TECHNICAL PROCEDURE

HA/HAS Series

NO: 17730-224
SUBJECT: Driveline Angularity Procedures
DATE: March, 1999 REVISION: C

CONTENTS

Subject 1
INTRODUCTION EDGE

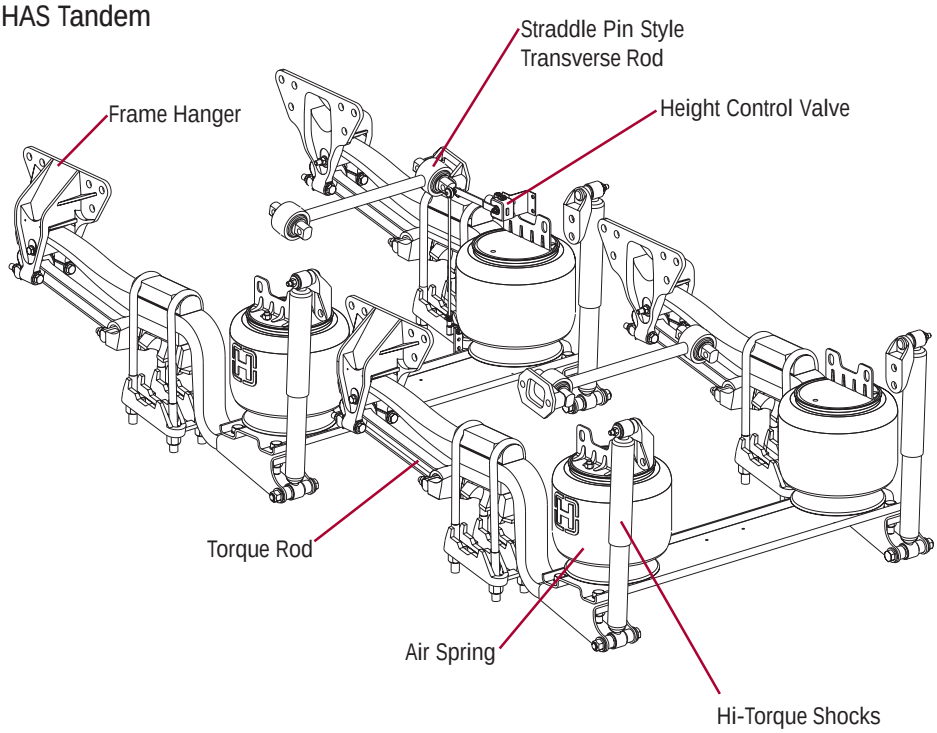
This publication is to acquaint and assist fleets, end users and maintenance personnel to appropriately set up and maintain universal joint angularity with Hendrickson HAS Series suspensions. Technical publications associated with this publication are 17730-197, 17730-212, 17730-222.

In the commercial trucking industry, drive train vibration is a major issue. Pinion angles and suspension ride height can cause undesirable noise and vibration issues as well as premature driveline component failures when not properly set. The only affect that the suspension has on the driveline is setting the seat angles as developed by the OEM. The suspension does not effect other vibration problems such as; engine excited torsionals, driveline system resonance, rotating imbalance, drive shaft runout and bearing looseness. Hendrickson has developed a system approach to accurately control driveline angularity. This system promotes Efficient Driveline GEometry (EDGE). The EDGE design features include.

- Hi-Torque shock absorbers.
- Optimal height control system.
- Education for optimizing vehicle set up.

For acceptable reductions in U-joint vibration all three features listed above must be applied.

Figure 1
HAS Tandem



Subject 2
IMPORTANT SAFETY NOTICE

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

There are various warnings and cautions that should be read carefully to minimize the risk of personal injury and to assure that proper methods are used. Improper servicing may damage the vehicle or render it unsafe in operation.

⚠ WARNING

HENDRICKSON SUSPENSION REMINDS USERS TO ADHERE TO THE PUBLISHED CAPACITY RATINGS FOR THE SUSPENSIONS.

