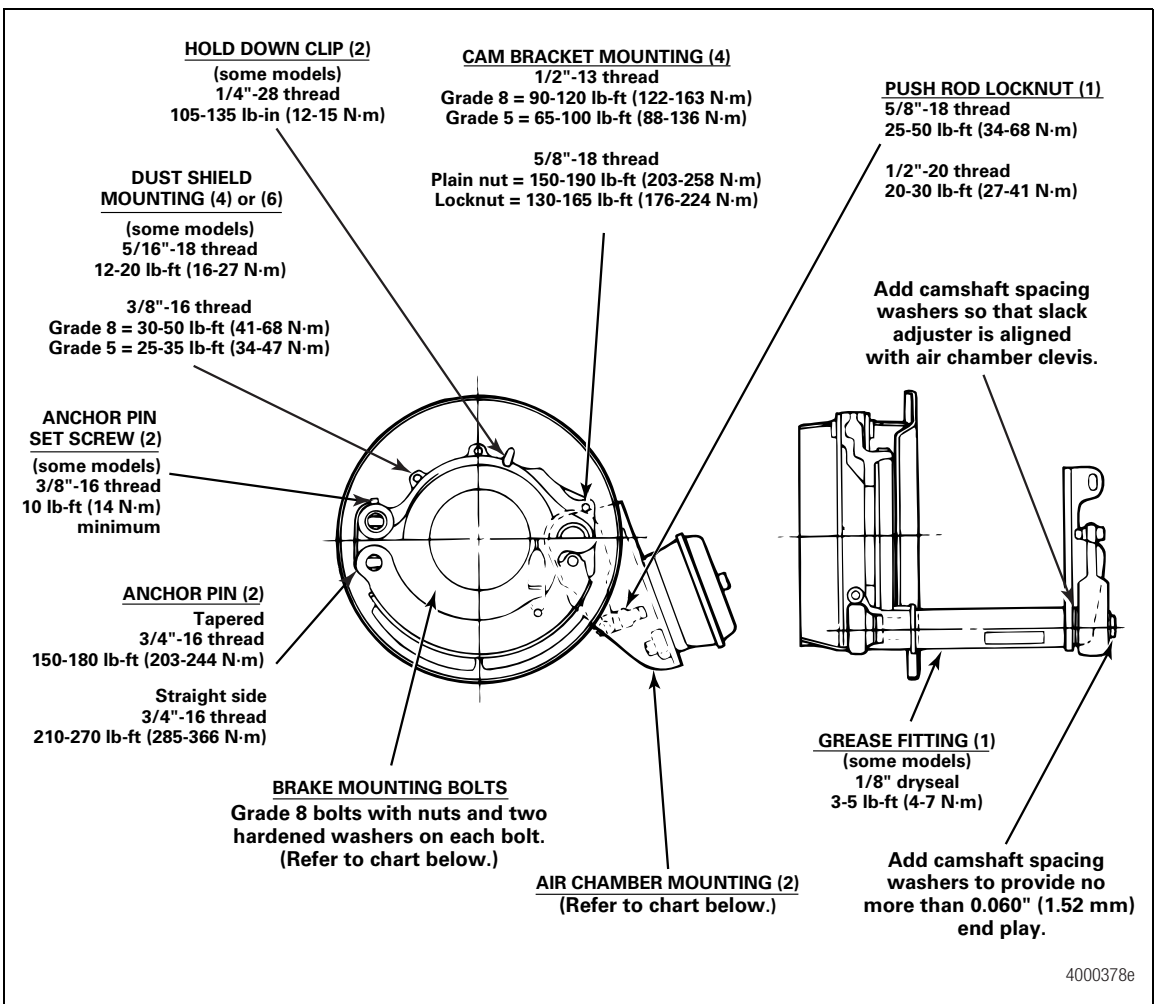


Figure 9.1

Table L: Brake Mounting Bolts

Bolt Size, Grade 8	Torque, lb-ft (N•m)
7/16″-20	60-75 (81-102)
1/2″-20	85-115 (115-156)
9/16″-18	130-165 (176-224)
5/8″-18	180-230 (244-312)

9 Specifications

Table M: Air Chamber Mounting, Grade 8 Nuts and Hard Flat Washers

Chamber Size	9	12	16	20	24	30	36	Spring Chamber
Bendix	20-30 lb-ft (27-41 N•m)		30-45 lb-ft (41-61 N•m)			45-65 lb-ft (61-88 N•m)		65-85 lb-ft (88-115 N•m)
Haldex	35-50 lb-ft (48-68 N•m)			70-100 lb-ft (95-136 N•m)				
MGM	35-40 lb-ft (48-54 N•m)			133-155 lb-ft (180-210 N•m)				
Anchorlok/ Haldex	—			130-150 lb-ft (177-203 N•m)				

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Maintenance Manual 4 (16579/22882)

ArvinMeritor™

Overview

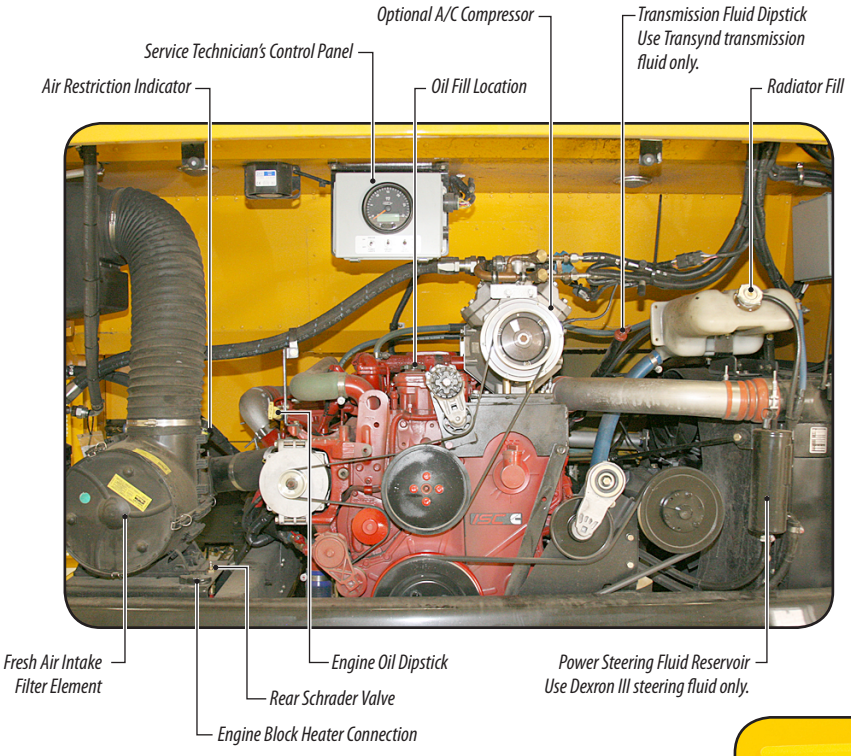
The Blue Bird All American engine/transmission package is a Cummins ISC-07 or ISL-G in-line six cylinder diesel engine mated to an Allison 2000 Series™ five-speed or Allison 3000 Series six-speed automatic transmission. Both engine and transmission have electronic control modules. For detailed instruction on engine maintenance and repair, please consult the appropriate Cummins publication. Check with your Blue Bird Dealer or the nearest Cummins Dealer to ensure you are working with the proper publication.

Engine Access

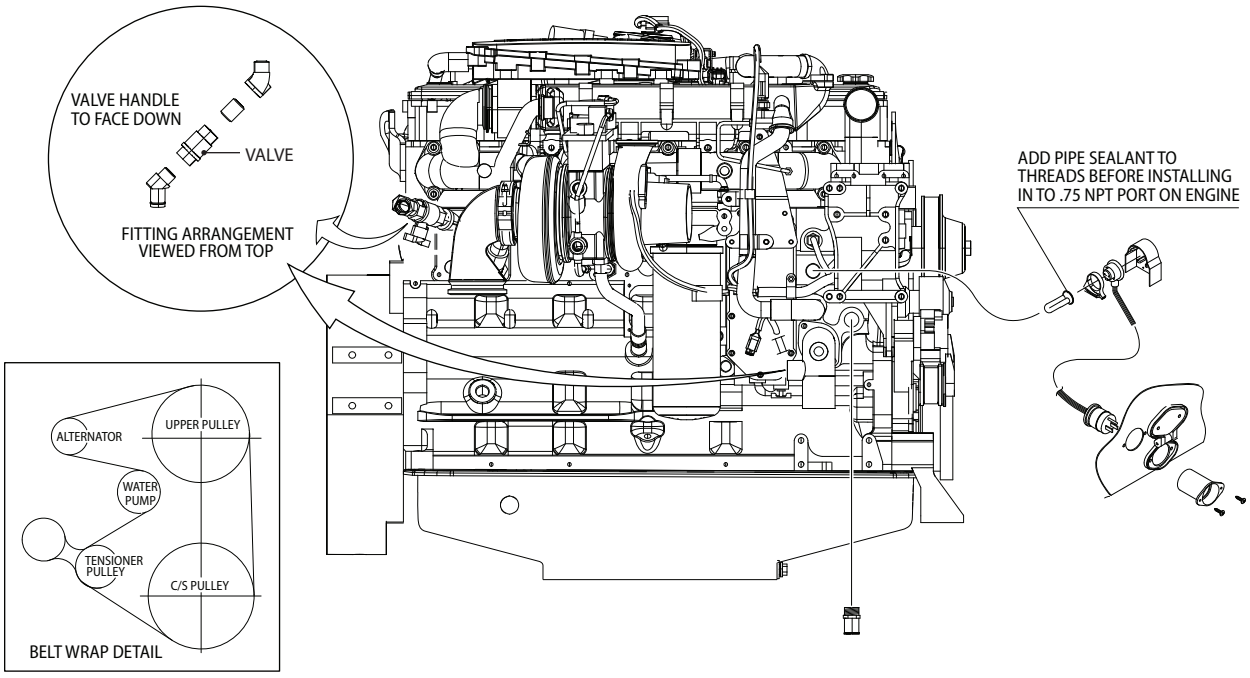
To access the engine, press release button latches located in four places on the engine cover. Pull and lift the access cover allowing it to fully open, up and out of the way. This will allow access to engine components, such as the oil dipstick, engine oil fill, transmission fluid dipstick, etc.

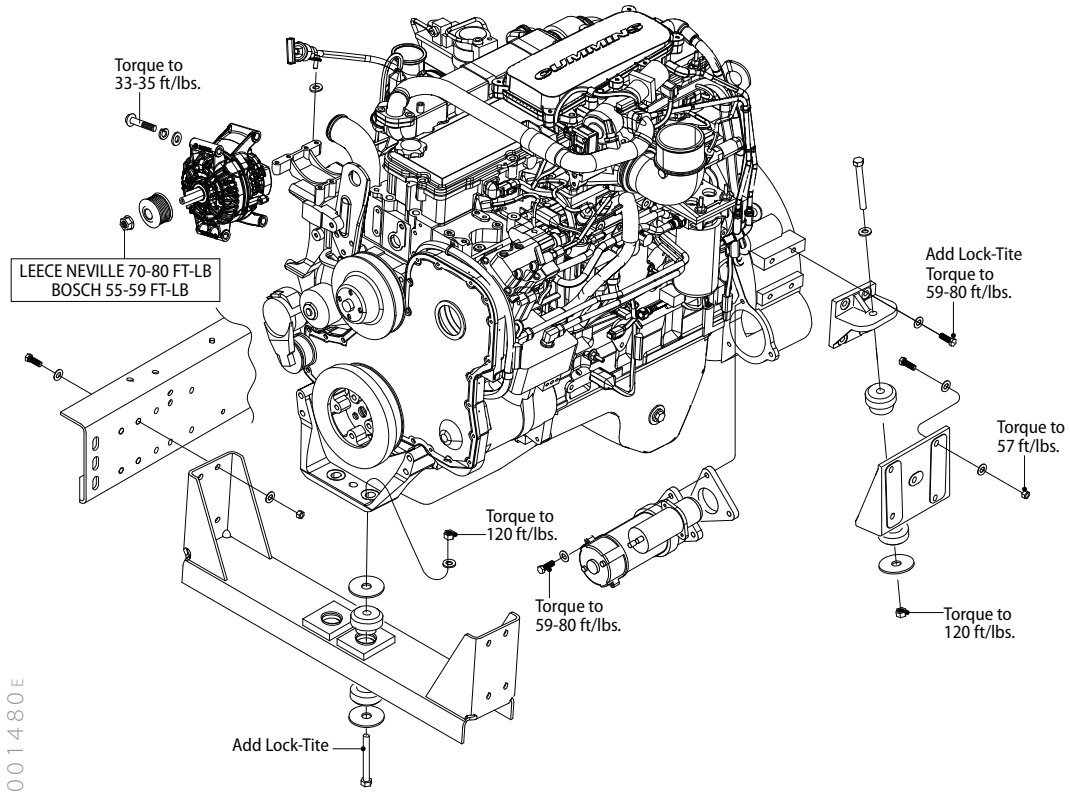
To gain better access to the front side of the engine, utilize the rear driver's side access grille. The curbside grille will allow access to the radiator for cleaning. Release two press button latches at the rear edge of the panels to open.

