VOLUME 1

Introduction

Chassis Frame

Front Axle & Suspension

Rear Axle & Suspension

Air Brakes

Hydraulic Brakes

D3FE

2013

SERVICE MANUAL

APPLIES TO THESE MODELS

ALL AMERICAN FORWARD ENGINE
TX3 FORWARD ENGINE
GLOBAL TRANSIT FORWARD ENGINE

COUNT ON BLUE BIRD

BLUE BIRD

BLUE BIRD

D3FE



10026183
Edition A

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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.

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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 54 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 ships parts directly from the home plant in Fort Valley, Georgia 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 Commercial 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 mechanical 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 Publications 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 mechanical 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 or Caterpillar engine and Allison transmission. Although this manual includes general maintenance information (such as fluid change intervals), mechanical information about the engine and transmission is beyond the scope of this manual. Refer to Cummins or Caterpillar, 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 entirity, 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 discrepencies 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 proceding.

About the TechReference DVD

While Blue Bird TechPubs recongnizes 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 Compact 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 technican. 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 electonic distribution via PDF has also allowed us to include these additonal 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.

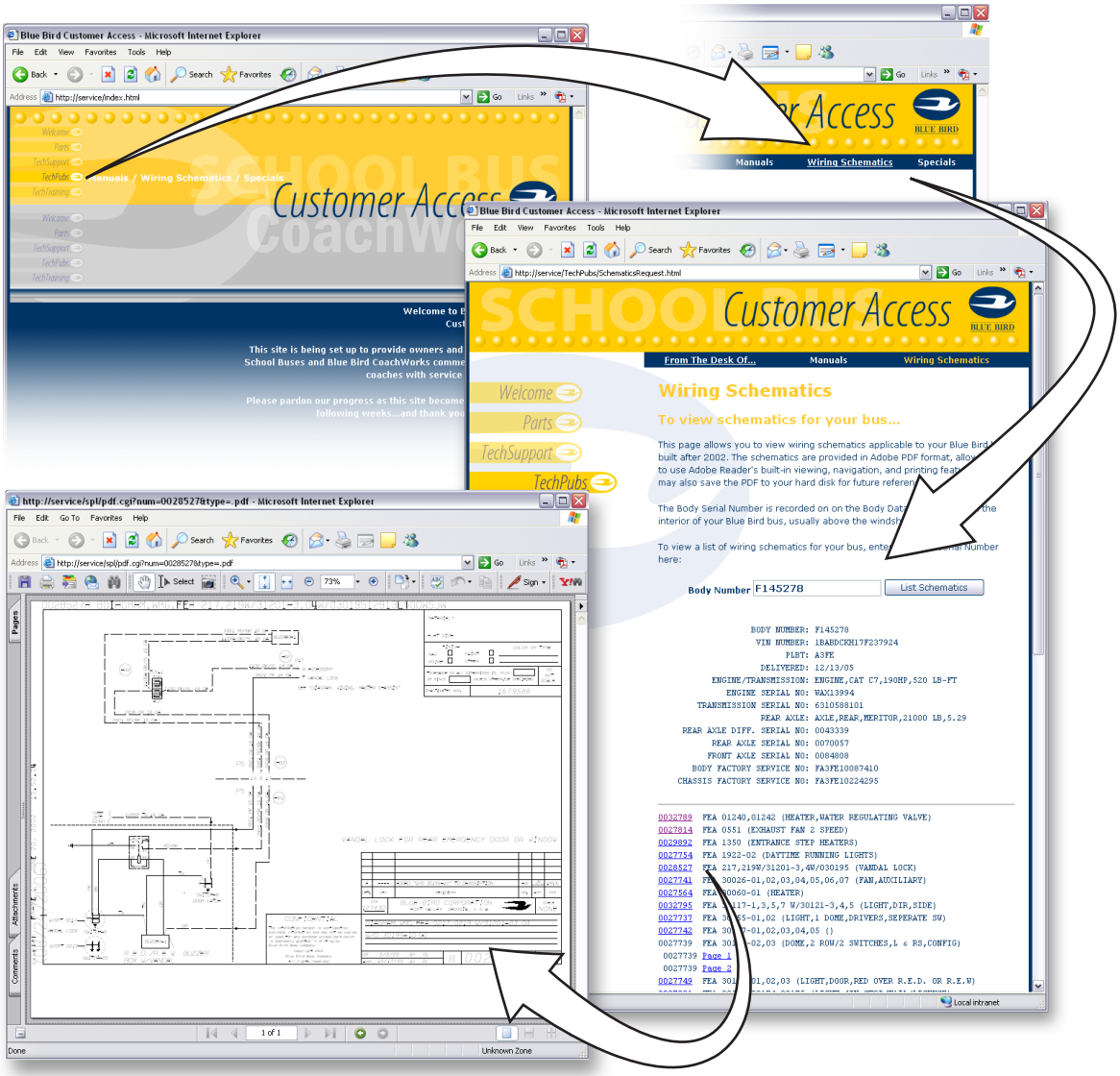
Electrical Schematics

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

Click on the TechPubs link; then on the Wiring Schematics link. 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 Forward Engine All Americans, engines are supported by S-shaped sub-frame members which are bolted into the C-channel of the front end of the main frame rails. The front bumper brackets and tow hooks are bolted to these sub frame members. Rear 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.

Frame 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.

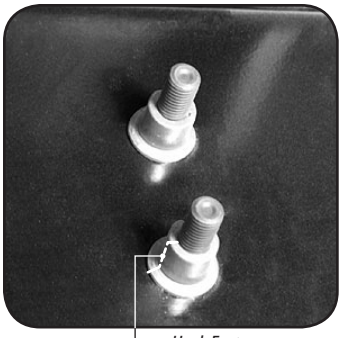
- Check for deteriorated, shifting or missing tie-down pads. Replace if needed.

- 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 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.***

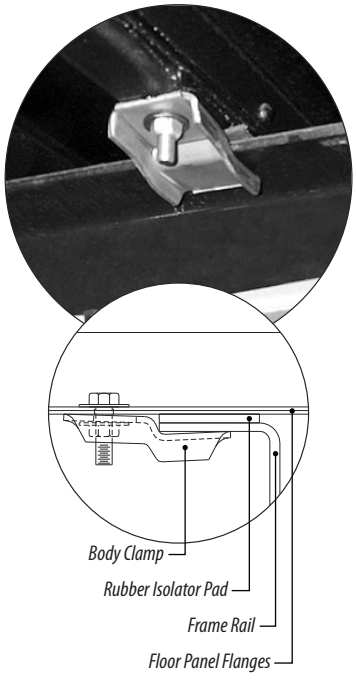
3. After drilling, use a cold chisel to break the collar or to spread it enough to allow removal. Remove the threaded bolt, using a hammer to tap it out if neces-sary.

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 flanges.

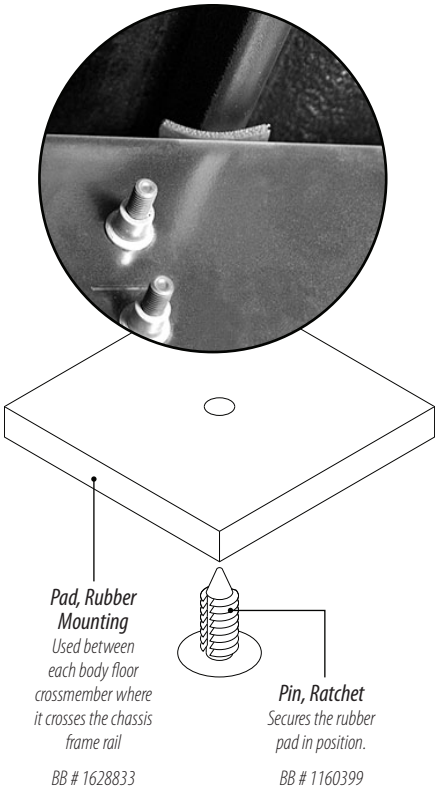


Inspection/Adjustment

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).

Swing-Out Radiator

Your bus may be equipped with an optional swing-out radiator. This feature allows better access for service or replacement of the engine belt, fan or fan clutch, as well as radiator cleaning.



1. Park the bus on a flat level surface. Remove Ignition key. Chock wheels. Turn off master power switch or disconnect battery positive cable.

2. Remove engine hood by first removing the cup holder and PA mic, then releasing the external rubber tension latches and the internal draw-down latches. See **Engine Access** in the Power Drivetrain chapter of this manual.

3. Remove curbside charge air cooler pipe by loosening the upper and lower spring clamps. *Note: Cover turbo outlet to prevent contamination*.

4. Open front grille and access panels by releasing the press button latches.

5. Swing the front bumper down by removing upper tow hook bolts then loosening lower bolts. See **Bumpers and Tow Hooks** in this chapter.

WARNING ***Be careful to support the bumper while loosening the lower bolts to prevent the weight of the bumper from pivoting on the bolt and causing bodily harm.***

6. Relieve any pressure in cooling system through the deaeration tank cap.

WARNING ***If cooling system is hot allow ample cool down time for the system before removing deaeration tank cap.***

7. Disconnect overflow hose at fill neck.

8. Disconnect 3/8 inch vent hose at driver side of dearation tank and remove hose from elbow. *Note: Clamp or plug the hose to help prevent spillage.*

9. Loosen spring clamp on road side charge air cooler pipe.

10. Loosen, but do not remove, curb side radiator mounting bolts.

11. Remove radiator mounting bolts on the driver's side of the radiator and partially open the swing-out radiator.

12. Remove 1/4 inch tubing from the quick disconnect at the shutters control cylinder, if so equipped.

13. Loosen S-hook fastener at end of retaining cable on front of radiator/charge air cooler package. Attach S-hook end of cable to end of frame rail to hold radiator.

14. After service is complete and radiator is returned to its operating position, check all upper and lower hoses and tubes to ensure they are free of kinks and there is ample clearance to adjacent components.



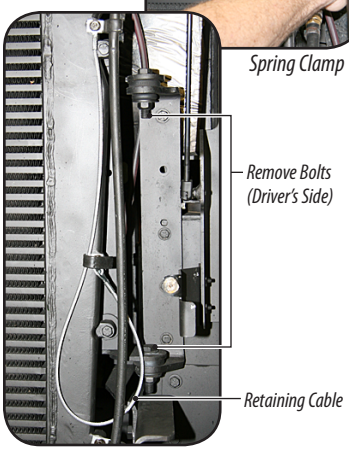
Latches

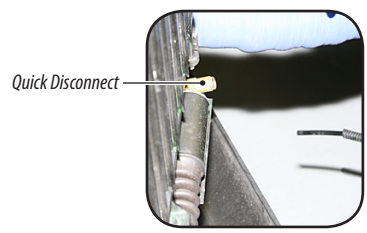


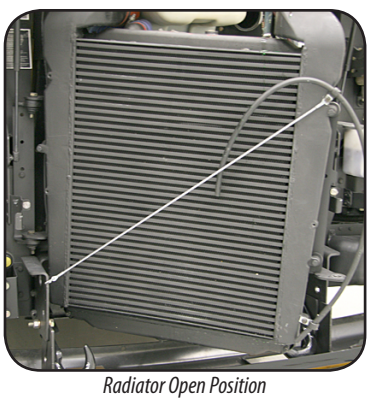
Vent Hose



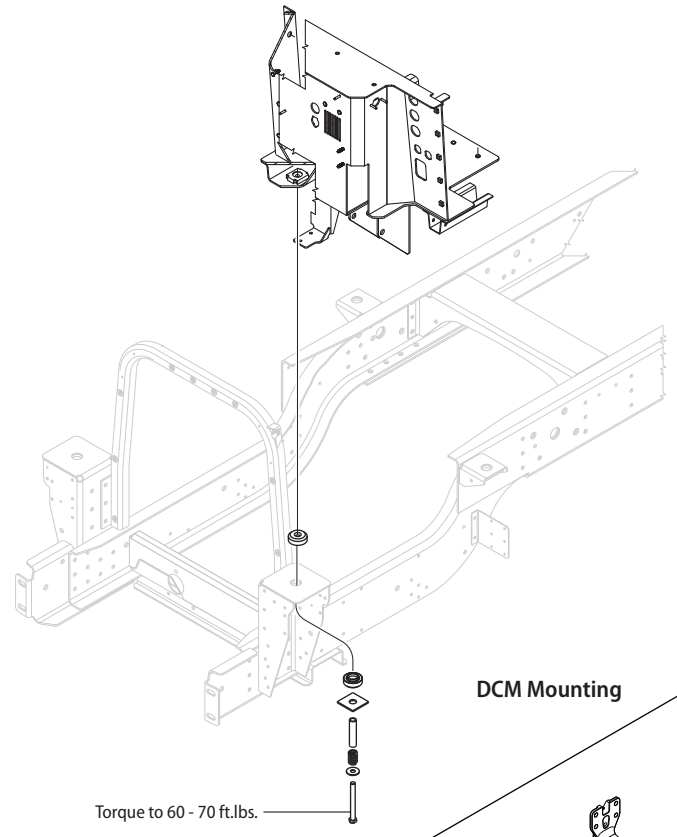
Spring Clamp





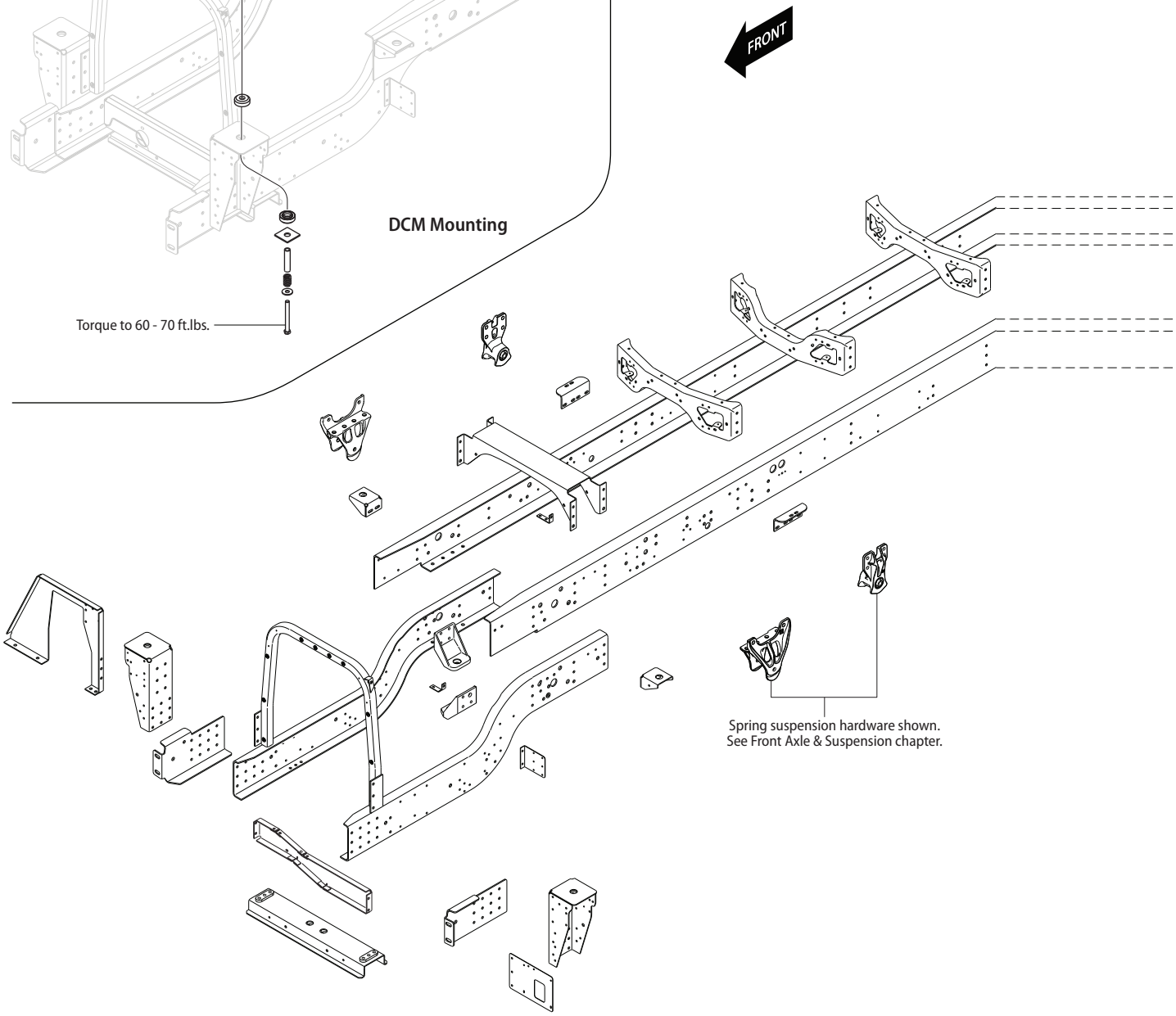


Radiator Open Position

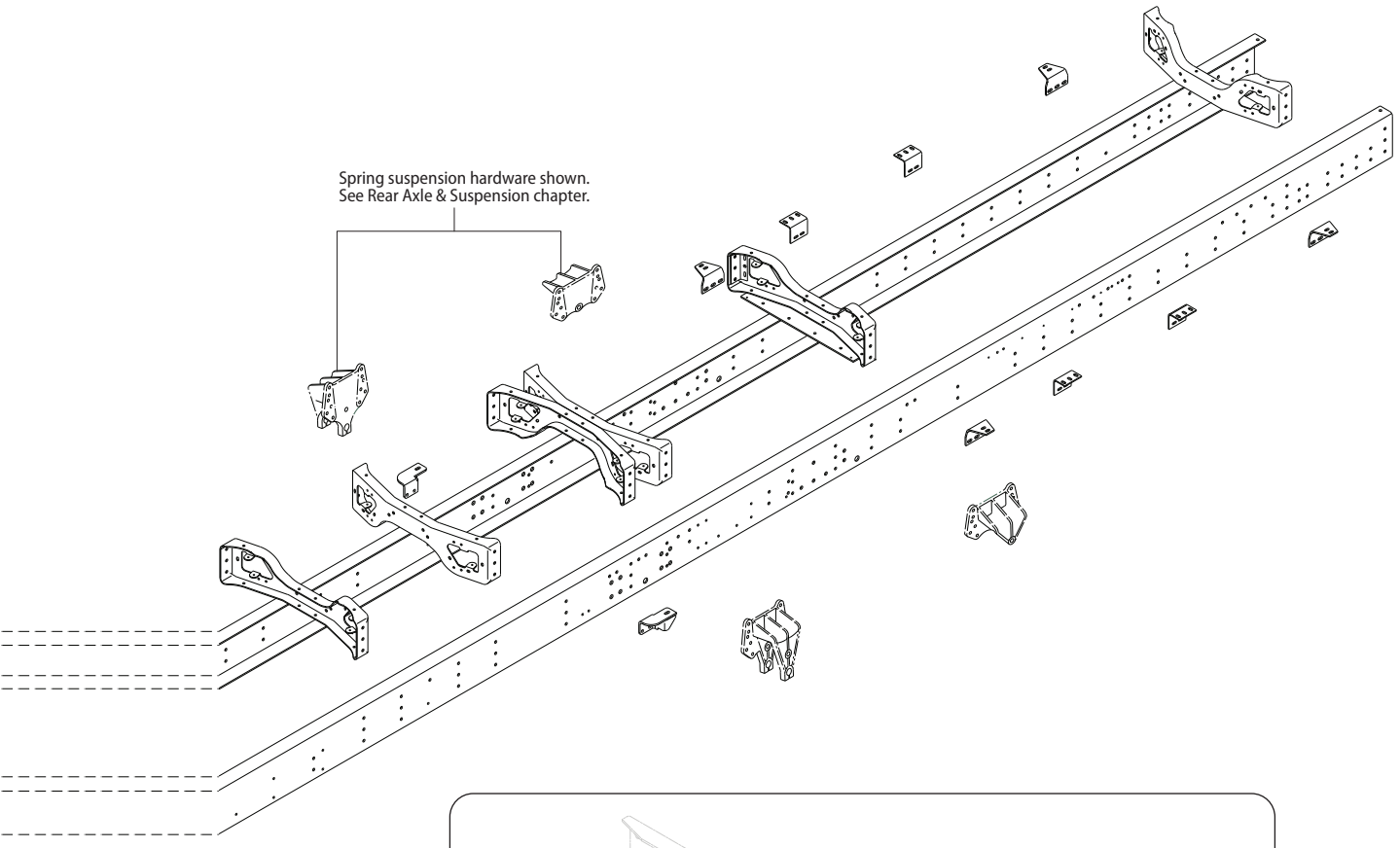


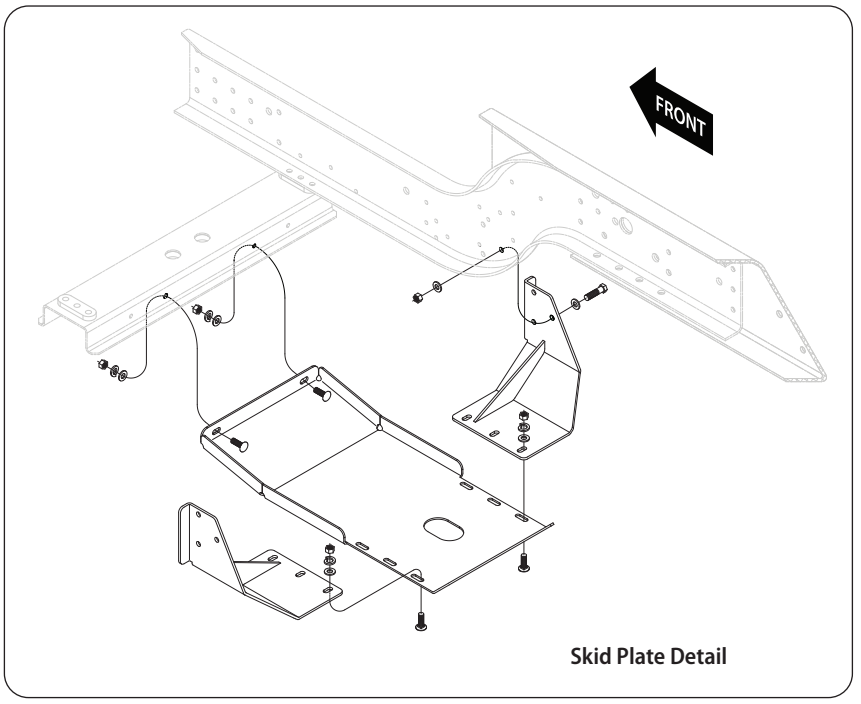
DCM Mounting

Torque to 60 - 70 ft.lbs.



Spring suspension hardware shown.
See Front Axle & Suspension chapter.





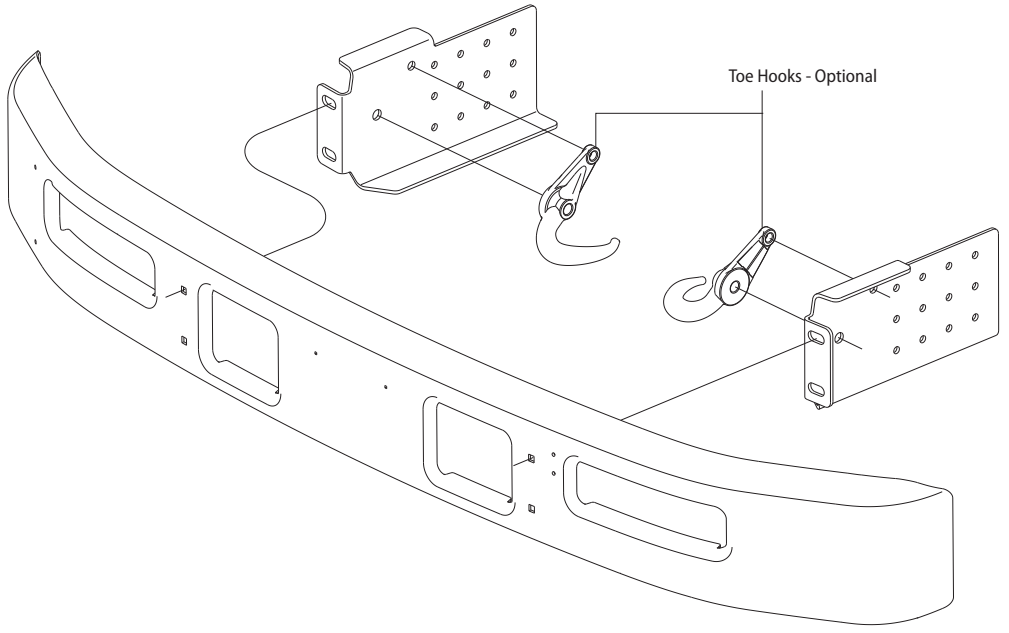
Skid Plate Detail

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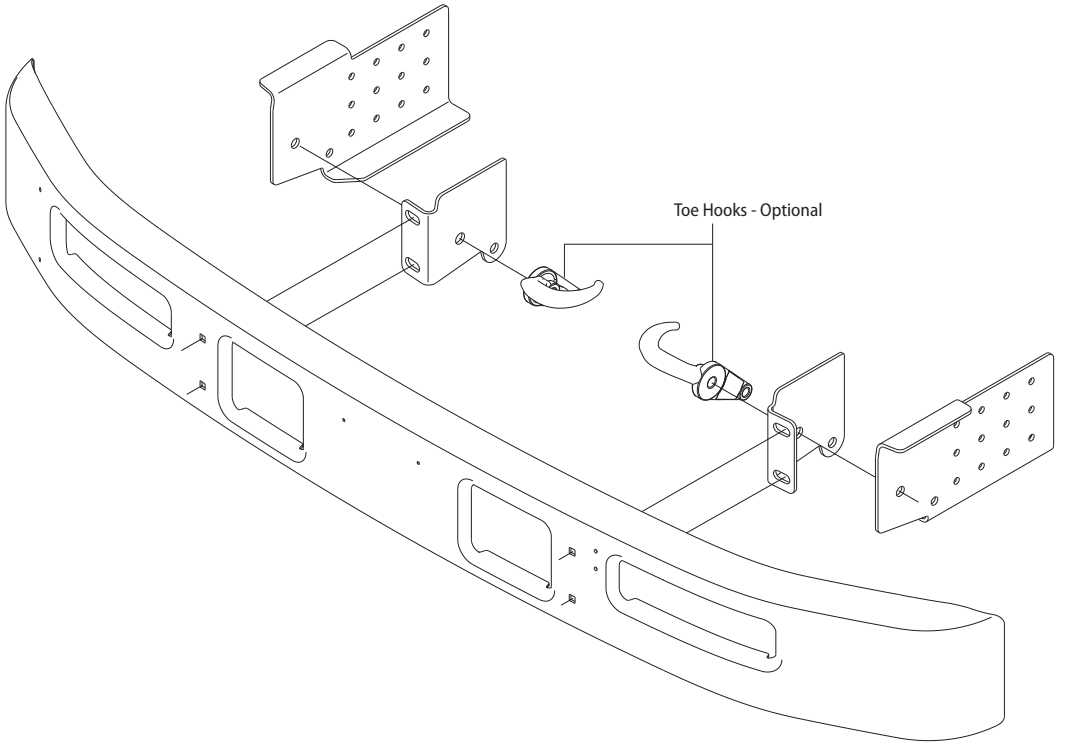
Chassis Frame

Bumpers & Tow Hooks

Front Bumper, Standard

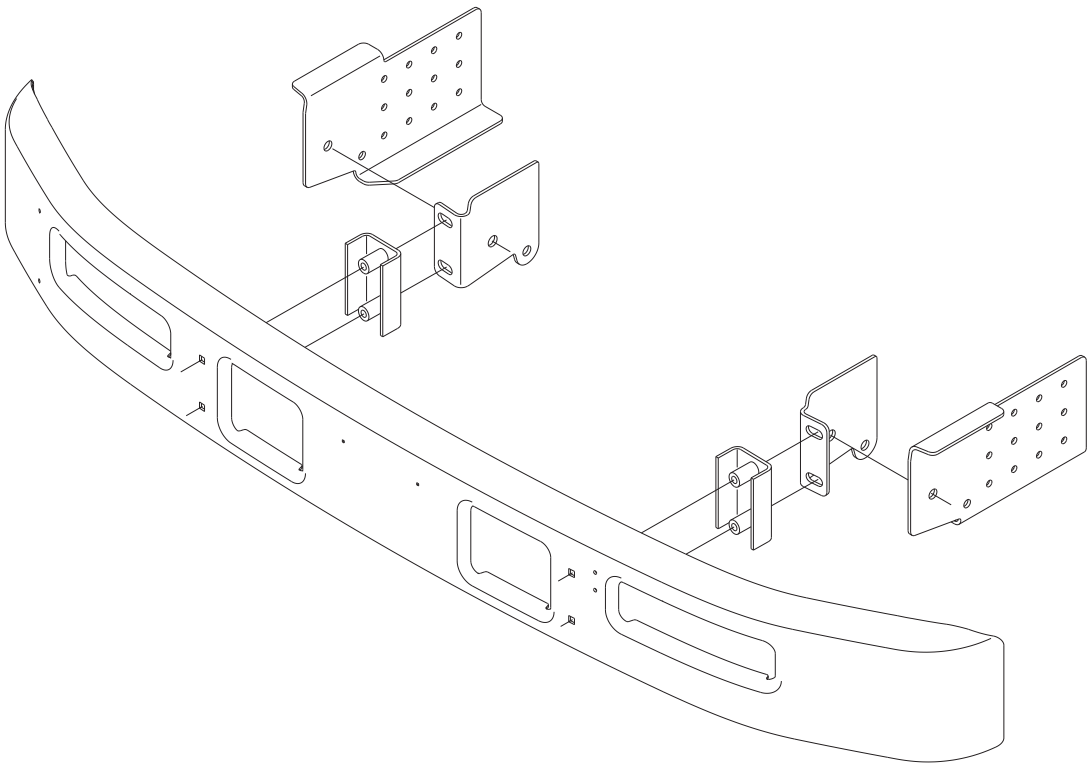


Front Bumper, Pivot

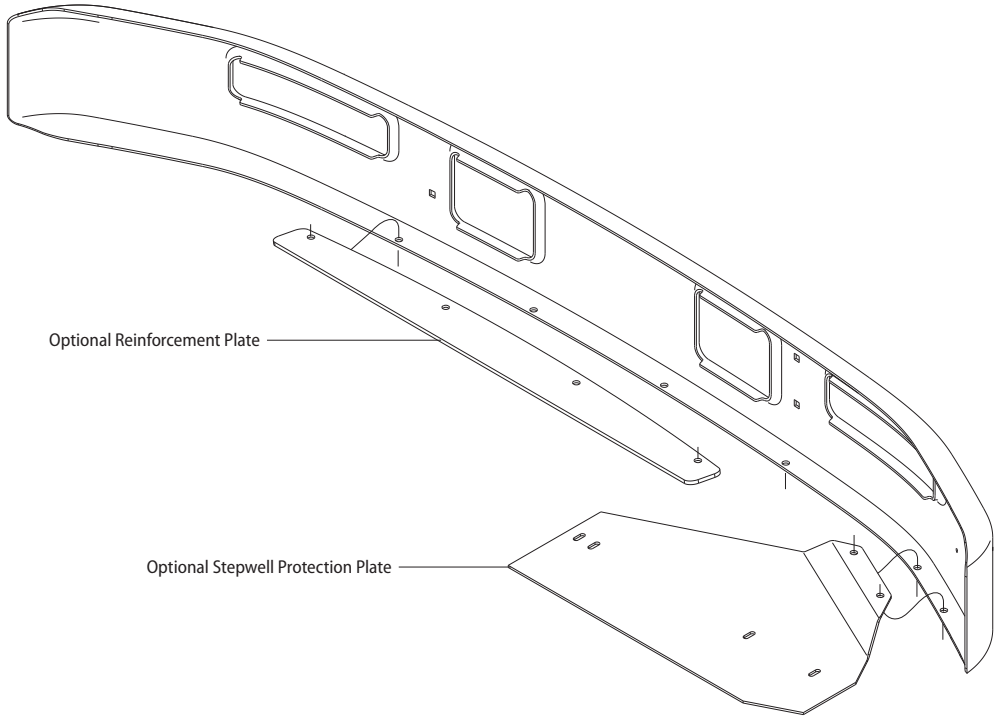


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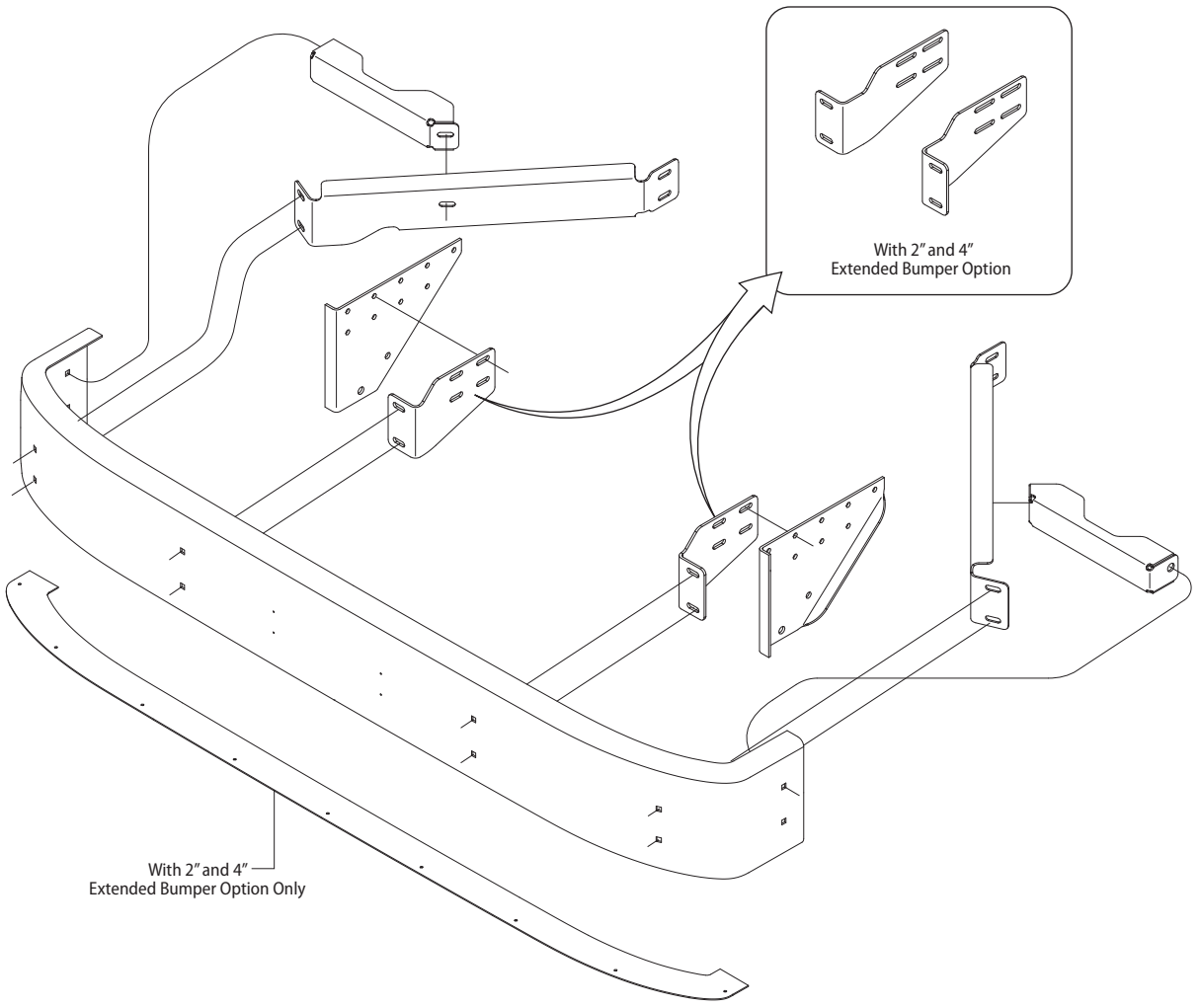
Front Bumper, 2" Extended



Front Bumper, Options

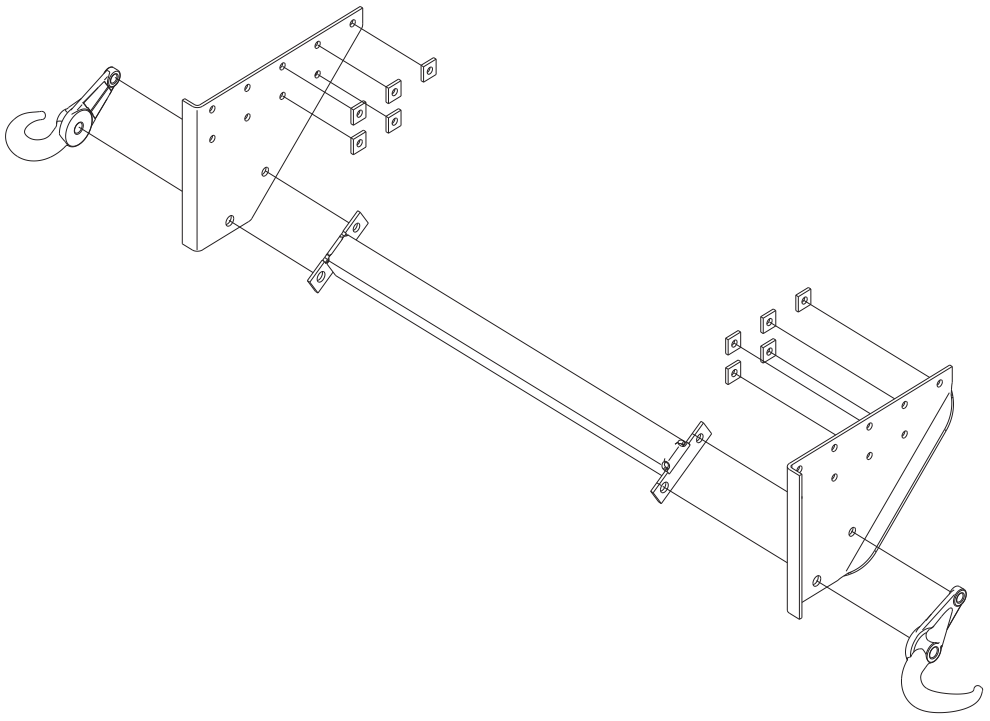


Rear Bumper & Rear Bumper Extended



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Rear Tow Hooks



Overview

Front Suspensions

The Blue Bird All American is equipped with one of two front suspension systems:
Hendrickson™ SofTek.™ The Softek front suspension is a three parabolic leaf spring configuration, and is standard equipment on the Forward Engine All American.
Hendrickson™ AirTek.™ The Airtek front suspension is an air spring suspension used on the Forward Engine All Americans equipped with air suspension option. Two leveling valves maintain ride height at varying axle loads.

Axles

Hendrickson™ SteerTek. The Forward Engine All American is 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.

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.

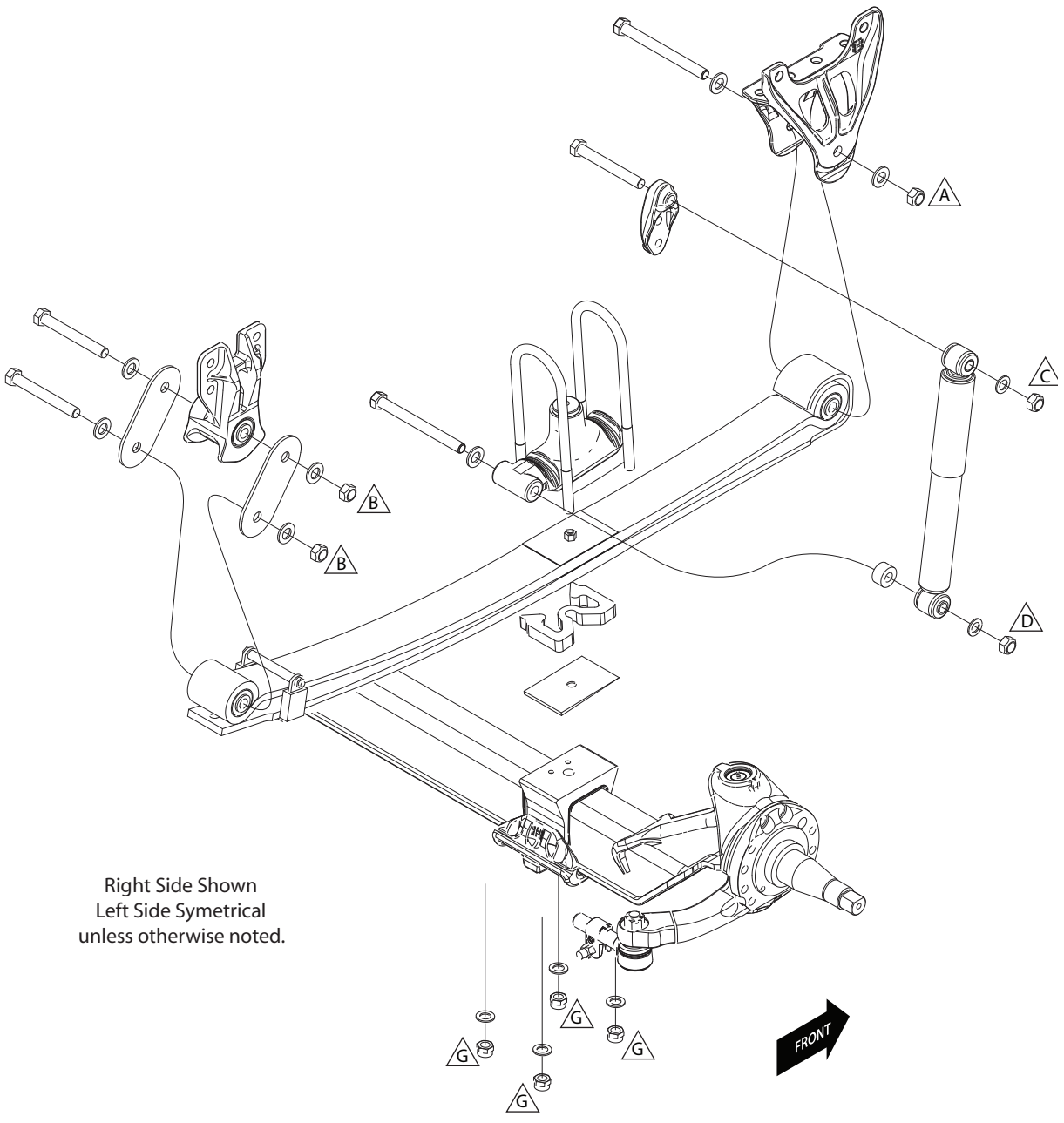
Also See: The Hydraulc Brakes chapter of this manual includes a procedure for removing the front disc rotor/hub assembly.



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.

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.



Right Side Shown
Left Side Symetrical
unless otherwise noted.

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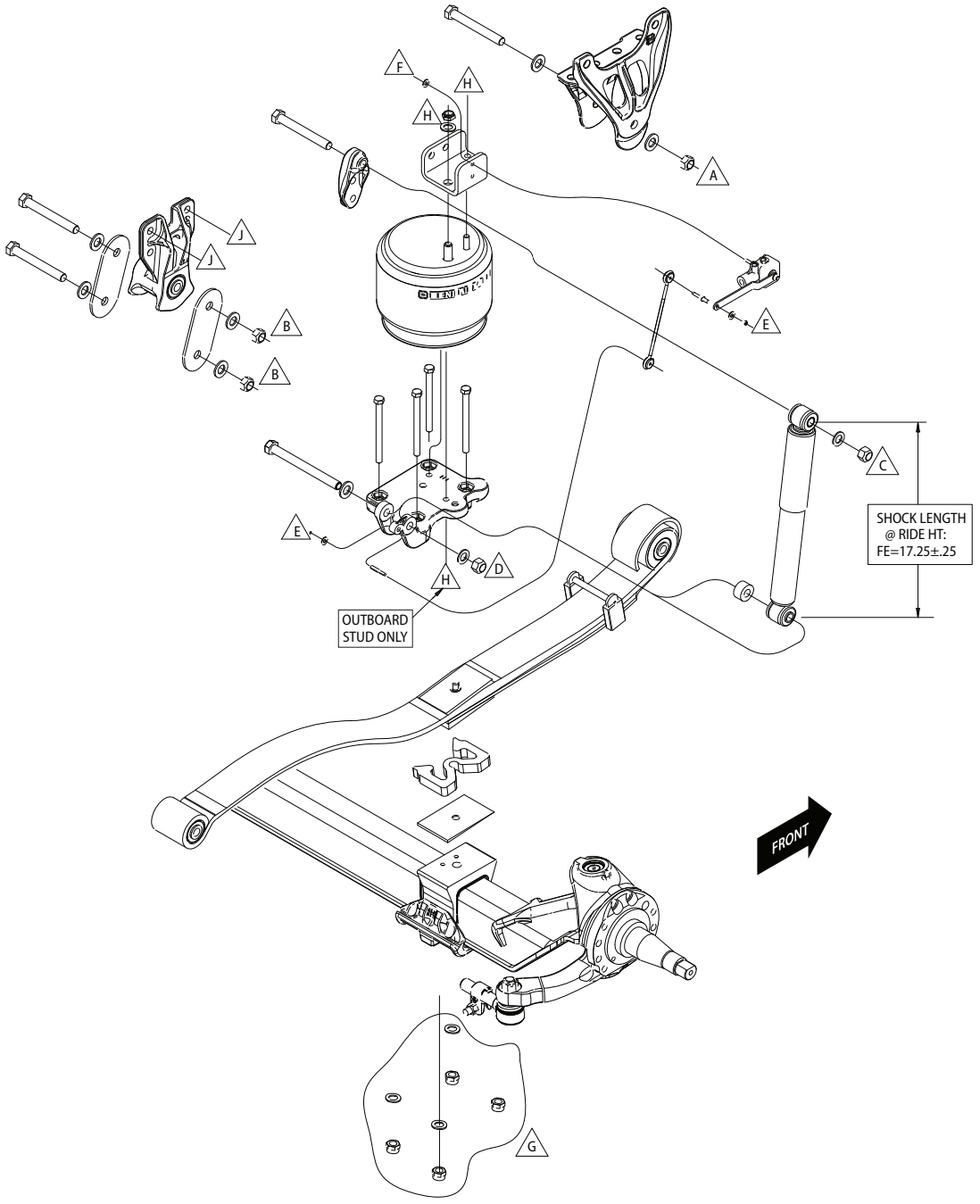
SofTek Front Suspension

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″**



00106294M

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.
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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 17.25" ± .25" for Forward 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.

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®



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January 2008
Rev. D

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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

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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

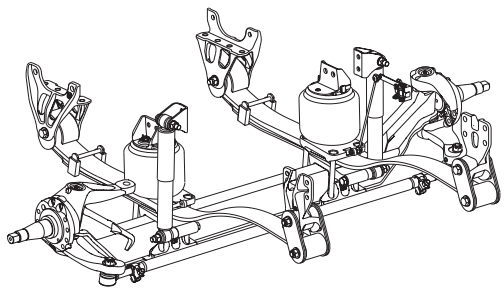
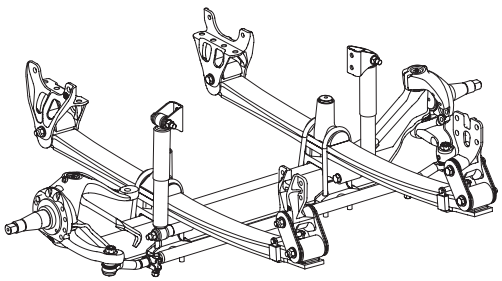


FIGURE 2-2
SOFTEK® Mechanical Suspension System
Capacity: 8,000/10,000 pounds



BLUE BIRD ALL AMERICAN BUSES

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

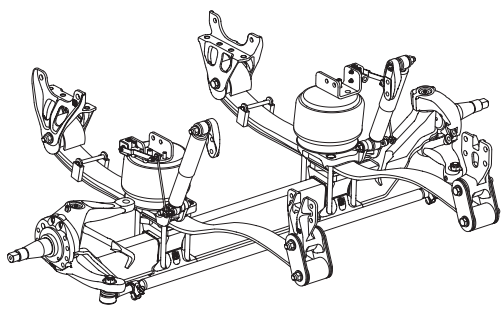
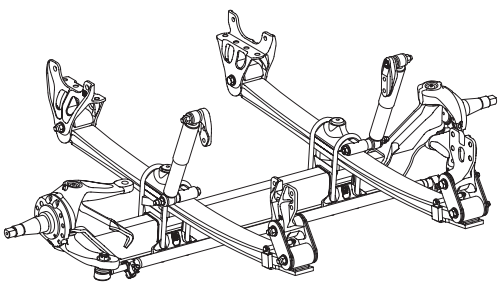
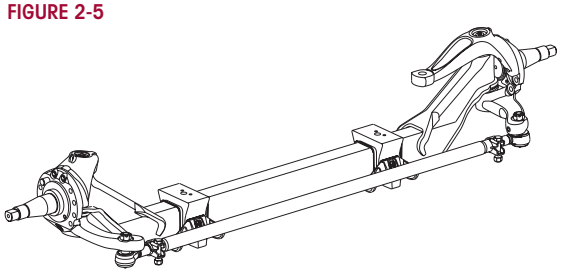


FIGURE 2-4
SOFTEK® Mechanical Suspension System
Capacity: 13,200/14,600 pounds



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.

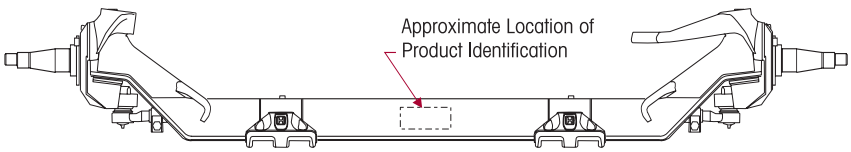
Shock absorbers — AIRTEK/SOFTEK utilizes premium shocks that have been tested and tuned specifically for the suspension system.

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.

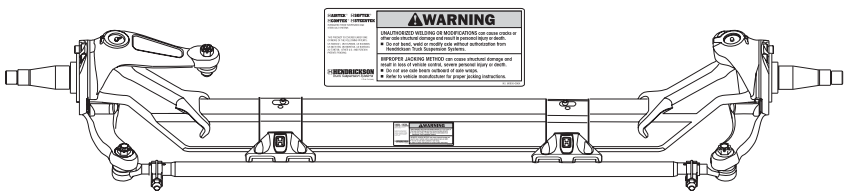
WARNING

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.

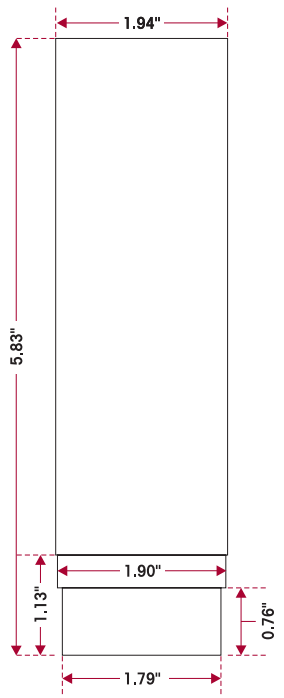
SECTION 4

Special Tools

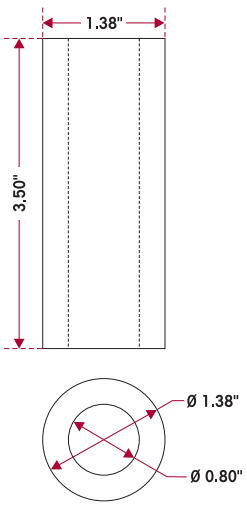
These shop made tools are designed to install and remove kingpin bushings. Bushing tools are made from cold rolled steel or equivalent. Drawings are for reference only. Hendrickson does not supply these tools.

KINGPIN BUSHING TOOLS

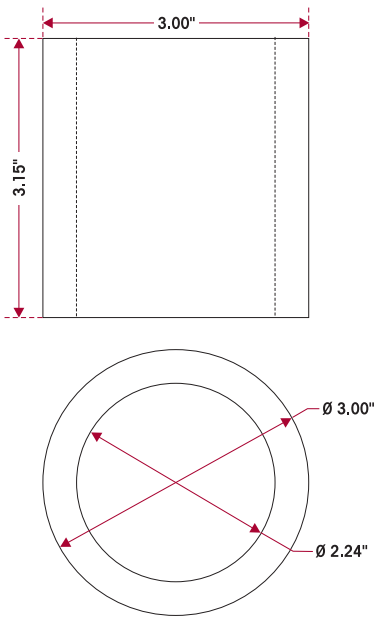
Kingpin Bushing Installer



Kingpin Bushing Removar



Steering Arm Receiver



ADJUSTABLE STRAIGHT FLUTE REAMER

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

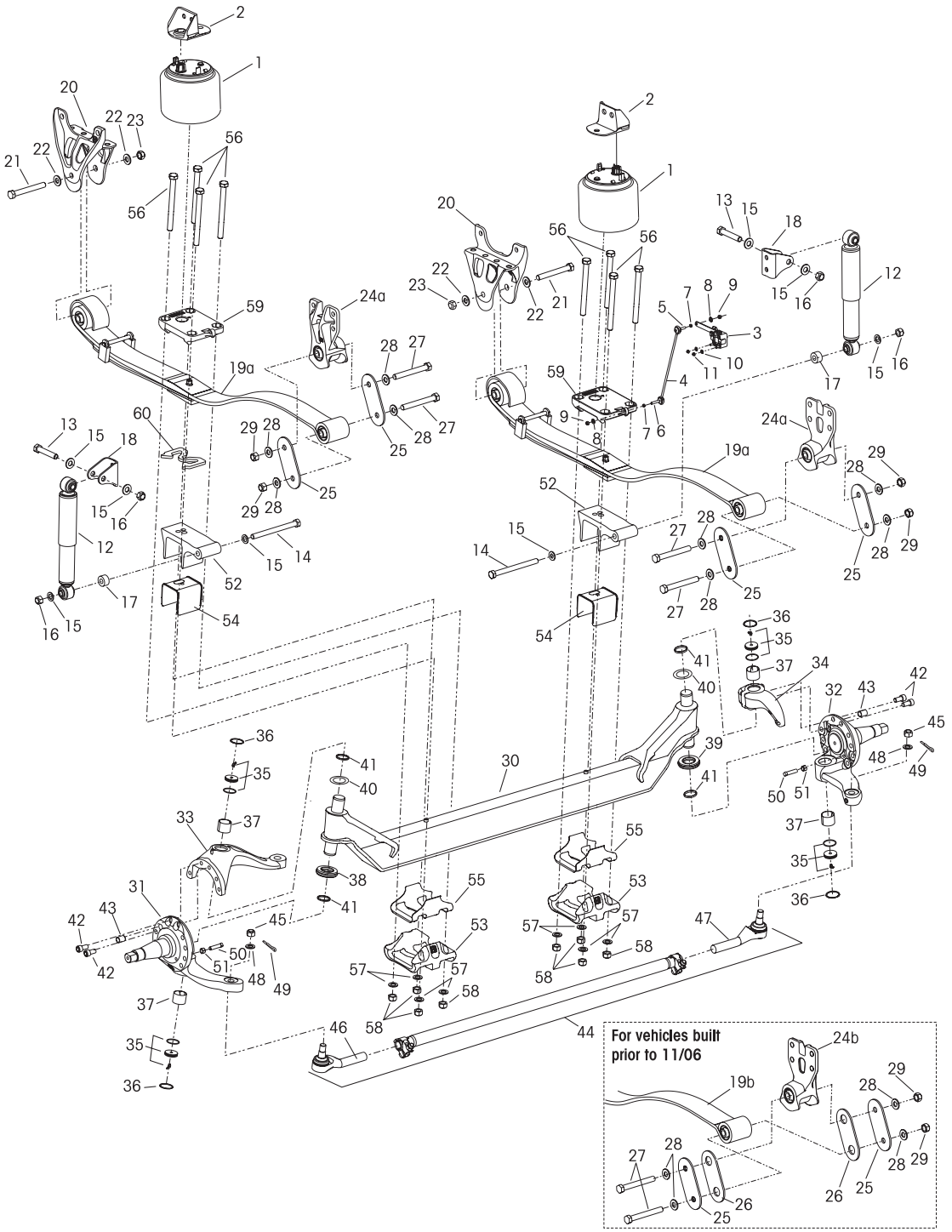


SECTION 5

Parts List

AIRTEK®

Blue Bird Vision Buses - 10K Capacity

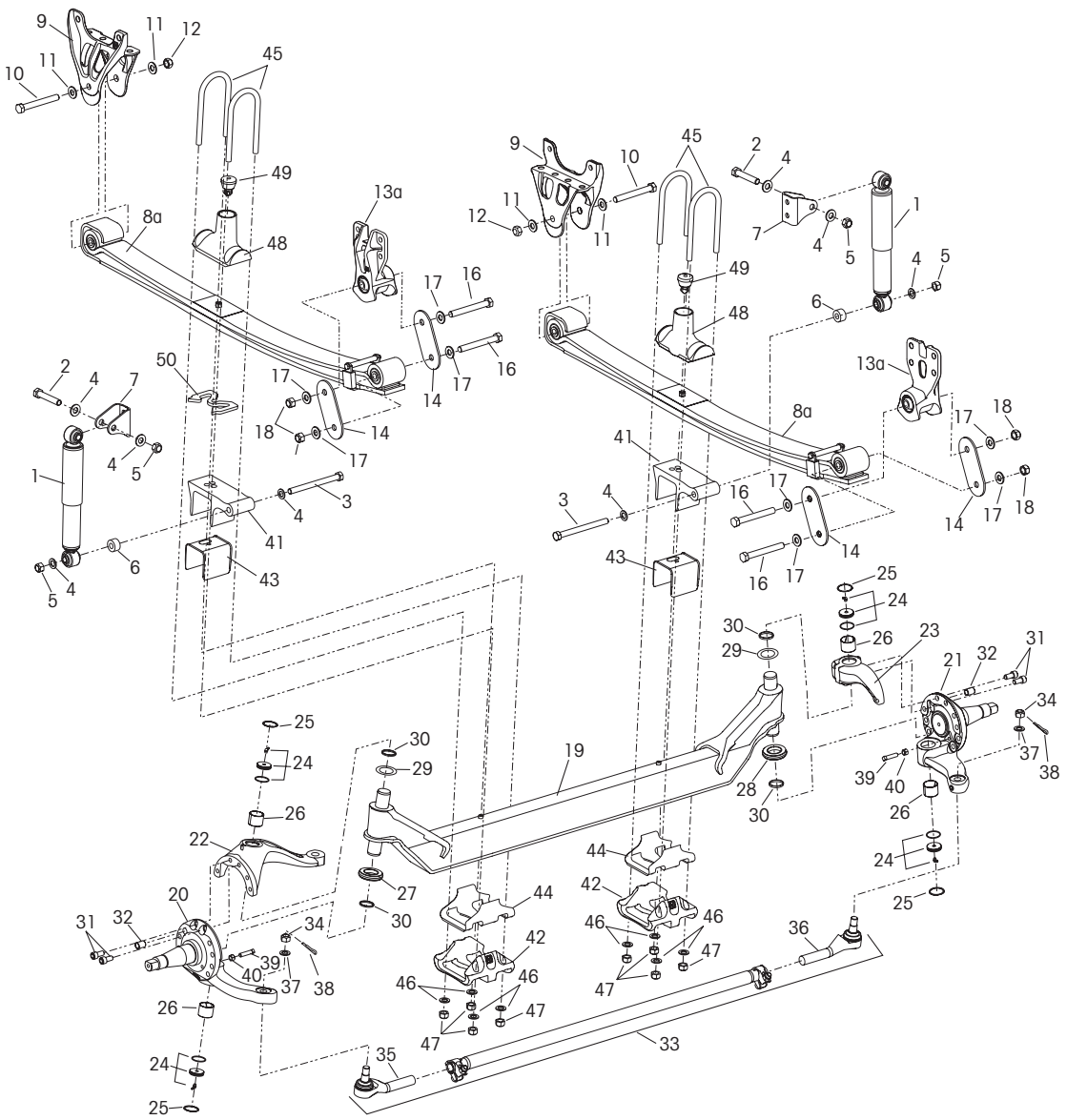


AIRTEK® for Blue Bird Vision Buses - 10K Capacity

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®



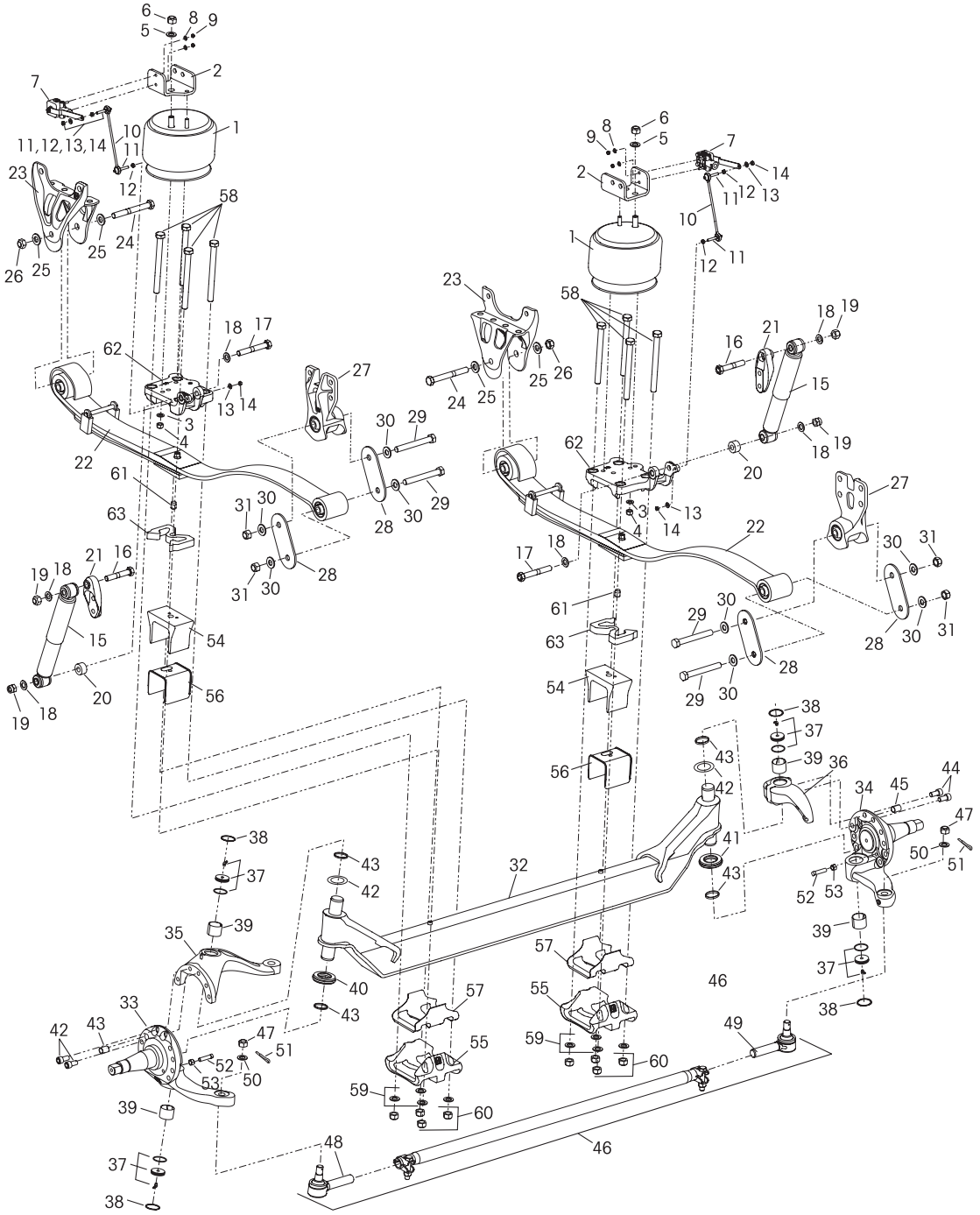
SOFTEK® for Blue Bird Vision Buses - 8K/10K Capacity

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®





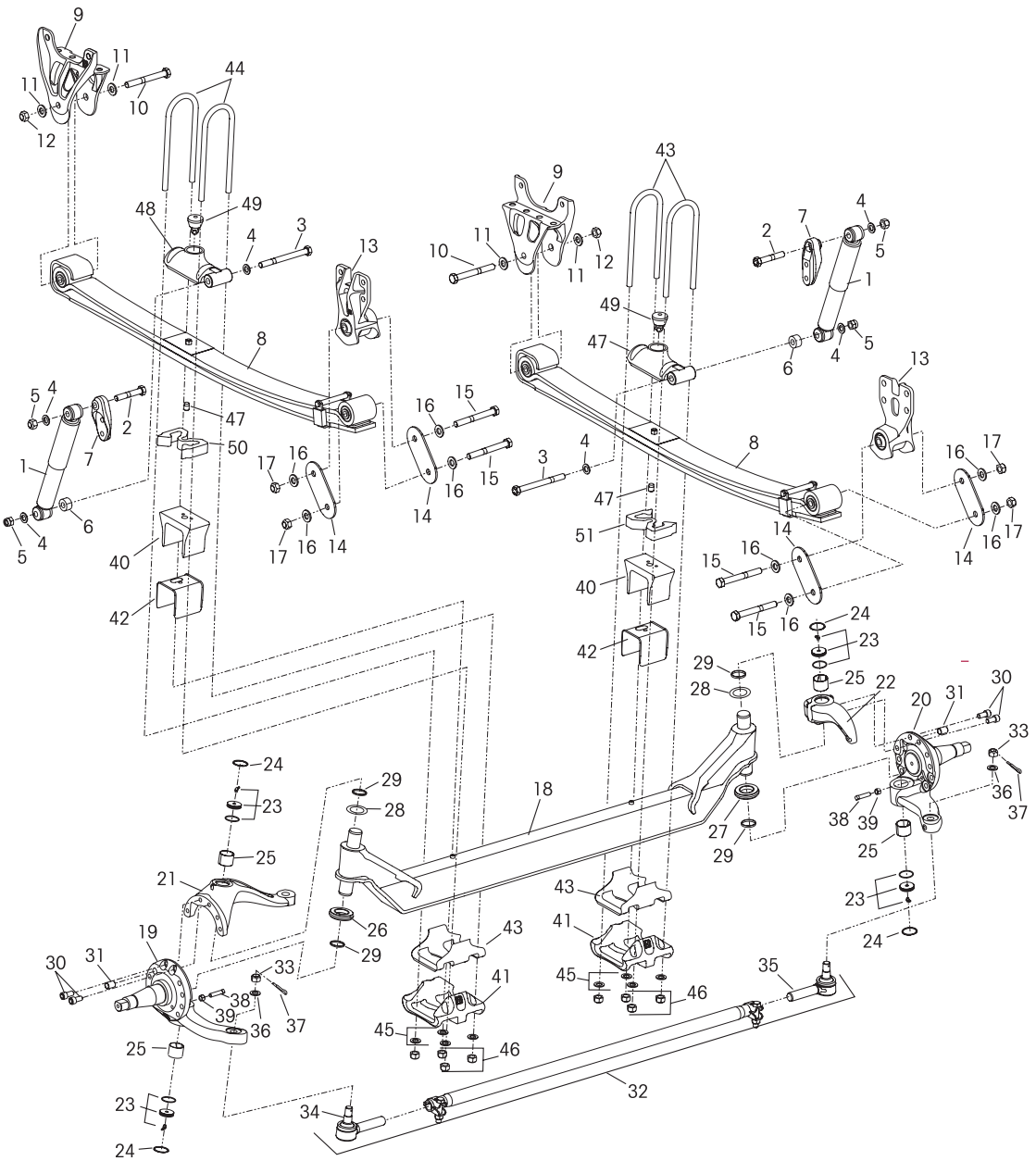
AIRTEK® for Blue Bird All American Buses - 14.6K Capacity

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®





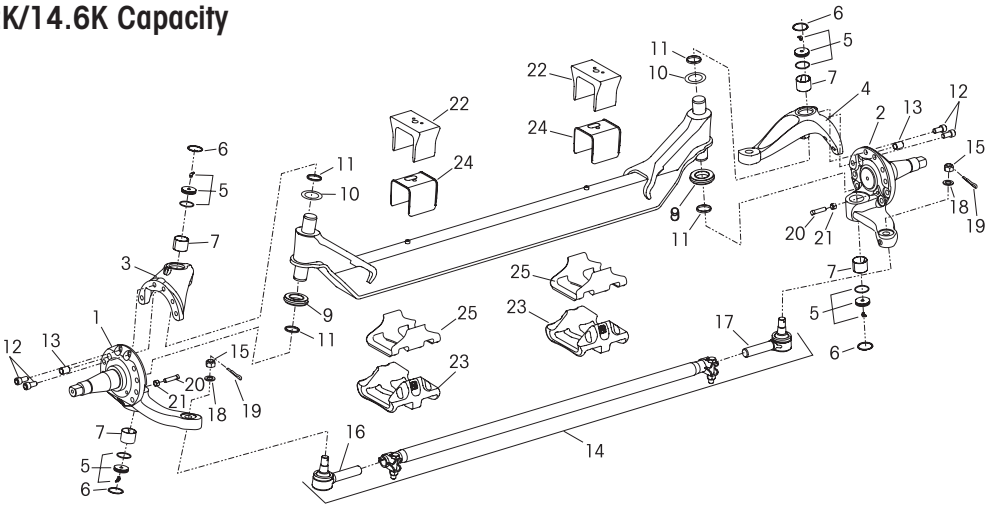
SOFTEK® for Blue Bird All American Buses - 13.2K/14.6K Capacity

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.

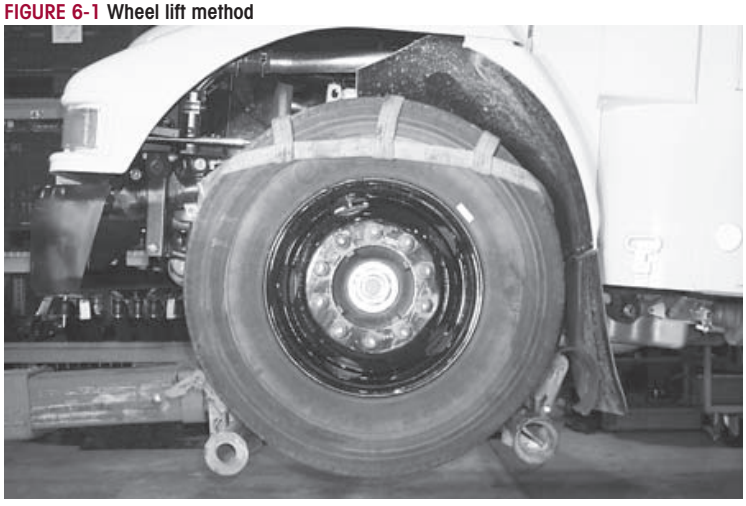
Hendrickson will not be responsible for any damage to the axle, suspension or other vehicle components resulting from any towing method or fixture not authorized by Hendrickson.

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.

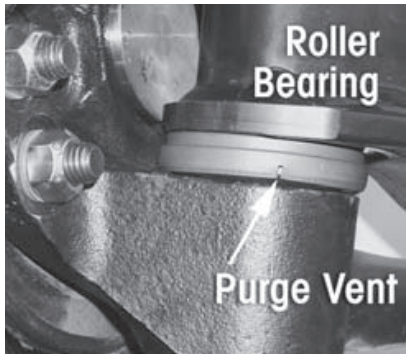
1. Place the vehicle on a level floor.
2. Prior to greasing the kingpins on the vehicle, the suspension must be in a loaded condition.
3. Clean off all the grease fittings and grease gun tip with a clean shop towel prior to lubrication.
4. Lubricate the kingpins through the grease fittings on the top 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

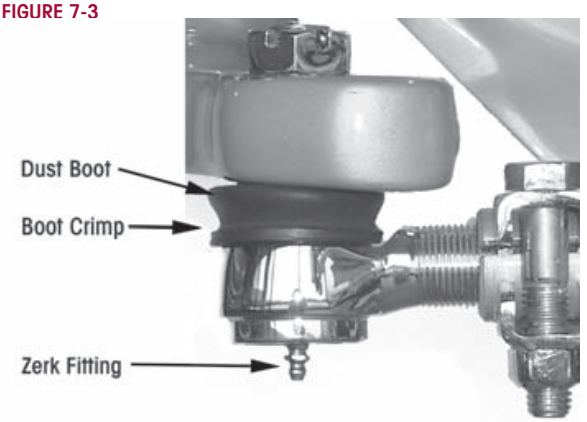
1. Turn the vehicle wheels straight ahead.
2. Wipe the zerk fitting and grease gun tip with clean shop towels.
3. Wipe the seal/boot clean with shop towels.
4. Attach a grease gun to the zerk fitting. Either a hand or pneumatic grease gun is acceptable. If air operated grease gun is used, system air 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.

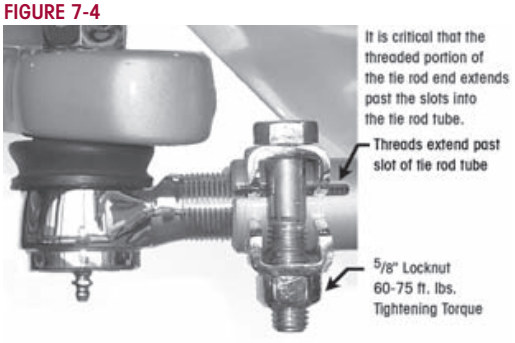
1. Block rear wheels of vehicle. Using the bottom of the axle beam or the frame rails, raise the front end off the ground and support with stands.
2. With the engine off, turn the wheels from full left to full right and then return to the straight-ahead position.
3. Check that the boots are in place 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



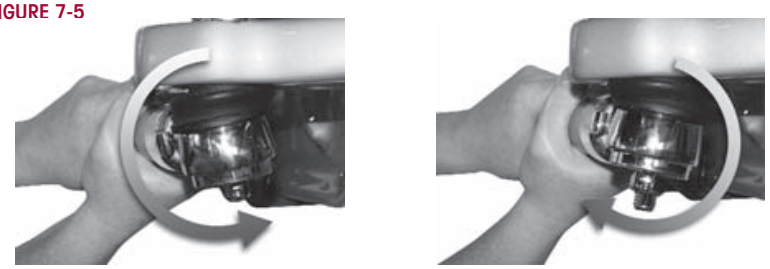
⚠ CAUTION

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.

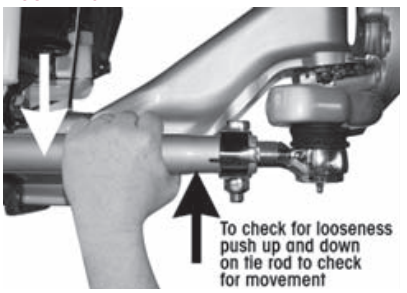
8. By hand or using a pipe wrench, with jaw protectors to avoid gouging the cross tube, rotate the cross tube toward the front of the vehicle and then toward the rear. After rotating, center the cross tube. If the cross tube will not rotate in either direction, replace both tie rod ends, see Figure 7-5.

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

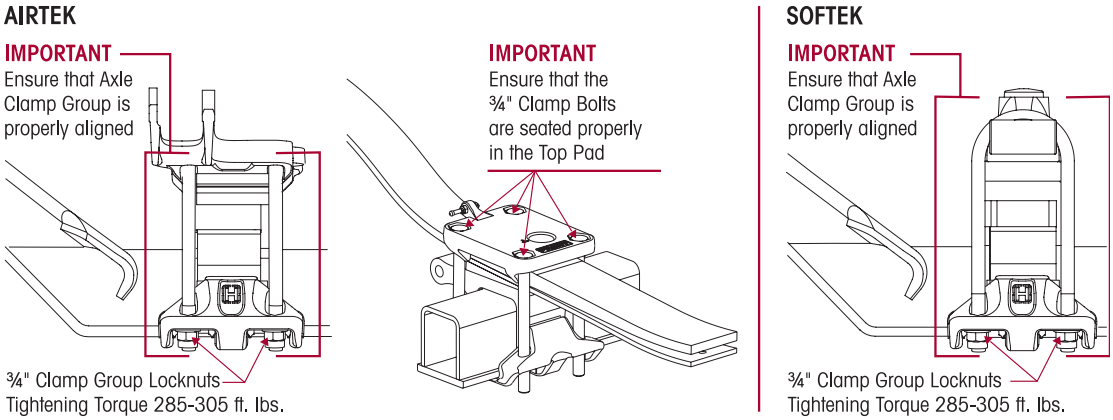


NOTE According to the Commercial Vehicle Safety Alliance (CVSA), the vehicle "out of service" criteria is: Any motion other than rotational between any linkage member and its attachment point of more than ⅛" (3mm) measured with hand pressure only. (393.209(d)), (published in the North American Standard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

CLAMP GROUP RE-TORQUE INTERVAL

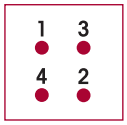
1. Clamp group locknuts must be torque to specification at preparation for delivery.
2. Clamp group locknuts must be re-torqued at 1,000 miles.
3. Thereafter follow the 6 month/ 25,000 mile inspection and annual re-torque interval.
4. Ensure that the clamp group is properly aligned and the hex bolts/U-bolts 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.

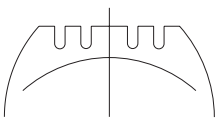
Tire wear is normally the best indicator of vehicle alignment condition. If tires are wearing too rapidly or irregularly, alignment corrections may be needed. The tire wear patterns described below can help isolate specific alignment problems.

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

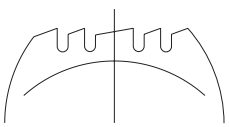
OVERALL FAST WEAR (Miles per 32nd)



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:

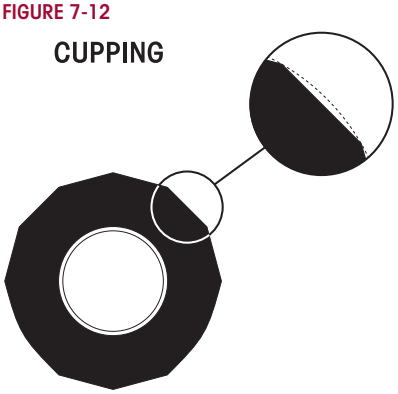
With one hand flat on the tread of the tire and a firm down pressure, slide your hand across the tread of the tire. In one direction, the tire will feel smooth and in the opposite direction there will be a sharp edge to the tread. Typical causes of feather wear include: excessive side force scrubbing, 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



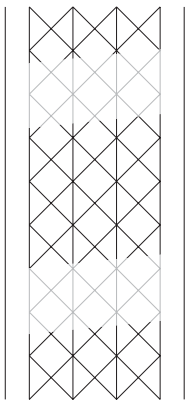
Cupping — Localized, dished out areas of fast wear creating a scalloped appearance around the tire. Cupping, which appears around the tire on the shoulder ribs, may also progress to adjoining ribs, see TMC RP 219A publication, page 7.

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

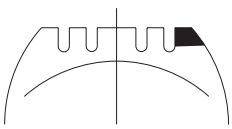


Diagonal Wear — Can be described as localized flat spots worn diagonally across the tread at approximately 25-35° angles, often repeating around the tread circumference. For more information, see TMC RP 219A publication, page 20.

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)



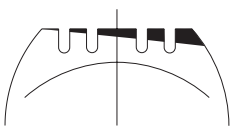
Rapid Shoulder Wear (One Shoulder Only) — Is defined as a tire worn on the edge of one shoulder, sometimes extending to inner ribs. It can progress to diagonal wipeout. For more information, see TMC RP 219A publication, page 22.

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

FIGURE 7-16



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.

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.

FIGURE 7-17



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.

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.

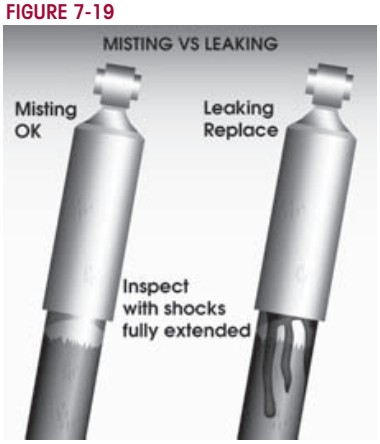
FIGURE 7-18



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

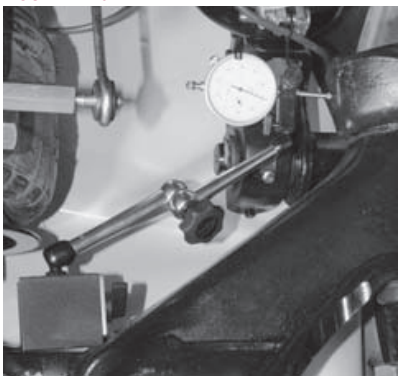
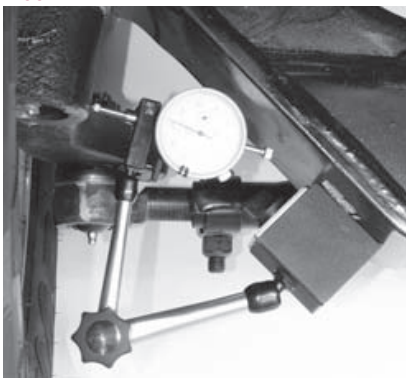


FIGURE 7-21



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



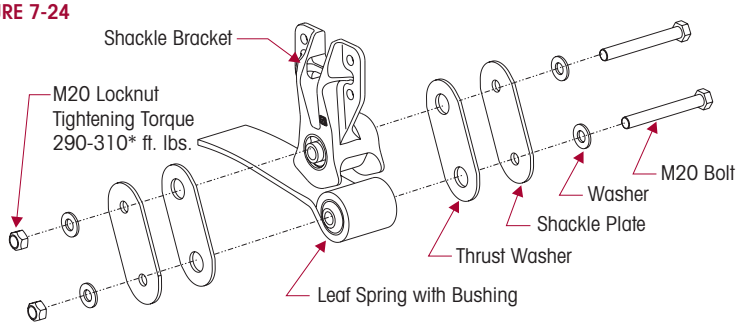
4. Place a dial indicator on each side of the axle as follows:
   a. Index the wheels slightly (left or right).
   b. Place the magnetic dial indicator base on the axle, see Figure 7-23.
   c. Place the tip of the dial indicator on the top of the upper steering knuckle (not on the grease cap).
5. Set 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.

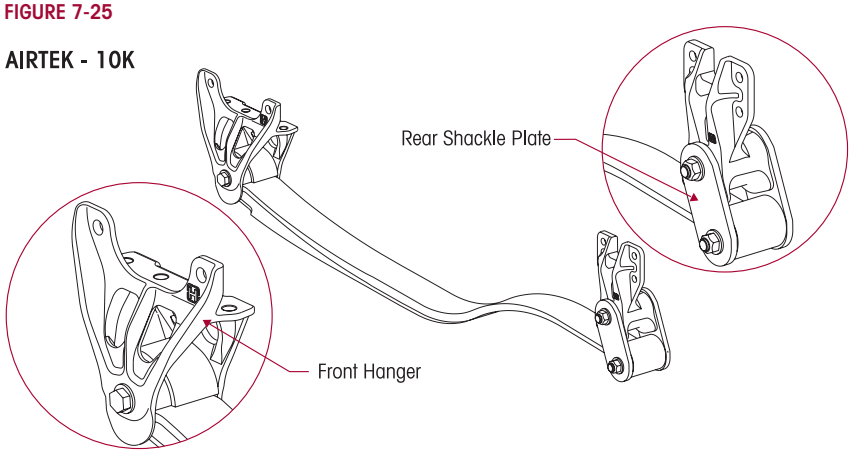
FRONT HANGER/REAR SHACKLE BRACKET SURFACE PAINT WEAR

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

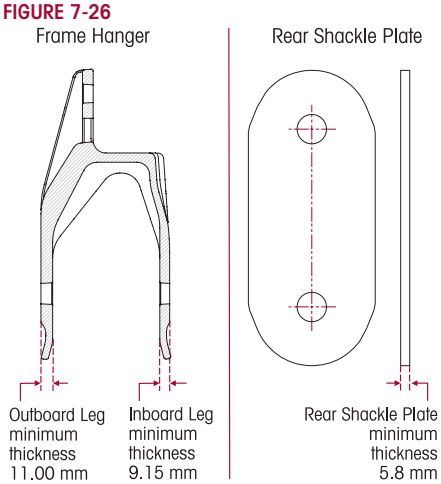
AIRTEK - 10K



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

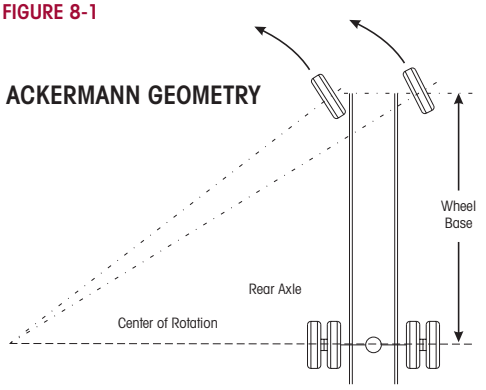


SECTION 8

Alignment & Adjustments

ALIGNMENT DEFINITIONS

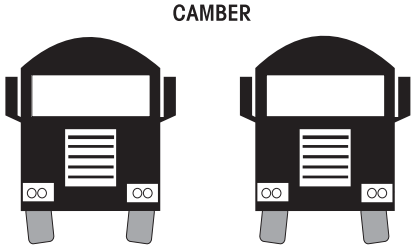
FIGURE 8-1



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.

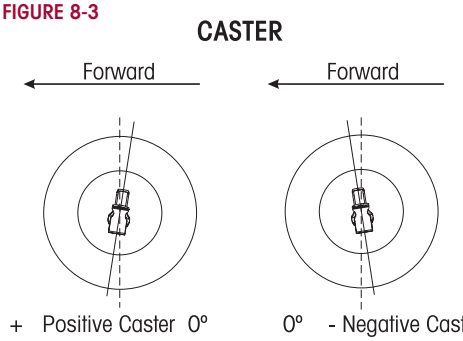
FIGURE 8-2



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.

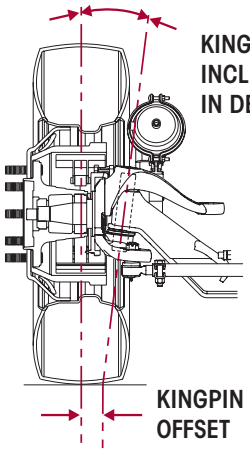
Excessive positive camber may cause smooth wear on the outer half of the tire tread. Excessive negative camber may cause wear on the inner half of the tread. Static-unloaded camber angles are built into the axle to put the loaded tire perpendicular to the road.

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

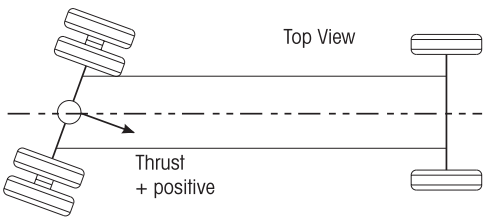


Kingpin Inclination (KPI) — The inward tilt of the kingpin from the vertical. This front suspension parameter has a pronounced effect on steering effort and returnability. As the front wheels are turned around an inclined kingpin, the front of the truck is lifted. This lifting of the vehicle is experienced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

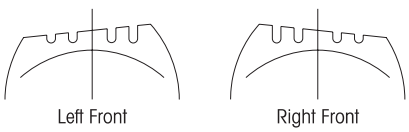


Thrust Angle, Tracking, or Square — The angle formed by the centerline of the vehicle frame (geometric centerline) and the direction that an axle points. As indicated by the term "square", the ideal value for the angle is 0° or when the axle centerline is at 90° or perpendicular to the geometric centerline.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

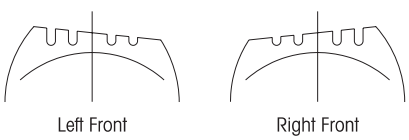
FIGURE 8-6



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



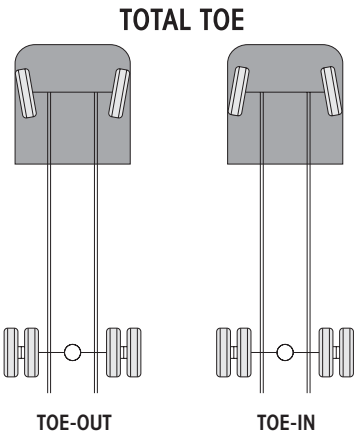
TOE-OUT

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

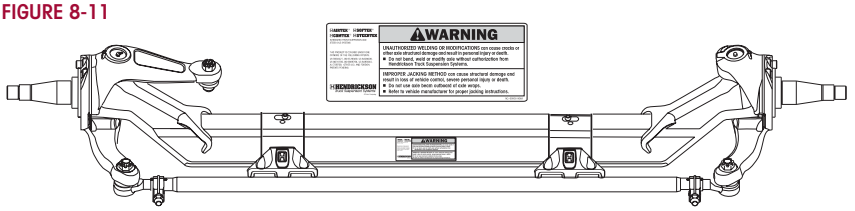


5. Check the kingpin (or steering axis) inclination (the kingpin inclination is not adjustable). Refer to "Kingpin Inclination", in the Alignment Definitions in this section.
6. Check the camber angle. Do not attempt to adjust. Refer to "Camber" in the Alignment Definitions in this section.

⚠ 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

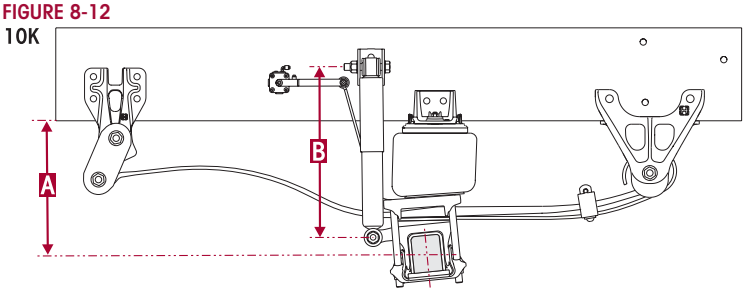
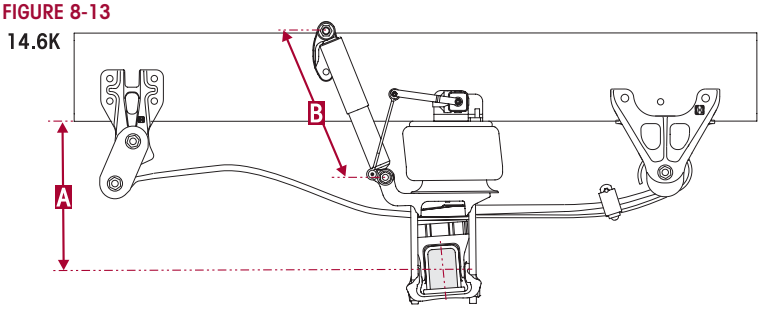


FIGURE 8-13



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

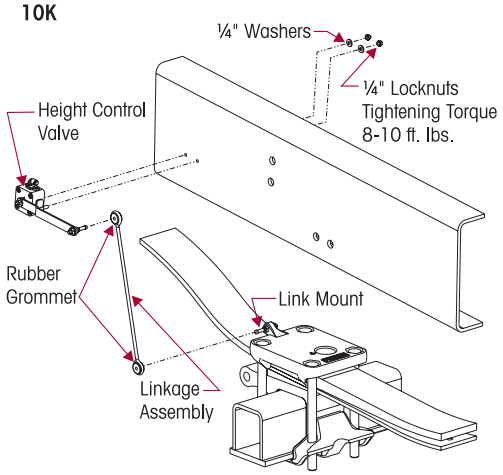
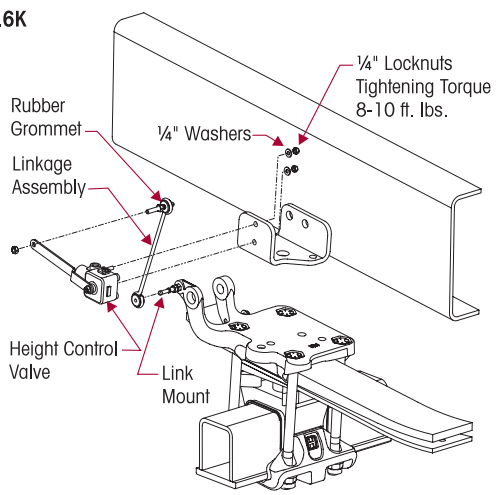


FIGURE 8-15

14.6K



AIRTEK HEIGHT CONTROL VALVE TEST

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

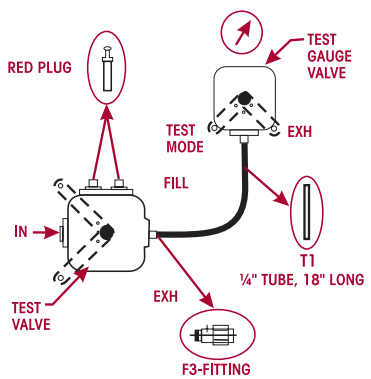
KIT CONTENTS

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

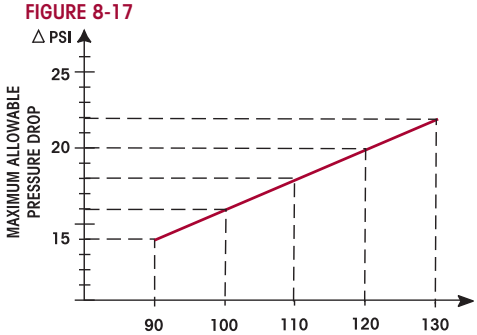
1. Disconnect linkage from valve handle.
2. Lower height control valve linkage arm down to exhaust air from the suspension system.
3. Remove the tubing from both air spring ports, see Figure 8-16. Place supplied tool around the tubing, press down to pull out tubing. **DO NOT CUT THE TUBING.**
4. Install 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
DIAGRAM



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.

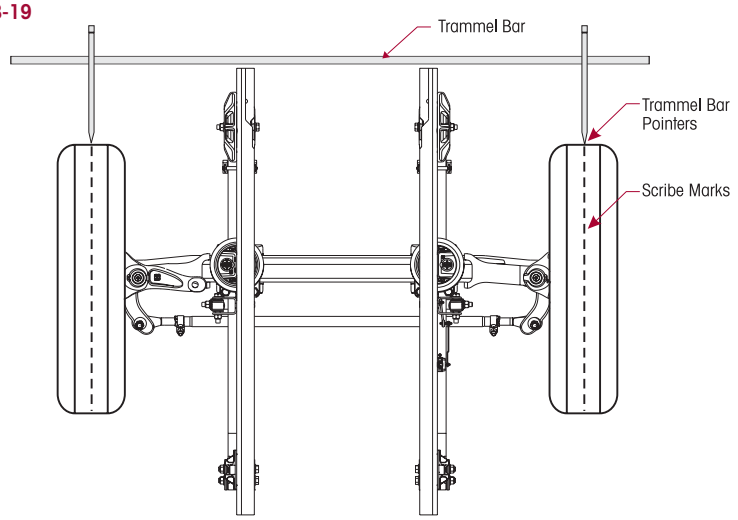
7. Use a trammel bar and measure the distance between the scribe marks at the rear of the steer axle tires. Record the measurement.

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

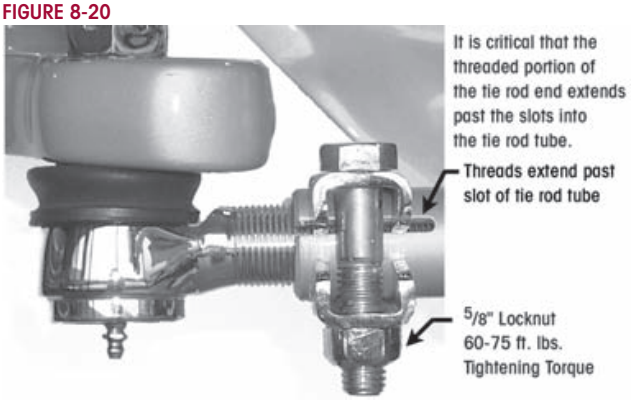


10. If the toe measurement is not within the specifications of 1/16" ± 1/32" (0.060" ± 0.030"), it will be necessary to adjust the toe setting. Refer to the following procedure.
    a. Loosen the tie rod cross tube clamp bolts and locknuts.
    b. Turn the tie rod cross tube until the specified toe-in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

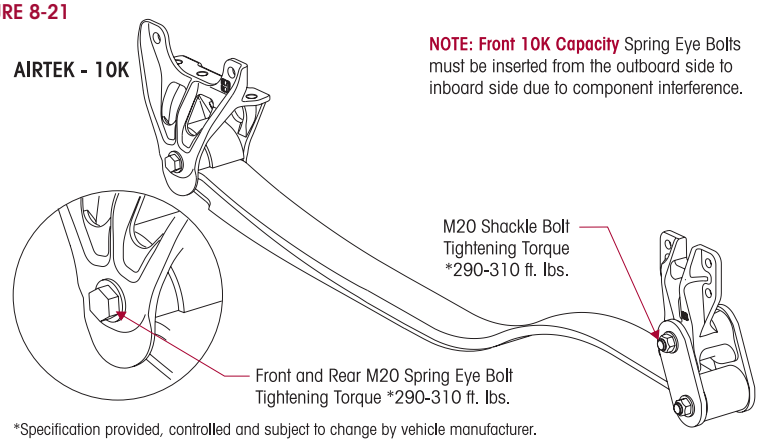
SPRING EYE RE-TORQUE

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.

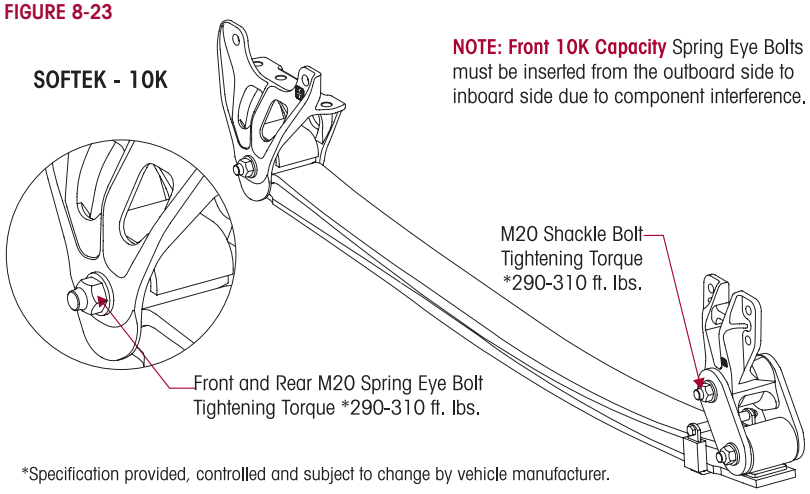
4. Let the suspension settle.
5. Tighten the front M20 spring eye bolt locknuts to vehicle manufacturer's specifications.
6. Tighten the rear M20 spring eye bolt and shackle bolt locknuts to vehicle manufacturer's specifications.
7. Affix a straight edge to the bottom of the frame rail in front of the 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



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

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.

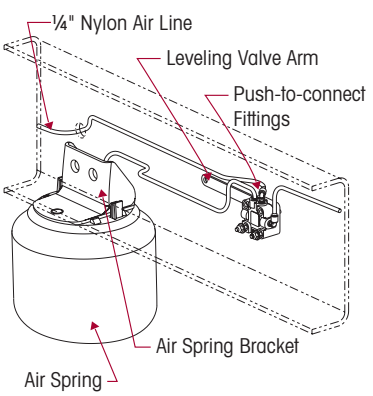
2. See additional Air Spring Cautions and Warnings in the Important Safety Notice Section of this publication prior to inflating or deflating the suspension system.
3. Deflate the air springs by removing the height control valve linkage at the rubber grommet and lowering the height control linkage arm.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

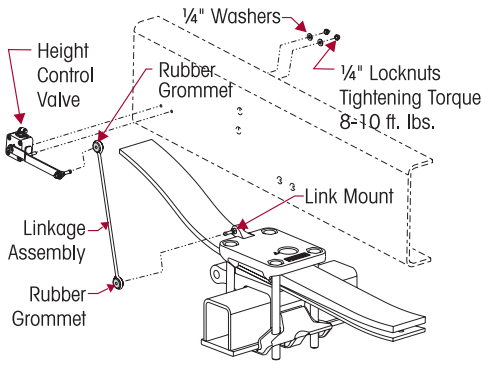


ASSEMBLY

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.

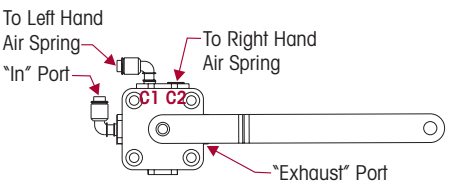
FIGURE 9-2 10K



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.