ADD-ON AXLE ATTACHMENTS AND OTHER LOAD TRANSFERRING DEVICES CAN INCREASE THE SUSPENSION LOAD ABOVE THE RATED AND APPROVED CAPACITIES WHICH COULD RESULT IN FAILURE OF THE SUSPENSION AND LOSS OF VEHICLE CONTROL, POSSIBLY CAUSING PERSONAL INJURY OR PROPERTY DAMAGE.

DUMP TRUCK APPLICATIONS — WHEN THE BED OF THE TRUCK IS LIFTED IT IS MANDATORY TO COMPLETELY EXHAUST THE AIR FROM THE SUSPENSION SYSTEM TO PROVIDE STABILITY ON AN UNEVEN TERRAIN. FAILURE TO DO SO COULD RESULT IN LOSS OF VEHICLE CONTROL, POSSIBLY CAUSING PERSONAL INJURY OR PROPERTY DAMAGE.

DO NOT MODIFY OR REWORK PARTS. DO NOT USE SUBSTITUTE PARTS. USE OF A MODIFIED OR SUBSTITUTE PART IS NOT RECOMMENDED BECAUSE THE PART MAY NOT MEET HENDRICKSON'S SPECIFICATIONS, WHICH COULD RESULT IN FAILURE OF THE PART, LOSS OF VEHICLE CONTROL, AND POSSIBLE PERSONAL INJURY OR PROPERTY DAMAGE.

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 MAY 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 MAIN SUPPORT MEMBERS. DO NOT CONNECT ARC WELDING GROUND LINE TO THE MAIN SUPPORT MEMBERS. DO NOT STRIKE AN ARC WITH THE ELECTRODE ON THE MAIN SUPPORT MEMBERS. DO NOT USE HEAT NEAR THE MAIN SUPPORT MEMBERS. DO NOT NICK OR GOUGE THE MAIN SUPPORT MEMBERS. A MAIN SUPPORT MEMBER THAT HAS BEEN SUBJECTED TO ANY OF THESE CONDITIONS MAY FAIL, CAUSING LOSS OF VEHICLE CONTROL AND POSSIBLE PERSONAL INJURY OR PROPERTY DAMAGE.

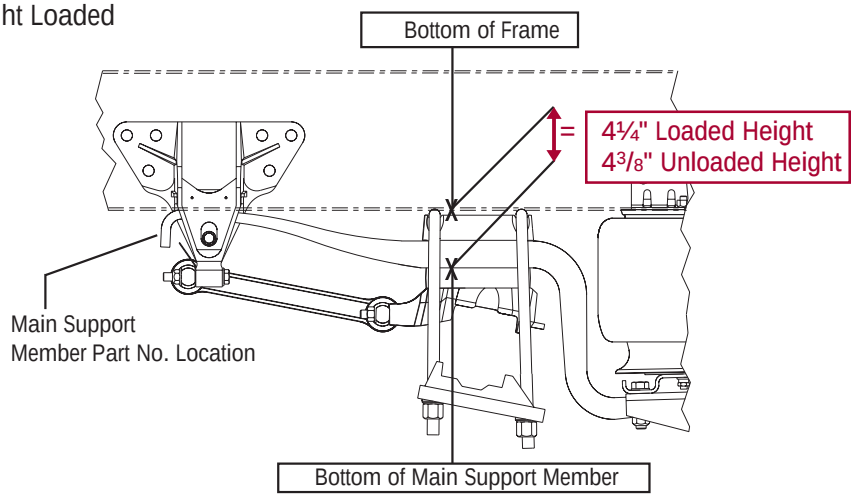
A MECHANIC USING A SERVICE PROCEDURE OR TOOL WHICH HAS NOT BEEN RECOMMENDED BY HENDRICKSON MUST FIRST SATISFY HIMSELF THAT NEITHER HIS SAFETY NOR THE VEHICLE'S SAFETY WILL BE JEOPARDIZED BY THE METHOD OR TOOL SELECTED. INDIVIDUALS DEVIATING IN ANY MANNER FROM THE INSTRUCTIONS PROVIDED ASSUME ALL RISKS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

Subject 3
FRAME SLOPE

Drive axle pinion angles are established by the vehicle manufacturer. The suspension spring seats called out in Hendrickson Technical Publications 17730-197, 17730-212 and 17730-222 are cast and machined to specific angles to meet the vehicle manufacturer specified requirements. Because the main support members deflect slightly under a full load, empty chassis axle angles measure about one degree less than when the vehicle is fully loaded.