CAUTION ***Engine and components can be very hot. If the engine has been running, be careful to avoid burns during engine access and removal process.***



Rear Side Access Grille





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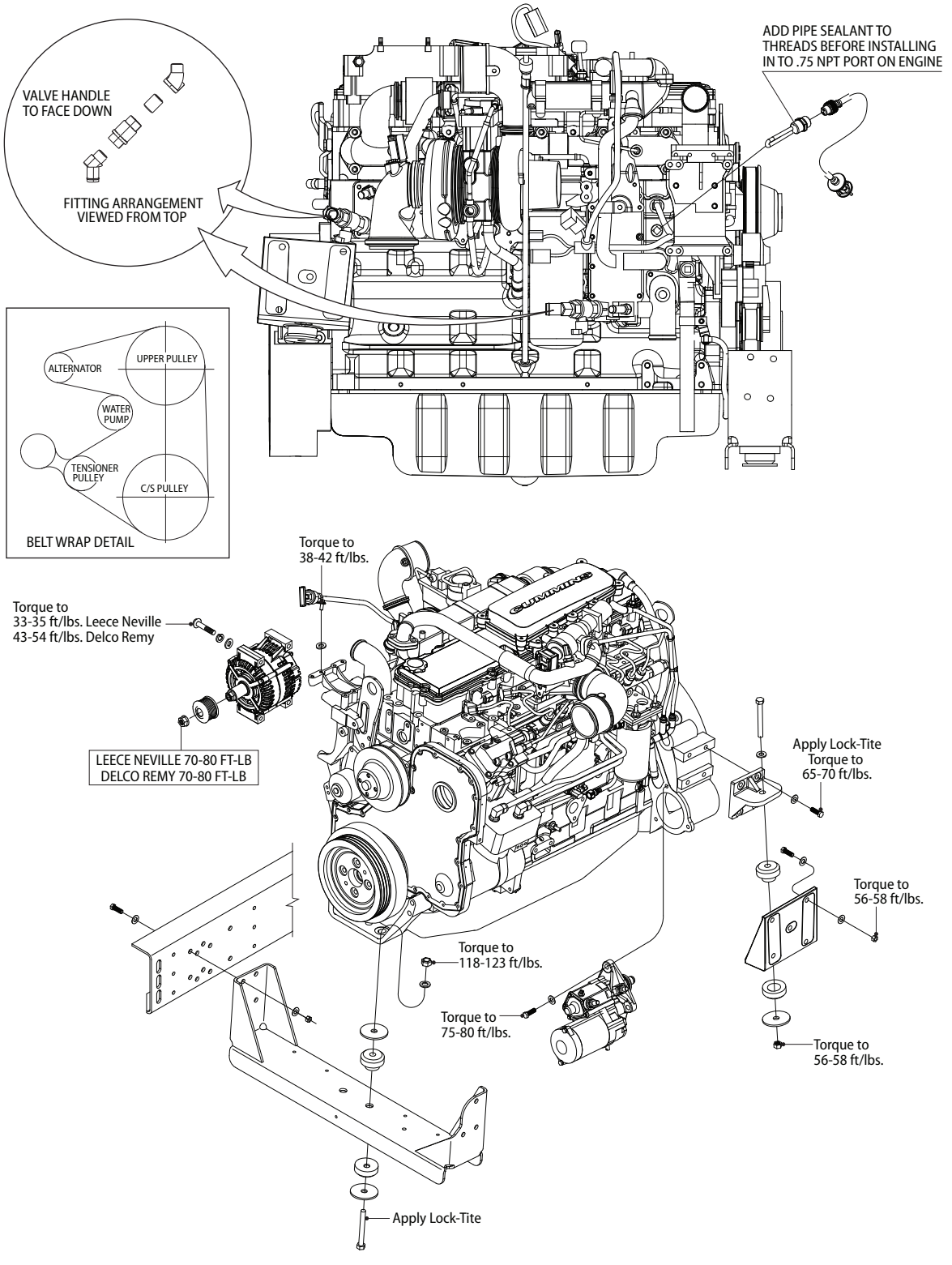
Engine Trim, Cummins ISC-07



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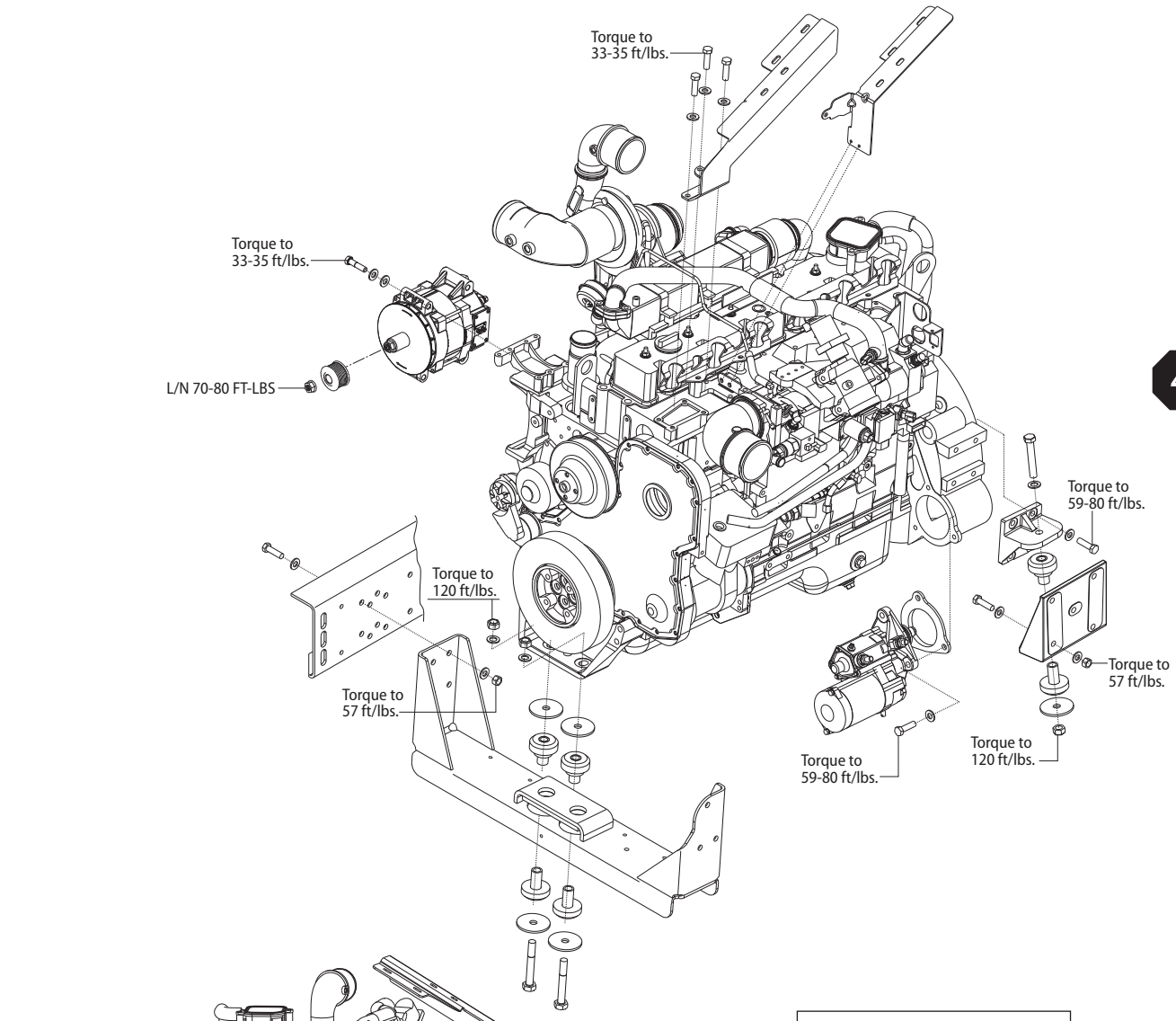
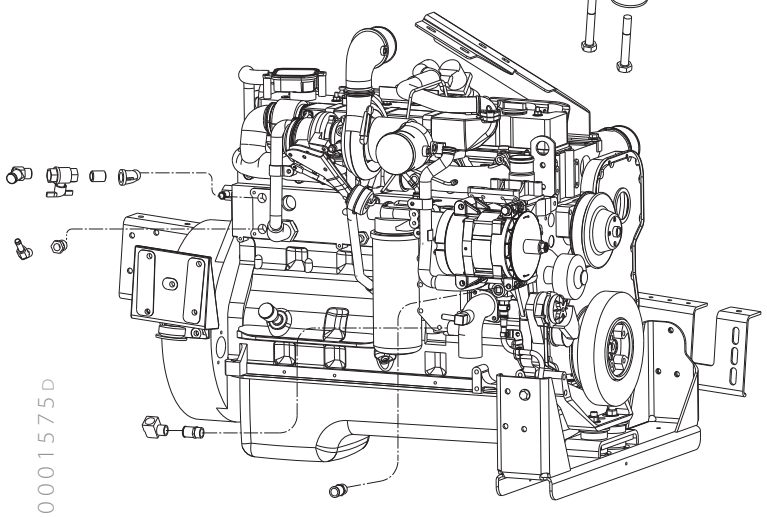
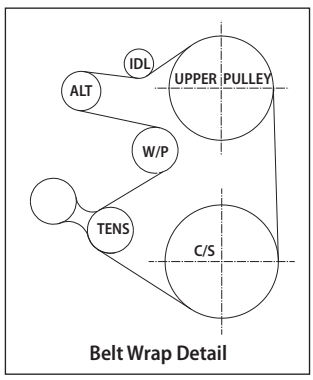
Engine Trim, Cummins ISC-10







Belt Wrap Detail

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Engine Trim, Cummins ISL-G-07

Transmission

The Allison 3000 Series™ transmission is fully automatic, torque converter driven, and electronically controlled. The transmission offers 6 forward speeds and 1 reverse gear. All the clutches in the transmission are hydraulically actuated and spring released, and feature automatic compensation for wear. The gearing is of the helical type, arranged in planetary sets. Electronic control signals provide automatic gear selection in each drive range and automatic engagement of the torque converter (lockup) clutch.

The transmission has 4 major control systems, connected by the Blue Bird wiring harness: The Transmission Control Module (TCM), engine throttle position sensor (accelerator), 2 separate speed sensors and a control valve module which contains solenoid valves and a pressure switch module. The accelerator, speed sensors, and pressure switch module transmit information to the TCM. The TCM processes this information and then sends signals to actuate specific solenoids on the control valve module in the transmission. These solenoids control both oncoming and offgoing clutch pressures to provide closed loop shift control. This is accomplished by matching RPM during a shift to a previously established profile that is programmed into the TCM.

The 3000 Series™ electronic control system has an "adaptive shifting" feature which helps optimize shift quality. The feature monitors critical characteristics of clutch engagement and makes continuous adjustments to improve the next shifting sequence. The transmission shift calibration is based on several different types of shifts, (full throttle, partial throttle, closed throttle, upshifts, downshifts, etc.). Each shift is associated with specific speed and throttle positions. To optimize each type of shift for normal driving, the shift controls need to experience operation and shifting in a wide variety of conditions. A "drive in" period under varying driving conditions is required for the Adaptive Controls to begin to optimize shifting under all conditions. It may take as many as 5 shifts of each type to establish the automatic optimization sequence.

Torque Converter

The torque converter has 4 main elements: a pump, the turbine, and the stator and torque converter lockup clutch. The pump is the input component; it is driven directly by the engine. The turbine provides the output of the transmission; the pump hydraulically drives it. The stator multiplies the torque. When the pump is turning faster than the turbine, the torque converter is multiplying the torque. As the turbine reaches the speed of the pump, the stator starts to rotate and torque multiplication stops. The torque converter then acts as a fluid coupling device.

Series 3000™ torque converters have a torque converter clutch (a lockup clutch). When this lockup clutch is engaged, it causes the pump and turbine to be "locked" together so they rotate in unison, at engine speed. This provides direct drive through the transmission. This type of operation maximizes engine braking and fuel economy. The lockup clutch is regulated by the shift controls and operates automatically. The lockup clutch releases at lower speeds or when the TCM senses conditions requiring it to be released. The torque converter clutch features a damping mechanism, which reduces the transmittal of engine induced torsion vibration through the transmission.

Planetary Gears and Clutches

A series of 3 helical planetary gear sets and shafts provide the mechanical gear ratios and direction of travel necessary for the bus. These planetary gear sets are controlled by 5 multiple clutches that work in pairs to produce 6 forward speeds and 1 reverse gear. The clutches are controlled hydraulically in response to electronic signals from the TCM to the individual solenoids.

Cooler

Excessive heat in the transmission is dissipated by circulating the transmission fluid through a separate transmission cooler. Engine coolant and transmission fluid circulate through separate passages and the transmission fluid is cooled as heat is dispersed to the coolant.

Filters

Series 3000 transmissions require the main filters to be changed after the first 5,000 miles or 200 hours of operation, whichever occurs first. Thereafter they should be changed every 75,000 miles, 36 months or 3000 hours, whichever occurs first. Internal filter screens need to be changed only during a transmission overhaul. Use only Transynd™ / TES 295 synthetic transmission fluid or equivalent. Follow all recommendations outlined in the Allison operators and service manual.

Transmission Maintenance

Daily

- Check that the engine will not start with the shifter in any position other than "N" neutral.
- Before the trip; check the transmission fluid level. Transmission fluid must be hot, between 160°F and 220°F for an accurate dipstick reading. Allow vehicle run time to reach operating temperature. ***NOTE:*** *A cold fluid level check can be performed, see the Allison Operator's Manual for details.*
- Notice if there is a burned odor to the transmission fluid.
- Notice if the transmission shifts rough or fails to shift.

5,000 miles (8000 km) or 6 months

- Clean and inspect the transmission; look for missing or loose bolts.
- Carefully inspect the transmission and all hoses; look for signs of leaks, wear and abrasion.
- Check for worn or frayed electrical connectors and harnesses.
- Check the breather (vent) screen at the top of the transmission. See Transmission Removal illustration.
- Obtain fluid analysis for maximum efficiency. Refer to the Technician's Guide for Automatic Transmission Fluid, publication number SA2055, for more details.

Fluid Oxidation Measurement Limits	
Viscosity	± 25% change from new fluid
Total Acid Number	+ 0.3 change from new fluid
Solids	2% by volume maximum

75,000 miles (160,000 km) or 36 months

- Ascertain the oil vent (breather) is clean and free of dirt. Do not spray the vent with steam or cleaning solvents.
- Change lube filter, main filter, and the transmission fluid. Use only Transynd™ synthetic transmission fluid, or TES295 equivalent. Observe all applicable, environmental, health and safety regulations. Drain the fluid while the transmission is at normal operating temperature; 140°–220° F (60°–104° C). Use caution to avoid serious burns. Hot oil flows more quickly and drains more completely.

1. Remove the drain plug from the oil pan and allow the fluid to drain into a suitable container.
2. Examine the fluid to determine if there are metal fragments in it.
3. Replace the lube and main filters.
4. Install the drain plug and sealing washer. Torque the drain plug to 22–30 ft lb (30–40 Nm).