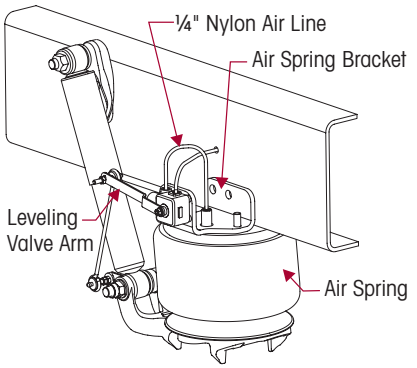
2. See additional Air Spring Cautions and Warnings in the Important Safety Notice Section of this publication prior to inflating or deflating the suspension system.
3. Deflate the air springs by removing the height control valve linkage at the rubber grommet and lowering the height control linkage arm.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

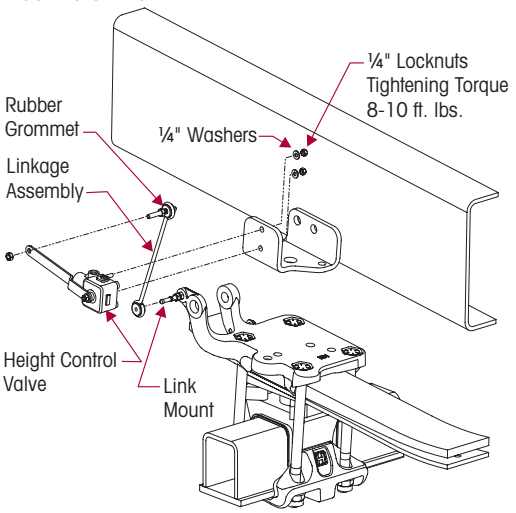
FIGURE 9-4 14.6K



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



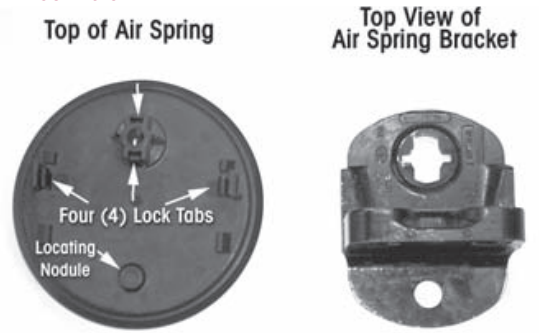
FIGURE 9-7



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

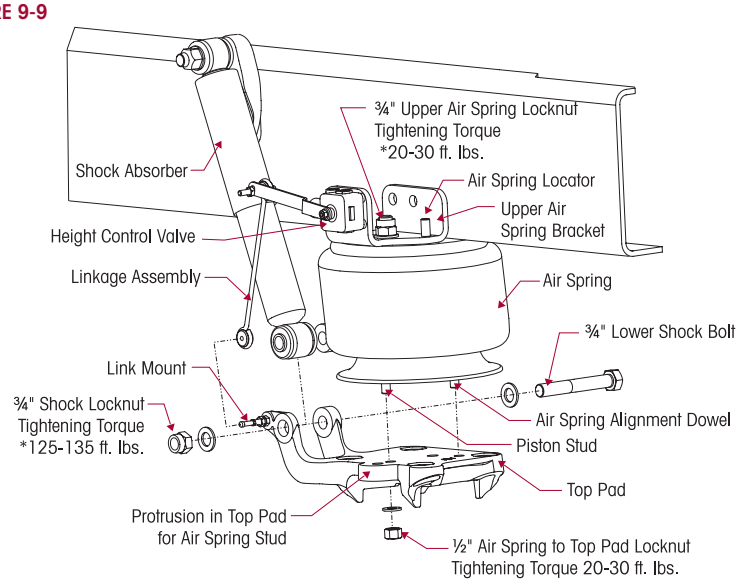
WHEN SERVICING THE VEHICLE OR ATTACHING AN AIR SPRING AND THE VEHICLE IS ON THE GROUND, PRIOR TO AIRING THE SUSPENSION SYSTEM MAKE CERTAIN THE AIR SPRING LOCATOR IS INDEXED INTO THE UPPER AIR SPRING BRACKET PROPERLY, AND THE AIR SPRING IS FULLY SEATED ON THE SPRING TOP PAD. FAILURE TO FOLLOW THESE INSTRUCTIONS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



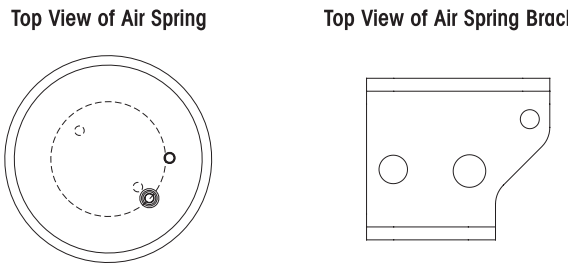
*Specification provided, controlled and subject to change by vehicle manufacturer.

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

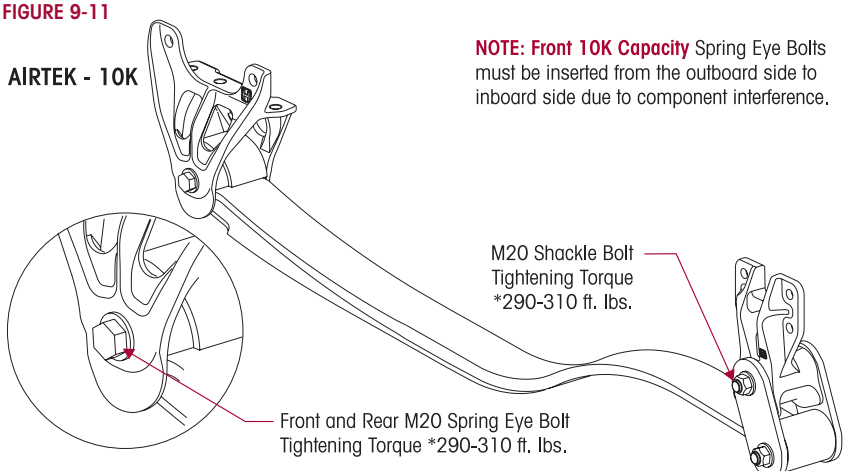
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6. See additional Air Spring Cautions and Warnings in the Important Safety Notice Section of this publication prior to inflating or deflating the suspension system.
7. Deflate the air springs by removing the height control valve linkage and lowering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

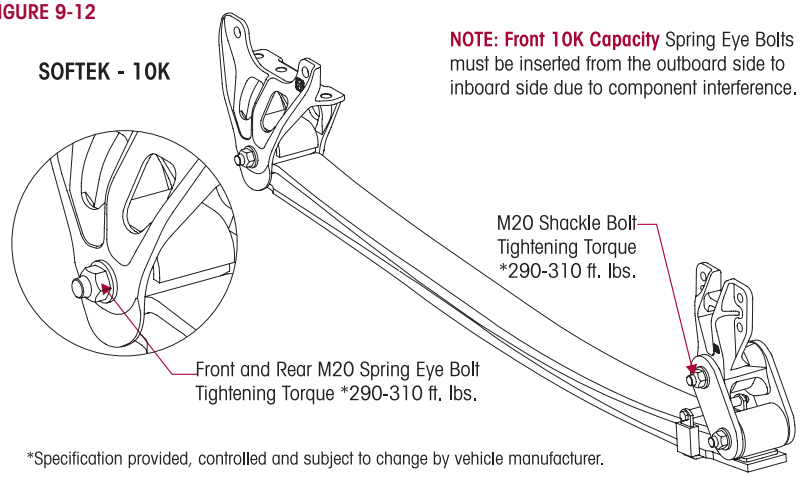
DISASSEMBLY

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.

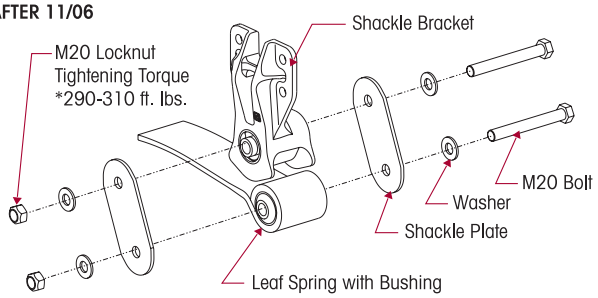
6. See additional Air Spring Cautions and Warnings in the Important Safety Notice Section of this publication prior to inflating or deflating the suspension system.
7. Deflate the air springs by removing the height control valve linkage and lowering the leveling valve arm. This will exhaust the air pressure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

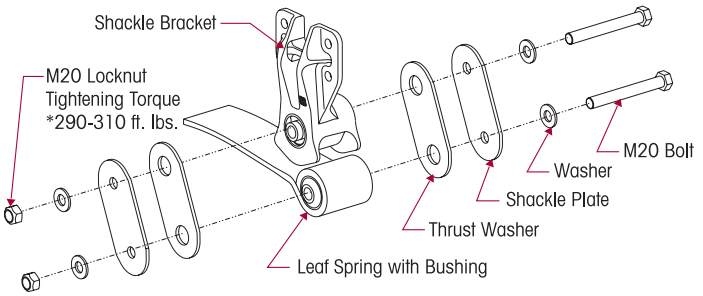
FOR VEHICLES BUILT AFTER 11/06



*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

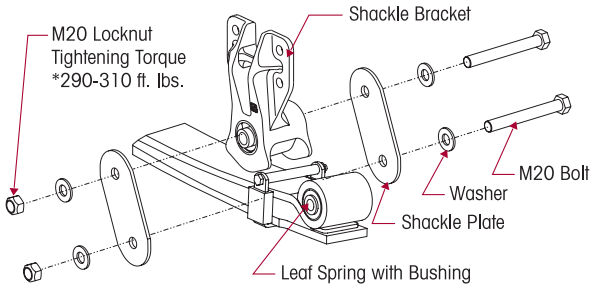
1. Place the vehicle on level floor.
2. Chock the wheels.
3. Raise the frame.
4. Support the vehicle with frame stands.
5. Suspend the front axle from the shocks.
6. Remove the rear M20 spring eye and shackle pivot bolts, washers and locknuts.

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.

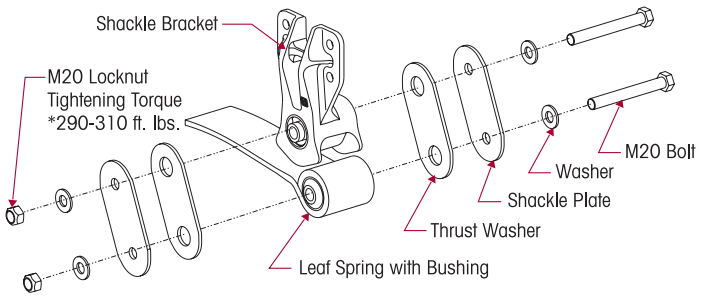
9. Inspect the shackle assembly and both thrust washers (if equipped) for excessive wear or damage. See Thrust Washer Inspection in the Preventive Maintenance Section of this publication. Hendrickson recommends the thrust washers be replaced when this assembly is serviced.
10. If damaged or worn excessively,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



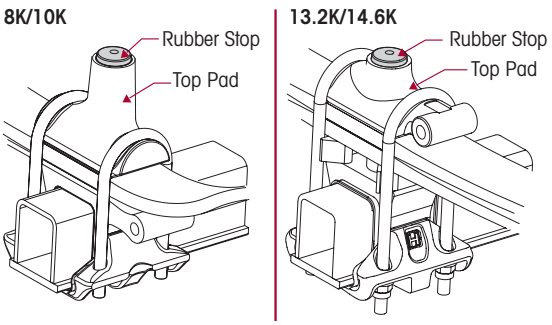
*Specification provided, controlled and subject to change by vehicle manufacturer.

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

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 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.

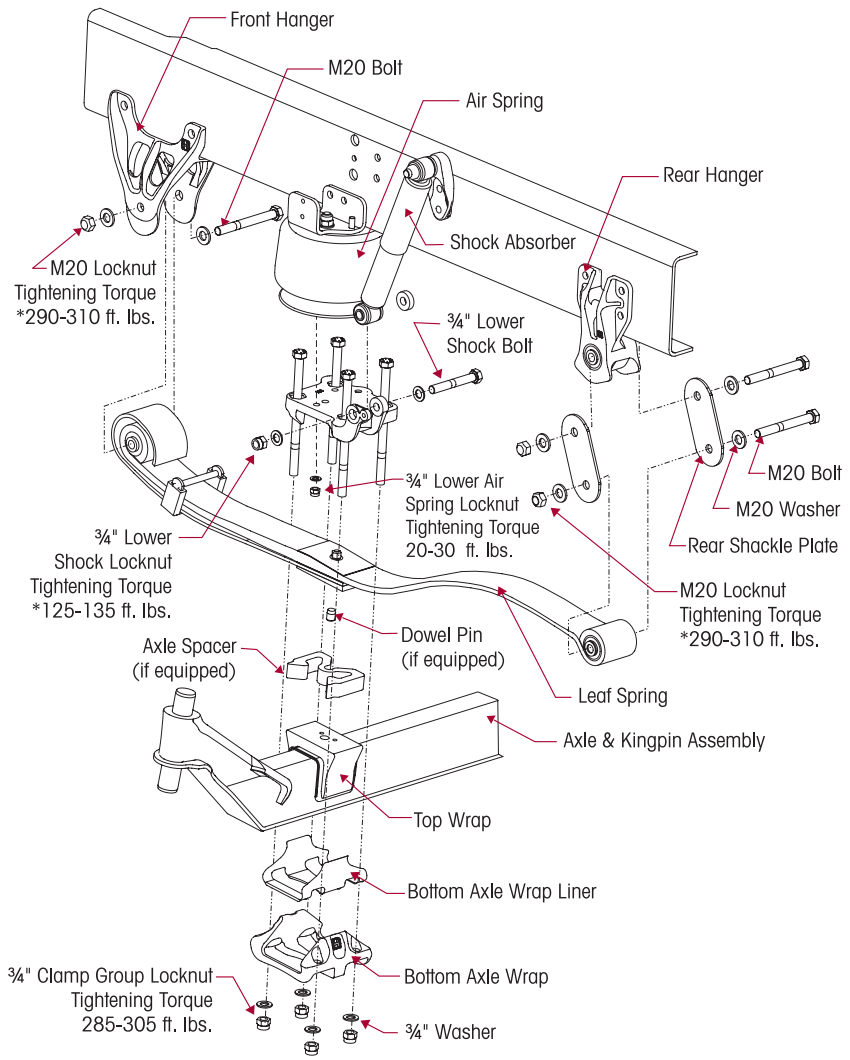
CAUTION

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

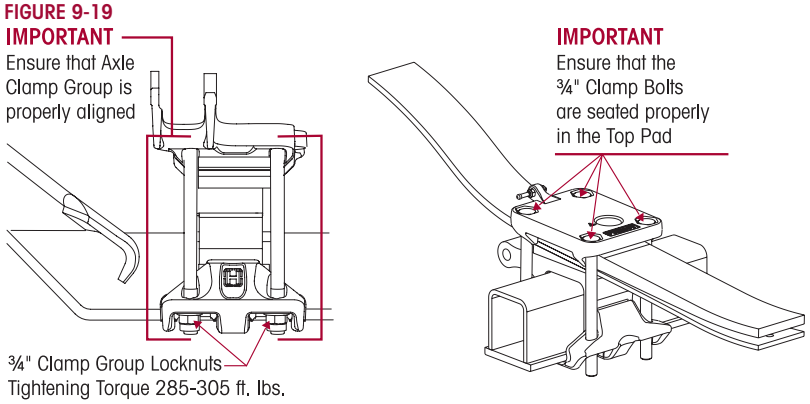
If a clamp group nut fails to come off bolt, cut half way through the bolt with an abrasive cut off wheel, taking care not to contact axle beam or other components. Using an impact wrench, spin the locknut to fracture the bolt and remove.

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.

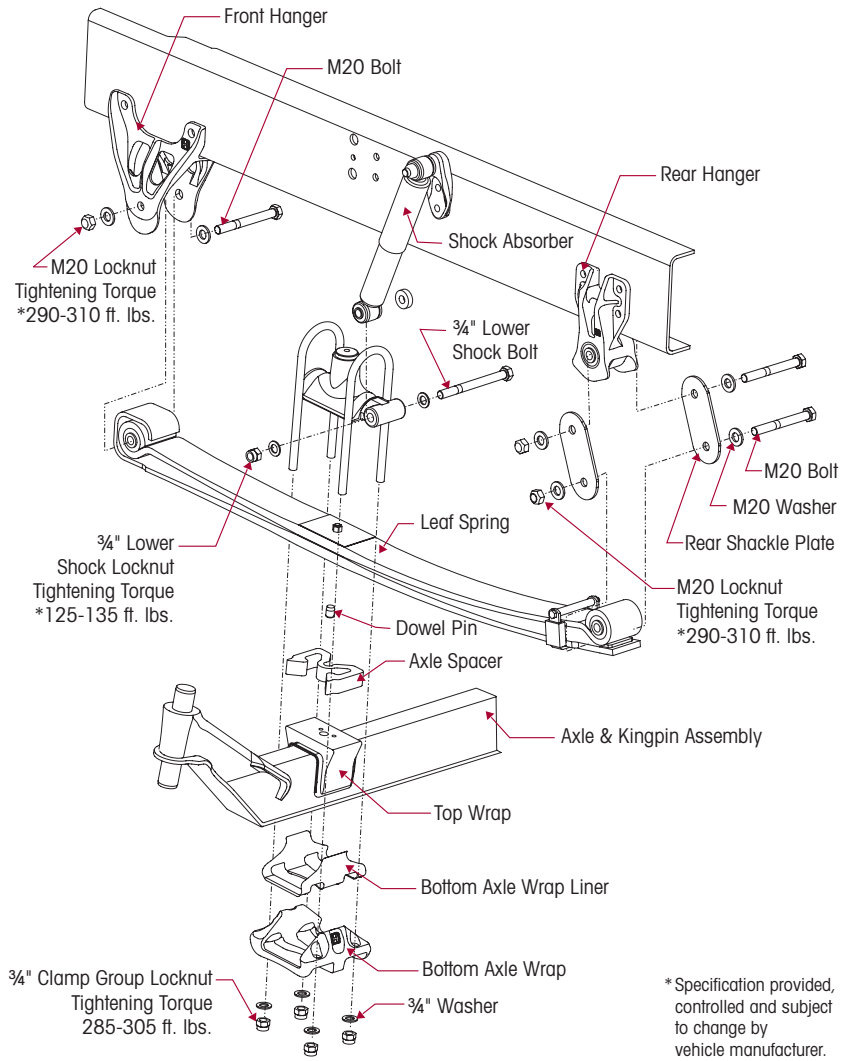
SERVICE HINT If a clamp group nut fails to come off bolt, cut half way through the bolt with an abrasive cut off wheel, taking care not to contact axle beam or other components. Using an impact wrench, spin the locknut to fracture the bolt and remove.

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

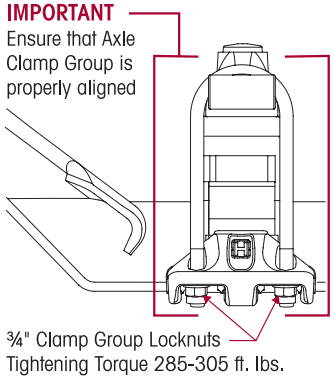
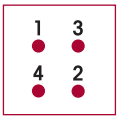


FIGURE 9-23



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.

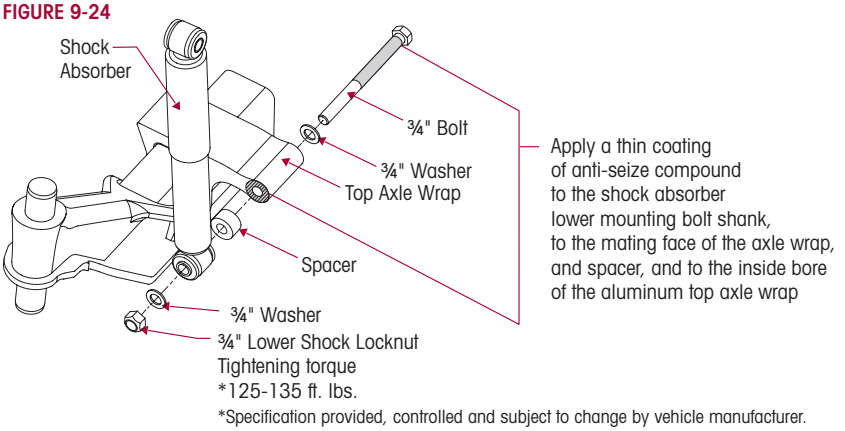
AIRTEK/SOFTEK SHOCK ABSORBER – VISION (8K/10K)

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

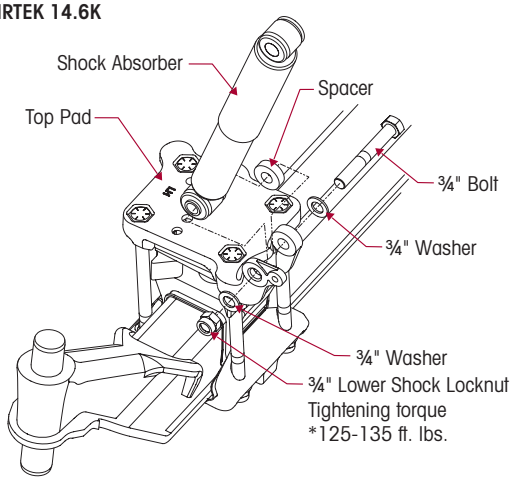
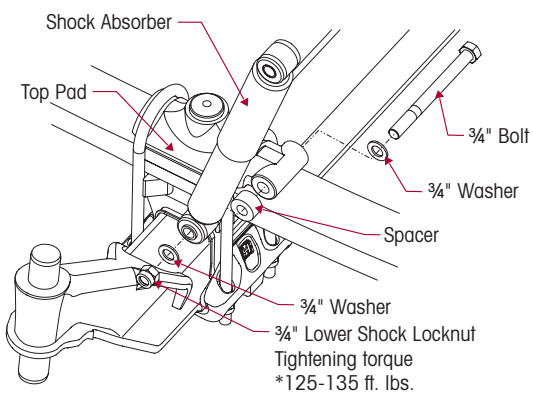


FIGURE 9-26
SOFTEK 13.2K/14.6K



*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

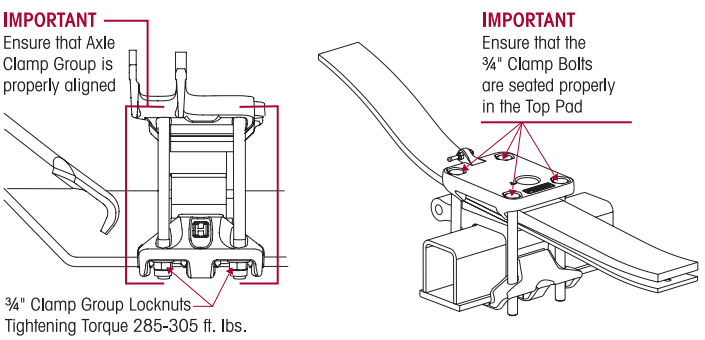
If a clamp group nut fails to come off bolt, cut half way through the bolt with an abrasive cut off wheel, taking care not to contact axle beam or other components. Using an impact wrench, spin the locknut to fracture the bolt and remove.

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

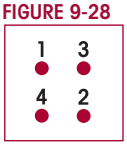
1. Install new bottom axle wrap liner into bottom axle wrap.
2. Install bottom axle wrap on axle.

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

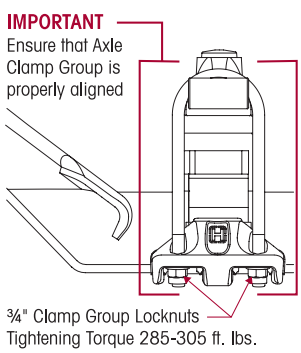
If a clamp group nut fails to come off bolt, cut half way through the bolt with an abrasive cut off wheel, taking care not to contact axle beam or other components. Using an impact wrench, spin the locknut to fracture the bolt and remove.

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.

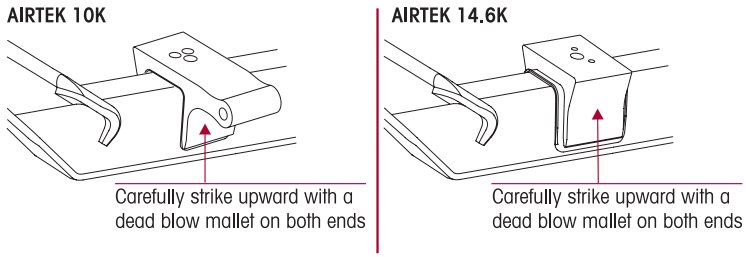
⚠ WARNING

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

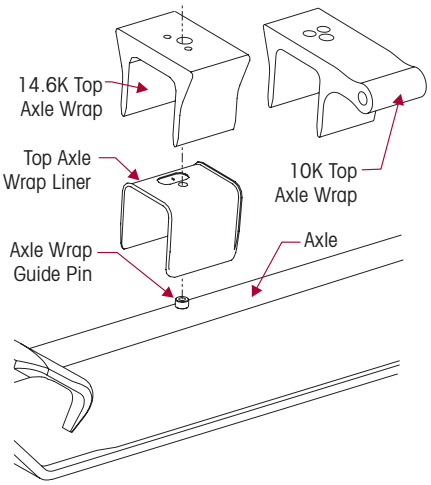


ASSEMBLY

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

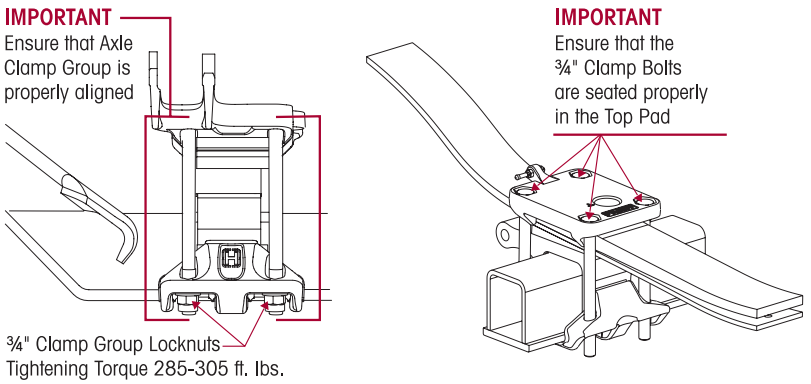
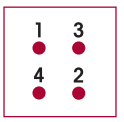


FIGURE 9-33



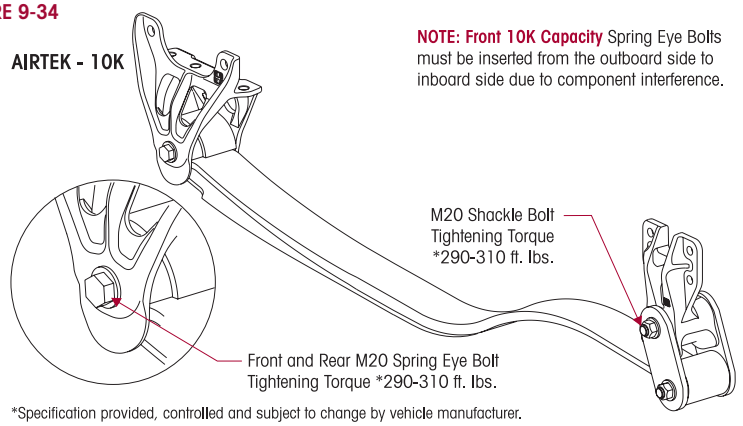
16. Tighten the ¾" clamp group locknuts evenly to 285-305 foot pounds torque in the proper sequence, see Figure 9-33.
17. Remove the jack from the axle.
18. Remove the frame stands.

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.

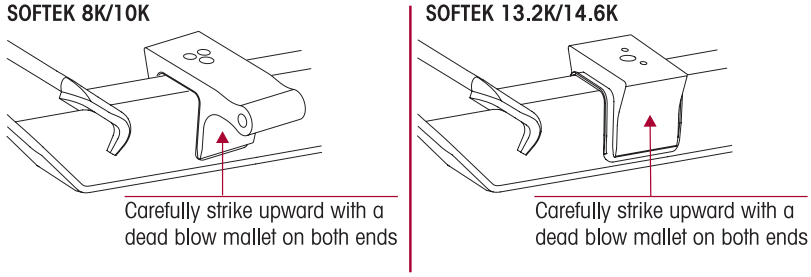
7. Support the axle with a jack.

⚠ 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

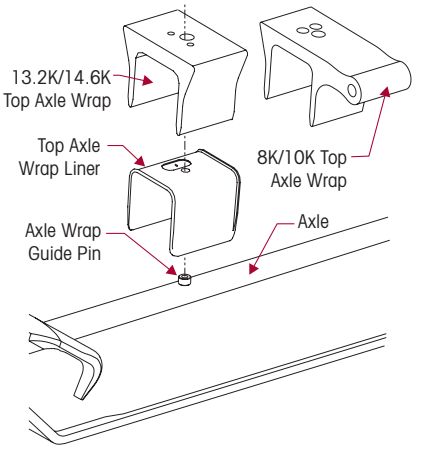


ASSEMBLY

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

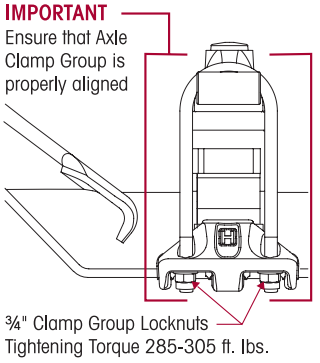


CAUTION

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



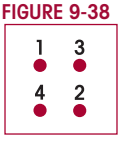
13. Use a jack and raise the axle and spring assembly into the front spring hanger and shackle assembly.

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.

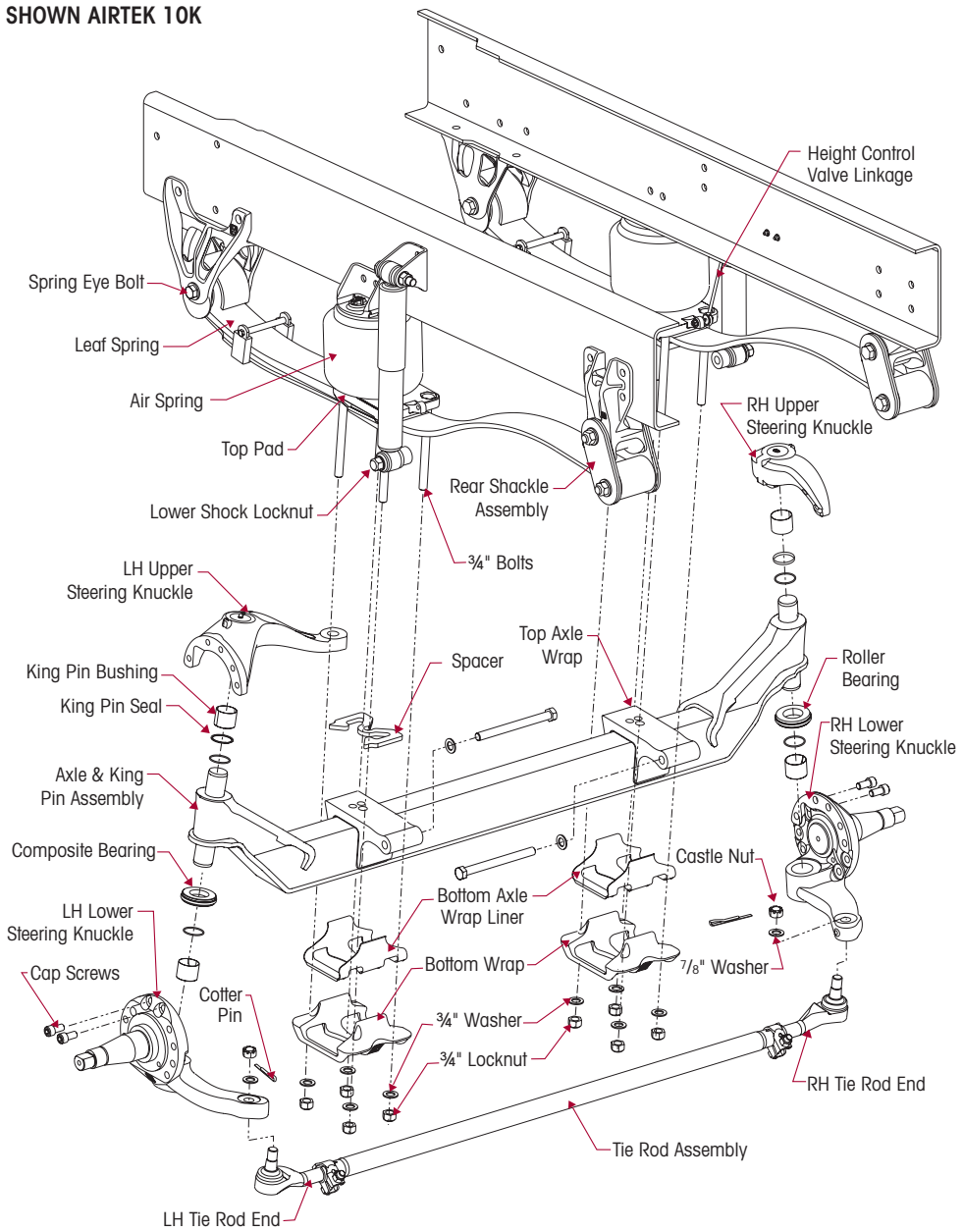
AIRTEK FRONT AXLE ASSEMBLY

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



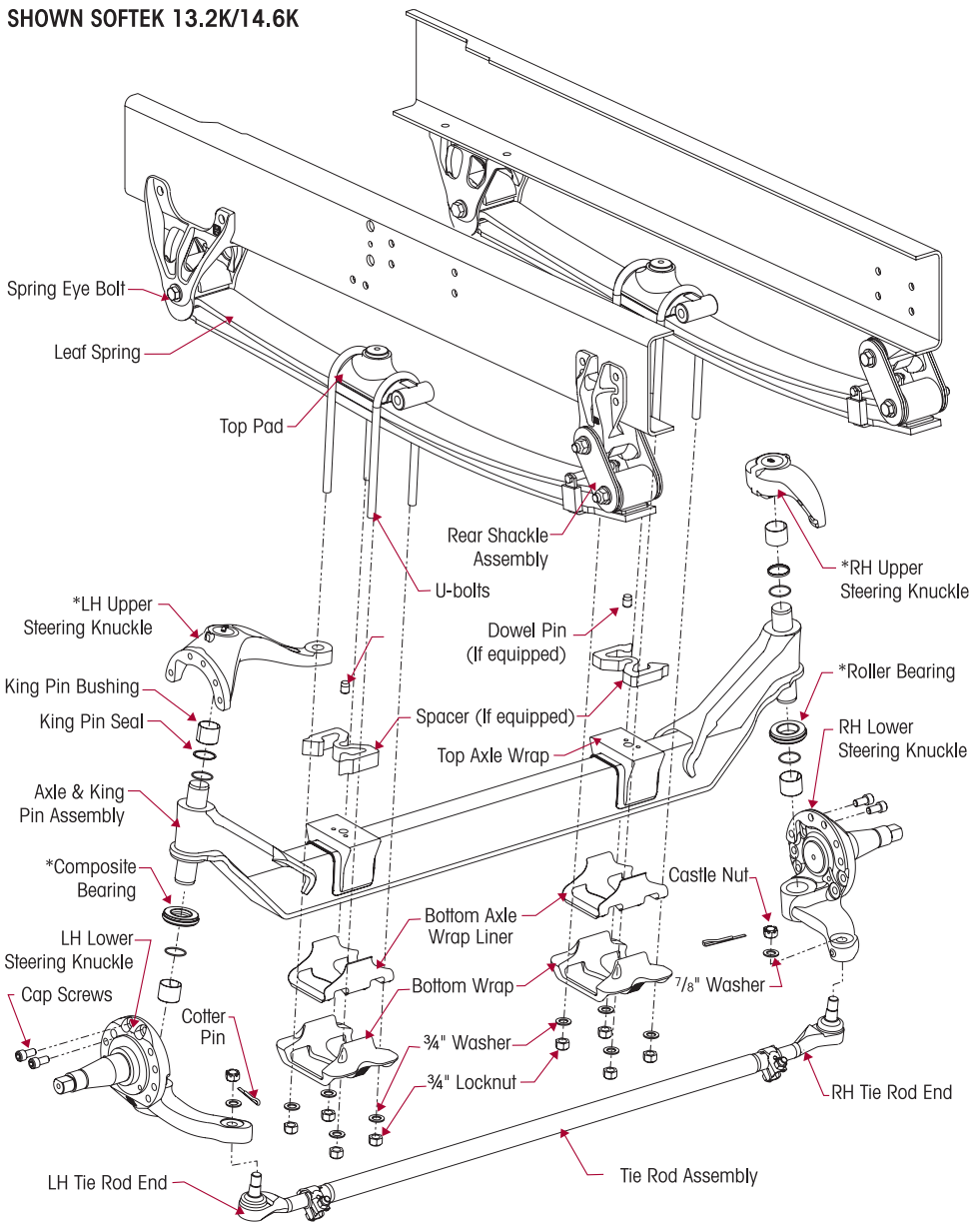
SOFTEK FRONT AXLE ASSEMBLY

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.

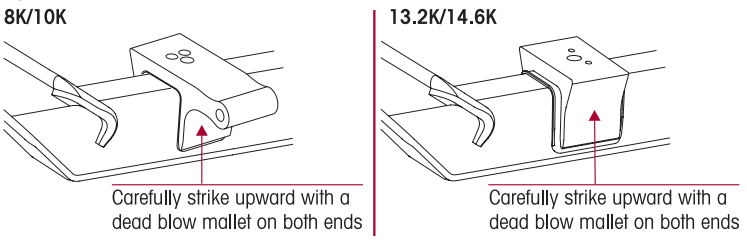
15. Remove the ¾" clamp group bolts, washers, and locknuts. Discard fasteners.
16. Lower the axle and remove from the vehicle.

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

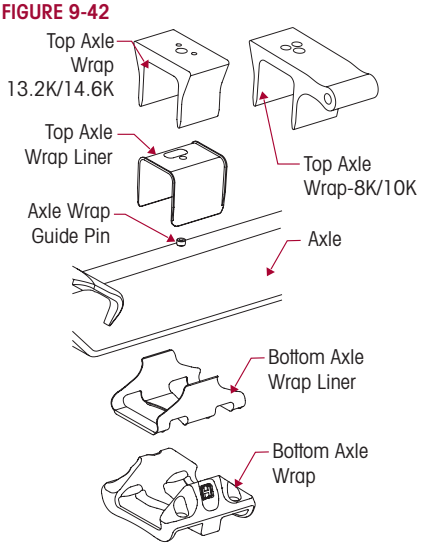
REMOVAL OF THE CAP SCREWS WILL ALLOW THE STEERING KNUCKLE TO SEPARATE FROM THE AXLE. THE BACKBONE MUST BE SUPPORTED BEFORE REMOVAL OF THESE TWO (2) CAP SCREWS. FAILURE TO DO SO CAN CAUSE COMPONENT DAMAGE OR PERSONAL INJURY.

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.

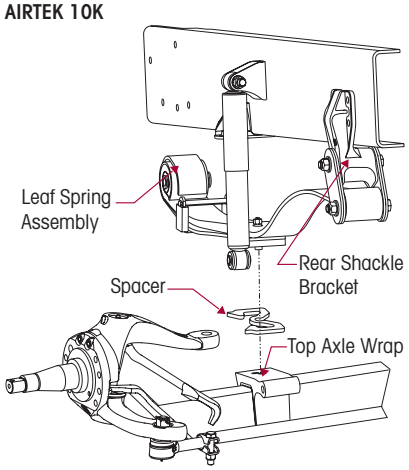
2. Install the top axle wrap, see Axle Wrap Assembly instructions located in this section. The axle wrap must be aligned with the guide pin on the axle.
3. At this point in the assembly, do not install anything further on the axle.

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

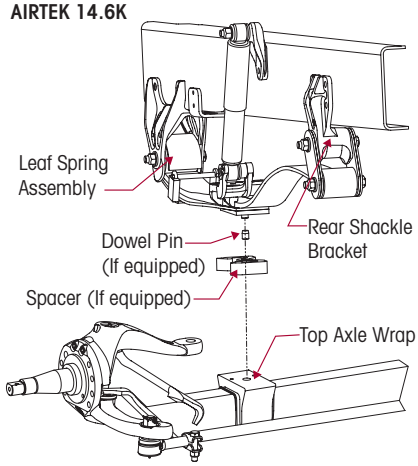
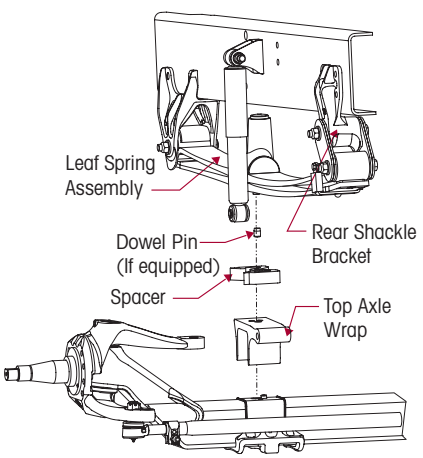
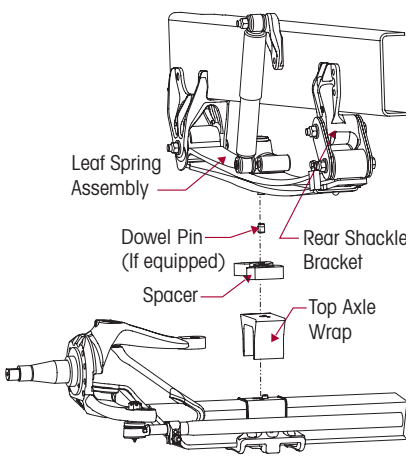


FIGURE 9-44

SOFTEK 8K/10K

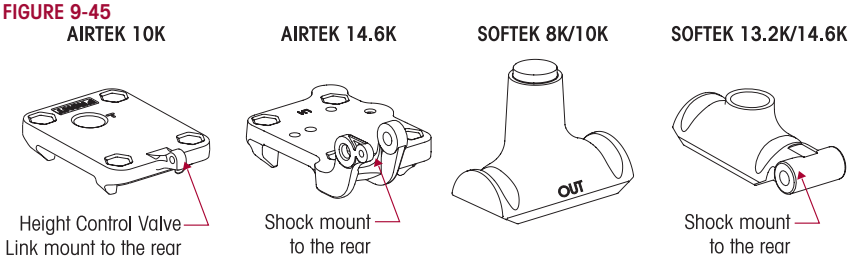


SOFTEK 13.2K/14.6K



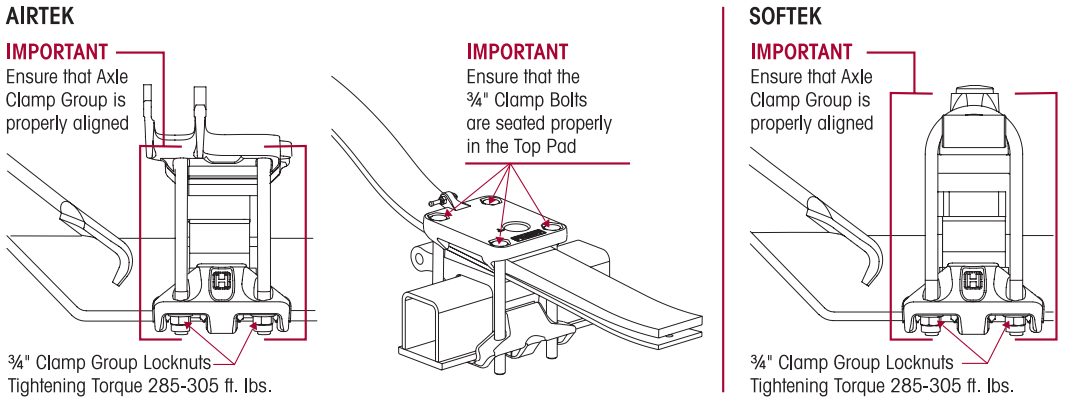
4. Verify that the galvanized liner is between the leaf springs and the top pad.
5 Install the new bottom axle wrap liners on the bottom axle wraps.
6. Install the bottom axle wraps on the axle.
7. Install the top pad with the directional identification facing correctly on the vehicle, see Figure 9-45.

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.

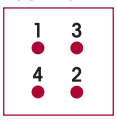
⚠ WARNING

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.

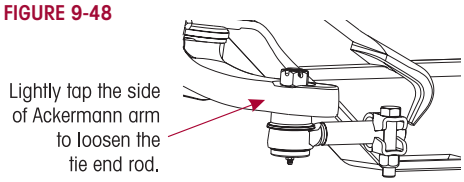
The steering knuckle disassembly and assembly includes the Kingpin Preparation and Measurement and Kingpin Bushing Removal process.

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

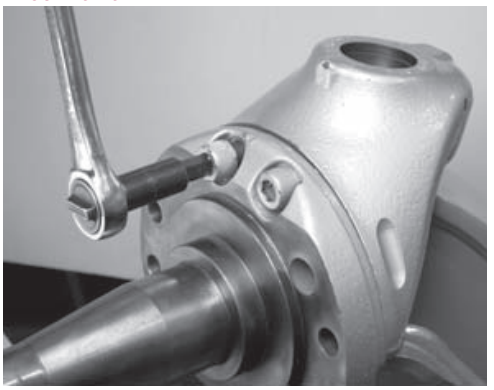


8. Remove the drag link from the knuckle if necessary.

⚠ 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

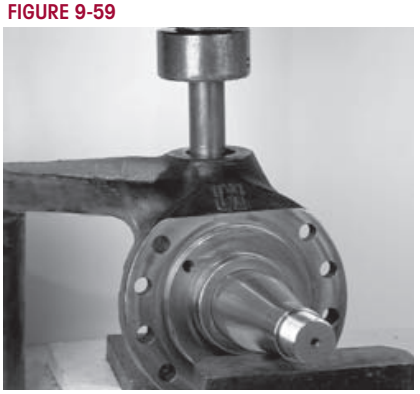


FIGURE 9-60

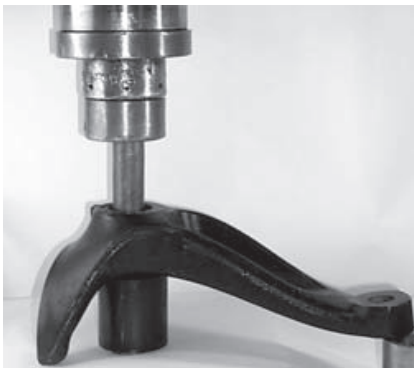
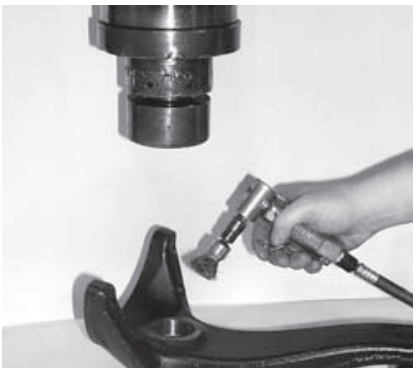


FIGURE 9-61



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

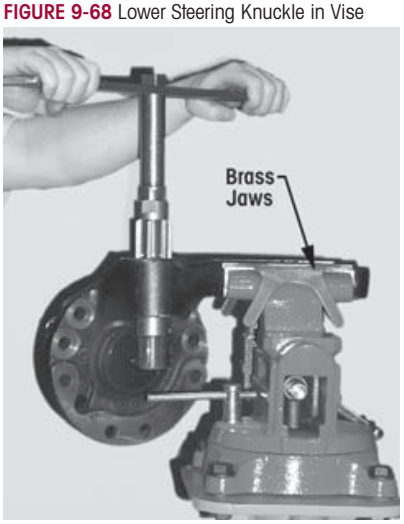
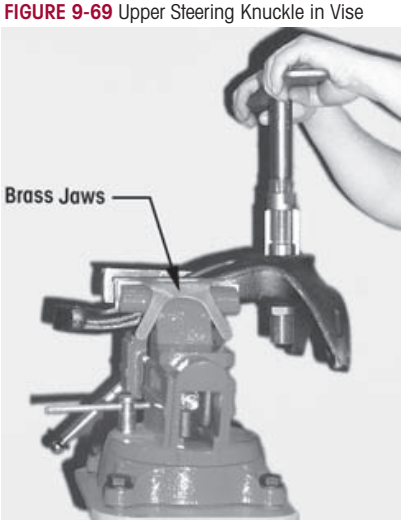


FIGURE 9-69 Upper Steering Knuckle in Vise



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

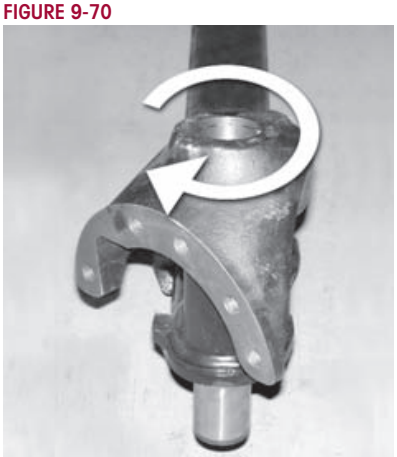
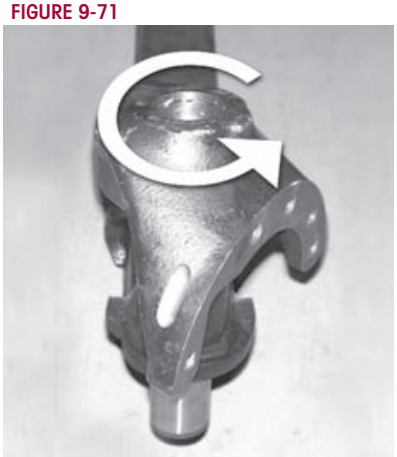


FIGURE 9-71



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

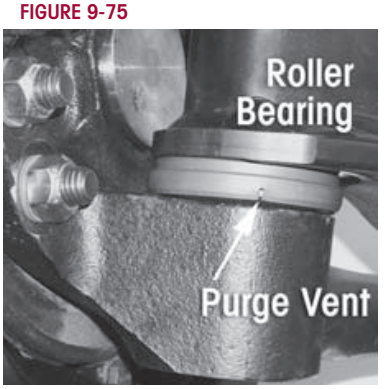
After replacement of the kingpin bushings it is necessary to re-assemble the steering knuckle assemblies. The STEERTEK axle is equipped with two different thrust bearings installed. The composite thrust bearing is installed on the left side of the axle. The roller bearing is installed on the right side 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



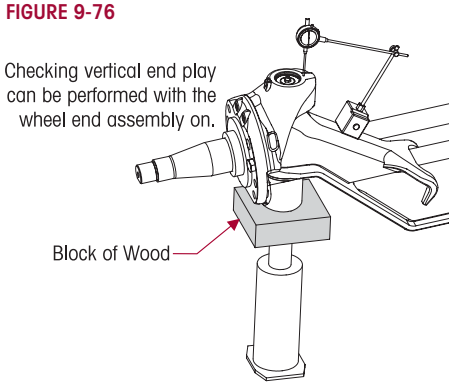
4. Install the upper steering knuckle on the upper arm kingpin.
5. Install the lower steering knuckle on the lower kingpin and install the old socket head cap screws loose into the top two threaded holes.

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.

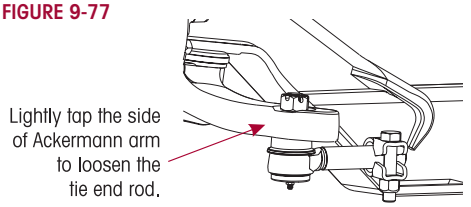
TIE ROD END AND CROSS TUBE

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:

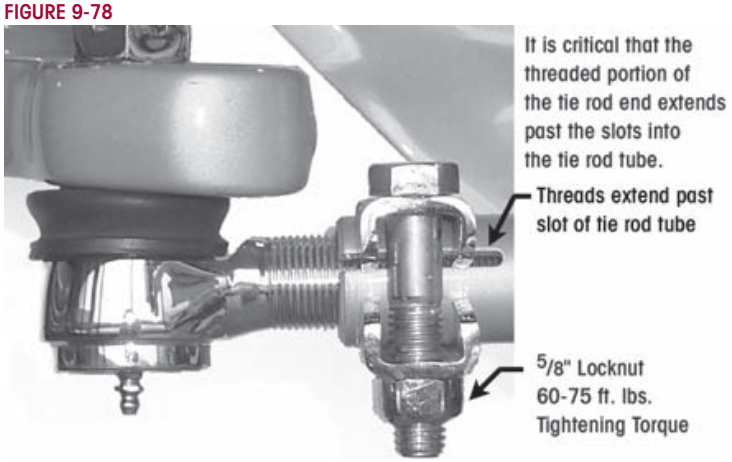
- A right hand threaded tie rod end will be installed into the right side Ackermann arm.
- A left hand threaded tie rod end will be installed into the left side Ackermann arm.

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.

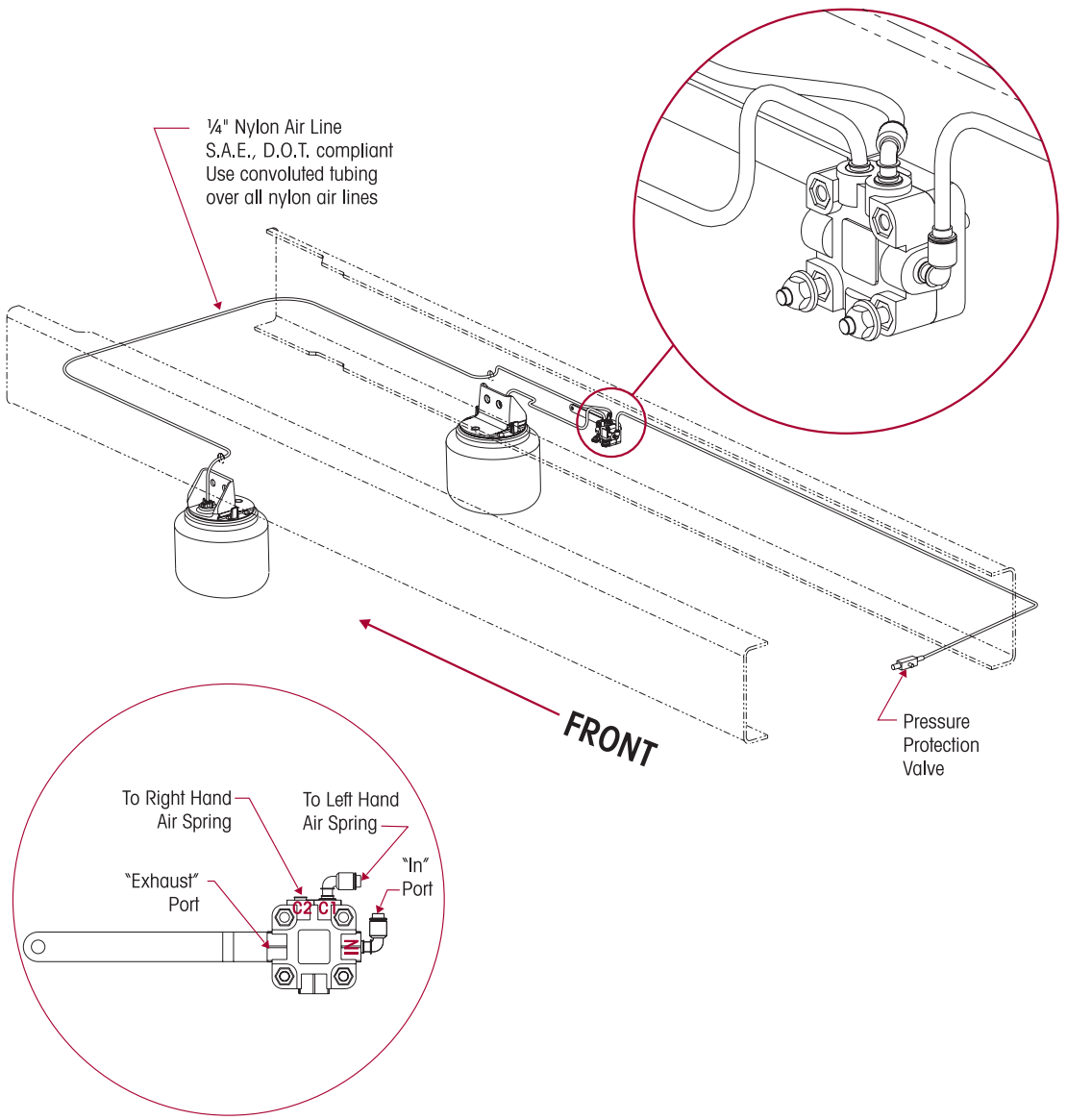
5. Install the cross tube into the Ackermann arms.
6. Tighten the castle nuts to 185 foot pounds torque then rotate the castle nut to the next castle slot and install cotter pin.
7. Grease tie rod ends, see Lubrication Chart for required lubricant in the Preventive Maintenance Section of this publication.
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

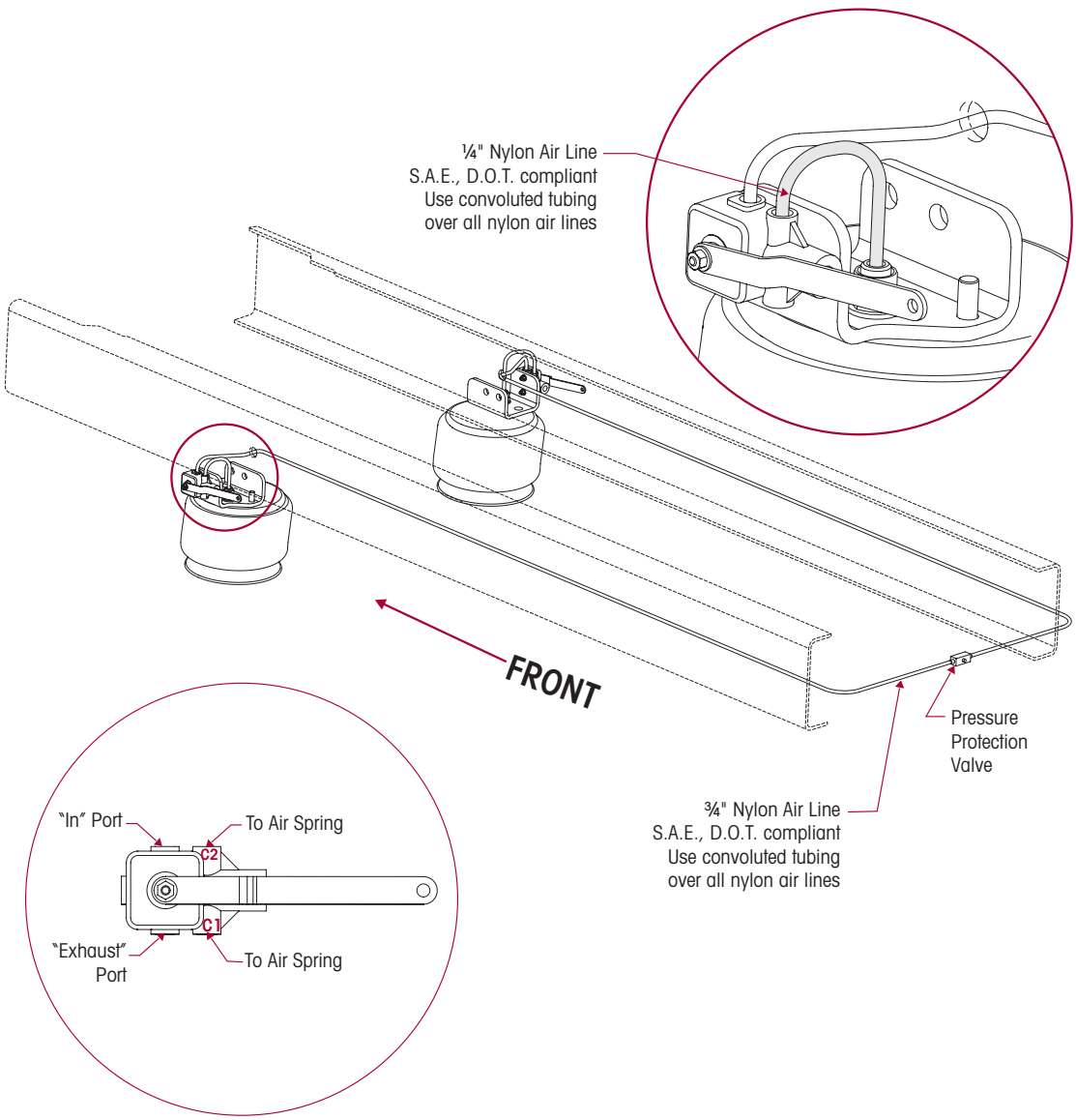
AIRTEK SINGLE HEIGHT CONTROL VALVE – 10K

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.

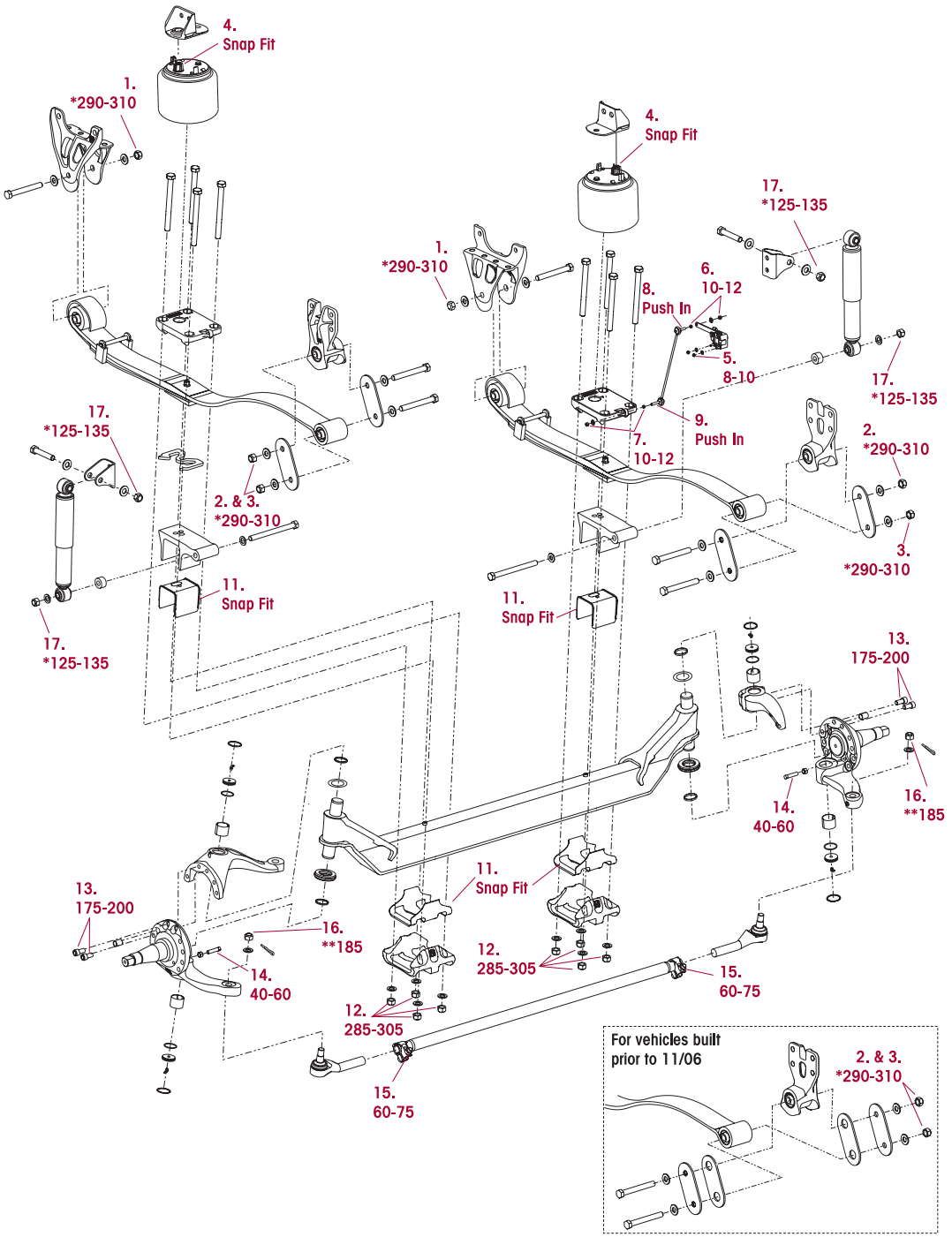
AIRTEK/SOFTEK

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.

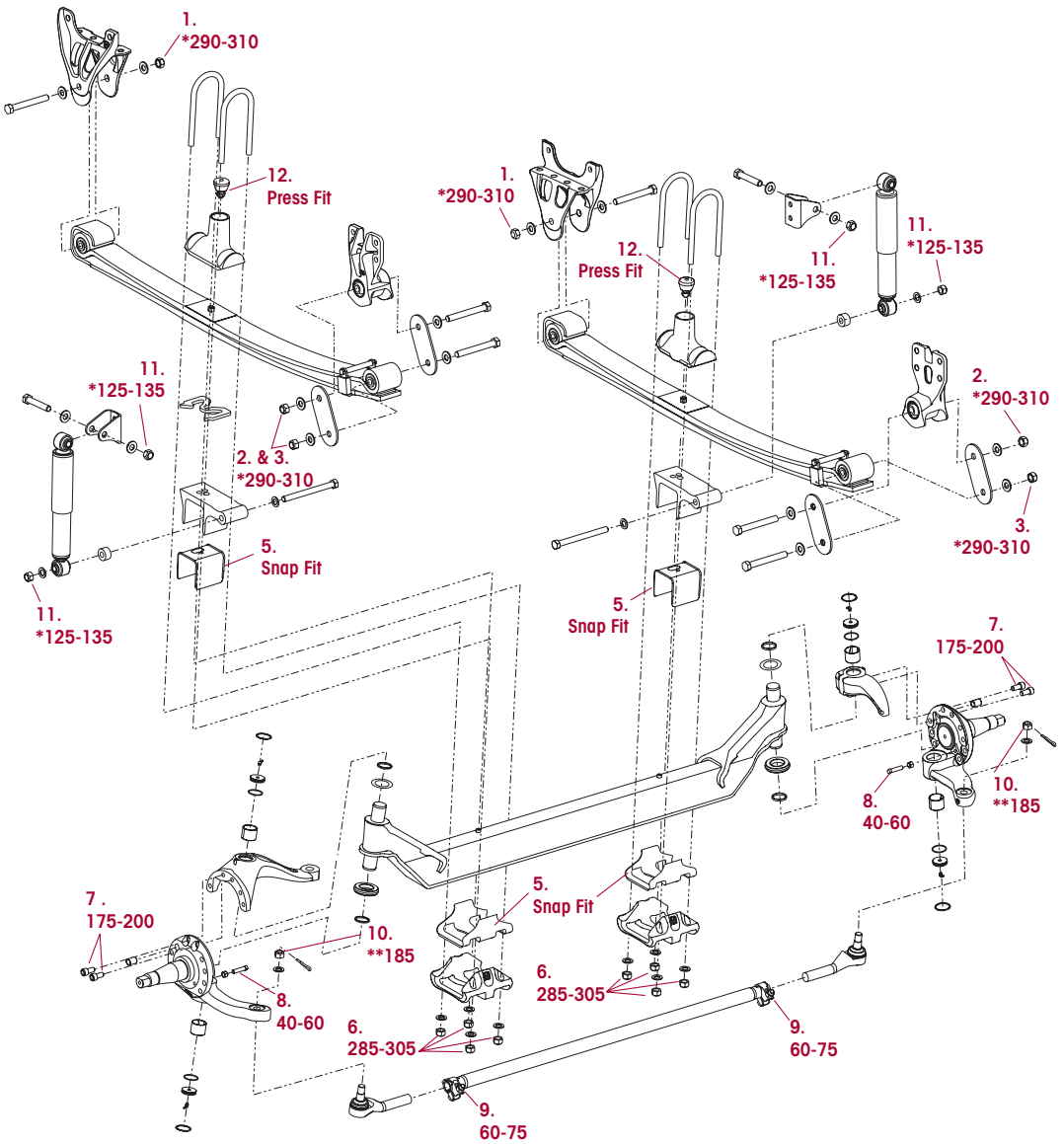
** Torque to 185 foot lbs., advance nut to next hex face to install cotter pin. Do not back off nut for cotter pin installation.

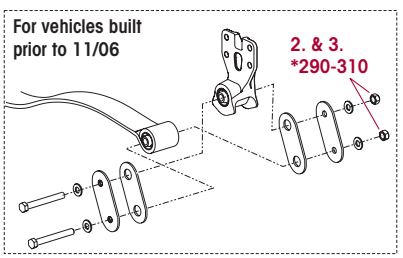
*** Denote items not shown on illustration.

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	5/8"	175-200
8	Knuckle / Axle Wheel Stop Bolt	2	5/8" Jam Nut	40-60
9	Tie Rod Tube to Tie Rod Ends	2	5/8"	60-75
10	Tie Rod Ends to Lower Steering Knuckle	2	7/8" 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:

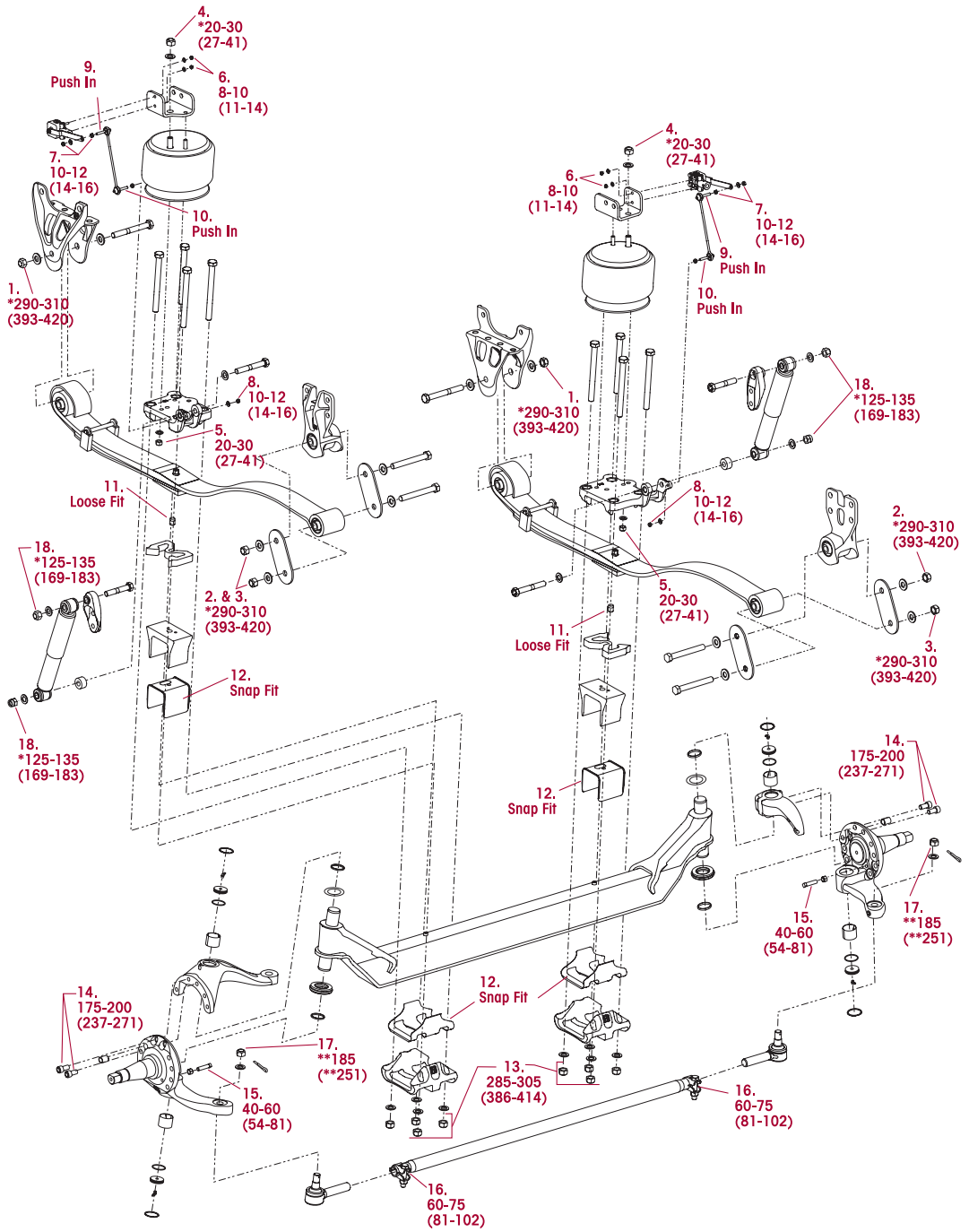
* All hardware information in gray in the matrix denotes recommended torques for fasteners originally supplied by the vehicle manufacturer. If Hendrickson supplied fasteners are used, tighten to Hendrickson torque values, if non Hendrickson fasteners are used, follow torque specifications listed in the 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:

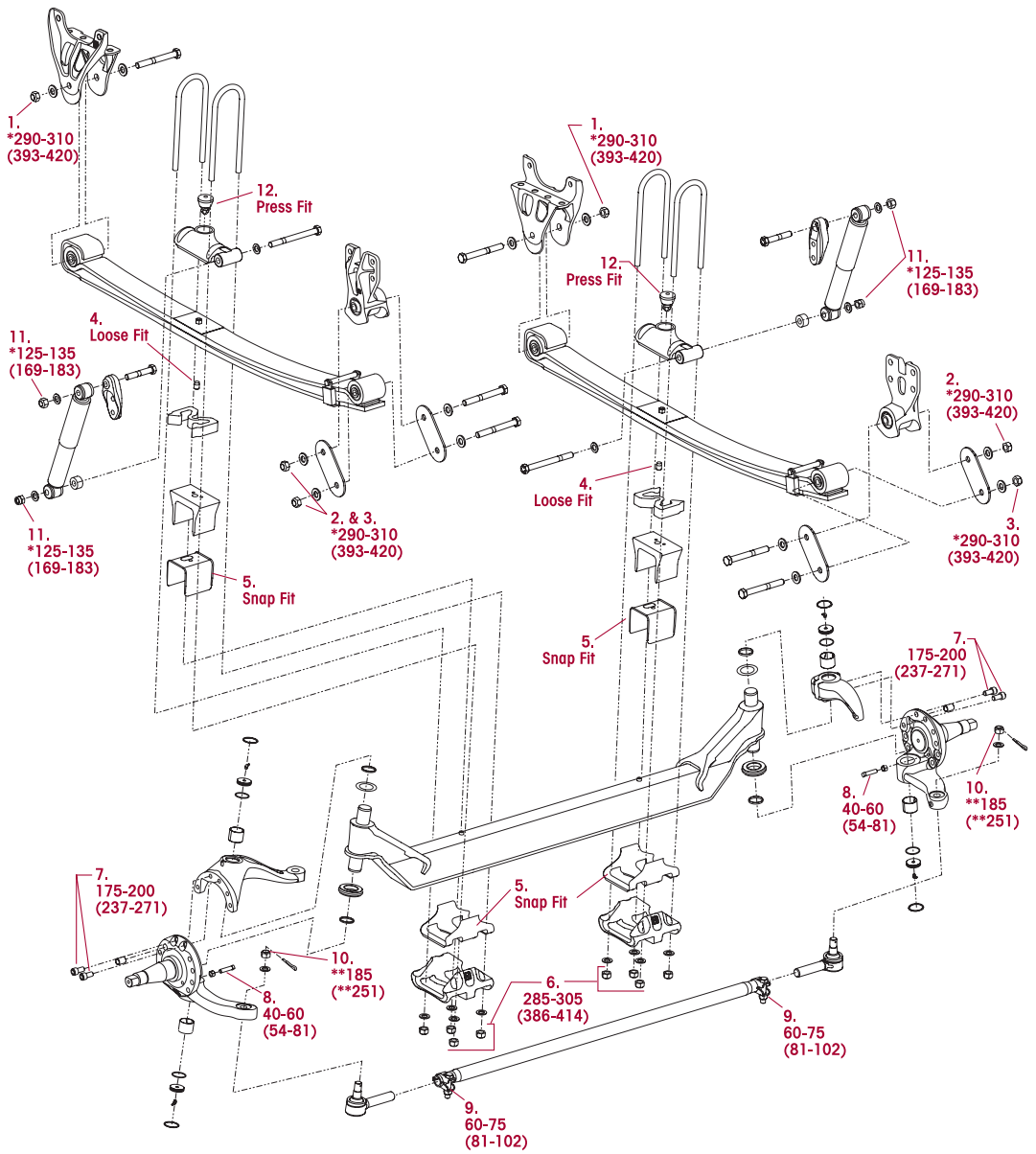
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** Torque to 185 foot pounds (251 Nm), advance nut to next hex face to install cotter pin. Do not back off nut for cotter pin installation.

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 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.

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 fire'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"

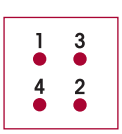
6) When reducing wheel cut on the STEERTEK axle it is necessary to check the steering gear box poppets.
   True or False

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

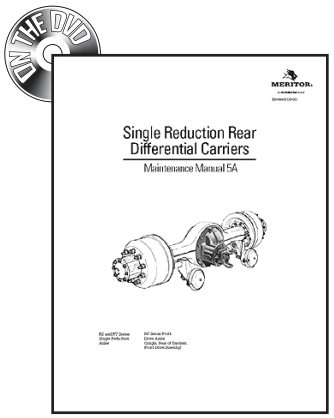
Rear Suspension

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 two rear suspension systems:

Hendrickson™ Softek.™ The Softek rear suspension is a 13-leaf slipper spring configuration, and is standard equipment on the Forward 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.



Single Reduction Rear Differential Carriers

Meritor Publication Maintenance Manual 5A

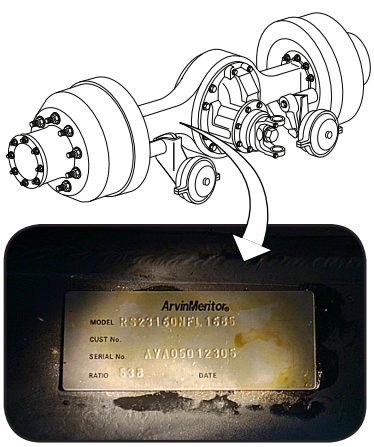
Forward Engine Rear Axle

Meritor single reduction speed with synthetic bearing lubrication. Standard model is RS21-145; 21,000 lb GAWR; 5.29:1 reduction ratio. All American FE 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	

Whether the bus is equipped with air or hydraulic brakes, wheel hubs and brake drums or rotors are mounted similarly. The wheel hub (with either an attached drum or rotor) is mounted upon 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.

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



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.

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.

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).

Also See…

The Hydraulc Brakes chapter of this manual includes a detailed procedure for removing the rear disc rotor/hub assembly.

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.

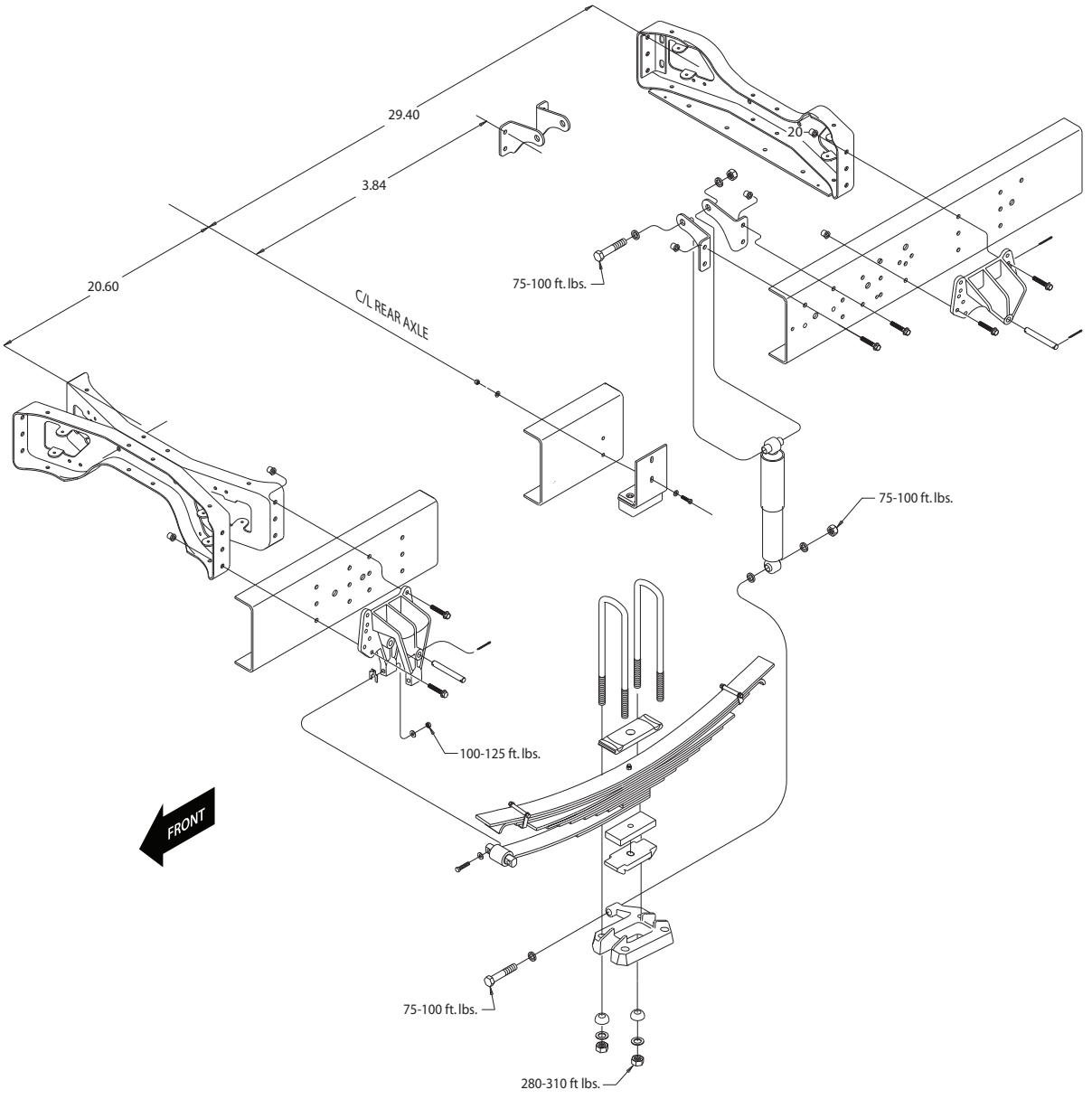
Rear Axle & Suspension

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).*



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Rear Spring Suspension

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 hydraulic brakes, disconnect the hydraulic lines at the frame rails.
7. 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.
8. Remove Shock Absorber as follows:
   - 8.1 Lift the axle/suspension assembly enough to take the weight off the suspension hangers.
   - 8.2. Remove hexnut, flat washers, and bolt from the bottom end of the shock absorber.
   - 8.3. Remove hexnut, flat washers and bolt from the top end of the shock absorber. The shock absorber can now be removed.

9. Remove the stabilizer bar, if so equipped, by removing locknut, flat washers and bolt from each end of the axle.

10. 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.***

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

12. Remove the rebound pin.

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

14. 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.***

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

16. Loosely install the inner wheels onto axle ends.

17. 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).

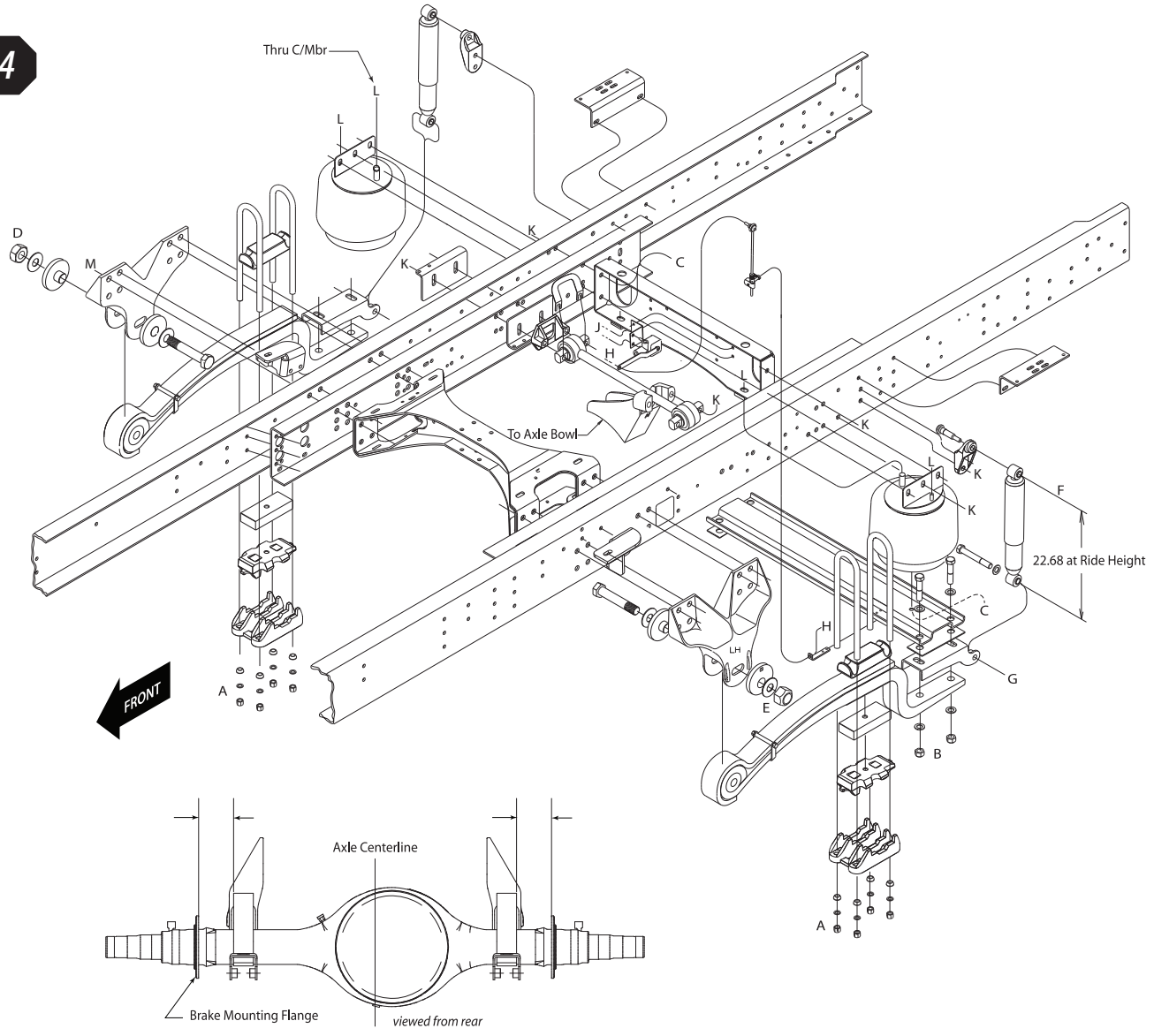
35. Install brake lines in accordance with instructions in the Brakes Section of this service manual.

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

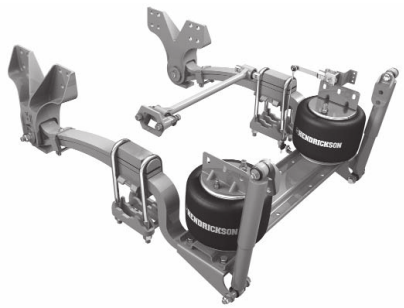
Measure from outside face of frame rail web to brake mounting flange, edge of brake drum, or edge of new tire. Measure both sides of chassis. Measurements should be equal within ¼".

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Rear Comfort Air Suspension

Torque Requirements

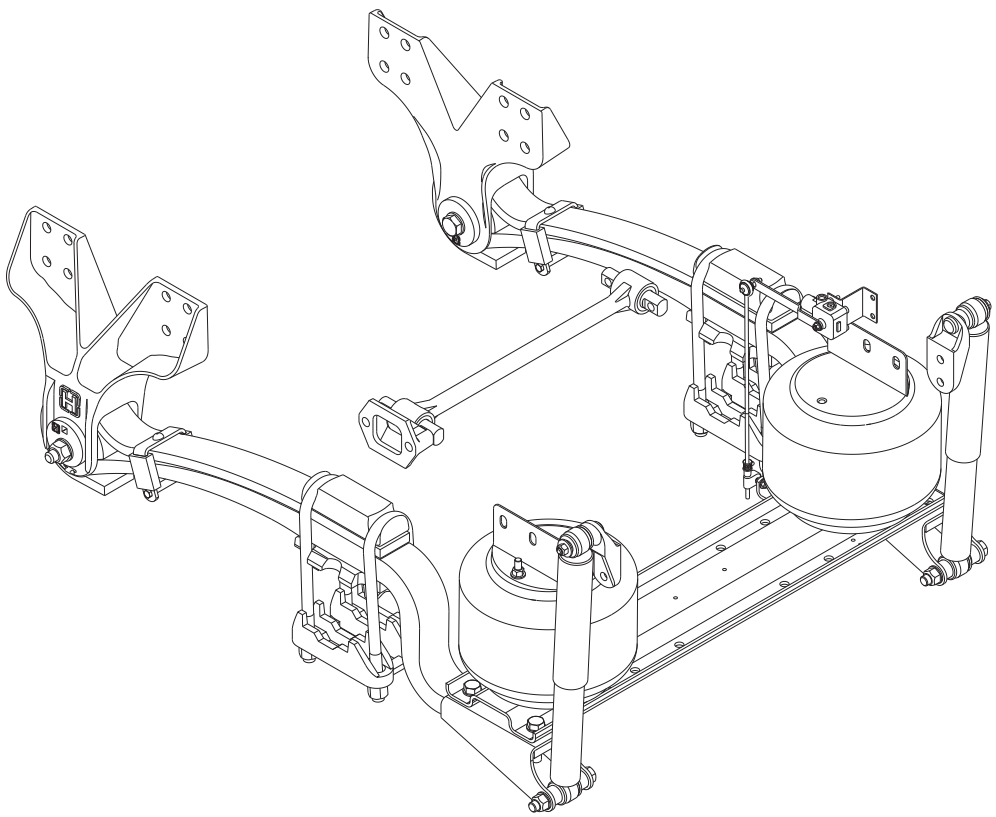
KEY	DESCRIPTION	TORQUE
A	U-bolt (High Locknut), 7/8″-14 Unf 2b	425 Ft.lbs.
	3/4″-16 Unf 2b	290 Ft.lbs.
B	Cross Channel To Main Support Mbr, 3/4″-10 Unc 2b	290 Ft.lbs.
C	Air Spring To Cross Channel, 1/2″-13 Unc 2b	25 Ft.lbs.
D	Quick Align Joint, Right Side Only, 1″- 8 Unc 2b	550 Ft.lbs.
E	Quick Align Joint, Left Side Only, 1″- 8 Unc 2b	550 Ft.lbs. (100 Ft-lbs During Alignment)
F	Shock Absorber, Upper Shock, 1/2″-13 Unc 2b	60 Ft.lbs.
G	Shock Absorber, Lower Shock, 3/4″-10 Unc 2b	170 Ft.lbs.
H	Linkage Rod Assy Locknut, 5/16″-24 Unf 2b	125 In.lbs.
J	Leveling Valve Mounting, 1/4″-20 Unc 2b	72 In.lbs.
K	Capscrew, 5/8″-11, Gr8	110 Ft.lbs.
L	Air Spring Stud Nut, 3/4″-16	25 Ft.lbs.
M	Hanger Assembly Nut, 3/4″-10	175 Ft.lbs.



TECHNICAL PROCEDURE

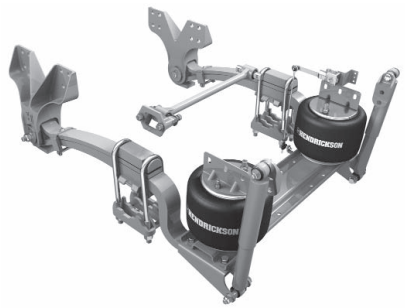
COMFORT AIR®

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

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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.

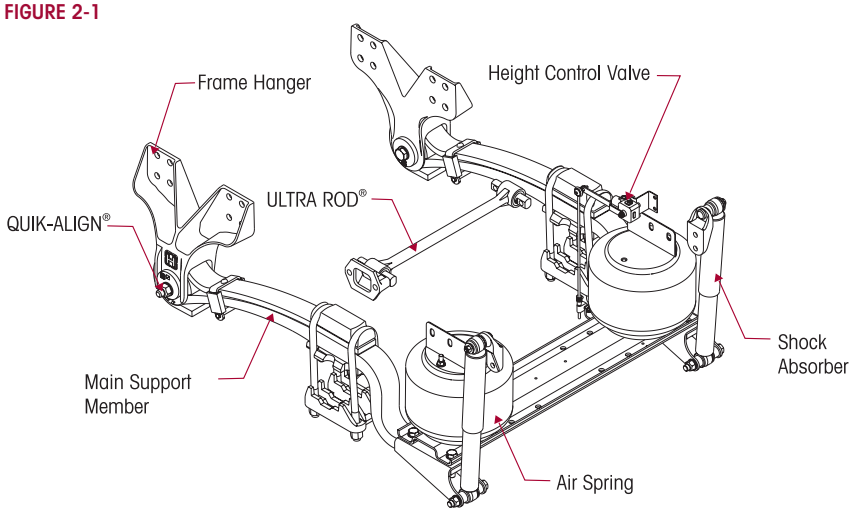
SECTION 2
Product Description

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

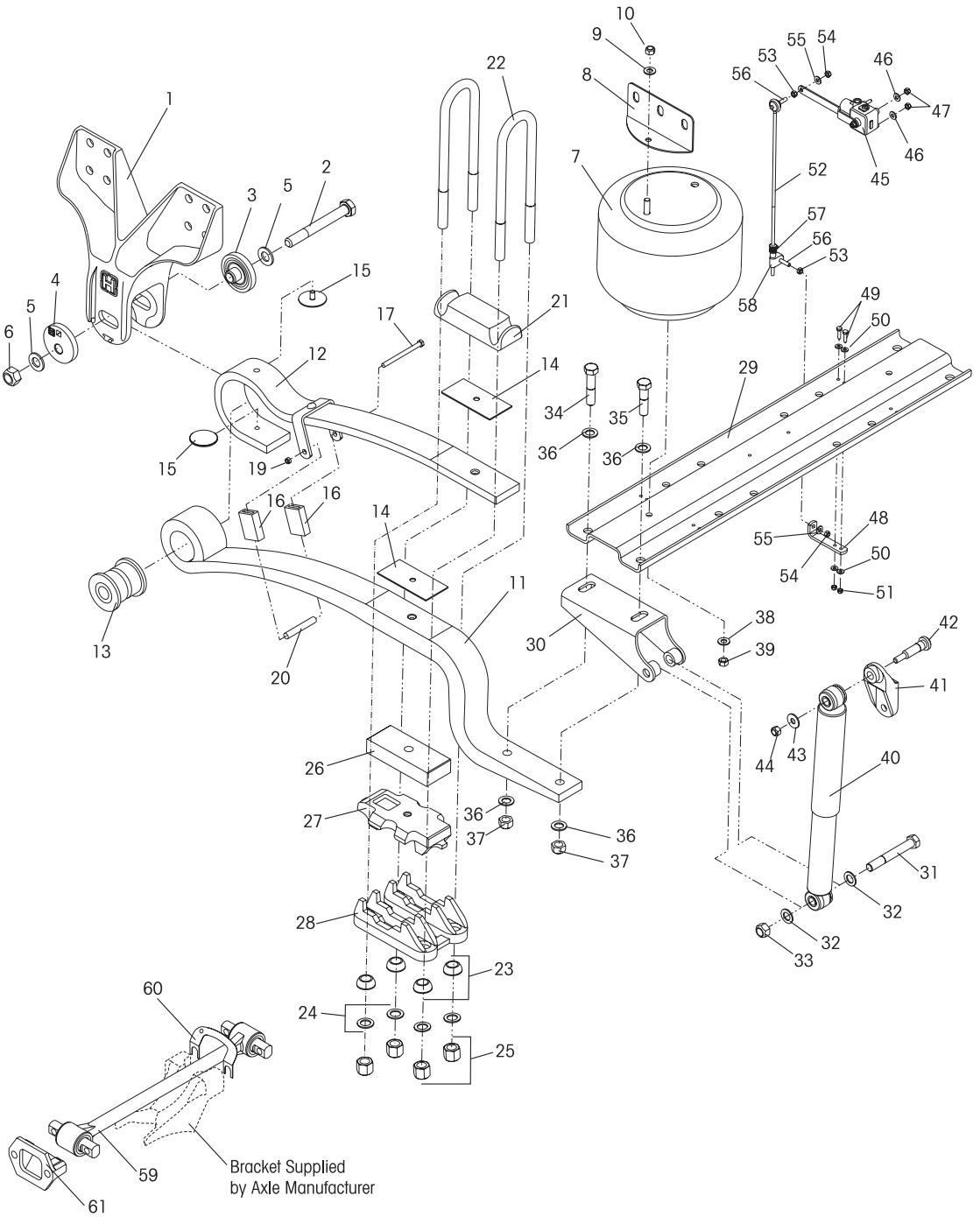
SHOCK ABSORBERS

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-	7/8" Specify Length,(Includes Key Nos. 22-25)	
	48718-104	3/4"-15,000 lb. capacity, (Includes Key Nos. 22, 24-25)	
22	47417-	7/8"-14 UNF U-bolt - Specify Length	4
	49684-014	3/4" 26 UNF U-bolt - 12.5" (15,000 lbs.Capacity)	4
23	48574-000	Spherical Washer	8
24	22962-002	7/8" Hardened Flat Washer	8
	22962-001	3/4" Hardened Flat Washer (15,000 lb. Capacity)	8
25	50765-000	7/8" 14UNF U-Bolt Locknut	8
	49685-000	3/4" 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	3/4"-10 UNC Bolt - 5.50"	2
32	22962-001	3/4" Hardened Washer	4
33	49842-000	3/4"-10 UNC Locknut	2
	50763-004	**Cross Channel Fastener Service Kit,** Axle Set (Includes Key Nos. 34-37)	
34	50764-003	3/4"-10 UNC Bolt - 3.50"	2
35	50764-005	3/4"-10 UNC Bolt - 3.00"	2
36	22962-001	3/4" Hardened Washer	8
37	49842-000	3/4"-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

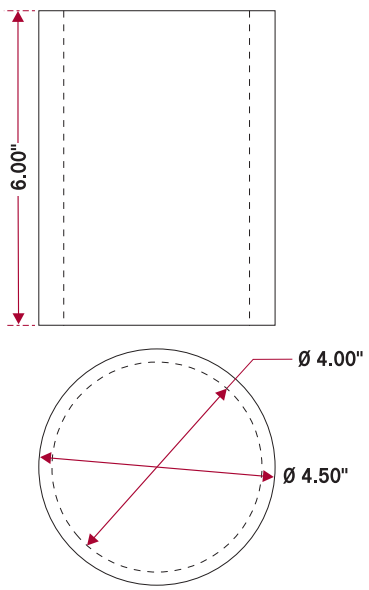
* Item included in assembly only, part not sold separately.

SECTION 5
Special Tools

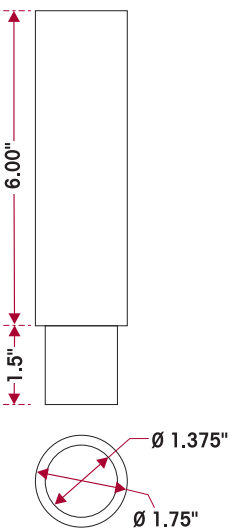
These shop made tools are designed to install and remove pivot bushing and torque rod bushing. Bushing tools are made from cold rolled steel or equivalent. Drawing is for reference only, Hendrickson does not supply this tools.