In most cases, the original vehicle manufacturer installs spring seats that are equal thickness on both the forward drive and the rear drive axles. These equal thickness spring seats are designed to have frames parallel to the ground which results in 0° frame slope. The intent is to maintain identical (4¼" loaded and 4⅜" unloaded) main support member heights on the forward drive axle and the rear drive axle as shown in Figure 2. Maintaining these identical heights assures equal loading on both drive axles as well as correct axle pinion angles. Chassis frame slope in excess of one degree may cause unequal loading between the two drive axles which may be detrimental to vehicle ride. If this condition persists contact the vehicle manufacturer for guidelines or proceed with the following recommendations:

Figure 2
Ride Height Loaded



1. If the frame slopes downward and toward the cab the front drive axle will, in all probability, weigh more than the rear drive axle.
2. If the frame slopes upward towards the cab the rear drive axle will be the heavier of the two.
3. If the frame height at the tandem suspension is too low, it could be corrected by adding spacer plates to all four corners of the tandem drive axles between the main support members and the spring seats. Do not attempt to correct frame slope by adding spacer plates on only one drive axle. The spacer plates can be made from ½" x 3" x 7" low carbon steel with a 13/16" dia. hole drilled in the center for dowel clearance. A maximum of two ½" shop made spacer plates between each main support member and spring seat is permissible. Longer U bolts will be required to accommodate spacer plates. Hendrickson has 1" and 1½" thick spacers available as production items. A maximum of one 1" thick, or one 1½" thick spacer is permissible.

4. If frame slope is excessive (greater than what can be corrected for with a 1½" spacer) it should be corrected by the vehicle manufacturer.
5. If the frame height at the tandem suspension is too high, the spacers can be removed (if so equipped), or the front steer axle suspension can be raised.
6. Do not make changes to the steering axle without prior approval and supervision of the O.E.M. as the steering geometry could be affected thus, causing steering problems.

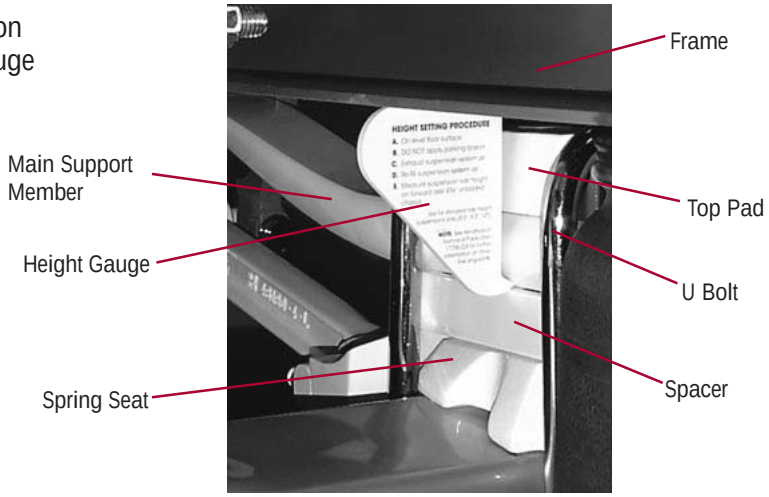
Subject 4
AXLE/ SUSPENSION ANGLE INSPECTION

The following inspection procedure is recommended when axle angle adjustment is required for the rear tandem axle using the HAS series suspension.

Inspections can be performed on an unloaded vehicle. Inspections on a loaded vehicle can be difficult to schedule.