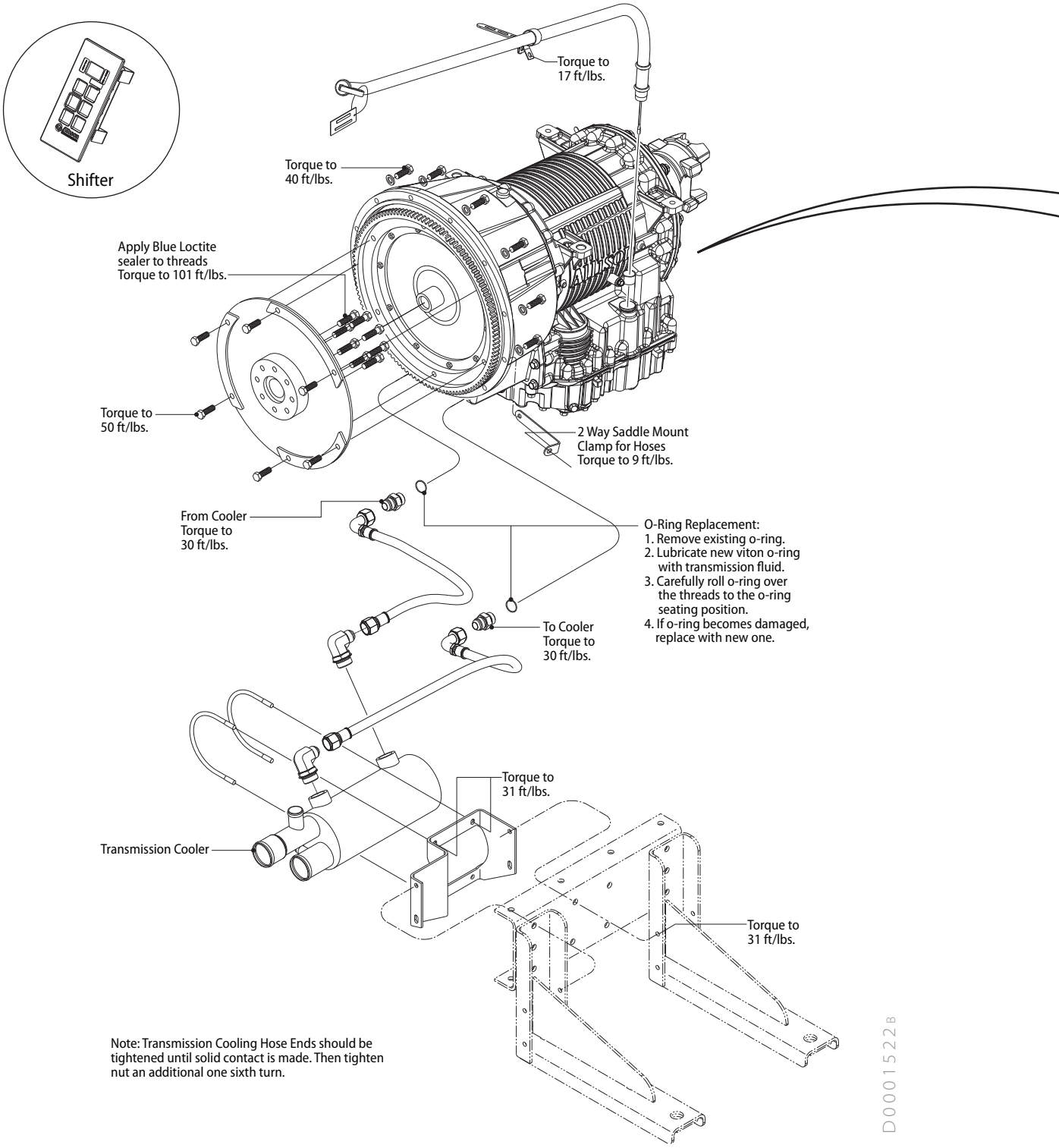
5. Refill the transmission. The capacity is approximately 19 quarts (18 L). The transmission refill capacity is substantially less than the initial fill (29 qts./27L with 4" sump) because a large amount of fluid remains in the transmission cavities after draining.
6. After filling the transmission to the cold check level on the dip stick, start the engine and allow it to idle for about a minute.
7. With the service brakes applied, shift to "R" for a few seconds, back to "N" for a few seconds, to "D" for a few seconds and then back to "N".
8. Allow the engine to idle at about 500–800 RPM and slowly release the service brakes.
9. With the engine running, remove the dipstick and wipe it clean.
10. Insert the dipstick into the tube and remove it. Check the fluid level indicated on the dipstick. Repeat at least twice for accuracy.
11. If the fluid level is still within the cold check band, the transmission may be operated until the fluid is up to operating temperature.
12. If the fluid level is not within the cold check band, you must drain or add fluid until it is before operating long enough to reach normal temperature.
19. Perform the hot check at the first opportunity after the transmission has been operated for about an hour and reached the normal operating temperature of 140°–220° F (60°–104° C)

For more information refer to the Allision Transmission Operator's Manual (Pupil Transport / Shuttle Series) for proper transmission operation, driver tips, scheduled maintenance and maintenance tips. This manual should be located in the bus when the bus is delivered to the customer.

For more technical information, consult the appropriate Allison publication or visit the Allison web site: www.allisontransmission.com.

Refer to the following resource for service literature:

SGI, Inc.
Attn: Allison Literature Fulfillment
8350 Allison Avenue
Indianapolis, IN 46268
Toll Free: 888.666.5799
International: 317.471.4995



Note: Transmission Cooling Hose Ends should be tightened until solid contact is made. Then tighten nut an additional one sixth turn.

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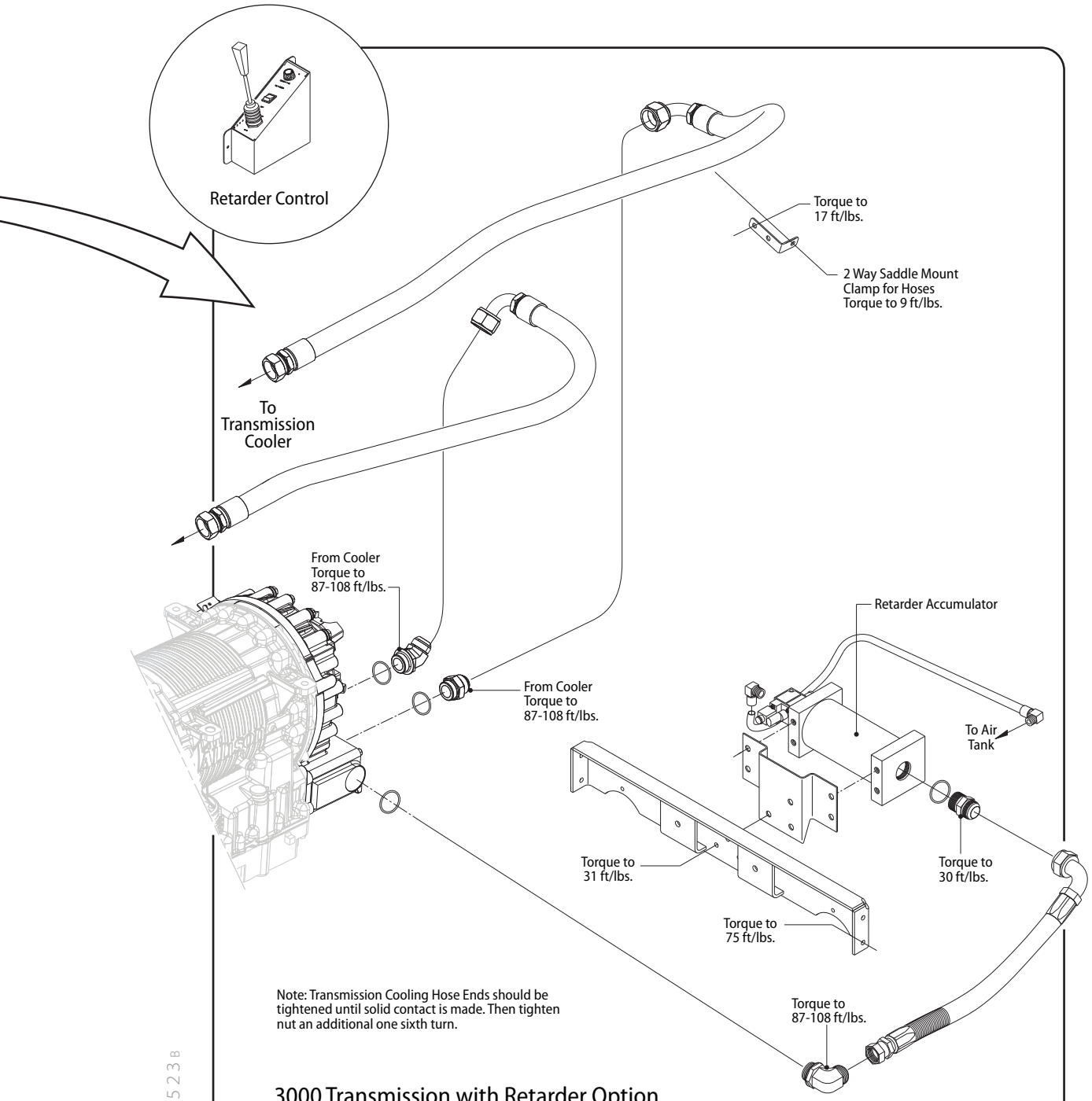

3000 Transmission with Retarder Option

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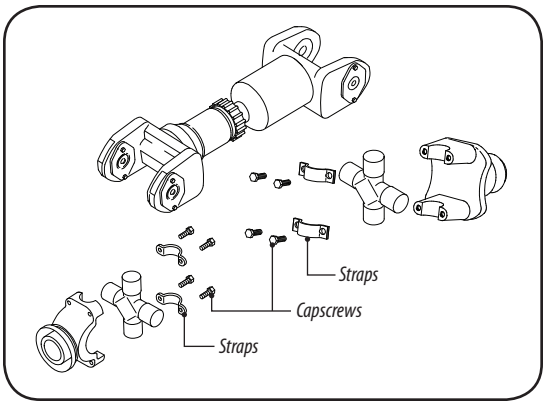
3000 Transmission

Drive Line

The purpose of the driveline is to transmit torque from the transmission to the drive wheels of the vehicle.



WARNING ***Before continuing with these instructions, please refer to the safety instructions in the Introduction Section of this Service Manual.***

WARNING ***Never work under the bus while the engine is running.***

Removal

To remove the driveline from the transmission, remove and discard the capscrews and straps at the universal joints necessary to remove the driveline.

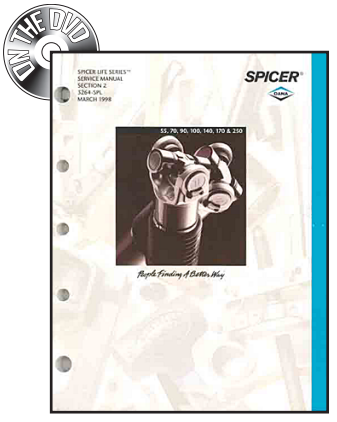
Reinstallation

1. Carefully position the driveline components while observing the previously marked phase indications.

2. Install new straps and hardware at the universal joints.
   - **SPL 70 & 100:** Torque the capscrews to 50–60 ft. lbs.
   - **SPL 140:** Torque the capscrews to 115–135 ft. lbs.

3. Lube grease fittings on **SPL140** driveline with N.L.G.I. Grade 2 E.P. Lubricant must have an operating range of +325°F to -10°F.

4. Ensure all driveline guards are securely in place before starting the engine.



Spicer Life Series Service Manual

Spicer Publication 3264-SPL

Transmission Service Prognostics

Service prognostics on all Allison Gen 4 transmissions require the use of Allison approved TES 295 fluids and Control Main filter. Prognostics is used to predict the need for transmission maintenance. Transmission operating parameters monitored by the prognostics feature are:

1. Oil Life Monitor

2. Filter Life Monitor

3. Transmission Health Monitor

2000 Series Product

When a specified service threshold is detected for one of the parameters listed above, the TRANS SERVICE indicator in the instrument panel will illuminate to alert the operator to the need for action. Failure to attend to the service condition and reset the indicator within a defined operating period will result in the illumination of the CHECK TRANS light and the TRANS SERVICE light, both located in the instrument panel.

Oil Life Monitor

The TRANS SERVICE indicator will illuminate when the remaining fluid life reaches approximately 2 percent, for two minutes after the initial selection of a drive range. This will indicate a required change of the transmission fluid. The TRANS SERVICE indicator will remain on until service is performed and the indicator is reset.

The TRANS SERVICE indicator can be reset with the Allison DOC For PC-Service Tool, or by selecting N-D-N-D-N-R-N on the shift selector, pausing briefly (less than 3 seconds) between each selector movement. The ignition must be on and the engine must be off before attempting to reset.

Filter Life Monitor

The TRANS SERVICE indicator will flash after reaching time and mileage parameters set in the control module. It will continue to flash for two minutes after selecting D (Drive) and until service is performed and the indicator is reset

The TRANS SERVICE indicator can be reset with the Allison DOC For PC-Service Tool or by selecting N-R-N-R-N-D-N on the shift selector, pausing briefly (less than 3 seconds) between each selector movement. Be sure the ignition is on and the engine is not running.

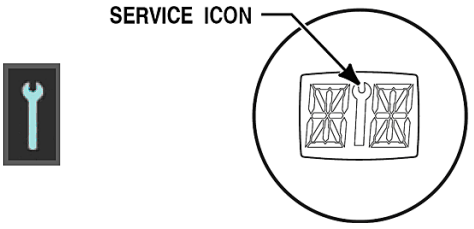
Transmission Health Monitor

The TRANS SERVICE indicator will illuminate when the remaining clutch life reaches approximately 10 percent, or if the running clearance exceeds maximum value which may indicate a non-wear-related issue. The indicator will be lit steadily at all times.

The indicator will reset automatically upon elimination of the clutch clearance condition which initiated it. The indicator can also be reset using the Allison DOC For PC-Service Tool if necessary.

3000 Series Product

Electronic shift selectors used with 3000 series transmissions have an integrated service icon in the shape of an open-end wrench located between the SELECT and MONITOR displays, which illuminates or flashes when a specified service threshold is reached for one of the three prognostic parameters.



When service is due for Allison 3000/4000 Series transmissions, a wrench icon on the shift selector's digital display alerts the operator. You can check the status of all three prognostics (oil, filter, clutch) simply by advancing through the shift selector's display.