PIVOT BUSHING TOOLS

Pivot Bushing Receiving Tool

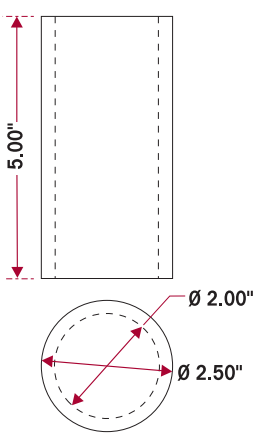


Pivot Bushing Push Out Tool



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

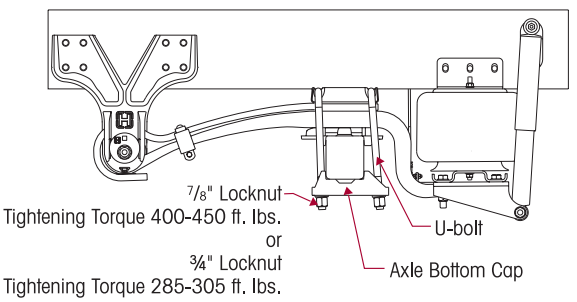
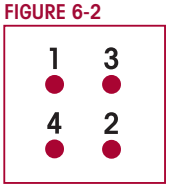


FIGURE 6-2



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.

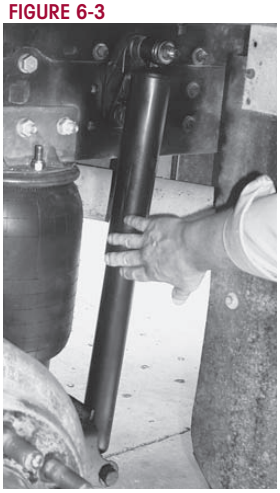
- 19,000 to 23,000 pound capacity equipped with ⅞" locknuts tighten to 400-450 foot pounds torque.
- 15,000 pound capacity equipped with ¾" locknuts tighten to 285-305 foot pounds torque.

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

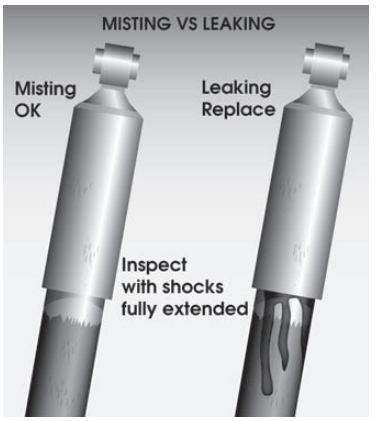
Bent or dented shock

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.

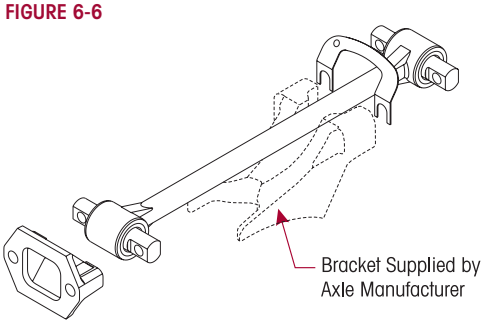
NOTE The COMFORT AIR suspension is equipped with a premium seal on the shock, however this seal will allow for misting to appear on the shock body (misting is not a leak and is considered acceptable).

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.

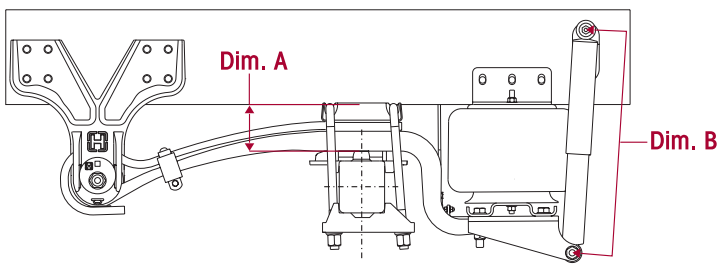
Dimension A

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

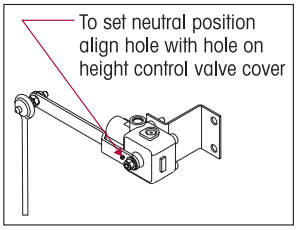
This option to measure the normal running length of the shock absorber will measure the ride height on the shock from center of eye to center of eye, see dimension **B** in Figure 7-1. The specific running length of the shock absorber varies per specific OEM applications as shown in the matrix.

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.

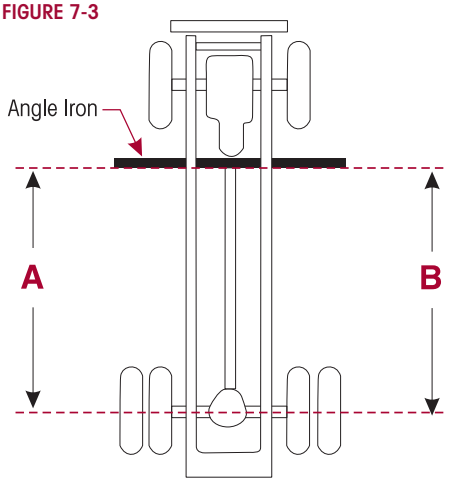
The following procedure should be performed after all repairs are completed.

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.

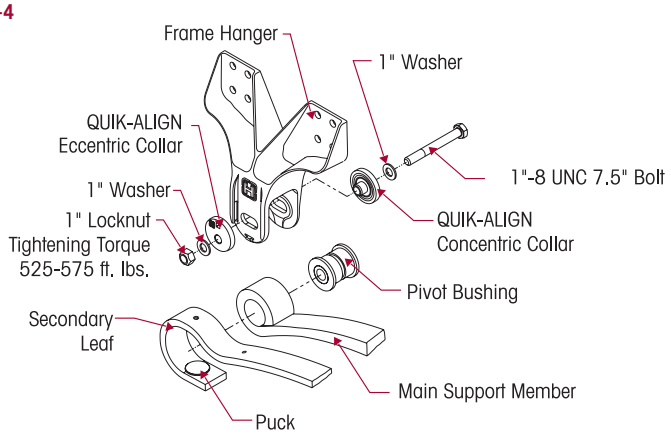
FIGURE 7-3



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

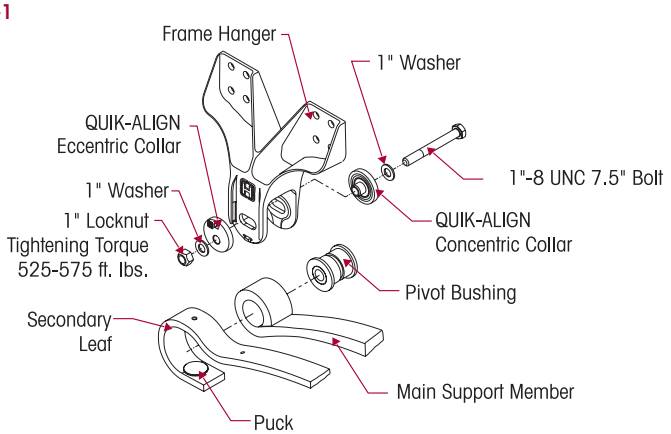
1. Chock wheels of axle.
2. Raise frame of vehicle to remove load from suspension.

⚠ 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.

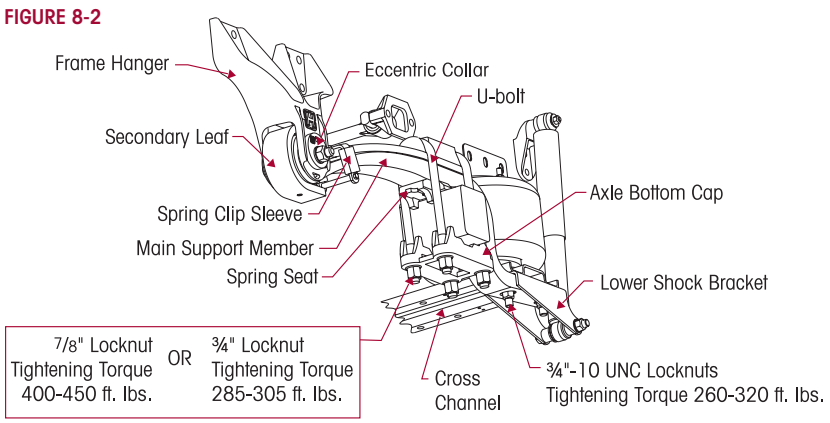
WARNING VEHICLE MUST BE FIRMLY SUPPORTED WITH JACK STANDS PRIOR TO SERVICING. FAILURE TO DO SO CAN RESULT IN PERSONAL INJURY OR PROPERTY DAMAGE.

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

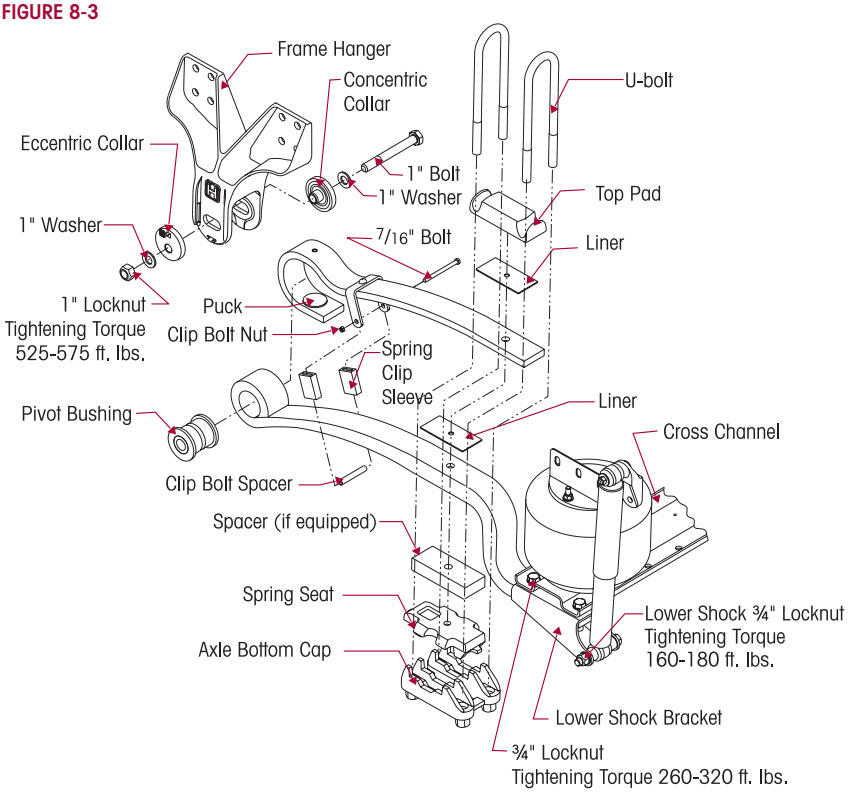


6. Remove the 1" pivot bolt, nut and QUIK-ALIGN collars that connect the main support member assembly to the frame hanger, see Figure 8-2.
7. Remove the U-bolts, locknuts and washers.
8. Remove the axle bottom cap and top pad.
9. Remove the ¾" fasteners that connect the cross channel to both main support 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

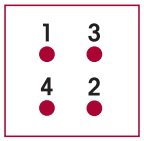
DO NOT ASSEMBLE QUIK-ALIGN JOINT WITHOUT PROPER FASTENERS. USE ONLY DACROMET PLUS XL PLATED FASTENERS TO SUSTAIN PROPER CLAMP FORCE. FAILURE TO DO SO CAN CAUSE LOSS OF VEHICLE CONTROL, PROPERTY DAMAGE OR PERSONAL INJURY.

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.

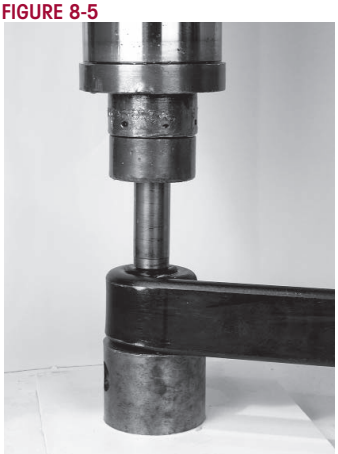
FIGURE 8-4



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.

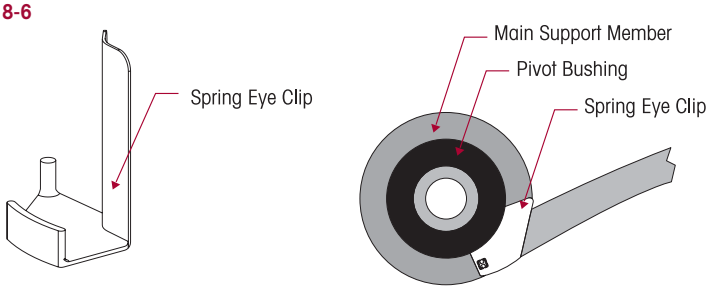
1. Remove the 7/16" bolt, clip bolt spacer and nut from the secondary leaf spring clip.
2. Cut the splicing tape that holds the liners to the center of the main support member assembly and rotate the secondary leaf to clear the spring clip from main support member.

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

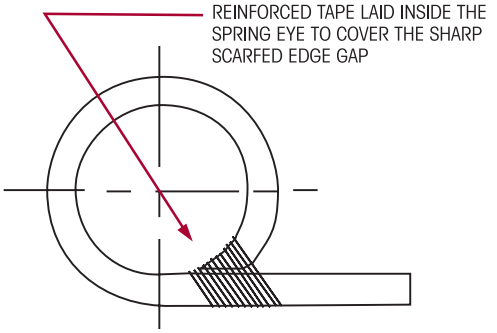


5. Center the push out tool on inner sleeve and press out the old bushing. (These bushings are not cartridge type bushings. They do not have outer metals).
6. Clean and inspect the I.D. of the main support member eye.

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.

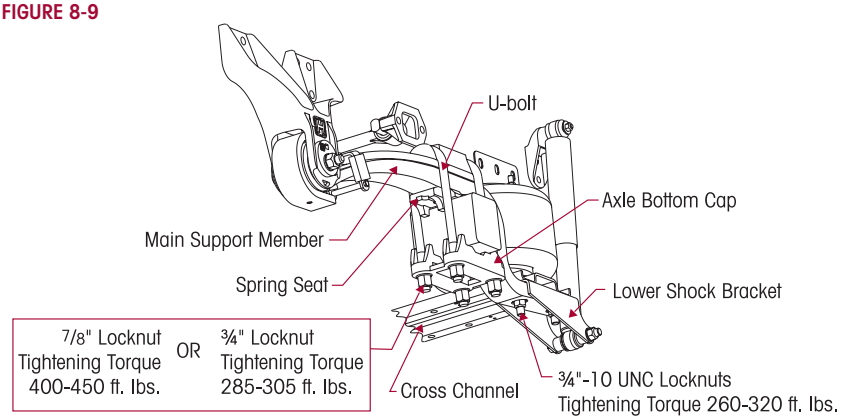
⚠ WARNING

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



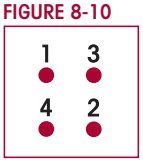
ASSEMBLY

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

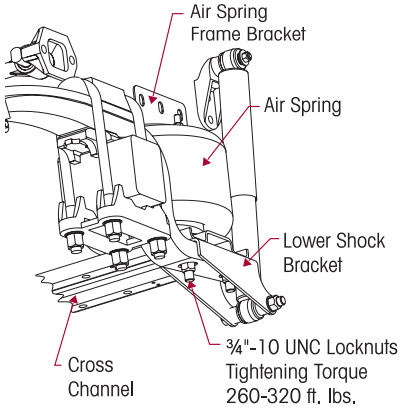
1. Chock wheels of axle.
2. Raise frame of vehicle to remove load from suspension.

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

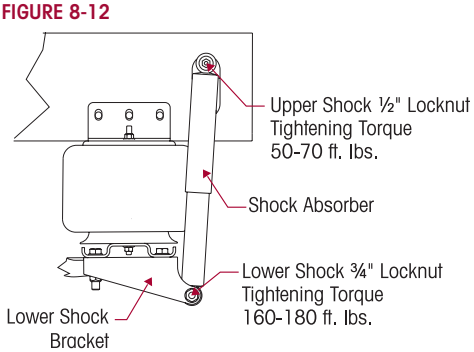
1. Install the cross channel to the lower shock brackets and main support member assemblies by attaching the ¾" bolts, washers and locknuts. Tighten to 260-320 foot pounds torque.
2. Install air springs in cross channel by inserting studs into appropriate holes and attach washers and locknuts. Tighten 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

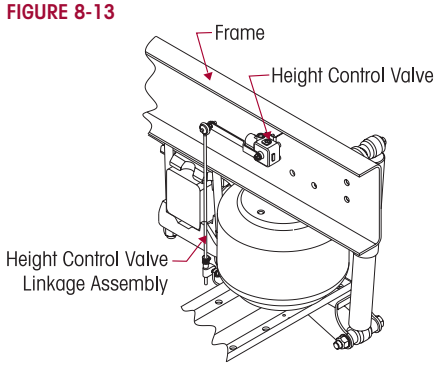
VEHICLE MUST BE FIRMLY SUPPORTED WITH JACK STANDS PRIOR TO SERVICING. FAILURE TO DO SO CAN RESULT IN PERSONAL INJURY OR PROPERTY DAMAGE.

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



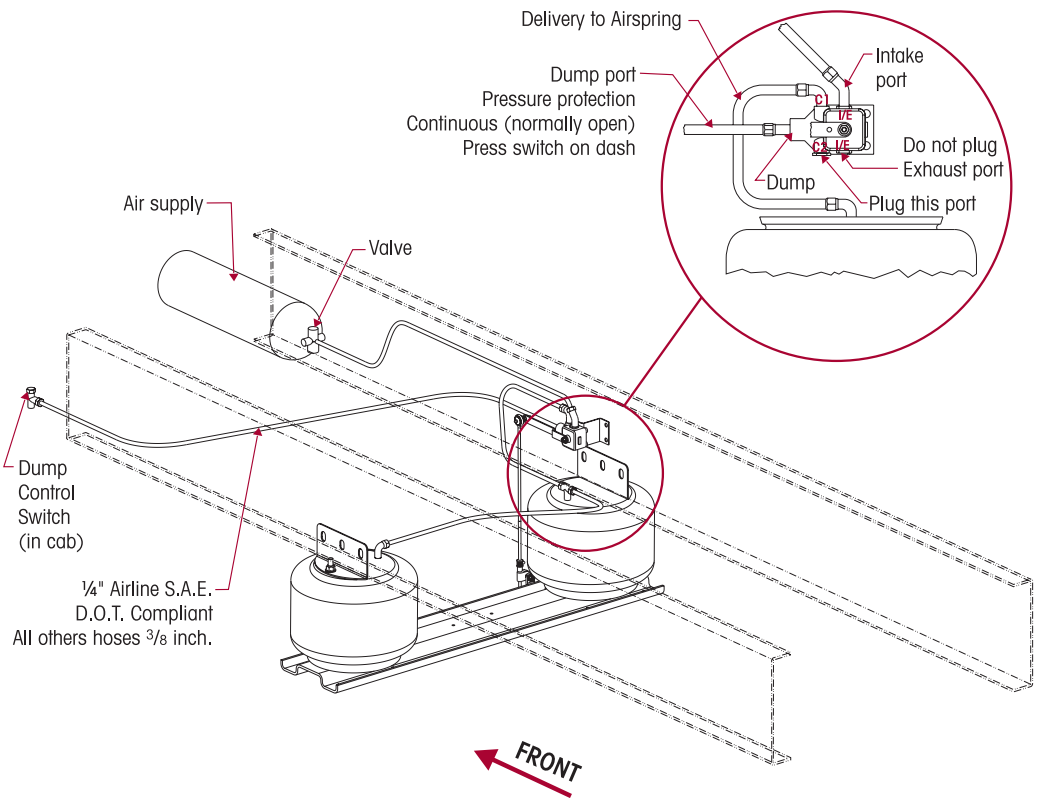
FIGURE 8-16



FIGURE 8-17



SECTION 9
Plumbing Diagram

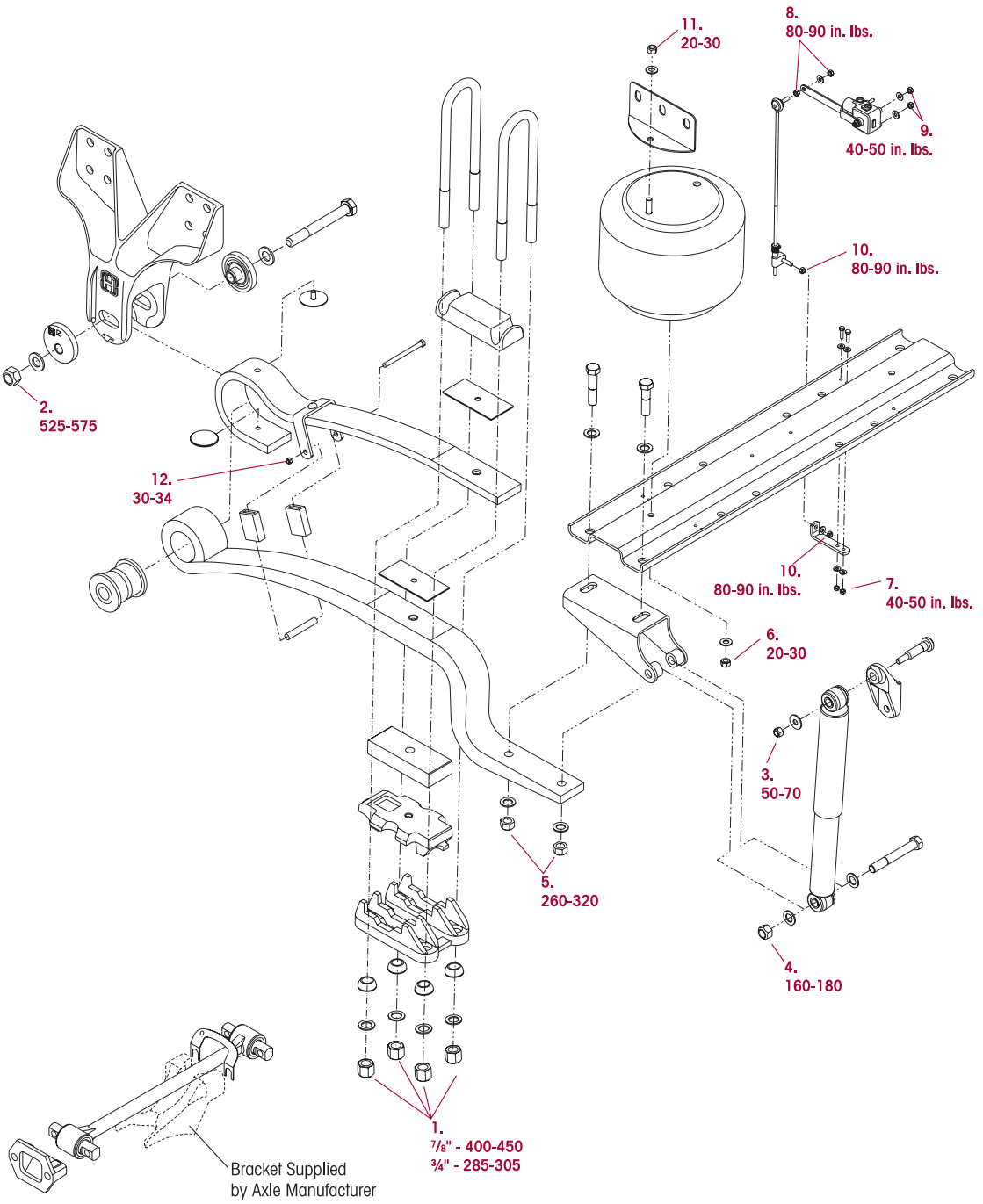


SECTION 10
Troubleshooting Guide

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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HENDRICKSON

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Printed in United States of America

Overview

The optional air brakes system on the Blue Bird All American 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.

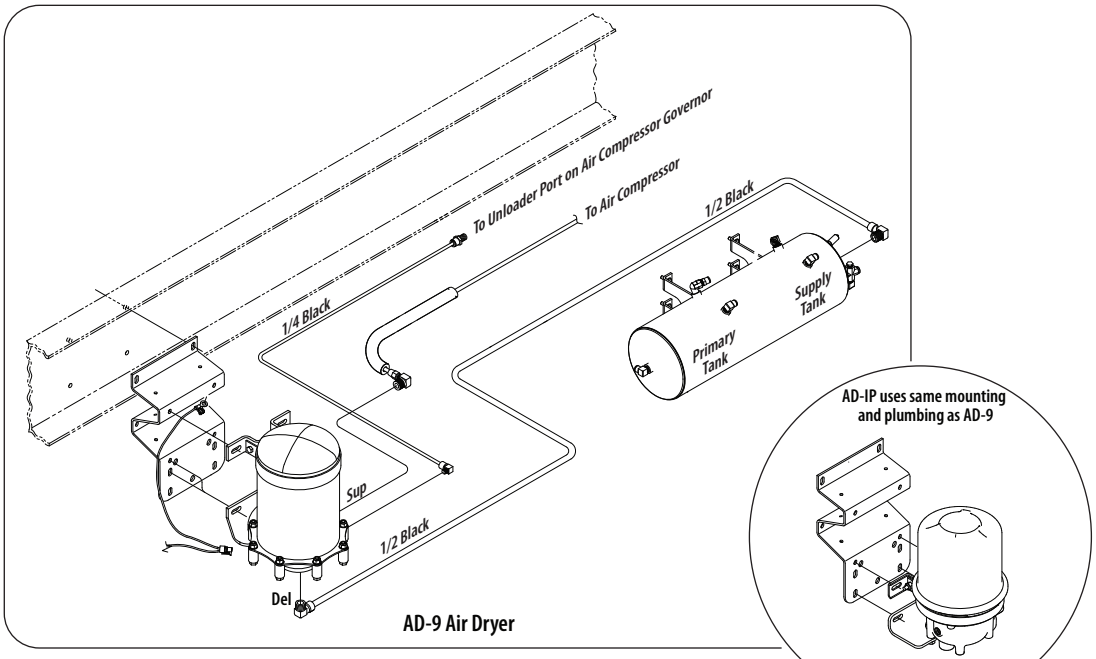
As air is compressed, moisture vapor tends to condense inside the storage tanks. The tanks are equipped with drain valves to allow removal of this built-up moisture. Some buses are equipped with an air dryer to assist collection and expulsion of the excess moisture. Air from the compressor passes through 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.

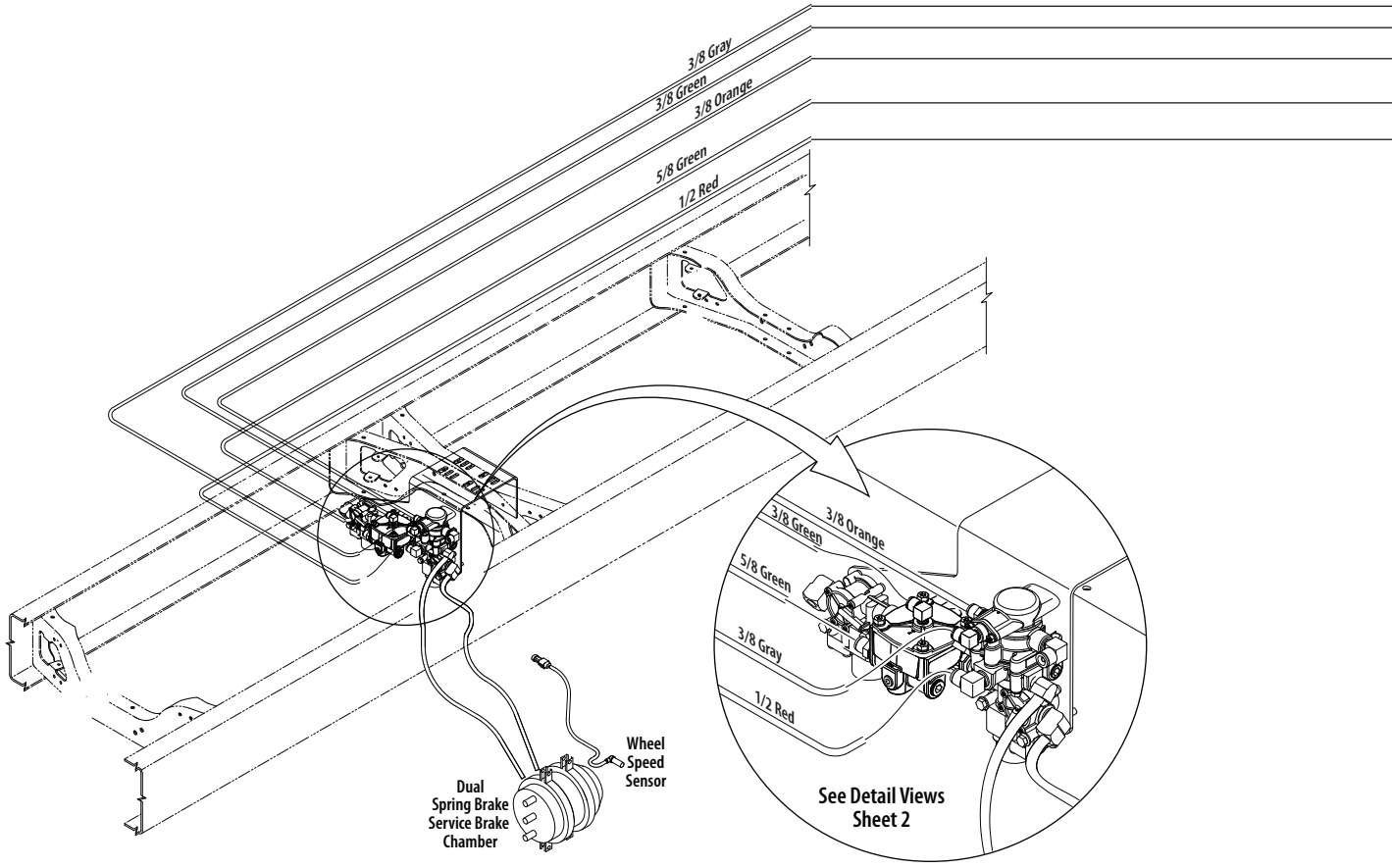
The system is divided into two separate circuits; one for rear brakes (primary) and one for front (secondary). The brake treadle valve receives pressure from both the primary and secondary tanks. The treadle valve directly controls the pressure and volume of air delivered to the front brakes. However, 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.

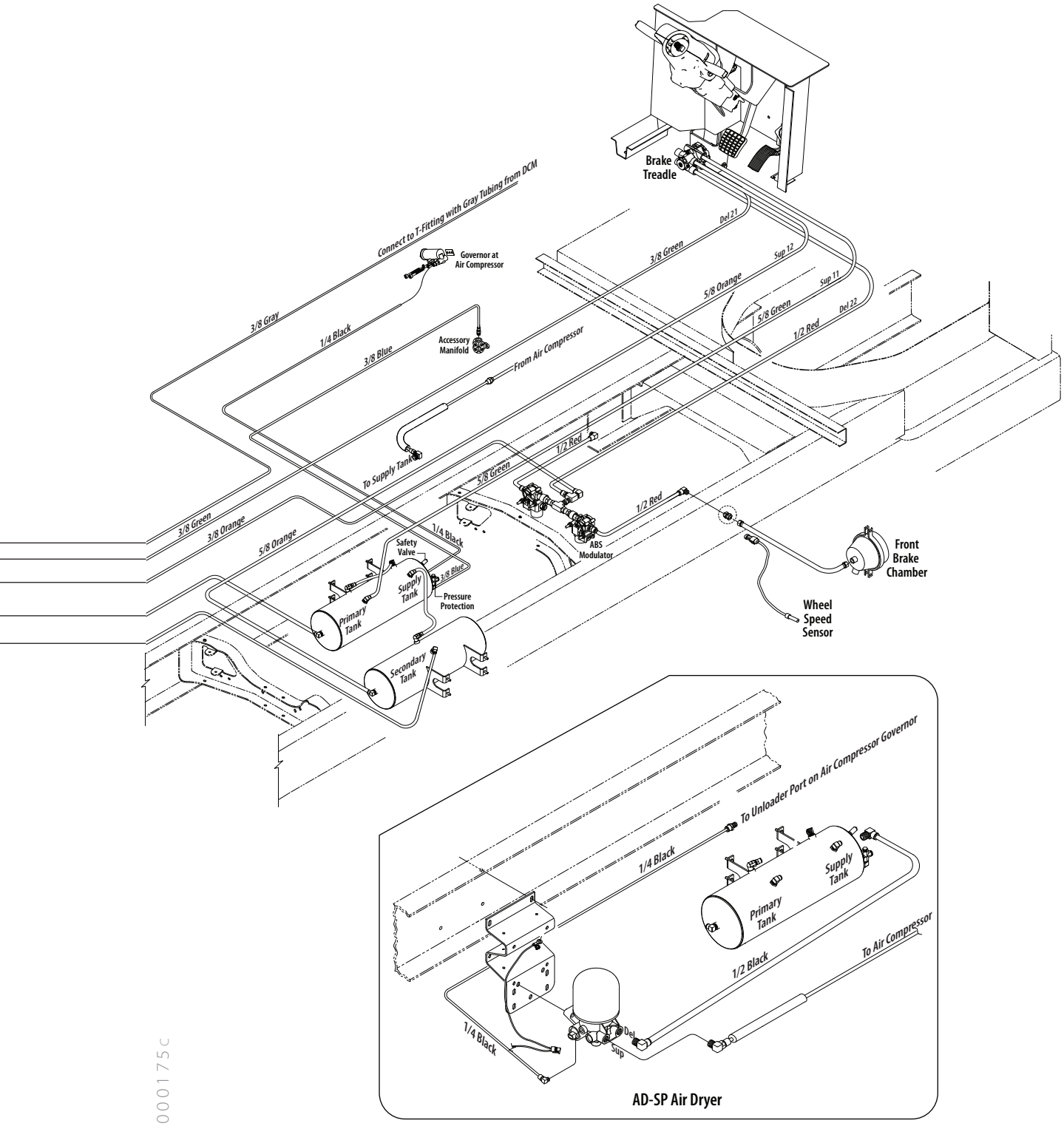
At each wheel, air pressure is delivered to a closed brake chamber, which encases a diaphragm. The increased pressure behind the diaphragm results in an increased mechanical advantage to move a pushrod, which rotates the shaft of an S-cam situated between the ends of two brake shoes. As the S-cam rotates, 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.


To Unloader Port on Air Compressor Governor
To Air Compressor
1/2 Black
1/4 Black
Supply Tank
Primary Tank
Sup
1/2 Black
Del
AD-9 Air Dryer
AD-IP uses same mounting and plumbing as AD-9
AD-IP Air Dryer


3/8 Gray
3/8 Green
3/8 Orange
5/8 Green
1/2 Red
3/8 Orange
3/8 Green
5/8 Green
3/8 Gray
1/2 Red
Wheel Speed Sensor
Dual Spring Brake Service Brake Chamber
See Detail Views Sheet 2

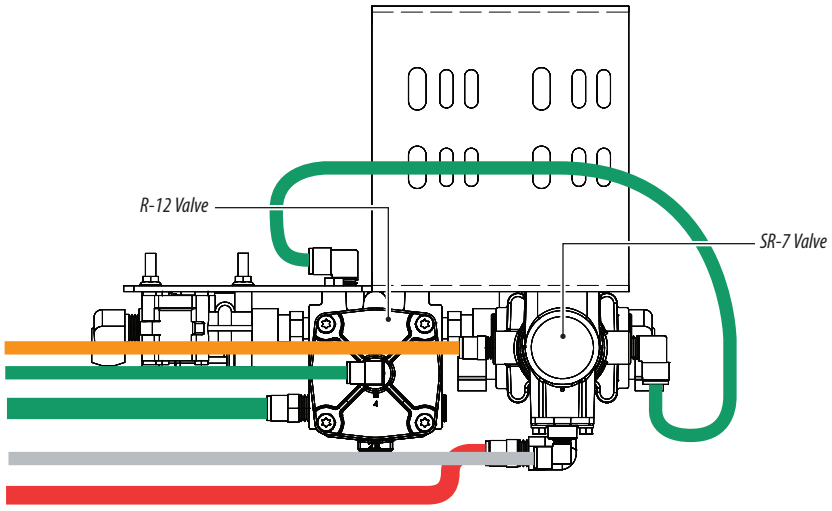


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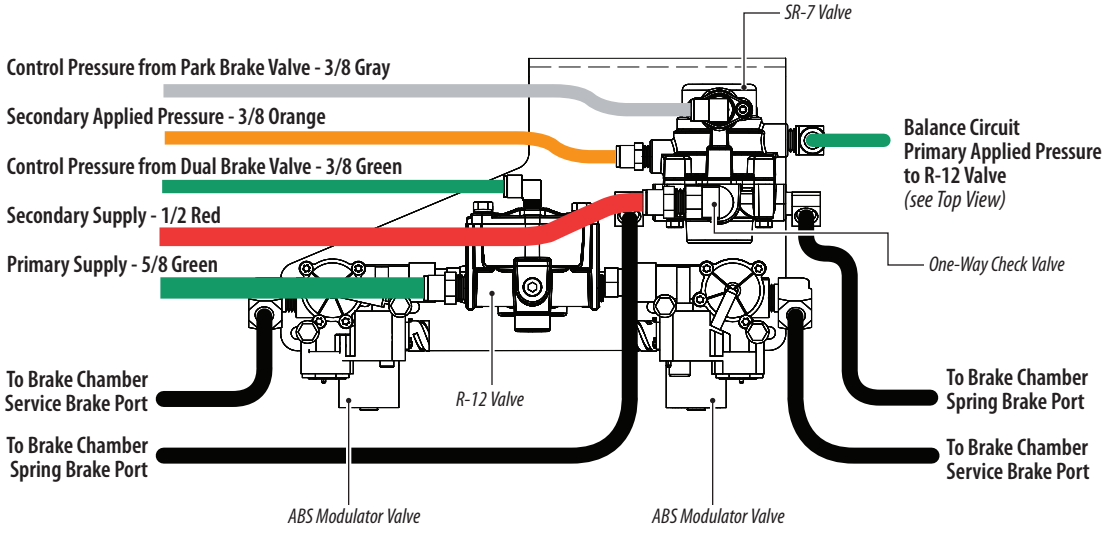
Sheet 1

See SR-7 Detail and Traction Control Features on Sheet 2

Air Brake System Diagram



Top View

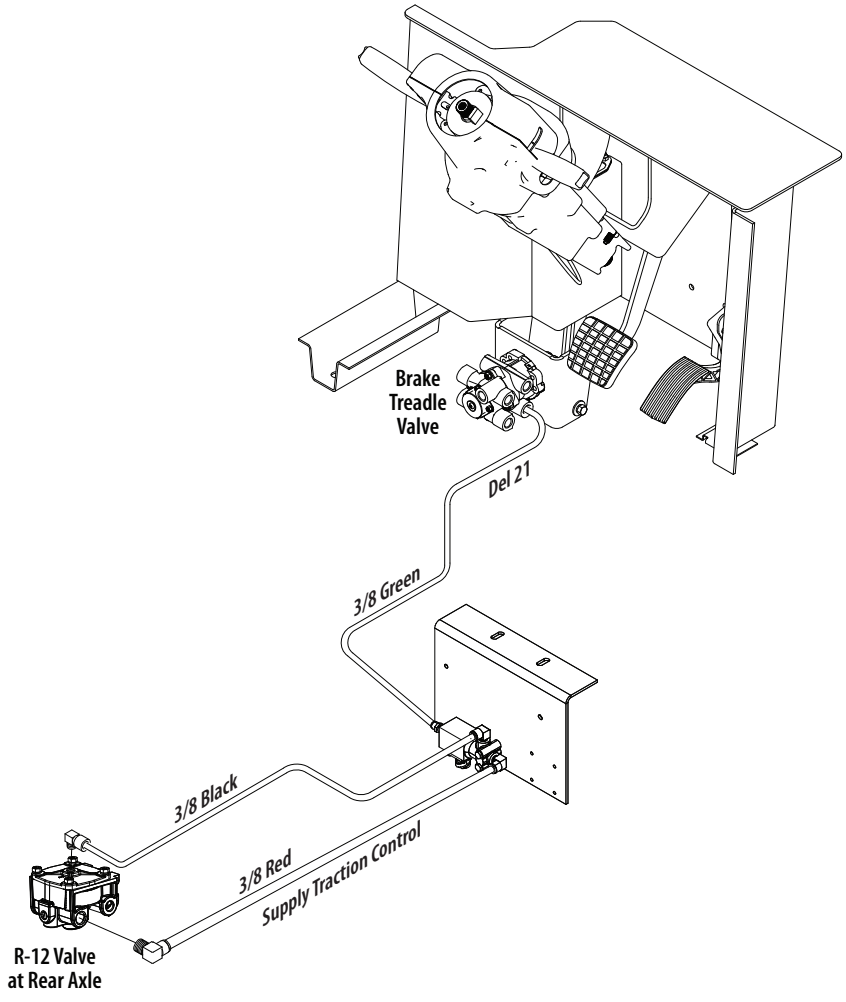


SR-7 Detail, Rear View

Sheet 2
See Air Brake Diagram, on Sheet 1

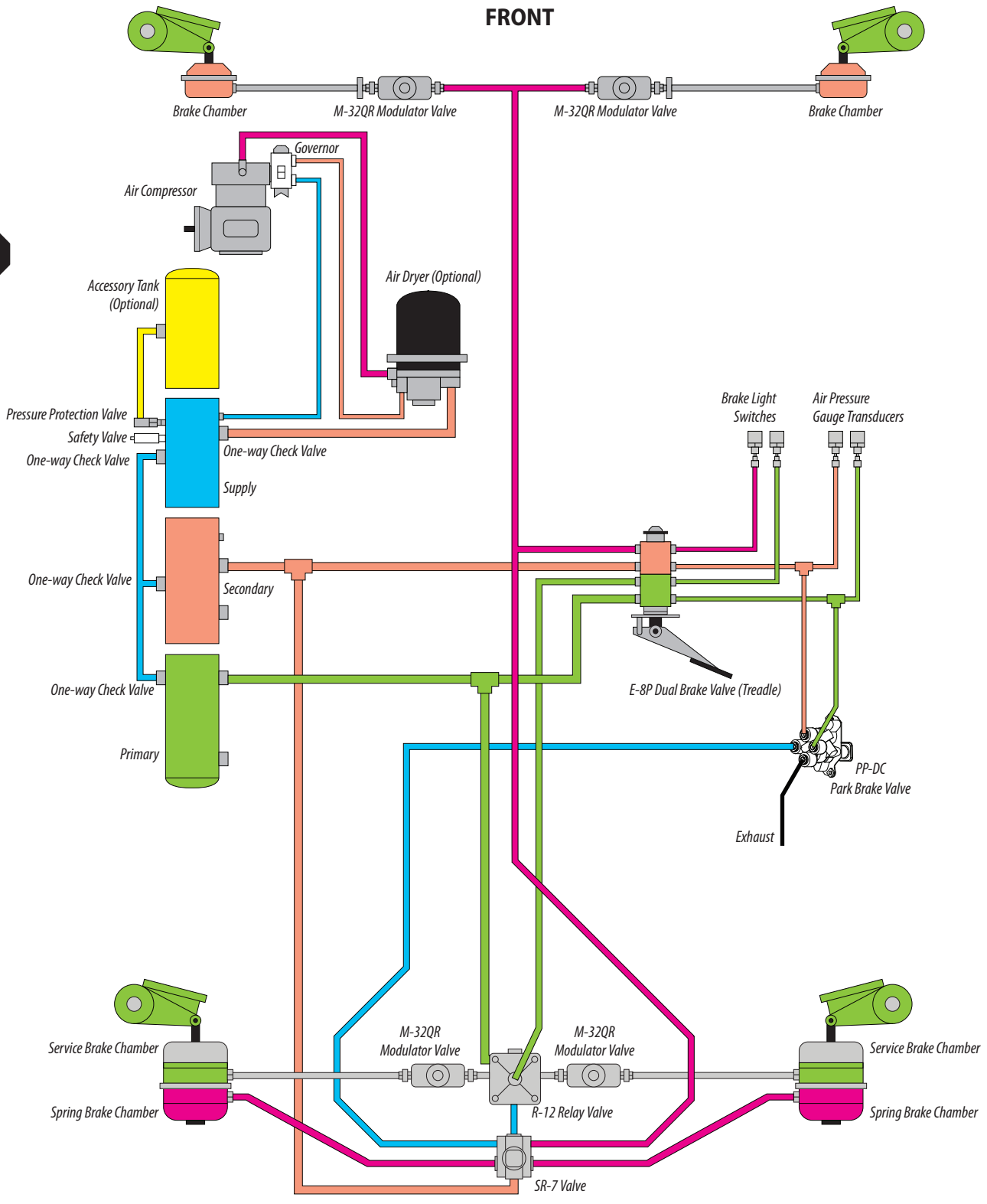
Automatic Traction Control

ABS Systems with ATC (Automatic Traction Control) will improve the vehicle stability and traction during vehicle acceleration or deceleration. The ATC function uses the same wheel speed information and modulator control as the ABS function. The ECU 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 ECU is configured to use differential braking and engine torque limiting to control wheel spin. Differential braking is automatically activated when drive wheels 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 that is spinning. The vehicle differential will then drive the wheels on the other side of the vehicle.



Traction Control Feature

00000175c



Air Brakes, Schematic

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.

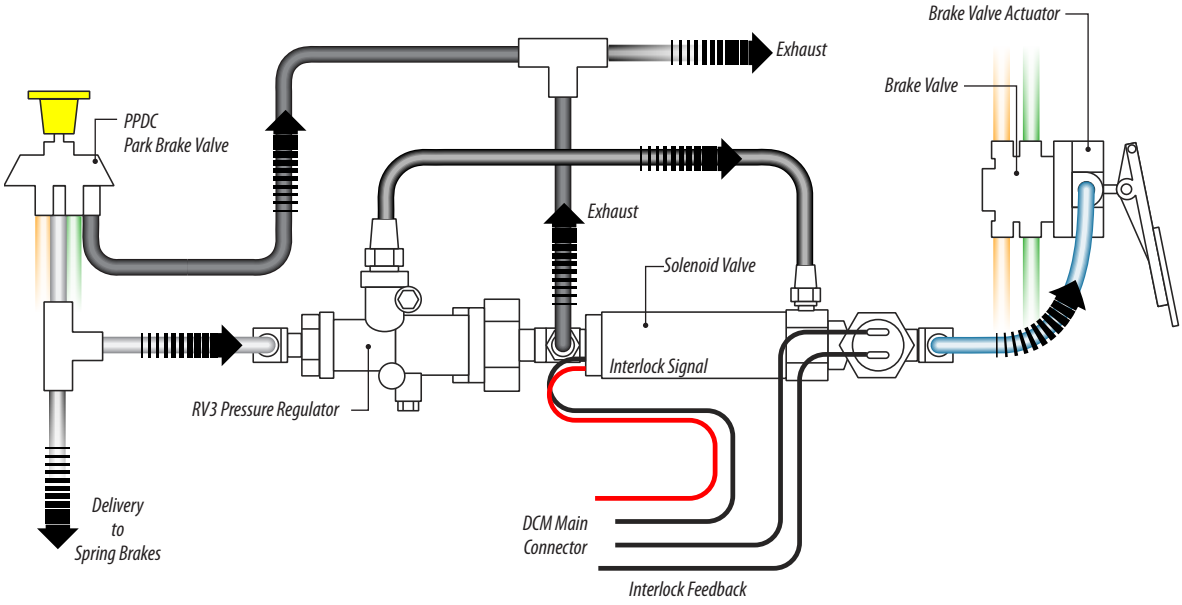
- **E-8P Dual Brake Valve.**
- **R-12 Relay Valve.**
- **M-32QR Antilock Modulator Valve**
- **WS-24 Wheel Speed Sensor**
- **AD -IP Air Dryer**
- **Haldex Slack Adjuster**

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.



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.

Air Compressor

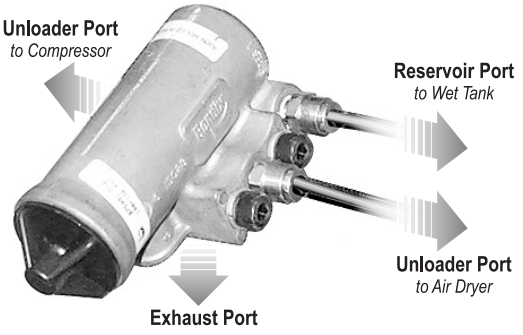
The Blue Bird All American's air compressor is a gear driven unit with turbocharged intake, and is mounted to the left side of the engine. Depending on engine application the air system will be equipped with a compressor selected by the engine manufacturer to best suite their engine.

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)



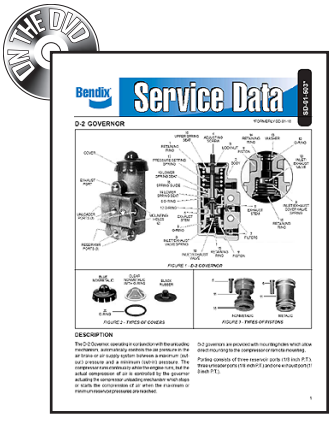
The Bendix D-2 air compressor governor operates in conjunction with the unloading mechanism of the compressor to automatically keep the air pressure in the system between 100 and 120 psi.

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.

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.



Bendix D-2 Governor

Bendix Publication SD-01-503

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.

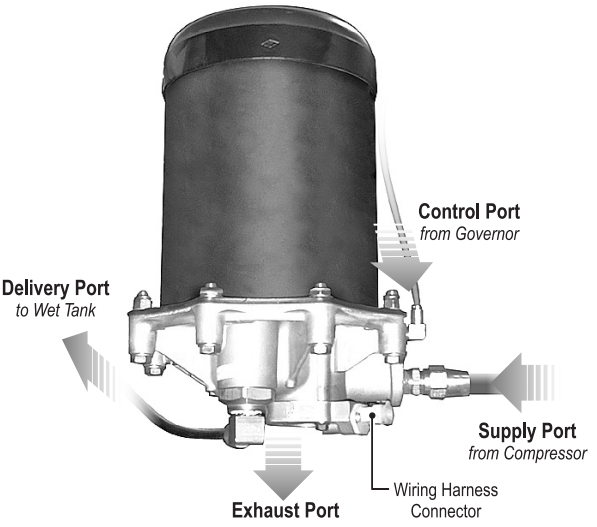
4. Disconnect from the unloader port the line which leads to the air dryer.

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.

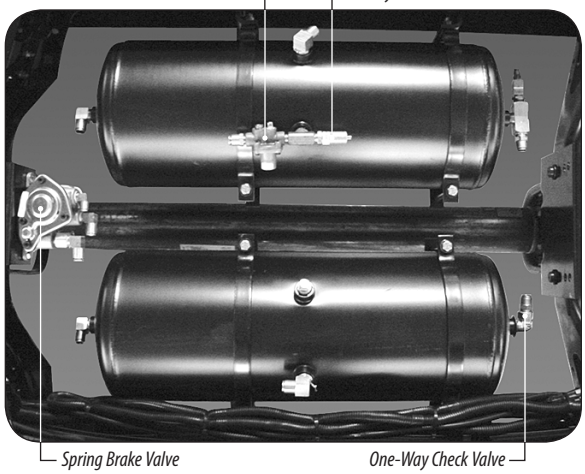
6. Before returning the Blue Bird All American to service, perform the operation and leakage tests in Appendix 1.

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.

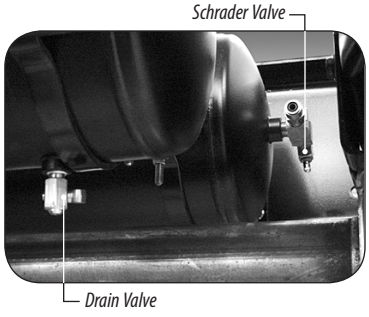
Each air tank (supply, primary, and secondary) has its own drain valve on the bottom side of the tank assembly for the purpose of manually expelling any moisture condensation that may have collected in the tanks. Optionally all drain valves can be located behind the front driver's side access panel. *Note: Air tank placement is determined by chassis option and wheelbase.*



Air Tanks (Top View)

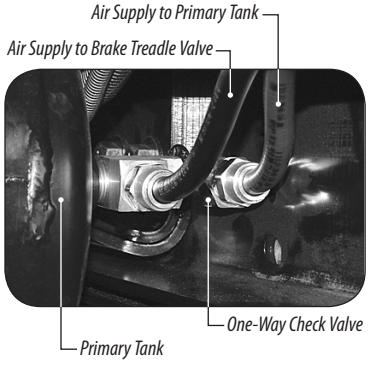
The supply tank chamber has these fittings:

- 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 these fittings:

- 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



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.

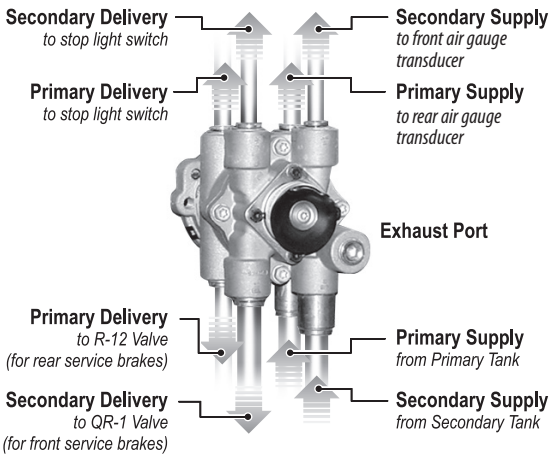
5. Remove the nuts and bolts from the supports.

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.



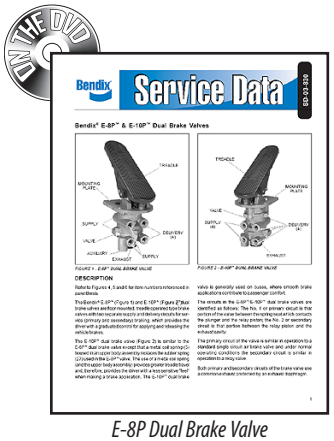
The E-8P is internally divided into two separate valves. The upper half of the valve controls the rear brakes (primary) and the lower half controls the front brakes (secondary). The upper half of the treadle has two identical primary supply ports (labeled Sup 11) and two identical delivery ports (labeled 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.

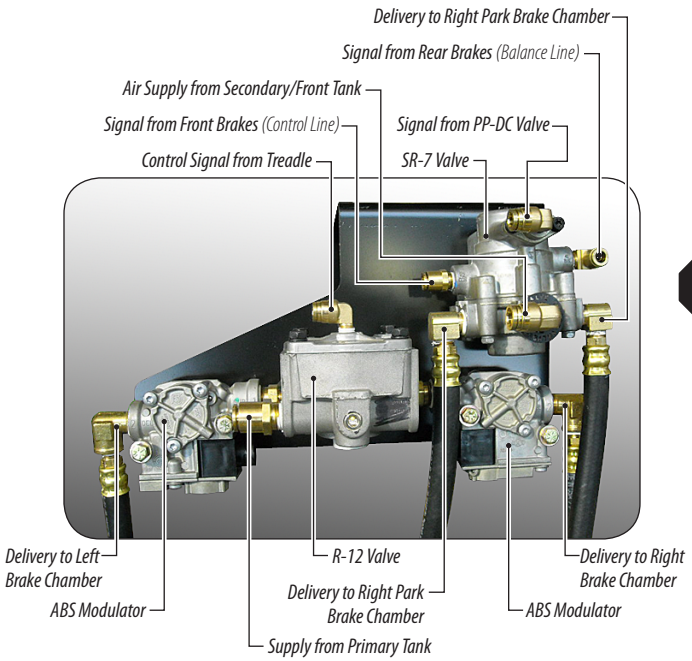
Relay Valve (R-12)

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 Spring Brake Quick Release 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

Because the two rear ABS modulator valves are mounted directly to the R-12 valve by ¾" x ½" male threaded nipples, it is necessary to remove the three units as an assembly to remove the R-12.

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 3 air lines connected to the R-12 valve, and the outgoing air line connected to each of the rear ABS modulators.

4. Remove the four 5/16" bolts which mount the ABS modulators to the frame mounting bracket Self locking nuts are on the inboard side of the bracket.

5. 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 and two rear modulators can now be removed as a unit.

6. Disassemble the modulators from the R-12.

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.

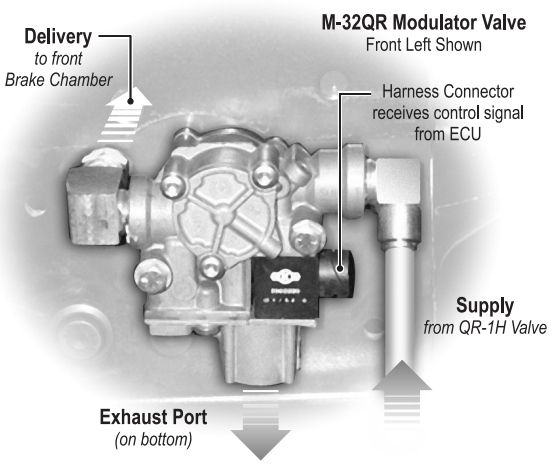
When the driver pulls outward on the PP-DC knob, the intake ports close, and the exhaust port opens, releasing the signal pressure going to the SR-7 causing the SR-7 to exhaust the pressure thereby allowing the spring to move the chamber shaft forward, applying spring pressure to the brakes as parking 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

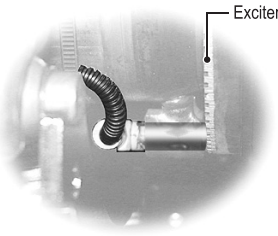
Reverse the removal procedure to install the front M-32QR modulator. Tighten the mounting bolts to 80–100 in. lbs. (9–13.5 Nm).

Removal & Installation, Rear

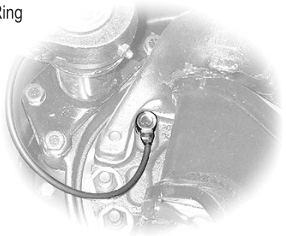
The rear M-32QR modulators are installed similar to the front modulators but mount on a frame crossemeber. See the section above on the R-12 valve for removal & installation procedure.

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.

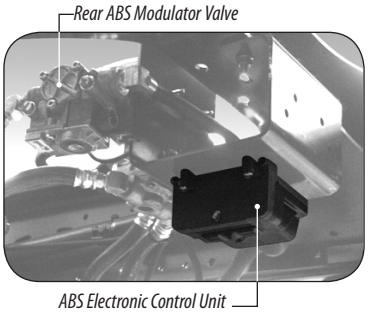
2. Gently push the sensor all the way into its mounting bore until it contacts the exciter ring. Do not strike the sensor to insert it.

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.

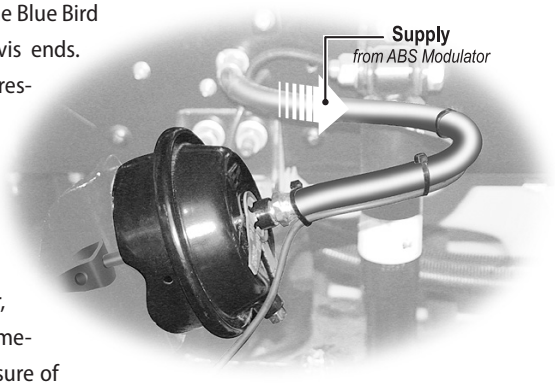
3. Remove the two mounting bolts. The EC-60 can now be removed.

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.***

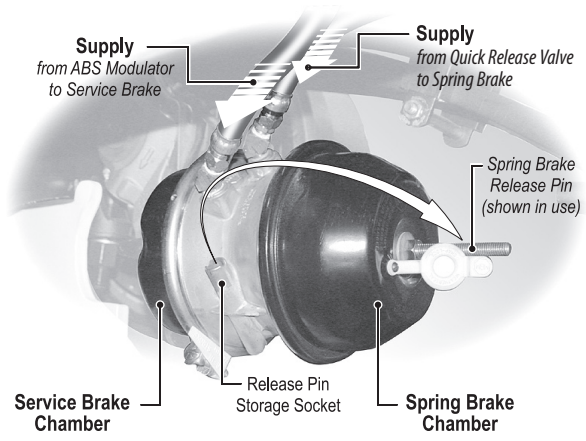
5. Remove the two self-locking nuts and flat washers which mount the brake chamber assembly to the axle bracket. The chamber can now be removed.

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.

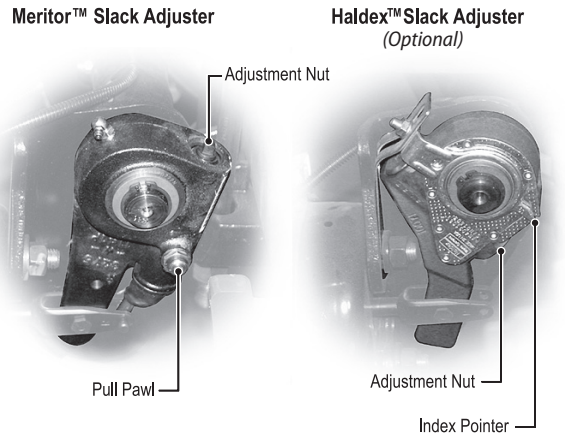
Installation

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.

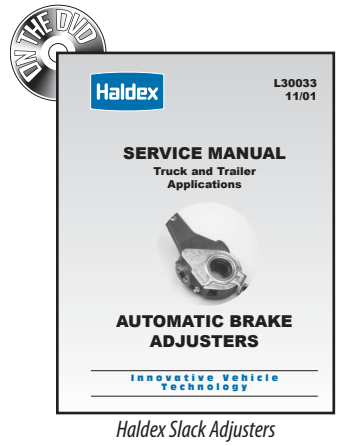


Meritor slack adjusters are standard on the Blue Bird All American. Haldex adjusters are on some units as an option. The two types perform the same function, but by somewhat different internal mechanisms.

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.

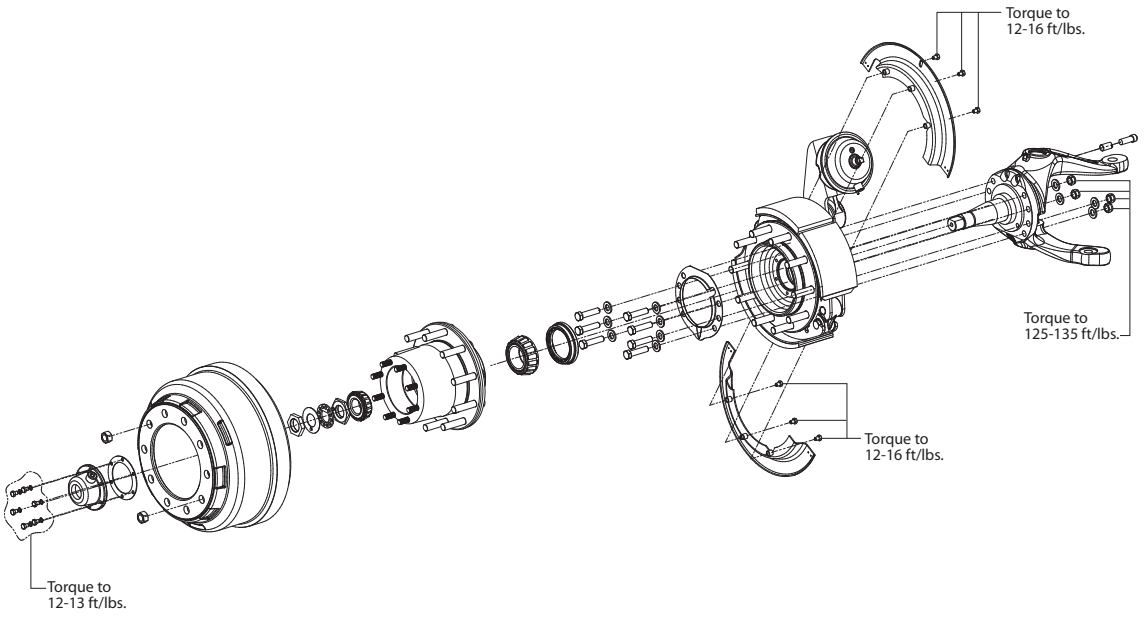
WARNING ***Do not re-use clevis pin retaining clips after removing them. Always replace used clevis pin retainer clips with new ones.***

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.

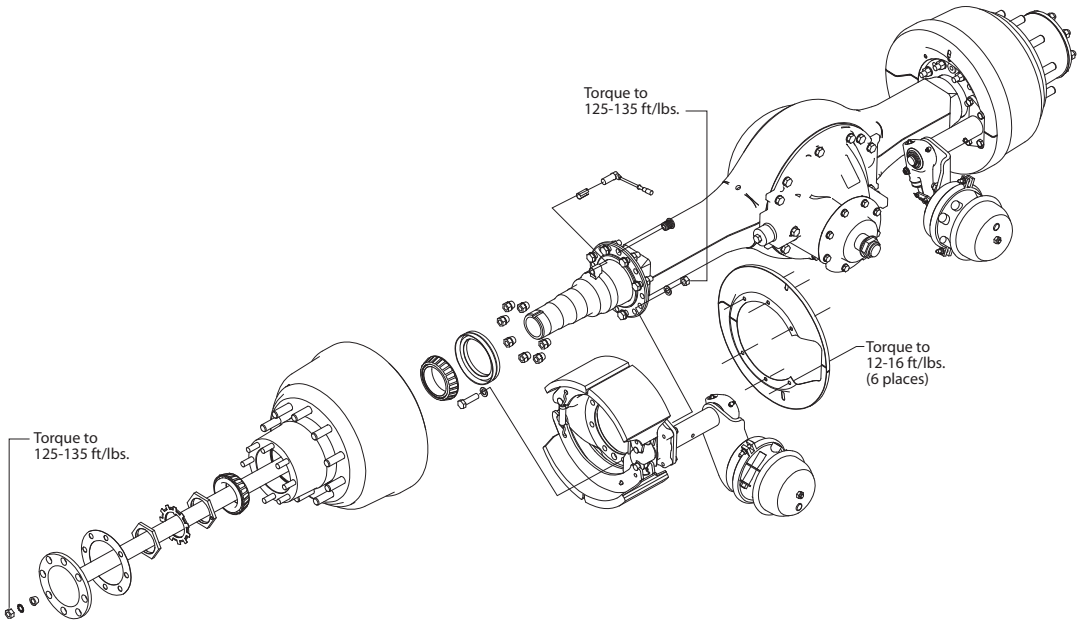
Installation

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.



0096722G

Air Brakes Wheel Ends, Front



0096704D

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.

4. 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).

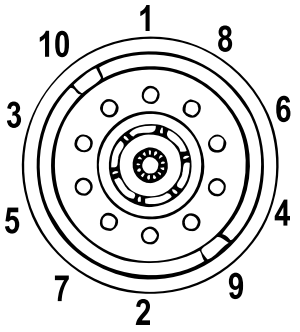
3. Remove the manual release tool from the spring brake chamber to engage the air spring. Reinstall the tool in its storage socket.

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

253

Bendix® AD-9® Air Dryer

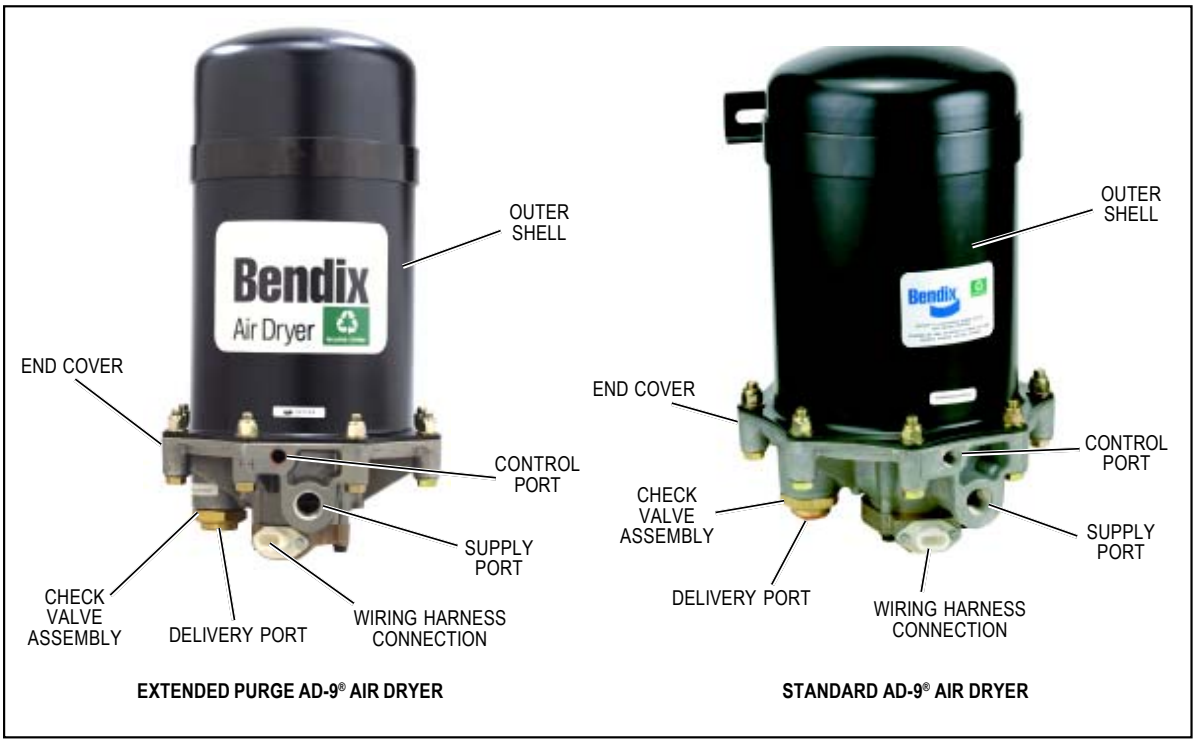


*FIGURE 1 - **AD-9® AIR DRYER MODELS***

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).

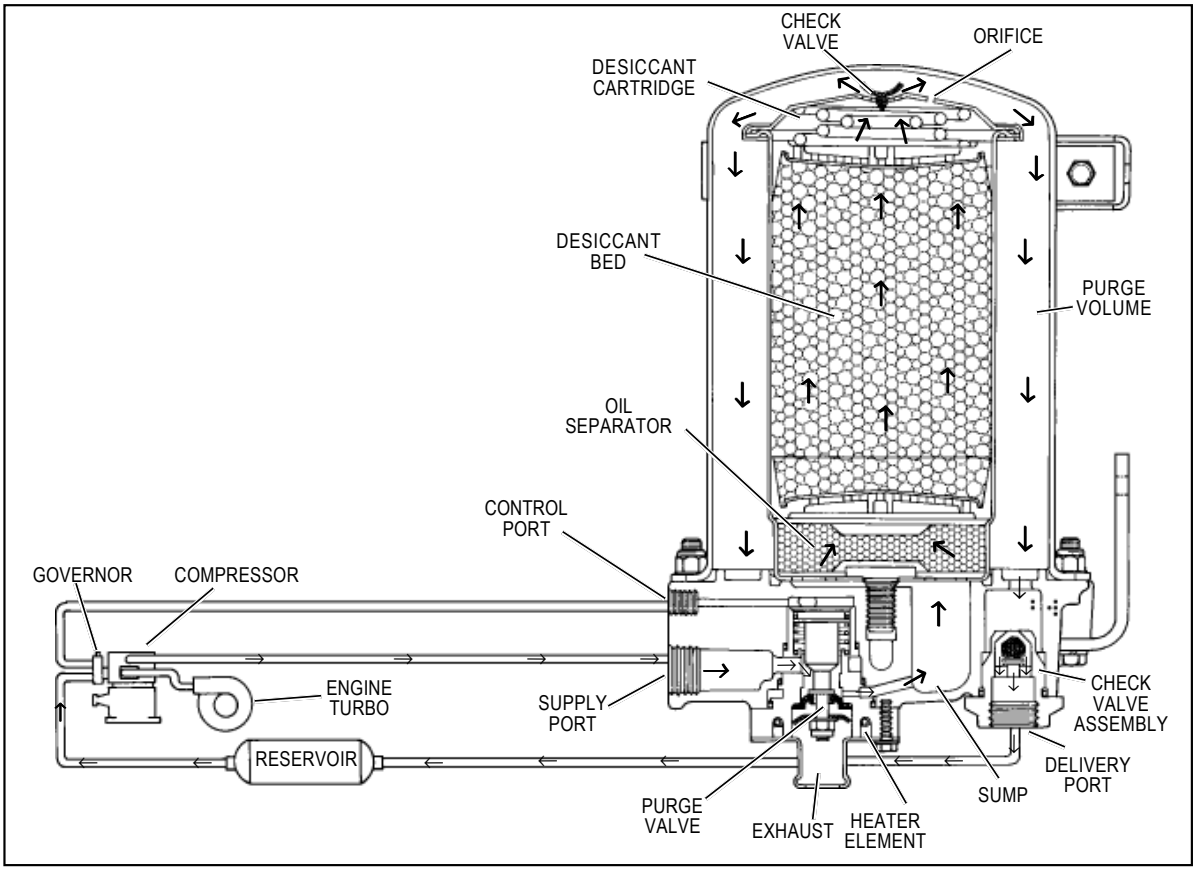


FIGURE 2 - ***AD-9® AIR DRYER CHARGE CYCLE***

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

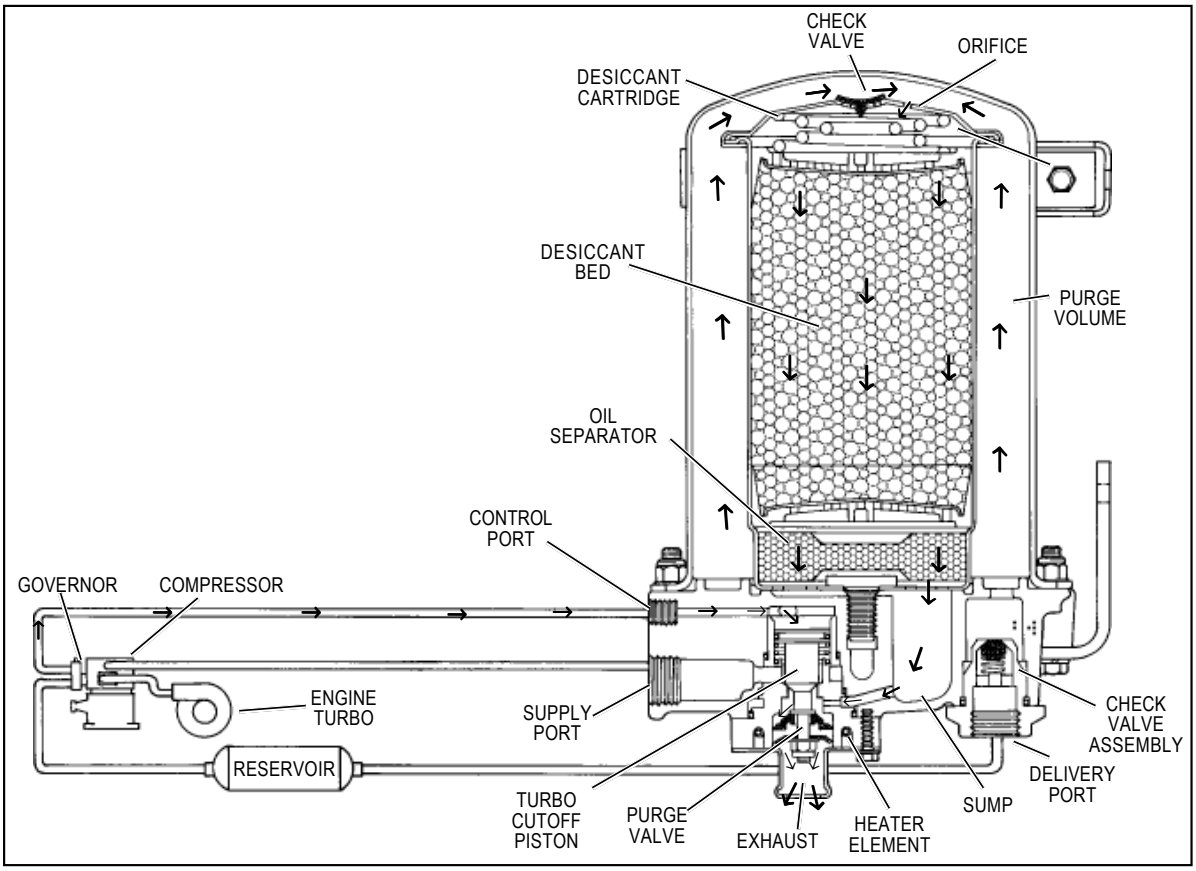


FIGURE 3 - ***AD-9® AIR DRYER PURGE CYCLE***

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.

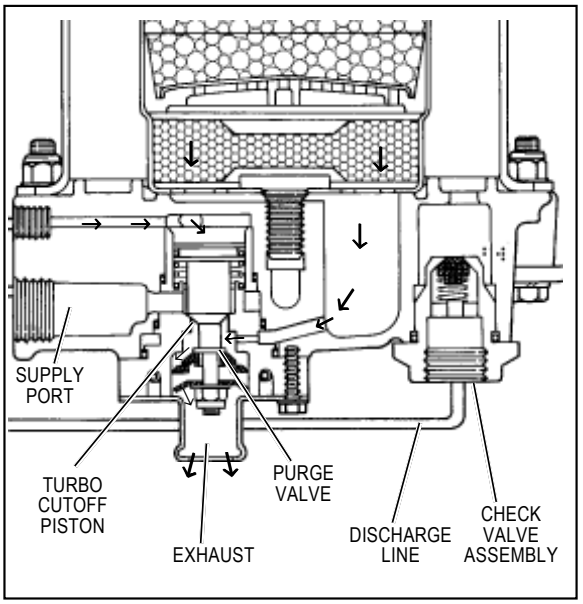


*FIGURE 4 - **AD-9® AIR DRYER TURBO CUTOFF***

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:

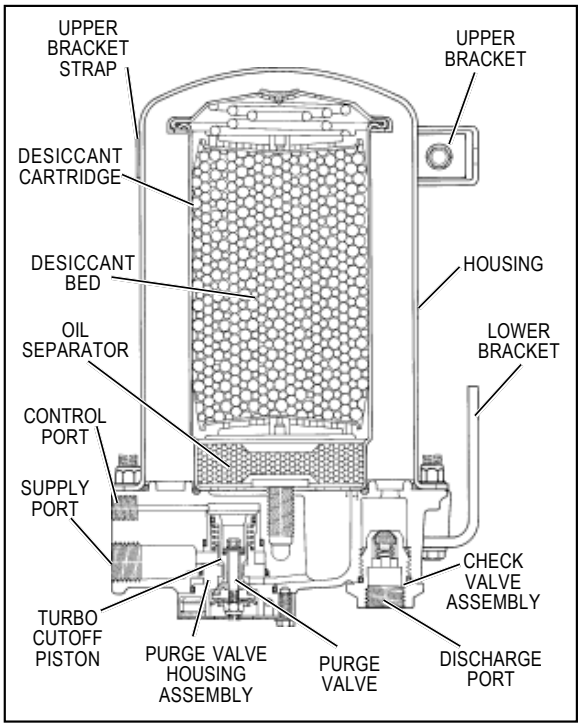


*FIGURE 5 - **AD-9® AIR DRYER SECTIONAL VIEW***

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.

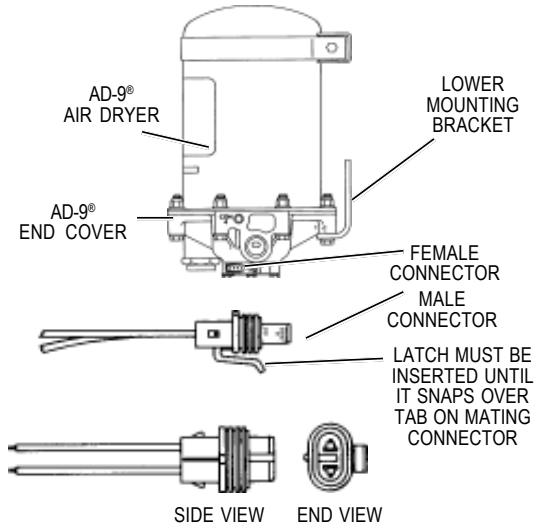
Note: The desiccant change interval may vary from vehicle to vehicle. Although typical desiccant cartridge life is three years, many will perform adequately for a longer period of time. In order to take maximum advantage of desiccant life and assure that replacement occurs only when necessary, it is 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

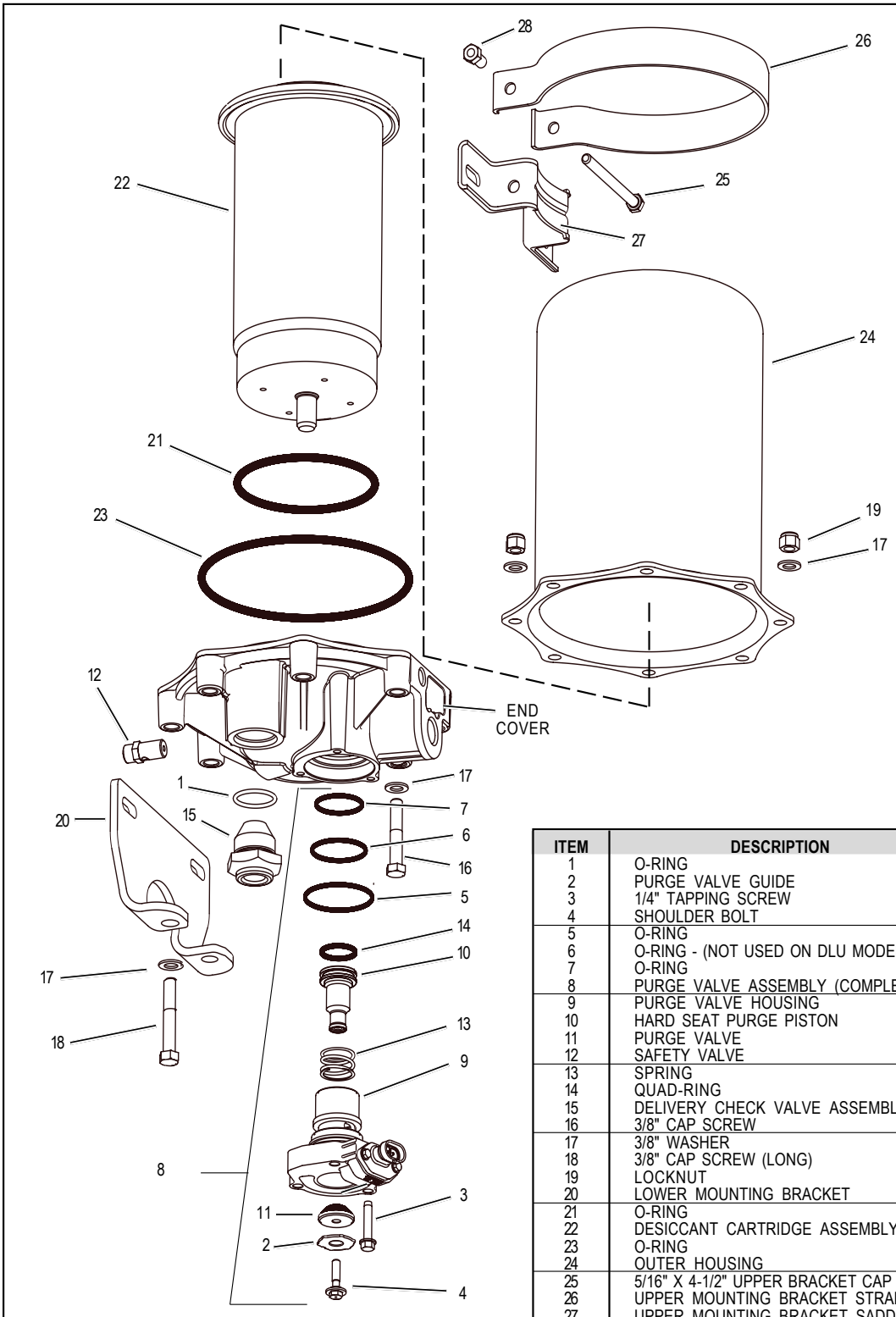
This kit contains the upper and lower brackets as well as the necessary hardware items to mount them.

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.

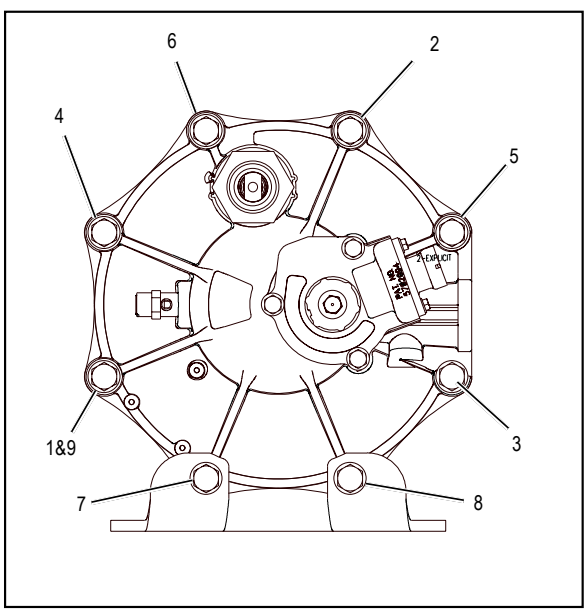


FIGURE 8 - ***END COVER TO HOUSING TORQUE PATTERN***

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).

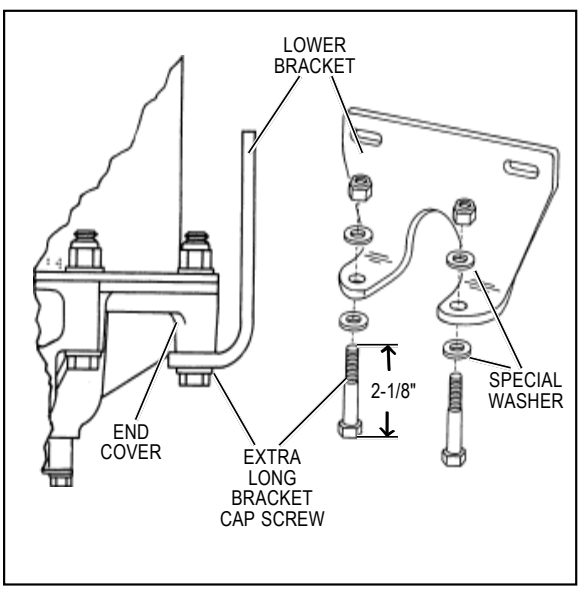


FIGURE 9 - ***LOWER BRACKET INSTALLATION***

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

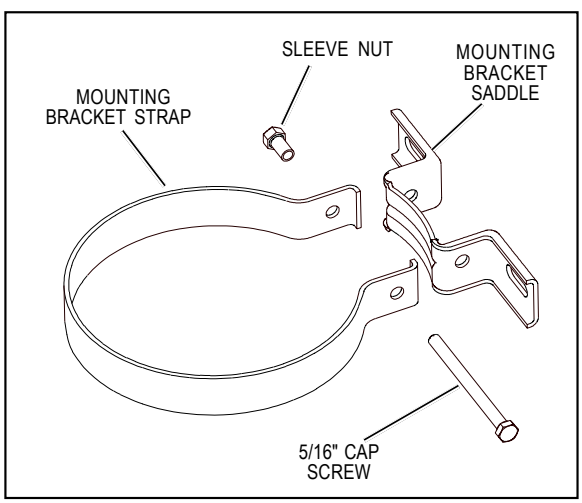


FIGURE 10 - ***UPPER MOUNTING BRACKET AND STRAP***

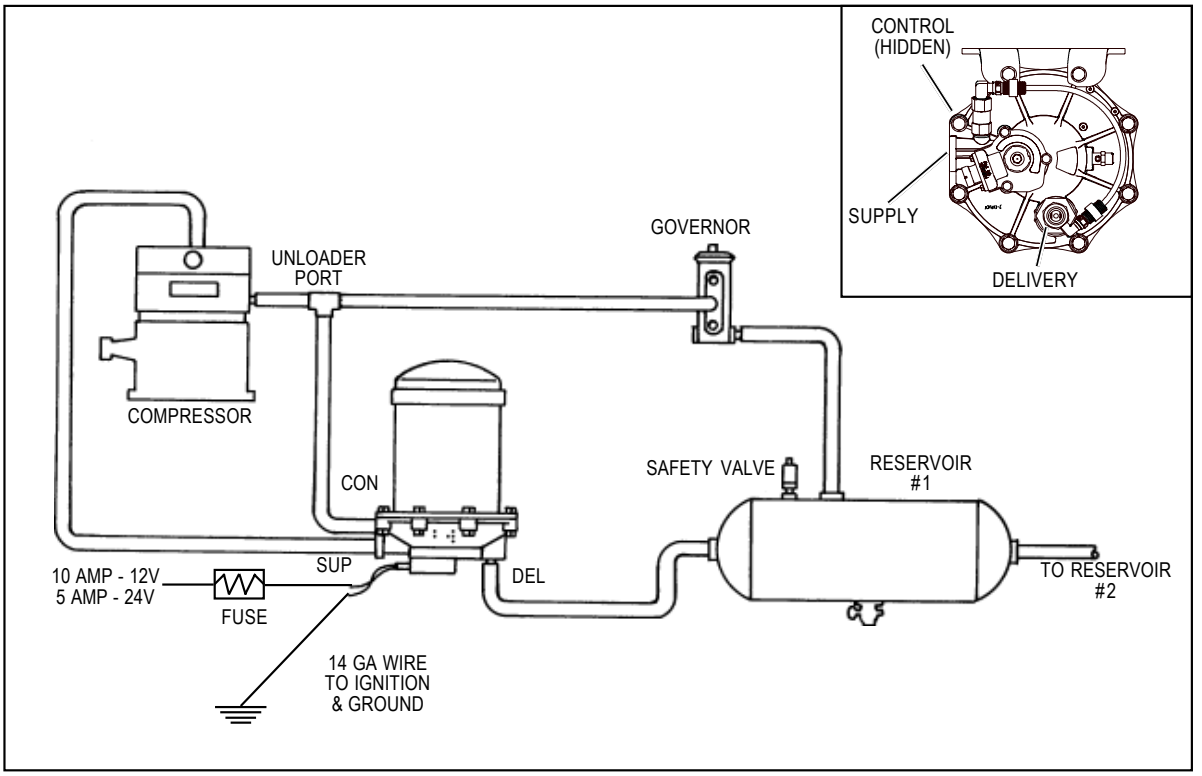


*FIGURE 11 - **AD-9® AIR DRYER CHARGE CYCLE***

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

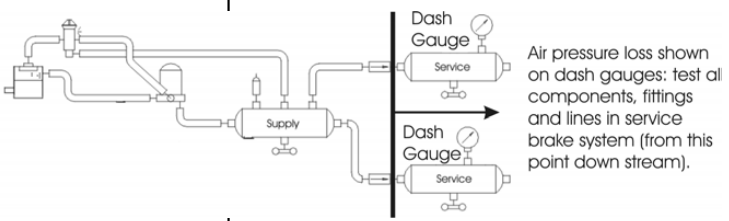
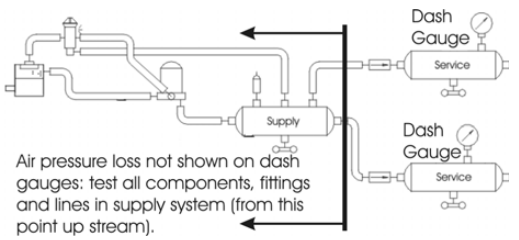
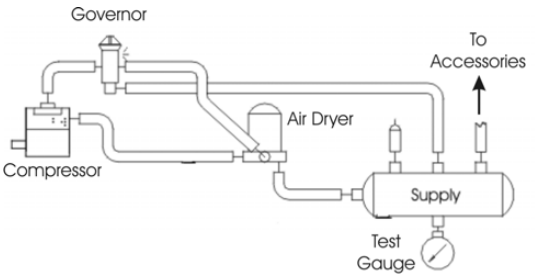
1. Determine the vehicle's electrical system voltage and make certain that the AD-9® air dryer that is to be installed contains the same voltage heater. Use the AD-9® air dryer part number to confirm the proper voltage. The AD-9® air dryer is available with either a 12 or 24 volt heater which uses 75 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.

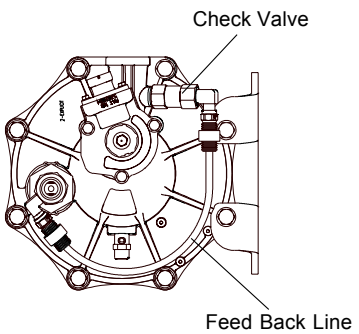
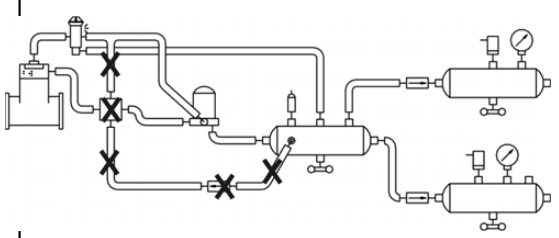
AD-9® AIR DRYER TROUBLESHOOTING CHART

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. 

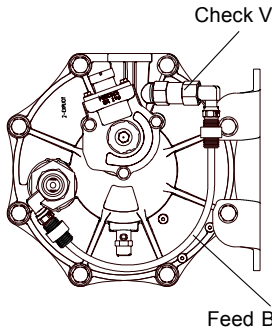
AD-9® AIR DRYER TROUBLESHOOTING CHART

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.

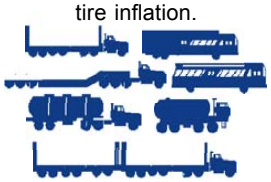
AD-9® AIR DRYER TROUBLESHOOTING CHART (Continued)

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							
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	*For the BASIC Test Kit: Order Bendix P/N 5013711*
			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		BASIC test acceptable range: 5 oil units per month. See appendix A.
			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).

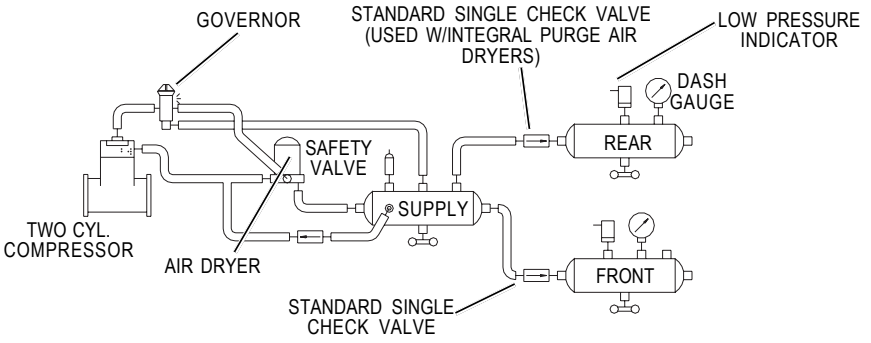
For Bendix® Tu-Flo® 550 and 750 compressors, unloader service is recommended every 250,000 miles.

Appendix B

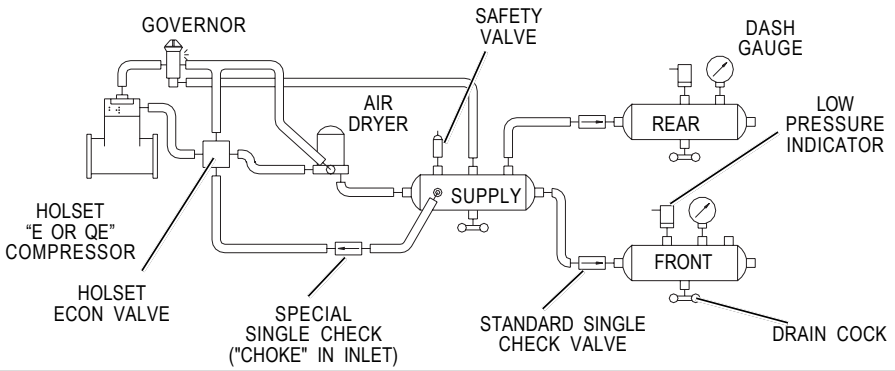
Additional Troubleshooting Information

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.

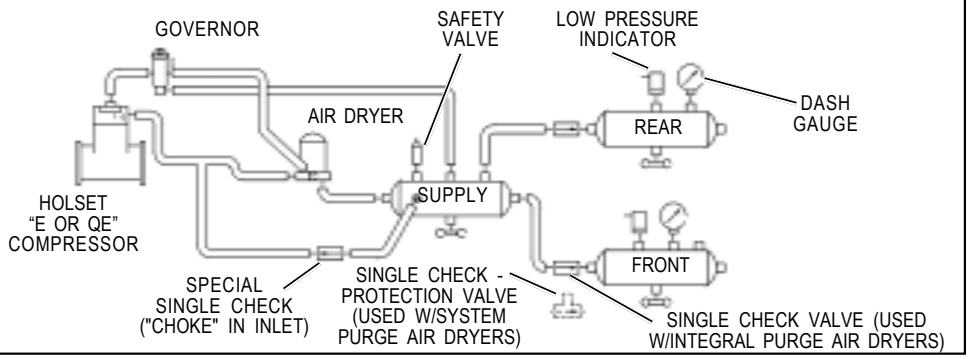
CONVENTIONAL SUPPLY SYSTEM & INTEGRAL PURGE AIR DRYER



HOLSET TYPE "E & QE" COMPRESSOR WITH ECON VALVE



HOLSET TYPE "E & QE" COMPRESSOR W/O ECON VALVE



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Bendix® Service Data

SD-03-3619

Bendix® PP-DC™ Park Control Valve

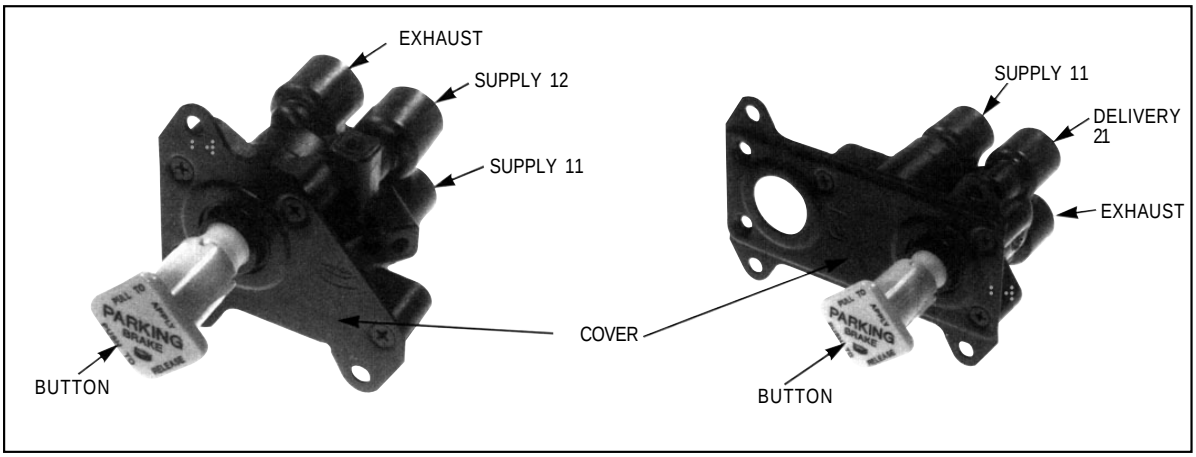


FIGURE 1 - PP-DC™ PARK CONTROL VALVE

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.