1. Free and center all suspension joints by slowly moving vehicle back and forth several times without using the brakes. When coming to a complete stop make sure the brakes are released. Chock front wheels.
2. Verify that the front steer and rear drive tires are inflated to normal operating pressure.
3. Using a Hendrickson height gauge, see Figure 3, (part number Loaded 45745-050, Unloaded 45745-106), measure the suspension height on the forward and rear drive axles, as shown is Figures 2 and 3. If the vehicle is equipped with equal thickness spring seats and the frame is level, all four main support members should have the same loaded suspension height of 4.25" ± .12" or 4.38" ± .12" unloaded. Again, this measurement is from the bottom of the frame to the bottom of the main support member (spring) as shown in Figure 2.

Figure 3
Hendrickson
Height Gauge



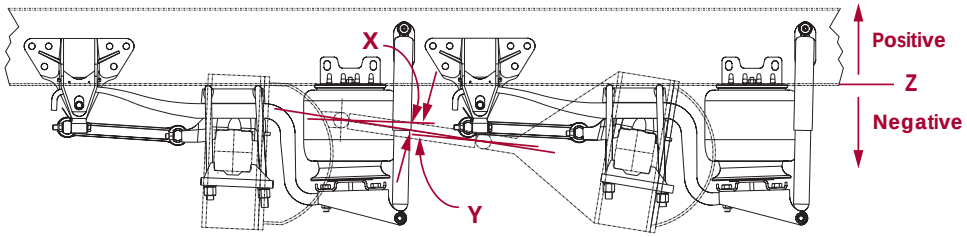
Subject 4
AXLE/ SUSPENSION ANGLE
INSPECTION (Cont.)

4. If the frame slopes toward the cab, (positive (+) frame slope) the front drive approval axle angle will be less compared to the vehicle manufacturer specified angle. If the frame slopes away from the cab (negative (-) frame slope) the front drive axle angle will be higher than the vehicle manufacturer specified angle. The frame slope on empty vehicles equipped with equal thickness spring seat must be ± 0.8º.
5. To correct frame slope, spacer plates can be added or removed on all four corners of both drive axles between the main support, as shown in Figure 5, or by adding spacer(s) to the front steer axle. If spacer plates are added, longer U-bolts will be required to accommodate the added spacer plates. Hendrickson has 1" thick spacers (part number 48902-000) and 1½" thick spacers (part number 48903-000) available as production items. A maximum of one 1" thick, or one 1½" thick spacer is permissible. Do not make changes to the steering axle without prior approval and supervision of the O.E.M. as the steering geometry could be affected.
6. Record the measurements obtained from step 3 in the appropriate spaces provided on the Inspection Form (See Page 8).

NOTE

If a Hendrickson height control valve assembly (part number 57977-000) is installed on the rear drive axle, the ride height setting, as shown in Figure 3 should still be measured at the forward drive axle.

Figure 4



4.25" ± .12" = Suspension Ride Height on Forward Axle

X ± Y< 2° = Minimum Cancellation Error
X or Y < 6° = Maximum Working Angle
Z < ± .2° = Loaded Condition
Z < ± .8° = Unloaded Condition

Subject 5
DRIVELINE INSPECTION

1. To measure driveline angles, the vehicle must be placed on a level floor.
2. Inspections can be performed on either loaded or unloaded vehicles.
3. The front steer and rear drive tires must be inflated to normal operating pressure.
4. Free and center all suspension joints by slowly moving vehicle back and forth several times without using the brakes. When coming to a complete stop make sure the brakes are released Chock the front wheels.
5. Using Figure 5 as a guide to determine the angles to be measured and a digital inclinometer as the measuring tool, measure the driveline angles and record them in the appropriate spaces on the Inspection Form (See Page 8). Figure 5 shows the proper method for using the inclinometer.
6. Using the driveline angles A4, A5, and A6 that were recorded in the Driveline Inspection Form and calculate the interaxle cancellation. The difference between the joint working angles (JWA) is the recorded result.
7. Hendrickson's specification for good interaxle cancellation is <2º and joint working angles (JWA) <6º as shown Figure 6.