When the fluid is due for a change:

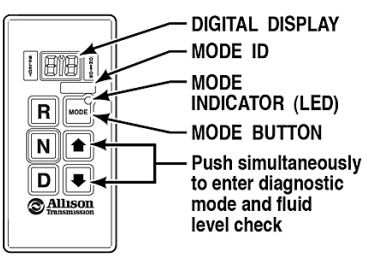
The wrench icon* **stays illuminated** for two minutes after the Drive range is selected.

When the filter(s) is due for a change:

The wrench icon* **flashes** on and off for two minutes after the Drive range is selected.

When clutch maintenance is due:

The wrench icon* comes on and **stays on in all ranges**.



Overview

Coolant is circulated through the closed pressurized system by the engine water pump whenever the engine is running. When the engine is cold, coolant flow through the radiator is blocked by a conventional thermostat mounted at the engine coolant outlet. The closed thermostat causes the coolant to be directed through a bypass integral to the engine block when the engine is cold.

As the engine warms, heat is transferred to the coolant and the thermostat gradually opens the radiator circuit while increasingly obstructing the bypass. Coolant from the engine coolant outlet increasingly enters the radiator at the top, passes through the radiator coils and leaves the radiator at the bottom on its way back to the engine coolant inlet. When the engine has reached full normal operating temperature, the thermostat is fully open, the bypass path is closed, and all coolant circulates through the radiator.

During normal operation, engine cooling is regulated by controling the effectiveness of the radiator. This is accomplished by powering and de-powering the fan which draws ambient air over the coils of the radiator. On Rear Engine All Americans, the fan is mounted to an electromagnetic fan clutch assembly mounted to the mechanical fan drive and driven by the fan belt. The engagement and disengagement of the fan clutch is controlled by the engine ECM. The electrically-controlled fan clutch of the All American Rear Engine is described in the electrical chapter.

On buses operated in colder climates, the radiator may be fitted with optional Radiator Shutters, a vane-like assembly which serves to block air from passing over the radiator coils. This prevents over-cooling and aids warm-up of the coolant so that interior heaters become effective sooner.

The cooling system components are plumbed using either standard black rubber hoses or optional hoses which are blue in color and typically have longer life.

The bus may be fitted with an optional Coolant Filter, which is attached to the engine water jacket at two locations, creating an alternate “side path” for coolant to flow. The filter traps contaminates as coolant circulates through the replaceable filter.

Engine coolant also circulates through a separate transmission cooler. Once the engine has reached normal operating temperature and the thermostat has fully opened, all the coolant passes through the transmission cooler, “in series” with the radiator. The inlet side of the transmission cooler receives coolant that has already passed through the radiator. Inside the transmission cooler, the water circulates around a coil through which transmission fluid circulates. At normal operating temperatures, the engine coolant is signifciantly cooler than the the transmission fluid and thereby serves to cool the transmission fluid. In extremely cold climates, during engine warm-up, the warming engine coolant helps bring the transmission fluid up to sufficient temperature for the transmission to operate.

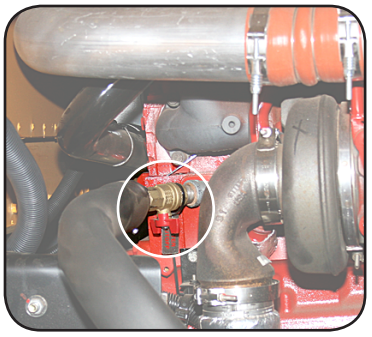
Heated engine coolant also provides the heat for the bus's interior heating units. The heater plumbing circuit is a "parallel" circuit which begins at the high pressure side of the engine water jacket, cycles through the various heater elements and returns by way of an inlet to the transmission cooler. There it rejoins the coolant bath circulating through the transmission cooler, and thereby finds its way back to the engine inlet. A cut-off valve is provided at engine heater outlet pipe and at the transmission cooler's heater circuit inlet. This allows the heating circuit to be blocked at both ends when servicing the cooling system or when it is desirable to prevent heaters from warming up during summer months.

The heater supply tubing from the engine leads to the Driver's remote heater valve, an electrically-controlled valve which enables the Driver to control the effectiveness of all heaters by regulating the amount of engine coolant circulating through the heater circuit.

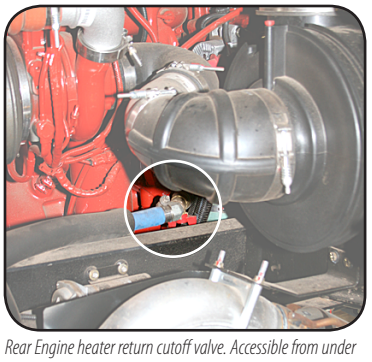
Depending upon the heaters configuration, the heater circuit may be equipped with an optional auxilliary water pump to help force-circulate coolant through the heaters. On Rear Engine All Americans, the auxilliary water pump is mounted forward of the air cleaner and is accessible from the driver's side engine access door. The inlet side of the auxilliary pump receives coolant from the pressure side of the engine water jacket. The outlet side leads to the series of heaters and then returns via the transmission cooler as described above. Thus, the transmission cooler receives coolant that has cooled by transferring its heat to the heaters and/or by passage through the radiator.

A translucent deaeration tank is located at the highest point of the cooling system flow circuits. Tubes lead to the deaeration tank from the tops of the radiator, the engine, and the transmission cooler. This provides a path for air bubbles in the circuits to rise to the deaeration tank. When pressure inside the system rises sufficiently to overcome the spring of the filler neck's pressure cap, air that has collected in the top of the deaeration tank escapes, reducing the system pressure to normal. Coolant level in the tank should be maintained at the full mark.

The three main symptoms of trouble in the cooling system are overheating, overcooling, and loss of coolant. A cooling system should first be diagnosed by a thorough visual inspection. Debris accumulation in the radiator fins or bent fins restricting airflow can cause overheating. If visual inspection reveals no cause, tools and test equipment will be needed to proceed.



Rear Engine heater supply cutoff valve. Accessible from engine compartment.

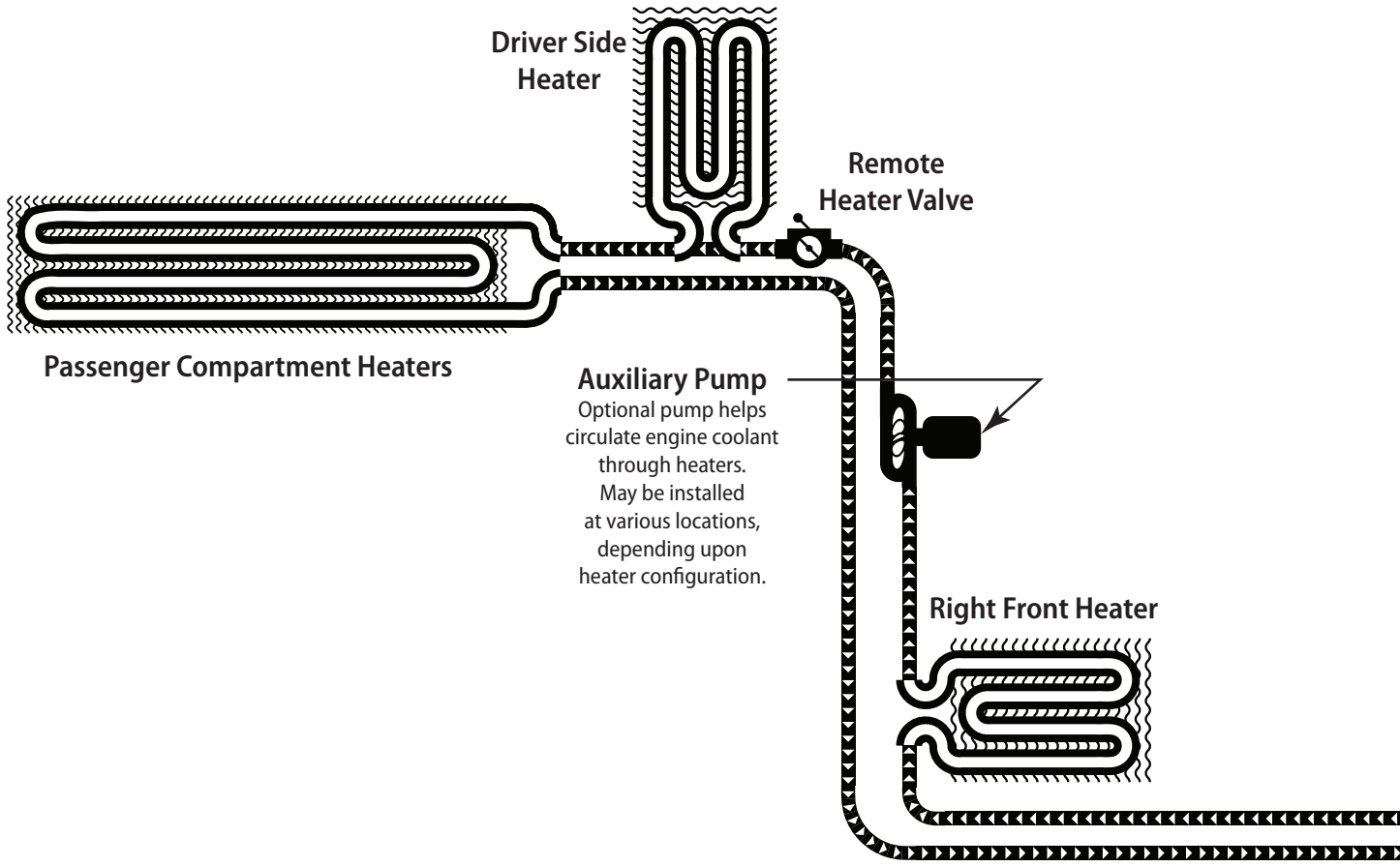


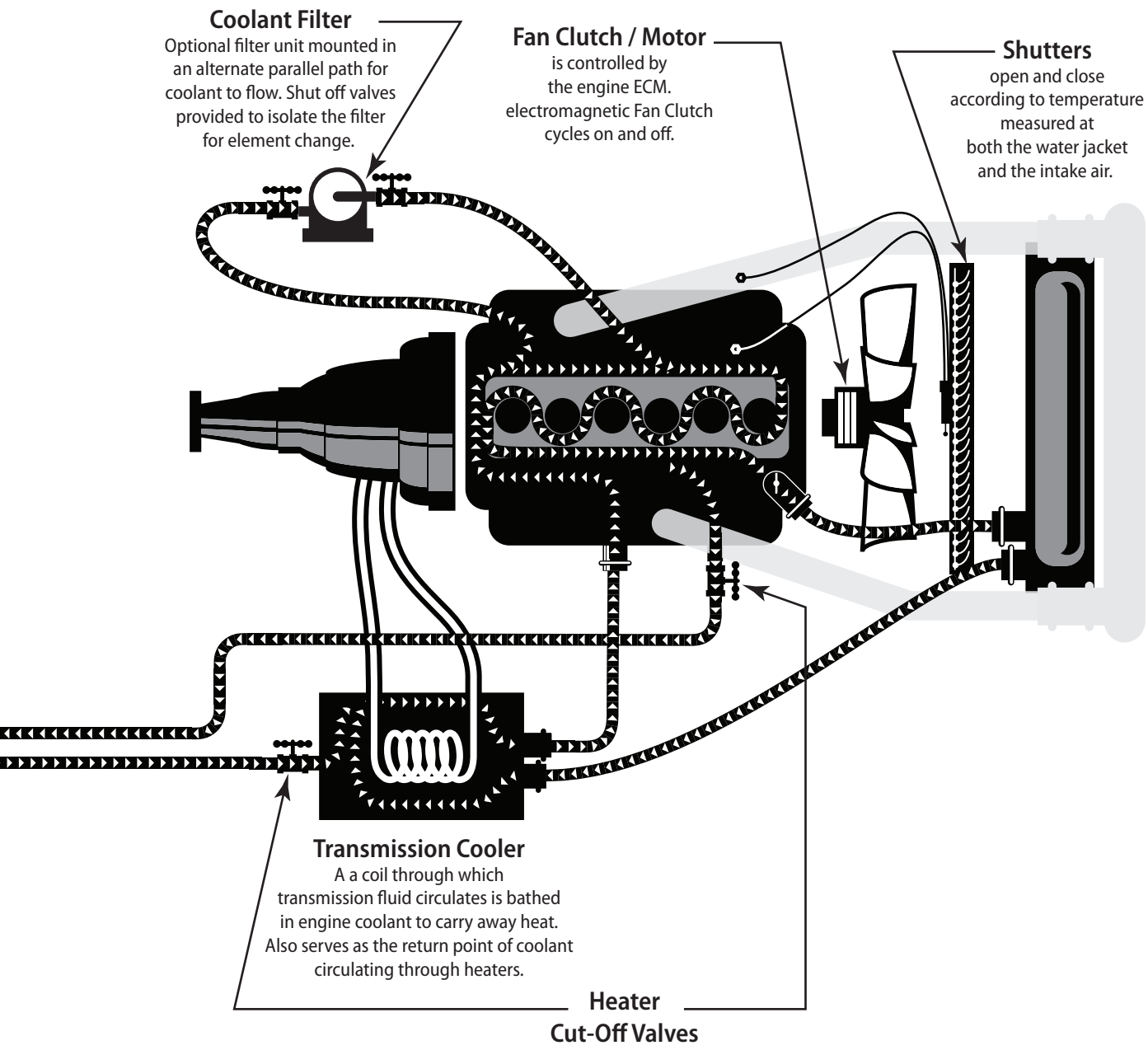
Rear Engine heater return cutoff valve. Accessible from under the bus, forward of the radiator.

When excessively high operating temperature is observed, first check for proper fluid level at the deaeration tank. If the fluid level is low and cannot be maintained without constant refill, inspect for leaks at pipe and hose connections. Also look for damaged hoses due to heat or chaffing from incorrect routing. Remember that the heater system is a potential area for leaks. The heating system can be isolated by closing the gate valves at the engine's heater outlet and the transmission cooler's inlet.