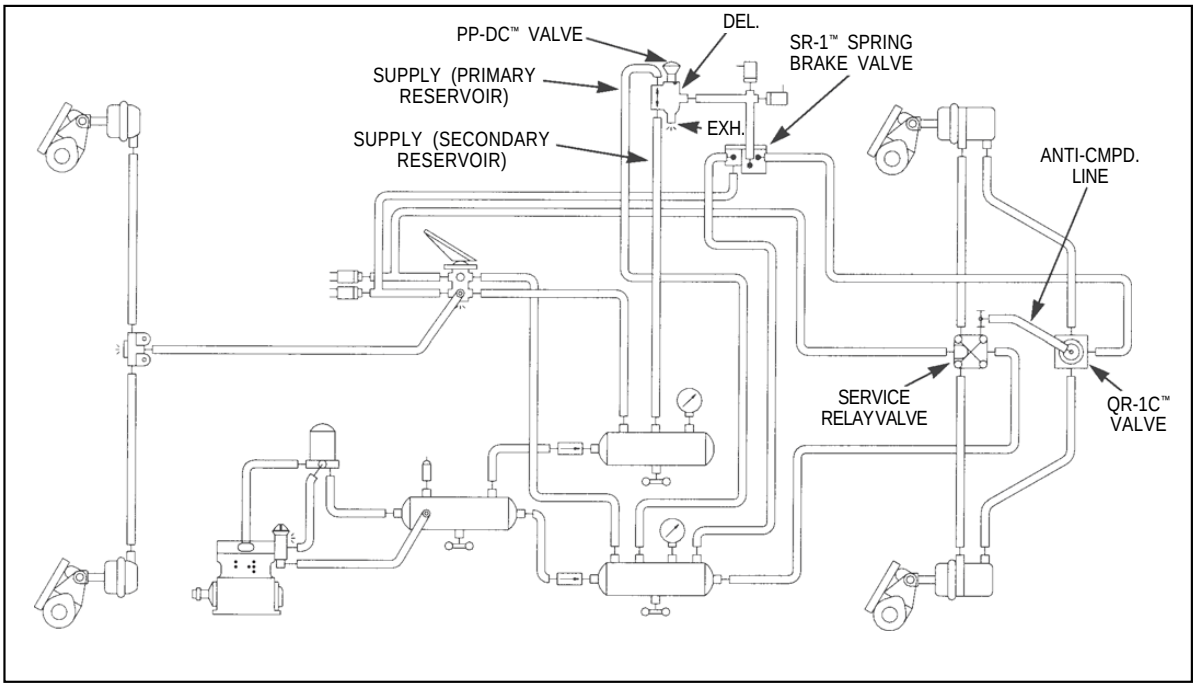


FIGURE 2 - TYPICAL 4 X 2 TRUCK SCHEMATIC WITH PP-DC™ PARK CONTROL VALVE

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.**

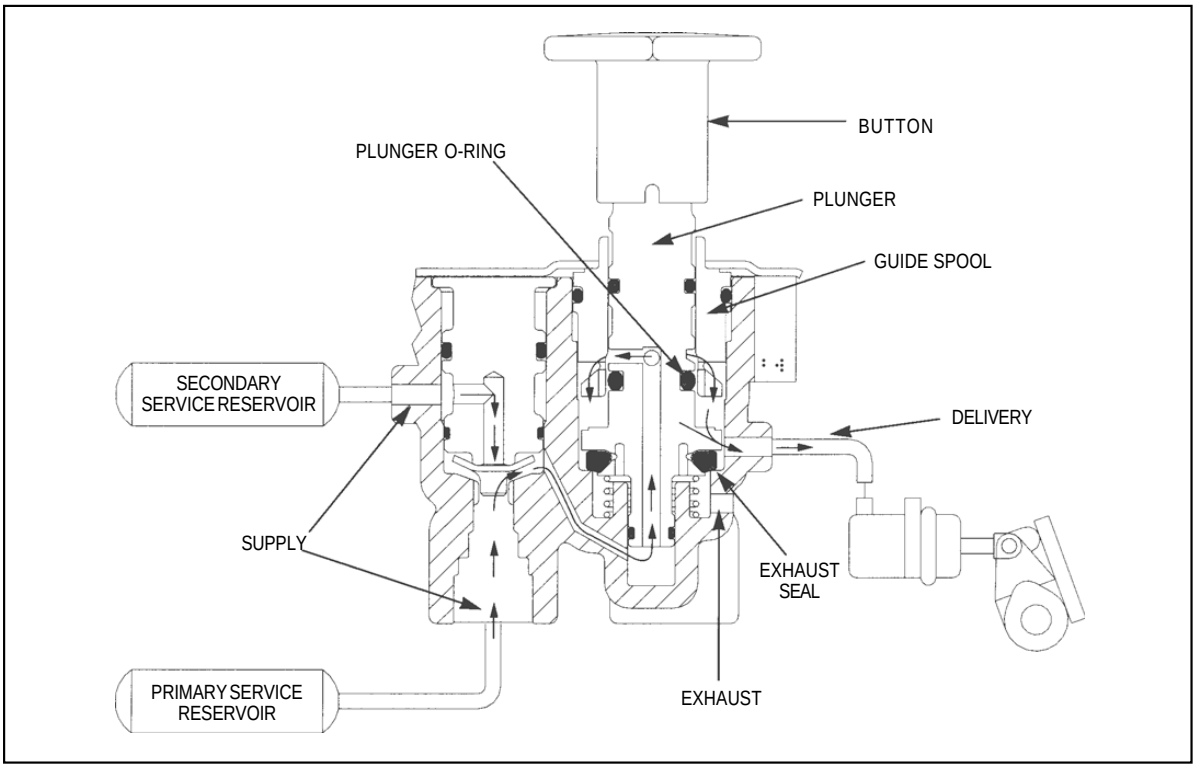


FIGURE 3 - SPRING BRAKES RELEASED (PRIMARY RESERVOIR SUPPLY)

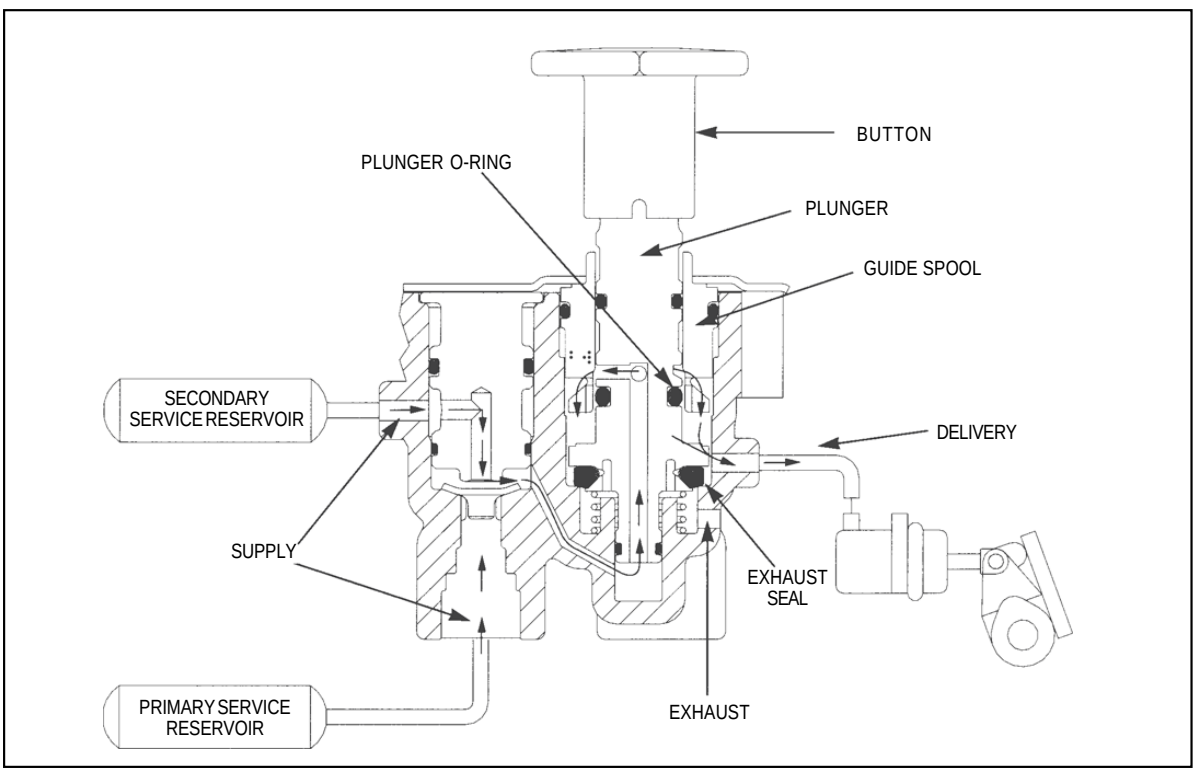


FIGURE 4 - SPRING BRAKES RELEASED (SECONDARY RESERVOIR SUPPLY)

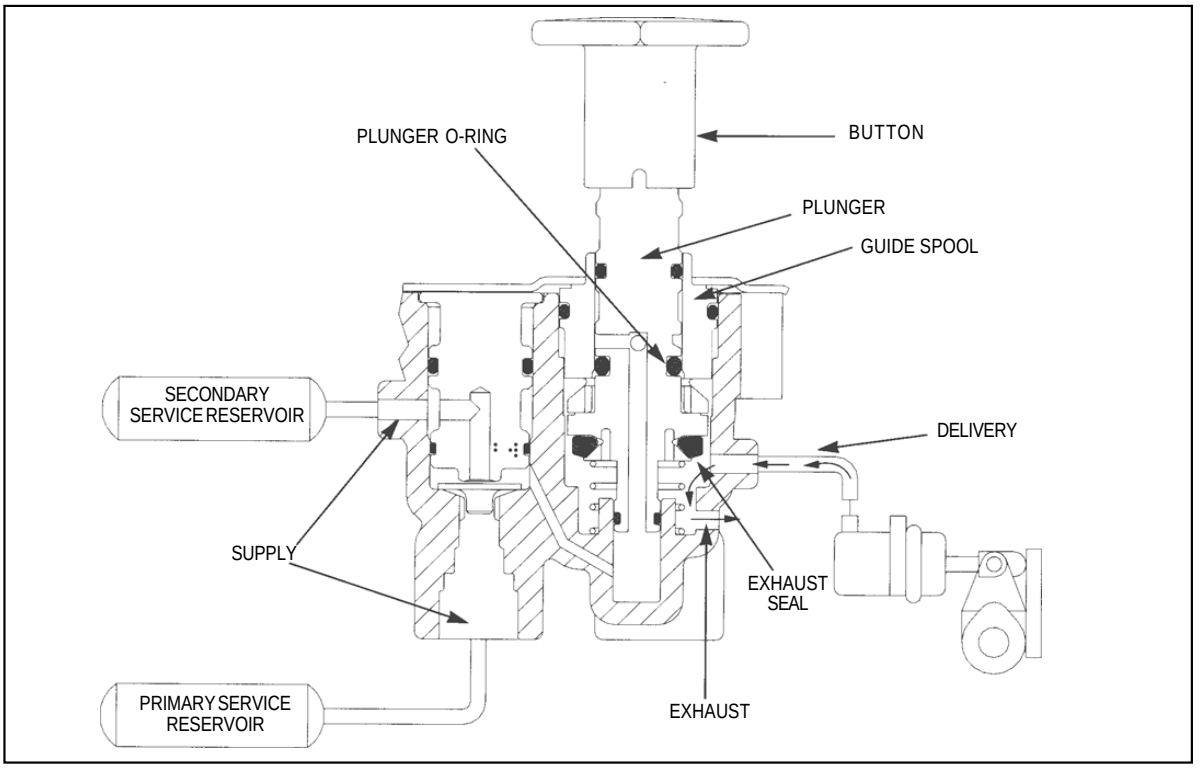


FIGURE 5 - PARKING BRAKES APPLIED

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.

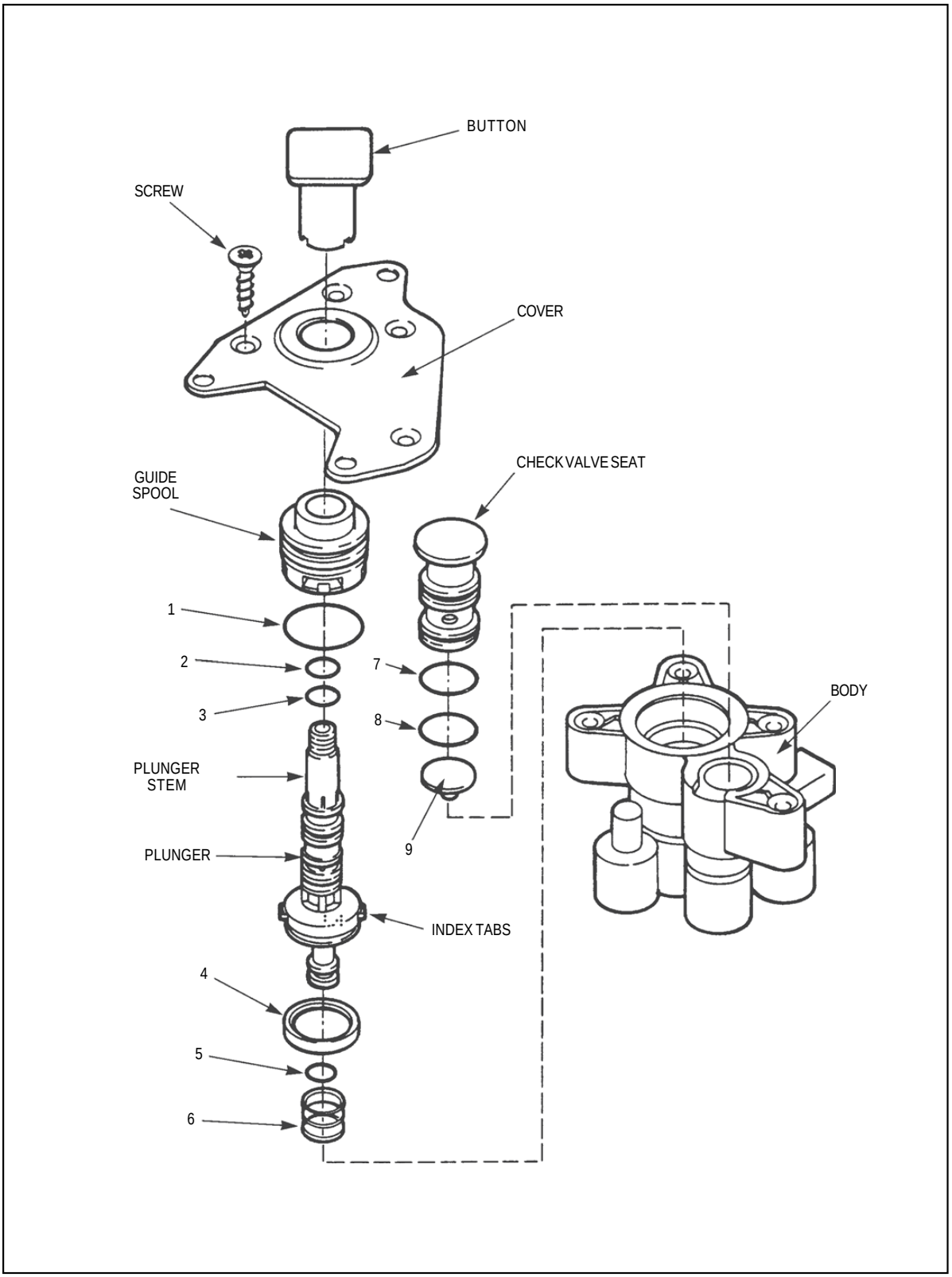


FIGURE 6 - EXPLODED VIEW

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.

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Bendix® Service Data

SD-03-9043

SR-7 SPRING BRAKE MODULATING VALVE

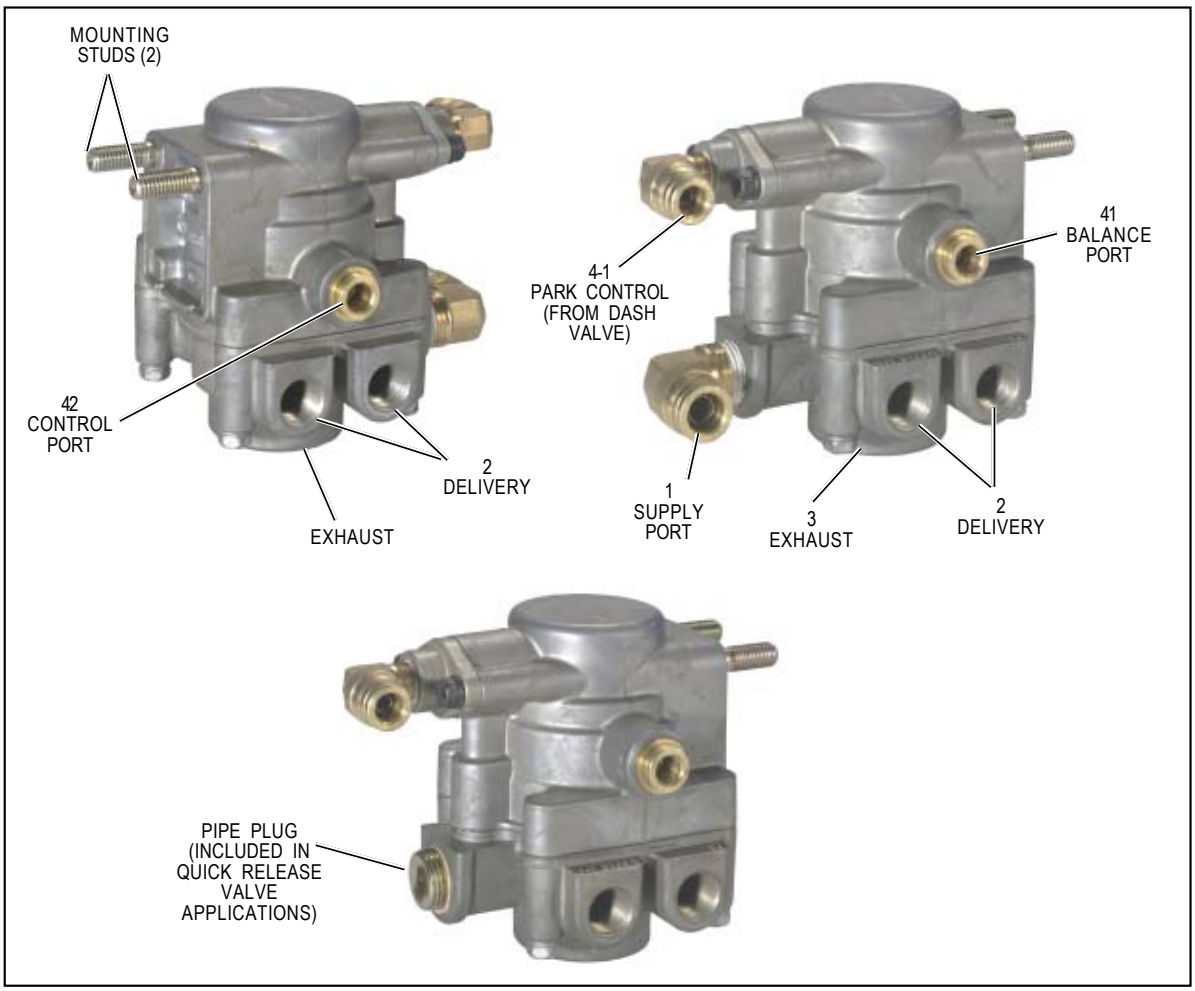


FIGURE 1 - EXTERIOR VIEW

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).

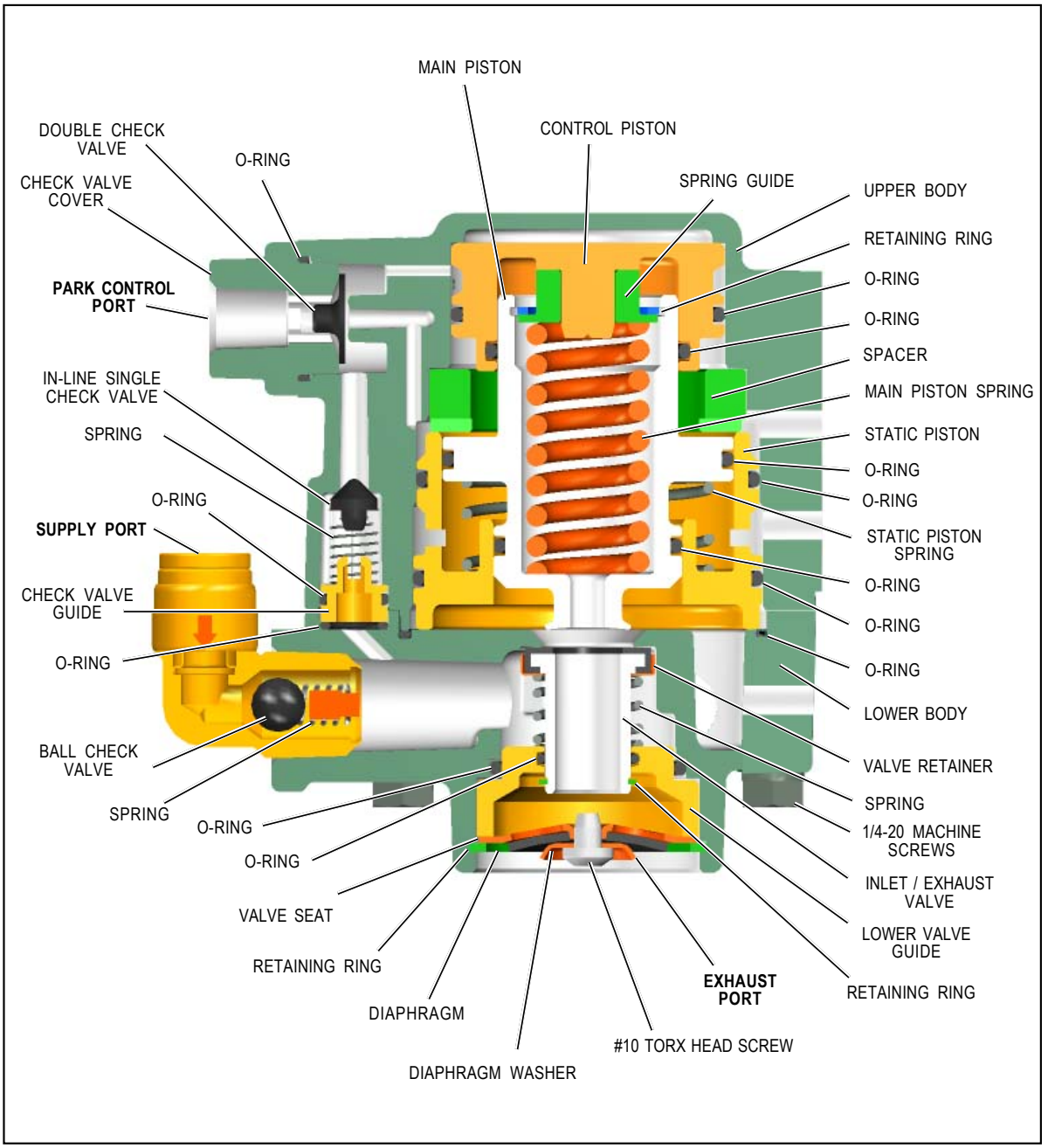


FIGURE 2 - SECTIONAL VIEW OF SR-7 USED IN RELAY VALVE APPLICATIONS

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.

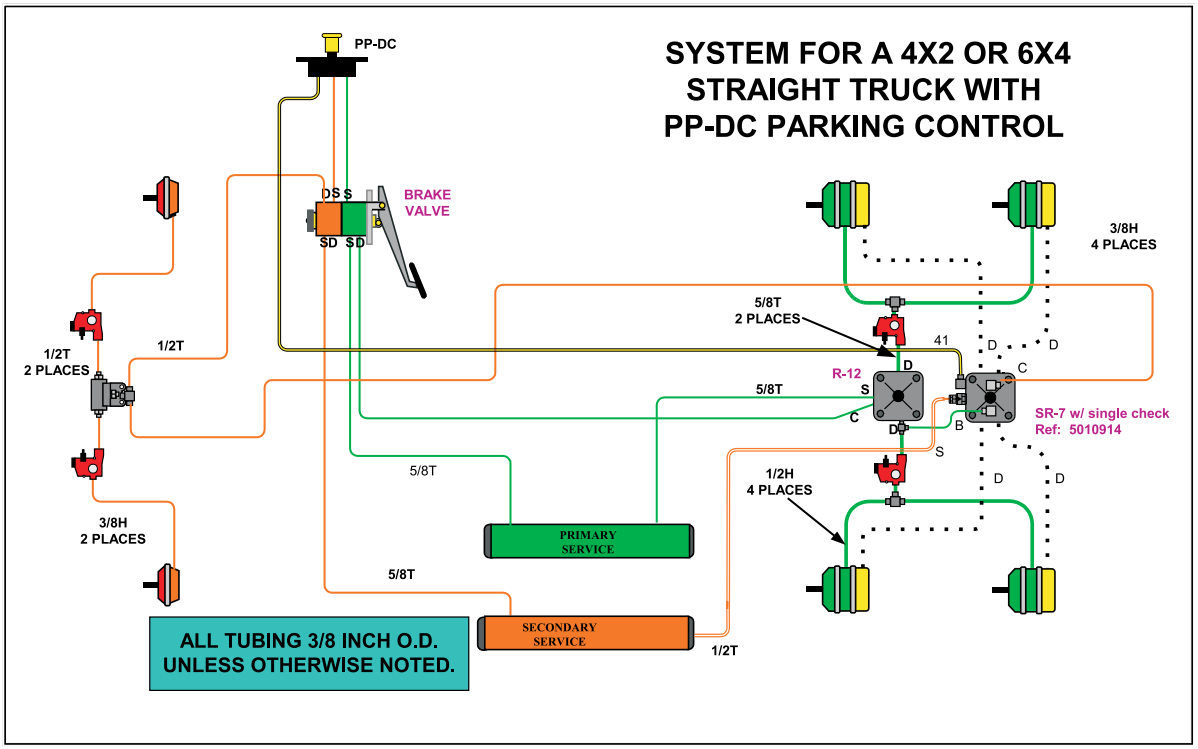


FIGURE 3 - SYSTEM SCHEMATIC WITH PP-DC PARK CONTROL

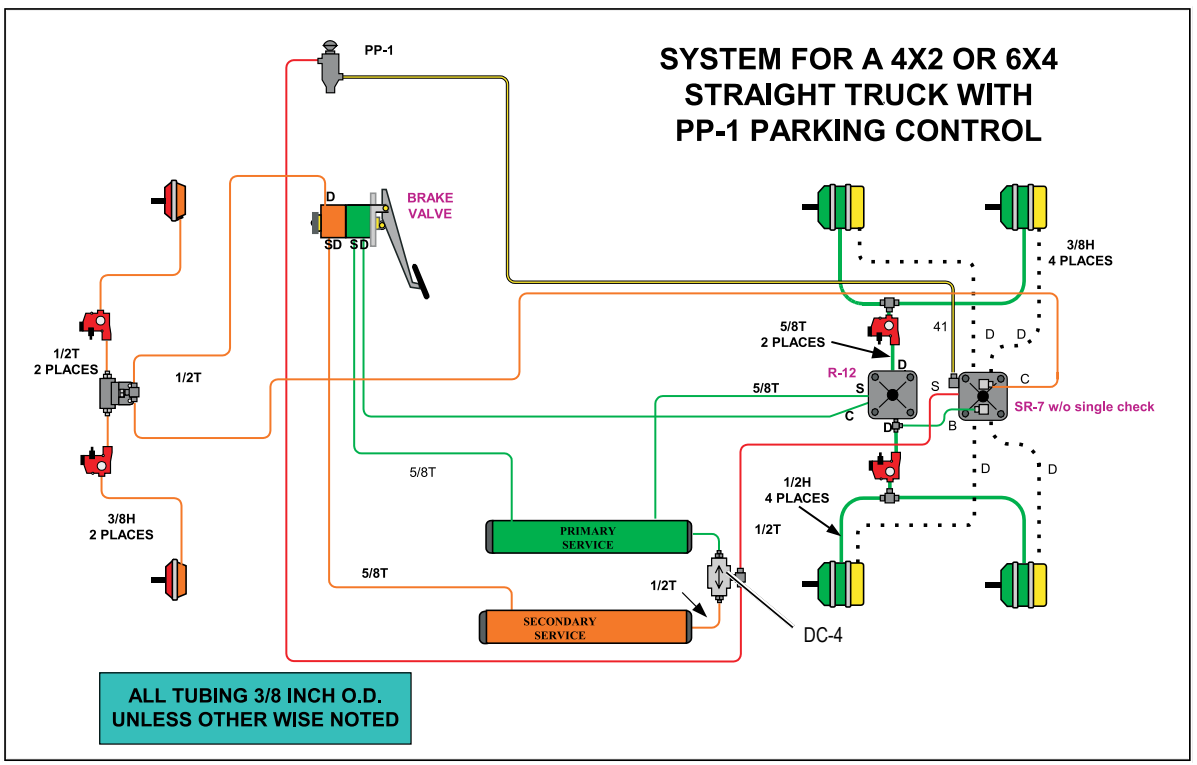


FIGURE 4 - SYSTEM SCHEMATIC WITH PP-1 PARK CONTROL AND DC-4 DOUBLE CHECK VALVE

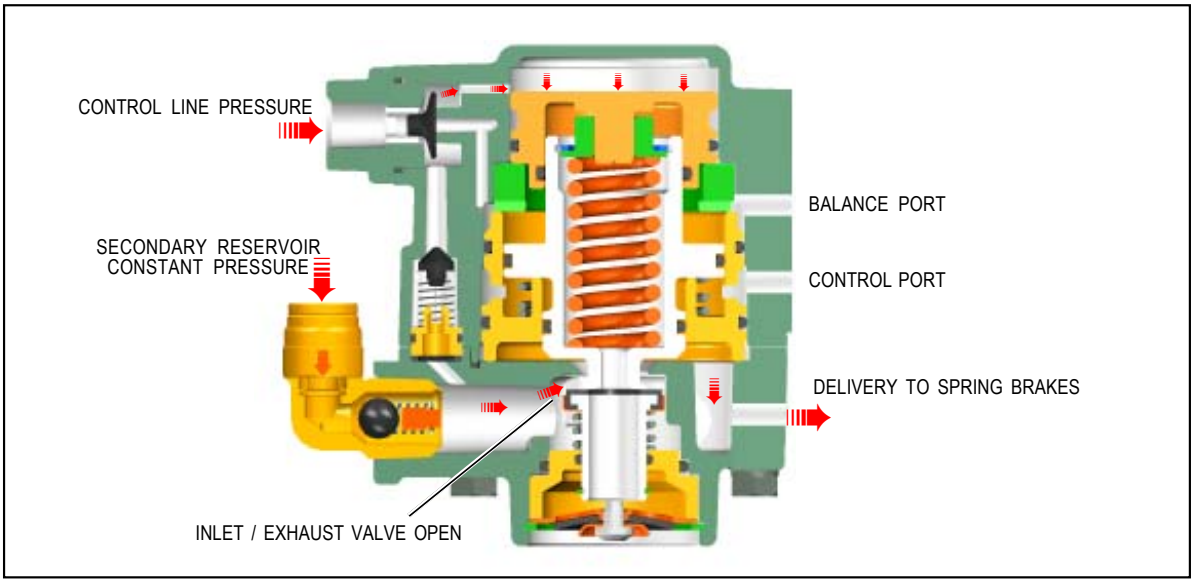


FIGURE 5 - CHARGING LESS THAN 107 PSI

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).

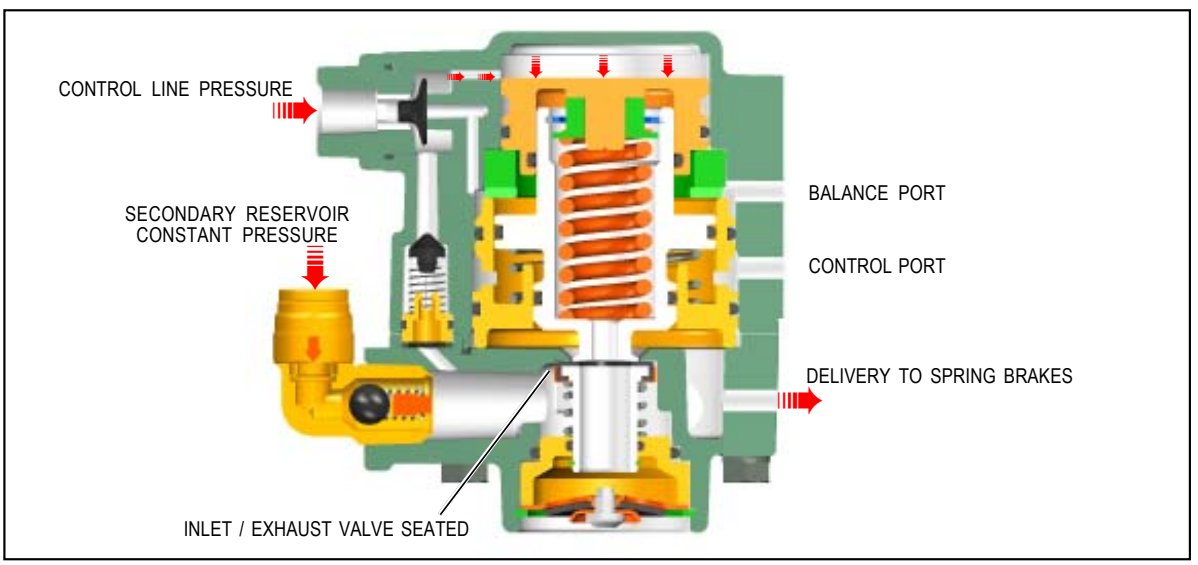


FIGURE 6 - CHARGING GREATER THAN 107 PSI

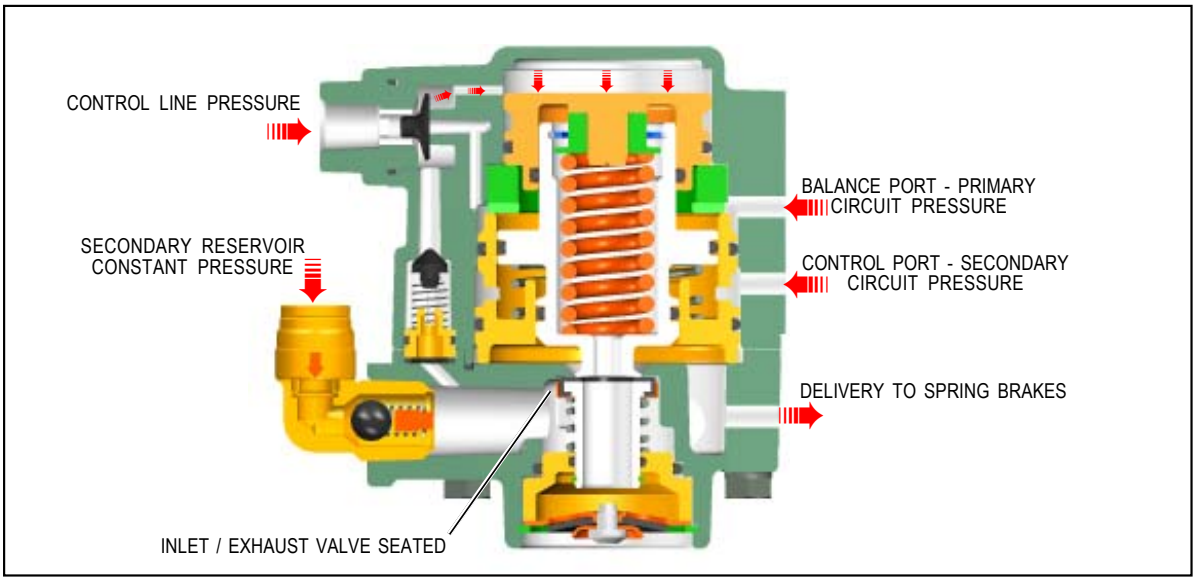


FIGURE 7 - NORMAL SERVICE APPLICATION

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.

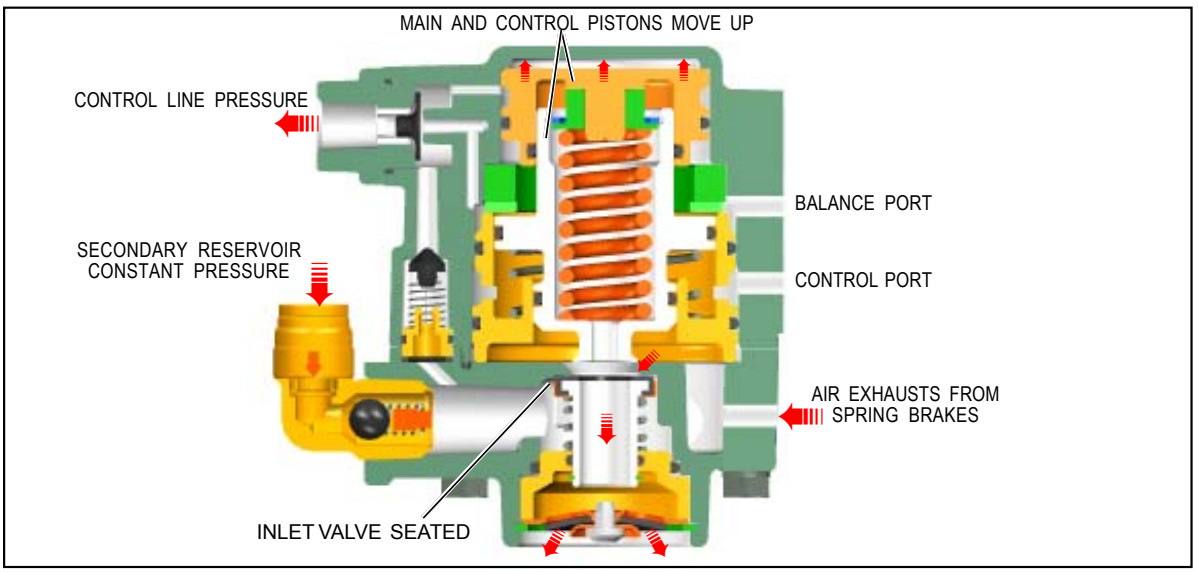


FIGURE 8 - PARKING

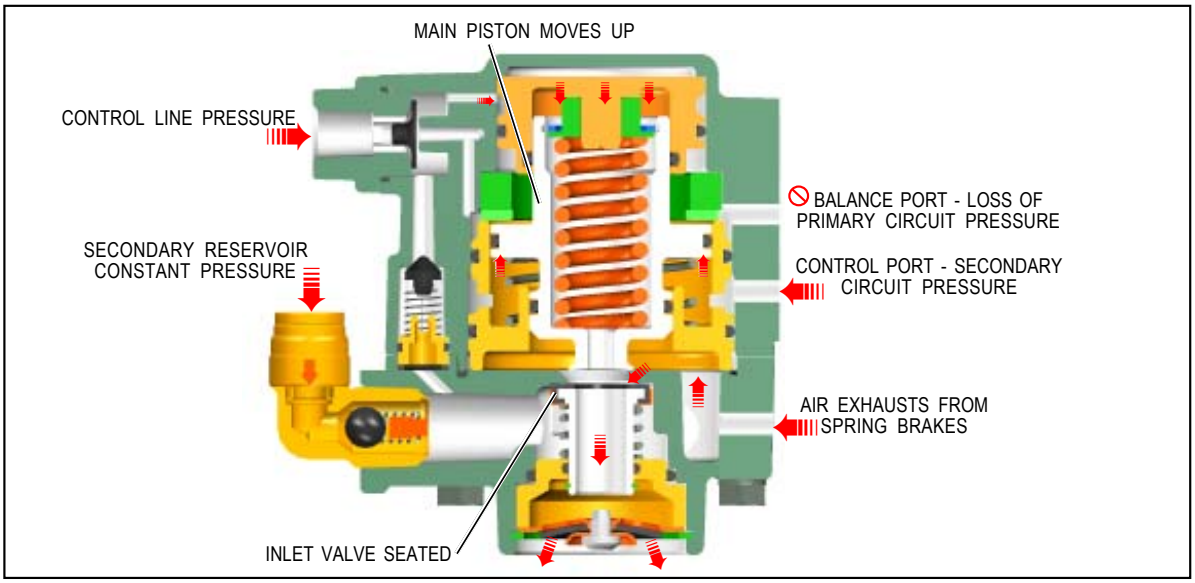


FIGURE 9 - SERVICE APPLICATION LOSS OF PRIMARY CIRCUIT

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.

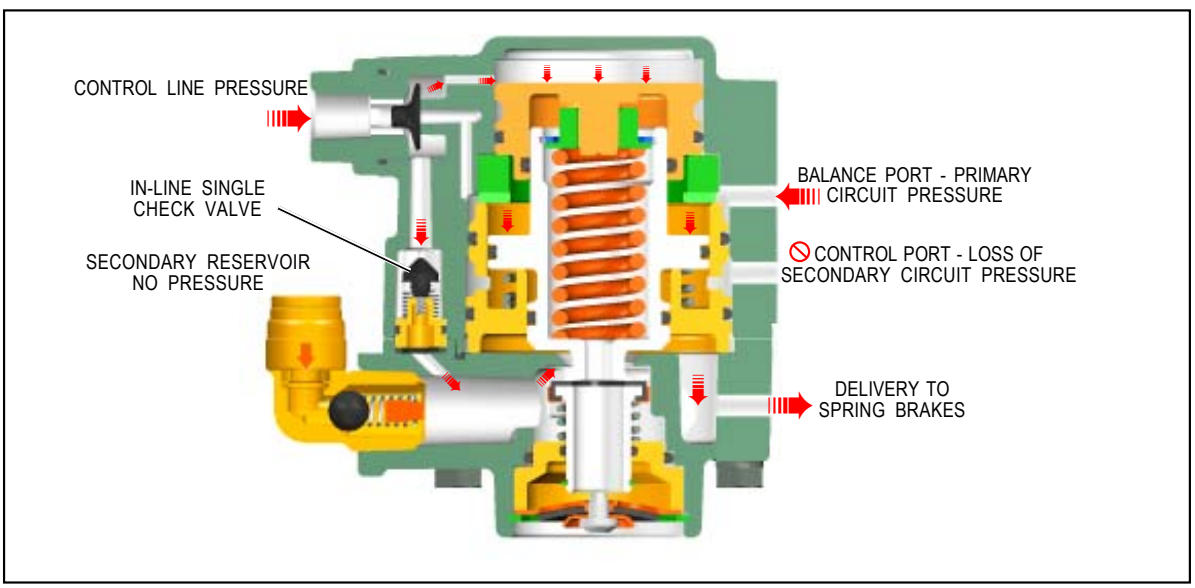


FIGURE 10 - SERVICE APPLICATION LOSS OF SECONDARY CIRCUIT

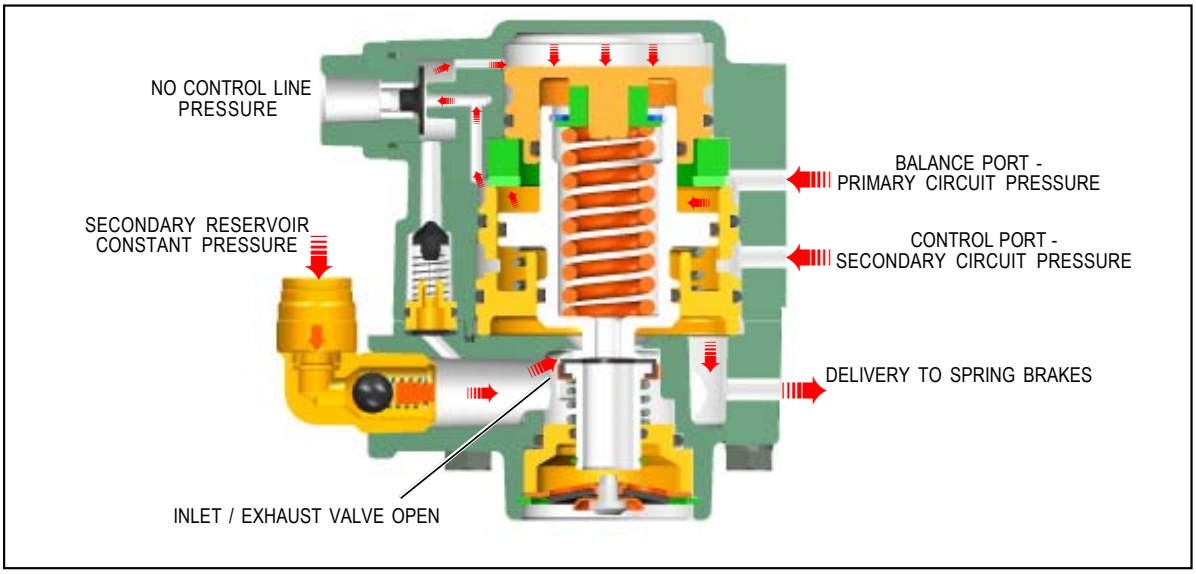


FIGURE 11 - ANTI-COMPOUNDING

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.

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Bendix

Service Data

SD-13-4863

291

Bendix® EC-60™ ABS / ATC Controllers (Standard & Premium Models)

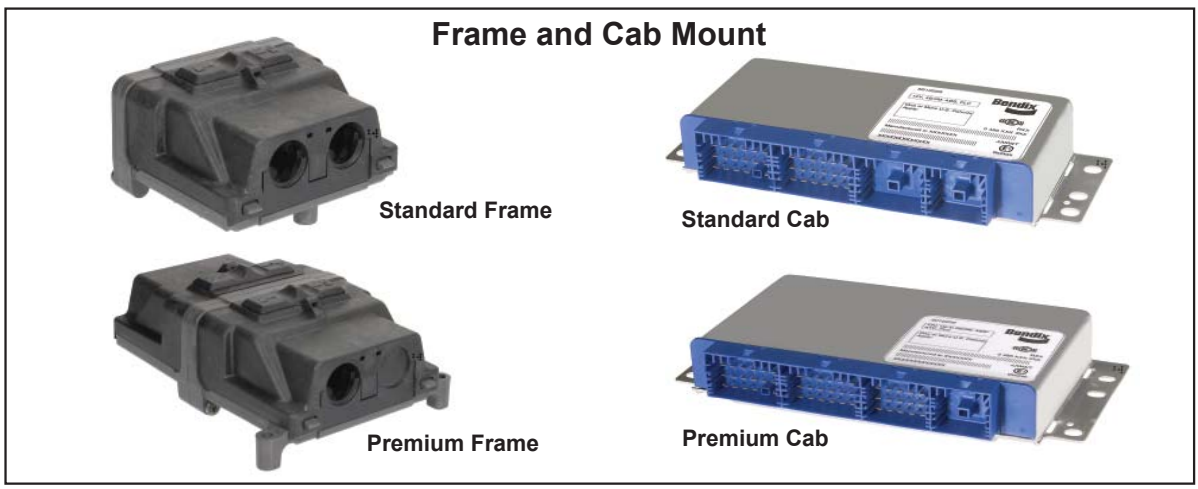


FIGURE 1 - EC-60™ CONTROLLERS

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.

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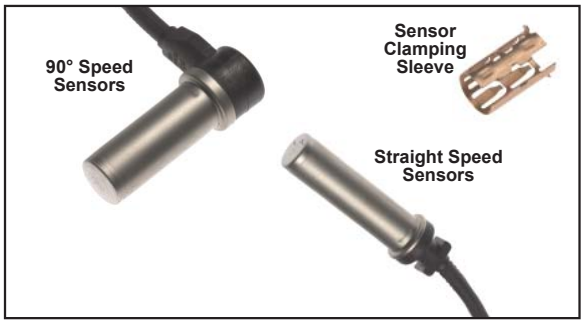


FIGURE 2 - BENDIX® WS-24™ WHEEL SPEED SENSORS

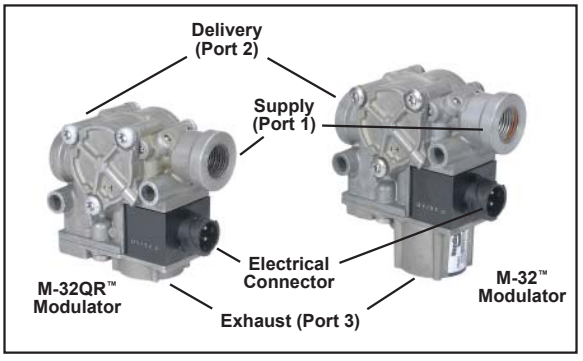


FIGURE 3 - M-32™ AND M-32QR™ MODULATORS

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

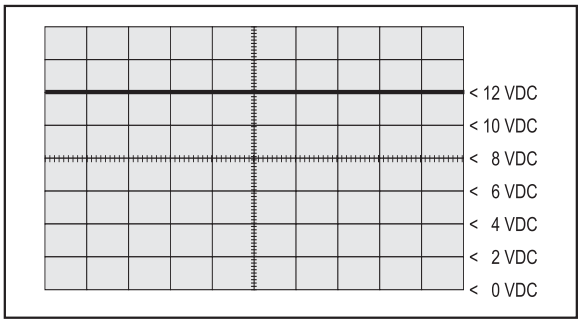


FIGURE 4 - POWER LINE WITHOUT PLC SIGNAL

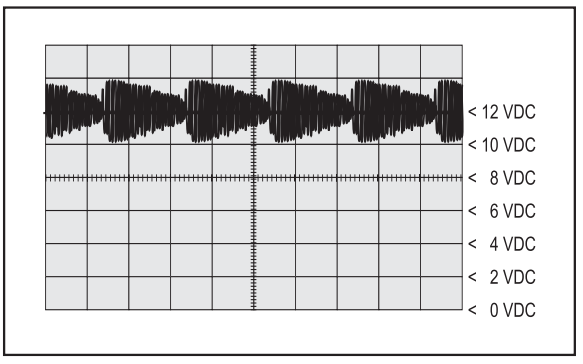


FIGURE 5 - POWER LINE WITH PLC SIGNAL

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.

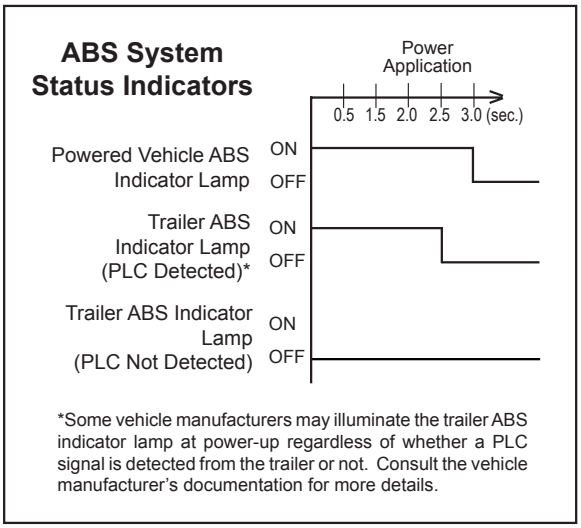


FIGURE 6 - ABS DASH LAMP START UP SEQUENCE

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.

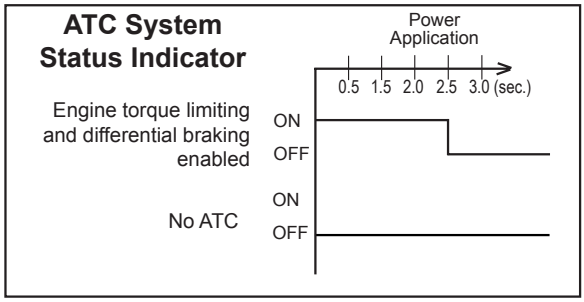


FIGURE 7 - ATC INDICATOR LAMP START UP SEQUENCE

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.

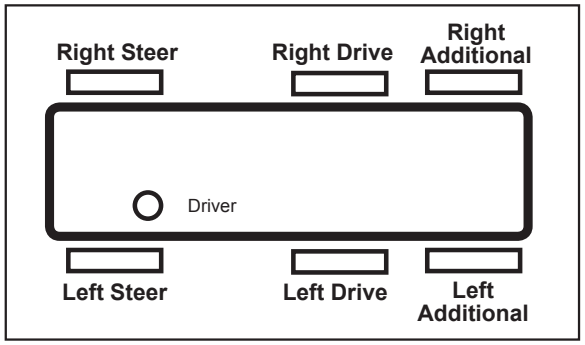


FIGURE 8 - VEHICLE ORIENTATION (TYPICAL)

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

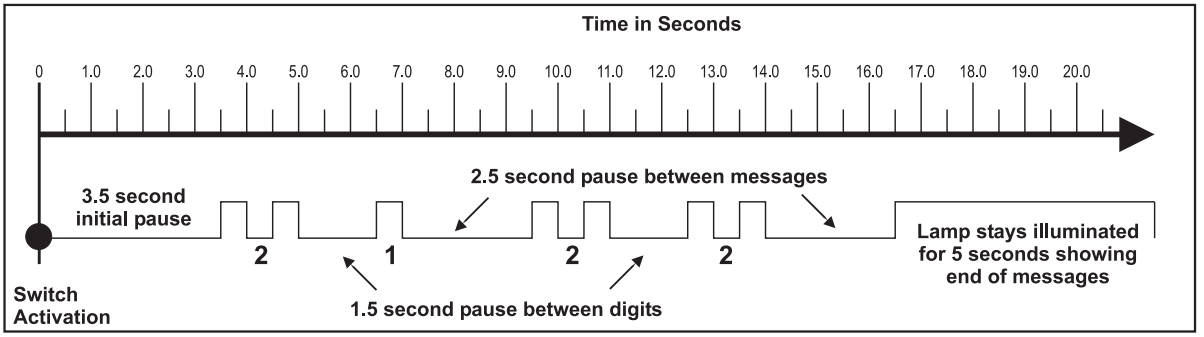


FIGURE 10 - EXAMPLE OF BLINK CODE MESSAGE

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.

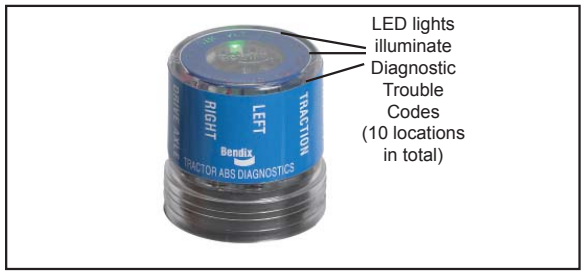


FIGURE 11 - *THE BENDIX® REMOTE DIAGNOSTIC UNIT*

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:

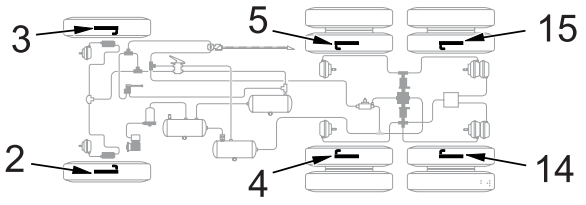
3, 2 12, 4

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.

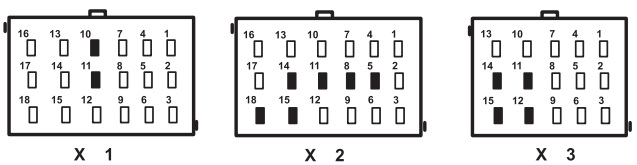
Speed Sensor Repair Tests:

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.

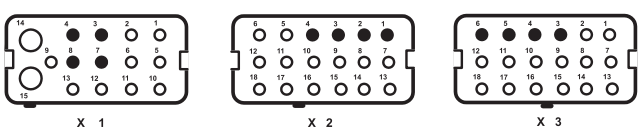
3. Clear DTC after issue is corrected. The sensor DTC will remain until the power is cycled to the ABS ECU and vehicle is driven above 15 MPH or DTC was cleared using either the diagnostic blink code switch or diagnostic tool.

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 (-)

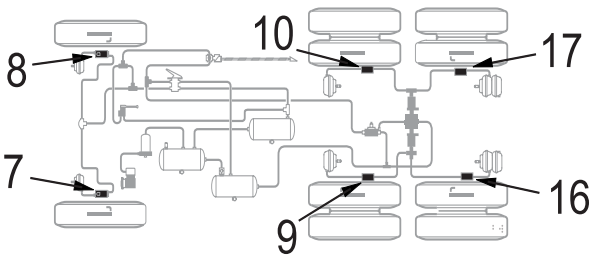
Frame-mount ECU: Looking into wire harness connector



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.

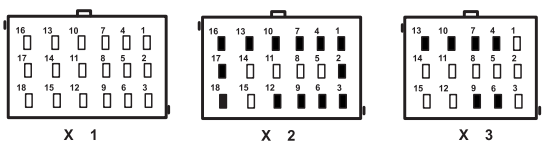
Pressure Modulator Valve Repair Tests:

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)

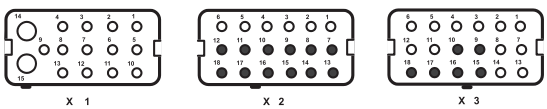
Caution: When troubleshooting modulator trouble codes, check inactive trouble codes and event history for over-voltage or excessive noise trouble codes. If one of these is found, troubleshoot these trouble codes first before the PMV.

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

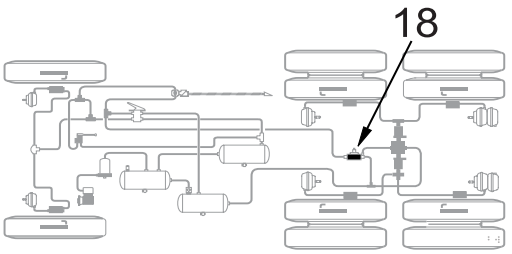
Frame-mount ECU: Looking into wire harness connector



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.

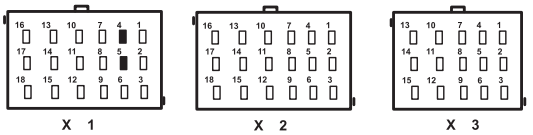
Traction Control Valve Repair Tests:

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:

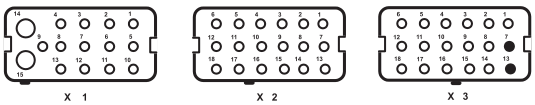
Looking into wire harness connector



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

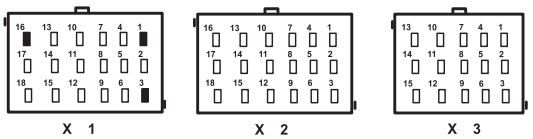
1st. Blink Code	Location
6	Power Supply

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:

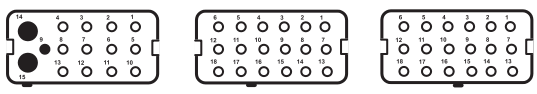
1. Take all measurements at ECU harness connector.
2. Place a load (e.g. an 1157 stop lamp) across battery or ignition and ground connection, measure ignition and battery voltage with the load. Ignition to Ground should measure between 9 to 17 VDC. Battery to Ground should also measure between 9 to 17 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

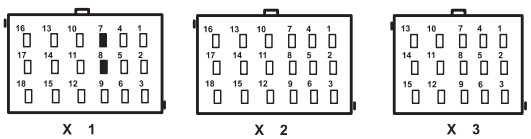
2nd. Blink Code	Diagnostic Trouble Code Description	Repair Information
1	J1939 Serial Link	Loss of communications between the EC-60™ controller and other devices connected to the J1939 link. Check for damaged or reversed J1939 wiring. Check for corroded or damaged connectors. Verify ECU Configuration. 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:

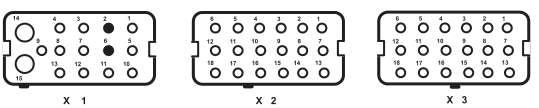
Looking into wire harness connector



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.

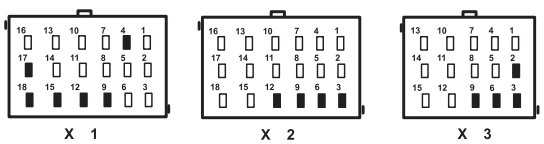
Test	Measurement
Any PMV, TCV, or Diff. Common to Voltage or Ground	Open Circuit (no continuity)

Differential Lock Solenoid

1. Measure resistance between Diff lock solenoid and voltage or ground.

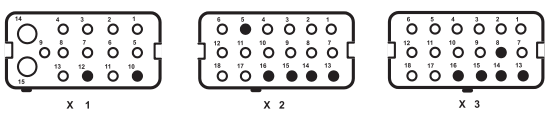
Test	Measurement
Diff. Lock Solenoid to Voltage or Ground	Open Circuit (no continuity)

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

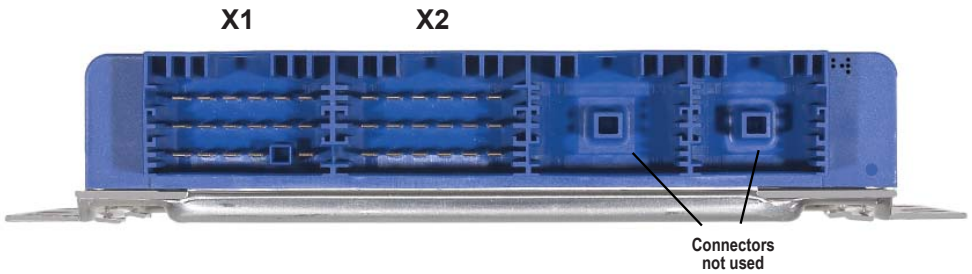
Frame-mount ECU: Looking into wire harness connector



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

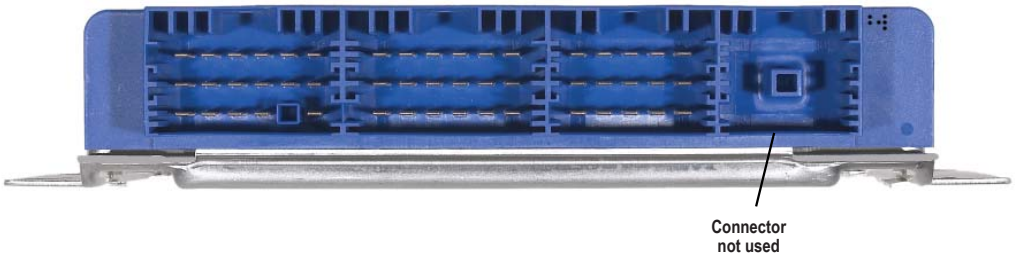
Standard Frame X2 Connector Pin Assignments

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

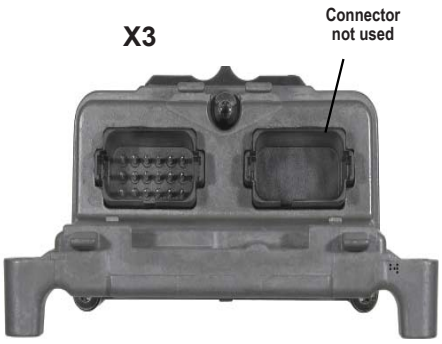
Pin	Designation	Pin	Designation	Pin	Designation
1	ABS ORS	6	PMV AA Left CMN	11	WSS AA Left (+)
2	Diff. Lock SOL[1]	7	PMV AA Left REL	12	WSS AA Right (+)
3	Diff. Lock SOL CMN[1]	8	Input/Output 3	13	PMV AA Right REL
4	PMV AA Left HLD	9	PMV AA Right CMN	14	WSS AA Left (-)
5	Input/Output 2	10	PMV AA Right 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)

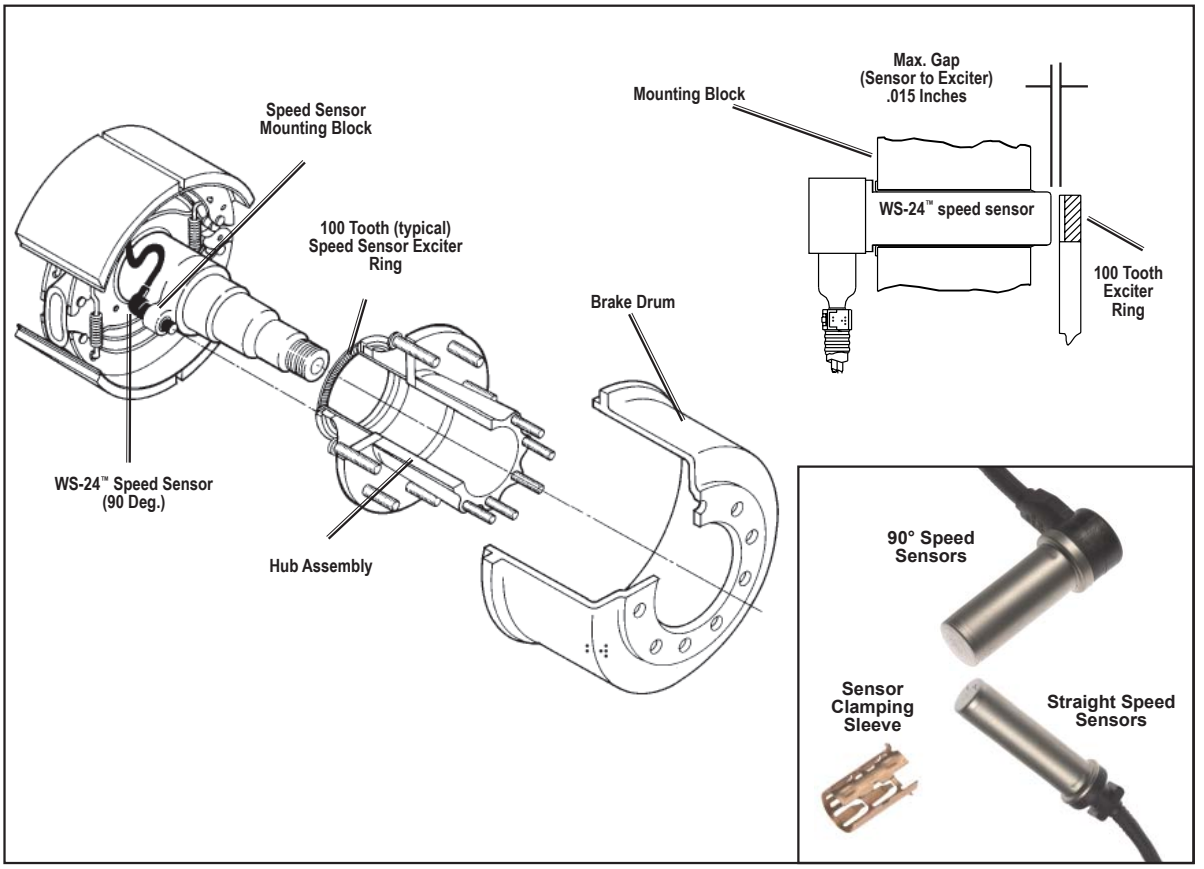


*FIGURE 15 - **WS-24™ WHEEL SPEED SENSOR INSTALLATION***

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.

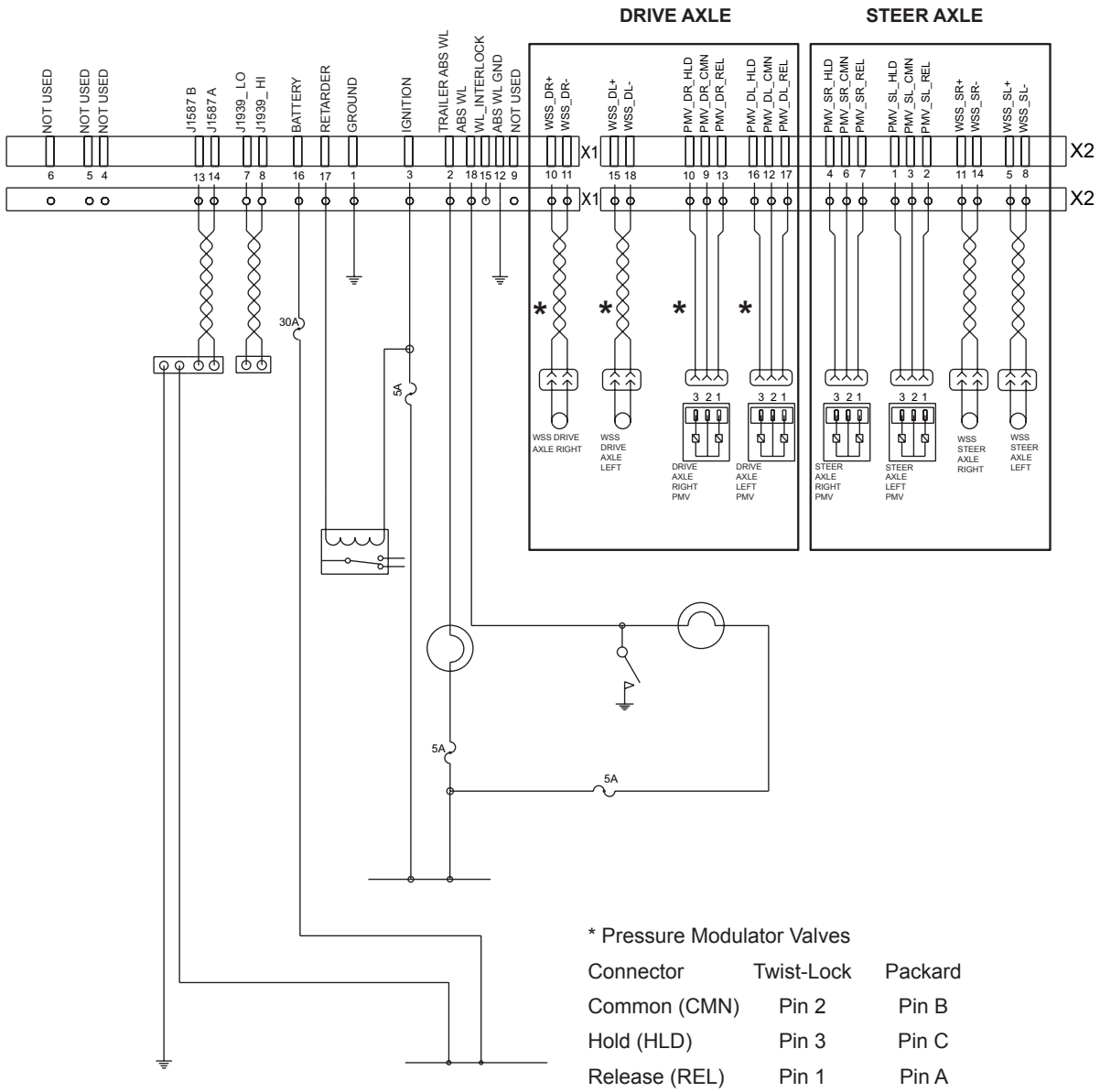
Bendix does not recommend using standard tie-wraps to secure wiring harnesses directly to rubber air lines. This may cause premature wiring failure from the pressure exerted on the wiring when air pressure is applied through the air line. Non-metallic hose clamps or bow-tie tie-wraps are preferred.

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)

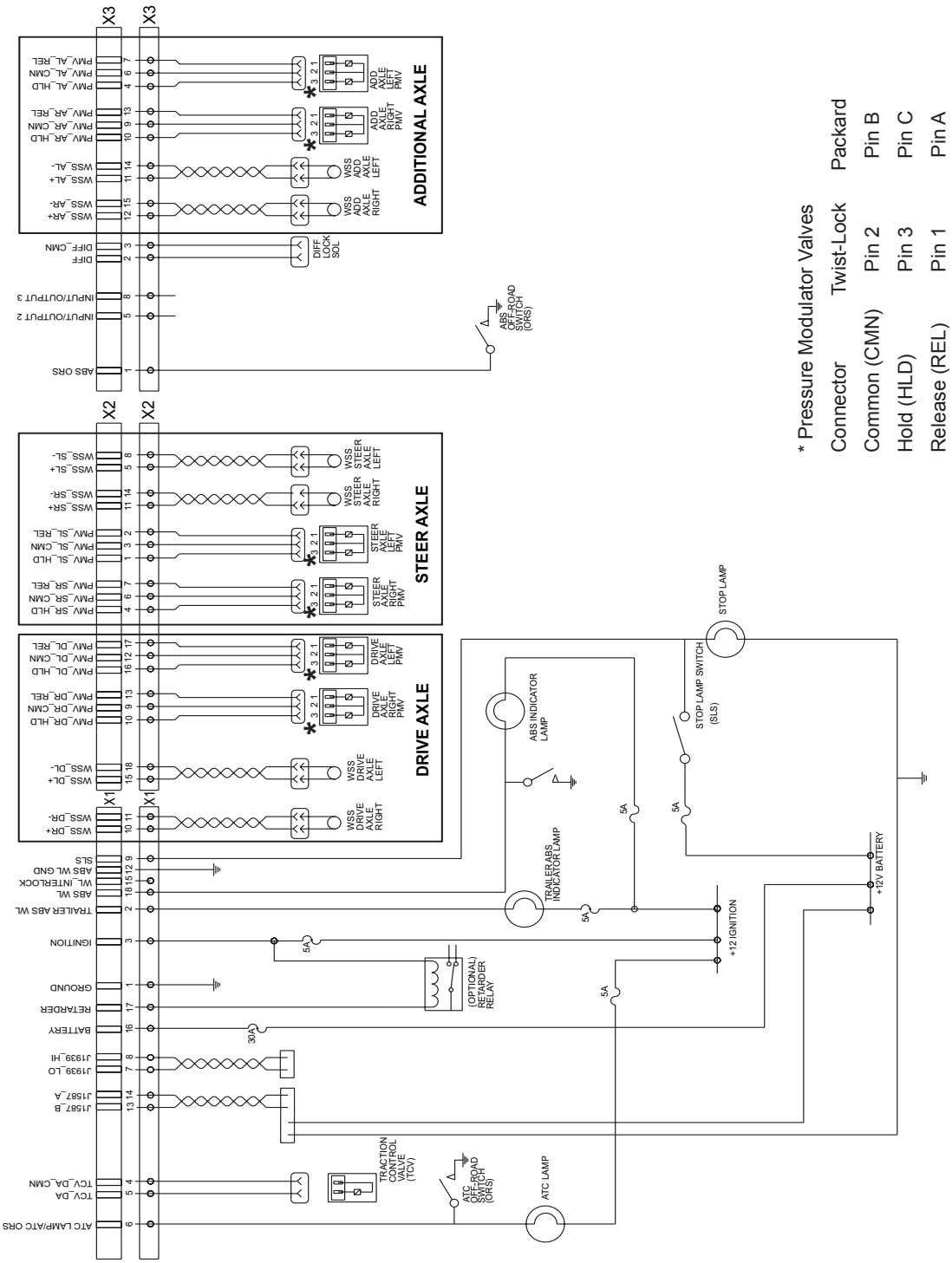


FIGURE 17 - PREMIUM CAB WIRING SCHEMATIC (6S/6M)
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Troubleshooting: Premium Cab Wiring Schematic (6S/5M)

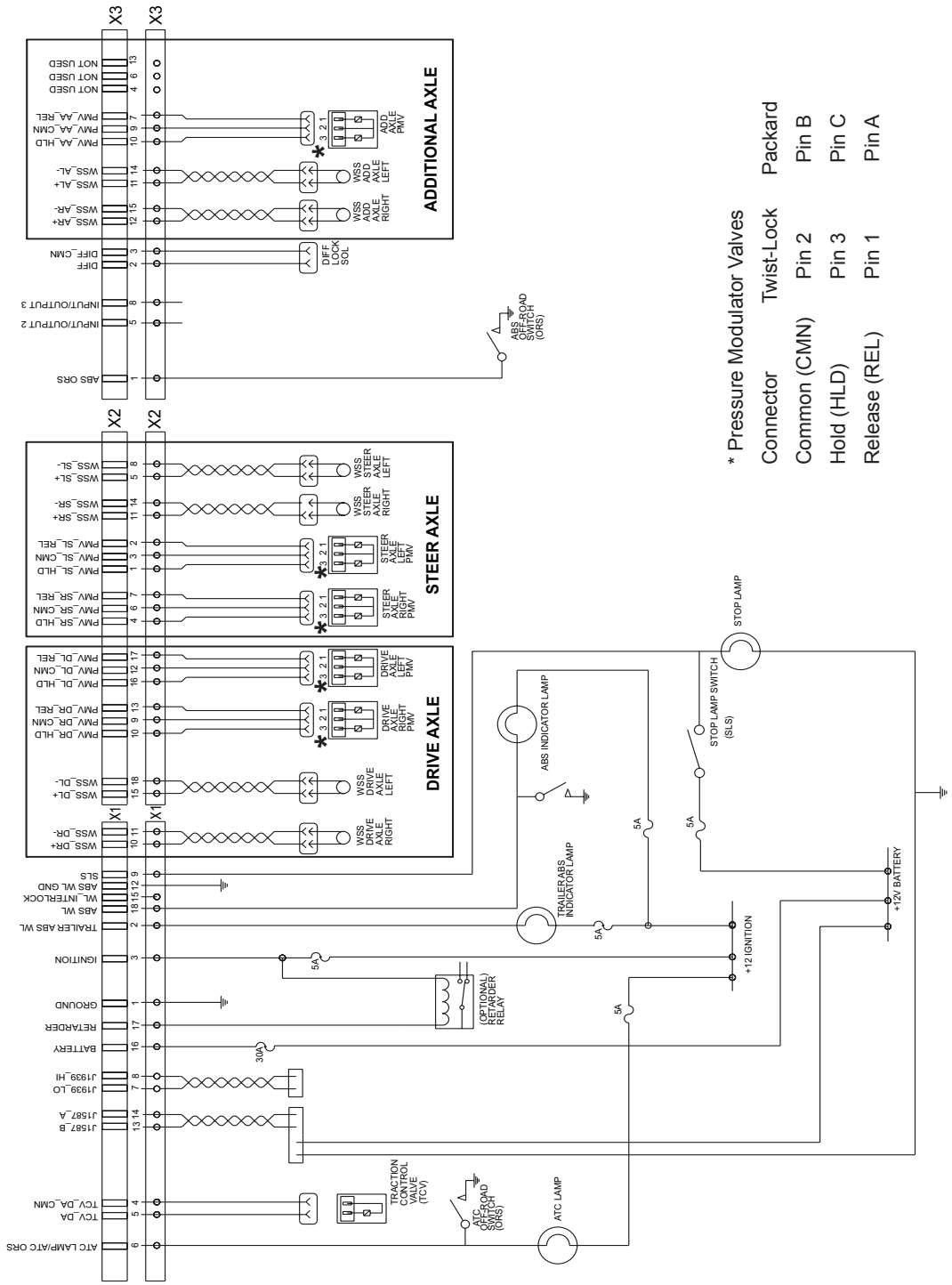
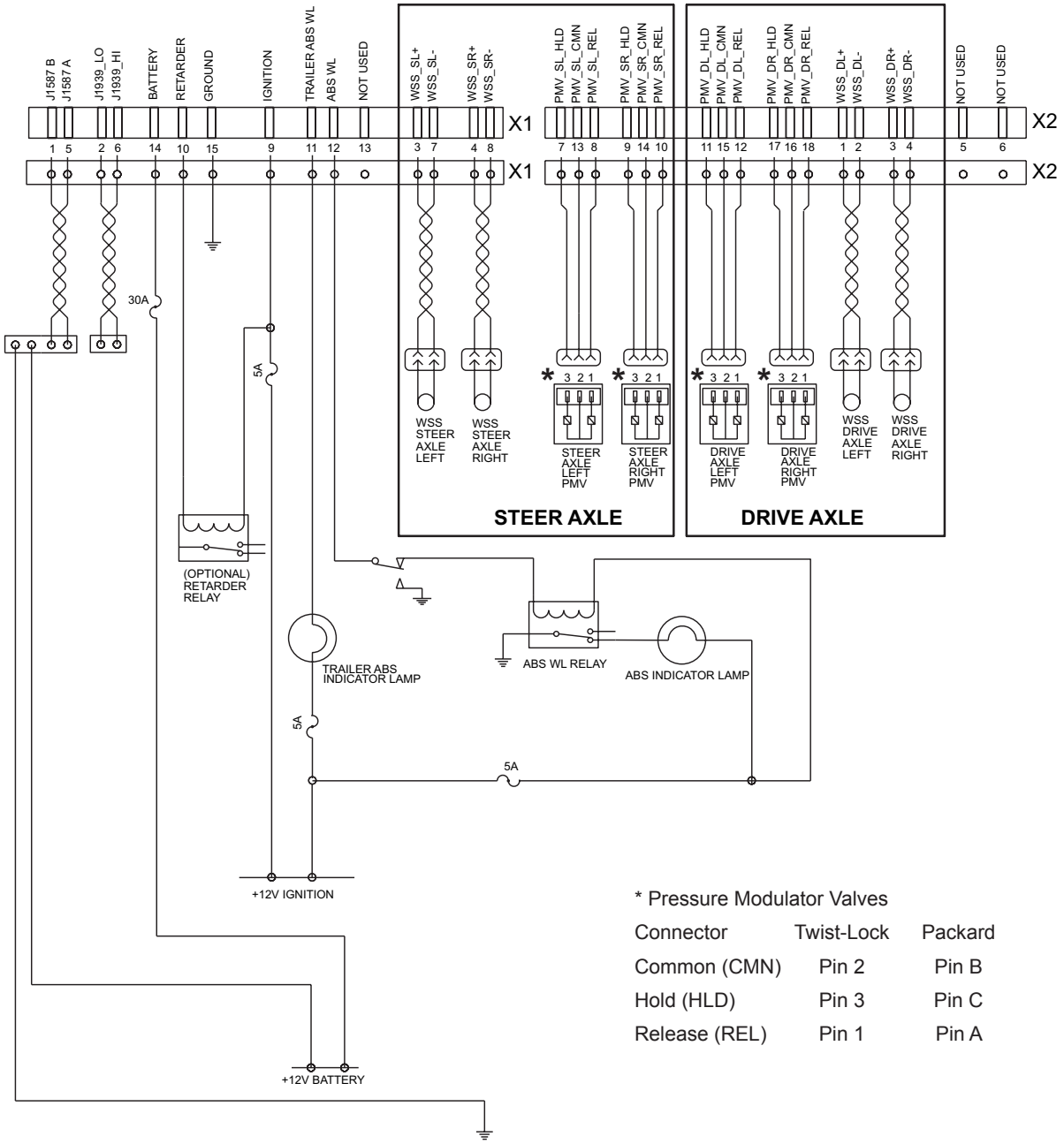


FIGURE 18 - PREMIUM CAB WIRING SCHEMATIC (6S/5M)

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)

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Troubleshooting: Premium Frame Wiring Schematic (6S/6M)

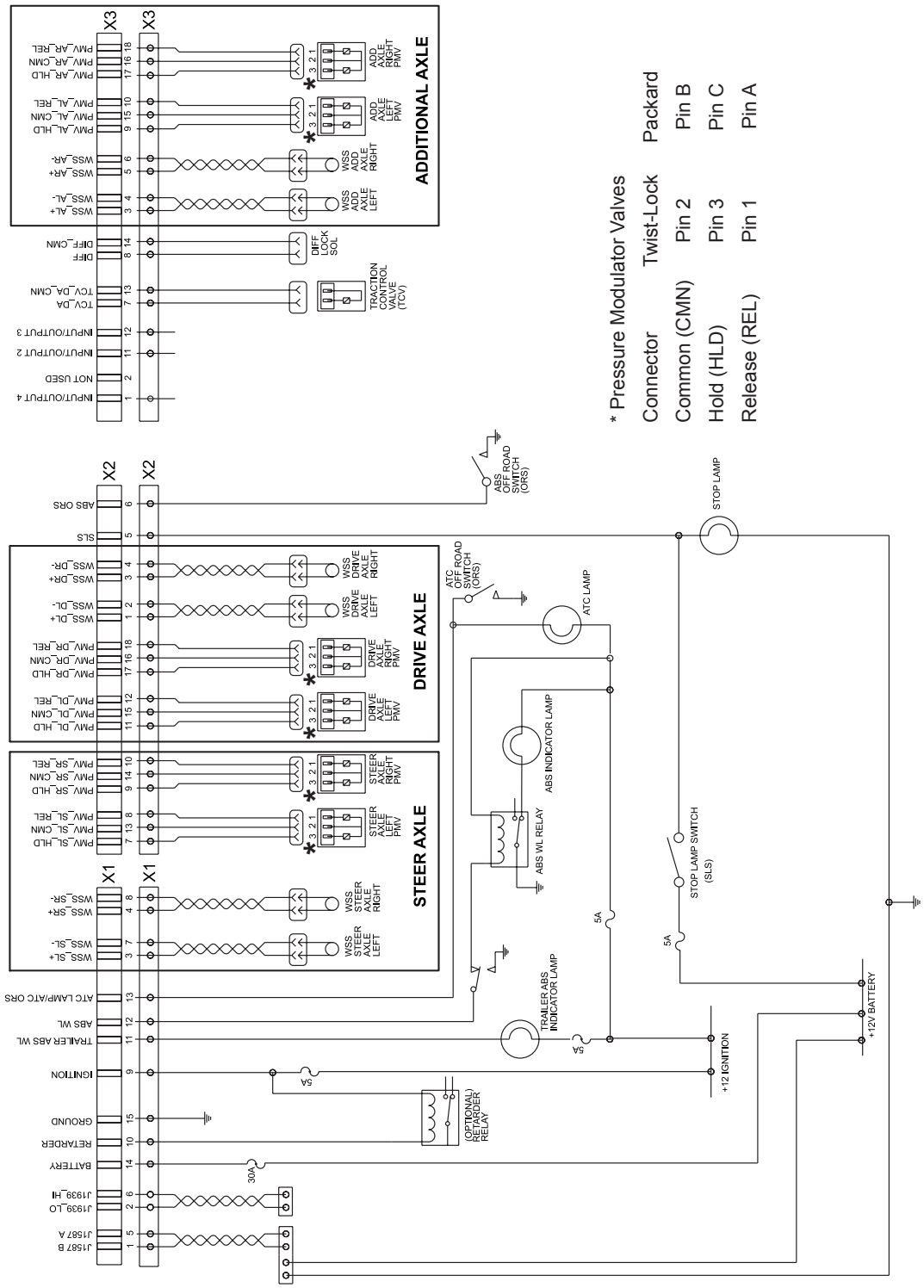


FIGURE 20 - PREMIUM FRAME WIRING SCHEMATIC (6S/6M)

Troubleshooting: Premium Frame Wiring Schematic (6S/5M)

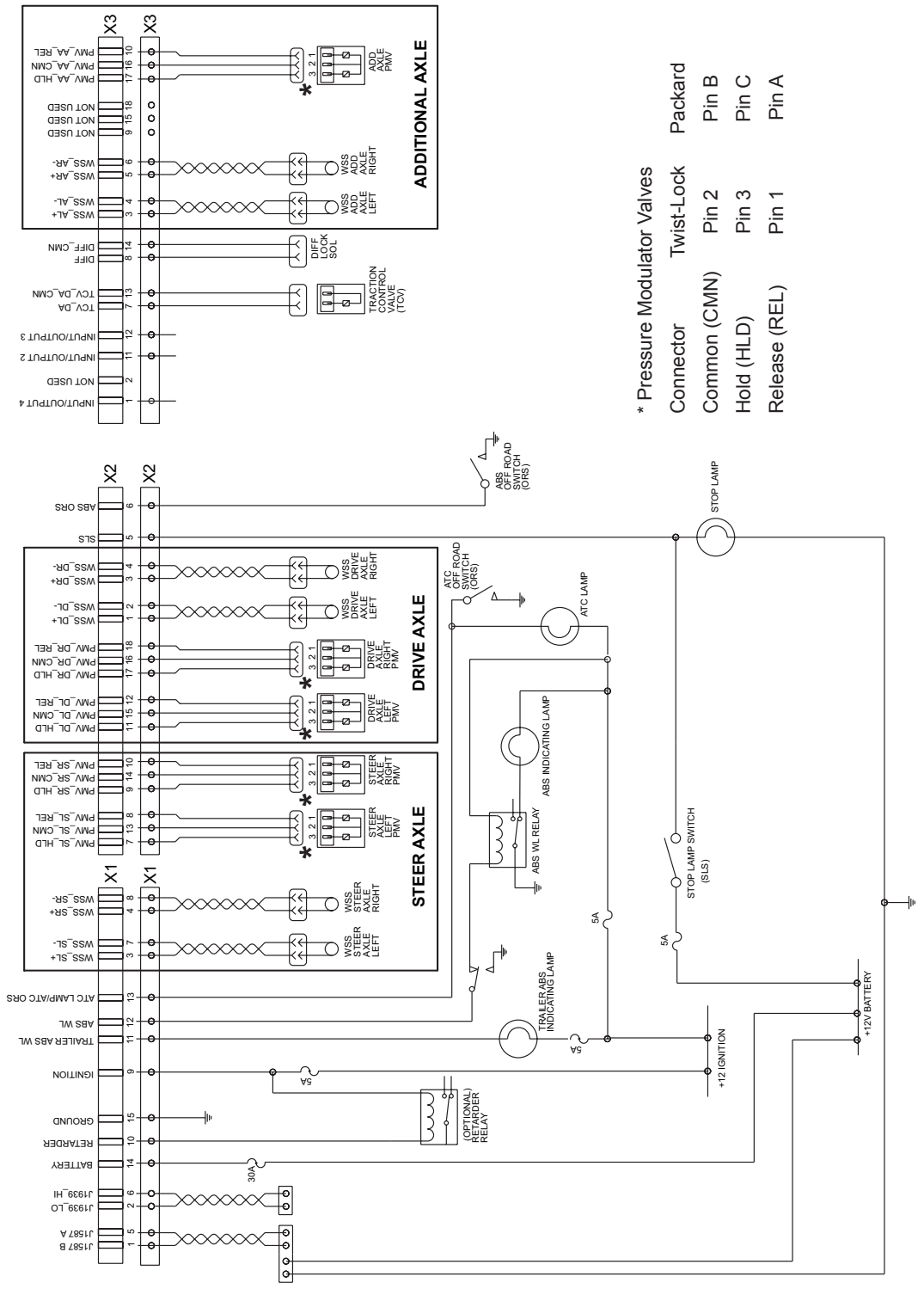


FIGURE 21 - PREMIUM FRAME WIRING SCHEMATIC (6S/5M)
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Glossary

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)

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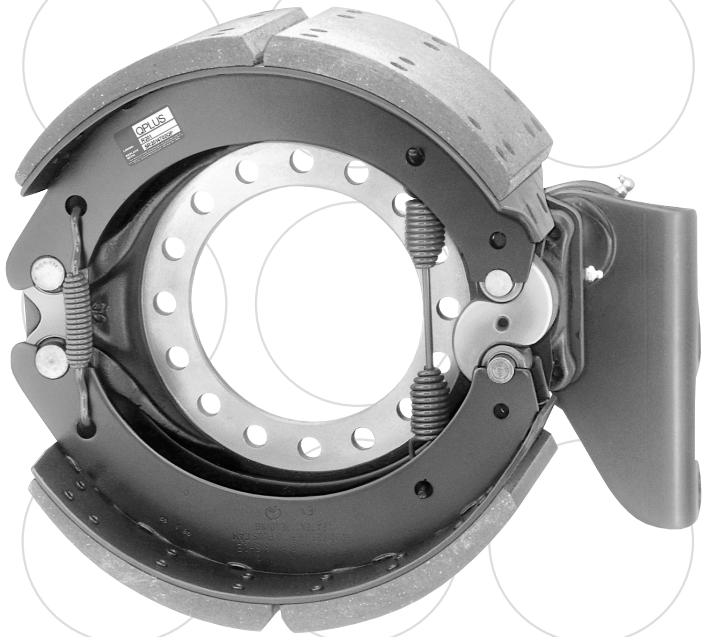
MERITOR®

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.

Information contained in this publication was in effect at the time the publication was approved for printing and is subject to change without notice or liability. Meritor Heavy Vehicle Systems, LLC, reserves the right to revise the information presented or to discontinue the production of parts described at any time.

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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.

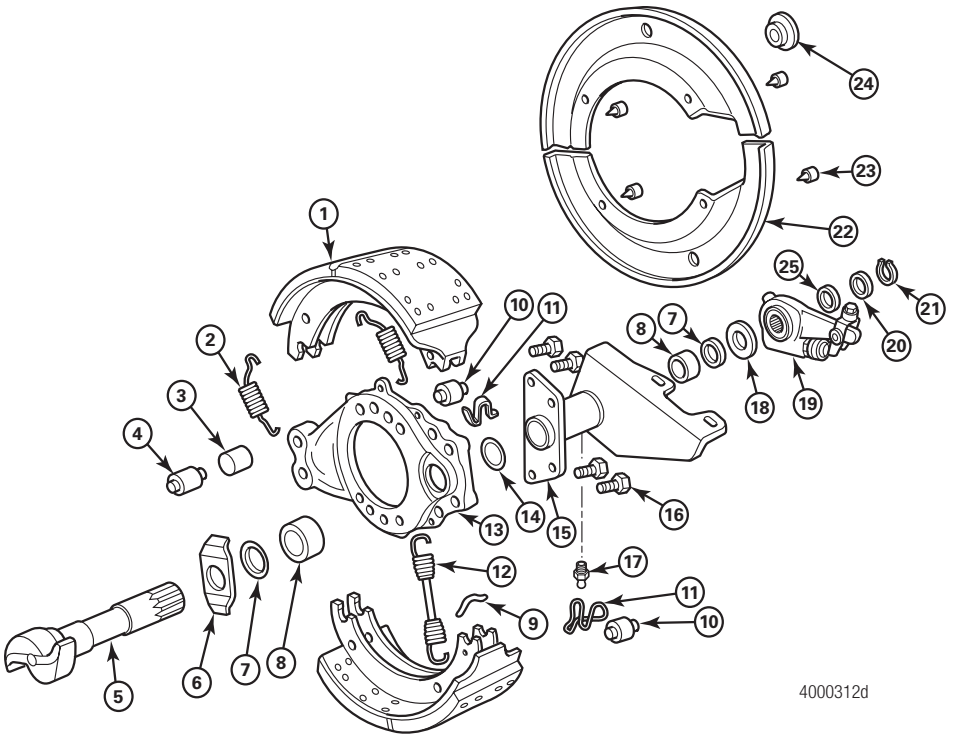
6. Waste Disposal**.** Dispose of discarded linings, used rags, cloths and HEPA filters with care, such as in sealed plastic bags. Consult applicable EPA, state and local regulations on waste disposal.