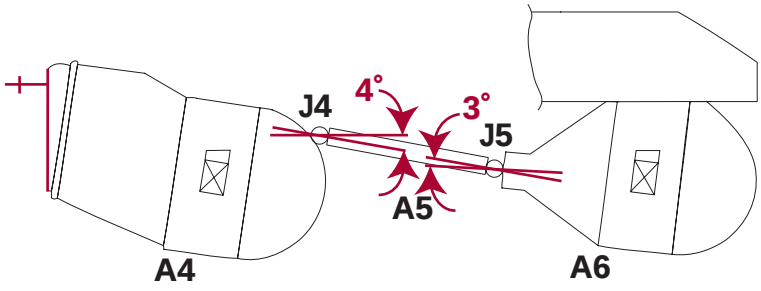
Figure 5
Measurement of Axle Angles (A4 + A5)

SERVICE HINT

The change in axle wind-up is less severe on the forward axle output (J4) then the rear axle input (J5). Optimum results occur when J4 is less then J5.

Figure 6

Joint working angles should not exceed 6°
Cancellation error should not exceed 2°



Forward Axle (A4 = 2.5°) I.A.S. (A5 = 6.5°) Rear Rear Axle (A6 = 9.5°)

("JWA" J4 = | A5 - A4 | = 4°) ("JWA" J5 = | A5 – A6 | = 3°)

Cancellation Error = | J4 - J5 | = 1°

DRIVELINE INSPECTION FORM

Vehicle Information

Vehicle Owner _____ Wheel Base _____

Vehicle Make _____ Drive Axle _____

Model _____ Tandem Suspension/Kit No. _____

VIN _____ Tandem Spread _____

Build Date _____ Mileage _____

By _____ Engine H.P./Torque _____

Date _____ Transmission Model/Speed _____

Data Collection

Frame Slope _____ Frame Height Front _____

Forward Drive Axle Height _____ Frame Height Center _____

Rear Drive Axle Height _____ Frame Height Rear _____

Engine/Trans Angle A1 = _____

1st Drive Shaft Angle A2 = _____ J1 = | A1-A2 | = _____

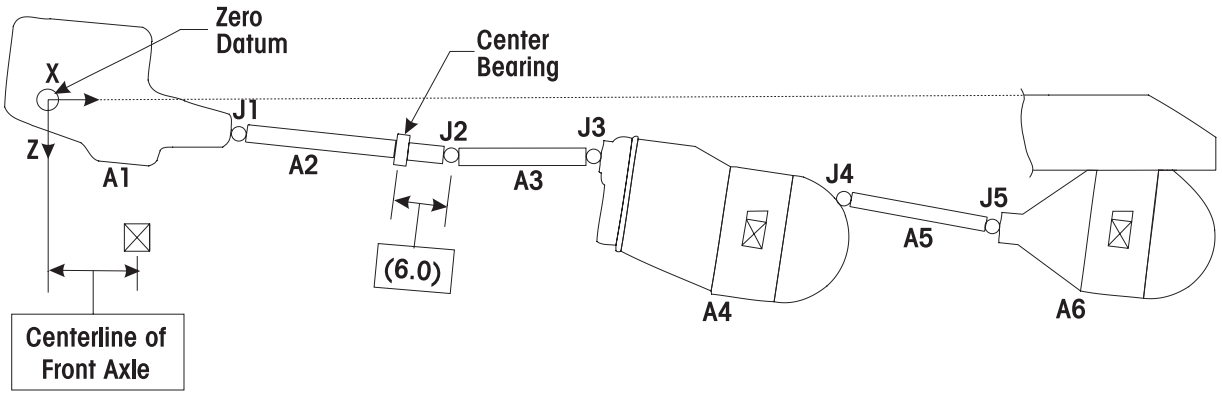
Coupling Shaft Angle A3 = _____ J2 = | A2-A3 | = _____ C = | J1-J3 | = _____