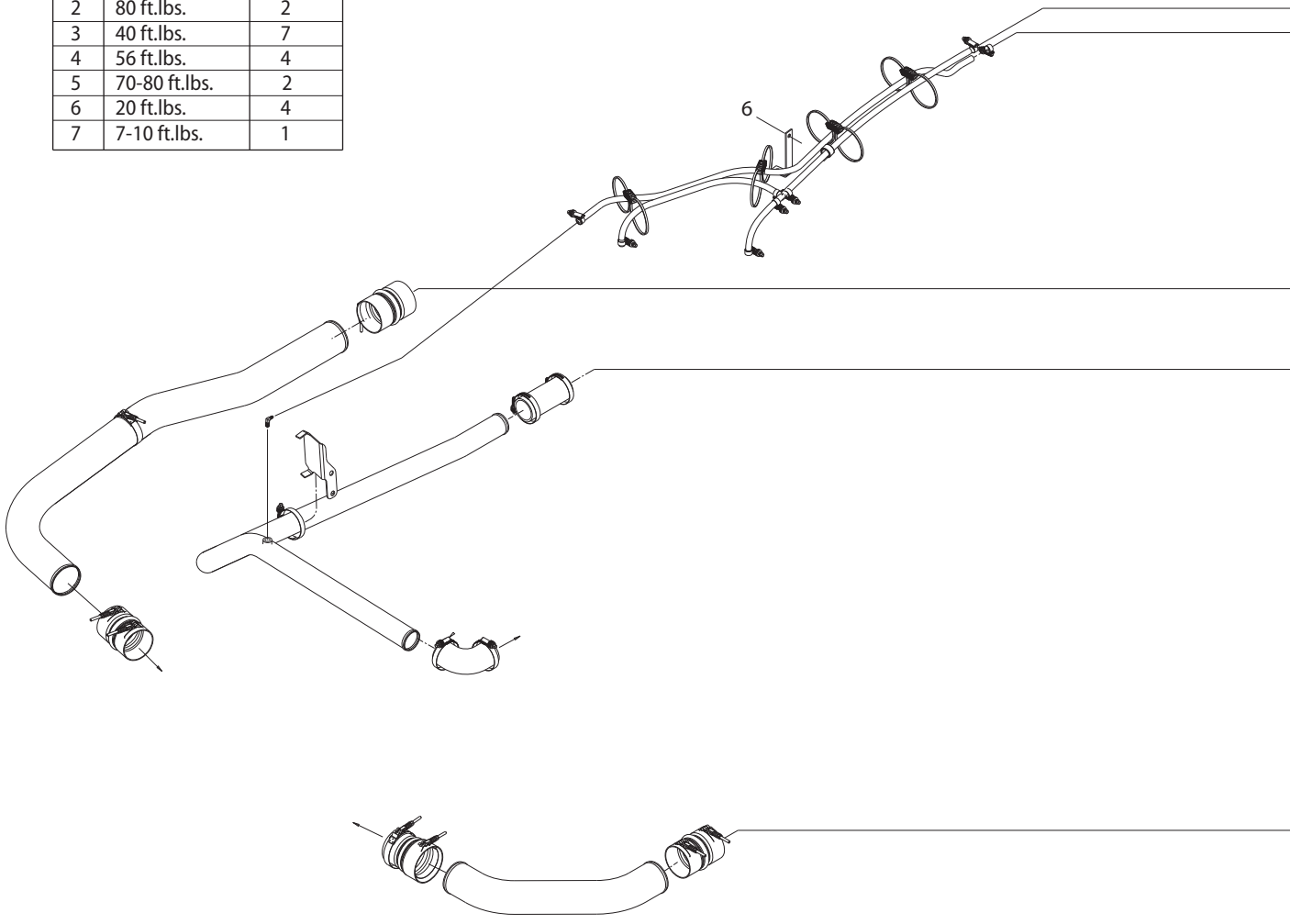
In the case of overheating, the next step is to verify the proper operation of the thermostats. Refer to the appropriate engine manufacturer's service publication for instructions on the removal and testing of the thermostats.

WARNING ***The engine, coolant, and transmission fluid may be very hot (possibly above the boiling point at atmospheric pressure). Allow the system to cool completely before working on it. Engine coolant use and disposal is governed by environmental regulations. Read carefully and abide by the warnings and guidelines on the coolant label.***


Driver Side Heater
Remote Heater Valve
Passenger Compartment Heaters
Auxiliary Pump
Optional pump helps circulate engine coolant through heaters. May be installed at various locations, depending upon heater configuration.
Right Front Heater


Coolant Filter
Optional filter unit mounted in an alternate parallel path for coolant to flow. Shut off valves provided to isolate the filter for element change.
Fan Clutch / Motor
is controlled by the engine ECM. electromagnetic Fan Clutch cycles on and off.
Shutters
open and close according to temperature measured at both the water jacket and the intake air.
Transmission Cooler
A a coil through which transmission fluid circulates is bathed in engine coolant to carry away heat. Also serves as the return point of coolant circulating through heaters.
Heater
Cut-Off Valves

Item	Torque	Quantity
1	29-33 ft.lbs.	8
2	80 ft.lbs.	2
3	40 ft.lbs.	7
4	56 ft.lbs.	4
5	70-80 ft.lbs.	2
6	20 ft.lbs.	4
7	7-10 ft.lbs.	1



NOTE: Torque all clamps to 5 Ft. Lbs.

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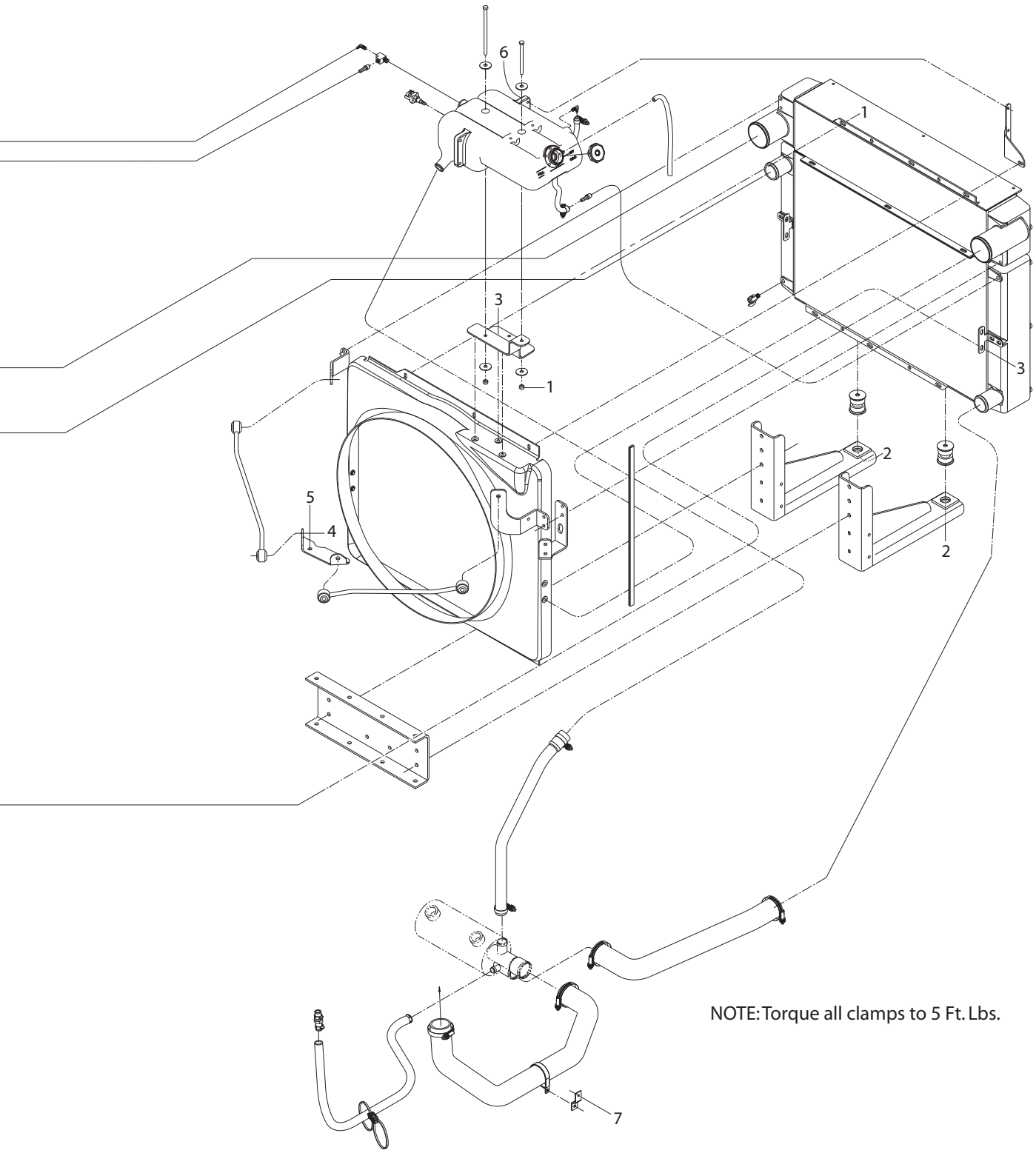
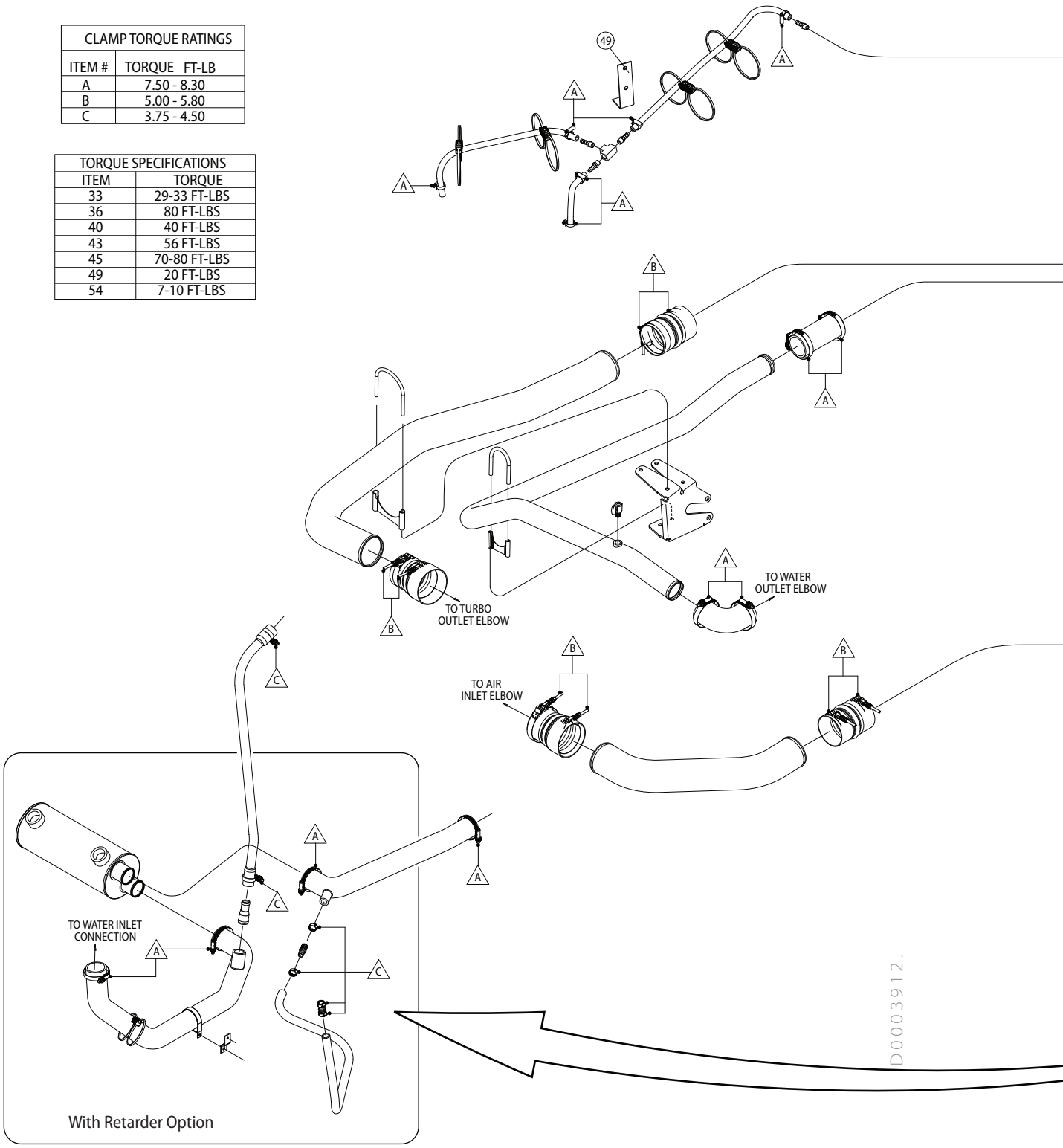
Cooling System: Cummins ISC-07