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

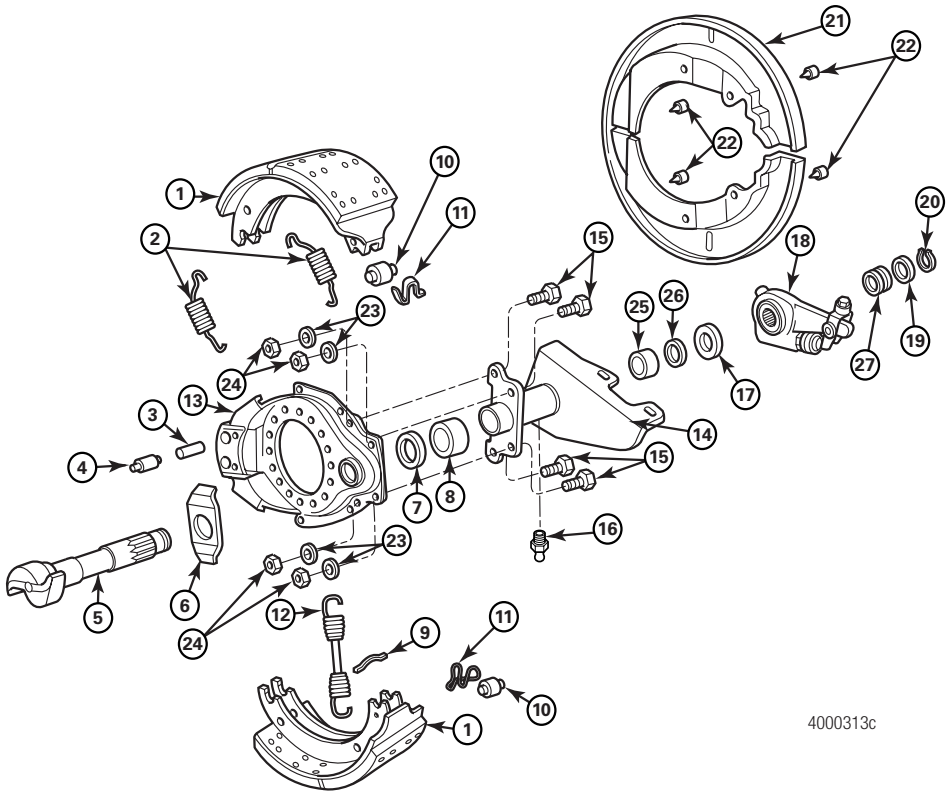
15- and 16.5-Inch Q Plus™ and Q Series Cam Brakes with Cast Spiders



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

16.5-Inch Q Plus™ Cam Brake with Stamped Spiders

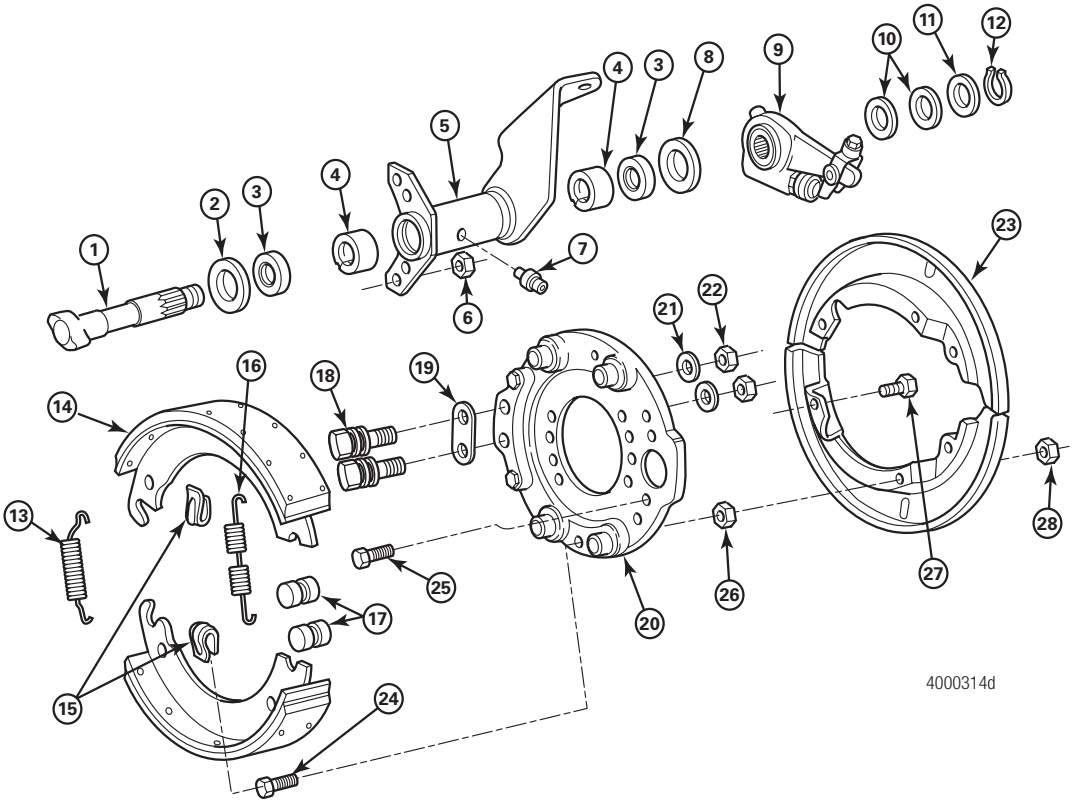


Item	Description
1	Shoe and Lining Assembly
2	Shoe Retaining Spring
3	Anchor Pin Bushing
4	Brake Shoe Anchor Pin
5	"S" Head Camshaft
6	Cam Head Washer
7	Camshaft Seal
8	Camshaft Bushing
9	Return Spring Pin
10	Brake Shoe Roller
11	Shoe Roller Retainer
12	Brake Shoe Return Spring
13	Stamped Brake Spider
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

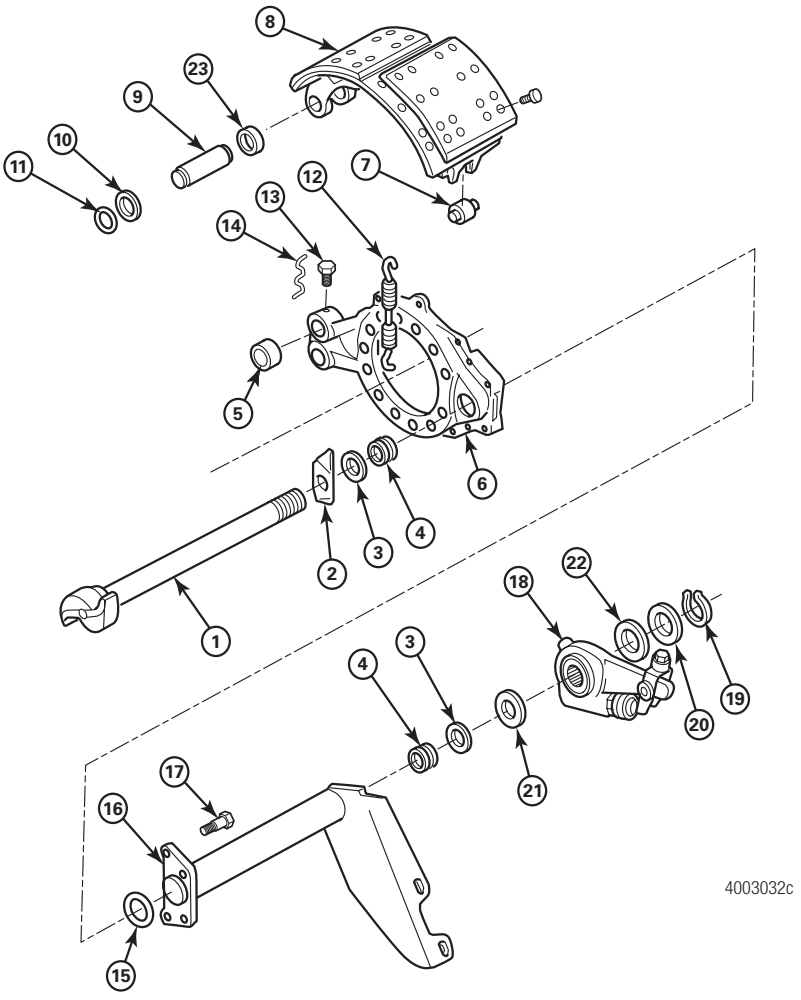


1 Exploded Views

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

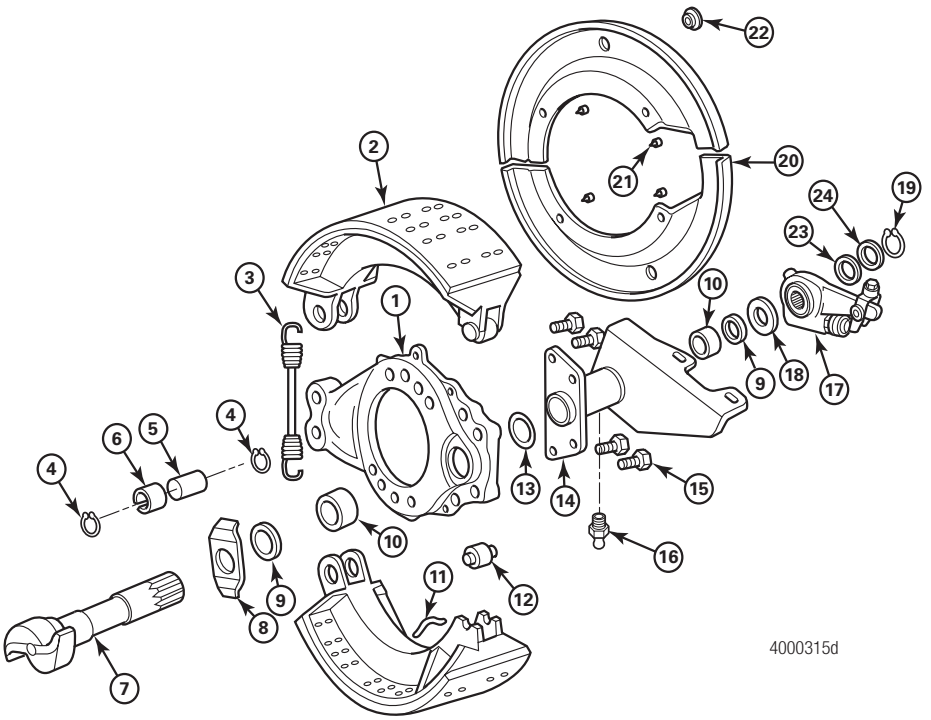


1 Exploded Views

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

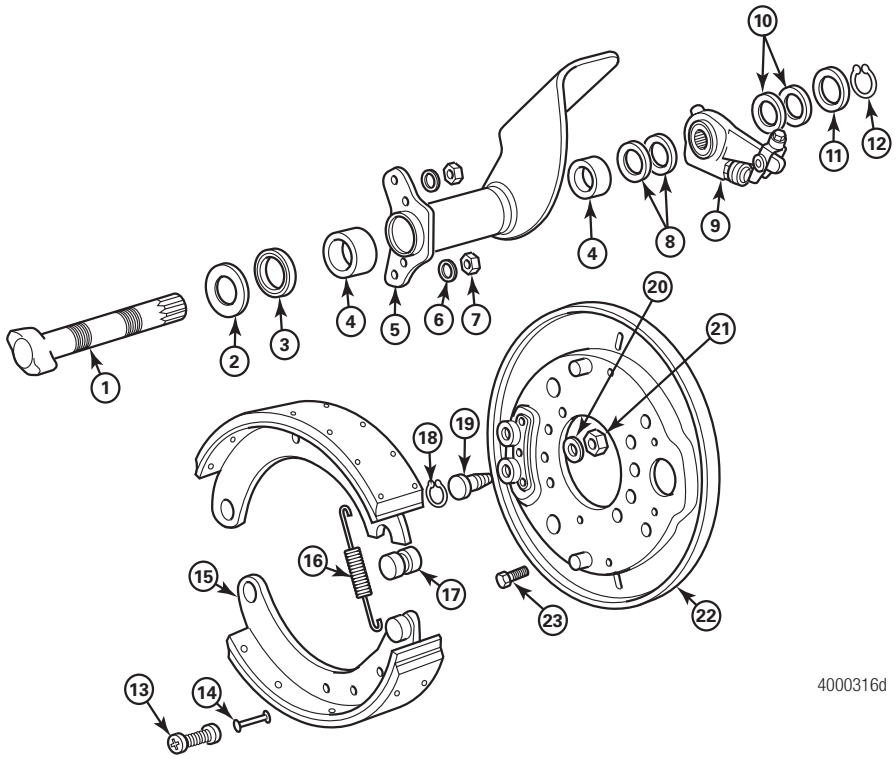


Item	Description
1	Brake Spider
2	Shoe and Lining Assembly
3	Brake Shoe Return Spring
4	Anchor Pin Snap Ring
5	Brake Shoe Anchor Pin
6	Anchor Pin Bushing
7	"S" Head Camshaft
8	Cam Head Washer
9	Camshaft Grease Seal
10	Camshaft Bushing
11	Return Spring Pin
12	Cam Roller
13	Camshaft Bracket Seal
14	Camshaft 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



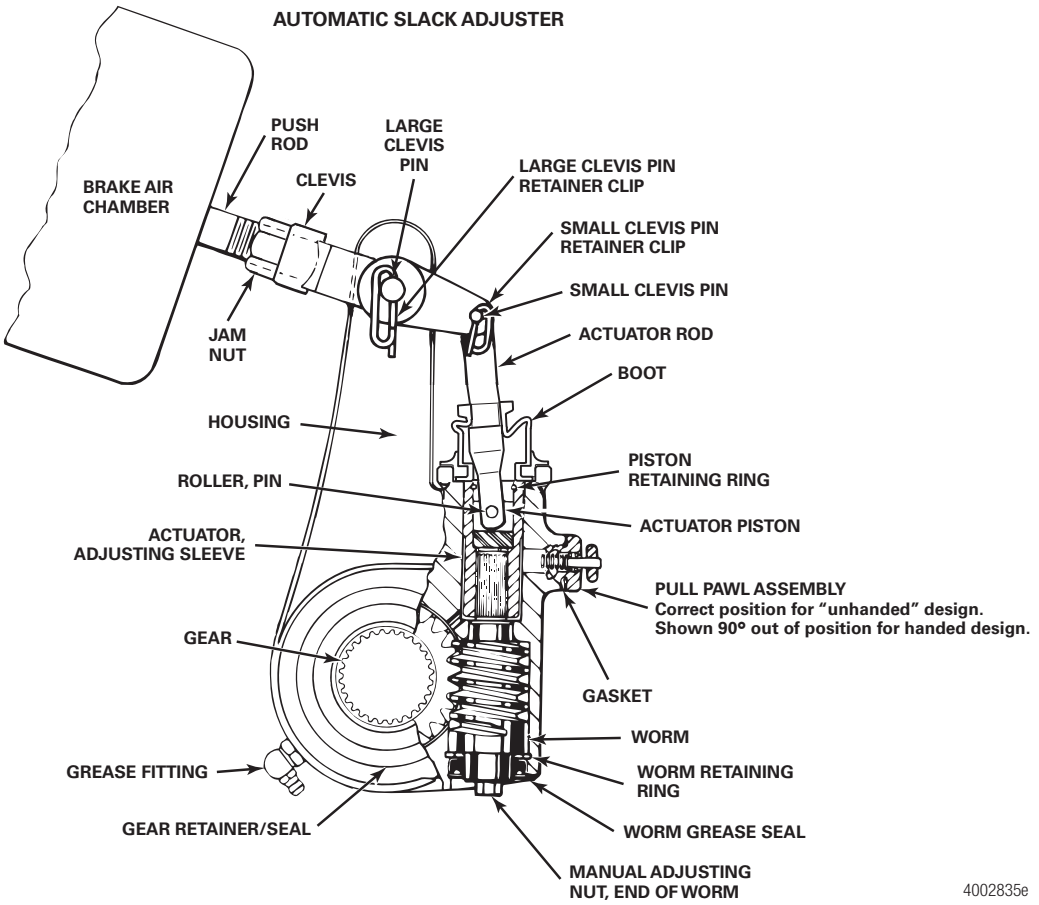
Item	Description
1	Camshaft
2	Cam Head Washer
3	Camshaft Grease Seal
4	Bushing
5	Camshaft and Chamber Bracket
6	Bracket Lock Washer
7	Bracket Nut
8	Thick Camshaft Thrust Washers
9	Automatic Slack Adjuster
10	Thin Camshaft Spacer Washer
11	Thick Camshaft Hardened Washer
12	Camshaft Snap Ring
13	Anti-Rattle 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

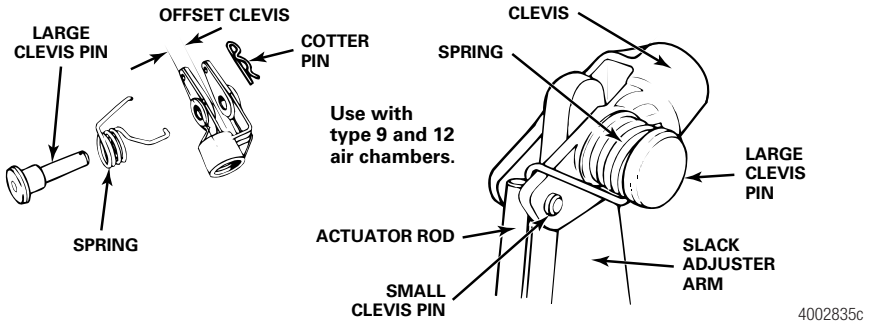
1 Exploded Views

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.

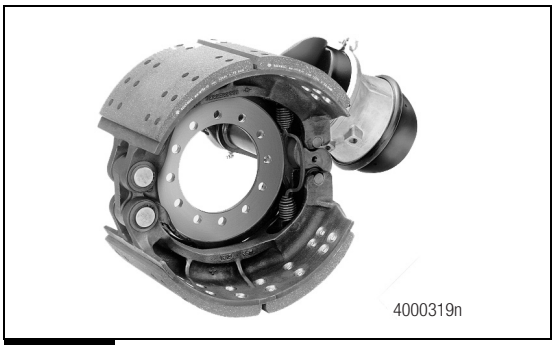


Figure 2.3

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.

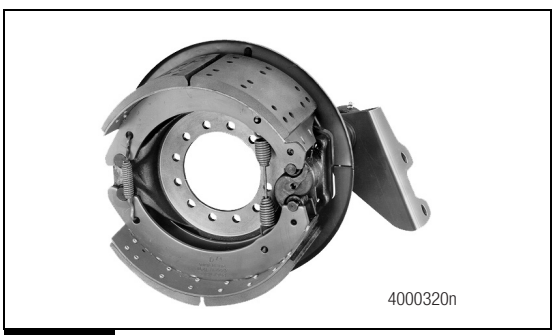


Figure 2.4

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.

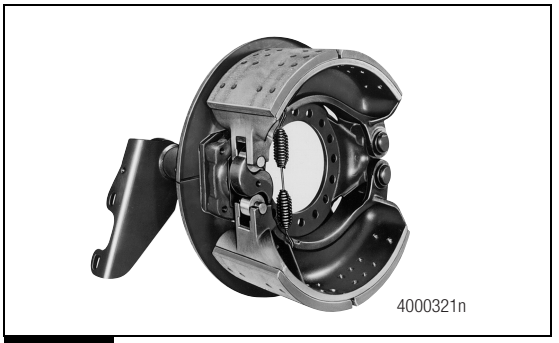


Figure 2.5

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

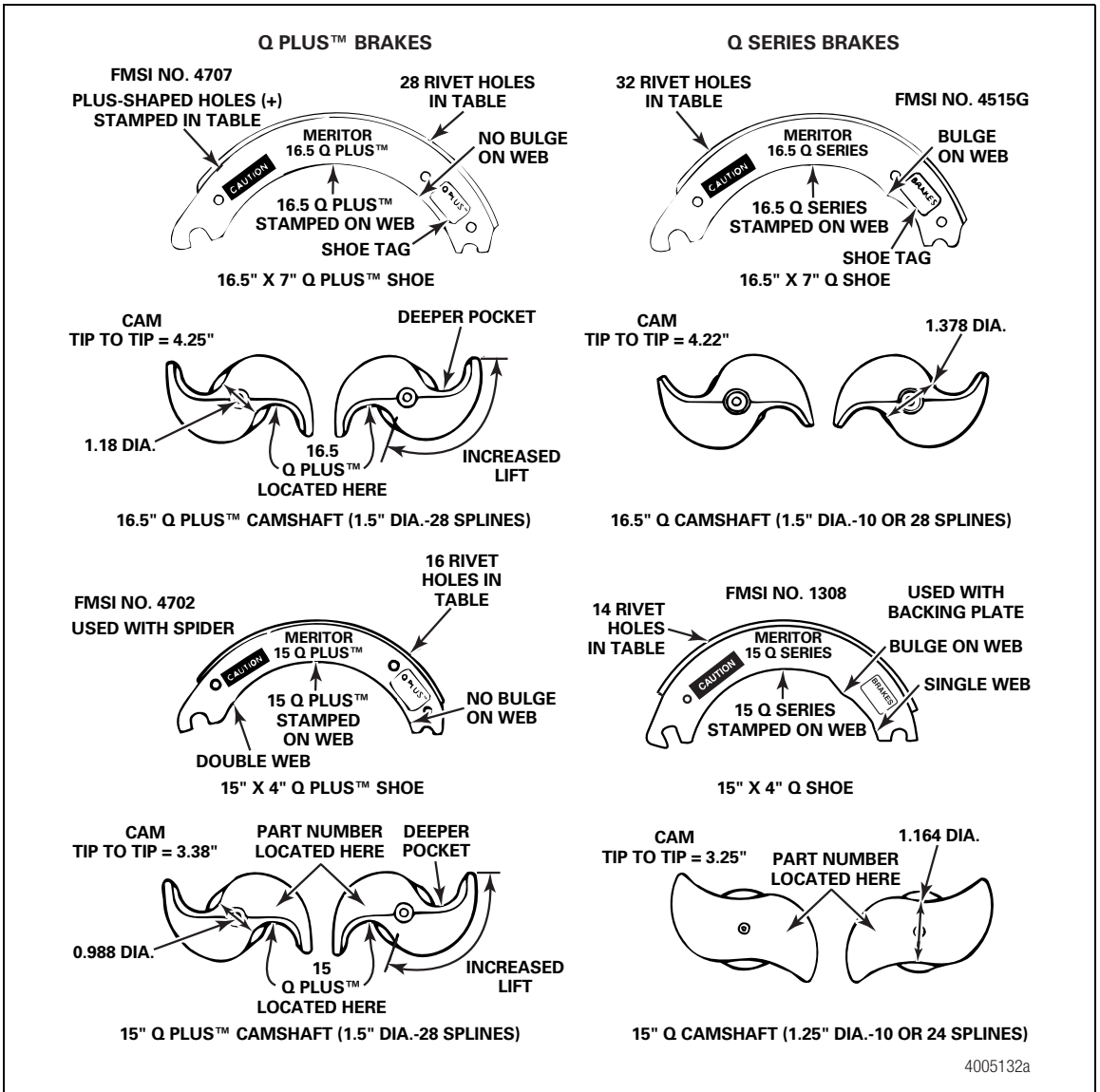


Figure 2.6

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.

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.

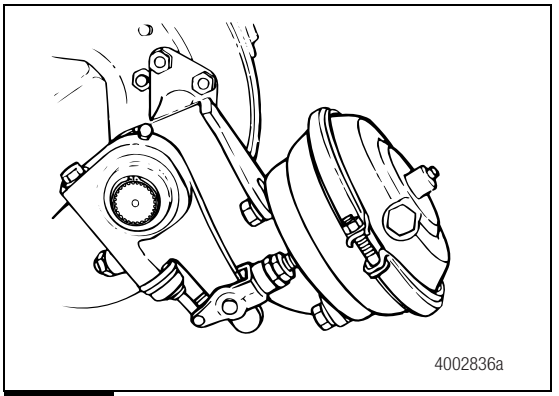


Figure 2.7

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.

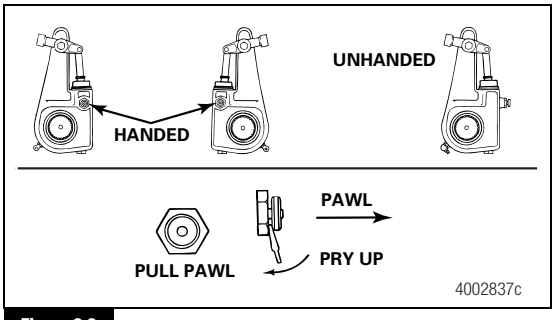


Figure 2.8

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.

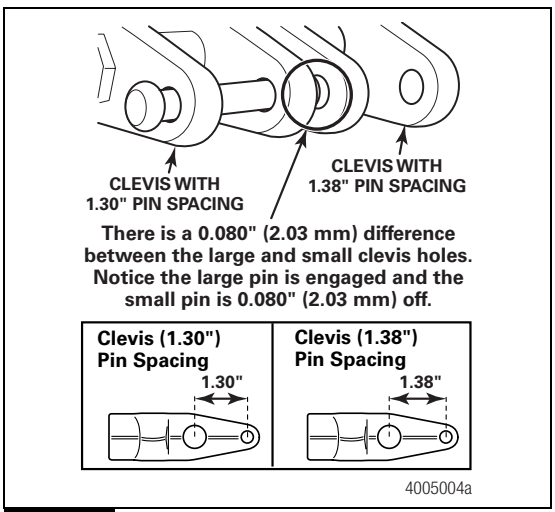


Figure 2.9

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.

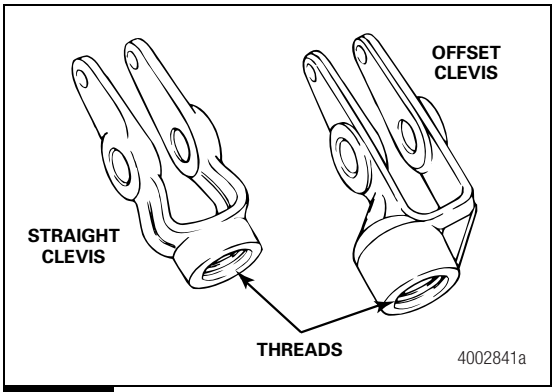


Figure 2.10

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

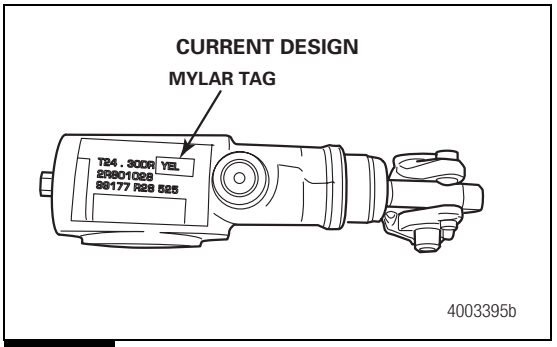


Figure 2.11

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.

3 Removal and Disassembly

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.

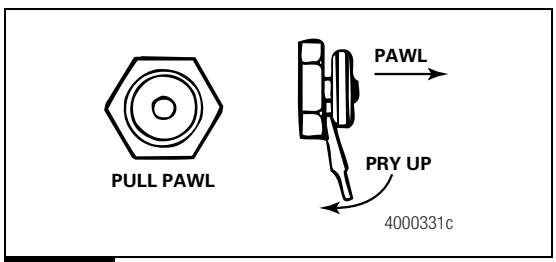


Figure 3.1

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

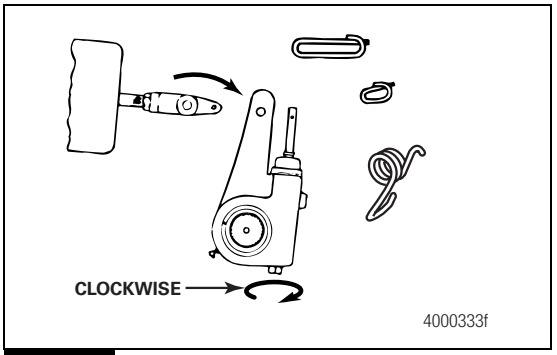


Figure 3.2

⚠ 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.

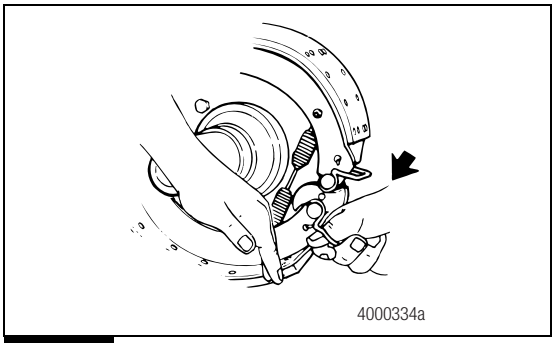


Figure 3.3

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.

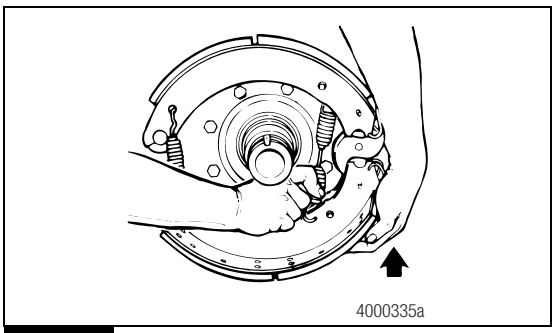


Figure 3.4

4. Rotate the bottom shoe to release the tension on the brake shoe retainer springs. Figure 3.5.

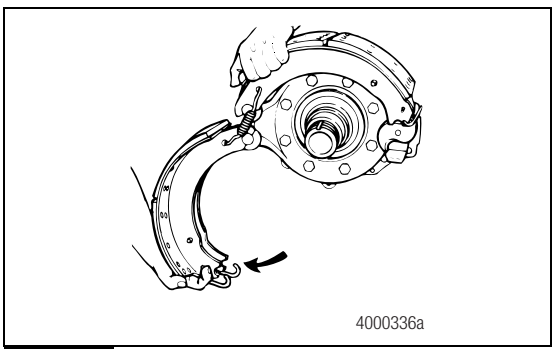


Figure 3.5

3 Removal and Disassembly

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.

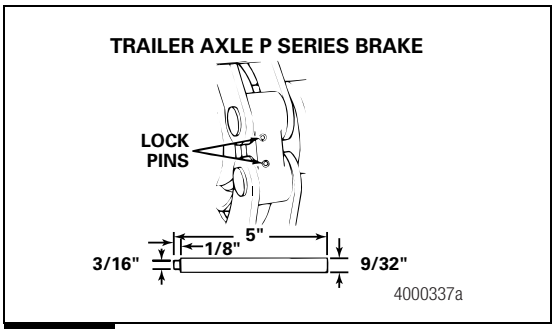


Figure 3.6

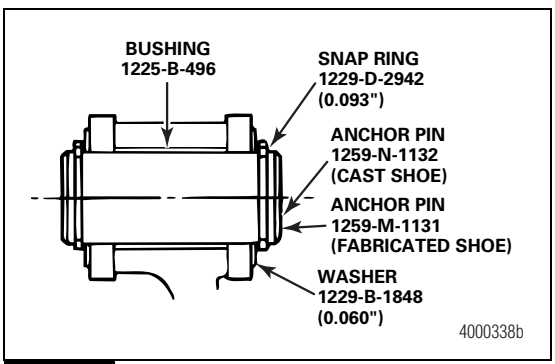


Figure 3.7

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.

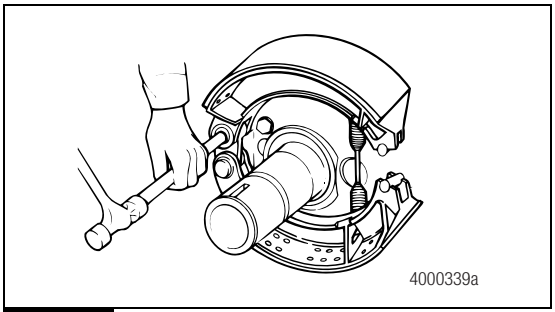


Figure 3.8

3. Rotate the top shoe to release the tension on the brake shoe return spring. Remove the shoe. Figure 3.9.

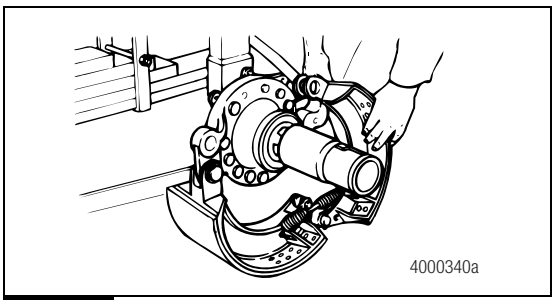


Figure 3.9

4. Use a brass drift to remove the bottom anchor pin. Remove the bottom shoe. If necessary, remove the rollers. Figure 3.10.

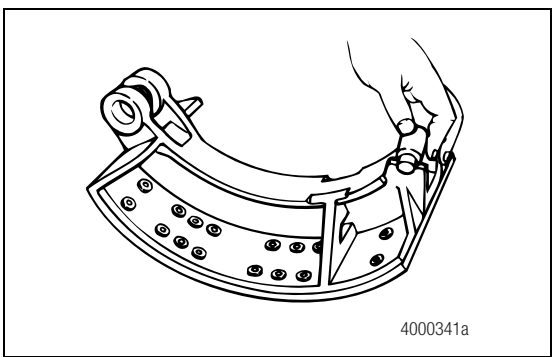


Figure 3.10

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.

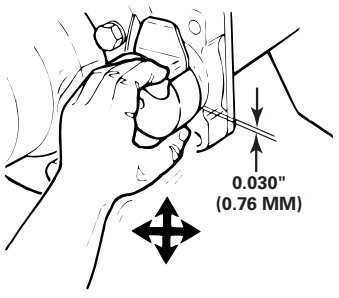


Figure 3.11

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.

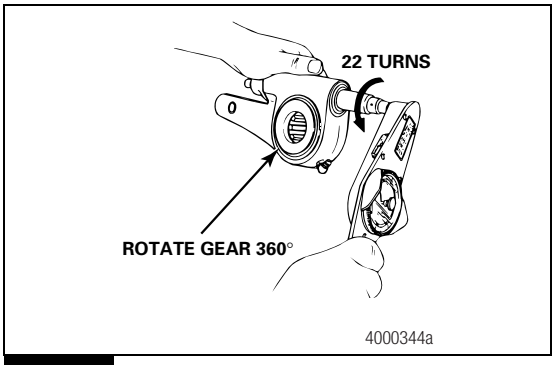


Figure 3.12

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.

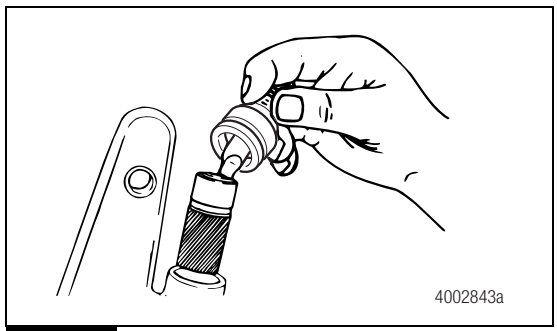


Figure 3.13

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.

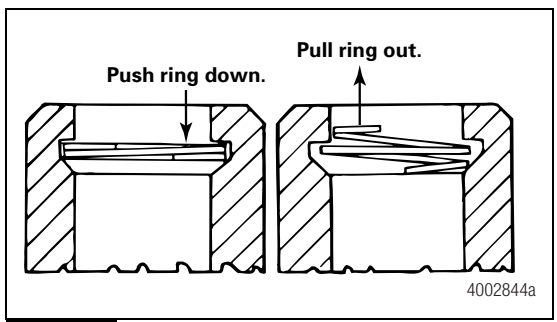


Figure 3.14

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.

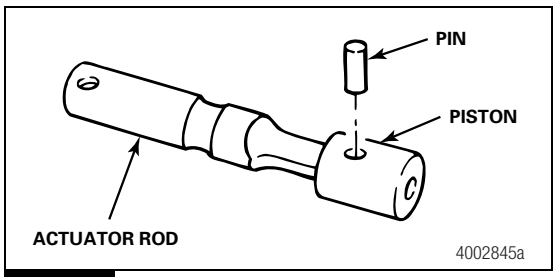


Figure 3.15

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.

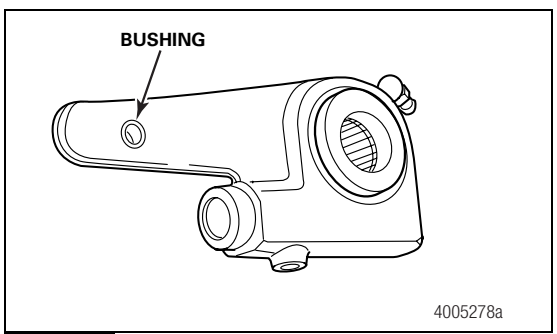


Figure 3.16

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.

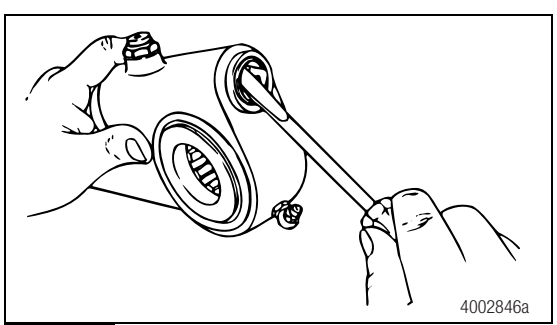


Figure 3.17

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.

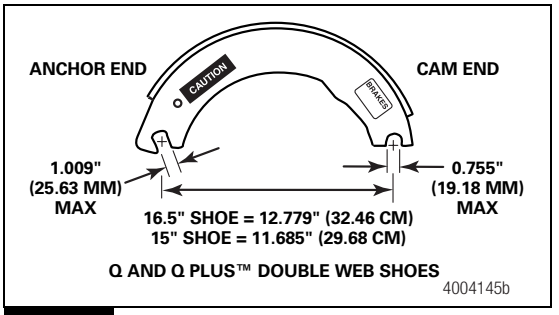


Figure 4.1

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.

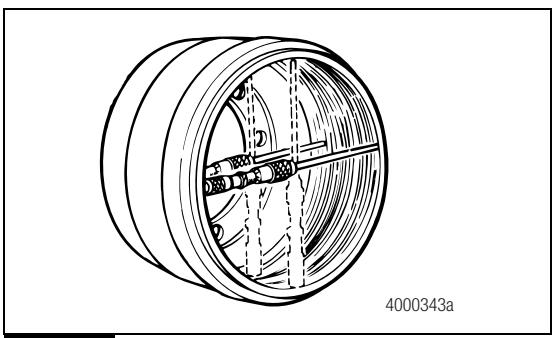


Figure 4.2

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.

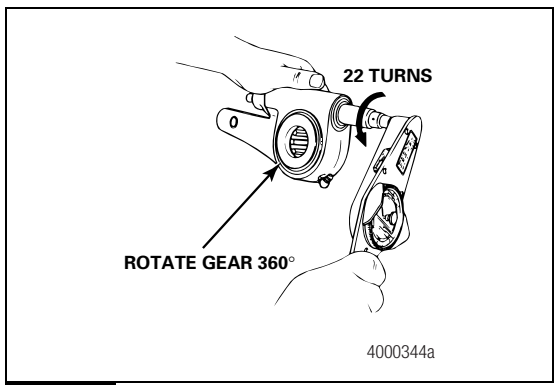


Figure 4.3

⚠ 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

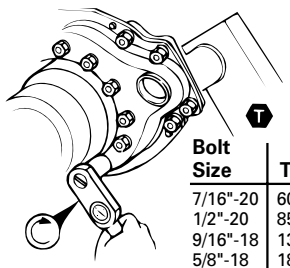
4. Inspect the boot assembly. If it is cracked, cut or torn, remove the pull pawl and inspect the areas around the actuator. If you find dirt, solid lubricant or corrosion, replace the slack adjuster. Otherwise, only replace the boot assembly.
5. Use a grease gun to apply Meritor specification O-692 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

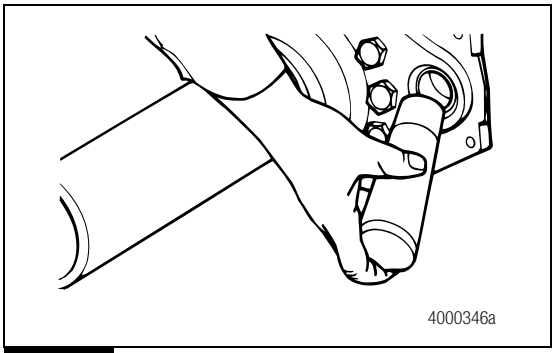


Bolt Size	Torque	
7/16"-20	60-75 lb-ft	81-102 N•m
1/2"-20	85-115 lb-ft	115-156 N•m
9/16"-18	130-165 lb-ft	176-224 N•m
5/8"-18	180-230 lb-ft	244-312 N•m
7/8"-9	440-580 lb-ft	598-789 N•m

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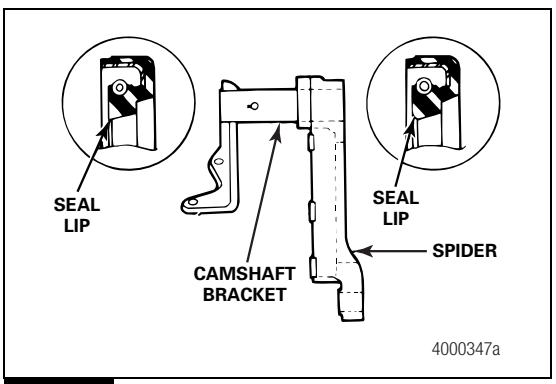
Figure 4.4

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.



4000346a

Figure 4.5



4000347a

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

5 Assembly and Installation

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.

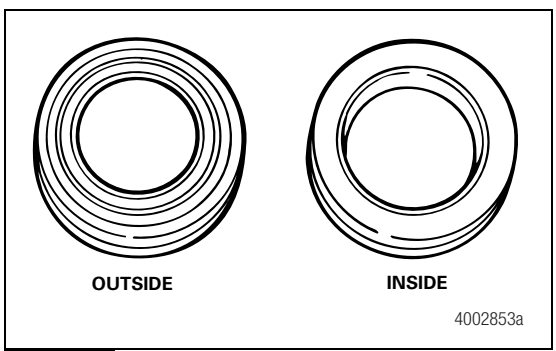


Figure 5.1

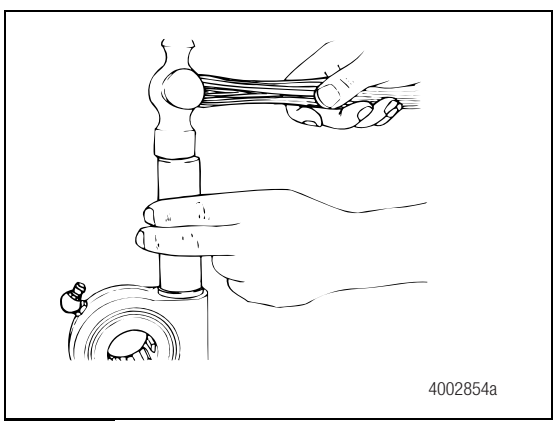


Figure 5.2

5 Assembly and Installation

5. If you removed the pin, install it into the rod and piston. Figure 5.3.

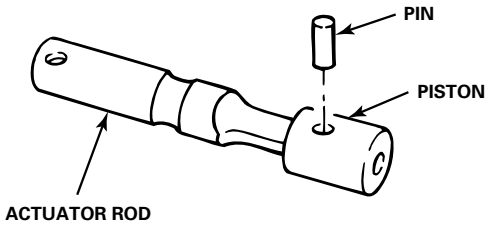


Figure 5.3

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.

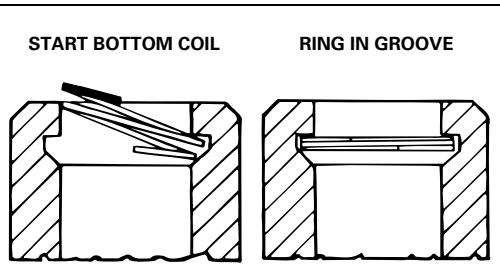


Figure 5.4

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.

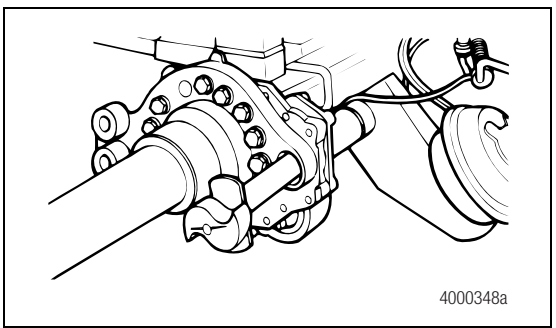


Figure 5.5



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.

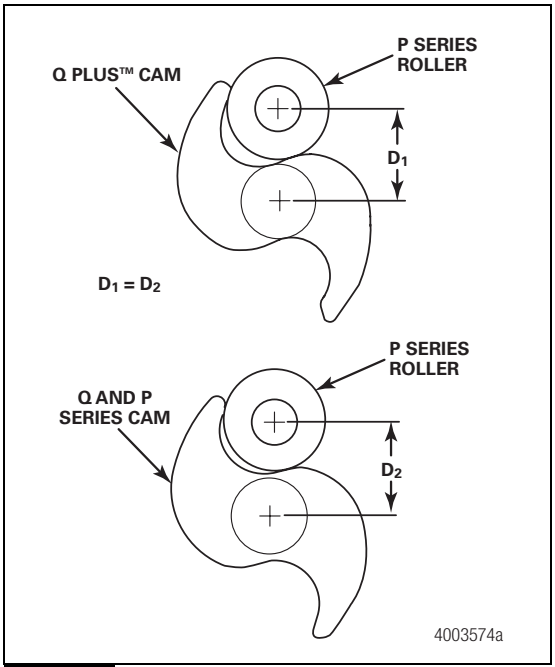


Figure 5.6

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.

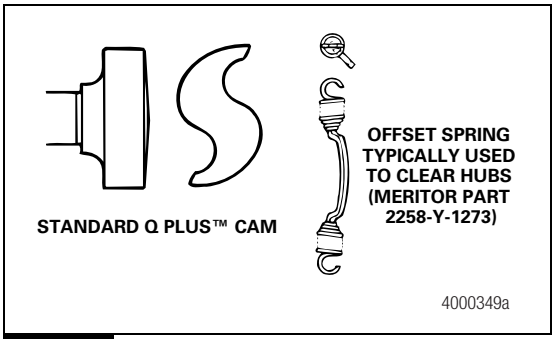


Figure 5.7

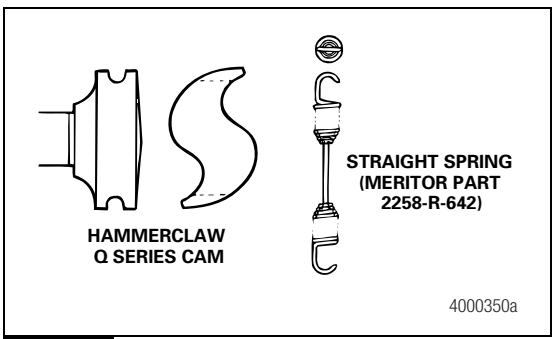


Figure 5.8

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

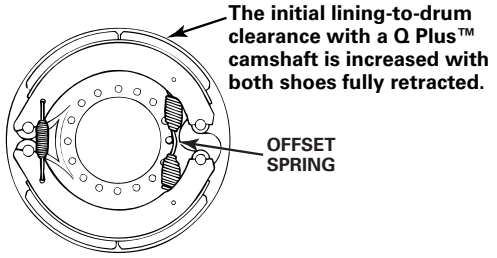


Figure 5.9

Shoe Return Spring

Install the new offset shoe return spring with the open end of the spring hooks toward the camshaft. Figure 5.10.

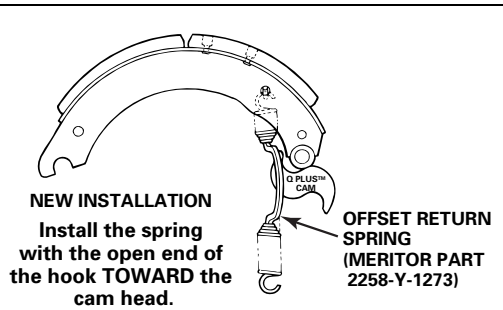


Figure 5.10

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.

⚠ 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.

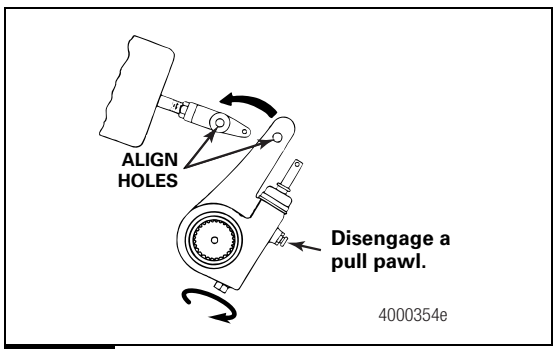


Figure 5.11

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.

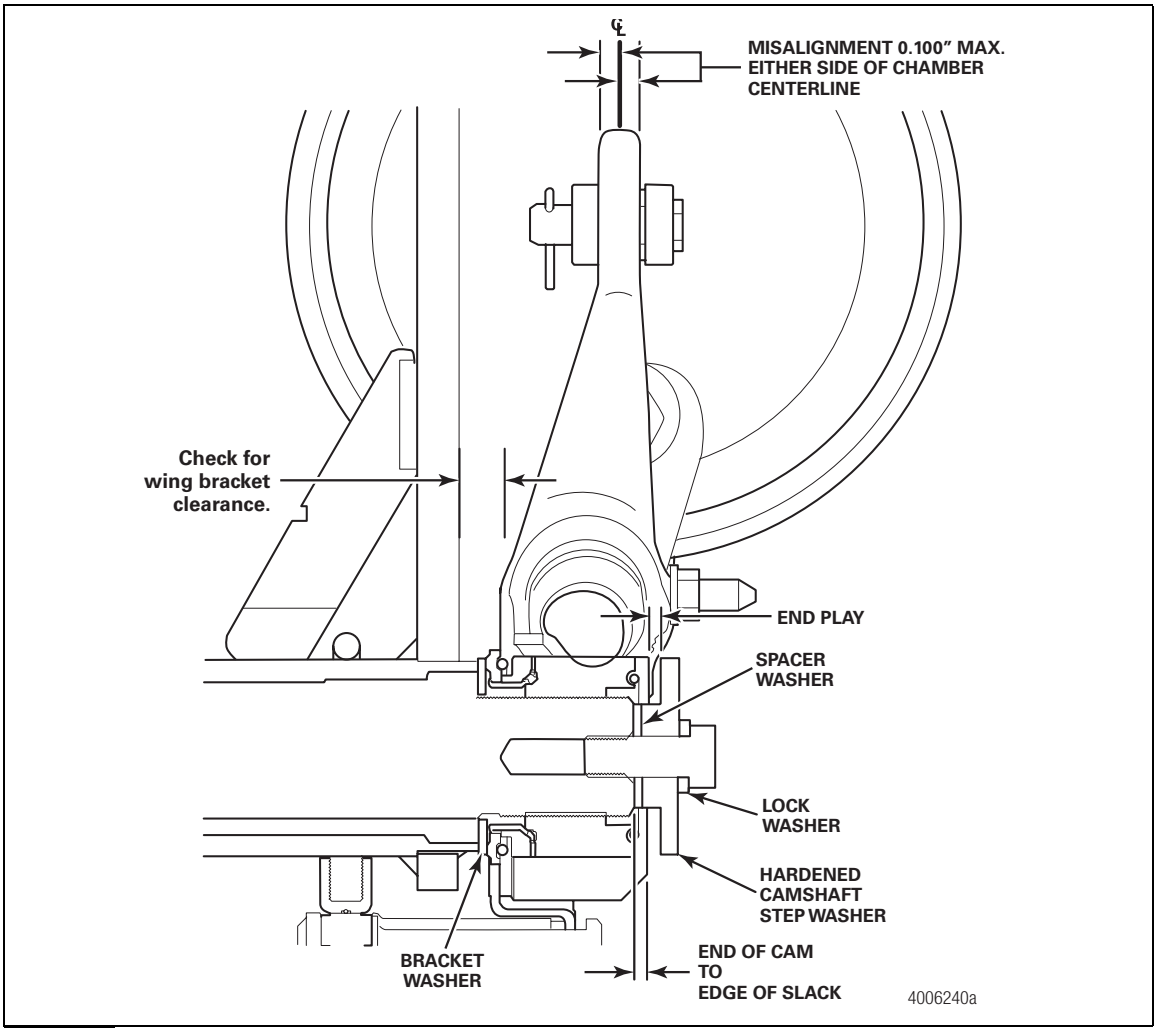

℄
MISALIGNMENT 0.100" MAX.
EITHER SIDE OF CHAMBER
CENTERLINE
Check for
wing bracket
clearance.
END PLAY
SPACER
WASHER
LOCK
WASHER
HARDENED
CAMSHAFT
STEP WASHER
BRACKET
WASHER
END OF CAM
TO
EDGE OF SLACK
4006240a

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 0-637, 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.

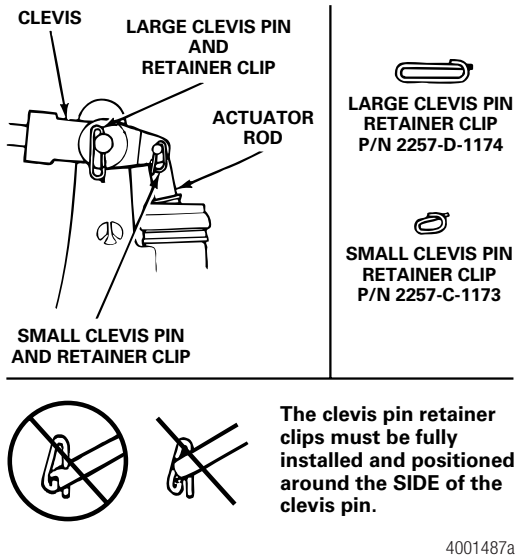


Figure 5.13

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.

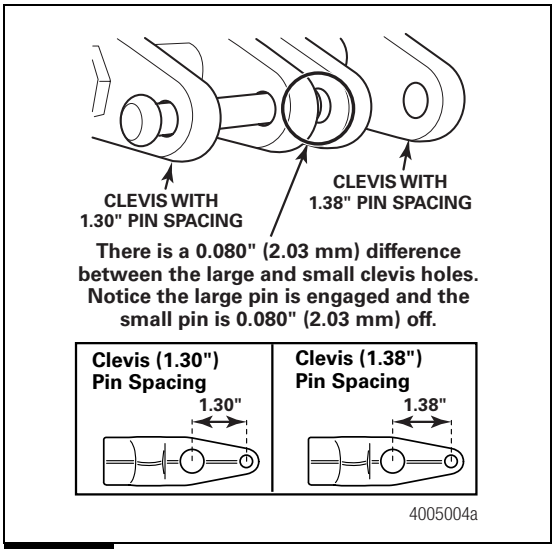


Figure 5.14

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.

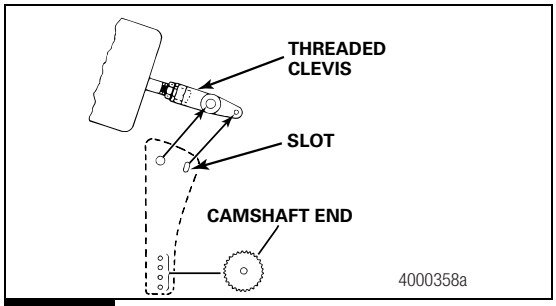


Figure 5.15

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.

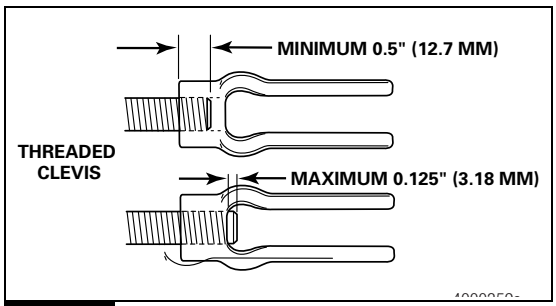


Figure 5.16

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

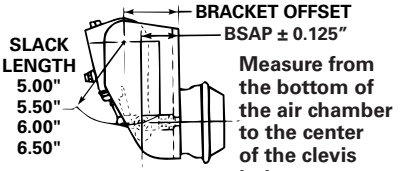
Table D: Jam Nut Torque Specifications

Threads	Torque
1/2-20	20-30 lb-ft (27-41 N•m)
5/8-18	35-50 lb-ft (48-68 N•m)

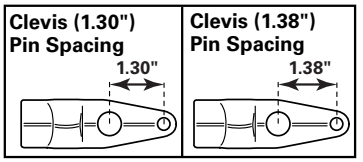
8. Use the following steps to install the automatic slack adjuster.
   A. Determine the clevis pin spacing.
   B. Determine the brake offset.
   C. Refer to Table E for the recommended installation.

5 Assembly and Installation

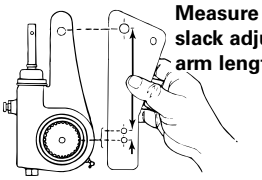
Table E: Meritor Automatic Slack Adjuster Installation Instructions



VIEW A 4005445a



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.

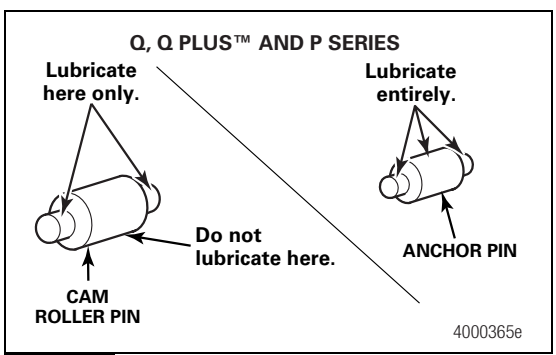


Figure 5.17

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.

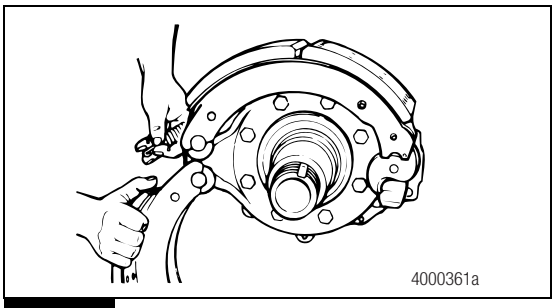


Figure 5.18

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.

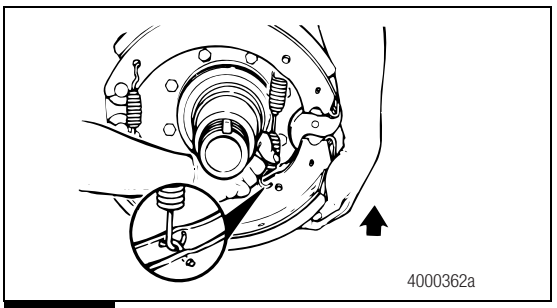


Figure 5.19

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.

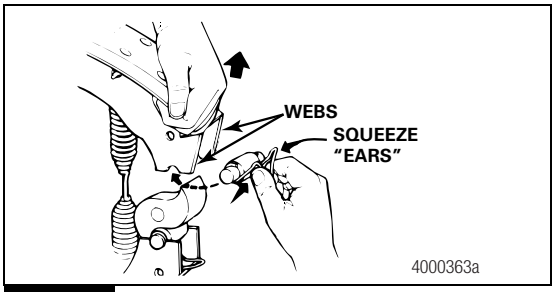


Figure 5.20

5. Push the brake shoe roller retainer into the brake shoe until the ears lock into the shoe web holes. Figure 5.21.

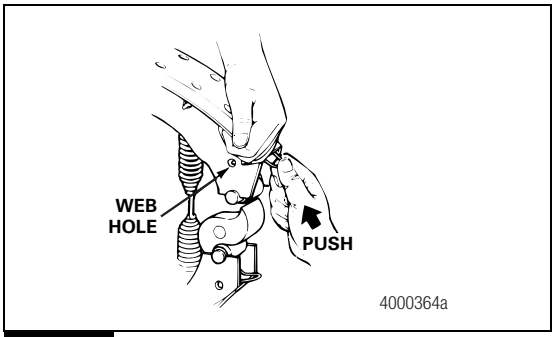


Figure 5.21

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.

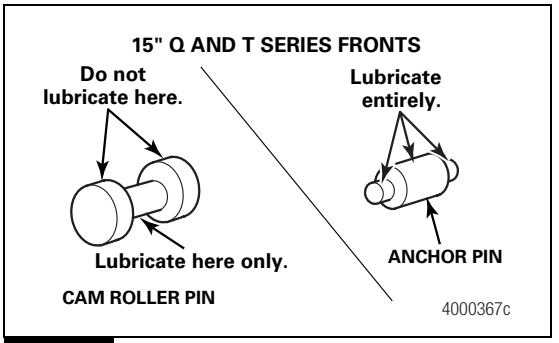


Figure 5.22

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.

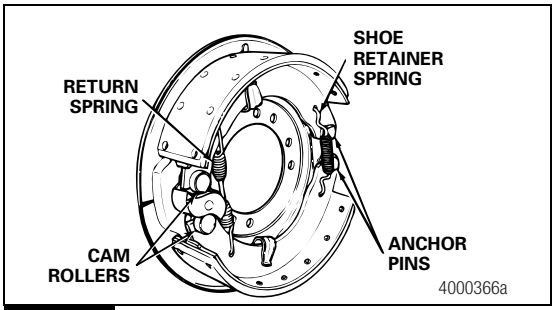


Figure 5.23

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.

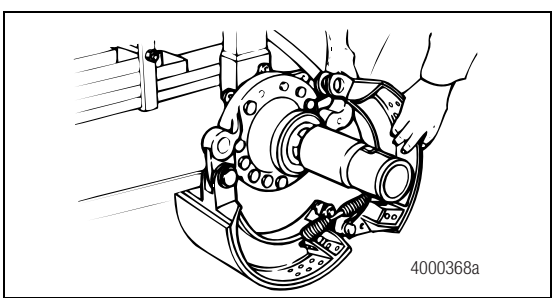


Figure 5.24

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.

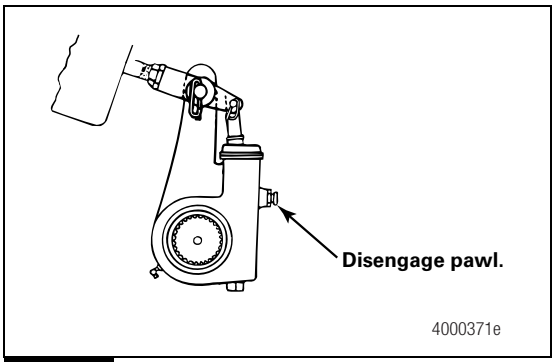


Figure 6.1

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.

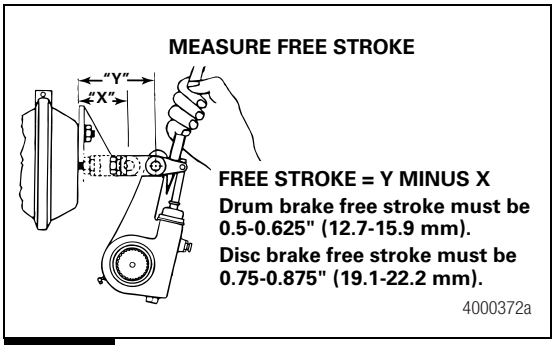


Figure 6.2

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.

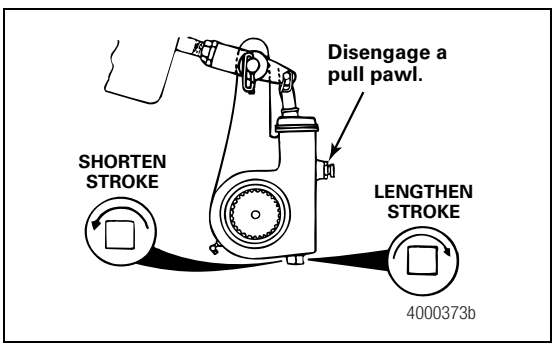


Figure 6.3

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."

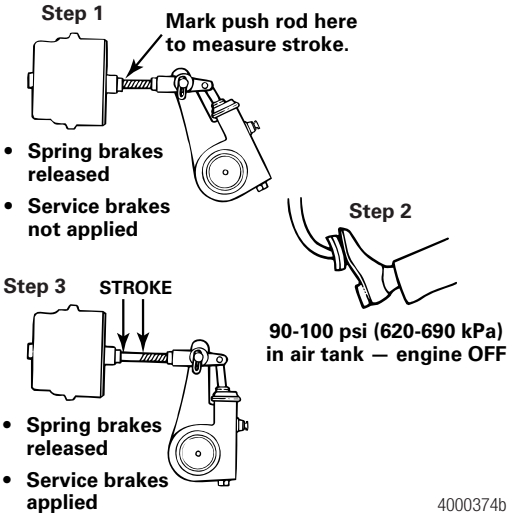


Figure 6.4

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.

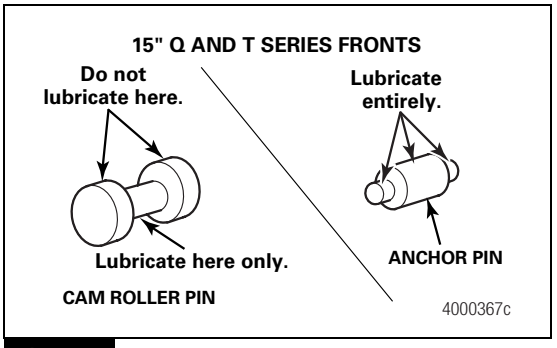


Figure 7.1

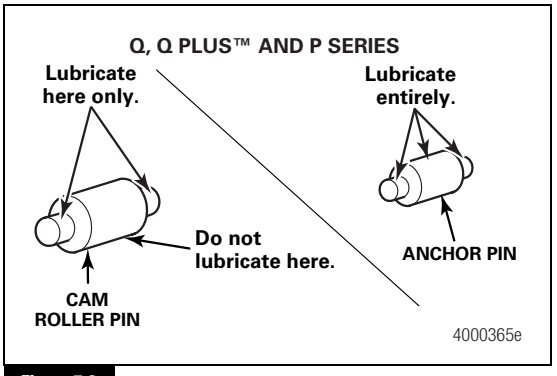


Figure 7.2

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.

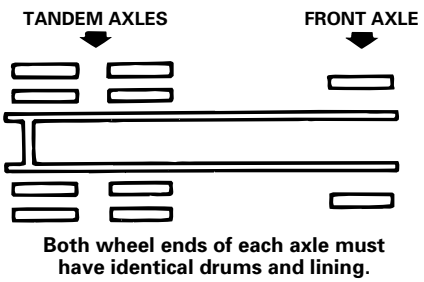
For complete maintenance and service information on the Meritor LX500 and MX500 cam brakes, refer to Maintenance Manual MM-96173, Q Plus™ LX500 and MX500 Cam Brakes. To obtain this publication, refer to the Service Notes page on the front inside cover of this manual.

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.

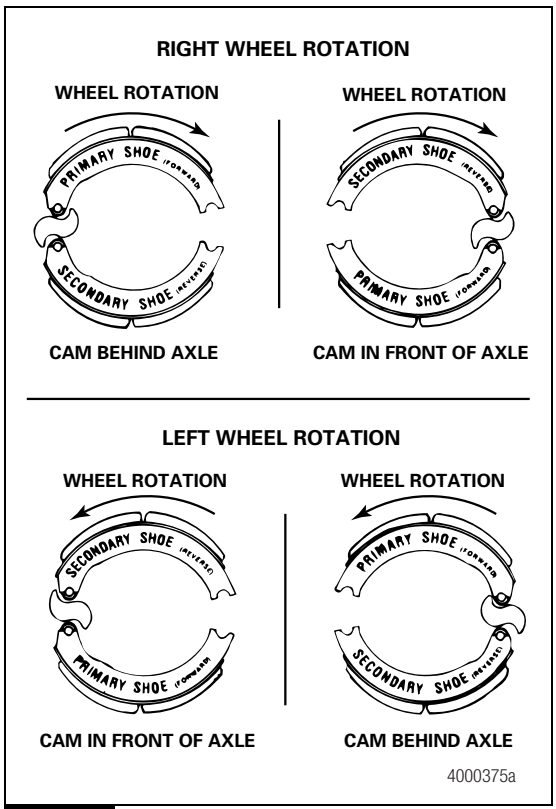


Figure 7.4

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.

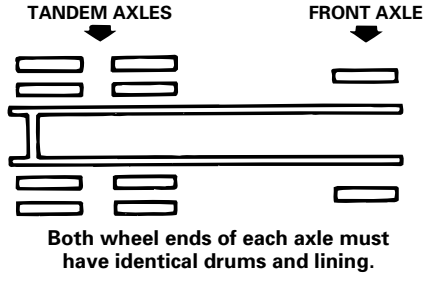


Figure 7.5

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.

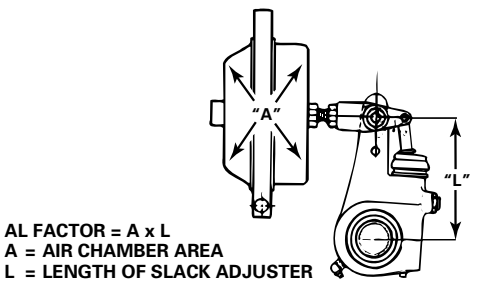


Figure 7.6



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

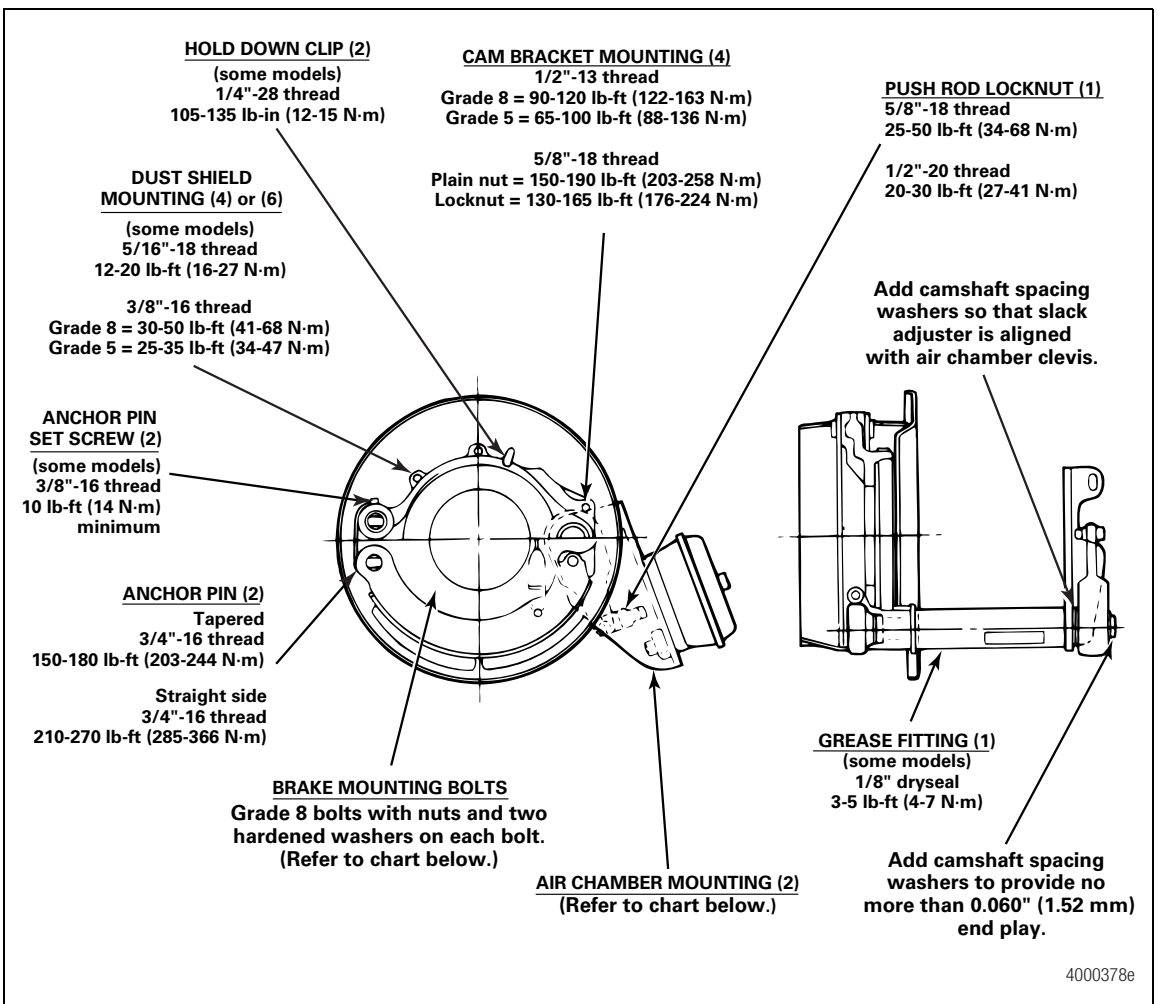


Figure 9.1

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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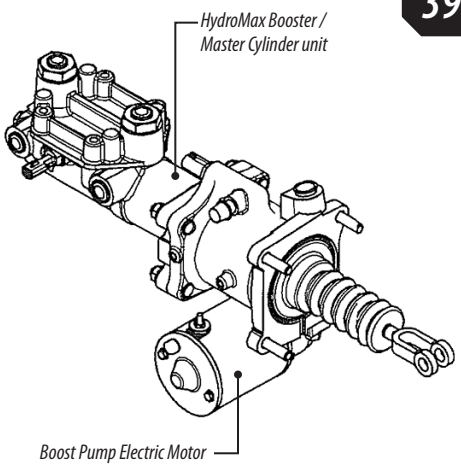
ArvinMeritor™

Overview

The All American Forward Engine buses are available with hydraulic disc brakes as the standard braking system and air brakes as the optional braking system.

When hydraulic brakes are applied, two separate hydraulic systems combine their mechanical output function: The hydraulic brake system, and the hydraulic power steering system. Although the two systems interact, they are separate closed circuits with separate fluid supplies. The component at which the two systems interface is the Bosch Hydro-Max™ Booster assembly/master cylinder.

Under normal operating conditions, the driver presses the brake pedal, actuating the HydroMax booster which actuates the master cylinder and transfers pressure to the brake calipers at each wheel. The booster portion of the HydroMax system receives hydraulic flow from the power steering circuit. When pressure is applied to the brake pedal it causes a restriction of flow inside the booster resulting in an increase of pressure. The increase in pressure provides a power assist (or boost), an increase of force applied to the master cylinder that is greater than the force the driver applied to the brake pedal.



A flow switch mounted on the body of the brake booster monitors flow in the power steering and brake booster hydraulic circuit. If the flow falls below a set point, the flow switch, through an electrical relay, activates an electric pump mounted on the underside of the HydroMax to provide hydraulic flow with in the booster. The BRAKE warning light on the driver's instrument panel is also activated.

When there is no hydraulic flow from the primary source (steering circuit) to the HydroMax, and no flow being provided by the electric pump, the hydraulic brakes still operate but with a reduced power assist.

The master cylinder, assisted by the HydorMax power booster, transfers hydraulic brake fluid to the Antilock Brake System (ABS) modulator which is mounted on the left frame rail. Under normal braking conditions the modulator distributes equal flow to the brake system caliper assemblies mounted on each wheel. When an aggressive braking condition occurs and the system enters an ABS mode, the flow of brake fluid to each caliper assembly will be regulated by the ABS modulators according to control signals it receives from the ABS Electronic Control Unit (ECU), which is mounted to the ABS modulator.

At each wheel, a wheel speed sensor detects the speed of the rotating wheel and sends a signal to the Antilock Brake Sytem ECU. The ECU monitors the wheel speed signals and controls the modulator to adjust the braking pressure at each wheel individually, to maintain traction (avoid wheel lock) at all wheels, providing better control of the bus under adverse braking conditions.

The All American Forward Engine bus equipped with hydraulic brakes may also be equipped with a brake interlock system, which actuates the brakes under certain conditions, such as a wheelchair lift door being open. The brake interlock system uses its own separate fluid supply, filled with DOT 5 fluid.

Blue Bird All American Forward Engine buses equipped with hydraulic brakes employ a cable-actuated drum-type parking brake installed on the rear of the transmission. The parking brake is not to be used as a normal service brake, but can be used to help stop the bus in an emergency situation.

Appendixes In This Chapter

Appendix 1: Hydro-Max Hydraulic Brake Booster and Master Cylinder. This Bosch publication details the operation of the master cylinder & booster assembly, and includes troubleshooting information.

Appendix 2: Hydaulic ABS. Meritor Wabco Maintenance Manual 39. Detailed information on the ABS Module and other ABS components. Includes troubleshooting using blink codes and Meritor Wabco Toolbox diagnostic software.

Appendix 3: Four Piston Quadraulic Disc Brake Caliper. Meritor MM-2075. Detailed information on disassembly, inspection, and reassembly of the brake calipers.

Appendix 4: Mico 691, Operation and Installation Instructions. Detailed information on the Mico 691 Brake Lock System. Includes principle of operation, installation, service and troubleshooting of the system.

Maintenance Overview

Servicing the hydraulic brake system involves procedures at several levels.

- Regularly scheduled maintenance tasks such as inspection, fluid replenishment, and linkage lubrication. See the Hydraulic Brakes Maintenance chart below (also included in the Brakes chart in the Specs & Maintenance Chapter).

- Replace and/or service normal wear parts, such as brake pads and rotor surfaces, as they approach their service life specifications. These procedures must be performed according to the manufacturers' specifications. References are provided in the various component sections that follow.

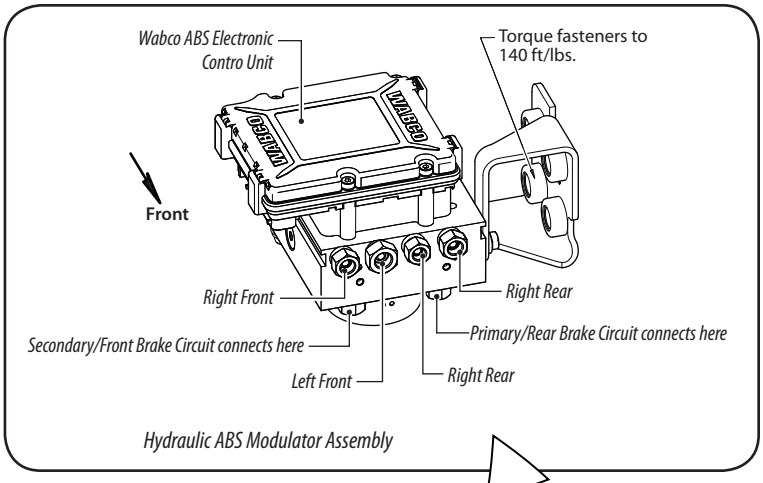
- More involved overhaul or rebuild procedures for major components; for example, replacement of seals in the caliper(s). These also must be performed according to manufacturers' procedures. Appropriate references are provided in the respective component descriptions below.

- When any part of the brake system's hydraulic fluid circuit is disassembled or loosened, the system must be bled before returning the bus to operation. This must be done according to procedures found in the following Appendixes, the **Hydro-Max Hydraulic Brake Booster and Master Cylinder, the Meritor Wabco, Hydraulic Anti-Lock Braking Systems (HABS) for Medium - Duty Trucks, Buses and Motor Home Chassis, Maintenance Manual MM-0677 and the Four Piston Quadraulic Disc Brake Caliper. Meritor MM-2075.** Arvin Meritor also provides additional information online at www.arvinmeritor.com. If the bus is equipped with the brake interlock feature see the Mico Service Manual listed above for bleeding procedures.

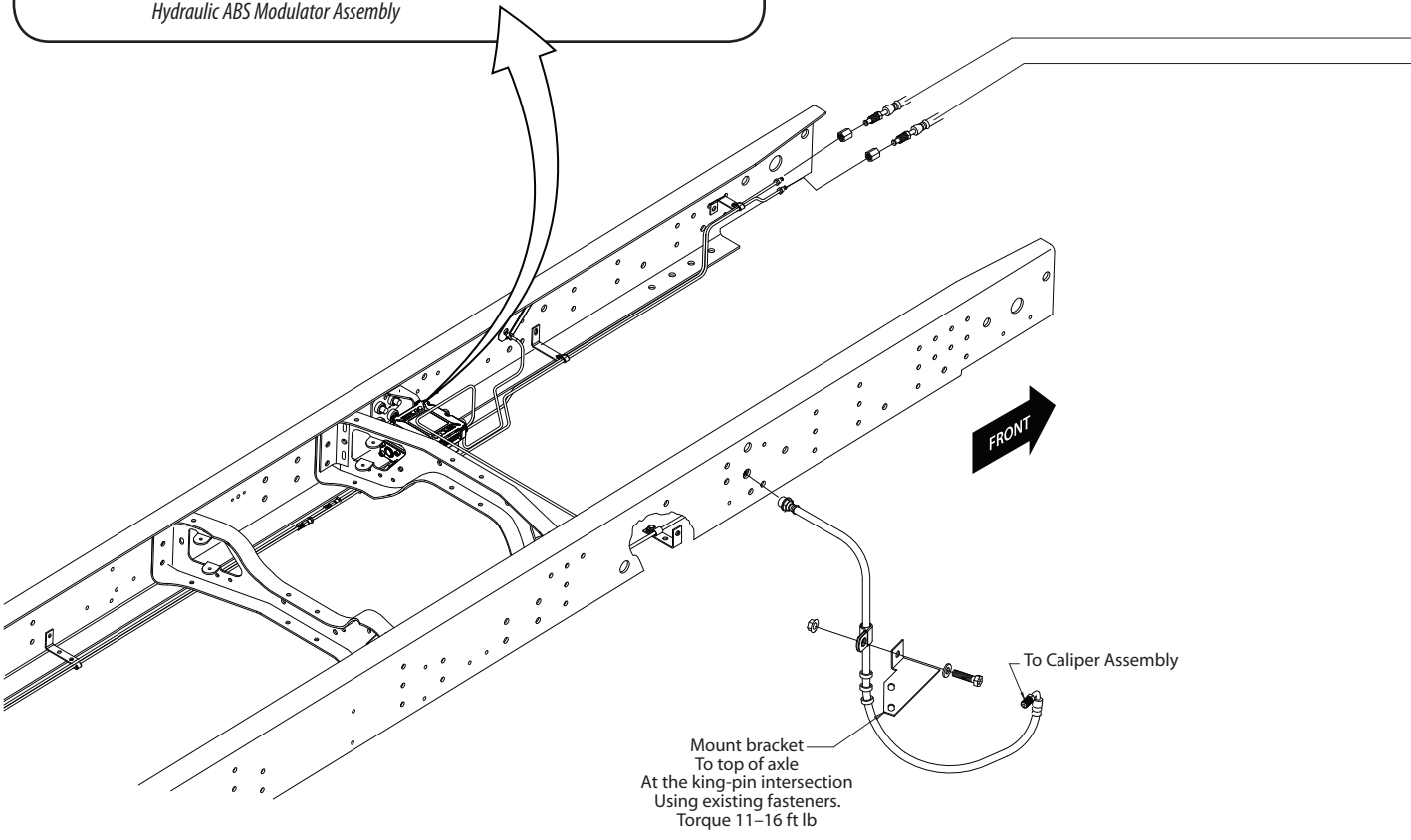
Hydraulic Brakes Maintenance

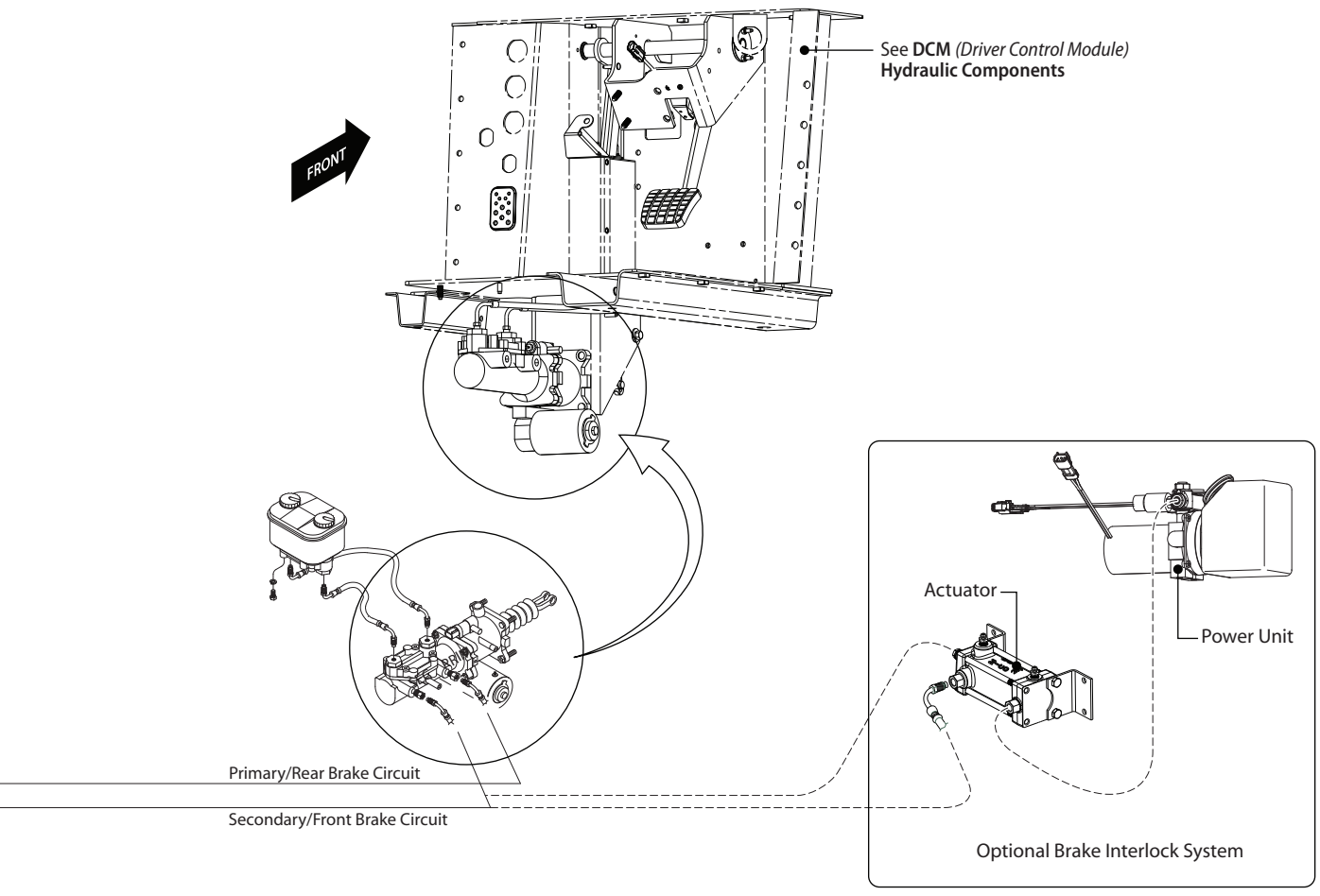
Interval: Months/1000 Miles
whichever occurs first

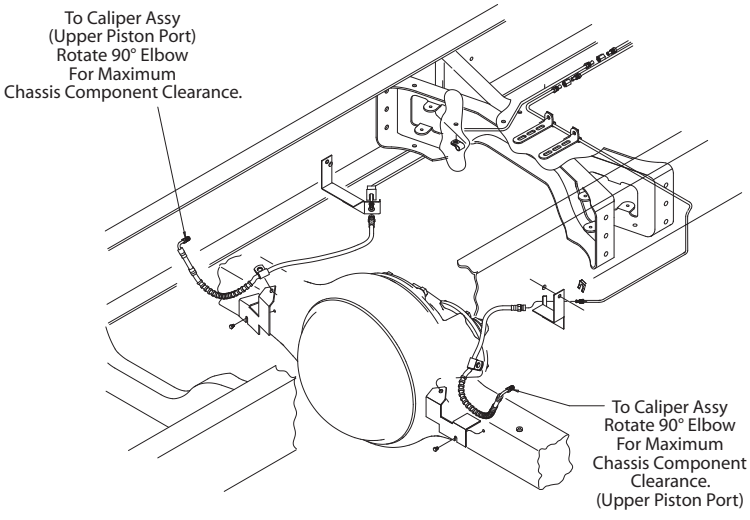
Operation	1 / 3,000	3 / 5,000	3 / 24,000	6 / 6,000	6 / 10,000	12 / 12,000	12 / 24,000	24 / 24,000	Notes
Hydraulic Brakes									
Check fluid level	•								*Use DOT-3 brake fluid.*
Inspect booster & master cylinder			•						*Inspect for signs of leakage or damage.*
Adjust park brake lever	•								*Adjust engagement pressure at foot pedal to 130-150 lbs. at forth click.*
Hydraulic Brakes Interlock									
Check fluid level	•								*Use DOT-5 brake fluid.*
Hydraulic Brake Wheel Ends									
Inspect calipers				•					*Inspect for signs of leakage or damage.*
Lubricate calipers		•							*See Meritor documentation.*
Check pad thickness	weekly or as needed in severe applications								*Minimum ⅛ inch (3.175 mm).*



Hydraulic ABS Modulator Assembly

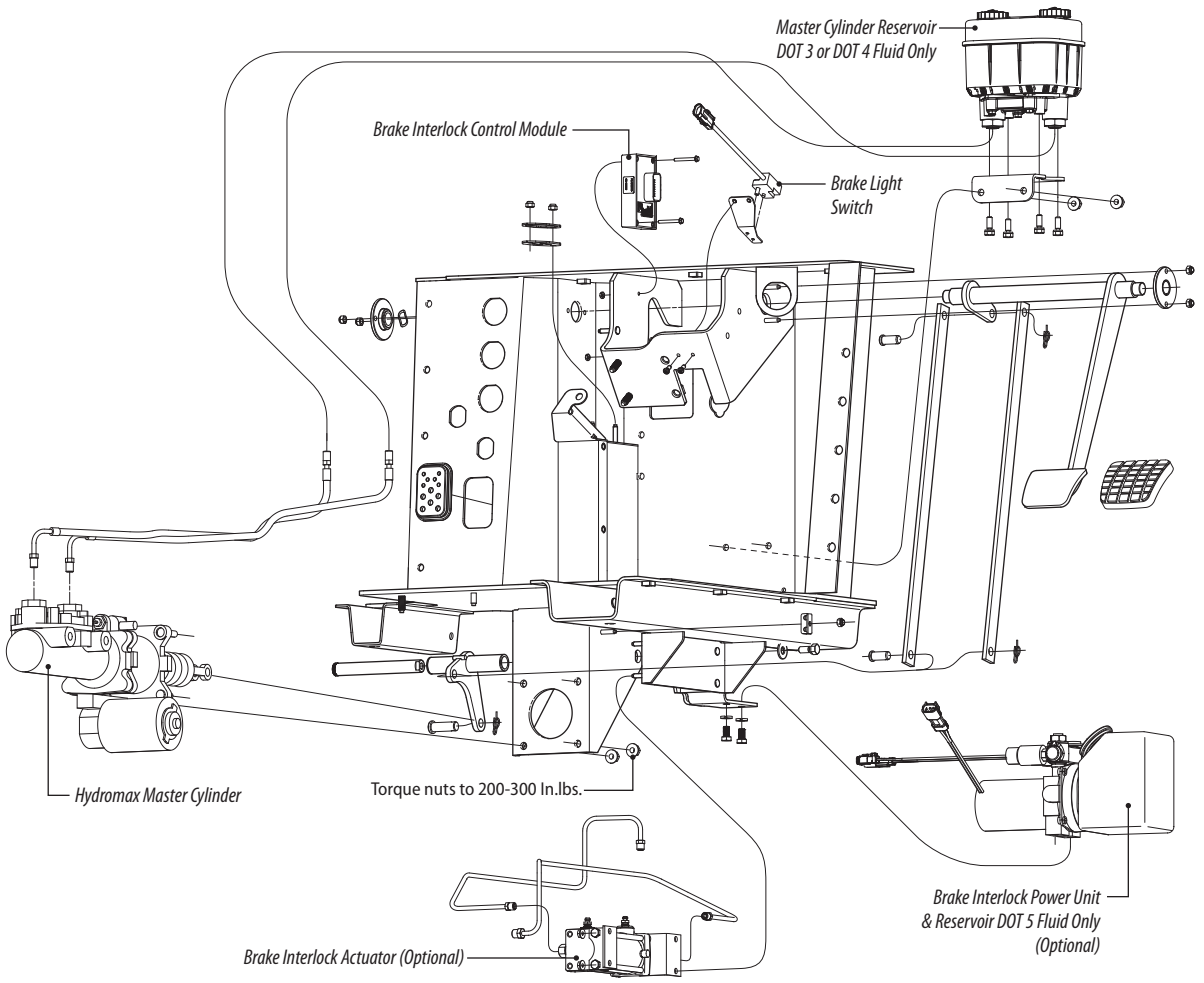


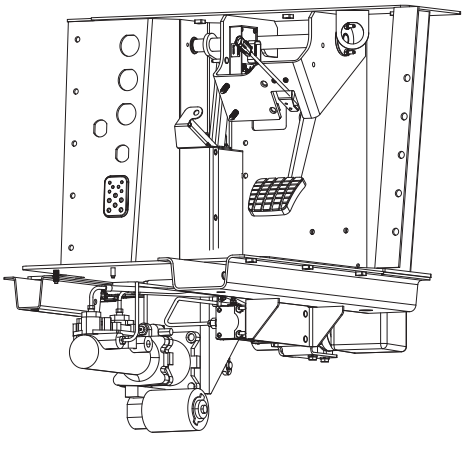




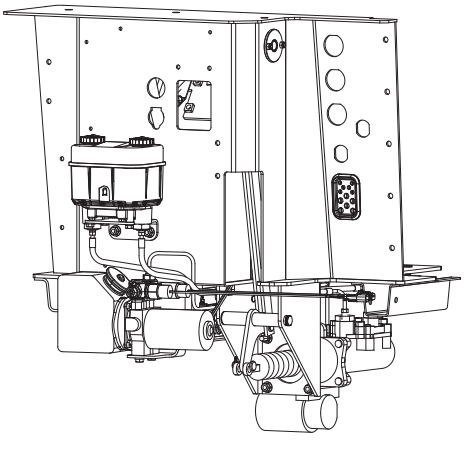
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Hydraulic Brake System Diagram





DCM Viewed from Driver's Side



DCM Viewed from Front Access Panel

DCM Hydraulic Components

- Whenever servicing any part of the hydraulic brake system, remember that up to three different sub-systems may be involved, each with its own fluid circuit; steering & boost circuit (HydroMax), brake circuit (master cylinder), brake interlock circuit (the Mico system). Each of these are closed hydraulic circuits using different fluid types. The different fluid types must not be intermixed and must not be allowed to contaminate each other.

WARNING ***The use of an incorrect fluid in the steering, brake or brake interlock circuit may result in a reduced brake function or a failure of the brake system resulting in a potential for bodily harm or death.***

Brake Light Switch Mounting & Adjustment

The brake lights are controlled by a magnetically actuated switch and relay. The switch is located on the brake pedal support bracket under the dash. Activation of the switch depends on the location of the brake pedal. When the brake pedal is released the brake pedal arm is at it's closes position to the switch. The magnet within the switch reacts to the brake pedal arm and forces the contacts in the switch open (brake lights off). When the brakes are applied, the brake pedal arm moves away from the switch, the magnet has nothing to react on and the switch contacts close (brake lights on).

The brake light switch is mounted to the stop light switch bracket which is mounted to the brake pedal support bracket . There are no adjustments provided in the mounting brackets so the brake light switch is non-adjustable.

The brake light and park brake switch are identical switches.

Master Cylinder

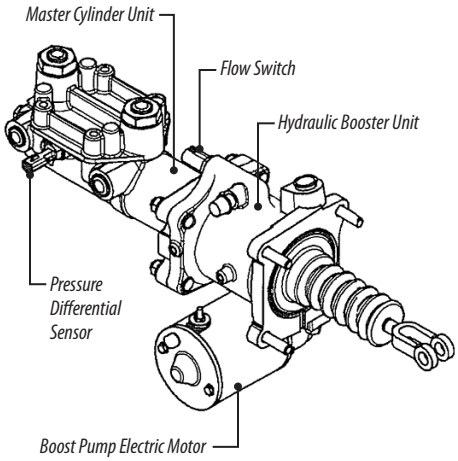
The master cylinder is mounted directly to the body of the HydroMax hydraulic booster. These two components are mounted as a unit to the underside of the chassis front assembly (driver control module, DCM), directly below the Driver area floor.

The brake fluid reservoir for the brake system is accessible by opening the driver's side front access panel. The reservoir and master cylinder circuit requires DOT 3 brake fluid.

When the brake is operated, a piston in the master cylinder drives brake fluid into the brake lines transferring the mechanical force to the brake calipers at each wheel.

The master cylinder is internally divided into two hydraulic circuits; one for the front brakes, and one for the rear brake circuit. The brake fluid reservoir is similarly divided, thus its two fill caps. Hydraulic leakage or complete failure in one system does not affect function of the other system.

An electric sending unit is mounted to the side of the master cylinder. If a significant pressure difference is detected between the front circuit and rear brake circuit inside the master cylinder during brake application, the sensor sounds an audible alarm in the driver's area and turns on the BRAKES warning light on the instrument panel.



Troubleshooting

Symptoms that may indicate Hydro-Max system failure include, but are not limited to:

- Brake fluid or power steering fluid leakage from between the master cylinder and booster.
- Hard pedal. Excessive pressure is required at the pedal to apply brakes.
- Excessive pedal travel. Pedal goes to the floor.
- Actuated pedal does not return.
- Brake drag.

For a more detailed description of the master cylinder's operation, as well as troubleshooting guidelines, see Hydraulic Brakes, **Appendix 1: Hydro-Max Hydraulic Brake Booster and Master Cylinder.**. If the master cylinder is determined to be malfunctioning, it must be replaced. Replacements are available from your Blue Bird Parts Dealer.

Removal

The master cylinder may be unbolted from the booster without removing the entire master cylinder/booster combination as a unit. However, it is possible that when the master cylinder is unbolted from the booster, the booster's internal spring may cause its o-ring seal to pop out, spilling hydraulic fluid. Thus, it is a good practice to take measures to catch the hydraulic fluid in case this occurs.

1. Park the bus on a level surface with parking brake on and block the front and rear tires to prevent vehicle movement.

2. Disconnect the negative terminal of the battery.

3. Disconnect the harness wire from the master cylinder's pressure differential sensor.

4. Position a suitable container under the master cylinder/booster assembly.

5. Disconnect the four hydraulic lines from the master cylinder.

6 Remove the four bolts and nuts which fasten the master cylinder to the booster and remove the master cylinder.



Reinstallation

Install the master cylinder by reversing the removal procedure.

1. Mount the master cylinder to the booster and tighten the four bolts to 25–30 ft. lbs. (33.9–40.7 Nm).

2. Reattach the brake fluid lines and tighten the nuts to 200 in. lbs. (22.5 Nm).

3. After installation, the brake system must be bled before operating the bus. This must be done according to procedure found in Appendix 1, 2, 3 and 4.

4. Test drive the bus for proper operation of the entire brake system before placing the bus back in service

Booster

The brake booster is the portion of the HydroMax unit which is mounted directly to the support bracket on the Chassis front assembly (DCM) under the driver's floor. The booster itself serves as the support for the brake master cylinder.

During normal operation, the hydraulic fluid flows through the booster's inlet port, a metering valve inside the power piston, and then exits through the outlet port. When the brake pedal is applied, the booster's input rod activates an internal metering valve, restricting flow through the power piston. The resulting pressure, acting upon the power piston, applies force to the master cylinder's piston "boosting" the force applied to the brake pedal by the driver.

Although the master cylinder is mounted to the HydroMax booster assembly the power steering fluid flowing through the booster is isolated from the DOT 3 brake fluid used in the master cylinder circuit. If the booster or the master cylinder leaks fluid between their matting housings, the fluid would leak through a weep hole formed by the two assembly joining together, preventing a transfer or contamination of the other systems

WARNING ***The use of an incorrect fluid in the steering, brake or brake interlock circuit may result in a reduced brake function or a failure of the brake system resulting in a potential for bodily harm or death.***

The Booster assembly incorporates an electric motor/pump which provides a secondary source of hydraulic flow inside the booster under the following conditions; whenever primary flow from the power steering circuit is not available, when the ignition switch is on and the engine is not running or the brake pedal is depressed and the ignition switch is off. A flow switch mounted at the top of the booster, near the outlet port is held open by normal flow of hydraulic fluid through the booster. When flow drops below one gallon per minute the switch closes, energizing a power relay, and thereby providing electrical power to the motor/pump. The switch also provides a signal to the instrument panel to activate a warning light and an audible alarm.

Troubleshooting

Symptoms which may indicate booster failure include, but are not limited to:

- Hydraulic steering fluid leakage between the master cylinder and booster.
- Hard pedal. Excessive pressure is required at the pedal to apply brakes.
- Actuated pedal does not return.
- Brake self apply, May indicate failure in the booster control valve.
- Brake drag. May indicate failure in the booster control valve

For a more detailed description of the booster's internal operation, as well as troubleshooting guidelines, see Hydraulic Brakes **Appendix 1: Hydro-Max Hydraulic Brake Booster and Master Cylinder**. If the booster is determined to be malfunctioning, it must be replaced. Replacements are available from your Blue Bird Parts Dealer.

Removal

As described above, the booster supports the master cylinder. Although it is possible to remove the booster without removing the master cylinder, doing so will require devising means by which to support the weight of the master cylinder to avoid bending the brake lines. The following procedure assumes that the master cylinder/brake booster assembly will be removed as a unit, and that the two components will be separated after removal. Note that this will require the brake system be bled after reassembly.

1. Park the bus on a level surface with the parking brake on and block the front and rear tires to prevent vehicle movement

2. Disconnect the negative terminal of the battery.

3. The pressure differential sensor and the booster flow sensor circuit lead to a single connector at the wire harness. Disconnect this connector and the boost pump motor circuit.

CAUTION ***DO NOT apply the brakes after removal of the input hose unless the reserve boost system is disconnected. Reserve boost pressure will blow the inlet check valve out of the booster.***

4. Loosen the hose clamp at the booster outlet, remove the hose and plug the end of the hose.

5. Remove the hose fitting at the booster inlet and plug the end of the hose, and/or support it vertically to prevent spillage.

6. Disconnect both output brake lines from the master cylinder.

7. Disconnect and plug the reservoir fluid lines which lead to / from the master cylinder.

8. Remove the cotter pin, washer and clevis pin which connect the booster push rod to the brake bell crank linkage.

9 Remove the four nuts which secure the booster's mounting studs to the mounting bracket. While doing this, have a helper support the master cylinder/booster assembly or devise other means to support it while removing the nuts.

10. With the HydroMax assembly removed from the bus, remove the four bolts, nuts, and washers which fasten the master cylinder unit to the booster unit.

Servicing

Any components found defective, in the brake booster must be replaced. Contact your Blue Bird parts dealer for a replacement. Refer to Appendix 1 for more information.

Installation

Install the booster by reversing the removal procedure.

1. Assemble the master cylinder to the booster and tighten the four bolts to 25–30 ft. lbs. (33.9–40.7 Nm).

2. Mount the reassembled master cylinder/booster unit on the vehicle and tighten the four mounting nuts to 18–25 ft. lbs. (24.4–33.9 Nm).

3. Reattach the brake fluid lines to the master cylinder and tighten the nuts to 200 in. lbs. (22.5 Nm).

4. Reattach the brake fluid reservoir lines to the master cylinder and tighten.

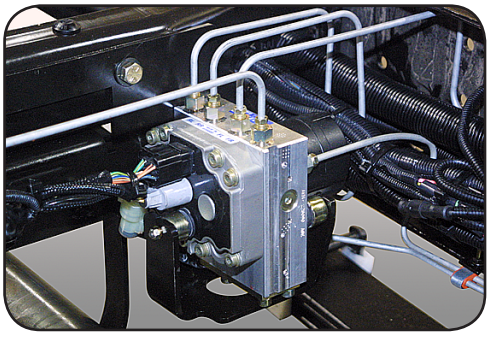
5. Attach the booster push rod to the brake bell crank linkage with the clevis pin and washer. Use a new cotter pin.

6. After installation, the brake system must be bled before operating the bus. This must be done according to procedures found in Brake Appendix 1, 2, 3. If the brake interlock feature is installed on the bus, Brake Appendix 4 will also need to be referenced for bleeding procedures.

ABS Modulator

The ABS modulator is mounted on a bracket affixed to a left frame rail.The modulator houses the ABS solenoid control valves (one inlet valve and one outlet valve per wheel), a pump motor, and two accumulators.

Under normal braking conditions, the modulator unit receives brake fluid pressure from its two inlets (one for the front brakes; one for the rear) and distributes the pressure evenly to the brake calipers. During an aggressive braking application if the ABS ECU detects an impending wheel lock up the controller will signal the modulator to regulate the brake fluid pressure for each caliper. If the ABS system is activated, the solenoid valve is rapidly pulsed; opening and closing many times per second to control the brake pressure and preventing wheel lock. When this occurs, the driver may notice a pulsation of the brake pedal.



Hydraulic ABS Modulator

Troubleshooting

For troubleshooting and diagnosis of the modulator, see Appendix 2. The modulator should be replaced as a unit if found to be defective. ABS error codes can be viewed through a diagnostic menu in the instrument panel message center. Refer to the instrument panel chapter in this manual

Removal

Removing the modulator involves three electrical plugs, six brake fluid tubes, and three mounting studs:

1. Park the bus on a level surface with the parking brake on and block the front and rear tires to prevent vehicle movement.

2. Disconnect the negative terminal of the battery.

3. Disconnect the chassis wire harness's control plug and main ground plug from the modulator unit. Disconnect the pump's pigtail connector from the chassis wire harness.

4. Mark the six brake lines for ease of installation. Place a container under the modulator assembly to catch leaking brake fluid. Disconnect the six brake lines

CAUTION ***Incorrect installation of the brake lines at the modulator may result in reduced control or a loss of control of the vehicle during an aggressive brake application resulting in a potential for bodily harm or death.***

5 The mounting holes of the bracket are slotted and open on the top. Loosen the mounting nuts on the modulator's three rubber isolator mounts and remove the modulator.

Reinstallation

Reinstall the modulator in the reverse order from removal, being sure to tighten fittings to the appropriate torque values:

1. Place the modulator in its bracket, being sure the studs of the three rubber isolators seat in the bottom of the mounting slots. Tighten the mounting stud nuts to 132 in. lbs (15 Nm).

2. Connect the main ground plug and the control plug on the chassis wire harness to the unit. Connect the pump's pigtail connector into the wire harness.

3. Connect the two small brake lines and tighten to 108 in. lbs. (12 Nm).

4. Connect the four larger brake lines and tighten to 132 in. lbs. (15 Nm.).

5. After installation, the brake system must be bled before operating the bus. This must be done according to procedures found in Brake Appendix 1, 2, 3. If the brake interlock feature is installed on the bus, Brake Appendix 4 will also need to be referenced for bleeding procedures.

Wheel Speed Sensors

A wheel speed sensor is mounted on the inboard side of each wheel assembly. As the wheel rotates, the flats of a notched casting (exciter ring) in the wheel end assembly pass in close proximity to the sensor. The sensor responds to the passing notches magnetically and outputs a voltage, which increases with the speed of the wheel. This signal is then used by the ABS ECU to determine when wheel lock is imminent.

Troubleshooting

Brake Appendix 2 includes specific information on testing the output voltage and resistance of the wheel speed sensors. Sensors found out of range should be replaced.