Forward Drive Axle Angle A4 = _____ J3 = | A3-A4 | = _____ C = | J1-J3 | = _____

Inter-Axle Shaft Angle A5 = _____ J4 = | A4-A5 | = _____

Rear Drive Axle Angle A6 = _____ J5 = | A5-A6 | = _____ C = | J4-J5 | = _____

A = Angle J = Joint Angle C = Cancellation Angle



Subject 6

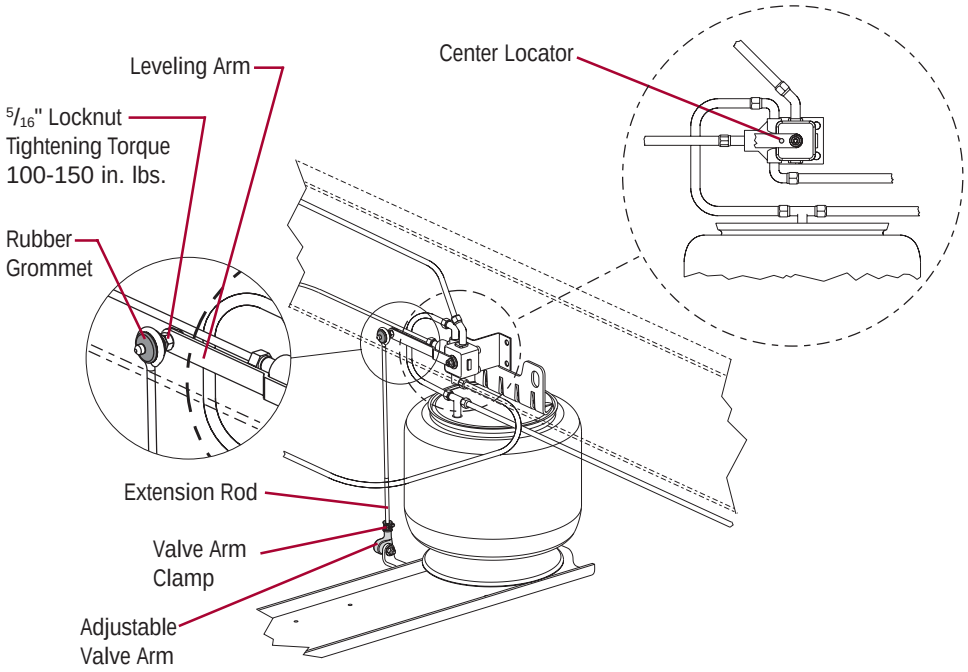
SETTING RIDE HEIGHT

1. The front steer and rear drive tires must be inflated to normal operating pressure.
2. Free and center all suspension joints by slowly moving vehicle back and forth several times without using the brakes. When coming to a complete stop make sure the brakes are released Chock the front wheels.
3. Remove upper fasteners from the linkage located at the rubber grommet and free leveling arm. See Figure 7.
4. Dump air from suspension system.
5. Refill suspension system air.
6. Measure (4¼" loaded or 4⅜" unloaded) on the forward axle.
7. Center the locator on lever arm as shown in Figure 7.
8. Adjustment of the ride height control valve linkage can be achieved by loosening the clamp at the bottom of the extension rod and repositioning the valve arm joint vertically on the extension rod, as shown in Figure 7.
9. All four main support members should have the same height (loaded 4¼" or 4⅜") unloaded as shown in Figure 2. A Hendrickson height gauge, (part number Loaded 45745-050, Unloaded 45745-106) is available from Hendrickson to simplify establishing the 4¼" or 4⅜" dimension as shown in Figure 3.
10. Attach upper fasteners, tightening torque 100-150 in. lbs. Tighten lower valve arm clamp until securely fastened.

NOTE

During cycle operation of the height control valve it is normal to experience a limited amount of exhaust noise.

Figure 7
Height Control Valve
Part No. 57977-000



Subject 7
HI-TORQUE SHOCK ABSORBER

1. Frame rise, as shown in Figure 8, is caused by axle wheel torque input. This can be reduced by installing the Hendrickson Hi-Torque shock part number 57905-001 as shown in Figure 9.