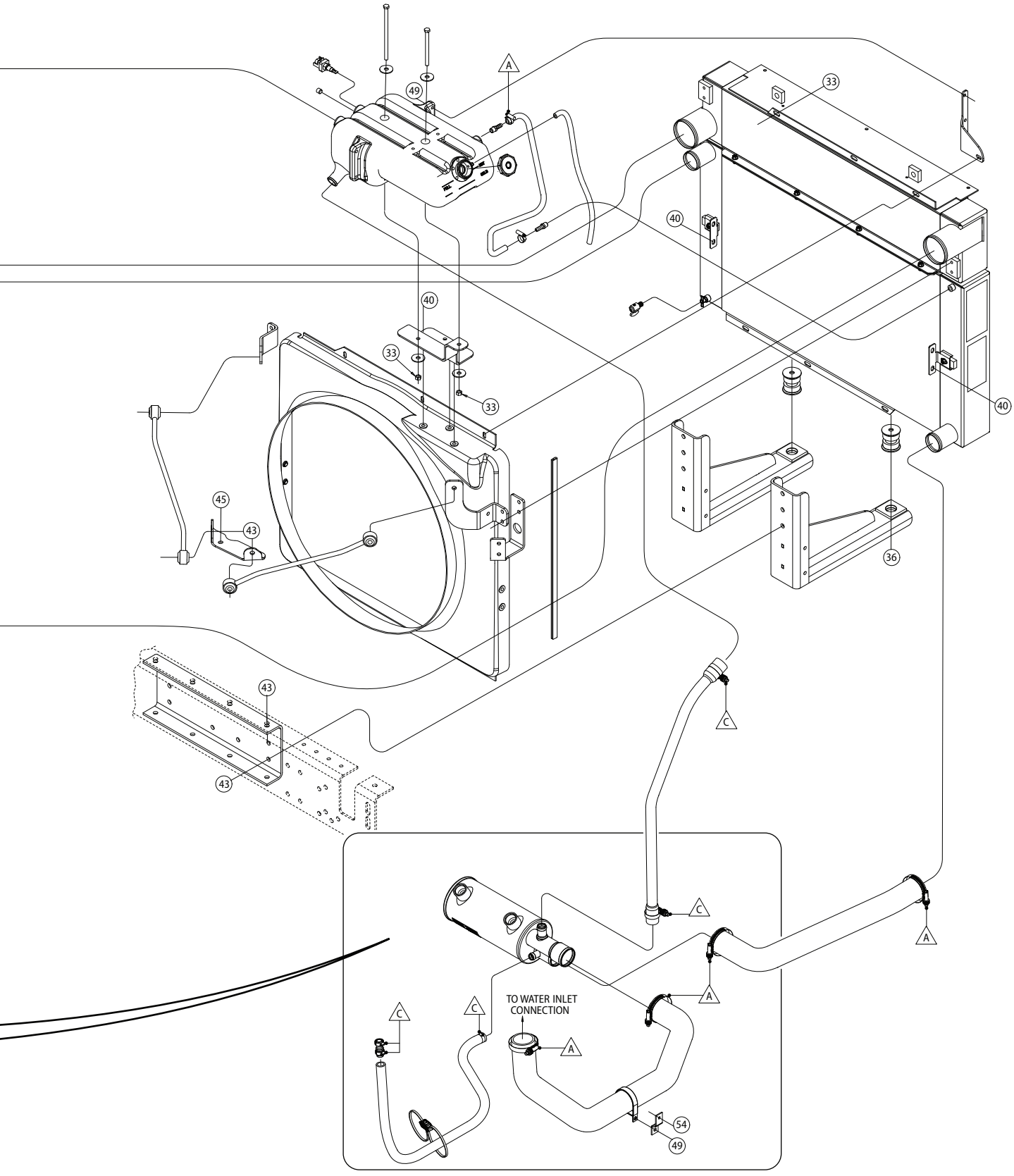
NOTE: Torque all clamps to 5 Ft. Lbs.

CLAMP TORQUE RATINGS	
ITEM #	TORQUE FT-LB
A	7.50 - 8.30
B	5.00 - 5.80
C	3.75 - 4.50

TORQUE SPECIFICATIONS	
ITEM	TORQUE
33	29-33 FT-LBS
36	80 FT-LBS
40	40 FT-LBS
43	56 FT-LBS
45	70-80 FT-LBS
49	20 FT-LBS
54	7-10 FT-LBS



Cooling System: Cummins ISC-10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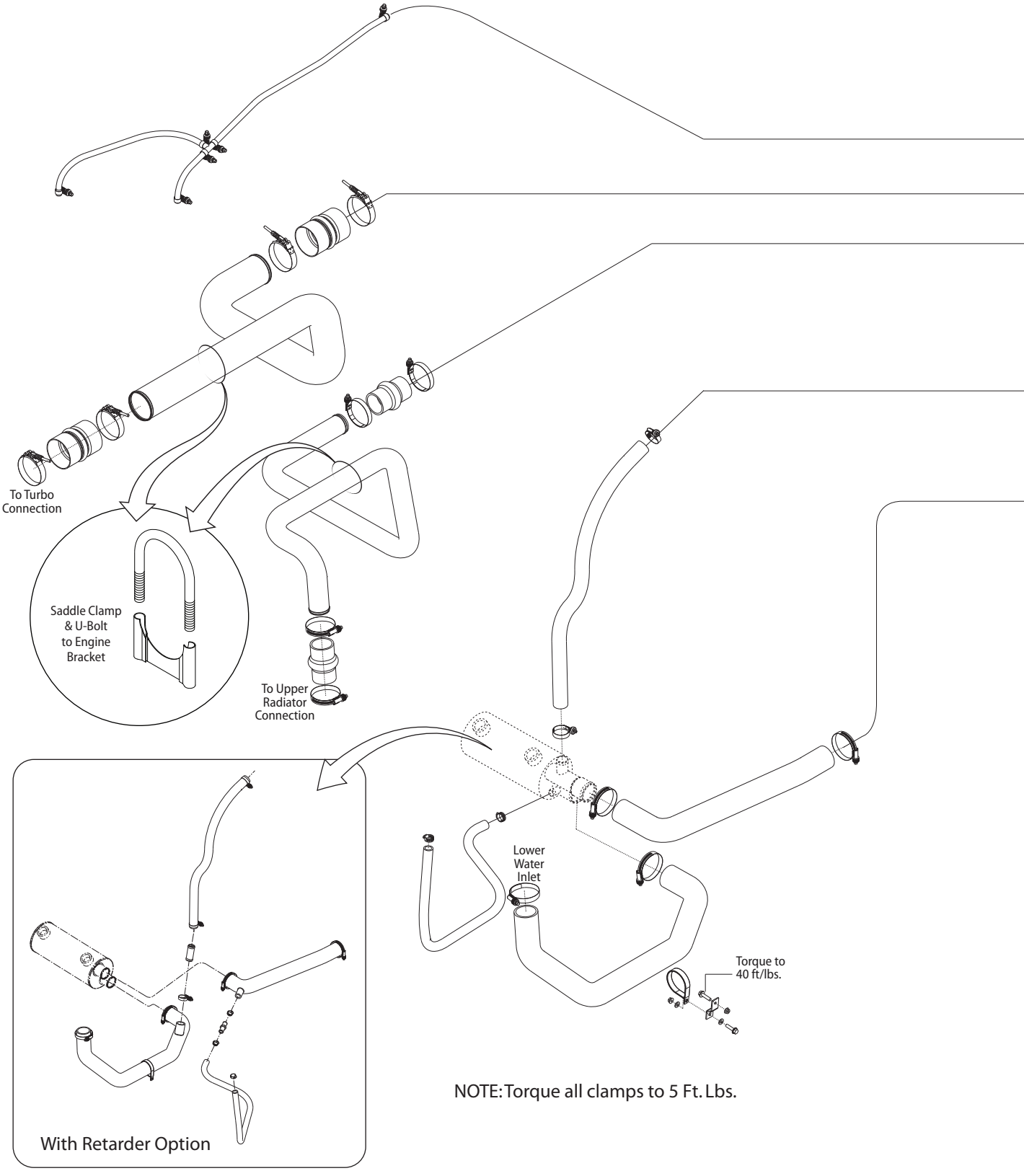
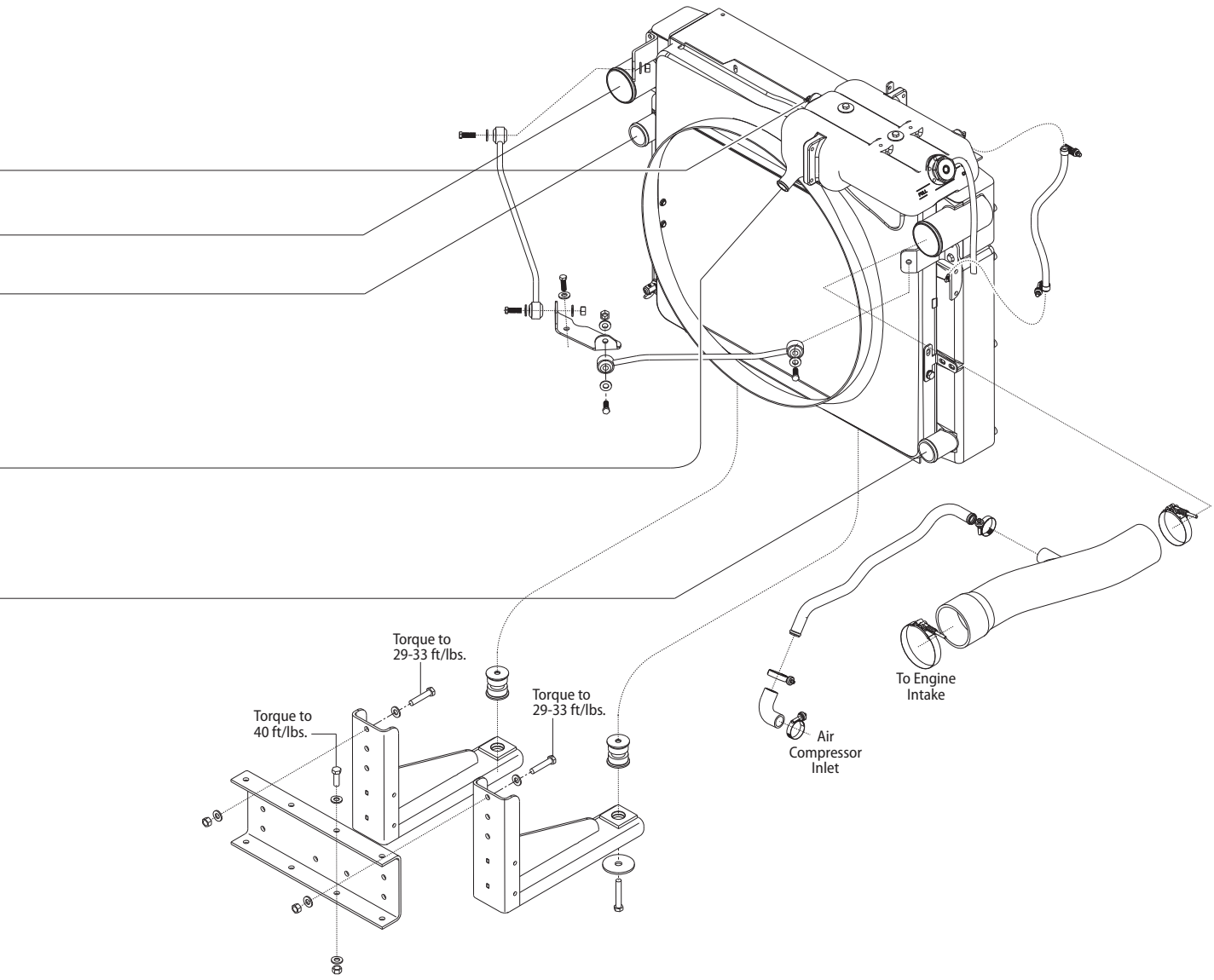


NOTE: Torque all clamps to 5 Ft. Lbs.



NOTE: Torque all clamps to 5 Ft. Lbs.

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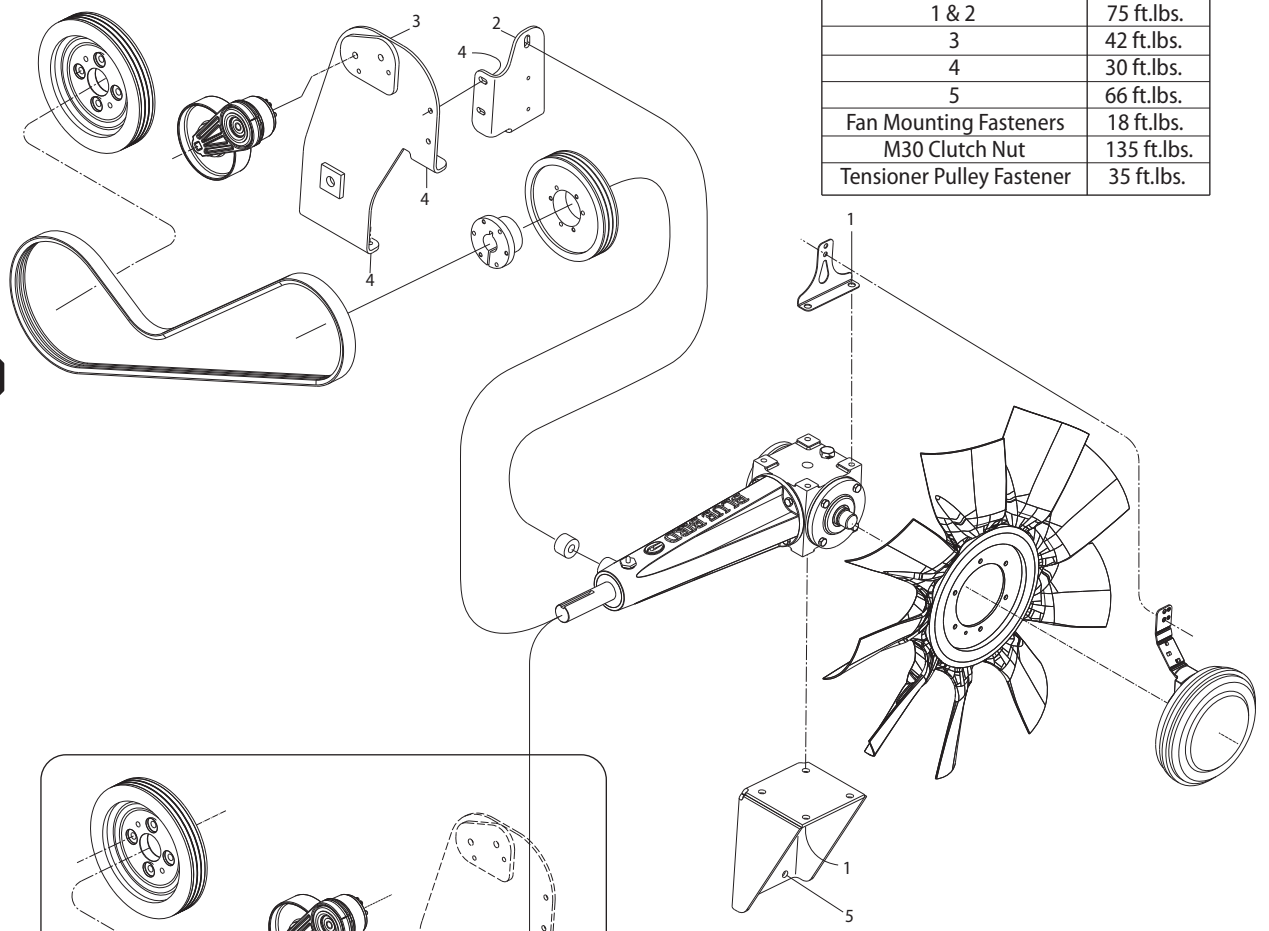
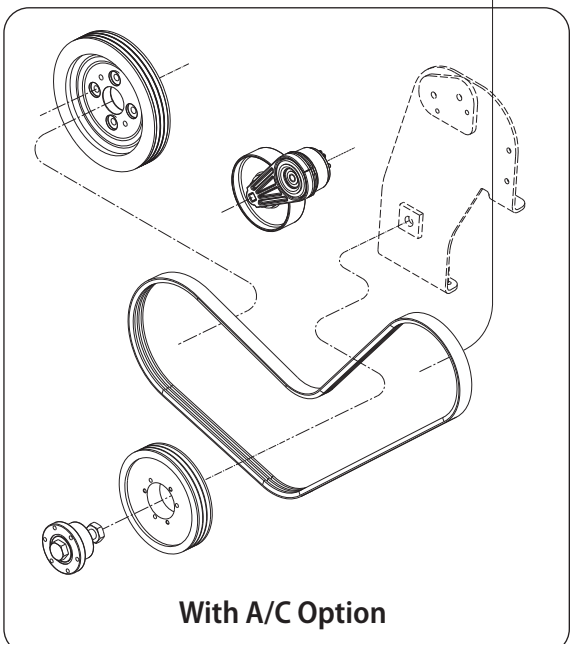
Cooling System: Cummins ISL-G-07

Item	Torque
1 & 2	75 ft.lbs.
3	42 ft.lbs.
4	30 ft.lbs.
5	66 ft.lbs.
Fan Mounting Fasteners	18 ft.lbs.
M30 Clutch Nut	135 ft.lbs.
Tensioner Pulley Fastener	35 ft.lbs.