Removal

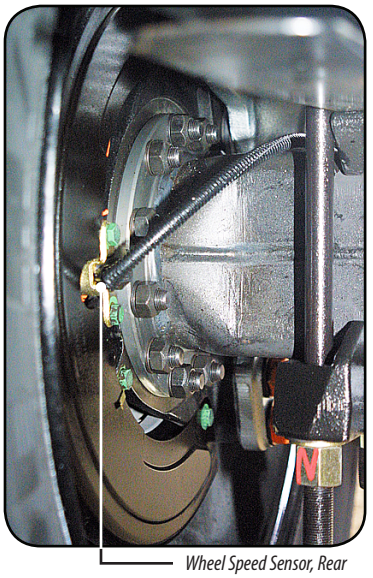
The sensors are held in place by the friction fit spring clip sleeves which are inserted into the mounting blocks with the sensors. To remove a sensor:

1. Park the bus on a level surface with parking brake on and block the front and rear tires to prevent vehicle movement.

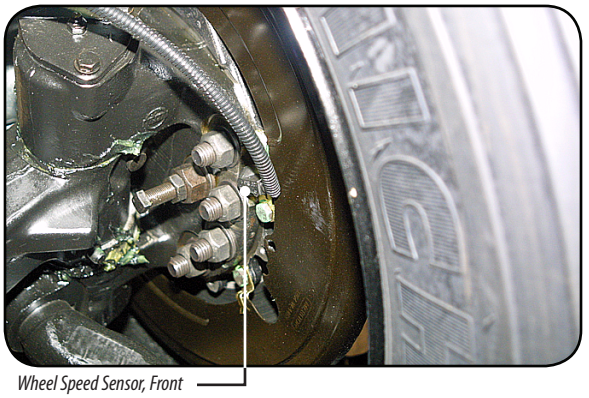
2. Disconnect the sensor cable from the wire harness and remove the cable from any cable clamps or clips.

3. Pull the sensor straight out of its socket, using a twisting motion if required. Do not pull on the wires. On front wheels, removal of the sensor may be impeded by interference with the steering arm casting. If this occurs, removal may be more easily achieved by removing the two bolts which secure the sensor's mounting block.

4. The spring clip may remain in the socket, or may pull out with the sensor. Remove and inspect the spring clip replaceing any damaged spring clips with new ones.



Wheel Speed Sensor, Rear



Wheel Speed Sensor, Front



Installation

The steps below assume the sensor has been removed without removing its mounting block. If removal of the sensor has required removal of its mounting block, install the new sensor into the mounting block according to the steps below and reinstall the mounting block using a thread locking compound on the threads of the two bolts and tighten the two mounting bolts to 16–18 ft. lbs. (21.7–24.4 Nm).

1. Connect the new sensor cable to the chassis harness.

2. Press the sensor spring clip into the socket until it stops. Make sure the tabs are on the inboard side.

3. Apply an appropriate lubricant to the shank of the sensor. Lube must be mineral oilbased and contain molydisulfide. It should have excellent anticorrosion and adhesion characteristics and be capable of continuous function in a temperature range of - 40° to 300°F (40 to 150° C).

4. Push the sensor completely into the spring clip until it contacts the exciter ring.

5. Reattach the sensor cable to the cable clamps or clips.

6. Secure the sensor cable with tie wraps every 6 to 12 inches as needed. Properly bundle and store excess cable.

ABS Electronic Control Unit (ECU)

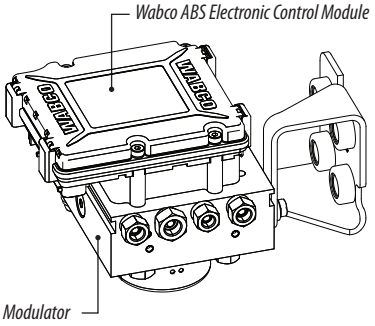
The ABS System ECU is the "computer" which monitors and controls the other components of the ABS System. The unit receives signals from the wheel speed sensors, processes them, and generates solenoid valve commands for the ABS modulator to reduce, maintain, or reapply brake pressure.

When the ECU senses an error in the system, it activates the ABS light on the driver's instrument panel. ABS error codes can be viewed through a diagnostic menu in the instrument panels message center. Refer to the instrument panel chapter in this manual.

The ECU also stores ABS errors which it has detected but are not presently active. This information can be accessed and used to troubleshoot the ABS system using Meritor Wabco's PC-based diagnostic software. The PC is connected using an appropriate adapter to the 9-pin diagnostic port located under the dash to the right of the steering column. Once connected, the diagnostic software can communicate with the ECU to display system faults and wheel speed data, test individual components, verify wiring, and more. The specific interface adapter needed varies according to the specific computer setup being used. Meritor Wabco provides a toll-free number, 800/535-5560, for ordering the software and for assistance.

Removal

On All American Forward Engine buses with hydraulic brakes, the ABS ECU is mounted to the ABS modulator which is mounted to the inboard side of the left frame and forward of a chassis cross member. See **Hydraulic Brake Sysem Diagram**.

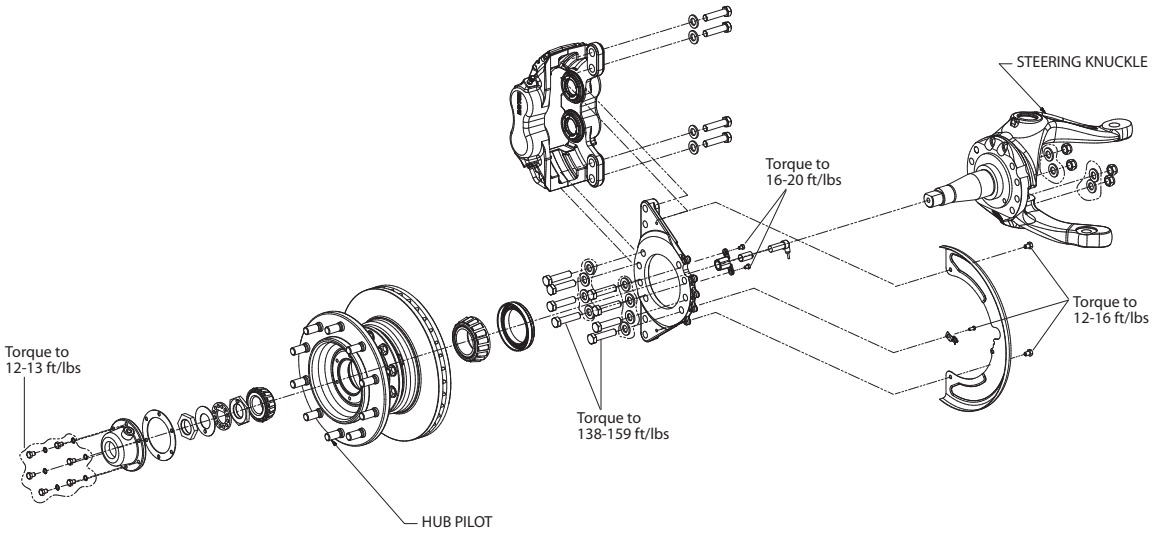


Hydraulic ABS Modulator Assembly

1. Park the bus on a level surface with parking brake on and block the front and rear tires to prevent vehicle movement
2. Disconnect the negative battery cable
3. Clean the area around the modulator and ECU
4. Open the latches on the 31-pin harness and remove the connectors form the ECU
5. Using a 4mm Allen wrench remove the mounting screws
6. Carefully remove the ECU by lifting straight out, do not twist the ECU during the removal.

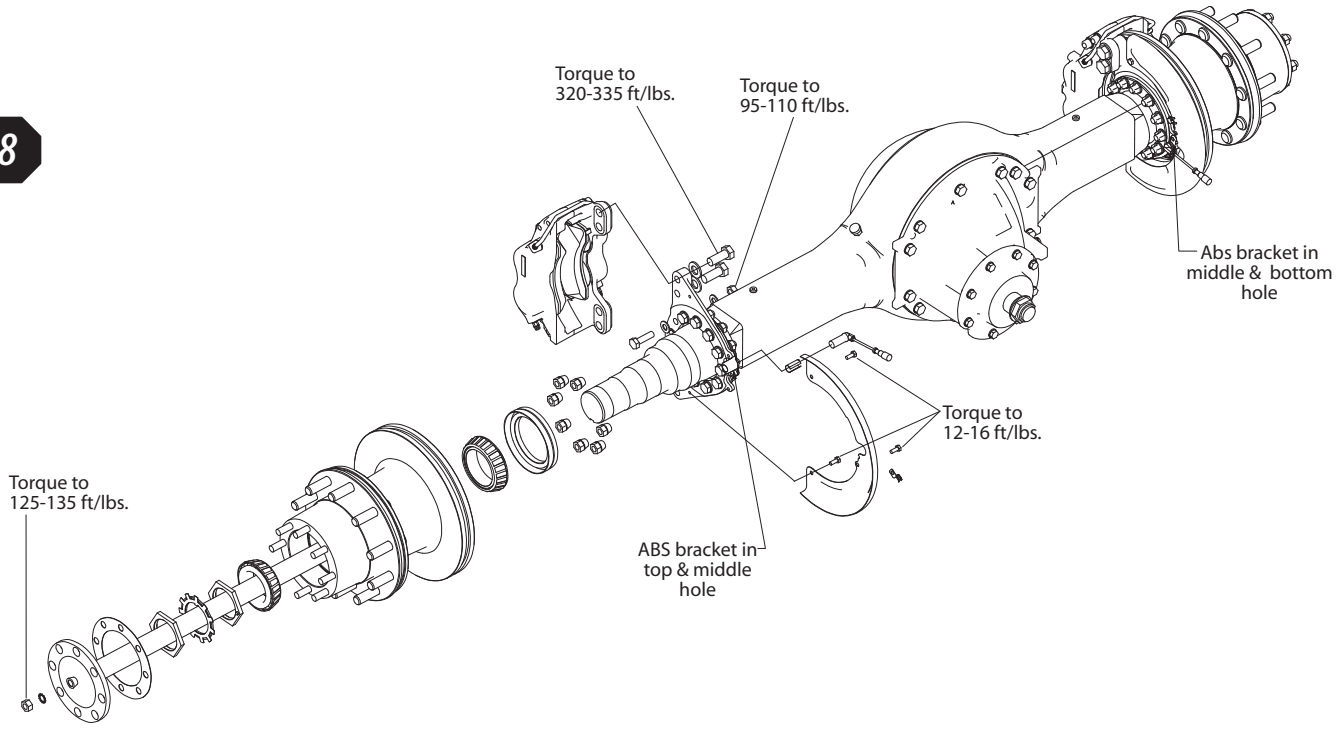
Installation

Reinstall the ECU in reverse order of the removal steps (see specific instructions in Brake Appendix #2).



0096733E

Hydraulic Brake Wheel Ends, Front



0098981E

Hydraulic Brake Wheel Ends, Rear

Calipers

The Blue Bird All American with hydraulic brakes uses Meritor 70mm four piston Quadraulic disc brake calipers. The same model caliper is used on all four wheels, but left and right side housings are mirror versions. An installation includes four major components: the caliper itself, the caliper support assembly, hub/rotor assembly, and attaching hardware.

When brakes are applied, brake fluid pressure (as regulated by the master cylinder during normal braking) causes the caliper's pistons to extend, pressing the brake friction pads against the surfaces of the rotor. The brake fluid line from the modulator attaches directly to the inboard side of the caliper. A crossover tube supplies fluid to the outboard pistons.

Servicing

If a caliper assembly is leaking, has stuck piston(s), or is otherwise found damaged, it must be replaced or rebuilt according to manufacturer's instructions. Step by step procedures for rebuilding the brake calipers are included in Appendix 3.

WARNING DO NOT rebuild a caliper with damaged piston bore(s). If the piston bore is corroded, galled or scratched, replace the caliper assembly. Replacing only the piston and seals will not correct the damage. Do not attempt to hone or rebore damaged piston bores. Piston sized for honed caliper bores are not available.

Removal

The caliper housing is mounted to the caliper support assembly by four bolts on the inboard side of the caliper.

1. Park the bus on a level surface with parking brake on and block the front and rear tires to prevent the vehicle movement.

2. Raise the wheel to be serviced and support the vehicle with safety stands.

3. Remove the tire and wheel assembly.

4. Remove the brake hose from the inboard side of the caliper.

5. Remove the four calipers to support assembly bolts.

Installation

To install the caliper, reverse the removal process. Torque the caliper mounting bolts to 320–360 ft lb (434–488 Nm). Bleed the affected brake line system After installation, the brake system must be bled before operating the bus. This must be done according to procedures found in Brake Appendix 1, 2, 3. If the brake interlock feature is installed on the bus, Brake Appendix 4 will also need to be referenced for bleeding procedures. Road test the vehicle before returning it to normal service.

Brake Pads

The brake pads on the front and rear of the All American, and on the inside and outside of the calipers are identical (8 total). Whenever working on the brake system, avoid contamination of the brake pads by brake fluid or grease. Contaminated brake pads, even if new, must be replaced.

Inspection

Brake pads should be inspected for the amount of wear at least every 3000 miles. When the friction pad material is worn to a thickness of 1/8 inch (3.2mm), the pads must be replaced. It is recommended that when one brake pad has reached its service limit, all brake pads should be replaced. If not, at least the brake pads on both sides of the same axle must be replaced at the same time.

Removal

Removal of the brake pads requires removal of the wheel, but not of the caliper. The brake pads are held in place by retainer spring plates, which are secured with one bolt.

1. After installation, the brake system must be bled before operating the bus. This must be done according to procedures found in Brake Appendix 1, 2, 3. If the brake interlock feature is installed on the bus, Brake Appendix 4 will also need to be referenced for bleeding procedures.

2. Remove the tire and wheel assembly.

3. Remove the master cylinder reservoir filler cap. Check the brake fluid level in the reservoir. If necessary, remove fluid to keep the reservoir from overflowing when the caliper pistons are compressed.

4. Remove the pad retainer spring bolt and remove the retainer spring. Remove the two brake pads.

Installation

Because the pistons travel out from their bore during the wear of the pads, it is necessary to compress them back into their bores sufficiently to accommodate the thickness of the new pads.

1. Compress the caliper pistons. This can be done with a thin plate and C clamps as shown. Compress the two pistons slowly and equally to avoid cocking or wedging either piston in its bore.

2. When the pistons have been retracted enough to accommodate the new pad, insert the new pad. Be sure that the friction side is against the rotor.

3. Insert the tab of the retainer spring into its retaining hole on the outboard side of the caliper. Install the retainer spring bolt and tighten to 30 ft lb.

Brake Rotors

Disc brake rotors are subject to temperature and stress extremes. As brake pads wear during normal operation, grooves or ridges may develop in the rotor surfaces as a result of road contaminants. The service life of the rotor surfaces may or may not correspond to that of the pads, depending upon operating conditions.

The front and rear brakes on D3 All Americans with standard hydraulic brakes are equipped with Meritor brake components but the removal procedures differ accordingly.

Inspection

When it is necessary to replace the brake pads, inspect the rotors for scoring, warping, cracks, bluing, heat spots or other damage, and for minimum thickness. Repair or replace if necessary. Rotors may be resurfaced at an appropriate truck brake service shop. The thickness of the resurfaced rotor must always exceed the minimum thickness dimension stamped or cast into the rotor. Replace if necessary.

Check the rotor while it is assembled to the hub and mounted on the axle. The lateral runout of the rotor friction surfaces should not exceed .015 in. (.381 mm) total indicator reading (TIR). The thickness variation of the rotor should not exceed .0012 in. (.03 mm). If the lateral runout and/or the thickness variation exceeds these values, have the rotor resurfaced.

Brake Rotor Removal

Remove the front rotor as follows:

1. Park the bus on a level surface with parking brake on and block the front and rear tires to prevent vehicle movement

2. Raise the wheel to be serviced and support the vehicle with safety stands.

3. Remove the tire and wheel assembly.

4. Remove the brake caliper assembly as described in the Calipers section.

5. Remove the ABS sensor.

6. Remove the drain plug from the oil lube hubcap. Drain the oil

7. Remove the six bolts which fasten the hubcap. Remove the hubcap and its gasket.

8. Flatten the tab of the bendable lock washer to allow removal of the wheel nut. Remove the wheel nut and bendable lock washer.

9. Remove the pierced lock ring.

10. Remove the adjusting nut.

11. Remove the outer tapered cage bearing.

12. Slide the hub/rotor assembly off the axle. Note that the inner bearing and seal will slide off together with the hub. Take care to maintain alignment to avoid damaging the seal.

Front Brake Reassembly

1. Clean mating surfaces of both the axle brake flange and the hydraulic brake torque plates.

2. Install the ABS bracket (supplied with brake) onto the torque plate.

3. Install the dust shield (if equipped) onto the torque plate.

4. Install torque plates on the brake mounting flange using specified hardware. Torque plates are right and left handed and must be installed on the correct side. Torque plates are to be installed with the caliper mounting surfaces toward the rear and outside of the chassis. 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 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 vehicle center end of the 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 deformities and check the rubber lip for a smooth even surface. Check for freedom of movement by manually moving the 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 200 ft lb while rotating the hub to seat the bearings. Back off the adjusting nut 1/2 turn. Re-torque nut to 50 ft lb while rotating hub back and forth. Back off nut 1/4 turn.
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 the plug in hub cap and fill with proper oil. Use the sight glass indicator to fill to proper level. Do not overfill!

15. Install brake calipers.

ABS Sensor Installation

1. Firmly install the abs sensor clip in the mounting bracket on the torque plate. The clip is designed to seat in the proper position in the clip.

2. Snap the ABS sensor into the clip just installed. The clip is designed to hold the sensor with a pressure fit.

3. Push the ABS sensor all the way in until it stops against the tone ring. The sensor is self gapping.

4. Route the wire from the wheel area to brake ECU Tie wrap the cable to the brake flanges or axle housing.

Rear Brake Removal,

1. Park the bus on a level surface with parking brake on and block the the front and rear tires to prevent the vehicle from moving.

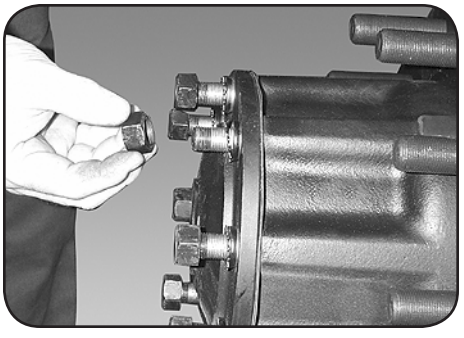
2. Raise the wheel to be serviced and support the vehicle with safety stands under the frame rails.

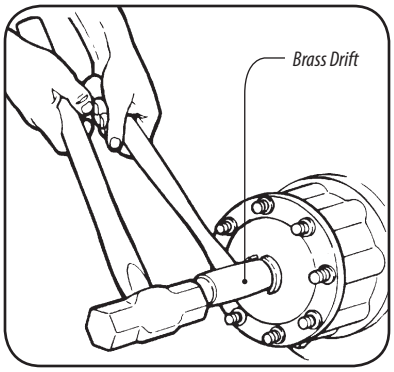
3. Remove the tire and wheel assembly.

4. Remove the brake caliper assembly as described in the Calipers section.

5. Place a drain pan under the end of the axle to catch brake axle lubricant.

6. Remove the 8 axle nuts and 8 star lock washers.





7. The axle end cap is centered by conical dowels on each of the 8 studs. It may be necessary to loosen the dowels to allow removal. Hold a 11/2" diameter brass drift against the center of the axle end cap, inside the round driving lugs. Strike the end of the drift with a large hammer (56 lbs.) and remove the loosened dowels.

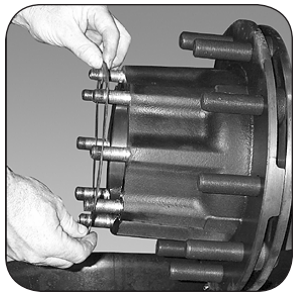
8. Remove the axle shaft and gasket.

9. Inside the rotor hub, the outer 4" adjusting nut is held in place by a tabbed retainer washer. Using a small hammer and punch, straighten the bent tabs of the lock washer.

10. Remove the outer 4" adjusting nut, the tabbed washer, and the wheel bearing lock washer.

11. Remove the 4" adjusting nut and the outer wheel bearing.





The rotor can now be removed. Remove it gently and straight as possible to avoid damage to the inner bearing rubber seal and ABS sensor.





ABS Sensor Installation

Inspect the ABS wheel sensor and replace if damage is found.

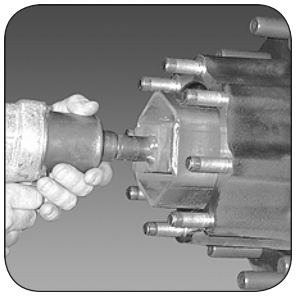
1. Firmly install the abs sensor clip in the mounting block on the spindle. The clip is designed to seat in the proper position in the clip.

2. Push the ABS sensor into the clip just installed. The clip is designed to hold the sensor in position.

3. Push the sensor all the way in until it is stopped by the mounting block.

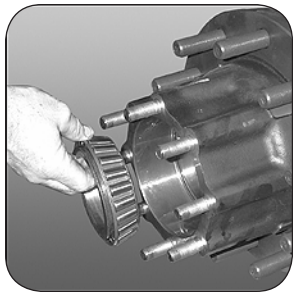
4. Route wire from wheel area to brake ECU. Tie wrap the cable to axle housing.

5. The sensor will properly gap itself when the rotor is re-installed.

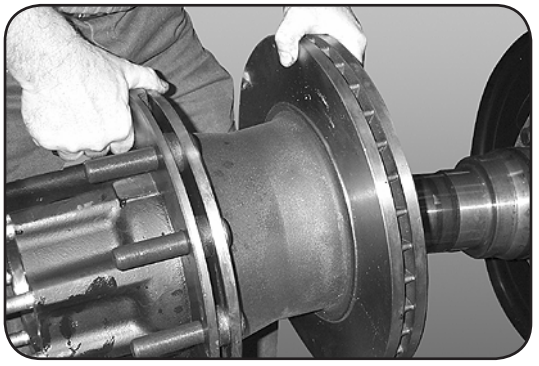








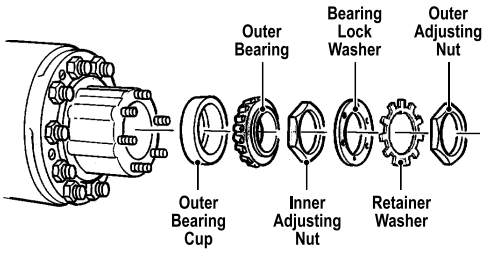
Rear Brake Rotor Reassembly



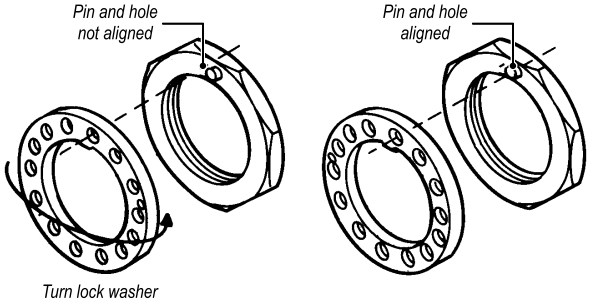
1. Slide the hub/rotor assembly onto the axle. Take care to maintain alignment to avoid damaging the inner seal.

2. Pre lube the outer wheel bearing. Lay out the bearings to be used in a clean area. Dip the clean bearings in the appropriate petroleum or synthetic gear oil until thoroughly saturated.

3. Install the 4" adjusting nut with locking pin facing outward. Torque to 100 ft lb (135.5 Nm). Back the nut off 1 turn. Torque to 50 ft lb (68 Nm) then back the nut off 1/3 turn.



4. Install the wheel bearing lock washer. If the hole in the washer is not aligned with the adjusting nut pin, remove the washer, turn it over, and reinstall. The pin should now be aligned. If not, slightly adjust the inner adjusting nut. Use whichever lock washer hole causes the least movement of the adjusting nut.



5. Install the tabbed retainer washer.

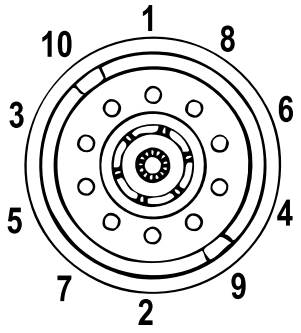
6. Install the outer wheel bearing adjusting nut and torque to 100–200 ft lb (136–271 Nm). Verify hub rotation.

7. Bend two tabs of the retainer washer up against the flats of the adjusting nut.

8. Install the axle shaft gasket. Use a new gasket if the original was damaged during removal.

9. Install the axle shaft.

10. Insert a tapered dowel onto each of the axle shaft studs, narrow end first. Install the eight star washers and eight nuts. Working back and forth across the center of the axle, gradually tighten the eight nuts to 150–230 ft lb (203–312 Nm).



11. Reinstall caliper assembly. Torque the four mounting bolts to 320–360 ft lb (434–488 Nm).

12, Check bearing adjustment with a dial indicator and magnetic base. Bearing end play should not exceed .010 in. (.254 mm).

13. Install 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. 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:

14. Lower the bus. Chock all wheels check axle fluid level and replenish if necessary.

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.

Parking Brake

The parking brake is a dual shoe drum type brake, similar in configuration and operating principle to a normal drum brake on a passenger car. However, rather than being mounted at the wheel(s), the single drum unit is mounted on the output flange of the transmission and rotates with the driveshaft. The brake shoe assembly is mounted stationary to the rear housing of the transmission.

When the driver pushes down on the parking brake pedal, the inner cable of a conventional control cable assembly is pulled. This actuates a pivoting bellcrank mounted at the opposite end of the cable, on the top of the transmission. The linkage rotates a lever and cam assembly situated between the two brake shoes, spreading them to force their friction linings against the drum, preventing the drive shaft from turning when the bus is parked. The configuration provides a typical drive line parking brake.

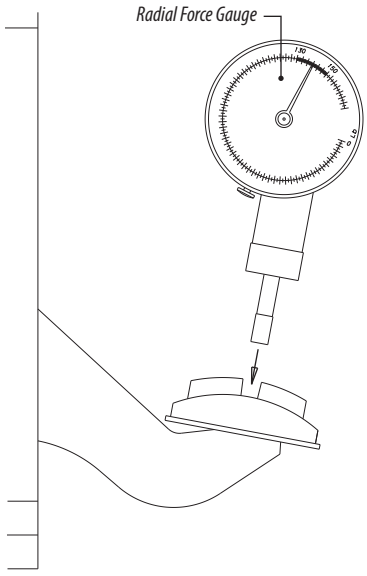
WARNING ***The parking brake relies on the rear wheels remaining in contact with the surface the bus is parked on. If one or both wheels are lifted off the surface the park brake will not function and the bus may move resulting in a potential for bodily harm or death.***

Park Brake Adjustment

Adjust engagement pressure at the foot pedal to achieve 130 - 150 lbs. on the fourth "click" on the parking brake pedal detent. The further the park brake pedal is depressed the greater the force that is required to achieve another click of the locking paw that holds the park brake engaged. A correctly adjusted park brake would require a force of 130 - 150 lbs applied to the center of the park brake pedal foot pad, to move the pedal far enough so that the locking paw will click 4 times.

Two cable adjustment locations are provided to make the adjustment: on the right side of the transmission housing, the outer cable is clamped to a bracket, which has several sets of mounting holes. Any of the mounting holes can be used to achieve the proper working range for the finer adjustments.

The clevis at the transmission end of the cable is threaded onto the end of the inner cable. The effective cable play can be adjusted by:



Park Brake Adjustment

1. Park the bus on a level surface and block the front and rear tires to prevent vehicle movement.

WARNING ***The park brake adjustment procedure requires the park brake to be engaged and released several times. When the park brake is released the bus may move resulting in a potential for bodily harm or death.***

2. Loosen the clevis lock nut.

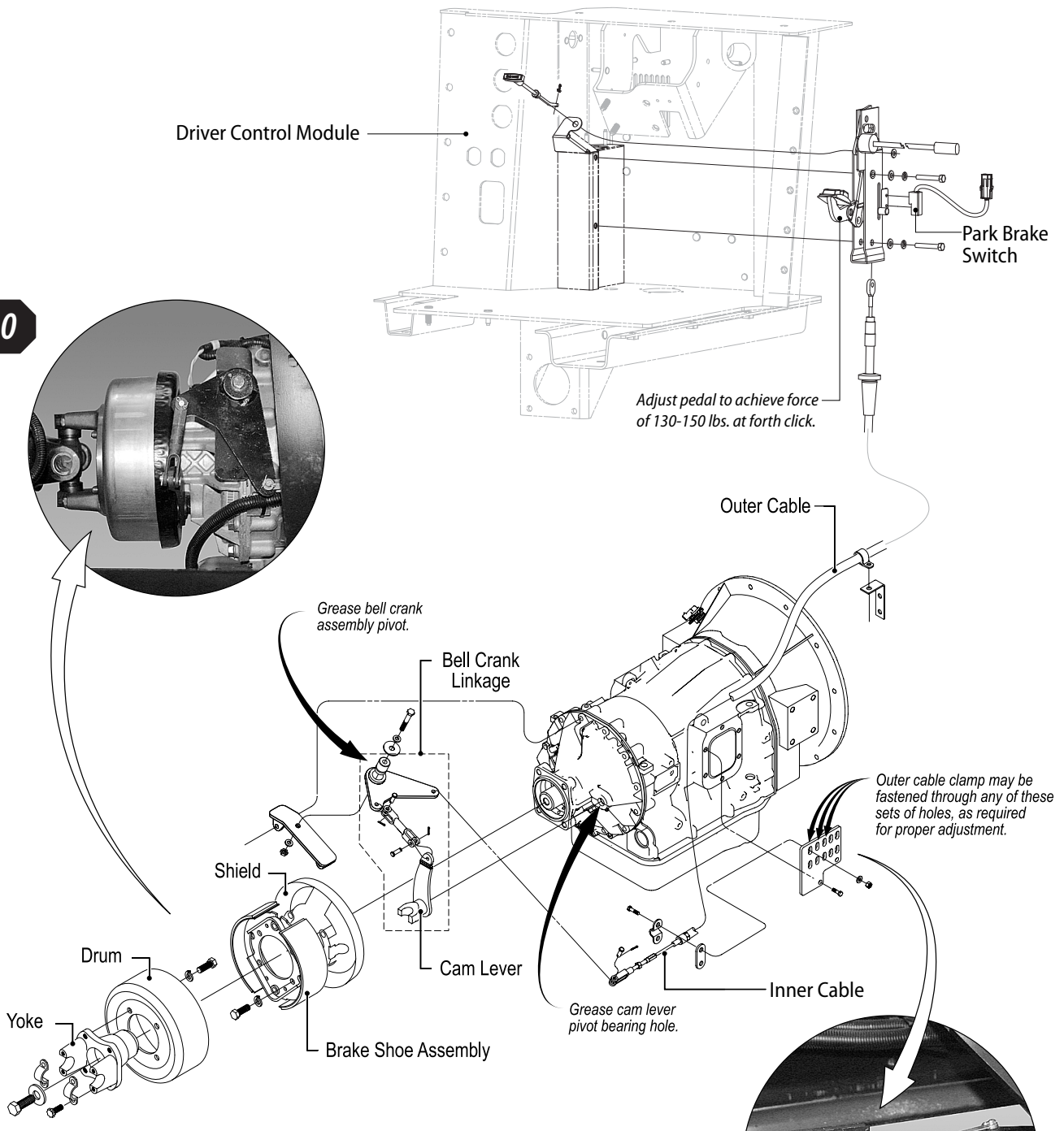
3. Disconnect the clevis by removing its cotter pin and clevis pin.

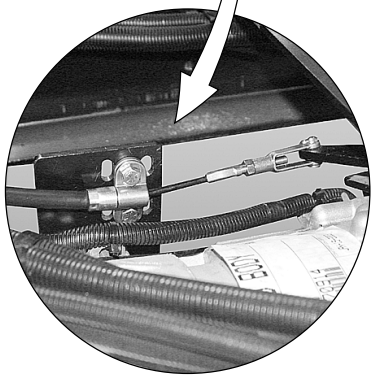
4. Turn the clevis to adjust the cable length. The cable may need to be reposition by re-clamping it at the mounting bracket. Be sure to keep 1/2 inch of thread engagement between the cable and the clevis.

5. Reattach the clevis using a new cotter pin and tighten the lock nut.

6 Operate the park brake several times and recheck for correct adjustment (130 - 150 lbs on the forth click).

7 Test the park brake before returning the bus to service. The parking brake system is designed to hold the vehicle stationary on a 20% grade of clean, dry, smooth, Portland cement concrete for a minimum of five minutes with the vehicle oriented downhill and uphill, with the vehicle loaded to its GVWR and empty, and with a pedal actuation force not to exceed 150 lbs. When not actuated, the parking brake shoes should not be in contact with the parking brake drum.





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Park Brake *(on units with hydraulic brakes)*

Inspection

Parking brake service life will be dependent upon operating conditions and usage. Being designed for normal use with the bus stopped and parked, the drum and shoes of the parking brake are smaller and thinner units than would be used in drum type service brakes. Under normal usage brake lining wear should be minimal. Applying the park brake while the bus is moving will greatly reduce its service life.

Inspect the brake drum for overheating from improper operation or improper adjustment. Check the brake shoes for wear and mechanical binding while applying and releasing the brake. The entire parking brake assembly should be disassembled and inspected after any use in an emergency stop situation.

Lubrication

A grease fitting is located on the bell crank pivot bushing. Grease should also be applied to the bearing hole on the transmission housing where the knob of the cam lever pivots.

Removal & Disassembly

To remove the parking brake to inspect its brake shoes, drum and other components:

1. Park the bus on a level surface with parking brake on and block the front and rear tires to prevent vehicle movement.

2. Loosen, but do not remove, the bearing hanger bolts forward of the driveshaft slip joint. This allows some axial movement of the driveshaft when unbolting the front shaft from the transmission yoke.

3. Remove the two yoke clamps securing the front driveshaft pivot pin to the yoke.

4 Use a pry bar to carefully push the driveshaft rearward enough to clear the yoke clamps, and carefully lower the front of the drive shaft.

5. Apply the parking brake to prevent the transmission shaft from turning when loosening the yoke mounting bolt. Remove the yoke mounting bolt, release the parking brake and remove the yoke & drum assembly.

6. To remove the drum from the yoke, mount the yoke in a bench vise with the drum facing upward, and remove the four bolts from the inside of the drum.

7. Remove the four bolts which fasten the brake shoe assembly and parking brake shield to the transmission housing. The brake shoes can now be removed from the plate by hand on a workbench.

To remove the bell crank linkage:

8. Remove the cotter pin and clevis pin at the end of the inner cable's screwon clevis.

9. Remove the bell crank pivot bolt. The bell crank linkage can now be removed as an assembly.

Installation

1. Grease the socket hole on the transmission housing where the cam lever pivots. Insert the pivot ball of the cam lever into the hole. Insert the pivot bolt through the bushing of the bell crank assembly, tightening it to 33 ft. lbs. (44.7 Nm). Connect the clevis end of the cable to the bell crank, using a new cotter pin on the clevis pin.

2. With the yoke mounted in a bench vise, assemble the drum to the yoke, tightening the four mounting bolts to 90 ft. lbs. (122 Nm).

3. Mount the parking brake shield and brake shoe assembly to the transmission housing. Check to ensure that the lugs of the cam lever properly engage the space between the ends of the brake shoes. tighten the four mounting bolts to 90 ft. lbs. (122 Nm).

4. Slip the assembled yoke and drum onto the transmission's splined output shaft. Insert the mounting bolt and handtighten. Apply the parking brake by pushing on the bell crank linkage, to prevent turning of the transmission shaft as the yoke mounting bolt is tightened. Tighten the yoke mounting bolt to 110 ft. lbs. (150 Nm).

5. Assemble the front driveshaft to the yoke using two new yoke straps. Tighten to 45–60 ft. lbs. (6181 Nm).

6. Tighten all driveshaft bearing hanger bolts to 29–33 ft. lbs. (39–45 Nm).

Brake Interlock, Hydraulic

As a safety feature, Blue Bird All Americans are equipped with hydraulic brakes and wheelchair lift doors incorporating a Mico 691 brake interlock system designed to automatically apply the front hydraulic service brakes when the lift door is open. The interlock system can also be activated by other options; entrance door, exit door etc. The main components of the interlock system include a motor driven hydraulic pump called the power unit, an actuator which operates similar to a master cylinder, and a solid-state control module with troubleshooting LED's. The Mico User Interface used on earlier Blue Bird buses and referenced in the Mico Appendix has been integrated into the D3 electrical system

The interlock system has its own separate hydraulic reservoir, and uses DOT 5 fluid. The interlock system's fluid supply is not shared by the service brake system, which uses DOT3 fluid.

*Note: See **Hydraulic System Diagram** in this chapter for brake interlock hydraulic circuit interface.*

WARNING ***The use of an incorrect fluid in the steering, brake or brake interlock system may result in a reduced function or failure of these systems resulting in a potential for bodily harm or death***

Several conditions must be met and communicated to the interlock system control module to initiate a brake interlock sequence. The logic (what conditions must be met) of the interlock system is managed by the Actia instrument panel and the Mico control module. The instrument panel receives several inputs; lift door open, bus below 3MPH etc., and provides an output signal to the interlock control module if the conditions meet required parameters. Reference the instrument panel chapter for brake interlock logic charts and system requirements.

The interlock system control module provides an interface between system logic generated by the instrument panel, and the operating components of the brake interlock system. The control module starts the power unit pumping the Dot 5 fluid into the actuator. As the actuator becomes pressurized it isolates the master cylinder and pressurizes the front service brake circuit. When lock pressure is reached, the high pressure switch, located on the power unit, signals the control module to stop the pump. The control module also transmits signals back to the instrument panel to communicate interlock operating conditions to the driver. While the pump is stopped, locking pressure is held in the front brake system. If locking pressure drops, the high pressure switch signals the power unit to turn "on" and restore locking pressure.

When the interlock system is deactivated (usually by closing the door), the pump reverses and releases pressure on the actuator. The actuator releases pressure from the brake circuit and opens the port to the master cylinder. When lock pressure returns to zero psi a signal from the low-pressure switch, also located on the power unit, signals the control module to stop the pump.

See **Hydraulic System Diagram** in this chapter for brake interlock hydraulic circuit interface.

The Power Unit

The power unit provides hydraulic flow directed to the actuator and creates locking pressure in the front service brake circuit. The power unit is able to reverse flow to release locking pressure on the brake circuit. The unit also incorporates two pressure switches that signal the control module to regulate flow and pressure. The high pressure switch starts and stops the pump while pressurizing the actuator circuit. The low pressure switch starts and stops the pump while releasing pressure from the system.

When locking pressure is reached, the high-pressure switch signals the control module to stop the pump. While the pump is stopped, locking pressure is held. If locking pressure drops, the high pressure switch signals for the power unit to turn on and restore locking pressure.

When the interlock system is deactivated, the pump reverses, releasing pressure from the actuator. When pressure reaches zero psi, a signal from the low pressure switch stops the pump.

The power unit can be accessed through the driver's side front access panel.

The Actuator

The actuator communicates the hydraulic pressure of the interlock system to that of the All American's service brake system, while keeping the two systems' fluid circuits separate. (The two fluid circuits use different types of brake fluid, which must not be allowed to contaminate each other.)

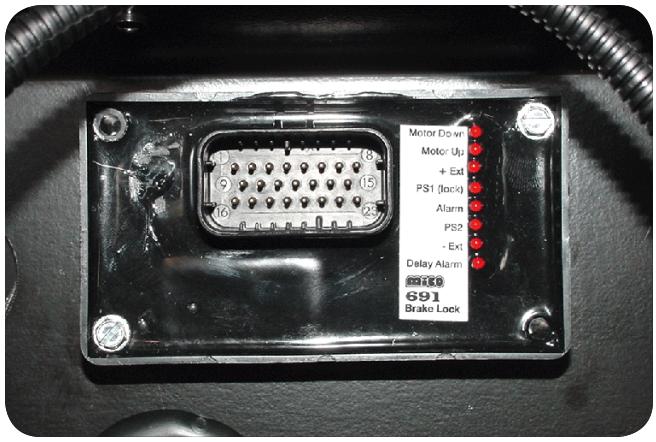
The power unit's fluid (DOT 5 Fluid) acts upon one side of a piston in the actuator. The opposite side of this piston is in contact with the service brake circuit (DOT 3 Fluid). When the power unit pumps fluid to the actuator, it acts against the power unit side of the actuators piston, moving the piston toward the brake circuit end of its bore, closing the port leading to the service brake master cylinder, and applying pressure to the front service brake circuit.

When the power unit's pump reverses, the actuator piston moves in the opposite direction, relieving pressure from the service brakes fluid circuit, and opening the port leading to the service brake master cylinder.

The actuator is mounted to the DCM under the driver floor side by side with the Hydromax unite.

Control Module

The control module is mounted to the left side of the steering column support bracket. In addition to acting as a solid-state starter solenoid for the interlock system's power unit motor and the interface between the system logic and the interlock components, the interlock control module also incorporates an LED array which displays the current state of the interlock system. The LEDs indicate the following.



Mico Control Module

Motor Down On when system is releasing pressure. Remains on for three seconds after PS2 goes off.

Motor Up On when system has been activated (proper signal on +Ext or -Ext), until PS1 comes on.

+Ext On when positive signal is present on brown harness wire and/or green user interface wire.

PS1 (lock) On when system is locked at full pressure. Receives ground signal from pressure switch #1 on white wire.

Alarm On when power unit is pressurizing the system. Controls user interface audible alarm.

PS2 On whenever any pressure is present in the system. REceives ground signal from pressure switch #2 on violet wire.

_Ext On when negative signal is present on gray harness wire.

Delay Alarm Comes on 9 seconds after activating the system if full system pressure has not been attained. Also comes on anytime the power unit runs to repressurize the system.

The input LEDs should be on when receiving their respective signal and off when not. Replace the 691 Control Module when this is not observed. Reference the Mico Appendix for full details

Control Module Troubleshooting

The following lists possible causes/solutions for particular observed situations: Reference the Mico Appendix for full details

- When the 691 System is activated, the brakes will not lock up and the power unit does not run.

  1. **No electric power.** Check the battery, fuse, and wiring connection.
  2. **High Pressure Switch is inoperative.** Activate the 691 system. If PS1 (lock) LED is on, unplug pressure switch 1. If pump runs, replace pressure switch 1 (high pressure switch), or check for a short to ground in the wiring.
  3. **The power unit or control module is inoperative.** Activate the 691 system. If the Motor Up LED is on, check for 12v DC at the power unit connector. Unplug the power unit and attach a voltmeter (+ to blue, - to green) to the connector leading to the control module. If 12v DC is present, replace the power unit. If 12v DC is not present, replace the control module.
  4. **The control module is not receiving an input signal.** Activate the 691 system. Check the +Ext and -Ext LEDs. If neither is on, check that a ground signal is present at the gray lead in the main wiring harness, or the green lead from the user interface; or that a positve signal is present on the brown wire in the main wiring harness. If not, determine the reason, and correct.

- When the 691 system is activated, the brakes will not lock up and the power unit continues to run.

  1. **The fluid level in the reservoir is low.** Deactivate the 691 system. Verify that the power unit is mounted level. Remove the reservoir breather/filler plug and fill the reservoir with proper fluid to within 1/4" of top. Reinstall breather/filler plug.
  2. **Hydraulic leak in either the 691 system or the service brake system.** Inspect all tubing and connections for leaks and tighten or replace as necessary.
  3. **The actuator is not functioning properly.** Activate the 691 system. Check the master cylinder reservoir for excessive fluid level. This condition indicates that the seals in the actuator are allowing 691 system fluid to leak into the vehicle service brake system. Replace the actuator and completely flush and refill the service brake fluid circuit.
  4. **The power unit is not properly building pressure.** Replace the power unit. (No test to troubleshoot this condition.)



- The 691 system will activate and lock up the brakes, but the power unit keeps running.

  1. **High pressure switch is inoperative.** Activate the 691 system. If PS2 LED is off, replace pressure switch 1 (high pressure switch).

- The power unit does not operate to release the brakes when the 691 system is deactivated.

  1. **No electric power.** Check the battery, fuse, and wiring connections.
  2. **Low pressure switch is inoperative.** Deactivate the 691 system. If the PS2 LED is off, replace pressure switch 2 (low pressure switch).
  3. **The power unit or control module is inoperative.** Deactivate the 691 system. If the Motor Down LED is on, check for 12v DC at power unit connector. Unplug the power unit and attach a voltmeter (-to blue, + to green) to the connector leading to the control module. If 12v DC is present, replace the power unit. If 12v DC is not present, replace control module.

- The brakes release, but the 691 power unit does not stop running.

  1. **Low pressure switch is inoperative.** Deactivate the 691 system. If the PS2 LED is on, replace pressure switch 2 (low pressure switch).
  2. **The control module is inoperative.** Deactivate the 691 system. If Motor Down LED is off, replace the control module.

- The 691 system and Motor Up LED come on unexpectedly without being activated.

  1. **The control module is receiving false signals.** Be sure stray signals are not being introduced into the external inputs. If the gray wire is not connected to an external input, ensure that it is capped off and not shorting to ground inadvertently. While deactivated, occasional operation of power unit and Motor Down LED is normal to relieve pressure caused by thermal expansion of fluid in the power unit.

- While the 691 system is activated, the power unit and horn activate intermittently.

  1. **Change in temperature has caused the system to contract and reduce brake system pressure.** The power unit runs briefly to restore brake system pressure to the orignal lock up pressure. This is considered normal operation as fluid temperature changes.
  2. **The service brake system or 691 system has air in it.** Bleed service brake and 691 system.

3. **Hydraulic leak in either the 691 system or service brake system.** Inspect all tubing and connectors for leaks and tighten or replace as necessary.

4. **The power unit is not functioning properly.** Replace the power unit. (No test to troubleshoot this condition.)

Bleeding Procedure

Because the interlock system has its own fluid circuit separate from that of the service brakes, the interlock system must also be bled separately.

1. Make sure the vehicle master cylinder reservoir (not the interlock reservior) is filled with DOT 3 brake fluid, and that the service brake system has been properly bled.

2. Activate the interlock system.

3. Open the bleeder valve on top of the power unit a quarter turn. Close the bleeder screw when a steady stream of fluid is present.

4 For full details reference the Mico Appendix in this chapter

Hydro-Max™ Hydraulic Brake Booster and Master Cylinder



Technical Manual

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Important Service Notes

The information in this publication was current at the time of printing. The information presented in this publication is subject to change without notice or liability.

The information contained in this publication is intended for use by properly trained and equipped professional technicians. It is NOT for the "Do It Yourselfer".

Failure to follow safety and repair procedures can result in personal injury, or damage to vehicles, components and equipment.

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August 2003



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General Description

The Hydro-Max™ is a hydraulically powered brake booster which provides power assist for applying hydraulic brakes. A booster combined with a master cylinder (refer to *Figure 1*) forms the hydraulic brake actuation unit. A typical assembly is shown in *Figure 1*. The booster reduces the pedal effort required to apply the brakes as compared to a non-power system.

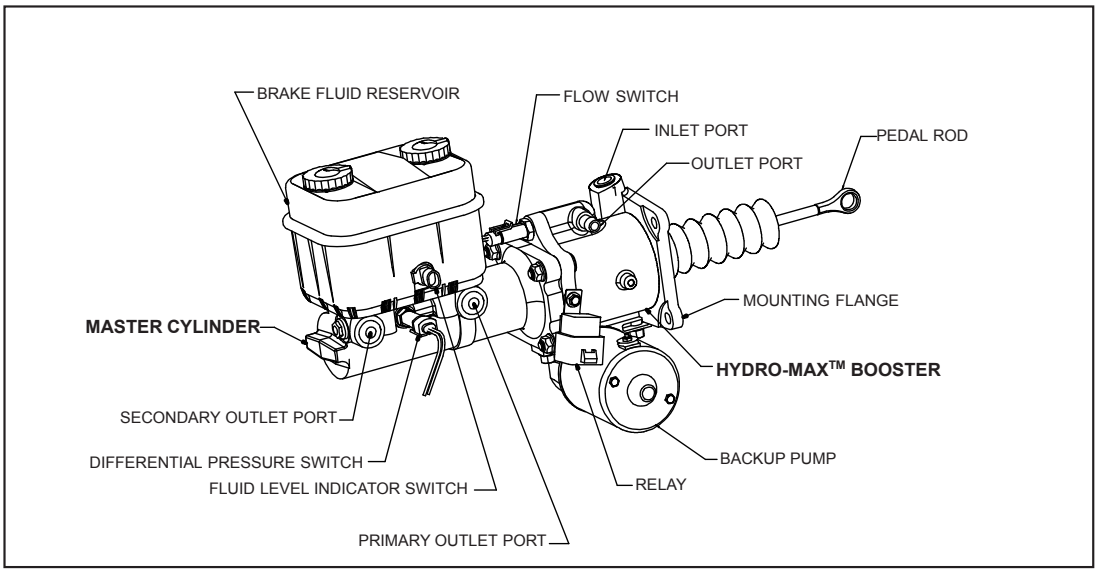


Figure 1 Hydro-Max™ Booster and Master Cylinder Assembly

Hydro-Max™ Booster

The hydraulic booster is comprised of an open center valve and reaction feedback mechanism, a power piston, a 12 and 24-volt backup pump and an integral flow switch. It is powered by either the power steering pump or other hydraulic source. The backup pump provides a secondary power source for the hydraulic booster and is controlled by the integral flow switch.

Master Cylinder

The master cylinder is a split system type with separate fluid chambers, pistons and outlet ports for the front and rear brake circuits. A differential pressure switch, fluid level indicator switch, and remote reservoir are also available.

A typical Hydro-Max™ booster and master cylinder assembly installation in a hydraulic braking system is shown in *Figure 2*.

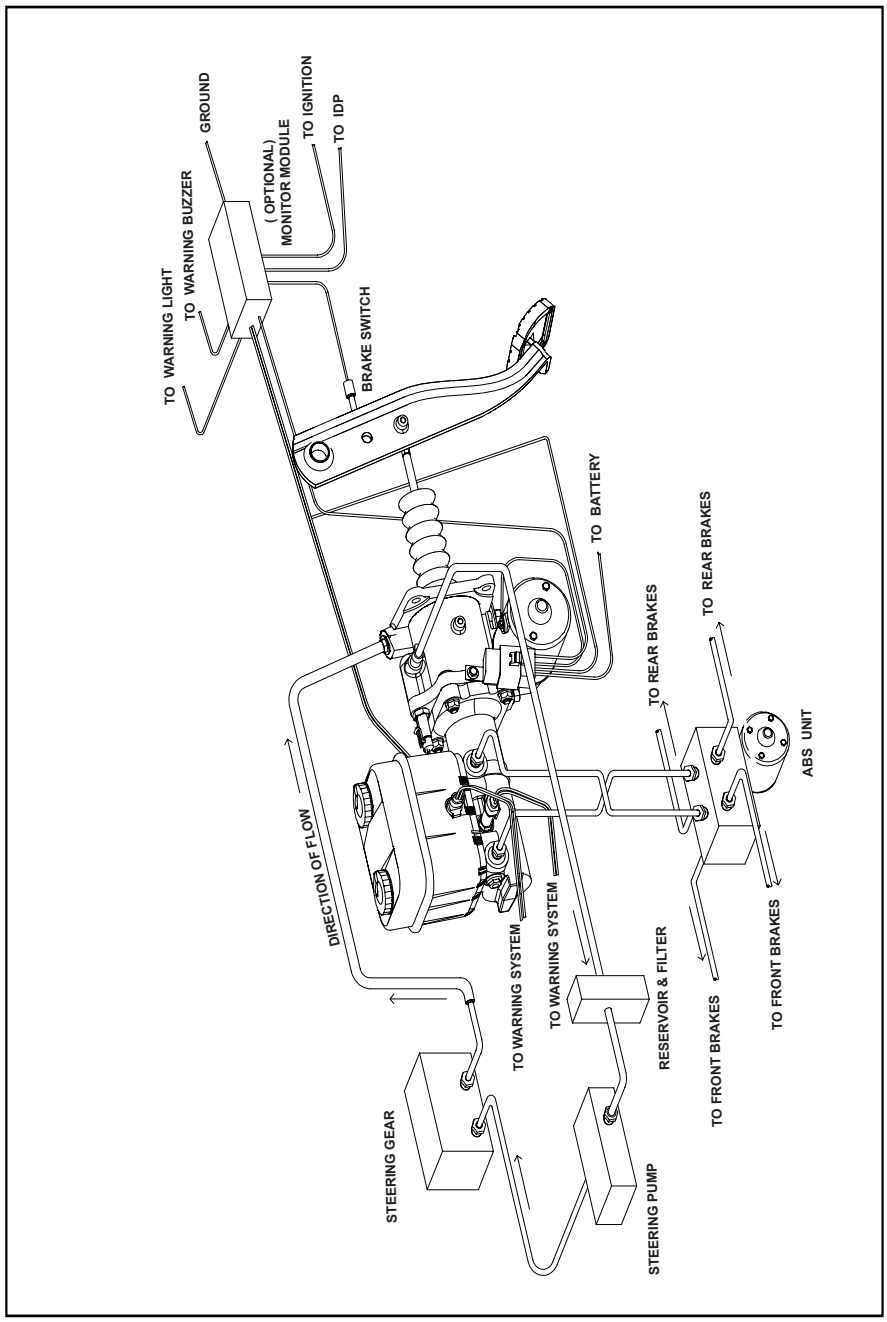


Figure 2 Typical Booster and Master Cylinder Assembly Installation in a Hydraulic Braking System

Principle of Operation

Hydro-Max™ Booster

During normal system operation, (refer to *Figure 4*) fluid flow from a hydraulic power source (usually the power steering pump) enters the inlet port of the Hydro-Max™ booster, flows through the power piston, around the throttle valve and through the flow switch, exiting through the outlet port.

Force applied to the brake pedal by the vehicle operator is multiplied by the lever ratio of the pedal mechanism to move the pedal rod of the booster. This movement closes the throttle valve, which restricts flow. This restriction of flow, which results in a pressure increase acting on the power piston, applies an amplified force to the master cylinder primary piston. A reaction piston, inside the power piston subassembly, provides the driver "pedal feel" during an application of the brake pedal.

Fluid flow through the flow switch opens the backup pump electrical circuit during normal operation. A separate check valve in the backup pump prevents back-flow through the pump during normal power applications.

In the event normal flow from the power source is interrupted, the backup pump provides the power at a reduced rate for stopping. See *Figure 3* for performance curve. Upon flow interruption, the integral flow switch closes, energizing a relay, providing electrical power to the backup pump.

During backup operation, the pump re-circulates fluid within the booster assembly with pressure built on demand via the throttle valve. Fluid is retained within the booster by the inlet port check valve.

Figure 3 illustrates the typical relationship of master cylinder pressure and input force of the booster.

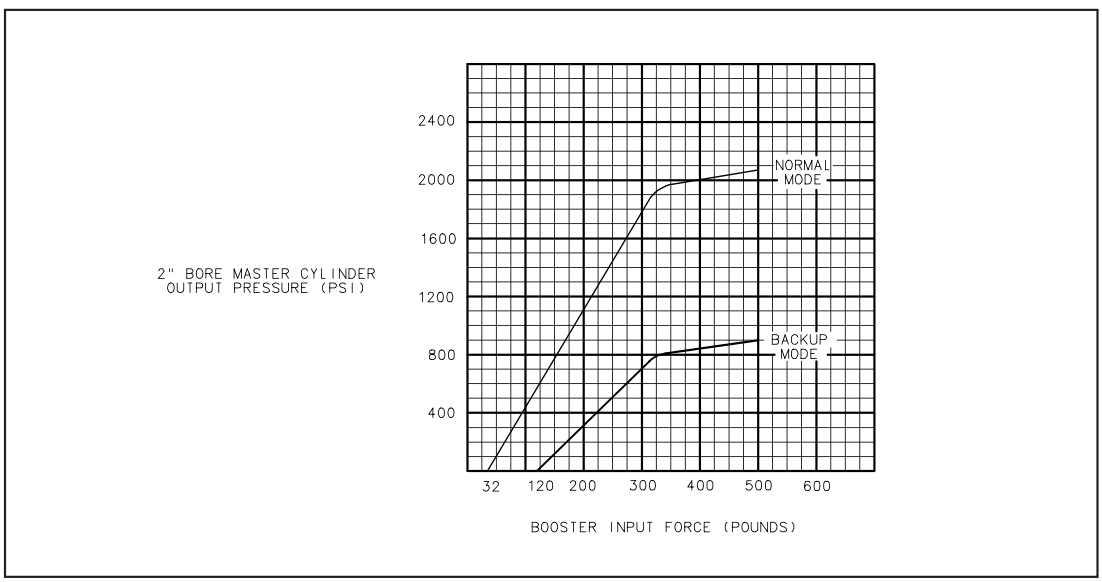


Figure 3 Typical Performance Curve

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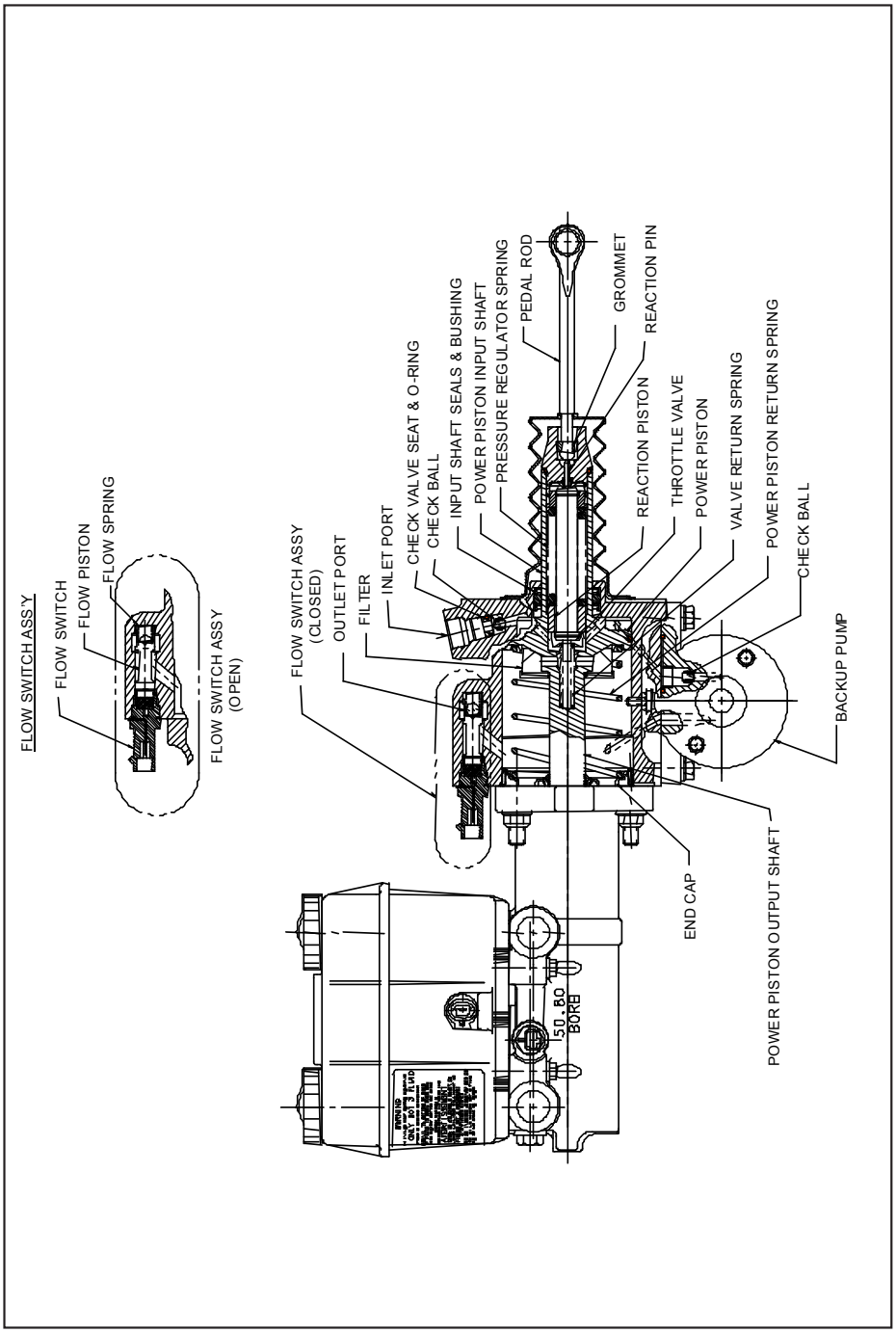


Figure 4 Hydro-Max™ Booster and Master Cylinder

Master Cylinder

In the released position, (refer to *Figure 5*) actuators of both the primary and secondary pistons are in with their respective compensating valve stems, which project into the cylinder bore. This contact tilts the valves to an open position, which allows hydraulic fluid in the reservoir sections to communicate with the primary and secondary pressure chambers. Each pressure chamber has a piston/actuator subassembly containing a preloaded (caged) spring and return spring.

Initial forward travel of the primary piston moves the primary actuator away from its compensating valve, permitting the valve to seat. Closure of this valve shuts off the passage between the primary pressure chamber and the reservoir section serving the primary chamber.

Further movement of the primary piston creates pressure in the primary pressure chamber, causing the secondary piston and actuator to move. As the secondary piston and actuator move, the secondary compensating valve closes, shutting off the passage between the secondary pressure chamber and the reservoir section serving the secondary chamber. Additional movement of the primary piston causes both chambers to build pressure.

When the load on the primary piston is removed, fluid pressure in each chamber, combined with return spring force, causes the primary and secondary pistons to return to their initial released positions. Each actuator opens its respective compensating valve, reopening the passage between the individual reservoir sections and its associated pressure chamber.

Should the rate of release be great enough to cause a partial vacuum in the chamber, the compensating valve will open to allow replenishment of fluid into the cylinder bore.

Any excess fluid remaining at the end of the stroke due to "pumping" and/or volume change due to temperature fluctuation is released to the reservoir as the compensating valves open.

The primary circuit is separated from the secondary hydraulic circuit. Hydraulic leakage in one circuit does not affect the function of the other circuit.

A fluid level indicator switch is available. It illuminates a light on the dash panel to warn of low brake fluid level in the master cylinder reservoir. A low fluid level can result from brake shoe lining wear, or it can occur if there is an external leak in the vehicle brake system.

A differential pressure switch is available. It illuminates a light on the dash panel to warn when there is a pressure differential between the primary and secondary brake circuits caused by a leak in one circuit. This may occur when one circuit leaks or is improperly bled.

A remote reservoir application is available where under-the-hood space constraints prohibit the use of a conventional booster and master cylinder assembly. In a remote application, the master cylinder reservoir is mounted separately from the master cylinder.

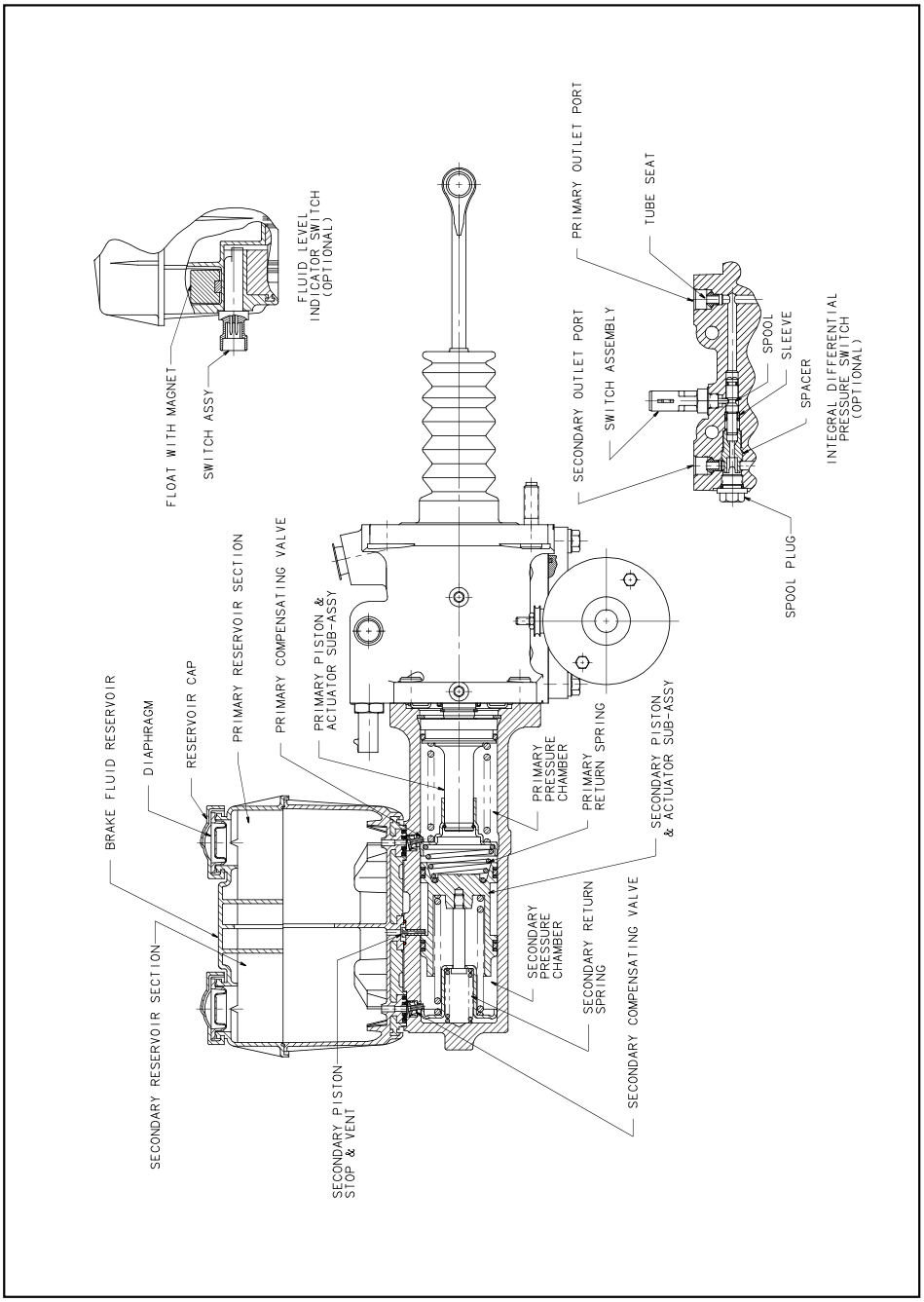


Figure 5 Master Cylinder

Electrical Operating Systems

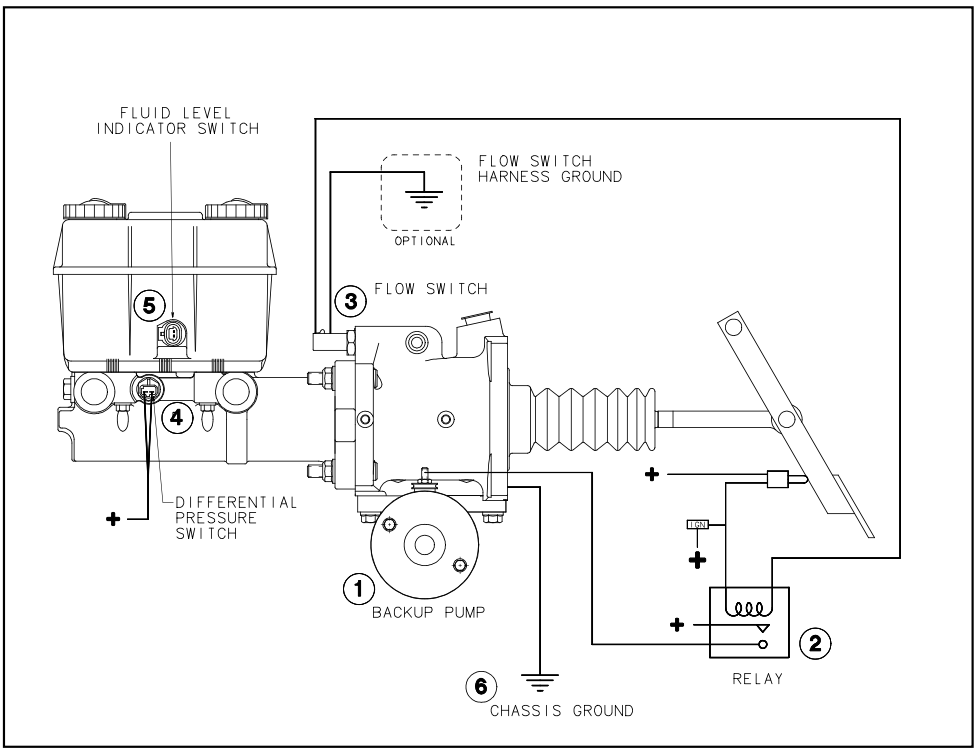


Figure 6 Schematic of Electrical Operating System

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Basic Operation of Hydro-Max™ Booster Assembly and Master Cylinder

Reference *Figure 6* for the following electrical components of the booster and master cylinder.

1. **Backup Pump**: The Hydro-Max™ hydraulic booster has a backup pump which will provide hydraulic boost at a reduced rate if the normal source of fluid is interrupted (refer to *Figure 3*). The signal for operation of the backup pump comes from the flow switch. If normal flow is interrupted, the flow switch will close and activate the relay, which will turn on the backup pump. The backup pump is available for 12 and 24-volt systems.

   The 12-volt backup pump can draw a steady state maximum of 55 amps at a power steering fluid temperature of 100° F. The 24-volt backup pump can have a steady state maximum draw of 27.5 amps at 100° F.

2. **Relay**: An optional relay is available for attachment to the booster. The relay connects to a sealed and mechanically latched wiring connector. The function of the relay is to provide current to the backup pump when triggered by the flow switch.

3. **Flow Switch**: The function of the flow switch is to activate the relay when normal hydraulic power source fluid flow is interrupted, turning on the backup pump. The flow switch has two terminals (A and B). A is positive. B is connected to the booster housing and can be used as an optional harness ground. The flow switch itself is grounded through the booster housing. A sealed and mechanically latched connector connects the flow switch to the backup pump relay circuitry.

4. **Differential Pressure Switch**: The differential pressure switch reacts to a loss of master cylinder hydraulic pressure in either side of the split hydraulic system and can illuminate a warning light at the instrument panel. When pressure is lost in either the primary or secondary circuit of the master cylinder, the switch closes. The electrical switch will remain closed until the malfunction is corrected. When both systems develop normal pressure, the switch will return to center and open the electrical switch circuit. A mechanically latched connector is attached to the switch. The switch has two tabs on a common terminal (positive) and is grounded through the master cylinder.

5. **Fluid Level Switch**: When the fluid reaches a predetermined level (low fluid level), the switch closes and can illuminate a warning light at the instrument panel. A sealed and mechanically latched connector is attached. The switch has two terminals, positive and negative, which are interchangeable.

6. **Chassis Ground**: The booster and master cylinder assembly must be provided with a ground path that will carry the maximum current of the backup pump.

Electronic Monitor Modules (12-volt only)

Bosch recommends that a monitor module be included to monitor the electrical integrity of the backup system. Bosch offers two types with the following features and functions:

Monitor Module Type I

Features

1. Performs start-up self test for proper electrical signal to reserve backup pump.
2. Continuously test for an open circuit in backup pump.
3. Turns on vehicle warning light and buzzer if any of the above tests indicate a backup system electrical malfunction. The warnings are continuous until the malfunction is corrected or the power is shut off.
4. Conveys signal to provide electrical power to the backup pump via the relay.
5. Provides a centralized housing for diodes.
6. Includes an integral differential pressure switch light check at start up.

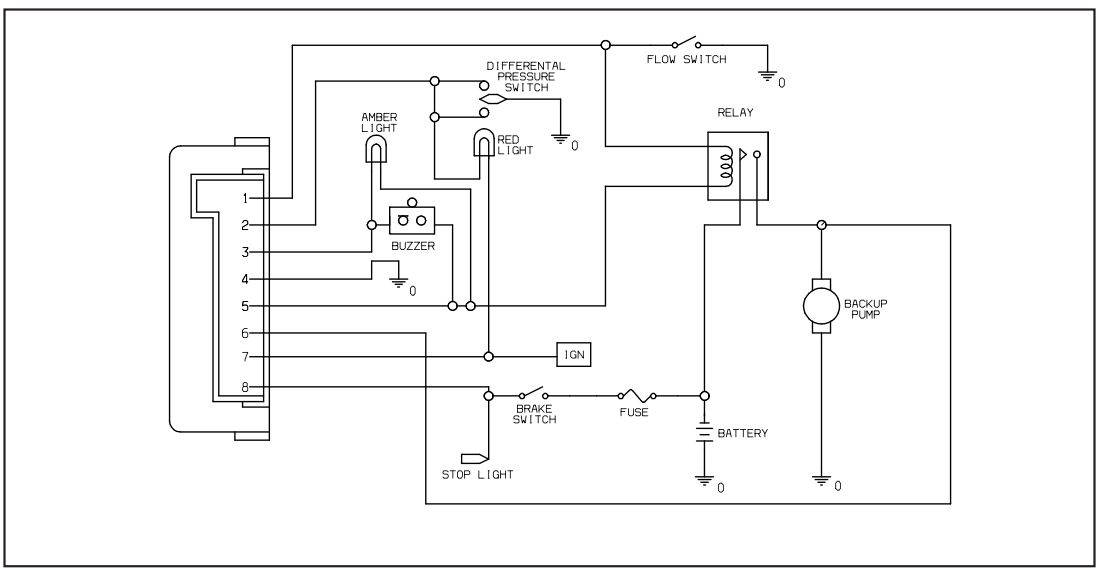


Figure 7 Schematic of Electronic Monitor Module Type I

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Pin Functions

Pin	Function
1	a) Provides path to flow switch to ground for pin 2 to allow test of red light during vehicle start up. b) Suppresses negative voltage transients into pin 5 from the relay coil.
2	Provides path to pin 1 to flow switch to vehicle ground to allow test of red light during vehicle start up. Note: Pin 1 and 2 are connected, with a diode in-between. With the key in the "on" position, the red dash panel light should illuminate anytime hydraulic flow (from the fluid power source) drops to a range of 0.5 to 1.1 gpm. (The range at which flow switch continuity occurs).
3	Open circuit when all is okay, but switches to ground (pin 4) during vehicle start or during a detected fault. Connection to ground turns on warning light and buzzer.
4	Connects monitor module to vehicle ground.
5	Supplies power from module to amber light, buzzer and relay coil. Current flow through this terminal must be limited to 300 mA.
6	a) Monitors for voltage to backup pump during startup. If none detected, pin 3 remains grounded (connected to pin 4). b) Monitors for continuity through the backup pump to vehicle ground during vehicle operation (engine on). Pin 3 switches to ground (pin 4) if continuity is lost.
7	Brings power into module from ignition switch.
8	Brings power into module from brake switch. Only needed when ignition switch is off. Enables backup pump to operate when ignition is off.

Monitor Module Type II (12 volt only)

Features

1. Performs start-up self test for proper electrical signal to backup pump.
2. Continuously tests for an open circuit in backup pump.
3. Tests for voltage during brake application in brake light circuit and backup pump relay coil circuit on vehicles equipped with dual brake switches.
4. Turns on warning light(s) and buzzer if any of the above tests indicate a backup pump system electrical malfunction. The warnings are continuous until the malfunction is corrected or the power is shut off.
5. Absence or malfunction of the module will not affect backup system operation.
6. Turns on light(s) and buzzer when integral differential pressure switch is activated.

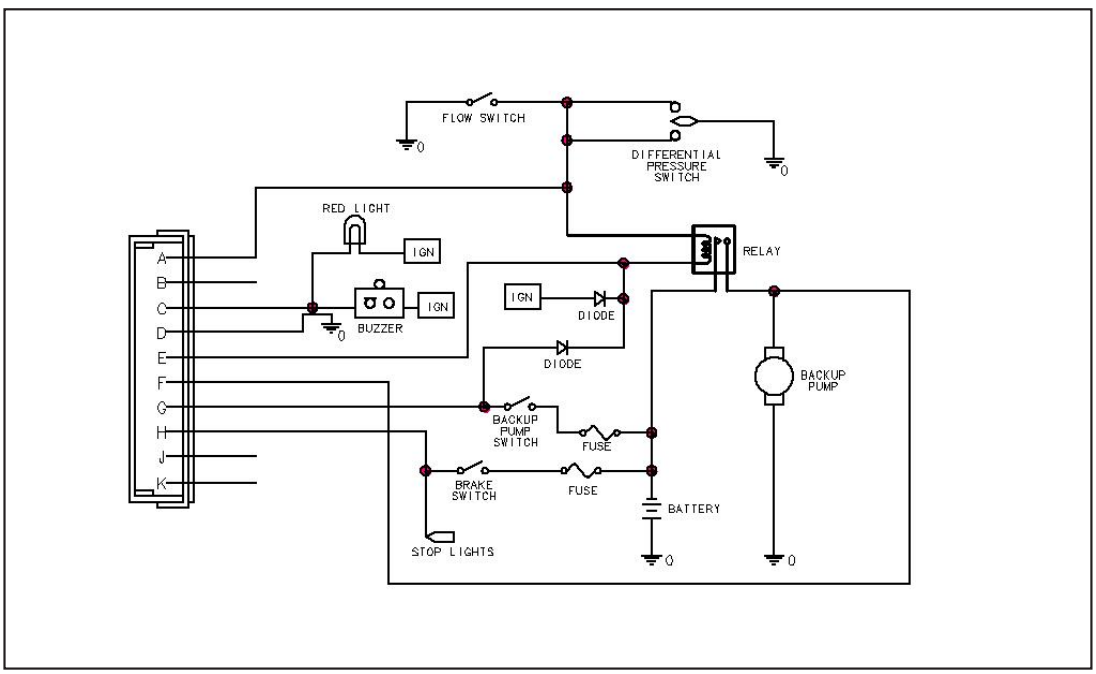


Figure 8 Schematic of Electronic Monitor Module Type II

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Pin Functions

Pin	Function
A	Suppresses negative voltage transients into pin E from the relay coil.
B	Not used.
C	Open circuit when all is okay, but switches to ground (pin D) during vehicle startup or during a detected fault. Connection to ground switches on warning light and buzzer.
D	Connects monitor module to vehicle ground.
E	Power input to monitor module from ignition switch or Hydro-Max™ brake pedal switch.
F	1) Monitors for voltage to backup pump during vehicle startup. If none detected, pin C remains grounded (connected to pin D). 2) Monitors for continuity through backup pump to vehicle ground during vehicle operation (engine on). Pin C switches to ground (pin D) if continuity is lost.
G	Monitors output of the backup pump switch that turns on the backup pump, to allow comparison with pin H. If different for > 14±5 seconds, then pin C switches to ground (pin D) and latches.
H	Monitors output of stop light switch to allow comparison with pin G. If different for > 14±5 seconds, then pin C switches to ground (pin D) and latches.
J	Not used.
K	Not used.

Application Information

Hydraulic Fluids

The Hydro-Max™ booster uses power steering fluid as the medium of transmitting power.

The master cylinder uses DOT 3 brake fluid per SAE J1703, unless otherwise specified on the top of the reservoir. Service maintenance of motor vehicle brake fluid in motor vehicle brake actuating systems is covered in SAE J1707 information report.

⚠CAUTION

Before using any other type of fluid in the booster or in the master cylinder, contact the Bosch Hydraulic Actaution and Truck Brake Engineering Department. (See inside of front cover).

⚠CAUTION

The booster and the master cylinder use two (2) distinctly different incompatible hydraulic fluids. They must not be mixed. Using the incorrect fluid will permanently damage the seals and can cause the brakes to malfunction.

Brake Fluid Tubing, Hoses and Fittings

Brake fluid lines (tubing and flexible hose) transmit fluid under pressure between the master cylinder and the brakes. The hoses are the flexible links between wheels or axles and the frame or body. The hoses must withstand fluid pressure with minimal expansion and must be free to flex without damage during normal suspension deflection and wheel turns. The following SAE specifications, or their successors if appropriate, are recommended for consideration as a minimum requirement when outfitting a vehicle with brake fluid tubing, hoses and fittings. The hoses should conform to SAE J1401 Hydraulic Brake Hose - Automotive. The tubing should conform to SAE J1047 Tubing - Motor Vehicle Hydraulic Brake System. The fittings should conform to SAE J516a - Hydraulic Hose Fittings, or SAE J512 - Automotive Tube Fittings. Contact the vehicle manufacturer for specific requirements for individual applications.

Booster Fluid Tubing, Hoses and Fittings

The pressure line that supplies fluid to the booster must be a 1/2" diameter flexible or rigid pressure line conforming to SAE J188 and typically designed to run from the steering gear to the Hydro-Max™ inlet. The Hydro-Max™ inlet port utilizes a tube "O" arrangement as shown in *Figure 9* (not supplied by Bosch). For tube flare configuration see *Figure 10.*

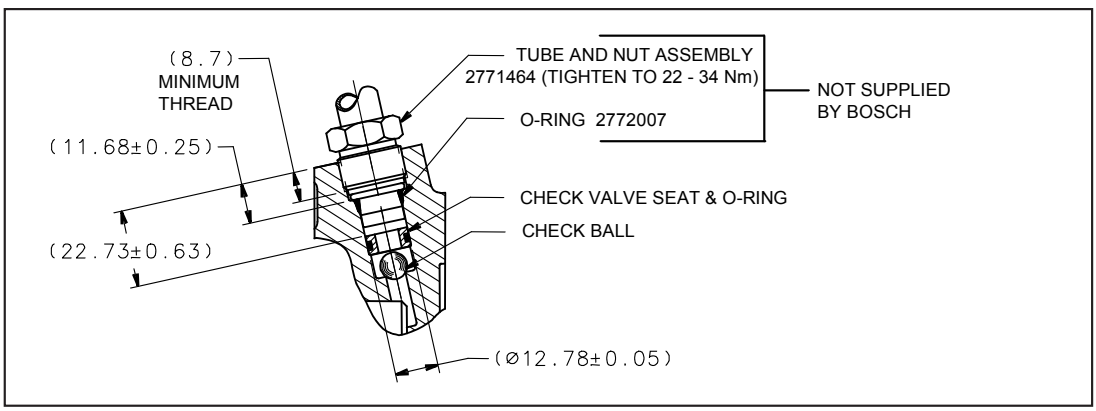


Figure 9 Tube"O" Fitting and O-ring Seal

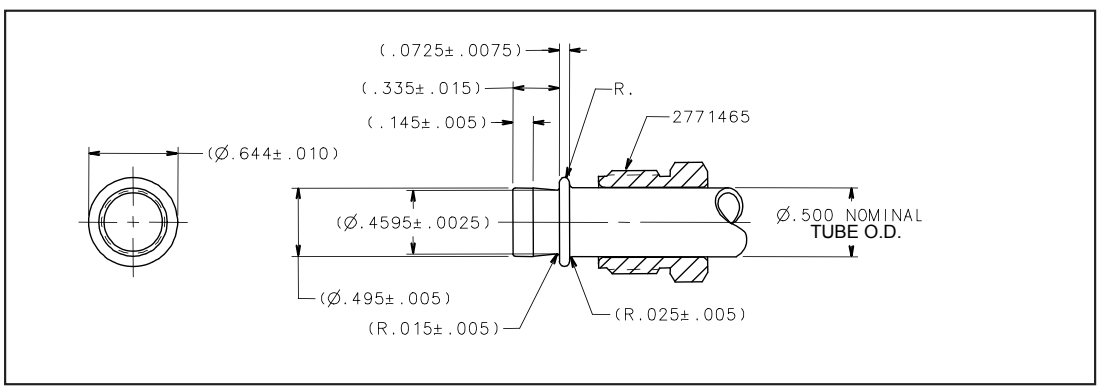


Figure 10 Tube Flare Configuration

The return line must be a 1/2" diameter hydraulic hose attached to the Hydro-Max™ outlet port (See *Figure 11*). The return line and clamp must be selected so that it will withstand worst case vehicle operating conditions, such as back pressures resulting from start up at extremely cold temperatures or from devices installed down stream of the booster.

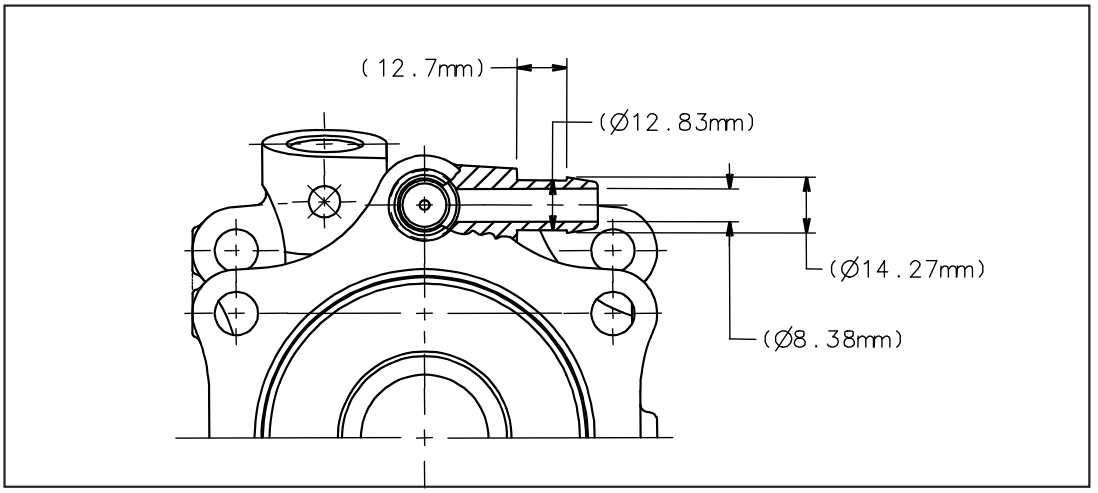


Figure 11 Outlet Port

Booster Fluid Source

The booster is designed to perform in a flow range of 3.2 to 5.0 gpm. Flow rate through the booster can impact vehicle stopping distance; therefore, the vehicle manufacturer must determine the required minimum flow rate. Flow rates below 3.2 gpm can cause slower response times when the booster is applied. Flow rates higher than 5.0 gpm may contribute to the booster self-applying, which will cause brake drag or fluid overheating.

The fluid power source must be capable of supplying 1,000 psi to the booster plus any additional pressure required by other devices in the system such as a power steering gear.

If a power steering gear is used, the steering gear must be "balanced" so that it can handle the pressures generated in the steering gear return line. It must also have an internal relief valve setting lower than the pump relief to allow the steering gear to relieve before the hydraulic pump does. It must also have an internal by-pass to allow manual steering during booster backup system operation. The manufacturer must adhere to the flow path illustrated in *Figure 2*.



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Installation Recommendations

The Hydro-Max™ booster is generally mounted to a vehicle's dash panel. If necessary, the Hydro-Max™ booster and master cylinder may be mounted remotely from the vehicle dash panel and actuated by appropriate linkage.

Four mounting holes are provided in the booster housing through which up to four studs can be pressed. Use of (Grade 5) 3/8-16 or M10 locknuts, having self-contained prevailing torque features that are frictionally resistant to rotation, are recommended.

See *Figure 12* for the three basic pedal rod designs offered. The threaded pedal rod screws into the customer supplied attachment to the brake pedal. The pin that attaches the pedal rod to the brake pedal must insert freely. The attachment mechanism of the pedal rod should be of sufficient strength to prevent linkage binding.

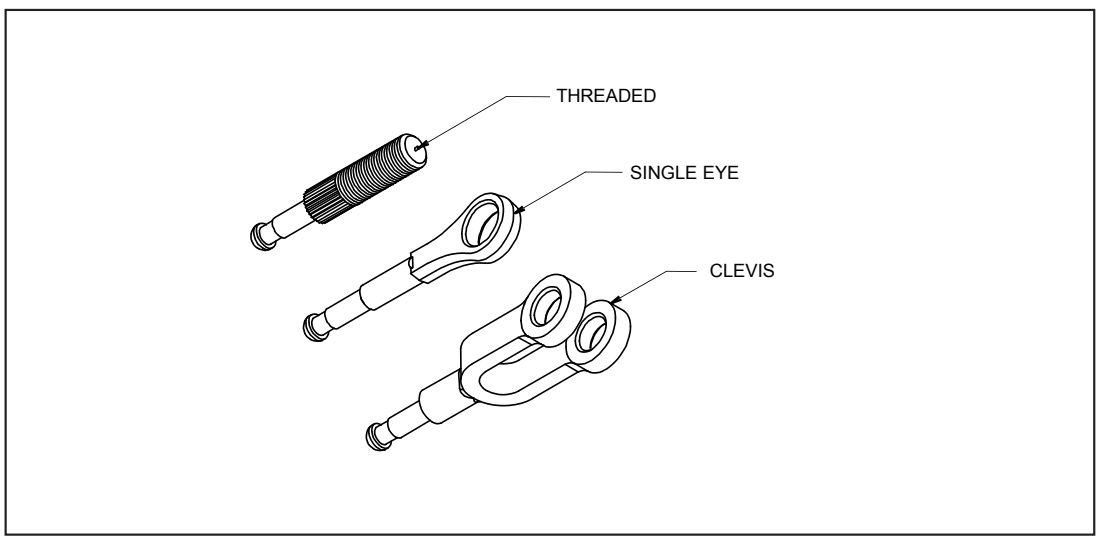


Figure 12 Basic Pedal Rod Designs



ATTENTION

Regardless of mounting location, the following requirements **must** be followed:

a. Mount the unit such that the pedal rod, throughout full pedal travel, does not articulate more than plus or minus 5^{o} above or below booster centerline. The brake pedal lever must be aligned side to side with the booster centerline to prevent linkage binding.

b. The brake pedal and mechanical linkage **must** provide enough travel to fully stroke both booster and master cylinder, i.e., the brake pedal must not bottom on the floor of the vehicle. A pedal ratio of between 2.8:1and 3.3:1 is recommended to provide the desired "pedal feel".

c. The Hydro-Max^{TM} booster and master cylinder assembly **must** be mounted horizontally.

d. The reservoir of the master cylinder **must** be upright. The backup pump must always be at the bottom of the booster.

e. The unit **must** be protected from environmental and fluid temperatures over 250^{o}F.

General Safety Note

Unique usage or applications of the Hydro-Max^{TM} booster and master cylinder assembly requires input from Bosch and validation by the vehicle manufacturer.

Pedal Return Springs

Any vehicle application utilizing a Hydro-Max^{TM} booster and a brake pedal return spring must have:

1. A properly adjusted pedal stop

2. A limited spring load at the pedal released position.

BOSCH

Pedal Stop and Proper Spring Load

The pedal stop must be adjusted such that when the brake pedal is fully released, there is no load on the grommet that retains the pedal rod to the Hydro-Max™ booster. When the brake pedal is fully released, the spring load must not be greater than that required to support the pedal weight.

The reason for a properly adjusted pedal stop and for the limitation on spring load is to prevent the spring from pulling on the grommet within the Hydro-Max™ booster and damaging the grommet. The grommet is not designed to be loaded in this manner.

Any adjustment of the brake switch and backup pump must not compromise the adjustment of the pedal stop.

⚠CAUTION

It is a commmon practice to stack vehicles on top of each other to deliver the vehicles. An air cylinder is typically used to apply the brake pedals in the towed vehicles. When installing such a cylinder, be sure that the backup pump turns off when the towing vehicle brake pedal is released.

TROUBLE SHOOTING

Condition	Cause	Remedy
Hard Pedal	Binding pedal linkage	Contact dealer for service
	Pedal misaligment (side to side)	Contact dealer for service
	Low booster supply flow	Repair/replace power steering pump, check tension in belt
	Power steering pump flow control valve	Repair/replace power steering pump, check tension in belt
	Power steering pump relief valve setting too low	Replace power steering pump
	Fluid contamination	See vehicle service manual for type of fluid required. Drain, flush and refill system, replace booster or master cylinder as appropriate, and power steering reservoir filter as necessary
	Master cylinder	Replace master cylinder
	Booster	Replace booster
	Tube and hose passages are blocked shut	Replace parts containing blocked passages
Excessive pedal travel (pedal goes to the floor)	Improper pedal adjustment	See vehicle service manual for pedal rod adjustment (if system is adjustable)

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TROUBLE SHOOTING

Condition	Cause	Remedy
Excessive pedal travel (pedal goes to the floor)	External leak in brake fluid system	Check all fittings and connections for the master cylinder, calipers, hoses, and tubes, replace if necessary
(continued)	Internal master cylinder leak	Replace master cylinder
	Air in brake fluid system	Bleed system
	Brake linings	Inspect and adjust, or replace brake shoes, if necessary
Pulsating brake pedal	Master cylinder	Replace master cylinder
	Weak brake hoses that expand under pressure	Replace hoses
	Poor quality brake fluid (low boil point)	Drain the system, flush and refill with the recommended fluid.
	Brake self adjusting mechanism	See vehicle service manual (if brakes are adjustable)
Soft, spongy brakes	Air in hydraulic brake system	Bleed brake system
	Poor quality brake fluid (low boil point)	Drain the system, flush and refill with recommended fluid
	Weak brake hoses that expand under pressure	Replace defective hoses
Actuated pedal does not return	Binding pedal linkage	Contact dealer for service

TROUBLE SHOOTING

Condition	Cause	Remedy
Actuated pedal does not return *(continued)*	Fluid contamination	See vehicle service manual for type of fluid required. Drain, flush and refill system, replace booster or master cylinder as appropriate, and power steering reservoir filter as necessary
	Master cylinder	Replace master cylinder
	Binding booster	Replace booster
	Self applied booster (fluid flow too high)	Repair or replace power steering pump.
Pulsating brake pedal	ABS operation	See appropriate service manual
	Wheel bearings loose or worn	See appropriate service manual
	Excessive rotor hickness variation	See appropriate service manual
	Parking brake control valve (HR1) has internal leak	See appropriate service manual
Brake self apply	Self applied booster (fluid flow too high)	Repair or replace power steering pump
	Constricted master cylinder reservoir vent	Clean vent passage in reservoir cap
Dragging brake	Self applied booster (fluid flow too high)	Repair or replace power steering pump

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TROUBLE SHOOTING

Condition	Cause	Remedy
Dragging brake (*continued*)	Stuck or bound caliper pins or rails	See appropriate service manual
	Binding booster	Replace booster
	Binding pedal linkage	Contact dealer for service
	Master cylinder	Replace master cylinder
	Soft or swollen master cylinder seals due to brake fluid contamination	Flush out old brake fluid then replace master cylinder and add new brake fluid
	Tube and hose passages restricted	Replace the parts containing the restriction
Noise / Whistle	Inherent in some boosters (whistle)	None - Does not affect operation
Backup pump operates continuously	Brake switch	See vehicle service manual
	Monitor module	See vehicle service manual
	Relay	See vehicle service manual
	Flow switch	Remove switch components, clean, inspect for damage or contamination and replace if necessary
	Binding pedal linkage	Contact dealer for service

TROUBLE SHOOTING

Condition	Cause	Remedy
Backup pump does not operate	Same as above	Repeat as above
	Electrical ground	See service manual
	Backup pump	Replace backup pump
Leakage	Master cylinder	Replace master cylinder
	Booster	Replace booster
	Master cylinder reservoir vent caps	Replace diaphragms and caps
	Fluid contamination	See vehicle service manual for type of fluid required. Drain, flush and refill system, replace booster or master cylinder as appropriate, and power steering reservoir filter as necessary
	Backup pump mounting seals	Replace seals
	Flow switch seal	Replace o-ring
	Hydraulic fittings and connections	See vehicle service manual, tighten and replace if necessary
Silicone floating in master cylinder	This material is an assembly lubricant	None - Does not affect operation

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TROUBLE SHOOTING

Condition	Cause	Remedy
Fluid level indicator light comes on	Low fluid level	Inspect brake pads, replace as necessary, add fluid as required
	Fluid level indicator switch	Replace master cylinder
	Brake pads worn out	Inspect brake pads, replace as necessary, add fluid as required
Brake indicator light and buzzer malfunction	Vehicle specific	See vehicle service manual

Correspondence concerning this manual should be addressed to:

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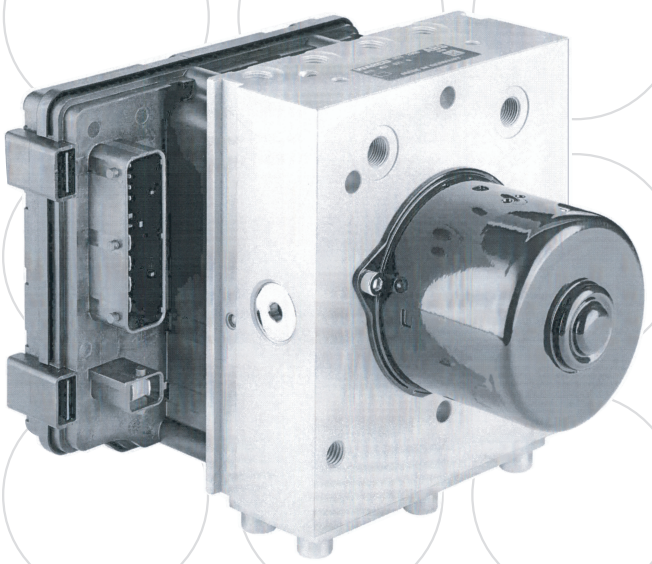
MERITOR WABCO

Maintenance Manual MM-0677

Hydraulic Anti-Lock Braking Systems (HABS) for Medium-Duty Trucks, Buses and Motor Home Chassis

For E Version Hydraulic ABS

Revised 10-08



Service Notes

About This Manual

This manual provides instructions for Meritor WABCO's E Version hydraulic anti-lock braking system (HABS) for medium-duty trucks, buses and motor home chassis.

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.

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 Additional Maintenance and Service Information

On the Web

Visit Literature on Demand at arvinmeritor.com to access and order product, service, aftermarket, and warranty literature for ArvinMeritor's truck, trailer and specialty vehicle components. Meritor WABCO publications are also available on our website:

www.meritorwabco.com

Literature on Demand DVD (LODonDVD)

The LODonDVD contains product, service and warranty information for ArvinMeritor and Meritor WABCO products. To order the DVD, visit Literature on Demand at arvinmeritor.com and specify TP-0742.

How to Obtain Tools and Supplies Specified in This Manual

Call ArvinMeritor's Commercial Vehicle Aftermarket at 888-725-9355 to obtain Meritor tools and supplies.

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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.

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1 Introduction

Maintenance

Manual Information

This manual contains service information for the Meritor WABCO **E Version** hydraulic ABS. For earlier versions of Meritor WABCO HABS, refer to:

- MM38 **C Version** HABS
- MM39 **D Version** HABS

Copies of these manuals are posted on our website:

meritorwabco.com.

Overview

Meritor WABCO Hydraulic Anti-lock Braking System (HABS) is an electronic wheel speed monitoring and control system used on medium-duty trucks, buses and motor home chassis equipped with a hydraulic brake system.

E Version HABS consists of an electronic control unit (ECU) mounted directly on a modulator valve. Typically, the modulator valve is mounted on the frame rail of the vehicle. Figure 1.1.

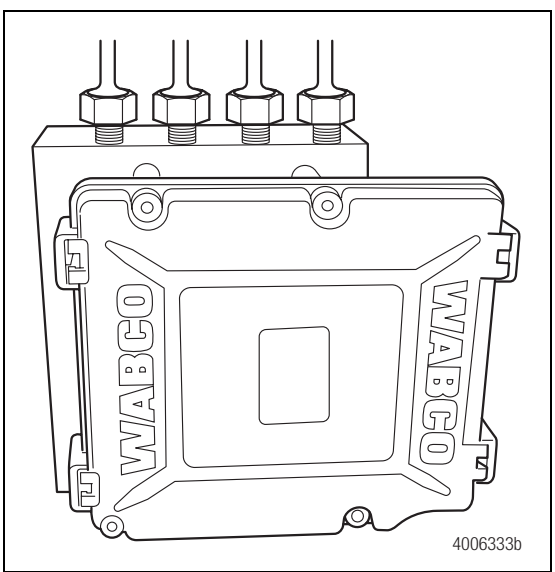


Figure 1.1

How Hydraulic ABS Works

ABS wheel sensors detect wheel speeds. The sensors generate signals that are transmitted to an ECU. If the wheels start to lock, the ECU signals the modulator assembly to regulate the brake pressure of each locking wheel.

During an ABS stop, a solenoid valve in the modulator assembly is rapidly pulsed; that is, it opens and closes several times per second to control the brake pressure. When this occurs, drivers may notice a pulsation of the brake pedal.

An ABS warning lamp on the vehicle instrument panel alerts the driver to a possible system fault and provides blink code information to diagnose the system.