Figure 8
Frame Rise

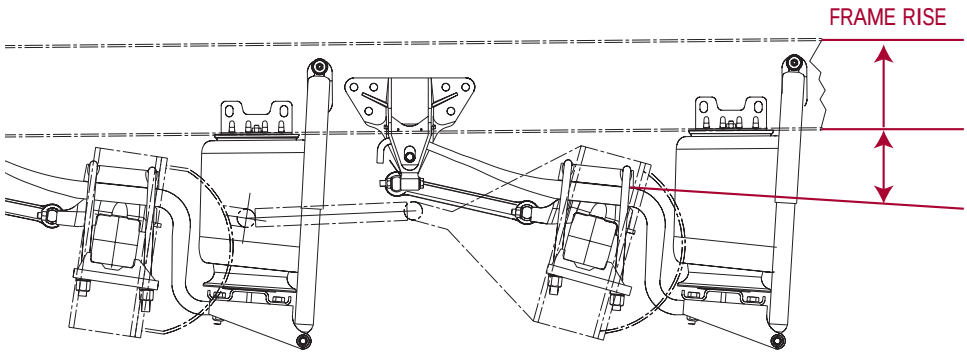
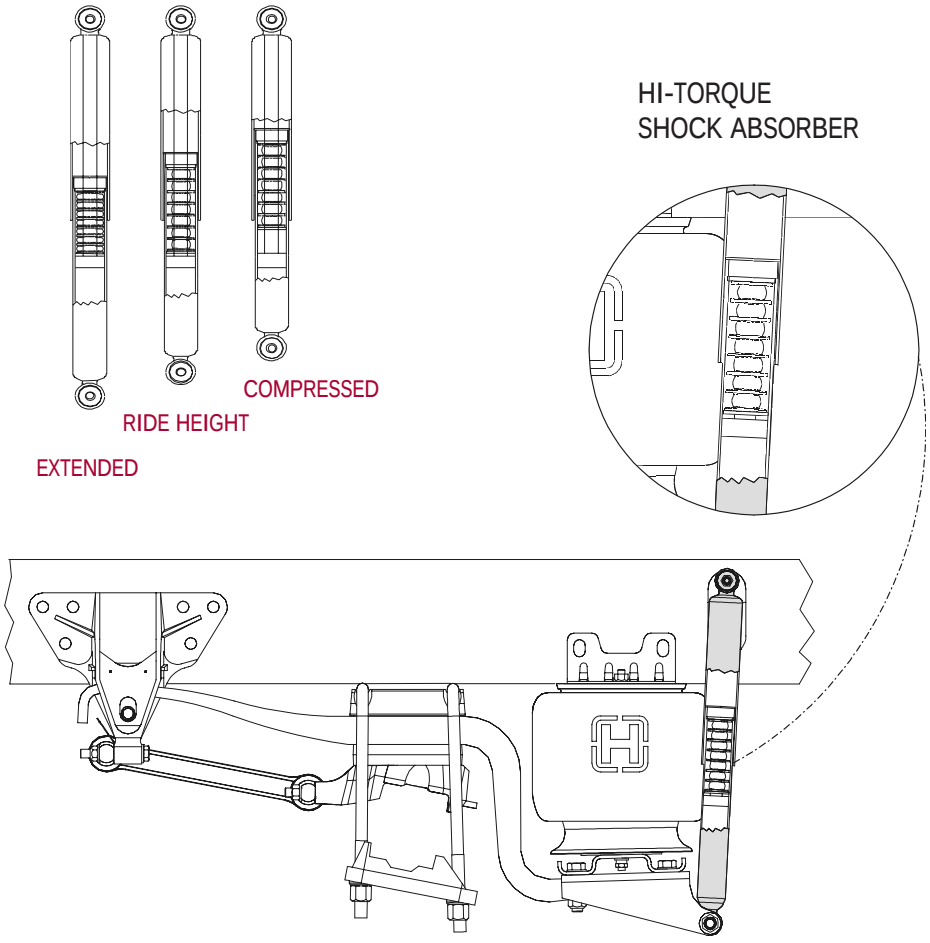