With A/C Option

Mechanical Fan Drive

Mechanical Fan Drive System

The cooling fan on the All American D3RE is driven by a mechanical drive unit manufactured for Blue Bird. It is a heavy duty bevel gear drive unit that is oil lubricated and requires minimal maintenance. Power transfer is achieved through use of a triple ribbed belt driven by the engine crankshaft. Two slightly different idler/tensioner arrangements exist; one for the standard configuration without air conditioning and one for optional air conditioning.

The mechanical drive unit is frame mounted on the right hand (curb) side of the engine compartment. It is mounted at an angle that matches the engine crankshaft / transmission angle. The drive sheave / coupling hub assembly attaches to the gear drive input shaft to maintain alignment of drive pulleys. The cooling fan is mounted to a viscous fan clutch which is threaded onto the output shaft of the unit.

Drive Gear

The mechanical fan drive is a precision made 90 degree bevel gear drive unit. It has a triple groove pulley mounted on a straight input shaft. The output shaft has been designed with left hand threads to accomodate the viscous fan clutch. The gear driv unit is bracket mounted to the right hand frame rail at an approximate angle of 4.5 degrees. Four 1/2 inch capscrews attach the unit to the mounting bracket while a fifth capscrew near the end of the input shaft housing at the tensioner bracket provides stabilization and adds rigidity to the mount.

The gear drive unit is internally lubricated with synthetic 75W-90 gear oil and has an oil level dipstick located near the output shaft. It is equipped with a 1/2 inch drain plug with magnet at the lower end of the input shaft housing and a breather vent is installed at the top of the input shaft housing.

Routine maintenance of the gear drive includes visual inspection of unit for wear and/or leaks as well as periodic flush and refills of the lubricating gear oil.

The input shaft of the fan drive is a straight 1.375" diameter shaft with a .312 keyway and accepts the Gates QD Bushing. The Gates QD Bushing is a tapered hub bushing that mates with the tapered bore triple groove drive sheave. When properly installed, the QD bushing hub/ drive pulley combination provides for pulley alignment and adjustment with positive lock placement.

Drive Gear Maintenance

Periodic maintenance of the drive unit is required. A daily visual inspection should be performed prior to operating the vehicle. Any leaks or malfunctioning component should be corrected immediately. Oil level should be checked using the dipstick located on top of the gear box housing. Add approved oil as needed.

Drive unit should be drained, flushed, and refilled after the initial 100 hours of operation and every 2500 hours or six months whichever occurs first, thereafter. Flush gear case with approved solvent such as Whitmores™ flushing oil or equivalent. Refill with a synthetic 75W-90 gear oil that meets API GL-5 / MT-1 specification. Approximately 44 ounces of gear oil is required for fill. After fill recheck fluid level on dipstick.

Drive Belt & Adjoining Components

The crankshaft pulley is a triple groove sheave bolted directly to the harmonic balancer on the crankshaft.

The standard drive belt arrangement for the mechanical fan drive is a Gates Powerband 3/3V840 belt with a single Gates 38555 spring loaded belt tensioner. The spring tensioner uses one of two different mounting locations, one for standard configuration and the other for optional air configuration.

The optional air conditioning feature also requires the use of a longer drive belt. A Gates Powerband 3/3V879 belt and an additional idler pulley are used to properly distribute the crankshaft lateral loading. The additional pulley is mounted to the lower portion of the tensioner mounting bracket.

Fan and Fan Clutch

The nine blade 28 inch diameter cooling fan is coupled to the mechanical fan drive by a Horton Viscous fan clutch. The fan clutch threads directly on to the left hand threads of the output shaft of the mechanical fan drive unit. The cooling fan is attached to the fan clutch by six capscrews.

The Horton viscous fan drive is an on/off configured unit, managed by the engine ECM. It provides precision fan control for increased cooling system performance and less noise. The fan drive default mode is "ON" or engaged, so that in the event of signal loss, the fan will remain on all the time.

About Coolant

As emission and performance regulations become more stringent, the normal operation temerature range for turbocharged diesel engines increases. One of the consequences is that careful maintenance of the cooling system becomes increasingly critical in prolonging the life of the engine. At higher temperatures, relatively minor imbalances or impurities in the coolant can dramatially increase the potential for corrosion. Establish a disciplined and consistent regimine for monitoring and testing the coolant in your Blue Bird school buses. Keep accurate records, use only coolants recommended by the engine manufacturer. Change coolant within its specification lifetime and never mix different types of coolant.

Periodic testing and maintenance of the coolant should be performed in accordance to the engine manufacturer's specifications. Testing and maintenance procecures differ between standard-life and extended-life coolants. Locally available test strips may be used to test standard-life coolants. However, such test strips are not appropriate for long-life coolants; therefore long-life or extended-life coolants must be sample tested at qualified cooant laboratories. Because specification, recommendation, and terminologies differ among engine manufacturers, Blue Bird advises stictly adhering to the coolant maintenance specifications of the engine manufacturer. Carefully following the engine manufacturer's recommendations is the surest way to maintain compliance with engine warranties.

Beginning in January of 2007, Blue Bird implemented a program to simplify the coolant types installed at the factory.

Standard Equipment Coolant

Cummins Fleetguard ES Compleat 50/50 premix (blue in color) is installed as standard equipment with Cummins.

This coolant meets all specifications and requirements for extended-life coolant and is to be considered standard-life coolant when installed in Cummins engines.

Note: *If you wish to convert from standard life coolant to Fleetguard ES Optimax extended life coolant, follow the guidelines set forth in the Fleetguard Maintenance Bulletin, MB1/04-1 at www.cumminsfiltration.com/pdfs/product_lit/americas_brochures/MB1-04-1.pdf.*

Optional Extended Life Coolant

Cummins Fleetguard ES Optimax 60/40 premix (red in color) is installed in bus products equipped with Cummins engines when purchased with an option for extended-life coolant.

Coolant Decals

On all of the above-listed bus models, Blue Bird installs a decal stating:

- The type of coolant installed at the factory.
- The coolant manufacturer's part number for one gallon quantity, suitable for regular top-off and refill.
- The coolant manufacturer's part number for one gallon quantity of the concentrate version of the installed coolant, suitable for formulating stronger glycol mixture ratio.

Blue Bird also installs a second decal containing radiator warnings. Both decals are mounted near the coolant fill neck.

Coolant Maintenance

Blue Bird advises strictly abiding by the following policy for all coolant maintenance for the life of the vehicle.

Never Mix Coolant Types

Routine coolant addition (top-off) must match the installed coolant type and brand. Do not mix coolants of different colors, types, or brands in the same engine.

Strictly Follow The Engine Manufacturer's Specifications

Each engine manufacturer publishes its own specific requirements for testing and maintaining coolant in their respective engines. Blue Bird recommends strictly abiding by the engine manufacturer's testing and maintenance schedules and draining, flushing, refilling procedures to maintain compliance with the engine warranty requirements. Blue Bird recommends that you maintain accurate vehicle-specific service records of all coolant system maintenance procedures performed.

For Cummins engines using Fleetguard ES coolants, send coolant samples to Fleetguard for Monitor C testing, as specified in the Cummins Operator's Manual. Label sample as Extended-Life coolant.

Note: *For more information on coolant testing tools see: www.cumminsfiltration.com/pdfs/product_lit/americas_brochures/LT15068.pdf.*

Always Mix Concentrate With Premix Coolant, Not Water

If concentrated coolant is added in order to raise the glycol ratio, use only the concentrate version of the same premix coolant type and brand as installed. Do not mix the concentrate with water. Instead, mix the concentrate with the premix version of the same coolant.

Only Add Tap Water In Emergency Situations

A regularly-scheduled bus inspection and maintenance program should be followed to prevent coolant losses due to damaged or worn hoses, loose clamps, etc.

If coolant is lost while the bus is in use, and roadside emergency measures are called for, replenish the coolant with the same premix type and brand if possible. If the proper coolant is not available, and water must be used, use only de-ionized water if possible. Ordinary tap water should only be used if proper coolant or de-ionized water are not available.

Whenever tap water alone has been added, the bus should be taken to a service facility and the entire cooling system should be completely drained, flushed, and refilled with premix coolant.

FACTORY INSTALLED COOLANTS

Cummins, Fleetguard ES Compleat

Blue in color. Standard equipment coolant in all D3FE, D3RE, BBCV.

Considered standard-life coolant in Cummins engines.

Concentrate version may be mixed with the pre-mix version to lower freezing point.

AVAILABILITY

50/50 Premix

1 Gallon Container

2 1/2 Gallon Container

55 Gallon Drum

330 Gallon Tote

Concentrate

1 Gallon Container

Cummins, Fleetguard ES Optimax

Red in color. Optional coolant in D3FE, D3RE, BBCV, with Cummins engines.

Qualifies as extended-life coolant in Cummins engines.

Blue Bird installs 60/40 premix, which is not available in one gallon containers, but is available in larger containers (listed).

The 50/50 premix may be mixed with the concentrate version per Fleetguard's instructions to achieve 60/40 ratio.

Concentrate version may be mixed with the pre-mix version to lower freezing point.

AVAILABILITY

50/50 Premix

1 Gallon Container

60/40 Premix

55 Gallon Drum

275 Gallon Tote

Concentrate

1 Gallon Container

Coolant Filter (Optional)

Your Blue Bird bus may be equipped with an optional Perry Coolant Filter, a separate filter assembly with a replaceable spin-on filter element. On All American Rear Engine, the filter is mounted to the left hand subframe at the left side of the engine compartment.

The entire volume of coolant does not pass through the filter on each cycle. Rather, the filter assembly is connected to two coolant ports on the engine block, effectively providing an "alternate path" for coolant to flow. As coolant circulates through the system, that volume which passes through the filter is cleaned of contaminates.

The filter mount is fitted with two shut-off valves. Closing both valves closes the inlet and outlet lines, to allow removal and replacement of the filter element without excessive coolant spillage. The amount of coolant lost is that contained in the volume of the filter element. The same Wix replacement filter element cartridge is used for both of the factory installed coolants:

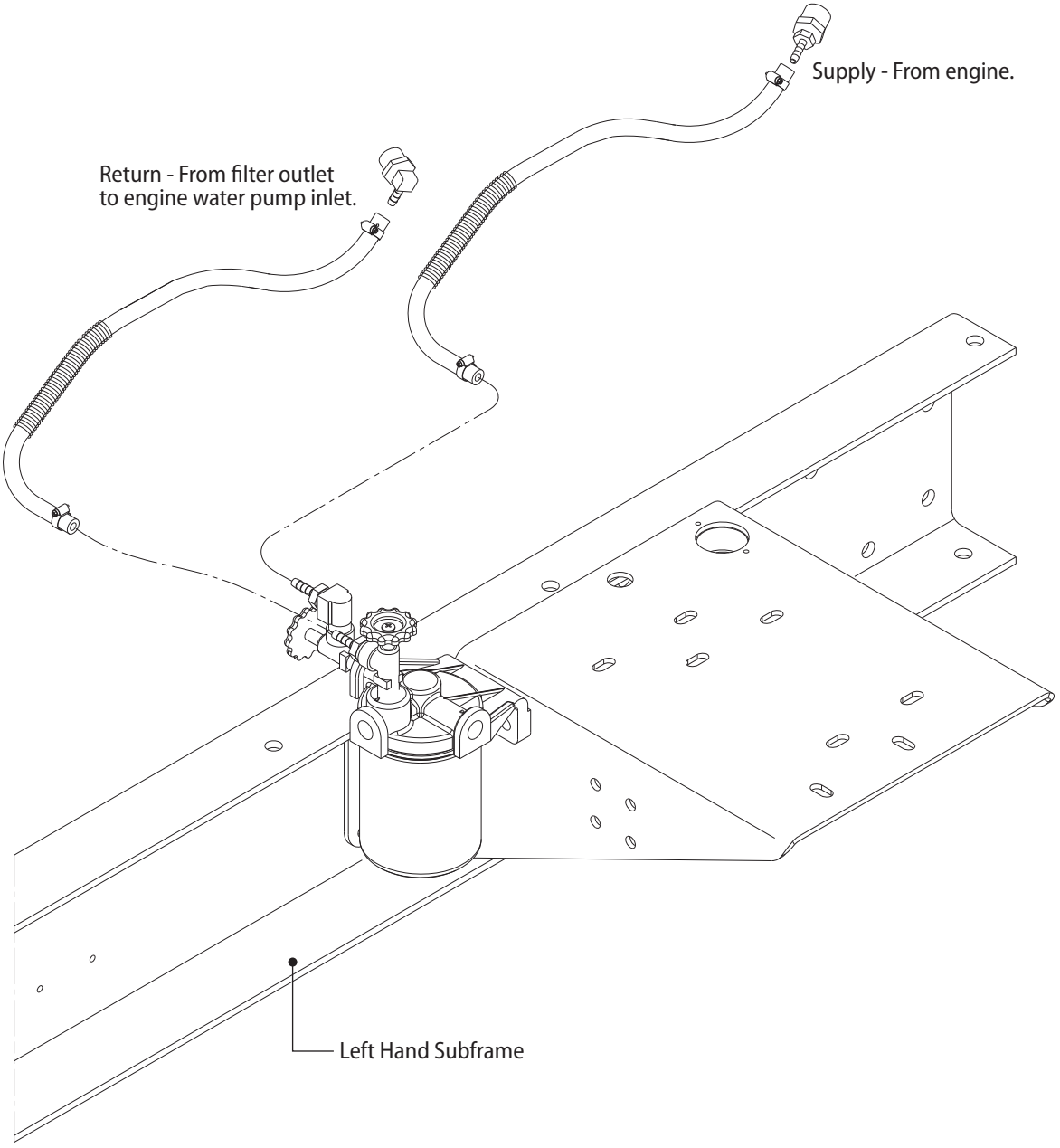
Blue Bird Part Number: **00064641**
Wix Part Number: **24070.**

Do not use coolant filter elements which dispense Supplemental Coolant Additives (SCAs) to the system.