If the ABS warning lamp comes on during normal vehicle operation, drivers may complete their trip, but are instructed to have their vehicle serviced as soon as possible.

In the unlikely event of an ABS system malfunction, the ABS in the affected wheel will be disabled and will return to normal braking. The other sensed wheels may retain their ABS function. Do not rely on the ABS functioning for any of the sensed wheels. Have the vehicle serviced as soon as possible.

1 Introduction

System Layout

A typical Meritor WABCO E Version HABS installation is illustrated in Figure 1.2.

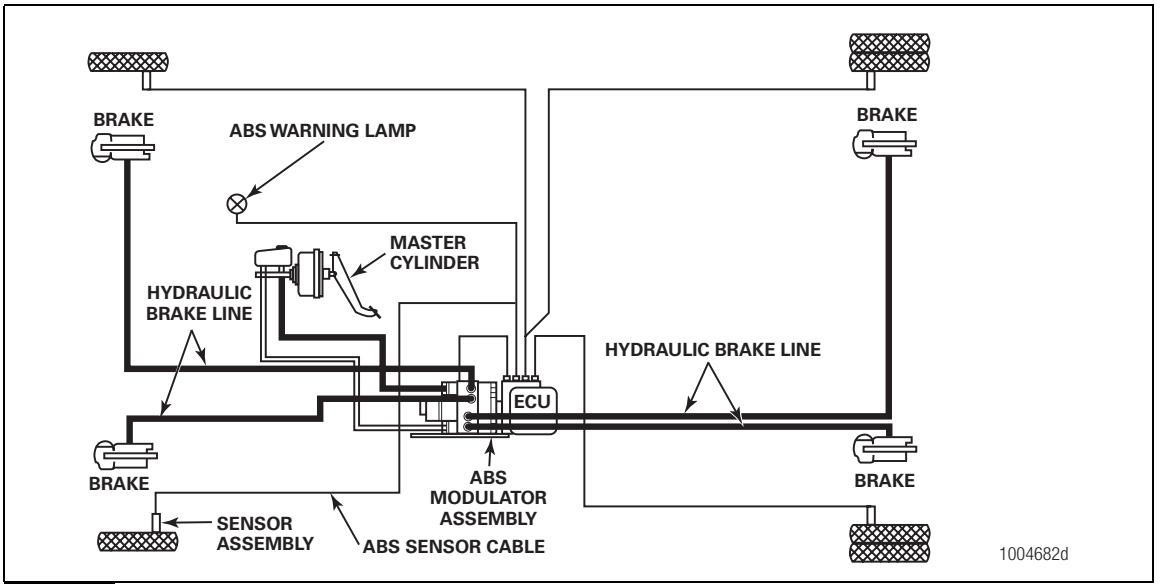


Figure 1.2

The ABS modulator assembly may be mounted in any orientation as long as the modulator is **below** the master cylinder and **above** the wheel cylinders.

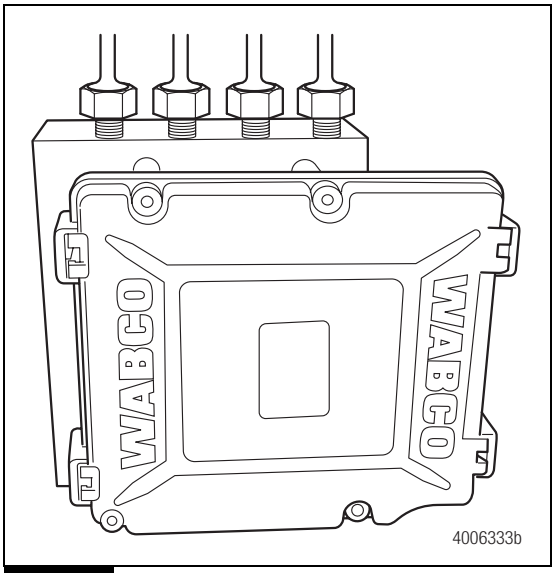


Figure 1.3

System Components

The following components make up Meritor WABCO E Version HABS.

Electronic Control Unit (ECU)

The electronic control unit (ECU) processes sensor signals and generates solenoid valve commands to reduce, maintain or reapply brake pressure. Figure 1.3.

Modulator Assembly

⚠ CAUTION

The modulator assembly contains brake fluid. Handle the modulator assembly with appropriate care. Do not expose the modulator assembly to impact loads or excessive vibrations. Do not blow compressed air into the hydraulic ports. Mishandling the modulator assembly may lead to component damage and system failure.

The modulator assembly houses the HABS solenoid control valves, one inlet valve and one outlet valve per wheel, a pump motor and two low pressure accumulators. Figure 1.4.

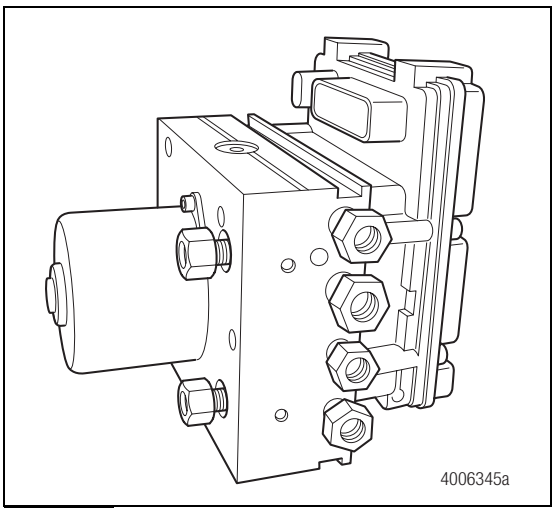


Figure 1.4

Sensors

Sensor with Molded Socket

- Used to measure the speed of a tooth wheel rotating with the vehicle wheel.
- Produces an output voltage proportional to wheel speed. Figure 1.5.

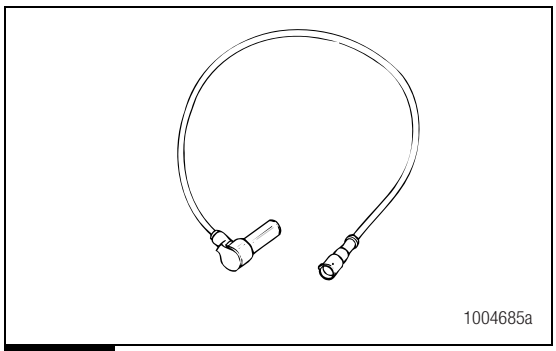


Figure 1.5

Sensor Spring Clip

- Holds the wheel speed sensor in close proximity to the tooth wheel. Figure 1.6.

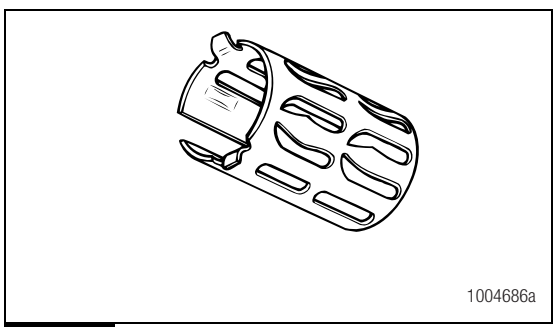


Figure 1.6

Tooth Wheel

- A machined or stamped ring mounted to a machined surface on the hub of each ABS-monitored wheel. Figure 1.7.

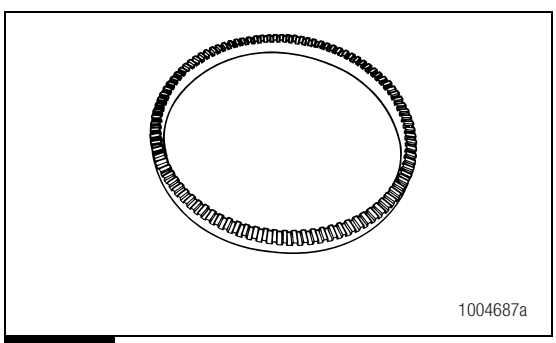


Figure 1.7

1 Introduction

Sensor Extension Cables

- Two-wire cable with molded-on connector. Figure 1.8.
- Connects the wheel speed sensor to the ECU.

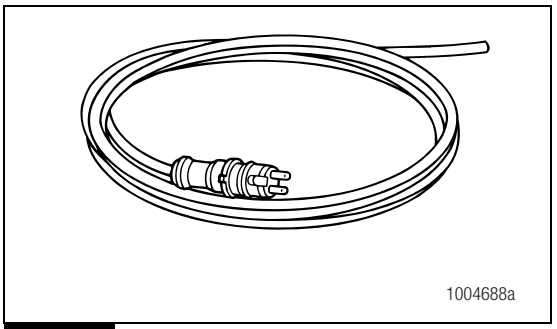


Figure 1.8

ABS Warning Lamp

- Located on vehicle instrument panel. Figure 1.9.
- Alerts drivers to a possible system fault.
- Used by service personnel to display blink codes (optional feature).
- ABS warning lamp is not provided by Meritor WABCO.

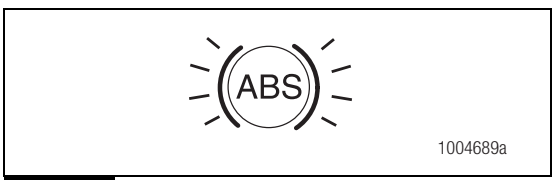


Figure 1.9

TOOLBOX™ Software

- A PC-based diagnostics program.
- Displays system faults and wheel speed data, tests individual components, verifies installation wiring and more.
- Runs in Windows® ME, XP, 2000 or Vista. Figure 1.10.

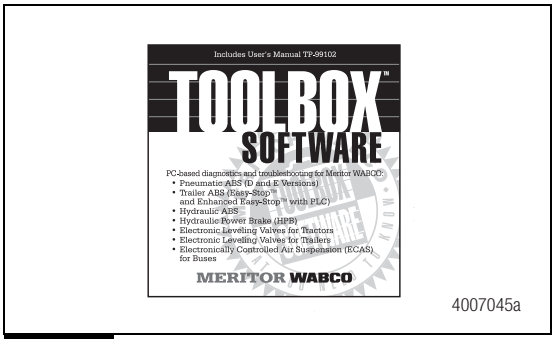


Figure 1.10

NOTE: An RS232 to J1708 converter box is required.

The converter box and the program are available from SPX. Call 800-328-6657.

Maintenance

General Information

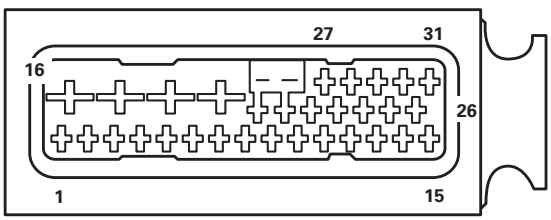
There is no regularly scheduled maintenance required for Meritor WABCO E Version Hydraulic ABS. However, ABS does not change current vehicle maintenance requirements. For example, it is important that the vehicle brake fluid level be correctly maintained.

Wiring Diagrams

System Wiring Information

Pin identification is shown in Figure 2.1. Wiring may vary according to the vehicle. Refer to the vehicle specifications for specific wiring diagrams. A typical Meritor WABCO Hydraulic ABS wiring diagram appears in Figure 2.2.

PIN IDENTIFICATION FOR HABS WIRE HARNESS CONNECTORS TO THE ECU



(9511)

Count from the pin number at the end of each row, identify pin assembly to measure. Connector view shows the back of the connector.

Pin #	Circuit Label
1	Ignition 12v
2	3rd Brake Relay (optional)
3	Not Used
4	Not Used
5	Not Used
6	Reference Ground
7	Not Used
8	Not Used
9	Not Used
10	Not Used
11	Not Used
12	Not Used
13	Not Used
14	J1939 + High – (optional)
15	J1939 – Low – (optional)

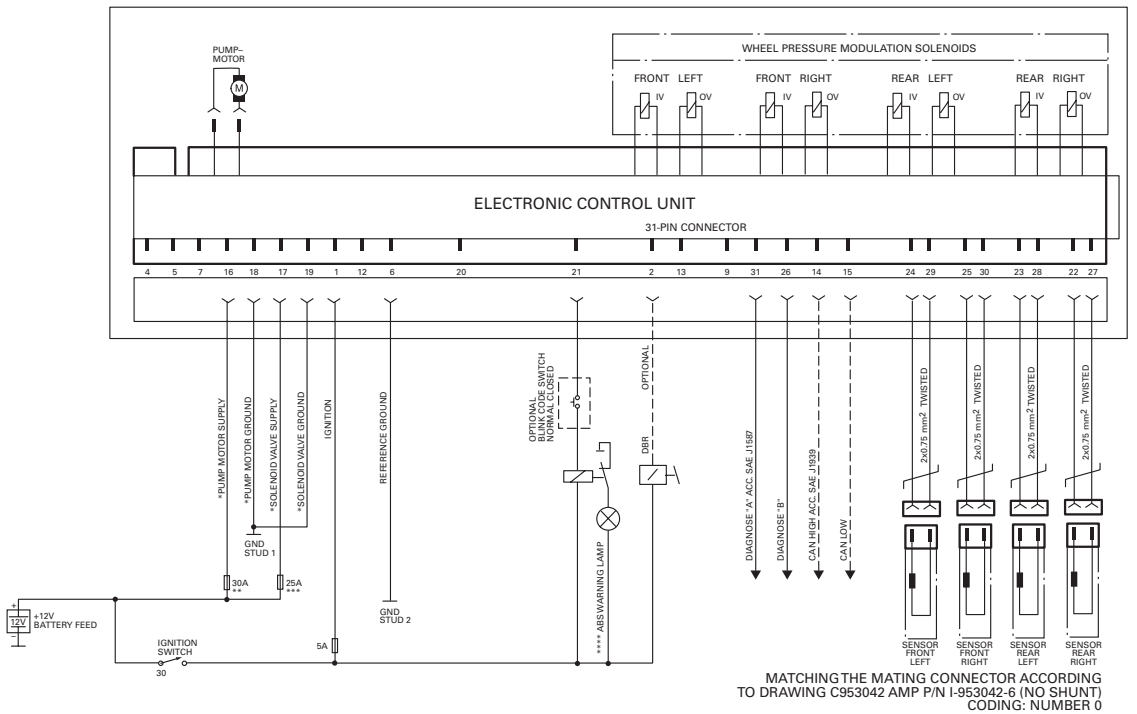
Pin #	Circuit Label
16	Pump Motor Supply 12v+
17	Solenoid Valve Supply 12v+
18	Pump Motor Ground –Gnd
19	Solenoid Valve Ground –Gnd
20	Not used
21	ABS Warning Lamp Relay
22	Rear Right Wheel Speed Sensor
23	Rear Left Wheel Speed Sensor
24	Front Left Wheel Speed Sensor
25	Front Right Wheel Speed Sensor
26	J1587 Diag. B + Low
27	Rear Right Wheel Speed Sensor
28	Rear Left Wheel Speed Sensor
29	Front Left Wheel Speed Sensor
30	Front Right Wheel Speed Sensor
31	J1587 Diag. A + High

4006172a

Figure 2.1

2 Troubleshooting and Testing

WIRING DIAGRAM
HYDRAULIC ABS E-VERSION HABS



NOTES:
Electric cables without marks:
AWG 18 (SAE J 1128 TYP: TXL-CABLE)
respectively 1 mm²
Blade type fuses corresponding to ISO/DIS 8820
Abbreviations: IV — Inlet Valve
OV — Outlet Valve

*** Wire size AWG 12 (SAE J 1128 TYP: GXL-CABLE)**
Respectively Min. 3 mm²:
Total resistance including crimp = 0.04 ohms.
Corresponds to an overall length of 6 meters.
**** According to SAE J 1284 or SAE J 1888.**
***** According to SAE J 1284.**
****** ABS lamp circuit (optional).**

4006173d

Figure 2.2

System Diagnostics

Use Meritor WABCO's PC-based diagnostic program, TOOLBOX™ Software, or standard blink codes to diagnose hydraulic ABS faults. Information for using standard blink codes appears in Table B in this section.

Meritor WABCO TOOLBOX™ Software

NOTE: For complete instructions for using this program, refer to the User's Manual, TP-99102. Contact Meritor WABCO at 800-535-5560 for information about TOOLBOX™ Software.

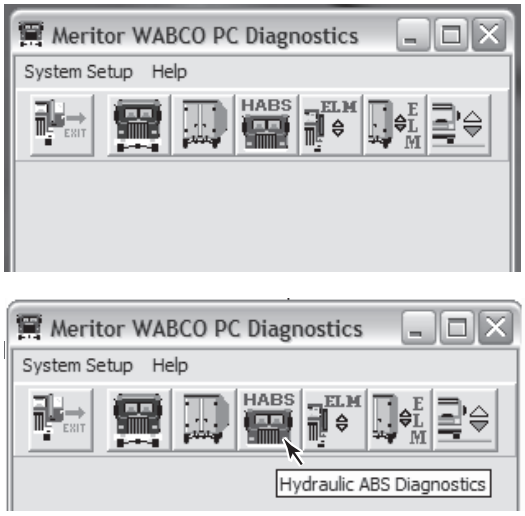
If you have TOOLBOX™ Software installed on your computer, use it to identify system faults. Then, follow the on-screen repair information to make the necessary repairs or replacements.

To display Hydraulic ABS faults, use the pull-down menu or the HABS icon, Figure 2.3, to select HABS (Hydraulic ABS) from the **Main Menu**. The **Hydraulic ABS Main Menu** will appear. Figure 2.4.

Select the View ECU Faults icon or select Display Faults to use the pull-down menu. Figure 2.5. This will display the **Fault Information** screen. Figure 2.6.

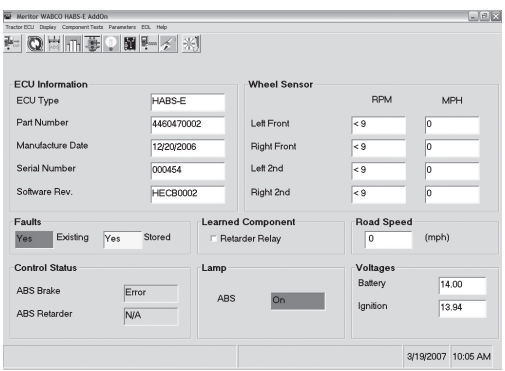


2 Troubleshooting and Testing



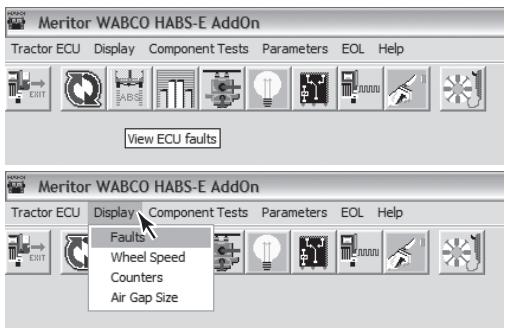
1004695b

Figure 2.3



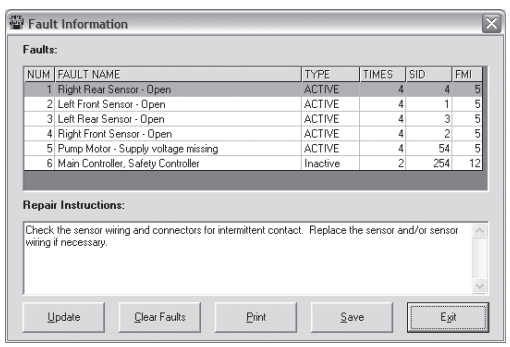
4006577a

Figure 2.4



1004697b

Figure 2.5



1004698b

Figure 2.6

The **Fault Information** screen contains a description of the fault. Repair instructions for each fault appear at the bottom of the screen.

Faults that occur after the screen is displayed will not appear until a screen update is requested. Use the ***Update*** button to refresh the fault information table.

After making the necessary repairs, use the ***Clear Faults*** button to clear the fault. Use the ***Update*** button to refresh the fault information table and display the new list of faults.

Most faults require an ignition cycle and/or test drive above 5 mph to verify fault resolution. Also check the ABS warning lamp to ensure the system functions correctly.

2 Troubleshooting and Testing

Blink Code Diagnostics

Definitions

ABS Warning Lamp: This lamp, located on the vehicle instrument panel, serves two purposes:

1. Alerts drivers or service personnel to a possible fault in the hydraulic ABS, as follows:

   IF the ABS warning lamp comes on briefly then goes OFF when the ignition is turned ON . . . . . there are no active faults in the hydraulic ABS

   IF the ABS warning lamp comes on and **stays on** AFTER the ignition is turned ON **and**

   The vehicle is driven in excess of four mph (6 km/h) . . . **There may be an active fault in the hydraulic ABS**

   IF the ABS warning lamp comes on and stays on **and**

   Goes OFF after the vehicle is driven in excess of four mph (6 km/h) or illuminates intermittently during driving . . . **There may be a stored fault in the hydraulic ABS**

2. Displays diagnostic blink codes for easy servicing.

   Blink Code: A series of blinks or flashes that describe a particular ABS system condition. Refer to Table B and Table C in this section for blink code identification.

   Blink Code Diagnostics: The ability of the Meritor WABCO ECU to sense faults in the ABS system and to define these faults via blink codes.

   Blink Code Switch: A momentary switch that activates blink code diagnostic capabilities. Usually, it is mounted under the instrument panel or on the steering column. Refer to the vehicle specifications for type and location.

   Clearing Fault Codes: The process of erasing faults from the ECU memory bank. Refer to Table B in this section.

   Fault Code: An ABS condition (fault) detected and stored in memory by the Meritor WABCO ECU and displayed by blink code. System faults may be **Active** or **Stored**.

   Active Fault: A condition that currently exists in the ABS system; for example, a sensor circuit malfunction on the left front steering axle. An active fault **must be repaired before you can display additional faults.** Once an active fault has been repaired, it becomes a stored fault.

   Stored Fault: A condition that caused the system to register a fault, but **is not currently active.** For example, a loose wire that corrected itself. A stored fault can also be an active fault that has been corrected. Refer to Active Fault.

   Table B, in this section, describes the method of distinguishing between active and stored faults and explains how to clear them.

   System Code: Displaying identifier for supply voltage (12V) during system mode. Figure 2.7.

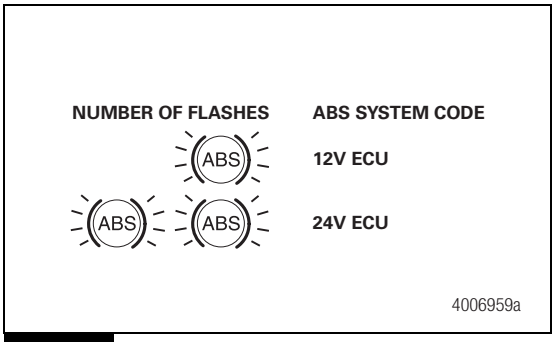


Figure 2.7

Using Blink Code Diagnostics — Optional Feature

Follow the steps listed in Table B to use blink code diagnostics. Refer to Figure 2.15 and Figure 2.16 in this section for blink code illustrations.

1. Wiring Diagram (Figure 2.8)

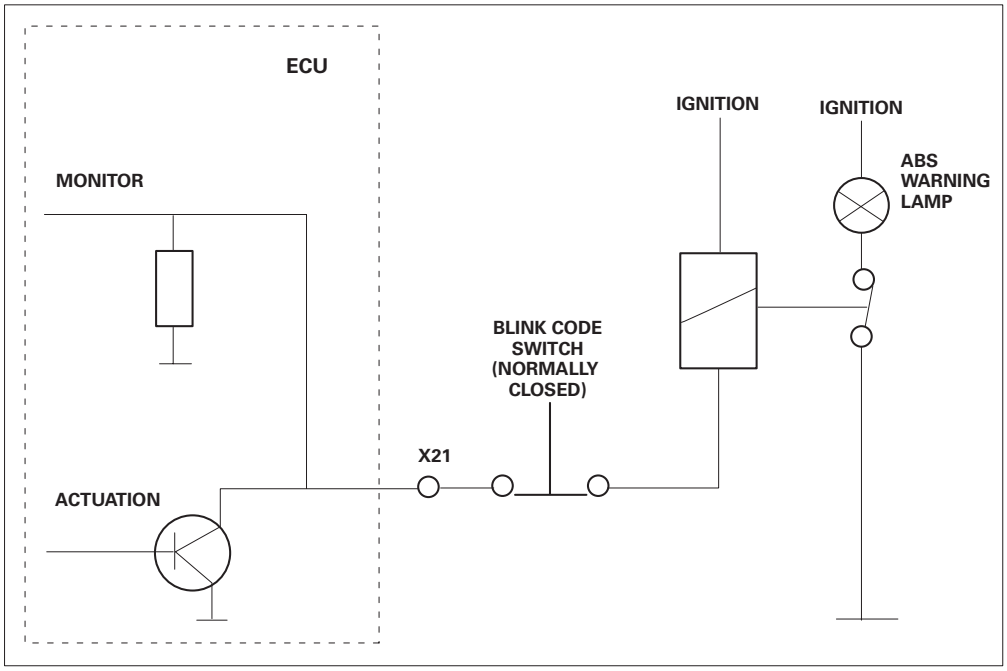


Figure 2.8

2. Activation of Blink Code Function — Optional Feature

   For activation, the blink code switch needs to be actuated for a variable length of time. The duration of the actuation determines the blink code mode. After the switch has been released again, the ABS warning lamp remains illuminated for 0.5 second to indicate the reception of a new blink code command from the user.

3. Termination of Blink Code Function — Optional Feature

   If either a system fault is detected or the blink code switch is depressed for more than 6.3 seconds, the current blink code command will be terminated immediately.

   If the diagnostic mode (output of fault codes via blinking the lamp) has been requested via blink code switch, and if there are no active faults stored inside the ECU (inactive faults only or no faults at all), the blink code is terminated as well after the fault codes have been blinked out once.

   Blink code is terminated if ignition is switched off and if the vehicle starts moving (vehicle speed greater than 2.5 mph or 4 km/h).

   If the blink code switch is held for 15 seconds or longer, an ABS warning lamp fault will be generated which also terminates the blink code.

2 Troubleshooting and Testing

4. Blink Code Frequency (Figure 2.9)

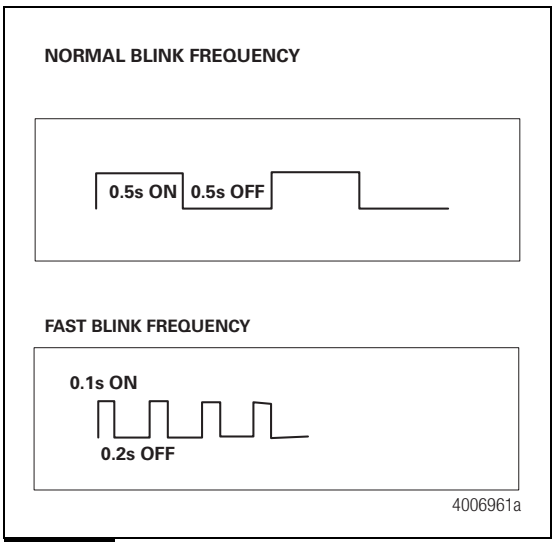


Figure 2.9

5. Diagnostic Mode

   To activate the diagnostic mode, press the blink code switch for more than 0.5 second but less than 3.0 seconds. Figure 2.10.

   With active faults:

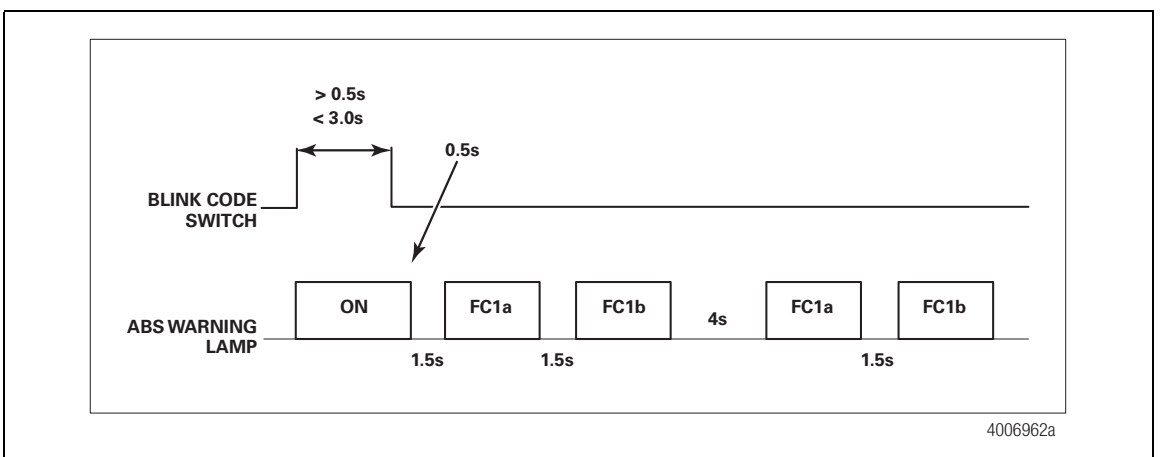


Figure 2.10



FC1 is the fault code for the first active fault. ***a*** indicates the first part of the code. ***b*** indicates the second part. Table C.

If a fault was detected during the current ignition switch cycle (an active fault), the corresponding fault code (FC1a and FC1b) is repeated continuously.

If there are several active fault codes, only the most recent is displayed.

The diagnostic mode is terminated if:

- The ignition switch is cycled.
- The vehicle starts moving and its speed exceeds 2.5 mph (4 km/h).
- The blink code switch is actuated for more than 6.3 seconds.

With inactive faults: Figure 2.11.

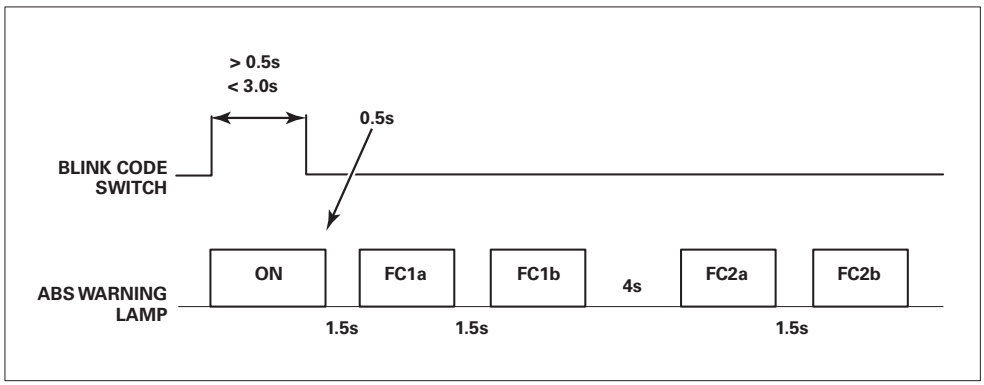


Figure 2.11

FCn is the fault code for an inactive fault. ***a*** indicates the first part of the code. ***b*** indicates the second part. Table C.

If there are no active faults, inactive fault codes will be displayed beginning with the most recent. When all inactive fault codes have been displayed, the diagnostic mode is terminated.

6. Clearing Faults (System) Mode

This mode will be activated if the blink code switch is held for more than 3.0 seconds but less than 6.3 seconds. Within this mode, the faults stored in the ECU will be cleared. After clearing all faults, the ABS warning lamp blinks rapidly eight times. Figure 2.12.

Faults will be cleared only if:

- There is no fault currently active. The system code will be displayed.
- There are air gap faults or pole wheel faults stored in the ecu with an occurrence count of less than 50. If the occurrence count for both air gap and pole wheel faults is more than 50, the ecu is running in ***Sensitive mode*** which prevents fault code clearance. The system code will be displayed.

  NOTE: In ***Sensitive Mode***, modified thresholds increase the speed with which faults are detected.

2 Troubleshooting and Testing

- The maximum on time of the abs inlet valves switches is not exceeded. The maximum on time is 1/3. The system code will be displayed continuously.

  When the faults are cleared, the system code is displayed continuously. Table A.

Table A: System Code

1x	12V ECU AddOn E
2x	24V ECU AddOn E

Two seconds after activating the system mode, endurance brake (retarder) reconfiguration can be requested by pressing the blink code switch three times for at least 0.5 second each at intervals of less than 3.0 seconds.

Completion of reconfiguration will cause the ABS warning lamp to blink rapidly four times.

The system mode will terminate if:

- The ignition switch is cycled.
- The vehicle starts moving and its speed exceeds 2.5 mph (4 km/h).
- The blink code switch is pressed for longer than 6.3 seconds.

All faults will be cleared in system mode only if:

- There are no active faults.
- There are no sensor counts of 50 or greater.
- The maximum inlet valve actuation time was not exceeded.

After clearing all faults, the ABS warning lamp blinks rapidly eight times followed by continuous repetition of the system code. Figure 2.12.

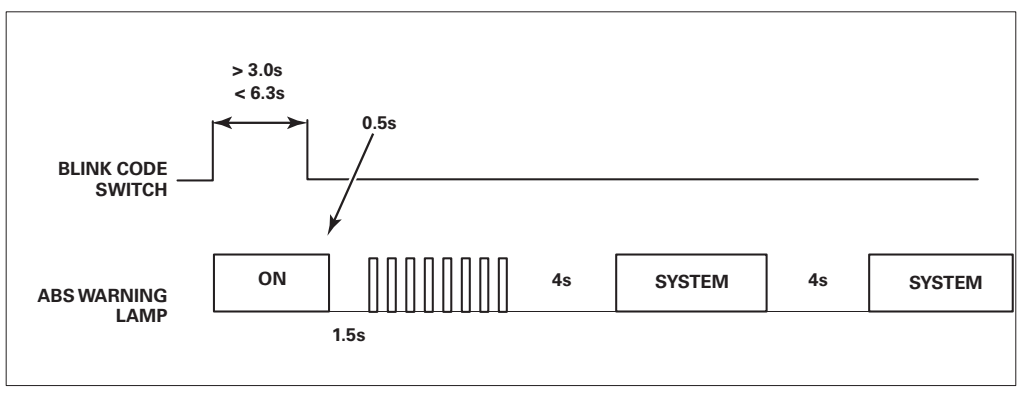


Figure 2.12

2 Troubleshooting and Testing

Faults will not clear if:

- Active faults are detected.
- Stored faults have an occurrence count of 50 or more.
- Maximum inlet valve actuation time is exceeded.

The system code will display continuously. Figure 2.13.

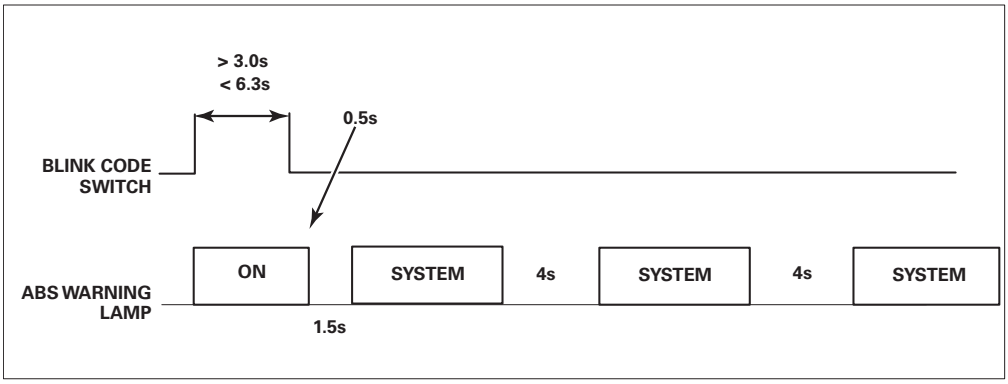


Figure 2.13

7. Retarder Reconfiguration

   Within system mode (after 2.0 seconds), request retarder reconfiguration by pressing the blink code switch three times for at least 0.5 second at intervals of less than 3.0 seconds. Figure 2.14.

   Reconfiguration occurs only if there are no active faults.

   The ABS warning lamp blinks four times to confirm that the retarder has been reconfigured. Then, the system code displays continuously. Figure 2.14.

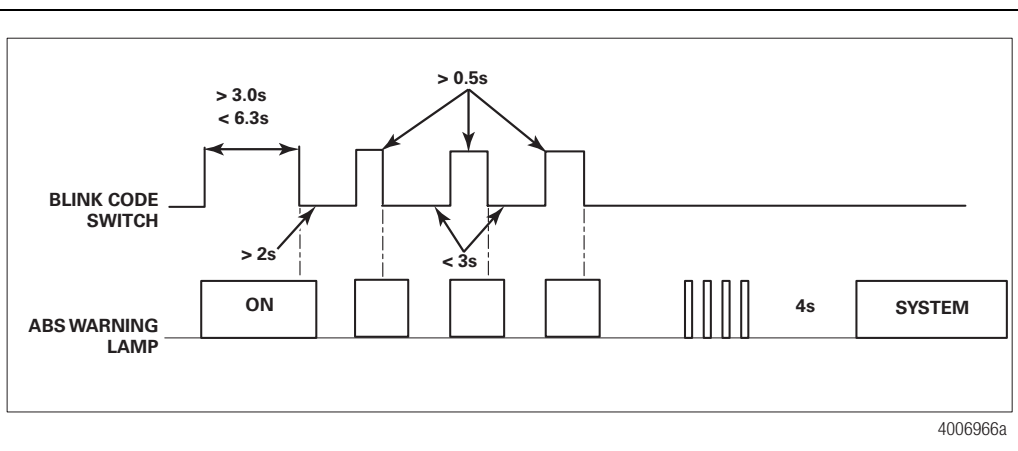


Figure 2.14

2 Troubleshooting and Testing

Table B: Identifying E Version Hydraulic ABS Blink Codes

Troubleshooting with Blink Code Diagnostics — Optional Feature			
Mode	**Procedure**	**System Response**	**Action**
Diagnostics	**Step I.** Turn ignition ON.	Possible responses:	
		1. ABS warning lamp comes on momentarily then goes out, indicating System O.K.	No recognizable active faults in the ABS. No action required.
		2. ABS warning lamp does not light, indicating possible wiring fault or burned-out bulb.	Inspect wiring. Inspect bulb. Make the necessary repairs.
		3. ABS warning lamp stays on, indicating:	
		• Fault, or faults, in the system	Continue with blink code diagnostics. Go to Step II.
		• Sensor fault during last operation	Continue with blink code diagnostics. Go to Step II.
		• Faults cleared from ECU, but vehicle not driven.	Drive vehicle — lamp will go out when vehicle reaches four mph (6 km/h).
		• ECU disconnected.	Connect ECU.
	Step II. Press and hold Blink Code Switch for one second, then release.	ABS warning lamp begins flashing two-digit blink code(s).	Determine if fault is active or stored: **Active Fault:** Lamp will repeatedly display one code. **Stored Fault:** Lamp will display code for each stored fault then stop blinking. Faults will be displayed **one time only**.
	Step III. Count the flashes to determine the blink code.	First Digit: 1-14 flashes, Pause (1-1/2 seconds). Second Digit: 1-11 flashes, Pause (4 seconds).	Find definition for blink code on blink code chart.
	Step IV. Turn ignition OFF. Repair and record faults	Active Fault.	Make the necessary repairs.
		Stored Faults.	Record for future reference.
Clear	**Step V.** Turn ignition ON. Clear faults from memory: **Press and hold** blink code switch for 3.0 to 6.0 seconds, then release.	ABS warning lamp flashes eight times.	All stored faults successfully cleared. Turn ignition OFF. Turn ignition ON. The warning lamp will stay on. This is because the ECU is looking for wheel speed. Drive the vehicle at a speed of four mph (6 km/h). Once the ECU senses wheel speed, the lamp will go off.
		Eight flashes not received.	Active faults still exist, repeat Step I through Step V.

Blink Codes Illustrated

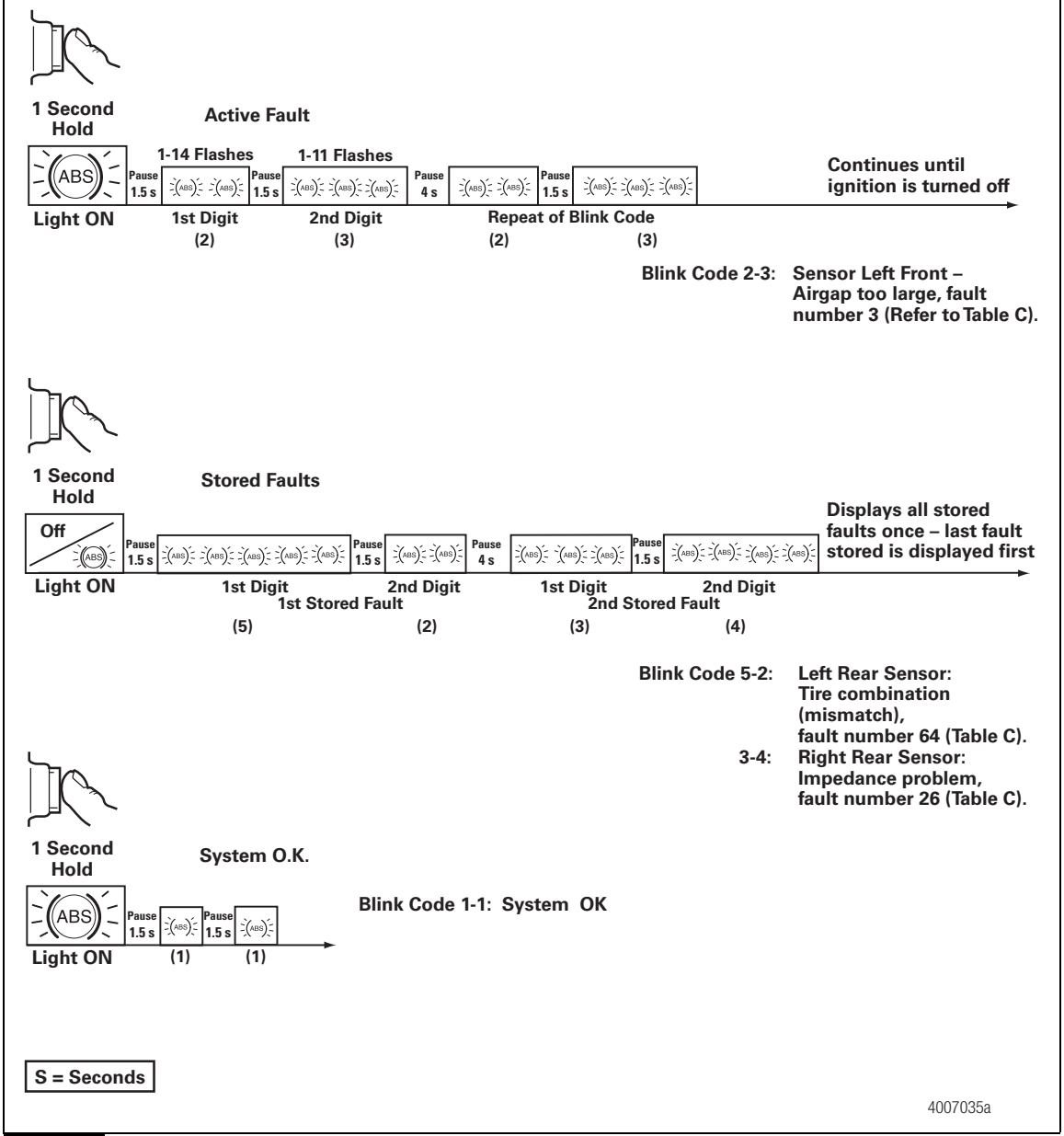


Figure 2.15

2 Troubleshooting and Testing

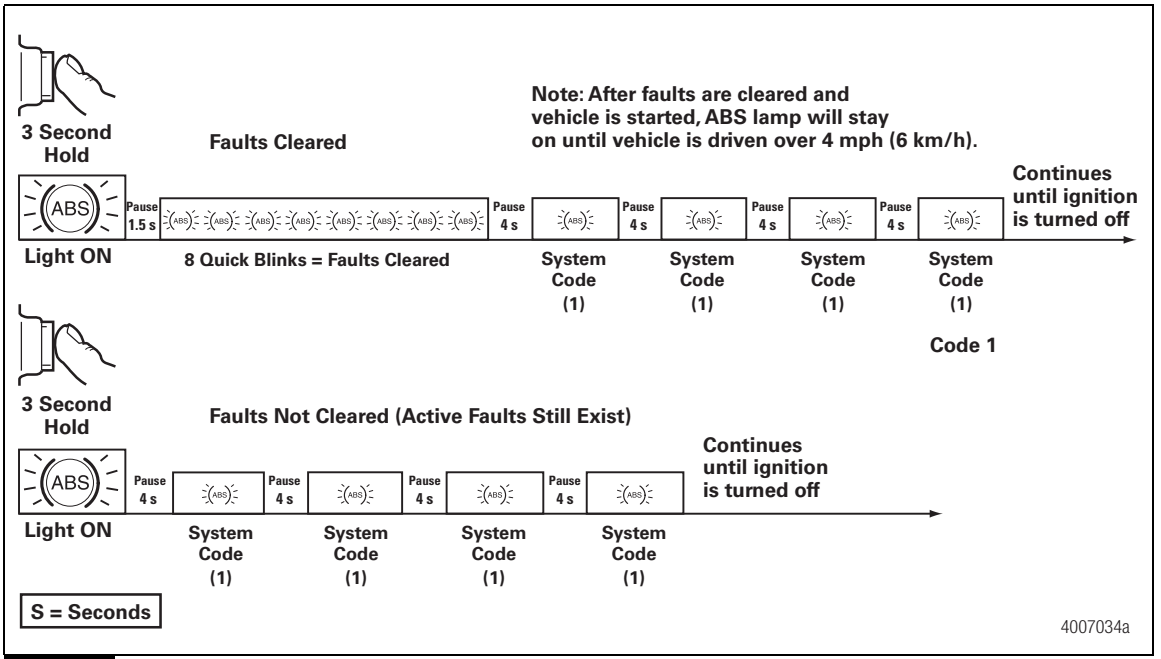


Figure 2.16

E Version Hydraulic ABS Blink Codes

Use the information in Table C to identify a fault and its fault number.

The blink code appears in two parts. The first part identifies the faulty component. The second part identifies the location or the description of the fault.

1. Identify and record the blink code. Blink codes are identified in Columns **1** and **2**.
2. Find the fault number in Column **3**.

Table C: E Version Blink Codes

First Part	Second Part	Fault Number
1 No Failure	1 No Failure	—
2 Sensor: Air gap	1 Right Front	1
2 Sensor: Air gap	2 Left Rear	2
2 Sensor: Air gap	3 Left Front	3
2 Sensor: Air gap	4 Right Rear	4
3 Sensor: Impedance	1 Right Front	23
3 Sensor: Impedance	2 Left Rear	24
3 Sensor: Impedance	3 Left Front	25



Table C: E Version Blink Codes

First Part	Second Part	Fault Number
3 Sensor: Impedance	4 Right Rear	26
4 Sensor: No trigger at all	1 Right Front	73
4 Sensor: No trigger at all	2 Left Rear	74
4 Sensor: No trigger at all	3 Left Front	75
4 Sensor: No trigger at all	4 Right Rear	76
5 Sensor: Tire Combination	1 Right Front	63
5 Sensor: Tire Combination	2 Left Rear	64
5 Sensor: Tire Combination	3 Left Front	65
5 Sensor: Tire Combination	4 Right Rear	66
6 Power Amplifier: Short to Ubat/Uvent	1 Right Front Inlet Valve	9
6 Power Amplifier: Short to Ubat/Uvent	2 Right Front Outlet Valve	10
6 Power Amplifier: Short to Ubat/Uvent	3 Left Front Inlet Valve	11
6 Power Amplifier: Short to Ubat/Uvent	4 Left Front Outlet Valve	12
6 Power Amplifier: Short to Ubat/Uvent	5 Right Rear Inlet Valve	13
6 Power Amplifier: Short to Ubat/Uvent	6 Right Rear Outlet Valve	14
6 Power Amplifier: Short to Ubat/Uvent	7 Left Rear Inlet Valve	15
6 Power Amplifier: Short to Ubat/Uvent	8 Left Rear Outlet Valve	16
6 Power Amplifier: Short to Ubat/Uvent	9 Engine Brake Relay	17
6 Power Amplifier: Short to Ubat/Uvent	10 Brake Light Relay	18
7 Power Amplifier: Open Circuit	1 Right Front Inlet Valve	27
7 Power Amplifier: Open Circuit	2 Right Front Outlet Valve	28
7 Power Amplifier: Open Circuit	3 Left Front Inlet Valve	29
7 Power Amplifier: Open Circuit	4 Left Front Outlet Valve	30
7 Power Amplifier: Open Circuit	5 Right Rear Inlet Valve	31
7 Power Amplifier: Open Circuit	6 Right Rear Outlet Valve	32
7 Power Amplifier: Open Circuit	7 Left Rear Inlet Valve	33
7 Power Amplifier: Open Circuit	8 Left Rear Outlet Valve	34
7 Power Amplifier: Open Circuit	9 Engine Brake Relay	35
7 Power Amplifier: Open Circuit	10 Brake Light Relay	36
8 Power Amplifier: Short to Ground	1 Right Front Inlet Valve	41
8 Power Amplifier: Short to Ground	2 Right Front Outlet Valve	42
8 Power Amplifier: Short to Ground	3 Left Front Inlet Valve	43
8 Power Amplifier: Short to Ground	4 Left Front Outlet Valve	44
8 Power Amplifier: Short to Ground	5 Right Rear Inlet Valve	45
8 Power Amplifier: Short to Ground	6 Right Rear Outlet Valve	46
8 Power Amplifier: Short to Ground	7 Left Rear Inlet Valve	47

2 Troubleshooting and Testing

Table C: E Version Blink Codes

First Part	Second Part	Fault Number
8 Power Amplifier: Short to Ground	8 Left Rear Outlet Valve	48
8 Power Amplifier: Short to Ground	9 Engine Brake Relay	49
8 Power Amplifier: Short to Ground	10 Brake Light Relay	50
9 Inlet Valve Actuation Time	1 Right Front	80
9 Inlet Valve Actuation Time	2 Left Rear	81
9 Inlet Valve Actuation Time	3 Left Front	82
9 Inlet Valve Actuation Time	4 Right Rear	83
10 Pump Motor	1 pm monitor voltage unexp. high	67
10 Pump Motor	2 pm monitor voltage unexp. low	68
10 Pump Motor	3 motor does not turn	69
10 Pump Motor	4 no pm supply voltage	70
10 Pump Motor	5 pm relay does not switch on	71
10 Pump Motor	6 pm relay does not switch off	72
11 J1939	1 Internal	77
11 J1939	2 bus failure	78
11 J1939	3 message failure	79
12 Pole Wheel	1 Right Front	84
12 Pole Wheel	2 Left Rear	85
12 Pole Wheel	3 Left Front	86
12 Pole Wheel	4 Right Rear	87
13 Brake Chatter	1 Right Front	90
13 Brake Chatter	2 Left Rear	91
13 Brake Chatter	3 Left Front	92
13 Brake Chatter	4 Right Rear	93
14 System	1 valve relay can't switch off	55
14 System	2 valve relay can't switch on	56
14 System	3 reference ground connection	57
14 System	4 tire parameter not correct	58
14 System	5 ABS warning light bulb	59
14 System	6 brake warning light bulb	60
14 System	7 High Voltage	61
14 System	8 Low Voltage	62
14 System	9 Clamp	88
14 System	10 Pull Up Down	89
14 System	11 Internal Error	0

Testing the System

This section of the manual contains information for testing the hydraulic ABS with TOOLBOX™ Software, as well as procedures for conducting standard air and electrical tests.

⚠ WARNING

To prevent serious eye injury, always wear safe eye protection when you perform vehicle maintenance or service.

Exhaust gas contains poison. When testing a vehicle with the engine running, test in a well-ventilated area or route the exhaust hose outside.

To avoid serious personal injury, keep away, and keep test equipment away, from all moving or hot engine parts.

Refer to, and follow, the vehicle manufacturer's Warnings, Cautions and Service Procedures.

When testing, set the parking brake and place the gear selector in NEUTRAL (manual transmission) or PARK (automatic transmission) unless otherwise directed.

Meritor WABCO TOOLBOX™ Software

Use TOOLBOX™ Software to verify the activation of various system components:

- Turn valves, pump and retarder relay on and off (Valve Activation Menu).
- Turn ABS warning lamp on and off (Miscellaneous Output Activation Menu).

NOTE: TOOLBOX™ Software must be connected to the vehicle and the vehicle ignition must be ON in order to display information.

NOTE: For complete instructions for using this program, refer to the User's Manual, TP-99102. Contact Meritor WABCO at 800-535-5560 for information about TOOLBOX™ Software.

E Version Hydraulic ABS Menus and Toolbars

Select Hydraulic ABS from the TOOLBOX™ ***Main Menu***. TOOLBOX™ senses the type of ECU being used and displays the ***HABS Main Screen***.

Main Screen

This screen provides icons and pull-down menu task selections. It also provides information about the current status of Meritor WABCO HABS. Figure 2.17.

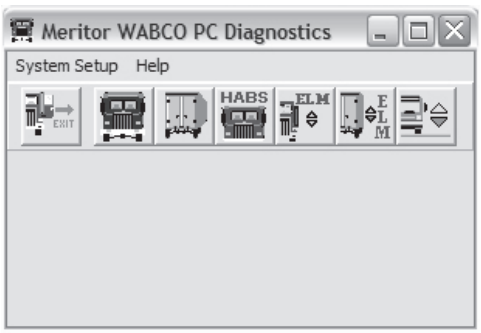


Figure 2.17

ECU information is read once from the ECU and does not change. All other information (e.g., wheel sensors, voltages and fault information) is read and updated continuously.

Display

Select ***Display*** from the HABS ***Main Screen***. A pull-down menu will appear. Figure 2.18.

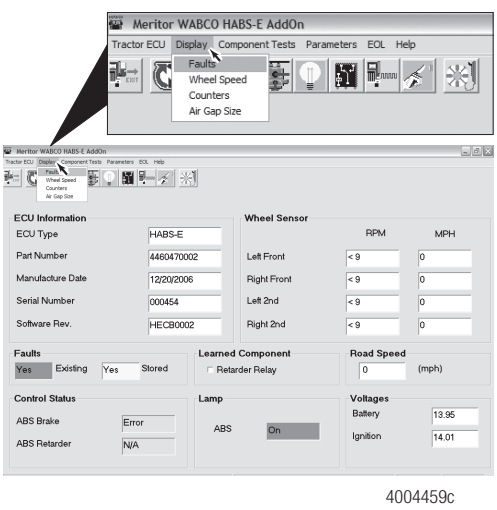
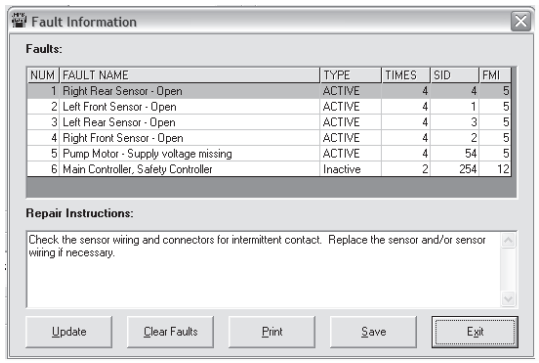


Figure 2.18

2 Troubleshooting and Testing

Faults

Select ***Faults*** to display the ***Fault Information*** screen. Figure 2.19.



4004460b

Figure 2.19

The ***Fault Information*** screen contains a description of each fault, including the type of fault (Active or Stored), number of occurrences, SID and FMI number. Repair instructions for the fault appear at the bottom of the screen.

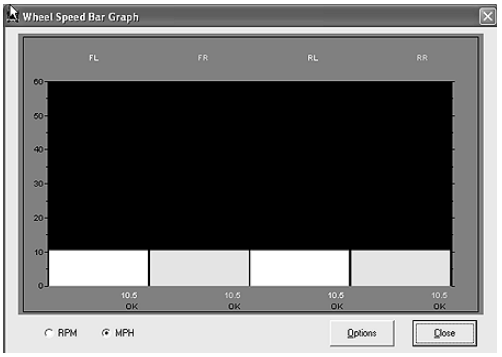
Faults that occur after the screen is displayed will not appear until a screen update is requested. Use the ***Update*** button at the bottom of the screen to refresh the fault information table and display a new list of faults.

After making any required repairs, use the ***Clear Faults*** button to clear the fault. Clear each fault as it is repaired. Cycle the ignition after clearing the faults.

Use the ***Save*** or ***Print*** button to save or print the fault information data. Select ***Exit*** to close this section.

Wheel Speed

Select ***Wheel Speed*** to display the ***Wheel Speed*** screen. Figure 2.20.



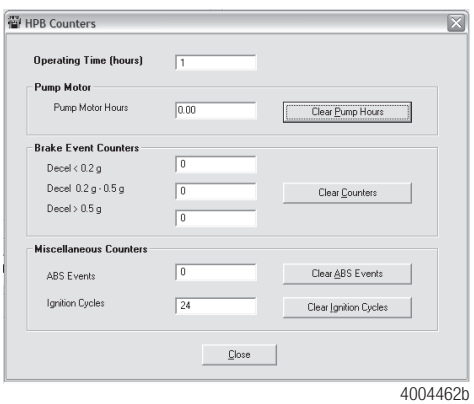
4004461a

Figure 2.20

Use the ***Wheel Speed*** screen to verify that sensors are connected at each wheel. Speed at a sensed wheel (FL, FR, RL, RR) indicates sensors are installed, but does not verify correct sensor installation.

Counters

Select ***Counters*** to display the ***Counters*** screen. Figure 2.21.



4004462b

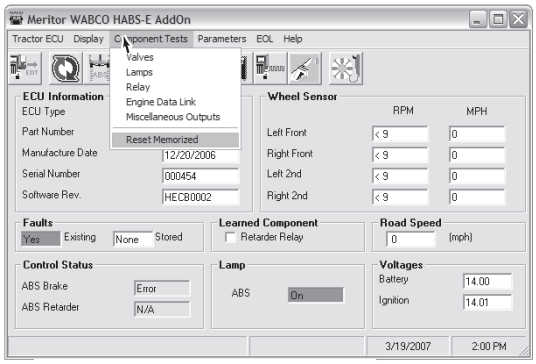
Figure 2.21

The ***Counters*** screen provides an overview of HABS component performance (pump hours, brake events, etc.) as well as general vehicle activity such as ignition cycles. Occurrences displayed on this screen accumulate until the ***Clear*** button is selected.



Component Tests

Select ***Component Tests*** from the HABS ***Main Screen***. A pull-down menu will appear. Figure 2.22.



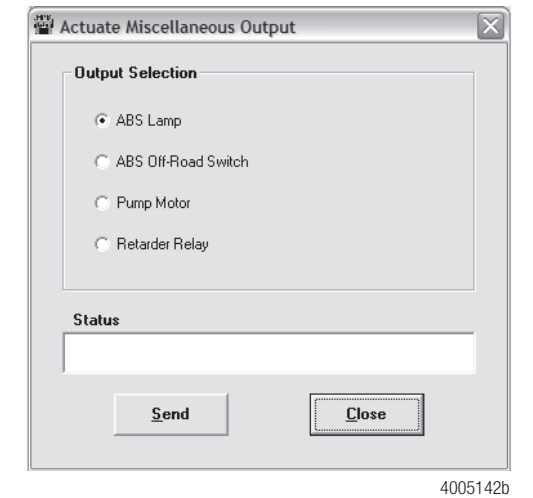
4004463b

Figure 2.22

Miscellaneous Outputs

Select ***Miscellaneous Outputs*** to display the ***Actuate Miscellaneous Outputs*** test screen. Figure 2.23.

NOTE: Use TOOLBOX™ Software to test the following components: Retarder Relay, Brake Light Relay, Supply Valve, Cut-Off Valve, ABS Lamp, Traction Lamp, Brake Warning, Pump Front, Pump Rear, Buzzer.



4005142b

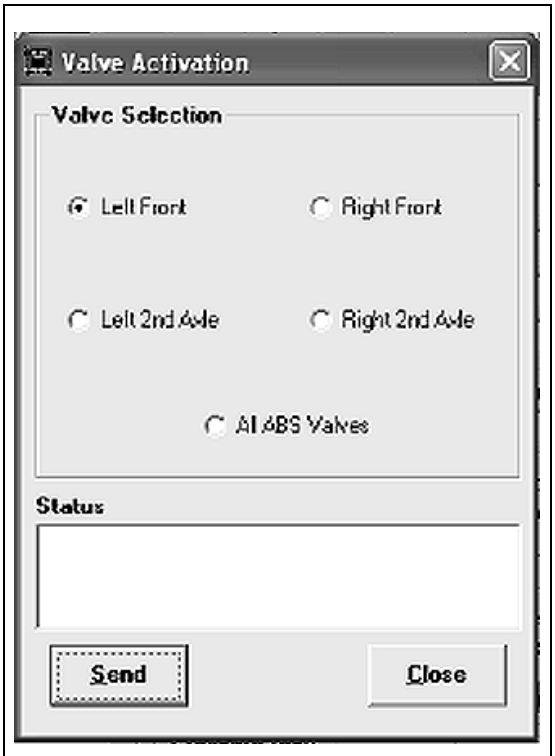
Figure 2.23

This screen provides a check of several HABS components, as well as a way to check either inlet or outlet activity of the valves, pump or retarder relay.

Highlight the component you wish to test, then select the ***Send*** button to actuate the component. Component activation status appears in the ***Status Box*** field. Select ***Close*** to exit this screen.

Valves

Select ***Valves*** to display the ***Valve Activation*** test screen. Figure 2.24.



4004464a

Figure 2.24

The ***Valve Activation*** test screen lets you activate the HABS valves to check for correct activation and to verify correct brake line installation.

Click on the valve you wish to test, then click the ***Send*** button to actuate the component. Component activation status appears in the ***Status*** box field. Select ***Close*** to exit this screen.

2 Troubleshooting and Testing

Lamps

Select ***Lamps*** to display the ***Lamp Test*** screen. Figure 2.25.

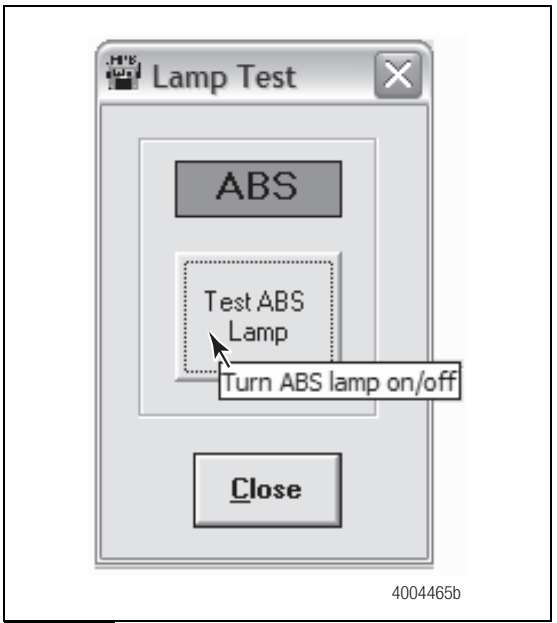


Figure 2.25

As each lamp is tested, check the actual lamp to verify correct operation. Select ***Close*** to exit this screen.

Relay

Select ***Relay*** to display the ***Activate Relay*** test screen. Figure 2.26.

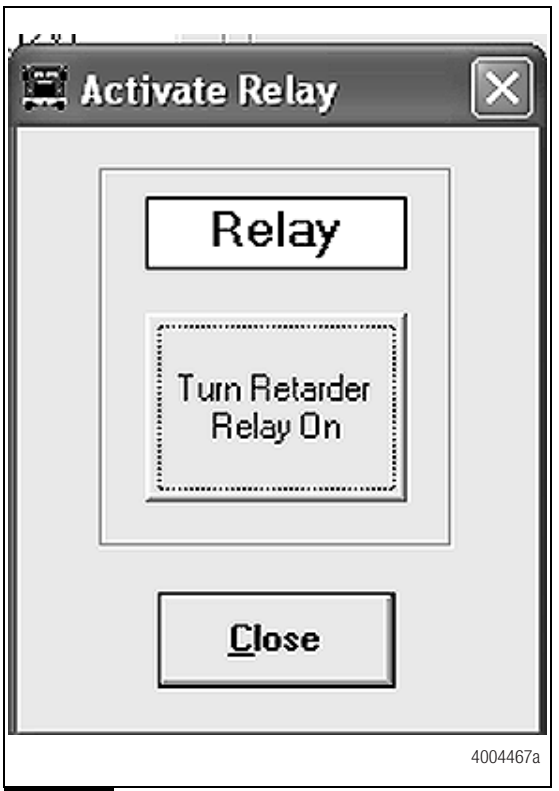


Figure 2.26

This screen allows you to turn the retarder relay on or off. This is helpful in verifying correct operation, installation and wiring of the unit under test. Select ***Close*** to exit this screen.

Engine Data Link

Select ***Engine Data Link*** to display the ***Data Link*** test screen. Figure 2.27.



Figure 2.27

This screen allows you to send a "limit engine torque" command to the engine or a "disable retarder" command to the retarder.

Select the data link destination (engine or retarder), then select ***Send*** to test. Use the ***Stop*** button to end testing. Select ***Close*** to exit this screen.

Reset Memorized

This is an automatic default and cannot be de-selected. It indicates the ECU has memorized the installed retarder relay. Once the ECU has seen a retarder, it expects to see it every time the vehicle is powered up. Figure 2.28.

Because there are times when an ECU is moved to another vehicle — or during diagnostic testing — you may want the ECU to disregard this learned component. Use the ***Reset Memorized*** command for this purpose.

Select ***Component Tests*** from the Hydraulic ABS ***Main Menu***. Then, select ***Reset Memorized*** from the pull-down menu to reset the ***Learned Component*** screen. Figure 2.29.

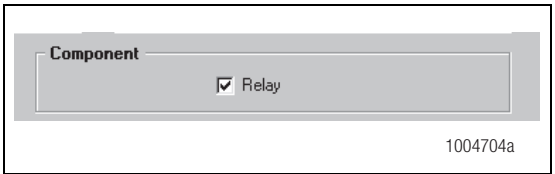


Figure 2.28

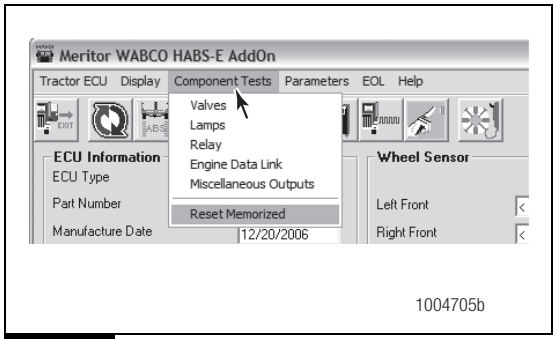


Figure 2.29

Standard Testing

Test Equipment: Volt-Ohm Meter (VOM)

Use of a VOM with automatic polarity sensing is recommended. This eliminates the concern of the polarity of the meter leads during voltage measurements.

System Requirements and Component Tests

Tire Size Range

For correct hydraulic ABS operation, front and rear tire sizes must be within 16% of each other.

Contact the Meritor WABCO Customer Support Center at 800-535-5560 if you plan a tire size difference greater than 8%.

Calculate the tire size with the following equation:

% Difference = (RPM Steer/RPM Drive) –1 x 100

RPM = tire revolutions per mile

2 Troubleshooting and Testing

⚠ CAUTION

When troubleshooting or testing the ABS system, do not damage the connector terminals. Damaged connector terminals may cause system malfunction.

Voltage Check

Voltage must be between 9.5 and 14 volts for the 12-volt hydraulic ABS to function correctly.

Check voltage as follows.

1. Turn ignition ON.
2. Check for the correct voltage.
   - Pins 16 to 18
   - Pins 17 to 19
   - Pins 1 to 6

Standard Component Testing

ABS Warning Lamp

If the ABS warning lamp does not come on after the ignition is turned on, or it comes on but does not go out after three seconds, check all ABS fuses or circuit breakers and replace if necessary. Check the wiring to the ABS diagnostic switch and the warning lamp and repair or replace the wiring as required. When checking the warning lamp, follow these steps:

1. Check voltage potential at the lamp socket.
2. Check continuity of the wires to the socket.
3. Replace the bulb.

NOTE: A complete wiring diagram for 4S/4M D Version hydraulic ABS appears in Figure 2.2 in this section.

ABS Blink Code Switch

When testing the ABS diagnostic switch, perform the following.

1. Check the resistance between the terminals while cycling the switch. A lack of continuity is an indication of a faulty switch.
2. Check the continuity of the wires to the switch:

   Pins 21 and 6 on the 31-pin harness

Sensor Adjustment

On steering axles, the sensor is typically accessible on the in-board side of the steering knuckle.

On drive axles, the sensor is typically accessible on the in-board side of the rear axle spindle.

To adjust the sensor, push the sensor in until it contacts the tooth wheel.

- Do not pry or push sensors with sharp objects.
- Sensors will self-adjust during wheel rotation.

NOTE: No gap is allowable at installation. During normal operation, a gap not to exceed 0.04-inch is allowable.

Sensor Output Voltage Test

Sensor output voltage must be at least 0.2 volt AC at 30 rpm. Test the sensor output voltage as follows:

1. Turn ignition OFF.
2. Disconnect the ECU to measure voltage at the pins on the ECU connector. Refer to Table D.

⚠ 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 and fall over. Serious personal injury and damage to components can result.

3. Place blocks under the front and rear tires to stop the vehicle from moving.
4. Raise the vehicle off the ground. Place safety stands under the axle.
5. Rotate the wheel by hand at 30 rpm (1/2 revolution per second).
6. Measure the voltage at the pins indicated in Table D. Voltage tolerance is ≥0.2 volts alternating current (VAC).

Table D: Sensor Check Pins

	HABS E Version ECU
Sensor	**31-Pin Harness**
Left Front	24 and 29
Right Front	25 and 30
Left Rear	23 and 28
Right Rear	22 and 27



Sensor Resistance

The sensor circuit resistance must be between 900 and 2000 ohms. Measure resistance at the sensor connector, or at the pins on the ECU connector, as follows.

1. Turn ignition OFF.
2. To measure resistance at the pins on ECU connector, disconnect the ECU connector from the ECU.

   To measure resistance at the sensor connector, disconnect the sensor from the sensor extension cable.
3. Measure output at the pins indicated in Table D.

   If measurement is not between 900 and 2000 ohms, replace the sensor.

3 Component Replacement

Component Removal and Installation

Sensors

Sensor Lube Specification

Meritor WABCO specifications call for a sensor lubricant with the following characteristics.

Lube must be mineral oil-based and contain molydisulfide. It should have excellent anti-corrosion and adhesion characteristics and be capable of continuous function in a temperature range of –40° to 300°F (–40° to 150°C).

Meritor WABCO provides sensor lube in a packet with each sensor service part.

Wheel Speed Sensor Replacement — Front Axle

Removal

⚠ WARNING

To prevent serious eye injury, always wear safe eye protection when you perform vehicle maintenance or service.

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 and fall over. Serious personal injury and damage to components can result.

⚠ CAUTION

To avoid damage to the electrical system or HABS components, when welding on a HABS-equipped vehicle disconnect the power connector from the ECU.

1. Park the vehicle on a level surface. Apply the parking brakes. Block the rear tires to prevent the vehicle from moving.

   If necessary, raise the front tires off the ground. Place safety stands under the axle.

2. Disconnect the fasteners that hold the sensor cable to other components.
3. Disconnect the sensor cable from the chassis harness.
4. Remove the sensor from the sensor holder. Twist and pull the sensor to remove it from the sensor bracket. **Do not pull on the cable. Figure 3.1.**

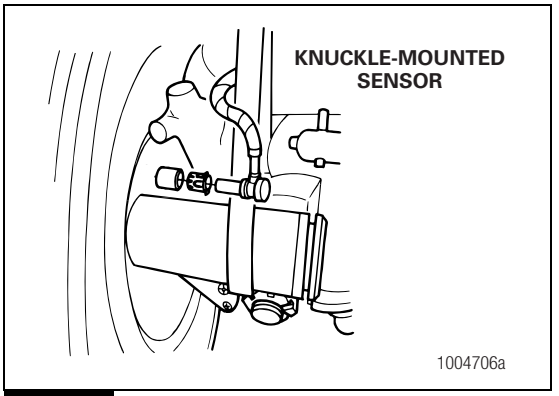


Figure 3.1

Installation

1. Connect the sensor cable to the chassis harness.
2. Install the fasteners used to hold the sensor cable in place.
3. Apply a Meritor WABCO-recommended lubricant to the sensor spring clip and sensor.
4. Install the sensor spring clip. Verify that the spring clip tabs are on the inboard side of the vehicle.
5. With the tabs on the inboard side, push the sensor spring clip into the bushing in the steering knuckle until the clip stops.
6. Push the sensor completely into the sensor spring clip until it contacts the tooth wheel.
7. Fasten the sensor cable every 12 inches. Correctly bundle and store any excess cable in the sub-frame. Figure 3.1.
8. Remove the blocks and safety stands.
9. Perform a voltage output check to ensure correct installation. Refer to Section 2.

Wheel Speed Sensor Replacement — Rear Axle

Removal

1. Apply the parking brake. Block the front tires to prevent vehicle movement.
2. Raise the rear tires off the ground. Place safety stands under the axle.
3. If the rear tire must be removed to gain access to the sensor, release the parking brake to release the brake shoe.

   Remove the wheel and tire assembly from the axle.

4. Remove the sensor from the mounting block. Use a twisting motion if necessary. **Do not pull on the cable.**
5. Disconnect the sensor cable from the chassis harness.
6. Remove the sensor cable from any cable clamps or clips.
7. Remove the sensor spring clip from the sensor bracket.

Installation

1. Connect the new sensor cable to the chassis harness.
2. Press the sensor spring clip into the sensor bracket, located on the rear axle, until it stops. Verify that the tabs are on the inboard side.
3. Apply a Meritor WABCO-recommended lubricant to the sensor.
4. Push the sensor completely into the spring clip until it contacts the tooth wheel.
5. Reattach the sensor cable to the cable clamps or clips.
6. Fasten the sensor cable every 12 inches. Correctly bundle and store excess cable in the sub-frame. Figure 3.2.

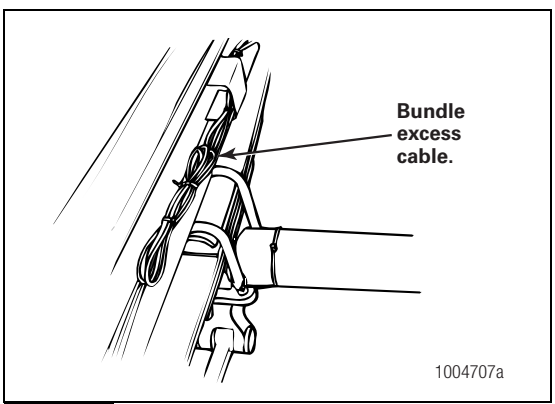


Figure 3.2

7. Replace the tire and remove the safety stands. Lower the vehicle and remove the blocks from the front tires.
8. Perform a voltage output check to ensure correct installation. Refer to Section 2.

Electronic Control Unit (ECU)

Removal

⚠ WARNING

To prevent serious eye injury, always wear safe eye protection when you perform vehicle maintenance or service.

⚠ CAUTION

Hydraulic brake fluid is a caustic substance. Contact with the hydraulic brake fluid can cause skin irritation. Do not let hydraulic brake fluid touch any painted surfaces, as it will remove the paint. Hydraulic brake fluid may also damage certain non-metal surfaces. Do not let fluid contact brake pads, shoes, rotors or discs.

NOTE: Do not open the ECU. Opening the ECU to gain access to the internal components will void the warranty.

NOTE: The following general guidelines are provided to facilitate the safe removal of the ECU module from the modulator assembly.

- It is not necessary to remove the entire modulator to replace the Electronic Control Unit (ECU).
- When only the ECU is replaced, bleeding the system is not necessary.

1. Park the vehicle on a level surface. For vehicles with manual parking brakes, apply the parking brakes.
2. Block the front and rear tires to prevent vehicle movement.
3. Disconnect the battery.
4. Use a clean rag to carefully wipe the surface of the modulator and the surrounding area.
5. Open the latches on the 31-pin harness attached to the ECU. After the latch is released, remove the connectors from the ECU.
6. Use a 4 mm Allen wrench to loosen and remove the four mounting screws that attach the ECU module to the modulator valve.
7. Carefully remove the ECU by lifting straight out. To avoid damage, do not twist the ECU during removal. Determine the warranty status of the ECU. If the ECU is under warranty, return it to Meritor WABCO. If it is not under warranty, discard the used ECU.
8. Use a clean rag to carefully clean the area around the valves formerly covered by the ECU.

3 Component Replacement

Installation

⚠ CAUTION

Excessive force in positioning the ECU onto the modulator will damage the ECU housing. Do not force the ECU into position. Use a gentle, even pressure when positioning the ECU.

1. Position the ECU onto the modulator valve. Apply gentle pressure to seat the ECU. Motor connectors must achieve full depth into the housing. The gap between the modulator and ECU must not exceed 0.08-inch (2 mm).
2. Use a 4 mm Allen wrench to tighten the four mounting screws that attach the ECU to the modulator. Tighten to 14 in-lb (1.5 N•m). Do not exceed this torque. The metal sleeves on the ECU housing must rest flat on the body of the modulator. ❶
3. When the ECU is correctly installed with the metal sleeves flat on the modulator, tighten the bolts to 21-30 in-lb (2.5-3.5 N•m). ❶

⚠ WARNING

Electrical connectors must be correctly installed with the latch pushed in to lock the connector. Failure to do so may allow the connectors to come loose or disconnect resulting in loss of ABS function.

4. Attach the 31-pin harness connector to the ECU.
5. Connect the battery.

Modulator Assembly

Removal

⚠ CAUTION

The modulator assembly contains hydraulic brake fluid, a caustic substance. Remove the valve carefully so that fluid does not leak and cause skin irritation or damage to components.

NOTE: If there is interference, the entire bracket and valve assembly can be removed.

1. Apply the parking brakes. Block the front and rear tires to prevent vehicle movement.
2. Place a container under the modulator assembly to catch leaking brake fluid.
3. Disconnect the electrical harness connectors from the modulator assembly.
4. Mark the six brake lines for ease of installation. Disconnect the lines from the modulator assembly.
5. Remove the three mounting capscrews and washers that attach the modulator assembly to the bracket.

   NOTE: Whenever any hydraulic system fitting is loosened or disconnected, the entire system must be bled to remove any air that may have entered. Refer to “Brake Bleeding Procedures” in this section.

6. Remove the modulator assembly.

Installation

1. Position the modulator assembly in place on the vehicle. Figure 3.3.

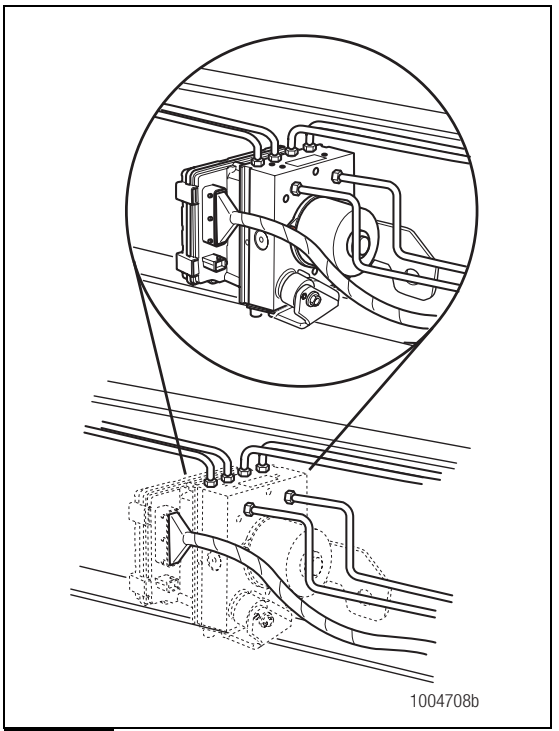


Figure 3.3

2. Tighten the three mounting nuts to 16 ft-lb (22 N•m). ❶
3. Connect the electrical harnesses to the modulator assembly.

4. Connect and tighten the brake line connections.
5. Bleed the brake system, per the following instructions.

Brake Bleeding Procedures

General

The following brake bleeding methods explain how to bleed the hydraulic ABS modulator assembly during installation, or in the event of air in the brake system. There are instructions for both pressure and manual bleeding procedures.

These instructions include the procedure for bleeding both the master cylinder and the brake system. In some cases, for example, if you are replacing only the modulator assembly, it may not be necessary to bleed the master cylinder. If you have any questions, please contact the Meritor Service Center at 800-535-5560.

NOTE: The modulator assembly must be handled with appropriate care and should not be exposed to excessive impact or compressed air at the hydraulic ports prior to assembly.

⚠ WARNING

Failure to bleed the system whenever any hydraulic system fitting is loosened or disconnected will allow air to remain in the system. This will prevent the hydraulic pressure in the brake system from rising enough to apply the brakes correctly. This will cause the stopping distance to increase and can result in serious personal injury.

Correctly discard hydraulic brake fluid that is removed from the brake system. Hydraulic brake fluid that is removed can be contaminated and can cause damage, loss of braking and serious personal injury.

Use only the type of hydraulic brake fluid specified by the equipment manufacturer. Do not use or mix different types of hydraulic brake fluid. The wrong hydraulic brake fluid will damage the rubber parts of the brake caliper and can cause damage, loss of braking and serious personal injury.

NOTE: Use DOT 3 or DOT 4 hydraulic brake fluid. Refer to the vehicle specifications to determine which fluid to use.

⚠ CAUTION

Hydraulic brake fluid is a caustic substance. Contact with hydraulic brake fluid can cause skin irritation. Do not let hydraulic brake fluid touch any painted surfaces, as it will remove the paint. Hydraulic brake fluid may also damage certain non-metal surfaces. Do not let fluid get on brake pads, shoes, rotors or discs.

Pressure Fill and Bleed

Pressure fill and bleed is the preferred method for bleeding the service brake system. It requires the use of a special pressure bleeder kit, consisting of a tank, pressure pump and valve, gauge, tubing and adapter. These kits are available from a number of manufacturers and include instructions for use. Figure 3.4.

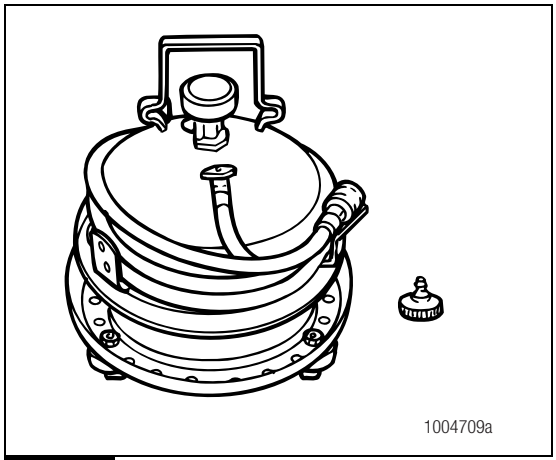


Figure 3.4

Pressure Fill and Bleed Procedure

⚠ CAUTION

Turn the ignition OFF for the entire bleed procedure. Do not energize the unit during the bleed procedure. Improper bleeding may result in system malfunction due to the presence of air in the closed hydraulic system.

1. Apply the parking brake and block the tires. Turn the ignition OFF and disconnect the battery terminals.
2. Fill the pressure bleeder with new DOT 3 or DOT 4 hydraulic brake fluid. Refer to the vehicle specifications to determine which fluid to use.

3 Component Replacement

3. Follow the manufacturer's instructions to connect the pressure bleeder to the brake master cylinder reservoir.
4. Set the filling pressure to 20 to 30 psi (1.5 to 2.0 bar).
5. Turn on the bleed equipment until the fluid level in the reservoir reaches approximately 0.875-inches (20 mm).
6. Release pressure for three to five seconds. Apply pressure for five to 10 seconds.
7. Repeat Step 5 and Step 6 approximately 10 times. After releasing the pressure, air bubbles should rise up into the reservoir.

⚠ WARNING

Do not let the brake master cylinder fluid get below the minimum level during the bleeding operation. Keep the master cylinder reservoir filled with new DOT-approved brake fluid, as specified by the original equipment manufacturer. Failure to keep the brake reservoir level above minimum could result in more air entering the system, making it impossible to effectively bleed the system resulting in increased stopping distance.

8. Bleed the brake system:
   - Set the filling pressure to 20 to 30 psi (1.5 to 2.0 bar).
   - Place a wrench on the brake actuator bleeder fitting. Start with the farthest from the modulator, typically the right rear, then attach a length of clear plastic tubing to the bleeder fitting. Verify that the tube fits snugly.

   NOTE: Both the tubing and container must be able to withstand the effects of hydraulic brake fluid. Tools used for bleeding the system should be brake fluid-safe.

9. Submerge the tubing in a container of clean hydraulic brake fluid. Figure 3.5.

   Loosen the bleeder fitting until the fluid begins to flow (about 3/4 turn). Let the hydraulic fluid flow out of the fitting until it is free of air bubbles.

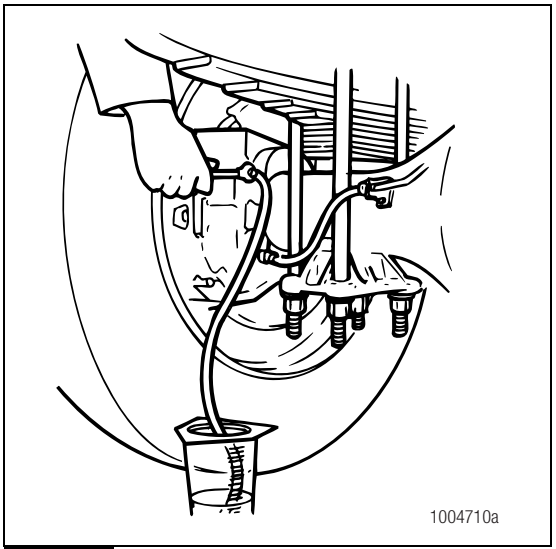


Figure 3.5

10. Tighten firmly to secure the fitting.
11. Repeat Step 5 through Step 8 to bleed the remaining three brake actuators. Bleed in sequence of the longest to shortest circuit from the modulator assembly.
12. Turn off bleed equipment and remove pressure. Remove the bleed device and check the fluid level in the reservoir. Fill if required. Replace the reservoir cap and dispose of used brake fluid.
13. Remove the wheel blocks.

Manual Bleed Procedure

NOTE: The ignition must remain off for the entire bleed procedure; energizing the unit during bleeding must be impossible.

1. Apply the parking brake and block the tires. Turn the ignition OFF and disconnect the battery terminals.
2. Fill the reservoir with DOT 3 or DOT 4 hydraulic brake fluid. Refer to the vehicle specifications to determine which fluid to use.
3. Depress the brake pedal five times using the stroke between 1/3 travel and maximum travel in five seconds.
4. Release the pedal for five to 10 seconds. Air bubbles will rise into the reservoir while depressing and releasing the pedal.



5. Repeat Step 3 and Step 4 another three times, or until sufficient pedal resistance is felt.

⚠ WARNING

Do not let the brake master cylinder fluid get below the minimum level during the bleeding operation. Keep the master cylinder reservoir filled with new DOT-approved brake fluid as specified by the original equipment manufacturer. Failure to keep the brake reservoir level above minimum could result in more air entering the system, making it impossible to effectively bleed the system resulting in increased stopping distance.

6. Bleed the brake system. Place a wrench on the brake actuator bleeder fitting. Start with the farthest from the modulator, (typically the right rear), then attach a length of clear plastic tubing to the bleeder fitting. Verify that the tube fits snugly.

   NOTE: Both the tubing and container must be able to withstand the effects of brake fluid. Tools used for bleeding the system should be brake fluid-safe.

7. Submerge the tubing in a container of clean brake fluid. Figure 3.5.
8. Depress the brake pedal 10 to 15 times, using the maximum available stroke.
9. Loosen the bleeder fitting until the fluid begins to flow (about 3/4 turn), while depressing the brake pedal through its maximum available stroke.
10. Tighten the fitting firmly prior to releasing the brake pedal.
11. Repeat Step 6 through Step 8 several times until the discharged fluid is free of air bubbles.
12. Repeat Step 3 through Step 9 to bleed the remaining three brake actuators. Bleed in sequence of the longest to the shortest circuit from the modulator.
13. Check the travel of the brake pedal. If a firm resistance is felt, the manual bleeding procedure is complete.
14. Check the fluid level in the reservoir and fill if required. Replace the reservoir cap and dispose of used brake fluid.
15. Remove the wheel blocks.

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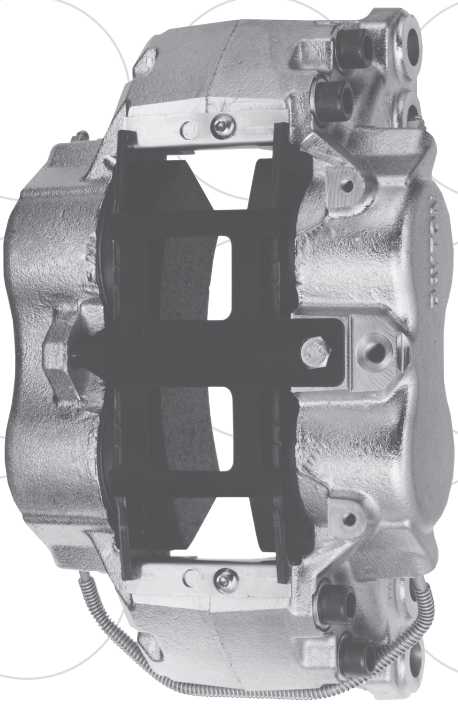
MERITOR WABCO

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Maintenance Manual MM-2075

Four-Piston Quadraulic™ Disc Brake Caliper

Revised 06-08



Service Notes

About This Manual

This manual provides instructions for Meritor four-piston Quadraulic™ disc brake calipers.

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.

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 Additional Maintenance and Service Information

On the Web

Visit Literature on Demand at arvinmeritor.com to access and order product, service, aftermarket, and warranty literature for ArvinMeritor's truck, trailer and specialty vehicle components.

Literature on Demand DVD (LODonDVD)

The LODonDVD contains product, service and warranty information for ArvinMeritor components. To order the DVD, visit Literature on Demand at arvinmeritor.com and specify TP-0742.

How to Obtain Tools and Supplies Specified in This Manual

Call ArvinMeritor's Commercial Vehicle Aftermarket at 888-725-9355 to obtain Meritor tools and supplies.

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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.

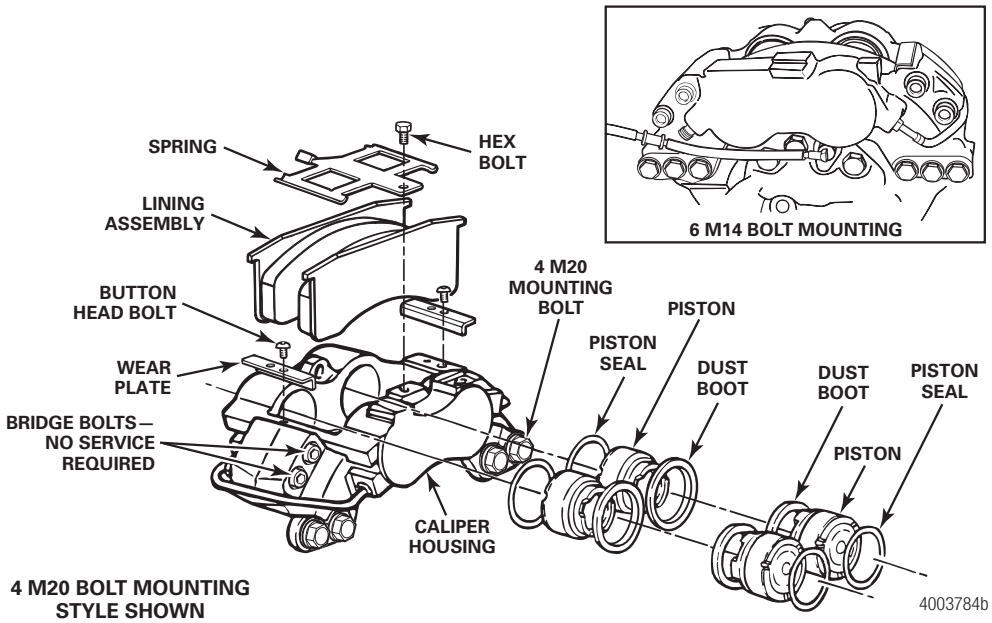
5. Worker Clean-Up. After servicing brakes, wash your hands before you eat, drink or smoke. Shower after work. Do not wear work clothes home. Use a vacuum equipped with a HEPA filter to vacuum work clothes after they are worn. Launder them separately. Do not shake or use compressed air to remove dust 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

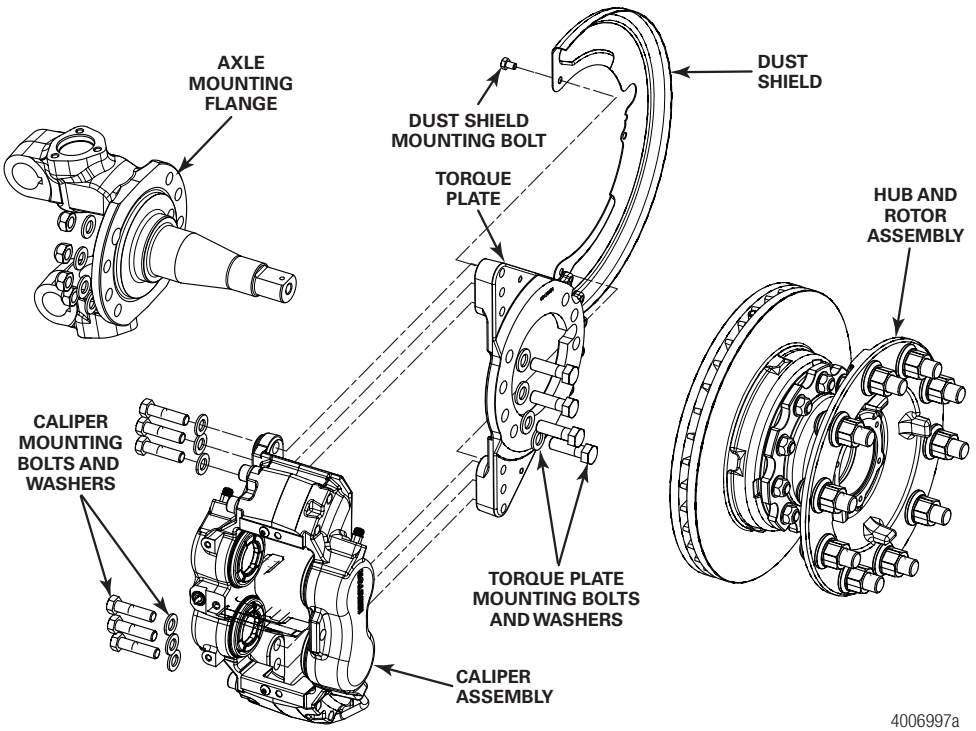
References to OSHA, NIOSH, MSHA, and EPA, which are regulatory agencies in the United States, are made to provide further guidance to employers and workers employed within the United States. Employers and workers employed outside of the United States should consult the regulations that apply to them for further guidance.

1 Exploded Views



4 M20 BOLT MOUNTING STYLE SHOWN

1 Exploded Views



The general assembly sequence is as follows.

1. Assemble the dust shield to the torque plate. The dust shield option varies by model.
2. Assemble the torque plate to the axle flange.
3. Assemble the hub and rotor assembly.
4. Assemble the caliper over the rotor and bolt it to the torque plate.

Features

Four-Piston Quadraulic™ Disc Brake Caliper

Meritor Quadraulic™ disc brakes have a four-piston, fixed-mount caliper design for use on both front and rear drive axles. An installation includes four major components — the caliper assembly, torque plate assembly, optional dust shield, hub or rotor assembly and attaching hardware.

There are two caliper-to-torque plate mounting styles for both the 64 mm and 70 mm size calipers. One uses six M14 bolts and the other uses four M20 bolts.

Caliper

Meritor caliper assemblies are designed as follows.

- The caliper assembly consists of two halves assembled with four bolts and washers.
- It includes four hydraulic piston bores, two brake pads, two stainless steel lining wear plates installed with button head bolts, a pad retainer spring and bolt, bleed screw and crossover tube.
- The piston bores contain the pistons, piston seals and piston boots.
- The crossover tubes connect the two halves of the caliper piston to supply brake fluid to the outboard pistons.

How to Identify the Caliper

The calipers are available in two sizes based on piston diameter: 64 mm or 70 mm. They are visually identifiable by boot color (64 mm is red, 70 mm is black).

Check for an assembly number on the side of the caliper for specific handed part numbers.

Torque Plate

The torque plate assembly may have a provision for an anti-lock braking system (ABS) sensor using either a bolt-on bracket, press-in bushing, clearance hole or slot. It also has provisions to mount an optional dust shield to protect the rotor and brake assembly from road contamination. When the ABS system is not used or the sensor is mounted through the axle flange, the supports are not equipped with the sensor bracket.

Hub and Rotor

Meritor hub and rotor assemblies incorporate the following design features.

- The hub and rotor assemblies consist of a hub and rotor, fitted with bearing cups and wheel attachment studs.
- There are two types of rotors used — a U-shaped rotor and a hat-shaped rotor.
- Some rotors are equipped with a cast-in ABS speed sensor tooth wheel, typically with 100 slots. Some rotors have separate ABS speed sensor tooth wheels attached to the rotor with bolts.
- Front hub and rotor assemblies can have various ABS speed sensor tooth wheels such as a separate ring mounted to the inboard end of the hub, ABS teeth integral to the rotor, or a separate ABS ring attached to the rotor by bolts.
- There are various hub configurations offered to accept the 19.5-inch (495.3 mm) eight-hole wheels, as well as 22.5-inch (571.5 mm) 10-hole wheels with the hub-piloted or stud-piloted system.

Operation

The hydraulic caliper assembly consists of a caliper housing and four pistons. The housing is bolted directly to the torque plate. The torque plate is bolted to the axle flange or may be integrated with the axle.

The caliper receives hydraulic fluid pressure by way of the centrally located inlet port. The inlet port can accept either a banjo bolt connection or an inverted flare type connection.

The arrows in Figure 2.1 show the fluid handling from the inlet port to each of the pistons. Also shown is the fluid handling for bleeding air from the caliper. Because there are two bleed screws, a special bleeding sequence is required to remove all air from the system. This procedure is detailed in Section 6.

During a brake application, the hydraulic pressure is uniformly applied to the rear of all pistons. The pistons extend out of the bores and push the brake pads into contact with the rotor. The hydraulic force creates a clamp force resulting in braking. After the brake is released, the pressure is released and the pistons retract.

2 Introduction

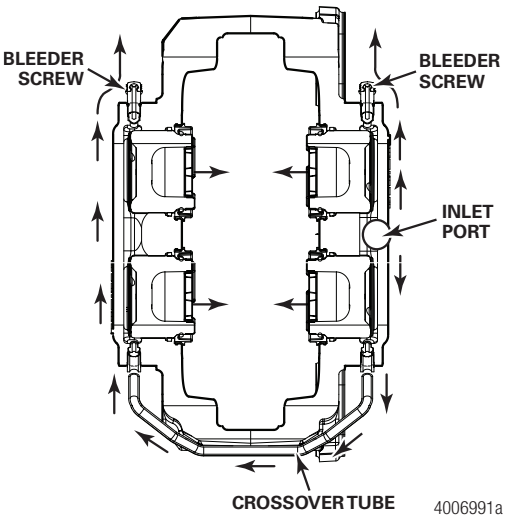


Figure 2.1

3 Disassembly

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.

⚠ DANGER

Before you perform any brake service, identify the vehicle's hydraulic system and refer to the service manual for procedures. Some brake application systems are fully-pressurized, and you cannot reduce this pressure by switching off the ignition or removing the battery. To prevent death, serious personal injury or damage to components, you must carefully follow procedures for the hydraulic system you are servicing.

⚠ WARNING

To prevent serious eye injury, always wear safe eye protection when you perform vehicle maintenance or service.

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 and fall over. 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.

Removal

Brake Pads

Visually inspect all brake pads. Replace the pads when the remaining lining reaches 1/8-inch (3.175 mm) thickness.

- **If you replace the pads:** Replace all the disc brake pads at the same time to maintain original brake balance.
- **If a complete vehicle pad replacement is not necessary or desirable:** Replace the pads on both wheel ends on the same axle.

Replace the Brake Pads

⚠ CAUTION

The brake pads must be installed when you apply the brakes. If brake pads are not installed, damage to the pistons can result.