Coolant Filter Element Replacement

The coolant filter should be replaced every 6 months or 6,000 miles; whichever occurs first.

1. Fully close both shut-off valves at the filter mount.
2. Remove the filter element by turning it counter-clockwise.
3. Fill a new filter element of the proper type for the coolant in use withi premixed coolant of the same type already in the engine. Install the new and filled filter element.
4. Open both shut-off valves.



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Coolant Filter

Radiator Shutters

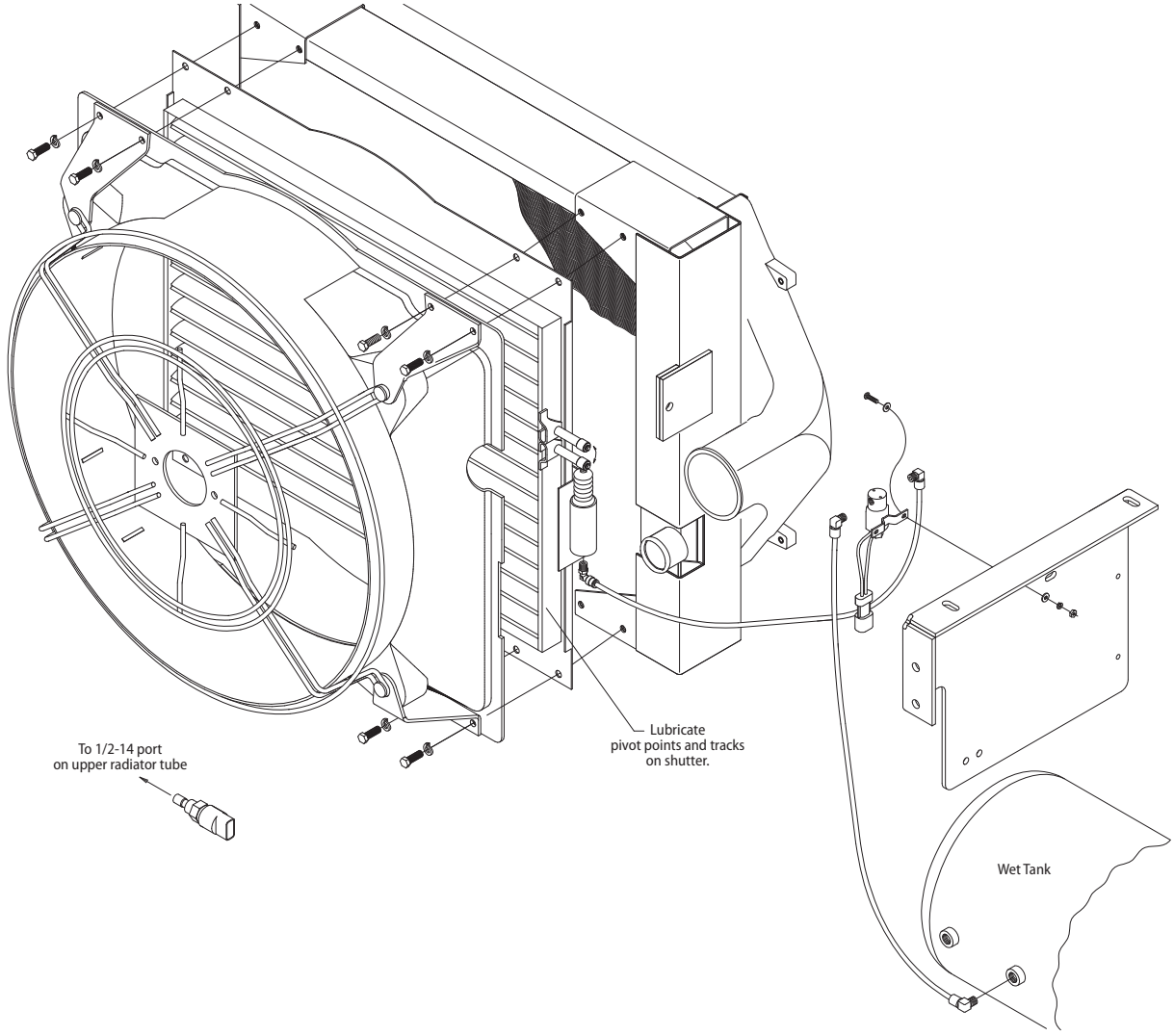
Your bus may be equipped with Radiator Shutters, a popular option on both Forward Engine and Rear Engine All American buses operated in colder climates. Shutters restrict ambient air passing through the radiator and over the engine, and thereby shorten warm-up time for the engine and passenger compartment heaters.

The Kysor Radiator Shutters unit is a window blind-like assembly of adjustable louvers mounted on the fan-side of the radiator. The shutters are spring-loaded in a normally-open position. On buses equipped with air brakes, the shutter mechanism is closed at certain temperatures by an air cylinder.

Unlike the radiator fan, shutters are not controlled by the engine ECU, but by their own independent circuit. Two temperature sensors—one mounted in the engine coolant circuit and the other in the intake tract of the Charge Air Cooler system—are wired in the Radiator Shutters control circuit. Both sensors are normally closed. When ignition is on, current passes through both sensors, and energizing the Shutter control solenoid to close the shutters. As the engine warms, one or both of the two sensors create an open in the circuit, de-energizing the shutter control solenoid and allowing the louver vanes to open the shutters.

Air-powered shutter solenoids receive actuation air from a line leading directly to the supply (wet) air tank. When the solenoid opens, the air which was closing the shutters is expelled through the solenoid's exhaust port.

Shutters should be inspected regularly and kept free of obstructing debris. The pivot points of the louvers and their linkages should be lubricated periodically with a light spray lubricant such as WD40 or a graphite spray.



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Shutters, Air, *Optional*

Radiator

On both All American Forward Engine and All American Rear Engine buses, the radiator is pre-assembled to a similarly-constructed Charge AIr Cooler; however, other than being assembled and mounted as a combined "cooling pack", the two units serve two separate circuits and do not directly interact. While the radiator serves to remove heat from the circulating engine coolant, the Charge Air Cooler removes heat from the engine intake air. Both perform their functions by passing ambient air drawn by the radiator fan across tubing coils which contain coolant (in the radiator) or filtered intake air (in the Charge Air Cooler). The thin corregated fins of each unit conduct heat from the internal coils and thereby disperses it across a broad surface area, allowing it to be carried away by the flow of air.

See the Intake chapter for a more complete functional description of the Charge Air Cooler system. In the descriptions below, references to "the radiator assembly" refer to the combined cooling pack, since the radiator and CAC are handled as a unit. If the bus is equipped with optional radiator shutters, the shutters unit is also attached to the radiator, and all three components are removed and installed together.

Cooling System Drain, Flush & Refill

The following is a general procedure for complete coolant change (drain, flush, refill). Blue Bird recommends that an authorized Cummins dealer/distributor perform this flush and fill in their respective engines. If there are differences between the information in this procedure and the engine manufacturer's Operator's or Maintenance Manuals, follow the engine manufacturer's instruction.

1. Drain the cooling system:

   1.1 Park bus on a level surface, apply parking brake, turn off engine, remove ignition key and chock wheels.

   1.2 Allow the engine to cool. Then remove the radiator cap. Locate and open both heater hose cut-off valves. Open all heater control valves fully. Removal of the thermostat may assist in draining, flushing, rinsing and refilling process. Follow engine manufacturers' recommendations on thermostat removal and installation.

WARNING ***Coolant released under pressure can cause serious burns. Remove filler cap only when cool enough to touch with bare hands. Slowly loosen cap to first stop to vent pressure before fully removing. Engine coolant is toxic and is an eye and skin irritant. Protective gear should be worn when working with coolant. Allow the system to cool before draining and flushing. Engine coolant is a threat to the environment. Use suitable containers for disposal. All applicable federal, state, and local laws must be observed when disposing of engine coolant.***

   1.3 Place a drain pan under the radiator drain and open the drain petcock. Drain and discard the coolant from the cooling system following all applicable federal, state, and local laws governing disposal of engine coolant. Be sure that all the heater valves are open in order to completely drain the engine, heaters, coolers, hose, etc.

   1.4 After system has drained, disconnect both the pressure and return heater hoses. Using a shop air hose set at a maximum of 15 PSI, blow air into the heater hoses to blow the remaining coolant from the heater system.

   1.5 Open the lowest coolant drain port or plug from the engine to drain any remaining coolant from the engine.

   1.6 Close all drains, reconnect heater hoses, and reinstall all plugs that have been opened or removed.

   1.7 If the system has a coolant filter, close the valves to the filter and remove the filter element.

   1.8 Reconnect all hoses that were disconnected while replacing components. Check all hose connections and clamps.

1.9 If the thermostat has been removed in an earlier step, reinstall thermostats following engine manufacturer's procedures.

2. Clean the Cooling System. Follow the engine manufacturer's instructions for chemically cleaning the entire cooling system.

   On Cummins engines, if sludge or oil is evident, Use Fleetguard Restore. For scale or heavy metal deposits, use Fleetguard Restore Plus (+).

   2.1 After the engine has been stopped and the cooling system has cooled, drain the cleaner from the entire system following the steps describe in the initial drain including blowing the system with 15 PSI (max) of shop air.

   2.2 Close all drains and reconnect all hoses that have been removed.

   2.3 Fill the system with fresh water and run for minimum of 30 minutes on high idle with heater pumps on and all heater valves open.

   2.4 After the 30 minute (minimum) run, stop the engine and allow it to cool. Then drain the water from the entire system following the steps describe in the initial drain, including blowing the system with 15 PSI (max) of shop air.

   2.5 With the hoses disconnected and the drain valves open, run fresh water through the heater system, radiator, transmission cooler and engine until the water is clear.

   2.6 Repeat steps 2.2 thru 2.5 as many times as required to ensure that the system is clean and the chemicals are completely removed.

CAUTION ***After having used cooling system cleaners, be sure the systems are flushed 3–5 times to remove all cleaner from the system. If cleaner is not completely removed, ammonia salts will be left from the cleaner and severe copper corrosion can occur.***

3. If the bus is equipped with an optional coolant filter, check the filter head, clean filter head and lines as required to remove all of the old coolant and any residue. Install a new coolant filter element.

4. Refill the cooling system with coolant recommended by the engine manufacturer. Read the About Coolant section of this chapter thoroughly for information about the coolants installed at the Blue Bird factory, and for Blue Bird recommendations. Blue Bird recommends using only pre-mixed coolant, or mixing of premixed coolant with concentrate of the same type and brand (as opposed to mixing concentate with water) to raise the glycol ratio above that of the premixed coolant. Blue Bird recommends always topping-off coolant with the same pre-mixed coolant as is installed, rather than topping off with water. If water is used for top-off, use only deionized water. Never add tap water to the cooling system unless absolutely necessary in roadside emergency situations. Never mix coolants of different color, type, or brand. Keep accurate records of all coolant changes and maintenance.

5. Bleed Air From the Cooling and Heater System:

   5.1 Fully open the pressure-side heater hose cut-off valve. Fully close the return-side heater cut-off valve (located near the transmission cooler).

   5.2 In the Driver's area, open all heater temperature controls to their full on position, and turn on all heater pumps. The number of heater controls, and the presence of heater pumps depends upon optional equipment purchased on the bus.

   5.3 With the engine stopped and a cool engine, remove the radiator cap.

   5.4 On All American buses, locate the ¼" bleeder tube which is located near the deaeration tank. The bleeder tube originates from a low point of the cooling system, where the return heater hose returns coolant to the transmission cooler; and runs to a location near the deaeration tank.

   On All American Rear Engine buses: The bleeder tube is located underneath the deaeration tank and its end is already connected to the to the tank. Open the in-line bleed valve fully. During bleeding, overflow coolant will be returned directly to the deaeration tank.

   5.5 Start engine and operate at 1800 to 2000 rpm. Watching the coolant temperature gauge, ensure the engine reaches 180-190 degrees, the temperature at which the engine's thermostat normally fully opens.

   5.6 Operate the engine with the bleeder valve open until all air has been purged from the system. During this time, monitor the level of coolant in the deaeration tank sight glass. As air trapped in the system escapes, the coolant level will occasionally rise and drop. Top-off the coolant level with pre-mixed coolant whenever it drops below the full level mark.

5.7 Air has been fully purged from the system when the coolant level no longer fluctuates, and the stream of coolant from the bleeder hose is constant. This may take 15-30 minutes.

5.8 After the air has been purged and solid stream is present, allow the engine to return to idle to cool down gradually. Close the bleeder valve and store the bleeder line in its original position.

5.9 Install the radiator cap.

5.10 Operate the engine until the thermostat opens. Then stop the engine and let it cool for 15-30 minutes. Check the entire cooling and heating system for leaks. Recheck coolant levels and top off with the same premixed coolant as is installed.

5.11 Obtain a coolant sample from the radiator drain petcock, and test the glycol level with a refractometer to ensure the glycol level is 50% minimum. If the glycol level is less than 50%, drain the appropriate amount of coolant and add concentrate per the engine manufacturer's instructions for increasing glycol percentage to correct level.

5.12 Pressure test the cooling system for leaks. If no leaks are found, the bus may be returned to normal service.

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