1. Wear safe eye protection.
2. Park the vehicle on a level surface. Block the wheels to prevent the vehicle from moving.
3. Use a jack to raise the vehicle so that the wheels to be serviced are off the ground. Support the vehicle with safety stands.
4. Remove the wheel and tire assembly according to the manufacturer's recommendation.
5. Remove the master cylinder reservoir filler cap. Check the brake fluid level in the reservoir. If necessary, remove fluid to keep the reservoir from overflowing when compressing the pistons into the caliper.
6. Remove the pad retainer spring bolt. Figure 3.1.

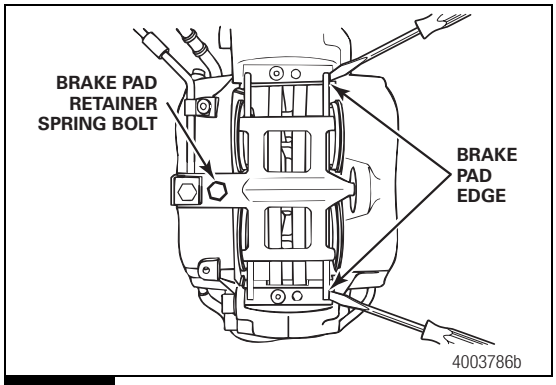


Figure 3.1

7. Insert flat screwdrivers under the brake pad edges. Work the pads out evenly to avoid binding. Figure 3.1.

⚠ CAUTION

Avoid placing direct pressure on a piston or damage to components can result.

8. Compress the pistons on each side. Use a piece of plate steel stock over the pistons to uniformly distribute the load. Figure 3.2.

3 Disassembly

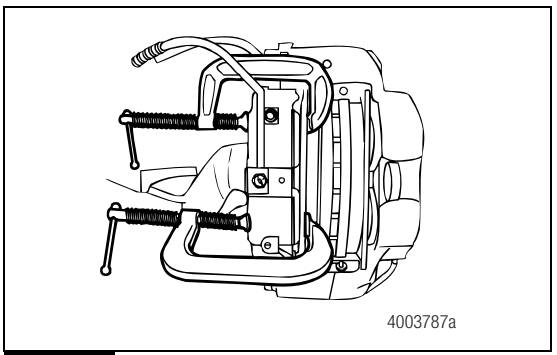


Figure 3.2

9. Inspect the rotor for scoring, warping, cracks, bluing, heat spots or other damage or defects and minimum thickness. Repair or replace if necessary.
10. Inspect the disc brake calipers for leakage, damage or defects to piston boots, seals or pistons. Replace or repair the parts as required.
11. Clean and inspect the lining wear plates. Replace damaged or worn wear plates.

NOTE: The inboard and outboard brake pads are identical, except when they are equipped with a mechanical wear sensor.

12. Install the brake pads. Install pads equipped with a mechanical wear sensor on the inboard side of the caliper. Ensure that the friction surface is against the rotor. Install the pad retainer spring and tighten the bolt. Refer to Section 8. Figure 3.3.

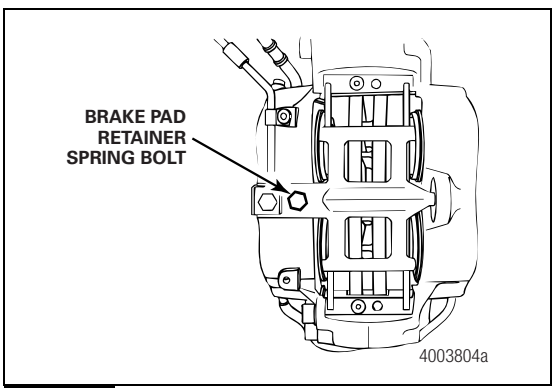


Figure 3.3

13. Fill the master cylinder reservoir with new, clean, high-performance DOT 3 brake fluid or equivalent. Make several brake applications to move the brake pistons and linings out into contact with the brake rotors.
14. Recheck the master cylinder reservoir and top off as necessary to the manufacturer's recommended level.
15. Install the tire and wheel assembly according to the manufacturer's instructions.
16. Lower the vehicle. Road test for correct operation.

Brake Caliper

1. Use a jack to raise the vehicle so that the wheels to be serviced are off the ground. Support the vehicle with safety stands.
2. Remove the tire and wheel assembly according to the manufacturer's instructions.
3. Remove the brake hose hold down clamp bolt, if equipped. Figure 3.4.

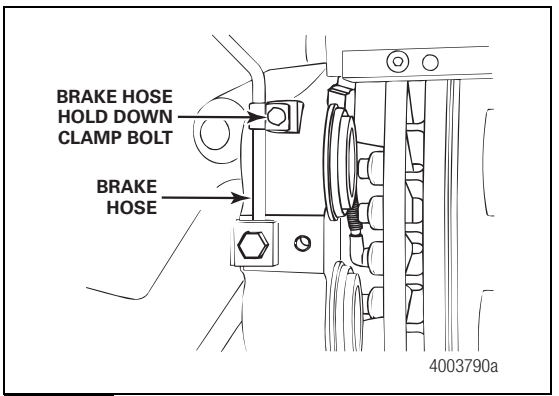


Figure 3.4

4. Remove the brake hose from the caliper. Figure 3.4.

⚠ WARNING

Do not remove the bridge bolts to perform service procedures. If the bridge bolts are removed, you must reinstall them correctly to prevent serious personal injury and damage to components.

5. Remove the caliper-to-torque plate assembly bolts. Do not disassemble the bridge bolts joining the two halves of the caliper. Refer to the bridge bolt procedure in Section 8. Figure 3.5.

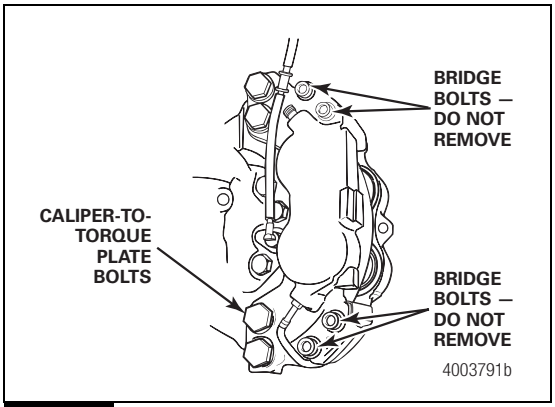


Figure 3.5

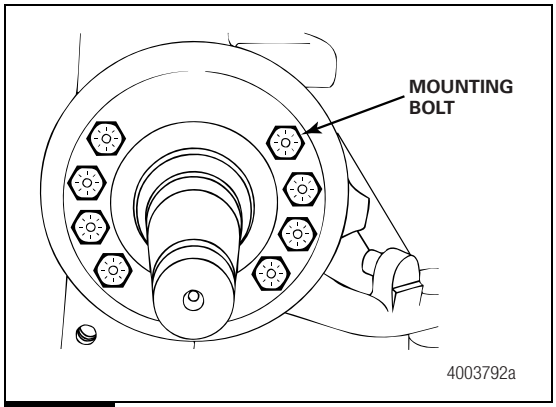


Figure 3.6

Rotor

NOTE: Refer to the vehicle manufacturer's rotor specifications for inspection and service requirements.

1. Check the rotor while assembled to the hub or spoke wheel and mounted on the axle spindle. The lateral runout of the rotor friction surfaces should not exceed 0.015-inch (0.381 mm) total indicator reading (TIR). The thickness variation of the rotor should not exceed 0.0012-inch (0.0300 mm).
   - **If the lateral runout or the thickness variation exceeds the above values:** Resurface or replace the rotor.
   - **If it is necessary to service the rotor, hub, hub seal or bearing:** Remove the caliper according to the procedure in this section.
2. Remove the hub and rotor assembly according to the vehicle manufacturer's recommendation.

Torque Plate

1. Remove the caliper from the vehicle. Refer to the procedure in this section.
2. Remove the dust shield, if installed, from the torque plate.
3. Remove the hub and rotor assembly according to the vehicle manufacturer's recommended service procedure.
4. Remove the ABS sensor, if equipped.
5. Remove the torque plate-to-axle mounting bolts. Figure 3.6.

Disassembly

Brake Caliper

1. Remove the brake caliper and brake pads. Refer to the procedures in this section.
2. Drain all fluid from the caliper.
3. Push all four pistons to the bottom of their bores.
4. Remove the piston boots by prying the metal ring portion of the boot out of the bore with a screwdriver. Use care to avoid damage to the piston or bore. Discard the boots. Figure 3.7.

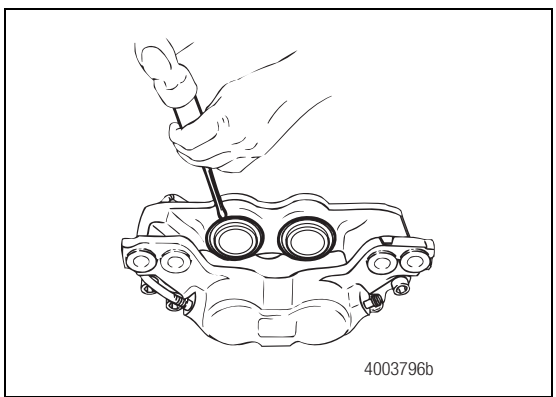


Figure 3.7

5. Remove the crossover tube.

3 Disassembly

⚠ WARNING

When you use compressed air to remove the pistons from the caliper bore, do not place your hands or fingers near the bore to catch or protect the pistons. Serious personal injury can result.

6. Install a plug screw in the inlet port on the inboard caliper half.
7. Place a section of plate stock across the pistons to be removed. Use a C-clamp to hold the plate against the pistons on one side of the caliper where the pistons are to be removed. Figure 3.8.

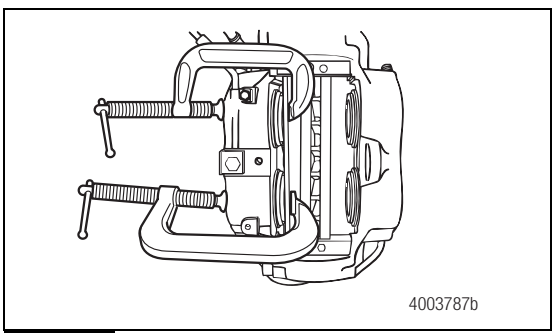


Figure 3.8

⚠ CAUTION

When you remove the pistons from the caliper bore, only direct enough compressed air into the caliper brake fluid inlet to ease the pistons out of the bore. Do not exceed 25 psi (172 kPa). Damage to components will result.

8. Apply low air pressure, no more than 25 psi (172 kPa), with a rubber nosed air fitting to the crossover tube port. Figure 3.9.

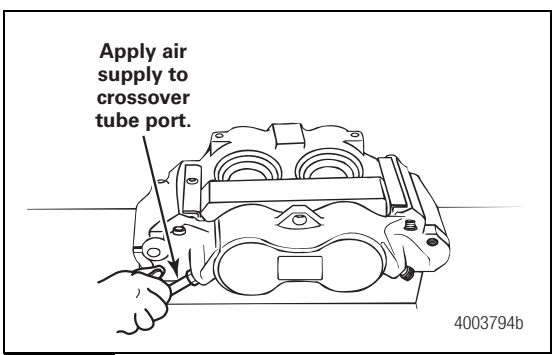


Figure 3.9

⚠ WARNING

Ensure the pistons are installed in the housing before you pressurize it to prevent serious personal injury and damage to components.

9. Gradually open the C-clamp to allow the pistons to move out evenly until free.
10. Repeat the procedure for the other caliper half.

⚠ CAUTION

Install a new caliper if the caliper bores are excessively scored or corroded. Do not hone the caliper bores, which can affect piston fit and operation. Damage to components can result.

11. Remove the piston seals with a non-metallic device. Discard the seals. Do not nick, scratch or scar the piston bores or seal grooves. Do not hone the caliper bores.
    - **If the caliper bores are excessively scored or corroded:** Install a new caliper.

⚠ CAUTION

The outside diameter of the piston is the caliper's primary sealing surface and is manufactured to very close tolerances. Replace a piston if the outside diameter is damaged. Do not refinish or use abrasives, including an emery cloth, on the piston. Damage to components can result.

12. Inspect the outside diameter of the pistons for scoring, nicks, corrosion, wear and damage.
    - **If any of these conditions exist:** Replace the pistons. Do not refinish or use abrasives.
13. Inspect the caliper bore for scoring, nicks, corrosion, wear and damage.
    - **If any of these conditions exist:** Replace the caliper.

⚠ CAUTION

Use a crocus cloth to remove minor stains and corrosion from the caliper bore. Do not use abrasives, including an emery cloth. If you cannot remove minor stains and corrosion, replace the caliper bore to avoid damage to components.

14. Inspect the caliper bore for minor stains and corrosion.
    - **If any of these conditions exist:** Use a crocus cloth to remove stains or corrosion. Clean the caliper bore after using a crocus cloth. Do not use abrasives, including an emery cloth.
    - **If you cannot remove stains and corrosion from the caliper bore:** Replace the caliper.

4 Prepare Parts for Caliper 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.

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.**

Clean, Dry and Inspect Parts

Clean Parts

For Ground or Polished Metal Parts

⚠ CAUTION

Do not use hot solution tanks or water and alkaline solutions to clean ground or polished parts. Damage to parts can result.

Use a cleaning solvent or kerosene or diesel fuel to clean ground or polished metal parts or surfaces.

For Rough Metal Parts

Use a cleaning solvent or a weak alkaline solution in a hot solution tank to clean rough metal parts. If you use a hot solution tank, follow the instructions below.

1. Leave the rough parts in the tank until they are completely cleaned and heated.
2. Remove the rough parts from the tank.
3. Wash the parts with water until you remove the alkaline solution.

Dry and Inspect Parts

1. Use soft, clean paper or cloth rags or compressed air to completely dry parts immediately after you clean them.
2. Carefully inspect all parts for wear or damage before you assemble them.
3. Repair or replace worn or damaged parts.

Apply Corrosion Protection

1. Apply a thin layer of brake fluid to cleaned, dried parts. Be careful that you do not apply the fluid to the linings or rotor.
2. If you will store the parts, apply a rust inhibitor, that prevents corrosion and rust, to all surfaces. Store parts inside to prevent rust and corrosion.

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.

Assembly

Brake Caliper

When using compressed air, use air lines that are completely free of oil and moisture. All brake parts must be clean and completely dried of cleaning fluid. Use only Meritor replacement parts to ensure correct caliper performance.

1. Assemble the crossover tube. Tighten the crossover tube nuts. Refer to Section 8.
2. Ensure the parts are clean and free of debris. Use compressed air to clean out and dry the grooves and passages.
3. Dip new piston seals in new, clean DOT 3 hydraulic brake fluid and install into the piston seal groove in the caliper piston bores. Verify that they are correctly seated.
4. Apply a thin film of silicon grease or brake fluid to the caliper bore seal land between the piston boot and seal groove. Apply the grease or brake fluid around the entire circumference of the caliper bore. Figure 5.1.



Figure 5.1

5. Apply DOT 3 hydraulic brake fluid to the outside of the caliper pistons and install them in the caliper bores with the piston steel cap facing out, verifying that they are square to the bore. Figure 5.2.

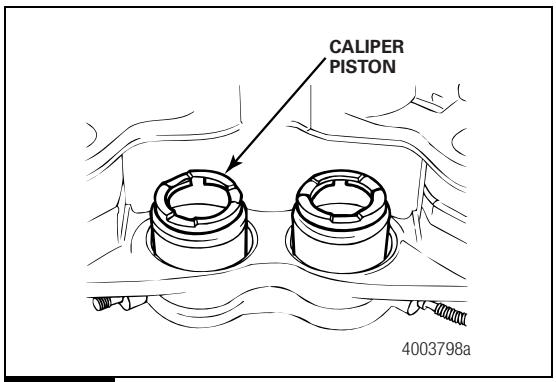


Figure 5.2

6. Press the pistons into the bores one at a time. Use a block and C-clamp to press the piston into the housing until lightly seated. Repeat this procedure for the other pistons. Figure 5.3.

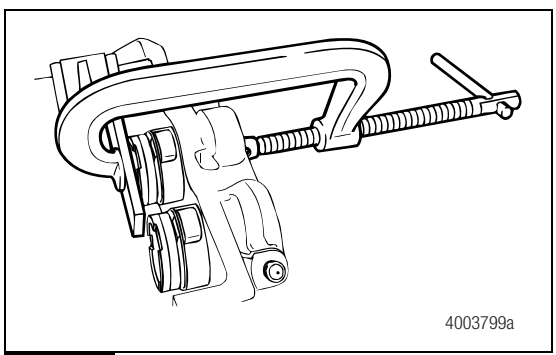


Figure 5.3

7. Install the piston boots over the projecting ends of the pistons and press the ring side of the boots into the boot bore with a seal driver or other method to evenly install the boot. An old bearing cup equal to the boot ring size helps install the boots. Verify that the piston boot bead is seated back against the shoulder of the projecting end of the piston. Boots for the 64 mm and 70 mm pistons are color-coded. The 64 mm boot is red and the 70 mm is black. Figure 5.4.

5 Assembly and Installation

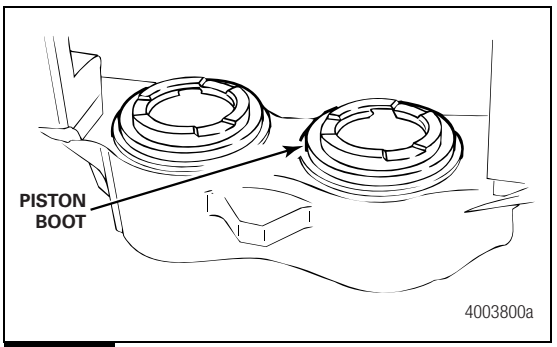


Figure 5.4

8. If required, replace the two stainless steel wear rails by removing the button head bolts.

Installation

Torque Plate

1. Install the torque plate mounting bolts. Tighten the bolts to the specified torque. Refer to Section 8. Figure 5.5.

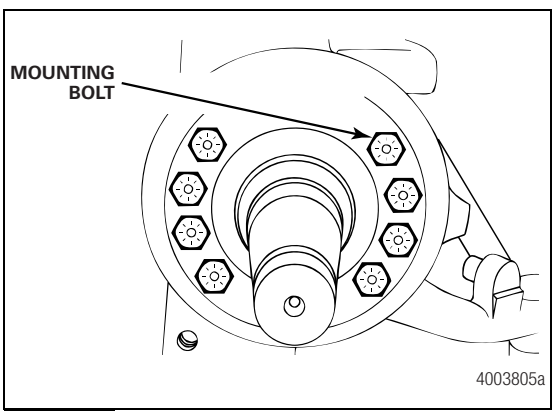


Figure 5.5

2. If equipped, install the ABS sensor according to the vehicle manufacturer's recommended service procedure.
3. Install the hub and rotor assembly according to the vehicle manufacturer's recommended service procedure.
4. Install the dust shield, if equipped.
5. Install the caliper. Refer to the procedure in this section.

Rotor

1. Install the hub and rotor assembly according to the manufacturer's recommended service procedures. Verify that the mating surfaces of the hub or spoke wheel and rotor are clean and free of rust build-up.
2. Check the rotor while assembled to the hub or spoke wheel and mounted on the axle spindle. The lateral runout of the rotor friction surfaces should not exceed 0.015-inch (0.381 mm) total indicator reading (TIR). The thickness variation of the rotor should not exceed 0.0012-inch (0.0300 mm).
   - **If the lateral runout or the thickness variation exceeds the above values:** Resurface or replace the rotor.

Caliper

1. Inspect the caliper before you reinstall it onto the torque plate. The pistons should be fully retracted into the caliper. Check to ensure the piston boots are not loose or damaged. Verify the piston boots are fully seated into the housing. If any leakage, damage or defect is found, it may be necessary to disassemble or replace the caliper. Figure 5.6.

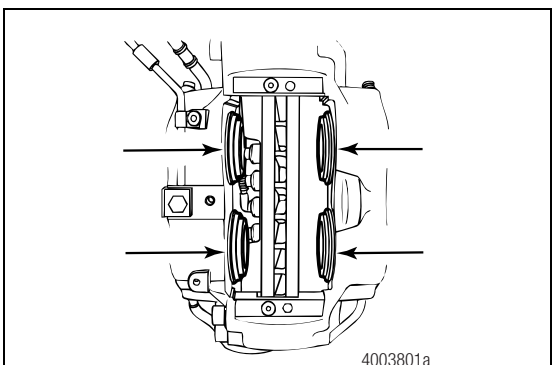


Figure 5.6

2. Install the caliper over the rotor. Install the washers and start the caliper-to-torque plate mounting bolts by hand.
3. Depending on the caliper configuration, tighten the four M20 mounting bolts or the six M14 mounting bolts. Refer to Section 8. ❶
4. Install the brake hose. Figure 5.7.

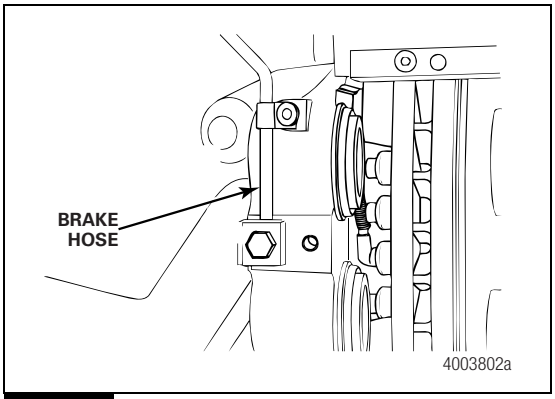


Figure 5.7

5. Secure the brake hose hold-down clamp with the bolt. Figure 5.8.

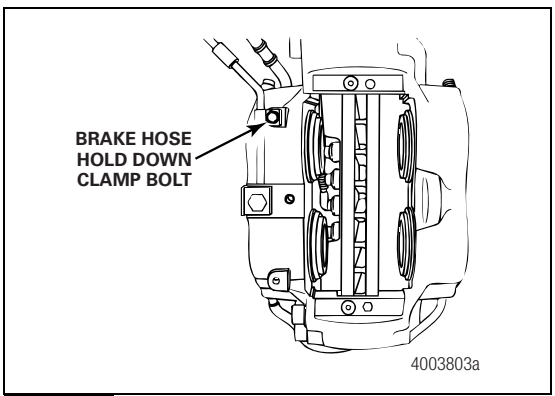


Figure 5.8

Brake Pads

1. Inspect the rotor for scoring, warping, cracks, bluing, heat spots or other damage or defects and minimum thickness. Repair or replace if necessary.
2. Inspect the disc brake calipers for leakage, damage or defects to piston boots, seals or pistons. Replace or repair the parts as required.
3. Clean and inspect the lining wear plates. Replace damaged or worn wear plates.

NOTE: The inboard and outboard brake pads are identical, except when they are equipped with a mechanical wear sensor.

4. Install the brake pads. Install pads equipped with a mechanical wear sensor on the inboard side of the caliper. Ensure that the friction surface is against the rotor. Install the pad retainer spring and tighten the bolt. Refer to Section 8. Figure 5.9.

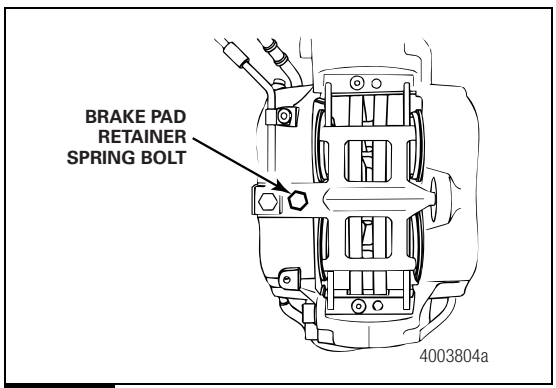


Figure 5.9

5. Fill the master cylinder reservoir with new, clean, high-performance DOT 3 brake fluid or equivalent. Make several brake applications to move the brake pistons and linings out into contact with the brake rotors.
6. Recheck the master cylinder reservoir and top off as necessary to the manufacturer's recommended level.

⚠ CAUTION

To remove air from the caliper, you must use the two bleed screws in a specific sequence to correctly bleed the brakes. Otherwise air can enter the system and affect brake performance. Damage to components can result.

7. Bleed the brake system according to the vehicle manufacturer's procedure. Bleed the caliper according to the procedure specified in Section 6 of this manual.
8. Install the tire and wheel assembly according to the manufacturer's instructions.
9. Lower the vehicle. Road test for correct operation.

6 Inspection

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.

Inspect Parts

Caliper

1. Clean the area around the brake hose. Use brake parts cleaner.
2. Inspect the piston and boots for wear and damage. Replace worn or damaged parts.
3. Inspect the caliper lining wear plates for wear and damage. Replace worn or damaged wear plates.
4. Inspect the housing for cracks or damage. Replace a cracked or damaged housing.

Torque Plate

1. Inspect the caliper mounting area of the torque plate for rust or corrosion. Replace a damaged or worn torque plate.
2. Use a wire brush to clean the caliper mounting area.
3. Inspect the torque plate for cracks or elongated bolt holes.
   - **If these conditions exist:** Replace the torque plate.

Brake Caliper Bleeding Procedure

⚠ DANGER

This bleed sequence refers to bleeding the caliper and does not consider the hydraulic application system requirements. Identify your vehicle hydraulic application system type and refer to that service manual before you perform any brake service. You must adhere to the hydraulic application system bleeding procedures to prevent death, serious personal injury or damage to components.

Refer to the manufacturer's service information for ABS bleeding instructions.

1. Check the master cylinder reservoir and fill, if necessary, with DOT 3 or DOT 4 brake fluid.
2. Bleed the brakes in the following order: right rear, left rear, right front and left front.

⚠ CAUTION

When you bleed a four-piston caliper, monitor the brake fluid level to ensure you do not drain the system. Add brake fluid to the reservoir as needed to prevent damage to components during operation.

Always install new brake fluid into the caliper. Discard old brake fluid. Do not reuse it. Damage to components can result.

NOTE: Each four-piston caliper is equipped with two bleed screws. To ensure air is removed from a caliper, the bleed sequence is inboard, outboard, and repeat inboard.

3. Install a section of clear, flexible tubing with a 1/4-inch inner diameter over the inboard bleeder. Insert the other end of the tubing into a container to collect the purged brake fluid. Discard the brake fluid. Do not reuse old brake fluid.
4. If a pressurized bleeding system is not required by the vehicle manufacturer's service procedures, apply and hold the brakes to pressurize the system.
5. Repeat the procedure for the outboard bleed screw.
6. Repeat the procedure for the inboard bleed screw.
7. Tighten the bleed screws to specification. Refer to Section 8.
8. Test the brakes prior to returning the vehicle to service.

7 Troubleshooting

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.

Brakes

Conditions	Possible Causes	Correction
Excessive Pedal Effort	Pads worn below minimum thickness	Install new pads.
	Faded, overheated condition, glazed pads, blued or heat-checked rotors	Replace the rotor and reface pads if sufficient lining remains.
	Grease, oil or brake fluid on linings	Install new pads in the axle sets.
	Seized or frozen pistons	Disassemble the calipers and free pistons, or replace the caliper.
	Incorrect pad friction material	Install the manufacturer recommended material.
	Incorrectly installed brake pads, backing plate facing the rotor	Inspect for damage and install the pads with the friction material toward the rotor.
Pedal Pulsation (Brake Roughness or Chatter)	Excessive lateral runout of brake rotor	Check with a dial indicator. Install a new rotor if the runout exceeds the maximum specified.
	Excessive out-of-parallelism of brake rotor	Check the parallelism or rotor thickness variation with a micrometer. Resurface the rotor or install a new rotor if the parallelism exceeds the maximum allowed.
	Loose or worn steering or suspension parts	Replace the parts and realign.
	Excessive front bearing clearance	Readjust the bearing to specifications.
Vehicle Pulls to One Side	Brake fluid, oil or grease on linings	Install new pads in the axle sets.
	Unmatched linings, uneven lining wear, distorted pads	Install new pads in the axle sets.
	Rough rotor surfaces on one rotor	Resurface or replace the rotor in the axle sets.
	Seized or frozen pistons	Disassemble the caliper and repair or replace.
	Loose caliper mounting bolts	Tighten to specifications.
	Uneven tire pressure, tread wear or size, right to left	Equalize to the recommended pressures. Install the correct size tires with good tread.
	Excessive rotor parallelism or runout	Resurface or replace the rotor.
	Restricted hose or line	Examine the hoses and lines, and replace as necessary.
	Front end out of alignment	Reset the alignment.

7 Troubleshooting

Conditions	Possible Causes	Correction
Leaky Caliper	Wheel seal damaged. A damaged wheel seal can make the wheel end and caliper appear as the problem.	Pressurize the caliper to determine the source of the leak. If necessary, replace the wheel seal.
	Crossover tube damaged	Repair or replace the components or housing as necessary.
	Bleeder screw damaged	Repair or replace the components or housing as necessary.
	Inlet port damaged	Repair or replace the components or housing as necessary.
	Cylinder bore surface scored or corroded	Disassemble the calipers, clean the bore and replace the seals and boots.
	Caliper piston seal damaged or worn	Disassemble the calipers and install new seals and boots.
	Caliper piston damaged	Replace the piston.
No Braking Effect or Excessive Pedal Travel	Reservoir fluid level low	Check for causes of fluid leak, repair as required and refill the reservoir. Bleed the system as needed.
	Air in the caliper	Bleed the caliper as needed. Refer to the brake caliper bleed procedure.
	Air in the hydraulic application system	Refer to the hydraulic application system manual for the correct bleeding procedure.
	Malfunction of the hydraulic application system	Refer to the hydraulic application system manual for the diagnostic procedures.
	Caliper piston seal damaged	Disassemble the caliper and replace the piston seals. Replace the piston if it is damaged.
	Excessive rotor runout or bent rotor	Check the rotor with a dial indicator. Install a new rotor if the runout exceeds the maximum specified.
	Worn or excessively loose wheel bearings	Adjust or replace the bearings as needed.
	Low quality brake fluid	Drain and clean the system. Replace with the recommended brake fluid.
	Weak brake hose that expands under pressure	Replace the hoses.
Brake Noise (Chatter)	Excessive lateral runout of rotor	Check the runout with a dial indicator. Install a new rotor if the runout exceeds the maximum specified.
	Lack of rotor parallelism	Check the parallelism with a micrometer. Resurface or install a new rotor as required.
	Loose wheel bearing	Readjust the bearing to the specified torque.
	Incorrect pad friction material	Install the manufacturer recommended material.
	Incorrectly installed brake pads, backing plate facing the rotor	Inspect for damage and install the pads with the friction material toward the rotor.

7 Troubleshooting

Conditions	Possible Causes	Correction
Brake Noise (Scraping)	Rust or mud build-up on edges of rotor and on caliper housing	Clean or replace as necessary.
	Worn pad or pad installed backward	Replace the pads in the axle sets only with the friction surface against the rotor.
	Incorrect caliper alignment permitting rotor to scrape on housing	Correct the alignment.
	Incorrect pad friction material	Install the manufacturer recommended material.
	Incorrectly installed brake pads, backing plate facing the rotor	Inspect for damage and install the pads with the friction material toward the rotor.
Brake Noise (Groan)	Pressure on the brake pedal too light	Slightly increase the pedal effort to eliminate the noise.
	Incorrect pad friction material	Install the manufacturer recommended material.
	Incorrectly installed brake pads, backing plate facing the rotor	Inspect for damage and install the pads with the friction material toward the rotor.
Brake Noise (Rattle)	Excessive clearance between the shoe and caliper	Install new pads.
	Pad retainer plate missing or not correctly positioned	Install a new pad retainer spring or position it correctly.
	Incorrect pad friction material	Install the manufacturer recommended material.
	Incorrectly installed brake pads, backing plate facing the rotor	Inspect for damage and install the pads with the friction material toward the rotor.
Brake Noise (Squeal)	Glazed pads	Resurface or replace the pads in the axle sets only.
	Weak pad retainer spring	Install a new pad retainer spring.
	Foreign material embedded in linings	Replace the pads in the axle sets only.
	Incorrect pad friction material	Install the manufacturer recommended material.
	Incorrectly installed brake pads, backing plate facing the rotor	Inspect for damage and install the pads with the friction material toward the rotor.

8 Specifications

Torque Specifications

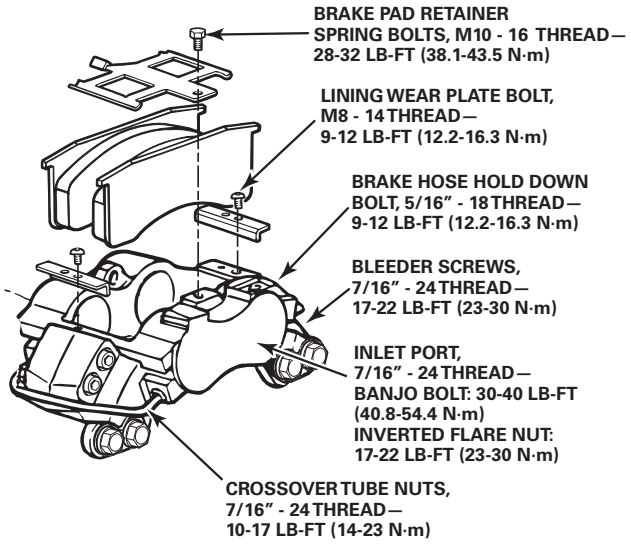


Figure 8.1

8 Specifications

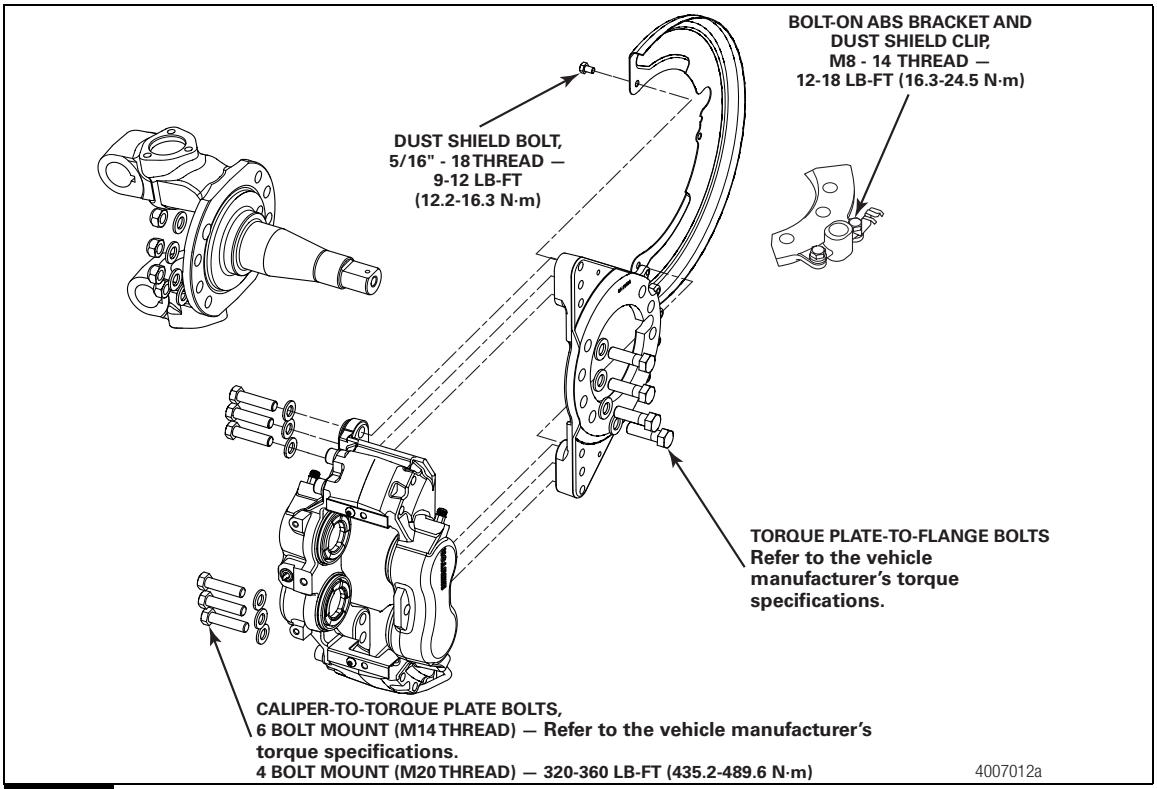


Figure 8.2

Bridge Bolts

⚠ WARNING

Do not remove the bridge bolts to perform service procedures. If the bridge bolts are removed, they must be reinstalled correctly or serious personal injury, brake loss or damage to components can result.

If the bridge bolts were removed, install new bridge bolts and tighten them in the correct sequence according to the following procedure. To obtain bolt hardware kits, call ArvinMeritor's Commercial Vehicle Aftermarket at 888-725-9355. Do not rebuild the calipers with used caliper parts.

1. Verify the two caliper halves are seated. If necessary, lightly press the halves together until correctly seated.
2. Loosely assembly all bridge bolts.
3. Perform the following two step bolt tightening procedure.
   A. Tighten the bolts to an initial torque of 50 lb-ft (68 N•m) in the sequence 1, 2, 3, 4. Figure 8.3.
   B. Use torque angle equipment to turn the bolts 70 +3/–2 degrees in the sequence 1, 2, 3, 4.

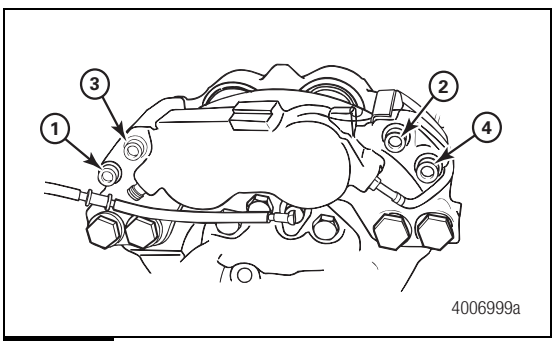


Figure 8.3

8 Specifications

Four-Piston Quadraulic™ Disc Brake Components

Description	Specification
Brake Pad — Thickness Above Metal (New) Minimum	0.73" (18.5 mm)
Thickness Above Metal (Discard)	0.125" (3.2 mm)
Brake Fluid — High-Performance Brake Fluid (Per Manufacturer's Recommendation)	DOT 3 or DOT 4

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ArvinMeritor™

691 LOCK SYSTEM

Operation and Installation Instructions

READ GENERAL INSTALLATION GUIDELINES SHEET (FORM NO. 81-600-001) BEFORE PROCEEDING.

⚠ WARNING

1. The MICO 691 System is a **supplemental** safety device which provides additional brake holding action **when used with existing vehicle parking brake**. **It is not for dynamic service braking.**
2. The 691 System must be used in combination with an audible and/or visual alarm as a warning to signal the user of any loss of brake system pressure. **Do not disconnect warning devices.**
3. All lines, fittings and surrounding areas must be cleaned of dirt or road residue before any lines or fittings are disconnected. Special care must be taken so dirt and road residue are not allowed to enter the hydraulic brake system. This can contaminate the system and interfere with proper operation of brakes and MICO 691 System.
4. Follow procedures outlined in Vehicle Manufacturer's Service Manual or SAE Standards when making new connections or adding to existing brake systems. Use only steel brake tubing conforming to SAE specifications.
5. **Vehicle Brake System:** Always use clean fluid conforming to vehicle manufacturer's recommendations. **691 Power Unit:** See *BEFORE PROCEEDING*, page 3 for proper fluid type. Improper or contaminated fluid may cause gummy deposits, softening and swelling of rubber seals, and may render the 691 System inoperative. Such a condition must be corrected immediately.
6. Do not use sealants, tapes, teflon or cement compounds on any connections or fittings. These sealants or compounds can contaminate the hydraulic brake system and interfere with the operation of brake components or MICO 691 System.
7. All fittings and connections must be in good condition and properly torqued.
8. Brake hoses, brake lines, MICO 691 System, brake components, cylinders, and all fittings must be routinely inspected for leaks, damage or wear. Proper fluid levels must be maintained. In the event of any loss of fluid, brake system must be carefully inspected for leaks.
9. When installation of MICO 691 System is complete, 691 System and brake system must be bled of air. Bleed MICO 691 System according to procedures outlined in this manual. Bleed brake system according to vehicle manufacturer's recommendations.
10. The self-adhesive warning labels, page 1, accompanying each MICO locking device must be affixed in the vehicle cab in view of operator.
11. Keep this manual in the cab of the vehicle after installing the 691 System.

MICO could not possibly know of and give advice with respect to all conceivable applications in which this product may be used and the possible hazards and/or results of each application. MICO has not undertaken any such wide evaluation. Therefore, anyone who uses an application which is not recommended by the manufacturer, first must completely satisfy himself that a danger will not be created by the application selected, or by the particular model of our product that is selected for the application.

MICO has made every attempt to present accurate information in catalogs, brochures and other printed material. MICO can accept no responsibility for errors from unintentional oversights that may exist. Due to a continuous program of product improvement, materials, specifications, and product documentation are subject to change without notice or obligation.

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Innovative Braking and Controls Worldwide

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SELF ADHESIVE LABELS

NOTE

All 691 models include the self adhesive labels shown below. Determine which labels are used in your application.

THIS NOTICE MUST BE AFFIXED ON DASH IN VIEW OF OPERATOR

⚠ WARNING

Serious injury or death can occur if these instructions are not followed



This vehicle is equipped with 691 Brake Lock System.

Operator must read and understand warnings and operating instructions before using vehicle (Form no. 81-690-032) .

Do not use 691 Brake Lock in place of original equipment parking brake.

Always apply parking brake and other provided holding devices when using 691 System.

Do not use 691 Brake Lock for overnight or prolonged parking.

Release 691 Brake Lock before moving vehicle.

691 Brake Lock and warning circuit are disabled if battery power is lost or disconnected.

Use in all applications.

THIS NOTICE MUST BE AFFIXED ON DASH IN VIEW OF OPERATOR

Operator must read and understand Warnings and Operating Instructions before using vehicle (Form no. 81-690-032).

691 Brake Lock

TO LOCK:

1. Set parking brake
2. Move lock switch to LOCK position

TO RELEASE:

1. Move lock switch to RELEASE position
2. Release parking brake

Use in all applications using a user interface.

THIS NOTICE MUST BE AFFIXED ON DASH IN VIEW OF OPERATOR

⚠ WARNING

Serious injury or death can occur if these instructions are not followed.

Operator must read and understand warnings and operating instructions before using vehicle (Form no. 81-690-032).

This vehicle is equipped with a 691 Brake Lock System that is activated by a remote input.

Unintended operation of the remote input will cause the brakes to apply or release without warning.

The operator must understand the function of the remote inputs.

Be aware of all conditions that will cause the 691 Brake Lock System to activate or deactivate without user intervention.

Use in all applications where the 691 System is remotely activated.

INTRODUCTION

Vehicles today have two separate brake systems. One is the service brake system and the other is the parking brake system. The service brake system is used to slow or stop a vehicle during normal operation. The parking brake system is usually cable operated and used to hold the vehicle stationary while parked.

Experience has shown that some vehicle applications require more brake holding capacity than provided by properly maintained parking brakes. The MICO 691 Brake Lock System uses the vehicle service brakes to supplement the parking brake. The 691 System provides pressure to the service brake system in the same manner as when the vehicle operator presses on the brake pedal.

The 691 also provides external inputs which can activate the system without direct operator interjection.

The 691 Brake Lock System consists of:

The Control Module and User Interface
(Figure 1)

The control module controls operation of the system through the user interface or remote activation. The user interface incorporates a manually activated switch, audible alarm, and "locked" lamp.

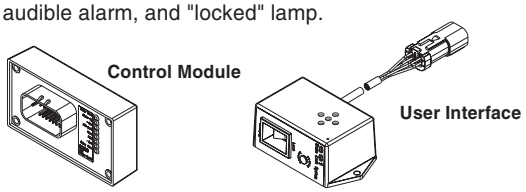


FIGURE 1

The Power Unit (Figure 2)

The power unit uses a 12 volt DC pump to produce pressure in the vehicle service brake system to lock the brakes. The pump reverses flow to release locking pressure.

Two pressure switches are located on the power unit. The pressure switches sense the pressure that the power unit is producing. The high pressure switch starts and stops the pump while pressurizing the system. The low pressure switch starts and stops the pump while releasing pressure from the system.

Although the power unit contains a built in fluid reservoir, a remote reservoir is available as an option for special applications. Refer to 691 Accessories chart on page 19.

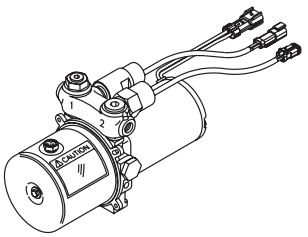


FIGURE 2

The Actuator (Figure 3)

The actuator is a mechanical device that links the hydraulics of the 691 System to the vehicle service brake system. The actuator separates the 691 System fluid from the vehicle service brake system. Various actuators are available for use in different types of service brake systems.

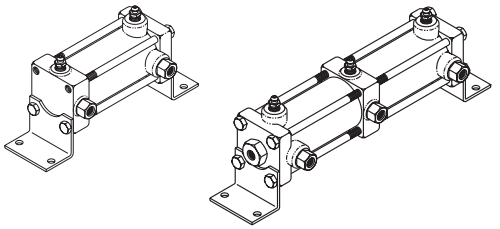


FIGURE 3

PRINCIPLE OF OPERATION

1. When the 691 System is activated, the control module starts the power unit pumping fluid into the actuator(s). As the actuator(s) become pressurized they isolate the vehicle master cylinder and pressurize the service brakes.

   When lock pressure is reached, the high-pressure switch signals the control module to stop the pump.

   While the pump is stopped, locking pressure is held in the brake system. If locking pressure drops, the high pressure switch signals for the power unit to turn "on" and restore locking pressure.
2. When the 691 System is deactivated, the pump reverses and releases pressure. The actuator releases pressure from the brakes and opens the ports to the vehicle master cylinder. When locked pressure returns to zero PSI a signal from the low-pressure switch stops the pump.

NOTE

Brake System fluid and 691 System fluid always remain isolated from one another.

INSTALLING A 691 SYSTEM

There are four steps to installing the 691 System.

1. Mounting
2. Plumbing
3. Wiring
4. Bleeding

The 691 System must only be installed by someone with good working knowledge of automotive brake and electrical systems.

It is important that the installer of the 691 System understands fluid types used in various 691 Systems. Read and understand this instruction manual before installing the 691 Brake Lock System.

Brake System Fluid

For all 691 installations the **vehicle's brake system fluid does not change**. Vehicles currently using brake fluid in the brake system will continue to use brake fluid. Vehicles currently using mineral base hydraulic oil in the brake system will continue to use mineral base hydraulic oil.

691 System Fluid

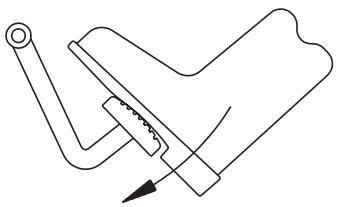
The two 691 Power Unit designs, DOT 5 silicone fluid (SF) and mineral base hydraulic oil (HO), assure seal compatibility with your existing brake system.
NOTE: Power unit and brake system fluids do not become intermixed when a 691 System is installed. The 691 Actuator(s) isolate the 691 System fluid from the brake system.

BEFORE PROCEEDING:

1. Identify your vehicle brake system. See pages 3 & 4.
2. Be sure you have the correct 691 model number and it contains all the parts. Refer to Table 1 (pages 19 & 20).

   All vehicles currently using automotive brake fluid (DOT 3, 4, 5 or 5.1) in the brake system must use the 691 model numbers designated (SF). All vehicles currently using mineral base hydraulic oil in the brake system must use the 691 model numbers designated (HO).
3. Check brake pedal height and feel. With the vehicle running, push on the brake pedal until there is no more forward movement. Measure and record the distance from pedal to floor. Brake pedal height and "feel" will be the same after the 691 System is installed, refer to Figure 4.

FIGURE 4



IDENTIFY YOUR BRAKE SYSTEM

Typical hydraulic braking systems in use today vary depending on manufacturer and size of vehicle. For instance, a vehicle equipped with a single system may have a firewall mounted booster or possibly a frame mounted remote booster. The same holds true for the dual and split systems. The rear wheel anti-lock system is a dual brake system with an anti-lock valve installed. All-wheel anti-lock systems are defined as 3-channel or 4-channel systems (Check the number of outlet lines from the anti-lock control valve). To be absolutely sure which braking system your vehicle is equipped with, check it. Look for identifying features such as dual flex lines at rear axle or front wheels, number of master cylinder lines, anti-lock valve(s), etc. Then, compare with the circuits shown in Figures 5 thru 11.

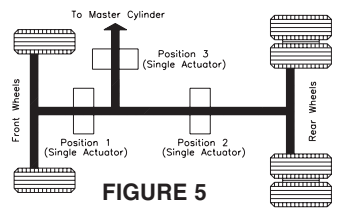


FIGURE 5

Typical Single System

One single hydraulic system serving both front and rear brakes.
Identifying Feature:
1.One line from master cylinder.
691 Actuator Position:
(1) Front axle (2) Rear axle (3) 4-wheel

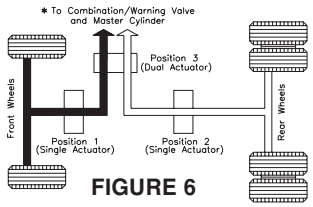


FIGURE 6

Typical Dual System (Vertical Split)

Two independent braking systems. One system leads to the front brakes and the other system to the rear brakes.
Identifying Feature:
1.Two lines from master cylinder.
2.Combination valve (used on some models).
691 Actuator Position:
(1) Front axle (2) Rear axle* (3) 4-wheel

* Some imported vehicles use two separate air boosted master cylinders.

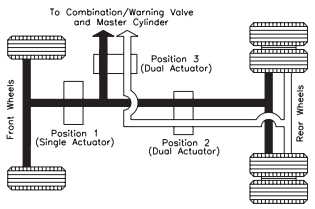


FIGURE 7

Typical Split System (1 1/2 x 1/2)

Two independent braking systems. One system leads to the front and the rear brakes and the other system leads only to the rear brakes.
Identifying Feature:
1. Two lines from master cylinder.
2. Single hose to each front wheel.
3. Two hoses to rear axle.

691 Actuator Position:
(1) Front axle (2) Rear axle (3) 4-wheel

CAUTION: Whether position 2 or 3 is used, both halves of system must be locked.

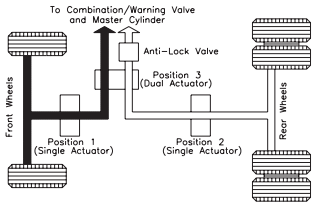


FIGURE 8

Typical Rear Wheel Anti-Lock System (Dual Vertical Split)

Two independent braking systems. One system leads to the front brakes and the other system to the rear brakes.
Identifying Feature:
1. Two lines from master cylinder.
2. Anti-lock control valve between master cylinder and rear wheels.

691 Actuator Position:
(1) Front axle (2) Rear axle (3) 4-wheel

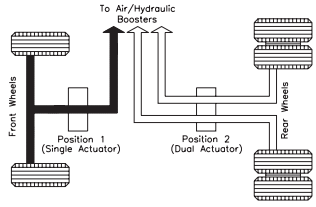


FIGURE 9

Imported Truck 3-Channel All-Wheel Anti-Lock System

Provides braking control by way of independent anti-lock channels for each rear wheel and a third channel for the front wheels.
Identifying Feature:
1. Three separate air/hydraulic brake boosters.
2. One line to front brakes.
3. Separate lines to each rear wheel.

691 Actuator Position:
(1) Front axle (2) Rear axle (1 & 2) 4-wheel

NOTE: The anti-lock functions on air booster system, not the hydraulic side.

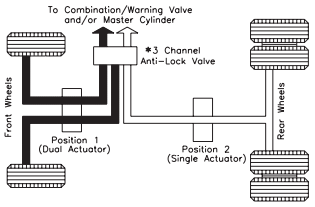


FIGURE 10

Typical 3-Channel All-Wheel Anti-Lock System

Provides braking control by way of independent anti-lock channels for each front wheel and a third channel for both rear wheels.
Identifying Feature:
1. Two lines from master cylinder to anti-lock valve(s).
2. One line from anti-lock valve to rear brakes.
3. Separate lines from anti-lock valve to each front wheel.

691 Actuator Position:
(1) Front axle (2) Rear axle (1 & 2) 4-wheel

NOTE: Some 3-channel anti-lock brake systems use two separate anti-lock valves.

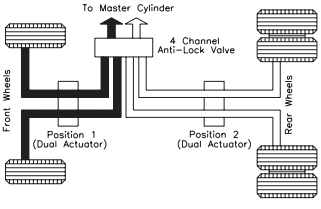


FIGURE 11

Typical 4-Channel All-Wheel Anti-Lock System

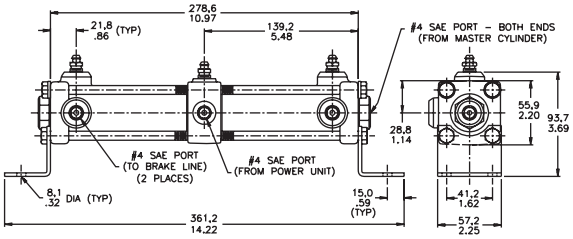
Provides braking control by way of an independent channel for each front wheel and each rear wheel.
Identifying Feature:
1. Two lines from master cylinder to anti-lock valve.
2. Separate lines from anti-lock valve to each of the front and rear wheels.

691 Actuator Position:
(1) Front axle (2) Rear axle (1 & 2) 4-wheel

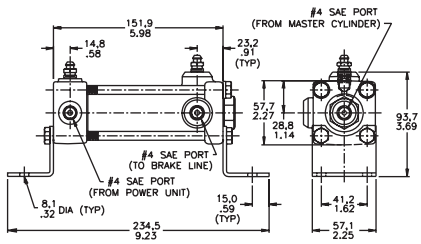
NOTE: Some 4-channel anti-lock brake systems use two separate anti-lock valves.

DIMENSIONAL DATA

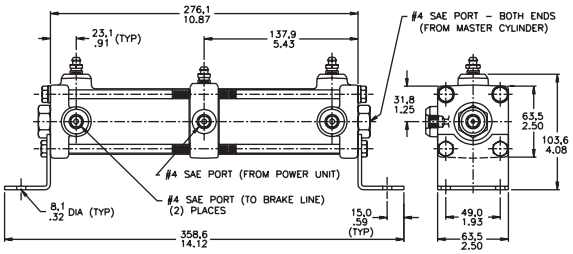
1 1/4 inch Diameter Bore Dual Actuator



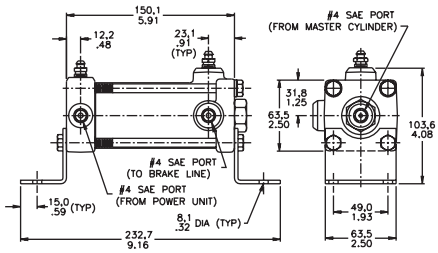
1 1/4 inch Diameter Bore Single Actuator



1 3/4 inch Diameter Bore Dual Actuator

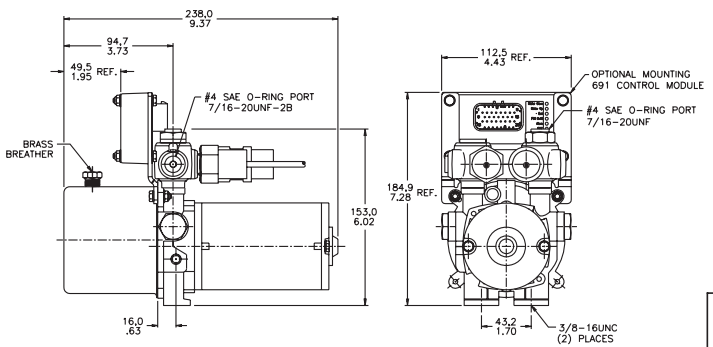


1 3/4 inch Diameter Bore Single Actuator

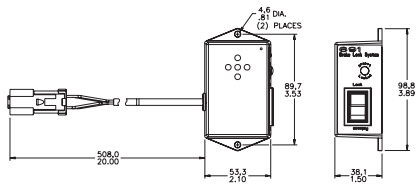


millimeters
inches

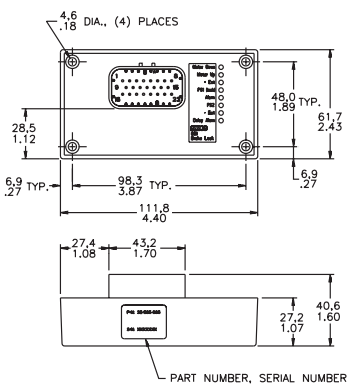
Power Unit



User Interface

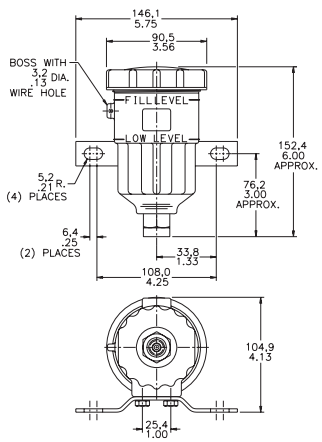


Control Module



Remote Reservoir - (optional)

See 691 Accessories on page 19



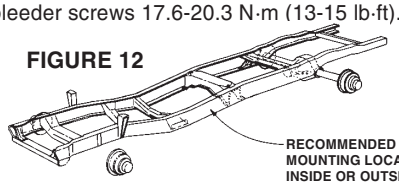
MOUNTING

Several self adhesive labels are supplied with each 691 Brake Lock. Determine which labels are used in your application and affix in the vehicle cab in view of the operator. See page 1.

Actuator

1. Repeat the mounting procedures for each actuator used in your system.
2. Find a location, preferably on the frame rail away from heat, where the actuator(s) will mount allowing easy access to brake lines, refer to Figure 12. The actuator(s) must be mounted horizontally below the level of the vehicle master cylinder. The bleeder screws must be in an upright position. Relocate the bleeder screws as necessary to maintain upright position. Torque bleeder screws 17.6-20.3 N·m (13-15 lb·ft).

FIGURE 12

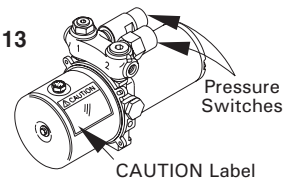


3. Using the actuator mounting brackets as a template, mark and drill four 11/32 inch diameter holes. Fabricated mounting brackets can be used to mount the actuator(s). The strength of fabricated brackets must be adequate to prevent flexing of brake lines.
4. Install the actuator using four 5/16-18UNC, grade 5, bolts, lock washers, and nuts. Torque 27.1-33.9 N·m (20-25 lb·ft).
5. Install the brass adapters from the fitting package in the actuator ports and torque 7.9-10.2 N·m (70-90 lb·in).

Power Unit

1. The power unit can be mounted horizontally in the engine compartment, on the frame rail, or in the cab. However, it must be protected from dirt, moisture and possible impact. Easy access to the reservoir breather/filler plug must be maintained to allow for filling and checking fluid level. The reservoir breather plug must be kept in an upright position. If this is not possible a remote reservoir can be installed, refer to 691 accessories on page 19.
2. Mark and drill two 7/16 inch diameter holes 2 5/16 inch apart. Fabricated mounting brackets can be used.
3. Mount the power unit using two 3/8-16UNC bolts and lock washers.
4. 691 models designated (HO) must use mineral base hydraulic oil in the power unit reservoir. 691 models designated (SF) must use DOT 5 silicone fluid in the power unit reservoir. Check the CAUTION label around the power unit reservoir breather/filler plug to verify fluid type, refer to Figure 13.

FIGURE 13



Control Module

1. A mounting bracket is provided with the 691 Control Module to mount the control module directly to the 691 Power Unit. See power unit dimensional drawing on page 5. The control module can be mounted on top of the power unit as shown, as well as mounted to either side. The control module can also be mounted to position the harness connection in the opposite direction shown.
2. When the 691 Control Module is not mounted to the 691 Power Unit, an optional 11 foot long wire harness (MICO part number 32-820-022) is available from MICO, Incorporated. See page 19 for 691 Accessories.

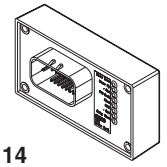


FIGURE 14

User Interface

1. A dash mounted user interface is provided for use by the operator in the cab. The user interface includes a manually activated switch, audible alarm, and "locked" lamp. Find a mounting location in the cab of the vehicle where:
   A. The operator has easy access to the "lock" - "release" rocker switch.
   B. The "lock" lamp is visible to the operator.
   C. It is protected from having something spilled on it.
   D. There is easy routing of wires from the 691 Control Module to the user interface.
2. The user interface is not necessary for applications where the 691 System is activated by other manual switches or electrical interlocks.

NOTE

When the 691 User Interface is not installed with this system, another visual identifier must be used to inform the operator that the 691 System is "locked". See schematic on page 14.

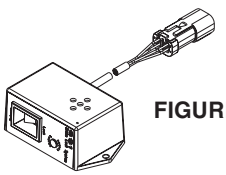
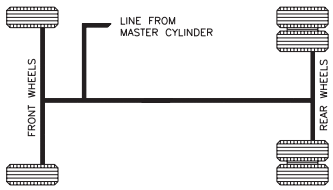


FIGURE 15

PLUMBING

Determine the type of brake system on your vehicle, refer to pages 3 & 4. All brake systems in use today require the MICO 691 Actuator(s) be installed **after** the anti-lock brake valve and combination warning valve if so equipped. Contact MICO, Incorporated if you have questions.

Single 691 Brake Lock System



Single Brake System

1. Disconnect the existing brake line necessary to install the single actuator. Reduce fluid loss by plugging the ports. Do not loosen or remove hydraulic lines that are not effected by the installation of the single actuator.
2. Determine the length and shape of new or modified brake lines needed to install the actuator. The installer must be qualified to modify existing brake tubing, or new factory double flared SAE approved brake line must be used. When adding or replacing brake lines, do not use smaller diameter than existing lines. The MICO 691 Actuator is supplied with brass adapters designed to mate with 1/4 inch inverted flare tube nuts. Contact MICO, Incorporated or a local brake fitting supplier to obtain proper fittings to install different size lines. All new connections or modifications between flexing vehicle sections, such as vehicle body and frame, must be made to absorb shock and vibration. Common methods used to absorb this shock are coiling the brake tubing or using a short length of purchased brake hose. Follow procedures outlined by the vehicle manufacturer or SAE specifications.
3. Connect the upstream line coming from the vehicle master cylinder to the fluid inlet port on the end of the single actuator. Connect the downstream line going to either the front or rear brakes from the side outlet port on the same end of the single actuator. See Figure 16.

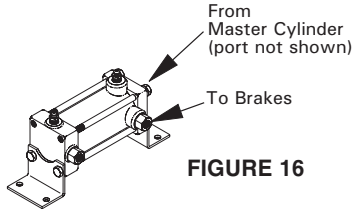
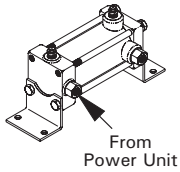


FIGURE 16

4. Determine the shape and length of a new piece of tubing to connect the power unit and single actuator. See Figure 17.

FIGURE 17



5. Connect one end of the new tubing to the single actuator.
6. Connect the other end of the new tubing to the power unit. This connection can be made to either the side or top port. Remove the plastic shipping plug from the top port. To install line in the side port use 3/16 inch hex key wrench to move the steel plug from side port to top port. Install the remaining brass adapter from the fitting package in the selected port prior to connecting the line. See Figure 18.

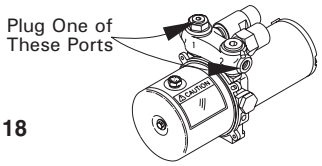
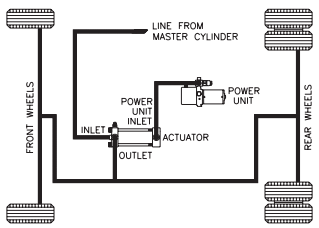
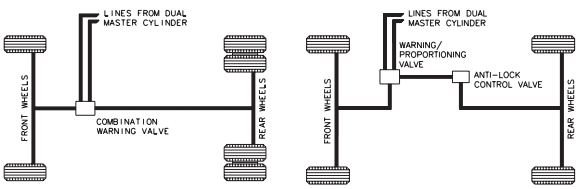


FIGURE 18



Single Brake System with 691 System

Dual 691 Brake Lock System



Dual Brake Systems

1. Disconnect the existing rear brake lines necessary to install the dual actuator. Reduce fluid loss by plugging the ports. Note which master cylinder port supplies fluid to the front brakes and rear brakes. Do not reverse the front and rear fluid paths during the installation of new brake lines.
2. Determine the length and shape of new or modified brake lines needed to install the dual actuator. The installer must be qualified to modify existing brake tubing, or new factory double flared SAE approved brake line must be used. When adding or replacing brake lines, do not use smaller diameter than existing lines. The MICO 691 Actuator is supplied with brass adapters designed to mate with 1/4 inch inverted flare tube nuts. Contact MICO, Incorporated or a local brake fitting supplier to obtain proper fittings to install different size lines. All new connections or modifications between flexing vehicle sections, such as vehicle body and frame, must be made to absorb shock and

vibration. Common methods used to absorb this shock are coiling the brake tubing or using a short length of purchased brake hose. Follow procedures outlined by the vehicle manufacturer or SAE specifications.

3. Connect the upstream line coming from the master cylinder to the fluid inlet port on one end of the actuator. Note that the actuator is not directional and does not have a front and rear. Connect the downstream line going to the rear brakes from the side outlet port on the same end of the dual actuator. See Figure 19.

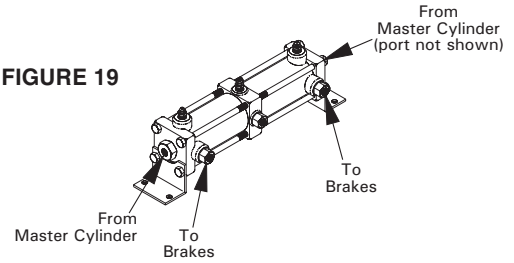


FIGURE 19

4. Repeat steps 1, 2 & 3 to install the front brake lines.
5. Determine the shape and length of a new piece of tubing to connect the power unit and dual actuator.
6. Connect one end of the new tubing to the dual actuator. See Figure 20.

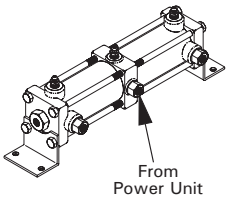


FIGURE 20

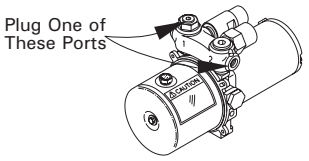
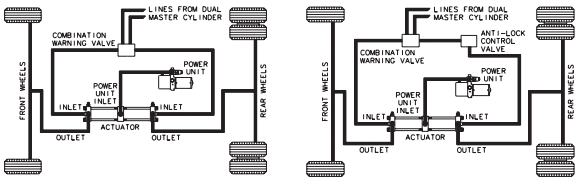


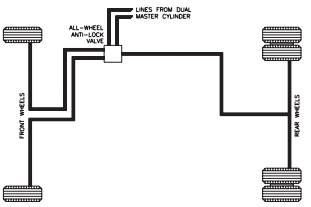
FIGURE 21

7. Connect the other end of the new tubing to the power unit. This connection can be made to either the side or top port. Remove the plastic shipping plug from the top port of the power unit. To install line in the side port use 3/16 inch hex key wrench to move the steel plug from side port to top port. Install the remaining brass adapter from the fitting package in the selected port prior to connecting the line. See Figure 21.



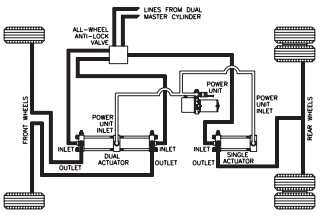
Dual Brake Systems with 691 System

3 Channel Anti-Lock 691 Brake Lock System



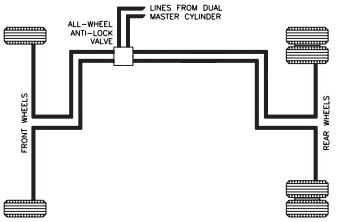
3 Channel Anti-lock Brake System

The 3-channel anti-lock brake system uses both a single and a dual actuator. Follow the plumbing instructions for both the Single 691 Brake Lock System and the Dual 691 Brake Lock System to connect the appropriate lines. To connect the hydraulic line from the power unit to both actuators, either a tee can be added to this line or the plug in the unused port on the pressure switch manifold can be removed to accommodate the connection.



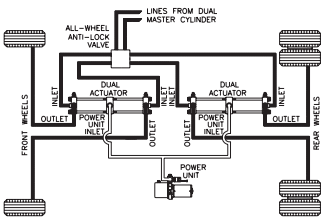
3 Channel Anti-lock Brake System with 691 System

4-Channel Anti-Lock 691 Brake Lock System



4 Channel Anti-lock Brake System

The 4-channel anti-lock brake system uses two dual actuators. Follow the plumbing instructions for the Dual 691 Brake Lock System to connect the appropriate lines. To connect the hydraulic line from the power unit to both actuators, either a tee can be added to this line or the plug in the unused port on the pressure switch manifold can be removed to accommodate the connection.



4 Channel Anti-lock Brake System with 691 System

WIRING

⚠ WARNING

Power is supplied to the 691 Control Module at all times. To prevent unintended actuation of the 691 System, be sure the "lock" - "release" switch (if applicable) is in the "release" position.

⚠ CAUTION

Do not operate the 691 Power Unit without first filling the power unit reservoir with proper fluid.

691 Wiring Instructions

(Refer to diagrams on pages 14 & 15)

The 691 System is designed for use on vehicles with a 12 volt DC, negative ground system. References to "ground" in this literature refer to vehicle chassis ground which is connected to the negative (-) battery terminal. References to "hot" or "positive" refer to connection to the positive (+) terminal of the 12 volt DC battery.

NOTE

All positive connections to the battery must be made through a high quality, properly rated fuse. Do not use a slow blow fuse or circuit breaker.

Optional extension harness (MICO part number 32-820-022, page 19) is available from MICO, Incorporated when the control module is not mounted directly to the power unit. The supplied wire harness has been designed with sufficient wire length to complete most installations. If additional wire is necessary, be sure to use the proper gauge.

When making wire connections, soldering and sealing with adhesive lined heat shrink is the recommended method.

All wires that are not used must be sealed and insulated to keep from shorting to each other or ground.

Connecting External Inputs

Activating the 691 System by use of the user interface rocker switch is not always convenient. External inputs can activate the 691 System through the use of external switches, dash mounted switches or relays. This provides flexibility for manual operation by the user or allows other circuits to activate the brakes.

External Inputs

There are three external inputs available. The 691 is activated upon receiving a signal at **any** of the inputs and does not deactivate until all input signals have been removed.

Two of the external inputs are activated by a positive signal (+12 VDC) and the third is activated by a negative (ground) signal.

The negative input is accessed from the gray wire in the main 691 Wire Harness.

The two positive inputs are:

1. The green wire in the user interface cable.
2. The brown wire in the main 691 Wire Harness. **NOTE: These inputs are connected together internally, so if one is receiving a positive signal, the other will also have a positive signal present. This is commonly used to provide an external signal (to the brown wire) when the switch on the 691 User Interface is activated.**

To prevent unintentional activation of the 691 System, insulate and seal any of the unused wires.

Using the Brown Wire as an External Output

When activating the 691 System with the user interface, the brown wire can be used to signal other circuits. It will provide a positive signal up to 1 amp of power to lights, relays, etc. If this current limit is exceeded, the output or control module may operate erratically or not at all.

***NOTE: The brown wire will not provide an output when the 691 System is activated by the external input of the gray wire. This is an inherent design to provide protection from improper wiring.**

⚠ CAUTION

If the gray wire is allowed to short to ground, the vehicle brakes will apply.

Connecting the Vehicle Horn

The yellow 691 harness wire must be connected to a horn or other suitable warning device for your application. The yellow wire sends a ground signal to sound the horn when necessary.

1. On most vehicles the best way to connect this wire without adding a relay is to find the horn wire from the horn switch in the steering wheel. This switch typically grounds this wire to sound the horn, splicing in the yellow wire at this point is all that is necessary.
2. If splicing into the horn switch wire is not convenient, add a relay that is switched by the ground signal from the yellow wire and that connects the appropriate signal directly to the horn itself.

   The yellow wire will provide a ground of up to 1 amp to drive a warning device. If this current limit is exceeded or if the yellow wire is connected improperly, the warning device or control module may operate erratically or not at all. Be sure to check for proper operation of the horn circuit on a regular basis. See page 11, "HORN WARNING CIRCUIT TEST".

Connecting Power for the Control Module

1. Connect the black wire directly to battery negative or equivalent ground. This wire carries the full current of the 691 System and must have a good ground. If additional wire is necessary for this connection it must be a minimum of 14 gauge wire.
2. Connect the red wire to a 30 amp fuse which is connected directly to battery positive. This wire also carries full 691 System current. Do not connect this through any auxiliary wiring. Do not use a slow blow fuse or circuit breaker.

BLEEDING

⚠ CAUTION

Vehicle Brake System: Always use clean fluid conforming to vehicle manufacturer's recommendations.

691 Power Unit: Check the CAUTION label on the 691 Power Unit reservoir for proper fluid type. Refer to Figure 13.

All electrical connections must be completed and the power unit reservoir filled with proper fluid before bleeding. The hydraulic brake system must be bled whenever any line has been disconnected. Although we recommend the use of pressure bleeding equipment when bleeding the system, some vehicle manufacturers do not advise certain bleeding methods. Refer to Vehicle Manufacturers bleeding recommendations. When pressure bleeding, use a system pressure of 1.72-2.07 bar (25-30 PSI).

Tips on Bleeding Brake Systems

1. Patience is often necessary. Brake fluids can be easily aerated by being forced through tubes too fast or agitating them. Once brake fluid has been aerated, the best way to get the air back out is to let it sit. Several hours or overnight may be necessary.
2. While bleeding, make every effort to move the fluid slowly. This is especially important when applying the brake pedal and when opening bleeder screws.
3. Avoid rapid pumping of the brake pedal as it can cause the fluid to become aerated.
4. Always wear safety glasses and be cautious when opening bleeder screws with any pressure applied. Air pockets will shoot the fluid out at a rapid rate.
5. Connect a length of poly-style air line from the bleeder screw into a container to recapture the fluid during the bleeding process.
6. In some cases, gravity bleeding is the best form of bleeding.
7. Start bleeding process at the actuators and work toward the foundation brakes.
8. Even when the brake system seems to be well bled, it may still contain small amounts of air. We recommend re-bleeding the brake system after the vehicle has been parked overnight.

Bleeding Procedures

NOTE

To assure successful brake system bleeding, complete all bleeding procedure steps in the order that they are listed.

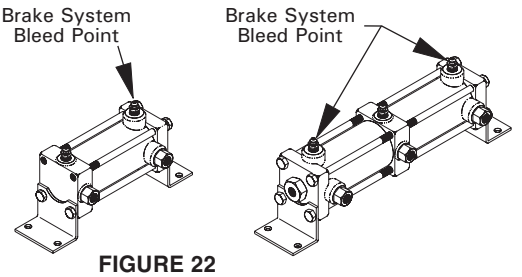


FIGURE 22

1. Disconnect the vehicle horn and other warning devices.
2. Be sure the 691 Power Unit reservoir remains filled with the proper fluid during entire bleeding process. Check the CAUTION label on the 691 Power Unit reservoir for proper fluid type.
3. Make sure the vehicle master cylinder reservoir is full of fluid specified by the vehicle manufacturer.
4. **Gravity Bleed** - After the initial installation, DO NOT apply the brake pedal. Remove the cap from the master cylinder reservoir. One at a time, open each bleeder screw in the vehicle brake system beginning with bleeder screws on the actuators and moving outward to the foundation brakes. **NOTE: In some situations, to save time, all bleeder screws may be opened simultaneously. Do not deplete reservoir fluid level.** When a steady stream of fluid is present, close the bleeder and proceed to the next. If gravity flow is not obtained within 5 minutes, proceed to next step. (Also check for blocked or crimped lines, or loops in tubing where air may be trapped).
5. **Manual Bleed** - Manually bleed the brakes, depressing and releasing brake pedal slowly and to disperse fluid through the brake system without agitating it. Do not depress pedal when bleeder screw is closed. Do not release pedal when bleeder screw is open. Bleed 691 Actuators first. After actuators are bled, continue by bleeding foundation brakes.
   A. Open bleeder screw, then slowly apply the pedal to the limit of its stroke.
   B. Close the bleeder and slowly release the pedal.
   C. Repeat this process multiple times at each bleed point without pumping the pedal in-between.

6. **Pressure Bleed** - There are two options for pressure bleeding the brake system, either using a commercial pressurized bladder type bleeder or by activating the 691 Power Unit.
   Using commercial bleeder
   Follow manufacturer's instructions.
   Using 691 Power Unit
   A. Activate the 691 System.

⚠ CAUTION

Be careful when opening the bleeder screw, it will be under high pressure. Wear safety glasses.

   B. Starting at the actuators and moving outward to foundation brakes, open bleeder screw 1/2 turn. The 691 Power Unit will run with the release of pressure and will stop automatically when the actuator reaches the end of its stroke. Most air will come out at end of the actuator stroke.
   C. After power unit stops running, close the bleeder screw.
   D. Deactivate the 691 System. After 691 Power Unit stops running, slowly depress and release brake pedal 3 to 5 times or until a firm pedal is achieved. This step is to replenish the actuators. **NOTE: The 691 Power Unit will run during first brake application.**
   E. Be sure the 691 Power Unit reservoir and vehicle master cylinder reservoir remain filled with proper fluid.
   F. Repeat steps A thru E at each bleed point until all air is purged before switching to the next bleed point.
   G. After the above steps are completed, check to see if brake pedal height and "feel" are the same as before the 691 System was installed. If the pedal does not "feel" as firm as before, let the vehicle sit for several hours or overnight and repeat pressure bleeding.
7. Activate the 691 System. Open bleeder screw 1/4 turn. See Figure 23. Close bleeder screw when a steady stream of fluid is present.

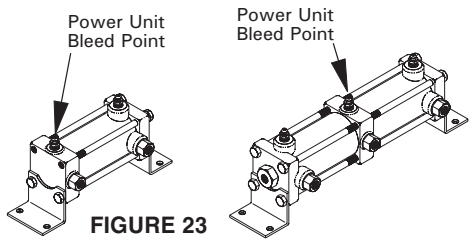


FIGURE 23

⚠ WARNING

Before moving the vehicle, a firm pedal must be achieved when the 691 System is deactivated. If a firm pedal is not achieved, repeat bleeding procedure for the 691 System and the service brake system until a firm pedal is achieved. Make several brake applications with vehicle stationary and check fittings for leaks.

8. Reconnect horn or other warning devices.

HORN WARNING CIRCUIT TEST

The 691 Control Module provides two alarm wires: "direct alarm" and "delayed alarm". The "direct alarm" wire is the white wire in the User Interface cable. It provides a ground signal whenever the system is pressurizing. It activates the User Interface audible alarm. The "delayed alarm" wire, the yellow wire in the main 691 wire harness, is also referred to as the horn wire. It provides a ground signal if the system takes longer than nine seconds to initially pressurize, or anytime the system is re-pressurizing.

The yellow wire must be connected to the vehicle's horn or to a form of warning device that will guarantee that the operator is aware that the system is re-pressurizing.

The horn warning circuit must be tested on a regular basis.

After the system has been activated and is locked, momentarily unplug the 2-wire (black & white) connector leading to pressure switch #2 (stamped "1-800"). While unplugged, the horn will activate.

If the horn does not activate during this test, determine the cause of the problem and correct before using the 691 Brake Lock System.

691 OPERATING INSTRUCTIONS

⚠ CAUTION

Do not operate power unit without first filling with proper fluid.

Using 691 as a Lock System

(Only units with 691 User Interface)

To Activate Lock System

1. Bring vehicle to a complete stop.
2. Set mechanical parking brake.
3. Move the user interface lock/release switch to the "lock" position.
4. User Interface alarm will sound and then deactivate after reaching locking pressure.
5. The "locked" indicator lamp will come on after locking pressure is reached.
6. Apply other provided holding devices.

NOTE

If pressure drops below required system pressure, the "locked" indicator lamp will go off and user interface alarm will activate. This process may take only a fraction of a second.

⚠ CAUTION

If user interface alarm does not sound or fails to deactivate or if the "locked" indicator lamp does not remain on, discontinue use of the 691 Brake Lock System. Determine the cause of the problem and correct before using.

To Deactivate Lock Device

1. Disengage other provided holding devices.
2. Switch the user interface to "release" position. The "locked" indicator lamp will deactivate and the power unit will return brake system to static system pressure.
3. Release mechanical parking brake.

Using 691 as an Interlock

NOTE

The 691 Interlock can be activated by the rocker switch (if applicable) whether the vehicle's ignition is on or off as long as the battery connection exists.

To Activate

1. Bring vehicle to a complete stop.
2. Set mechanical parking brake.
3. Satisfy the conditions that activate remote input.

To Deactivate

1. Disengage other provided holding devices.
2. Deactivate remote input.
3. Release mechanical holding devices.

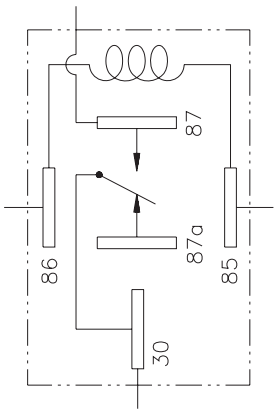
NOTE

To release the brakes in case of an electrical failure complete the following steps:

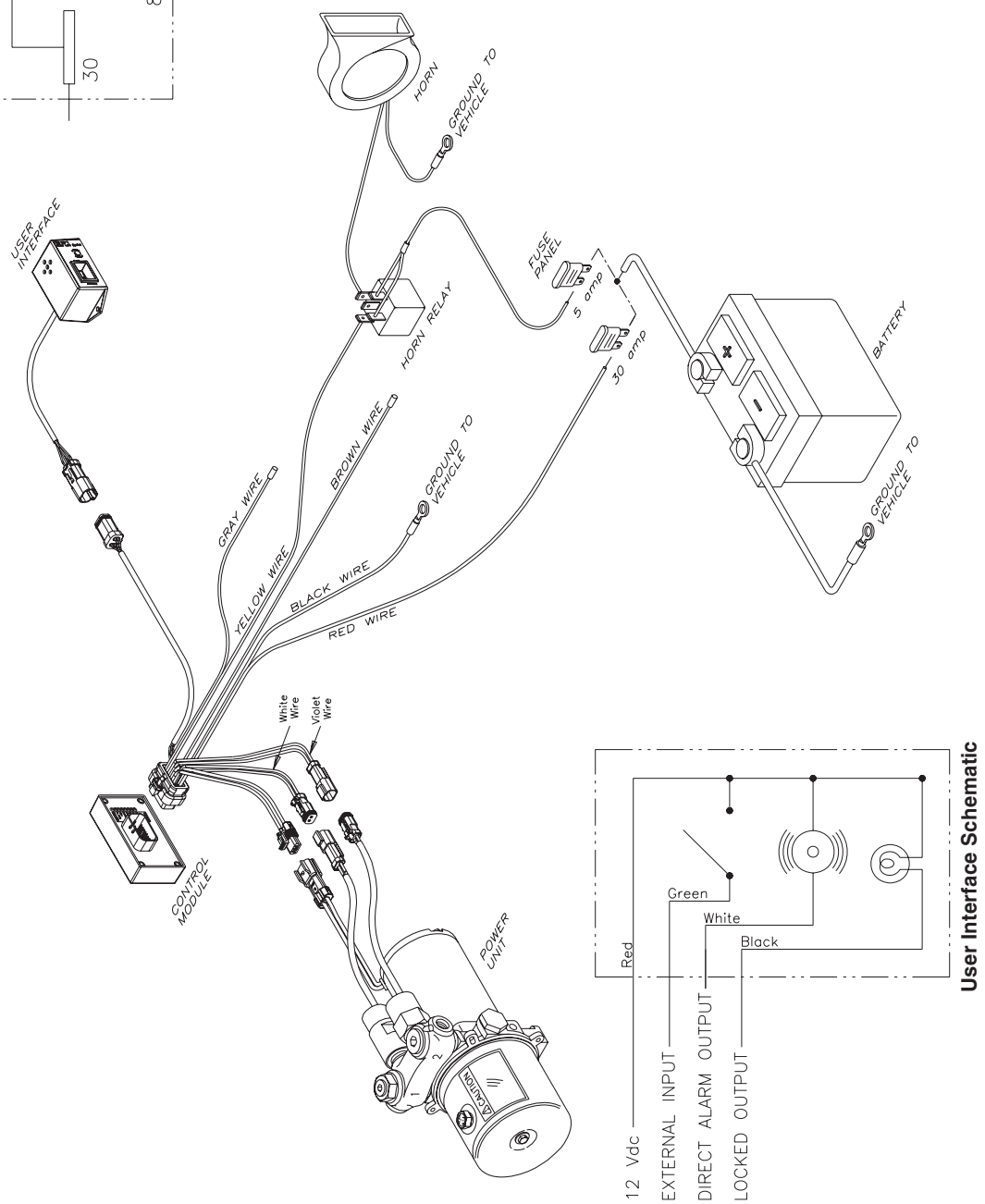
A. Remove 691 System fuse.
B. Apply other provided holding devices and mechanical parking brake to keep the vehicle from rolling.
C. Release residual pressure from 691 System by carefully loosening bleeder screw nearest the power unit inlet port of 691 Actuator. Be careful when opening the bleeder screw, it may be under high pressure.
D. Disengage other provided holding devices.
E. Release mechanical parking brake.

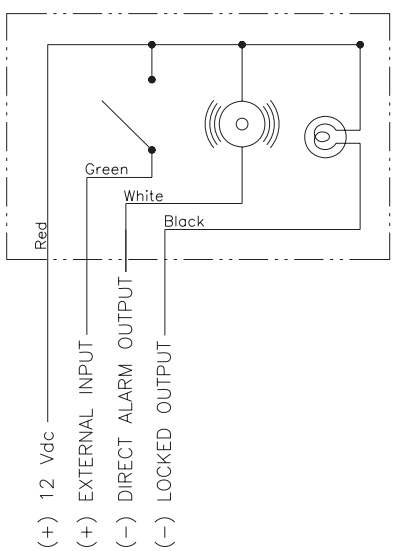
NOTES

BRAKE LOCK APPLICATIONS



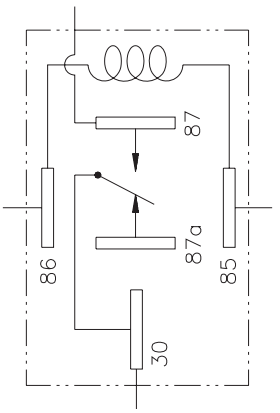
Horn Relay



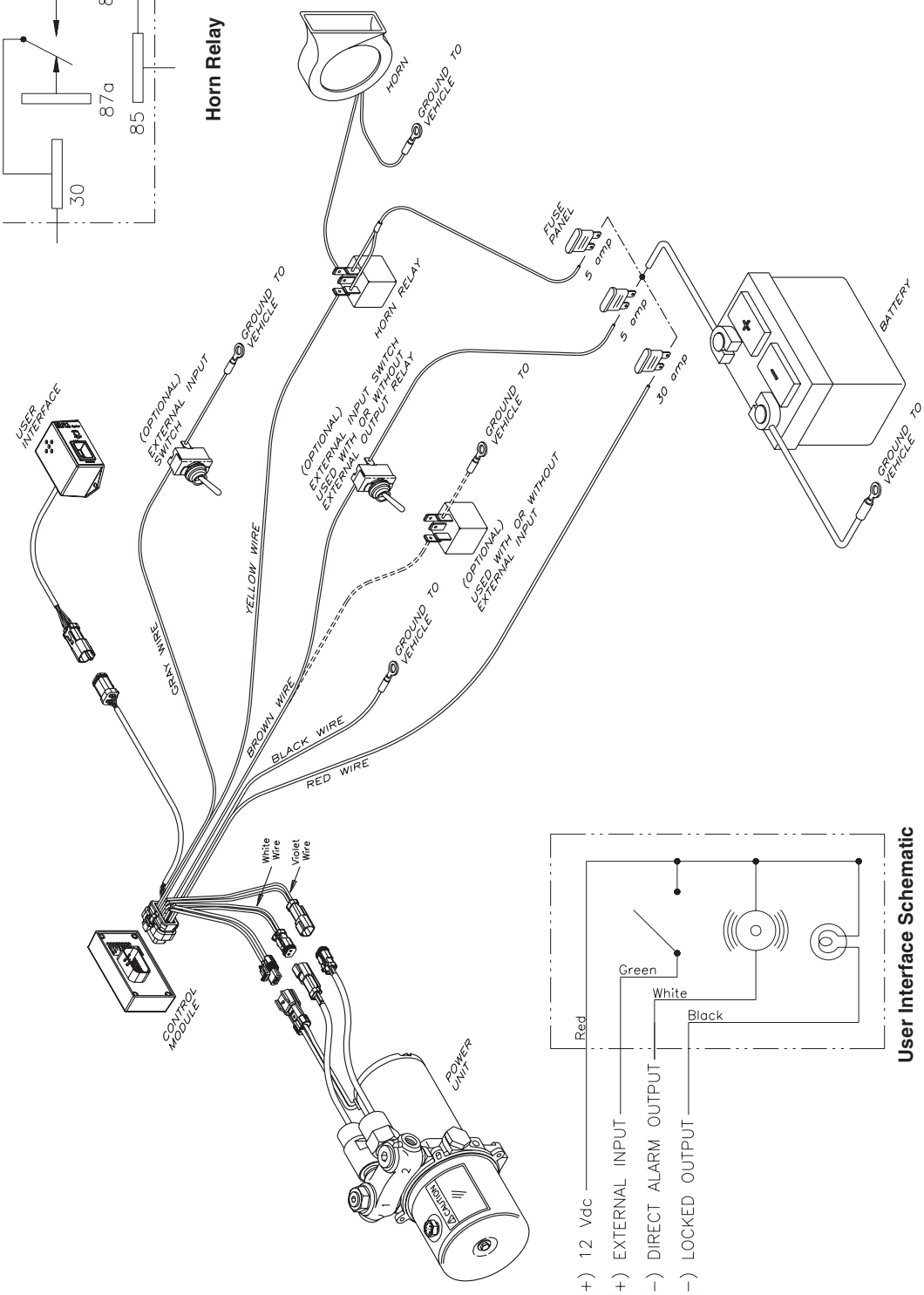


User Interface Schematic

INTERLOCK APPLICATIONS



Horn Relay



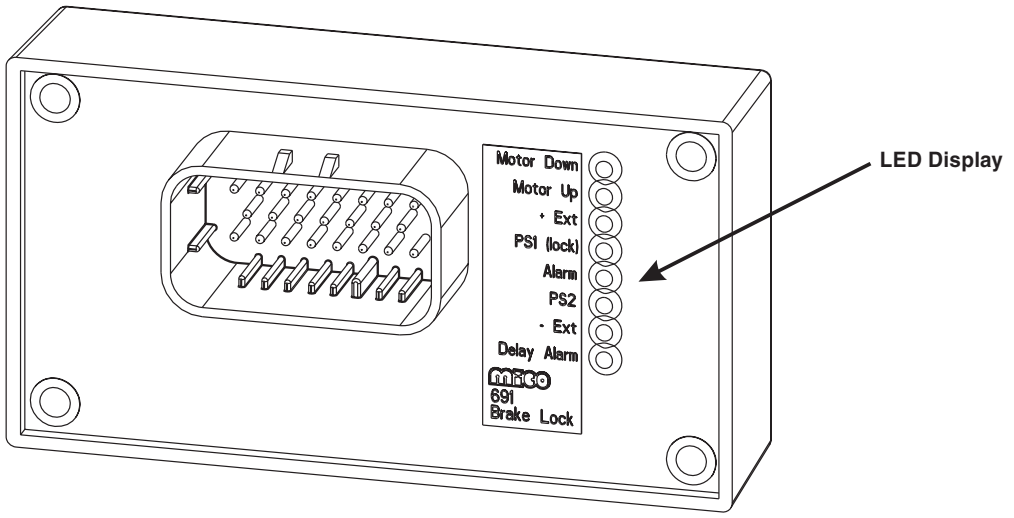
User Interface Schematic

(+) 12 Vdc
(+) EXTERNAL INPUT
(–) DIRECT ALARM OUTPUT
(–) LOCKED OUTPUT

Before Troubleshooting

Unplug wire harness connectors. Check to be sure contacts are clean and making good contact and re-connect. Check the integrity of all wiring at the connectors. Also check to be sure all unused wires are properly capped.

TROUBLESHOOTING



LED Display Explanation	
Motor Down	On when system is releasing pressure. (Remains on for three seconds after PS2 goes off).
Motor Up	On when system has been activated (proper signal on +Ext or -Ext), until PS1 comes on.
+ Ext	On when positive signal is present on brown harness wire and/or green user interface wire.
PS1 (lock)	On when system is locked at full pressure. Receives ground signal from pressure switch #1 on white wire.
Alarm	On when power unit is pressurizing the system. Controls user interface audible alarm.
PS2	On whenever any pressure is present in the system. Receives ground signal from pressure switch #2 on violet wire.
- Ext	On when negative signal is present on gray harness wire.
Delay Alarm (horn output)	Comes on 9 seconds after activating the system if full system pressure has not been attained. Also comes on anytime the power unit runs to repressurize the system.

The input LED's should be on when receiving their respective signal and off when not. Replace the 691 Control Module when this is not observed.

Situation	Cause/Solution (Test in order indicated)
When the 691 System is activated, the brakes will not lock-up and the power unit does not run.	**1. No electric power.** *Check the battery, fuse, and wiring connections.*
	2. High Pressure Switch is inoperative. *Activate the 691 System. If "PS1 (lock)" LED is on, unplug pressure switch 1. If pump runs, replace pressure switch 1 (high pressure switch) or check for a short to ground in the wiring.*
	3. The Power Unit or Control Module is inoperative. *Activate the 691 System. If "Motor Up" LED is on, check for 12 Vdc at the power unit connector. Unplug the power unit and attach a voltmeter (+ to blue, - to green) to the connector leading to the control module. If 12 Vdc is present, replace the power unit. If 12 Vdc is not present, replace the control module.*
	4. The Control Module is not receiving an input signal. *Activate the 691 System. Check "+ Ext" and "- Ext" LED's. If neither are on, check that a ground signal is present at the gray lead in the main wiring harness, or the green lead from the user interface; or that a positive signal is present on the brown wire in the main wiring harness. If not, determine the reason and correct.*
When the 691 System is activated, the brakes will not lock-up and the power unit continues to run.	**1. The fluid level in the reservoir is low.** *Deactivate the 691 System. Verify that the power unit is mounted level. Remove the reservoir breather/filler plug and fill the reservoir with proper fluid to within 1/4 inch of top. Reinstall breather/filler plug.*
	2. Hydraulic leak in either the 691 System or service brake system. *Inspect all tubing and connections for leaks and tighten or replace as necessary.*
	3. The actuator is not functioning properly. *Activate the 691 System. Check the vehicle master cylinder reservoir for excessive fluid level. This condition indicates that the seals in the actuator are allowing 691 System fluid to leak into the vehicle service brake system. Refer to TABLE 1 (pages 19 & 20) for the proper actuator repair kit. Replace the seals in the actuator.* ***NOTE: The vehicle brake system may need to be flushed and refilled.***
	4. The power unit is not properly building pressure. *Replace the power unit. (no test to troubleshoot this condition).*
The 691 System will activate and lock-up the brakes but the power unit keeps running.	**1. High pressure switch is inoperative.** *Active the 691 System . If "PS2" LED is off, replace pressure switch 1 (high pressure switch).*
The power unit does not operate to release the brakes when the 691 System is deactivated.	**1. No electric power.** *Check the battery, fuse, and wiring connections.*
	2. Low pressure switch is inoperative. *Deactivate the 691 system. If "PS2" LED is off, replace pressure switch 2 (low pressure switch).*
	3. The power unit or control module is inoperative. *Deactivate the 691 System. If the "Motor Down" LED is on, check for 12 Vdc at power unit connector. Unplug power unit and attach a voltmeter (- to blue, + to green) to the connector leading to control module. If 12 Vdc is present, replace the power unit. If 12 Vdc is not present, replace control module.*
The brakes release but the 691 Power Unit does not stop running.	**1. Low pressure switch is inoperative.** *Deactivate the 691 System. If the "PS2" LED is on, replace pressure switch 2 (low pressure switch).*
	2. The control module is inoperative. *Deactivate the 691 System. If "Motor Down" LED is off, replace the control module.*

The 691 System and "Motor Up" LED come on unexpectedly without being activated.	**1. The control module is receiving false signals.** *Be sure stray signals are not being introduced into the external inputs. If the gray wire is not connected to an external input, ensure that it is capped off and not shorting to ground inadvertently.* ***NOTE: While deactivated, occasional operation of power unit and "Motor Down" LED is normal to relieve pressure caused by thermal expansion of fluid in the power unit.***
While the 691 System is activated, the power unit and horn activate intermittently.	**1. Change in temperature has caused the system to contract and reduce brake system pressure.** *The power unit runs briefly to restore brake system pressure to the original lock-up pressure. This is considered normal operation as fluid temperature changes.*
	2. The service brake system or 691 System has air in it. *Bleed service brakes and 691 System.*
	3. Hydraulic leak in either the 691 System or service brake system. *Inspect all tubing and connectors for leaks and tighten or replace as necessary.*
	4. The power unit is not functioning properly. *Replace the power unit. (No test to troubleshoot this condition).*

NOTES

691 MODELS AND REPLACEMENT PARTS

TABLE 1

System Model Number	Description	691 Fluid	Vehicle Fluid	Power Unit	#1 - High Pressure Switch Kit	#2 - Low Pressure Switch Kit	
02-691-101	Single (1 3/4*)	SF	SF or BF	20-410-014	02-600-051	02-600-050	
02-691-102	Single (1 3/4*)	HO	HO	20-410-015	02-600-054	02-600-053	
02-691-109	Single (1 1/4*)	SF	SF or BF	20-410-014	02-600-051	02-600-050	
02-691-201	Dual (1 3/4*)	SF	SF or BF	20-410-014	02-600-051	02-600-050	
02-691-209	Dual (1 1/4*)	SF	SF or BF	20-410-014	02-600-051	02-600-050	
** 02-691-223	Dual (1 1/4*)	SF	SF or BF	20-410-014	02-600-051	02-600-050	
*** 02-691-303	3-Channel	SF	SF or BF	20-410-014	02-600-051	02-600-050	
**** 02-691-305	3-Channel	SF	SF or BF	20-410-014	02-600-051	02-600-050	
***** 02-691-403	4-Channel	SF	SF or BF	20-410-014	02-600-051	02-600-050	

BF = Brake Fluid HO = Mineral Base Hydraulic Oil SF = Silicone Fluid

* Inch diameter of actuator bore.
** Consists of two 1 1/4 inch diameter single actuator.
*** Consists of one 1 3/4 inch diameter single actuator and one 1 1/4 inch diameter dual actuator.
**** Consists of one 1 1/4 inch diameter single actuator and one 1 1/4 inch diameter dual actuator.
*****Consists of two 1 1/4 inch diameter dual actuators.

691 ACCESSORIES

Part Number	Description
02-600-038	Remote Reservoir Kit for Silicone Fluid Models
02-600-049	Integral Reservoir Kit for All Type Fluid Models
32-820-022	11 foot long Extension Harness from Power Unit to Control Module

	User Interface	Control Module	Actuator	Actuator Repair Kit	Main Harness	Reservoir Breather Plug
	32-585-007	32-585-006	20-460-013	02-600-035	32-820-021	34-001-089
	32-585-007	32-585-006	20-460-014	02-600-036	32-820-021	34-001-089
	32-585-007	32-585-006	20-460-018	02-600-042	32-820-021	34-001-089
	32-585-007	32-585-006	20-460-012	02-600-034	32-820-021	34-001-089
	32-585-007	32-585-006	20-460-017	02-600-041	32-820-021	34-001-089
	32-585-007	32-585-006	20-460-018 (two)	02-600-042 (two)	32-820-021	34-001-089
540	32-585-007	32-585-006	20-460-013 (one) 20-460-017 (one)	02-600-035 02-600-041	32-820-021	34-001-089
	32-585-007	32-585-006	20-460-018 (one) 20-460-017 (one)	02-600-042 02-600-041	32-820-021	34-001-089
	32-585-007	32-585-006	20-460-017 (two)	02-600-041 (two)	32-820-021	34-001-089

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