Figure 9

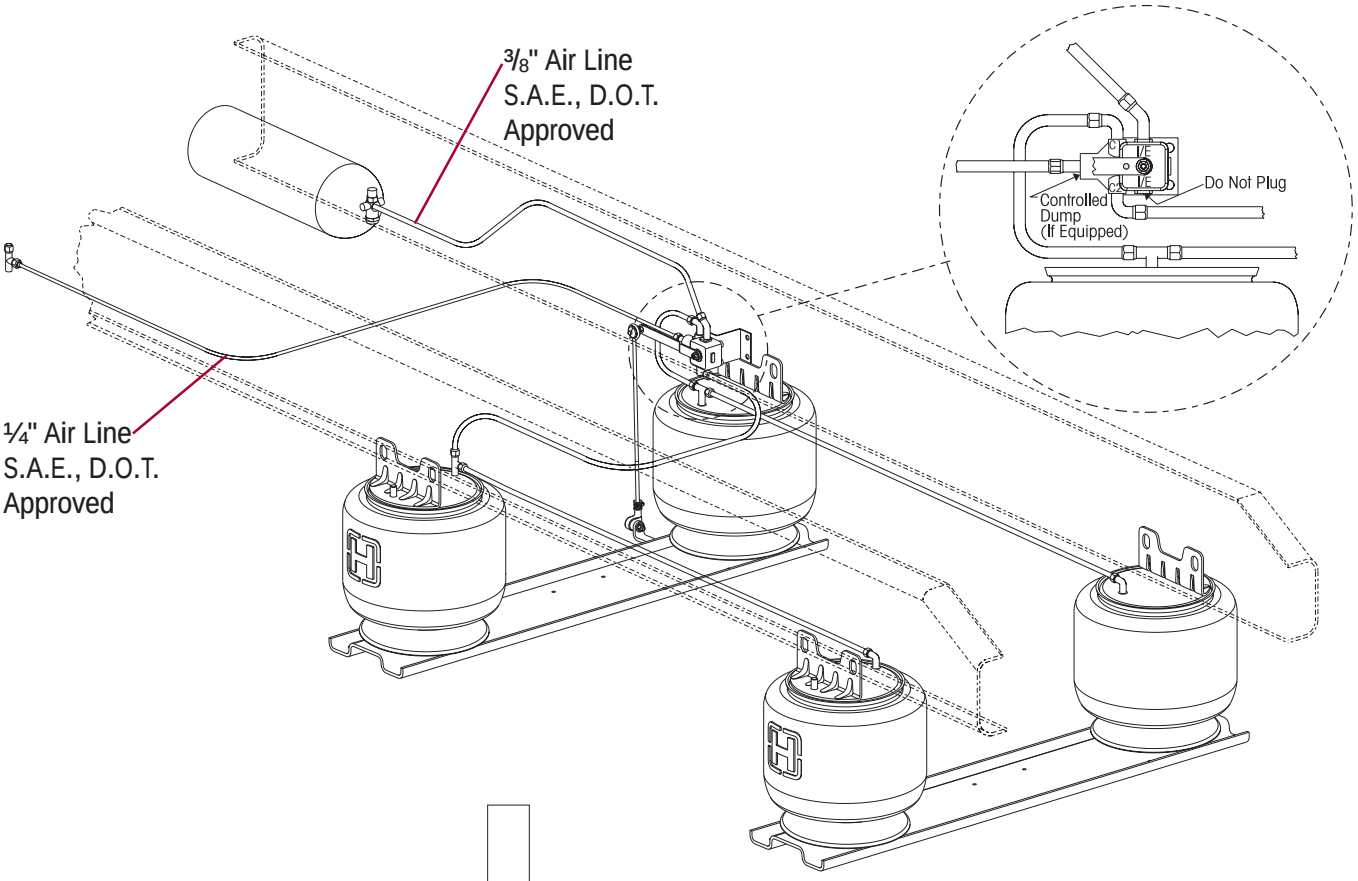


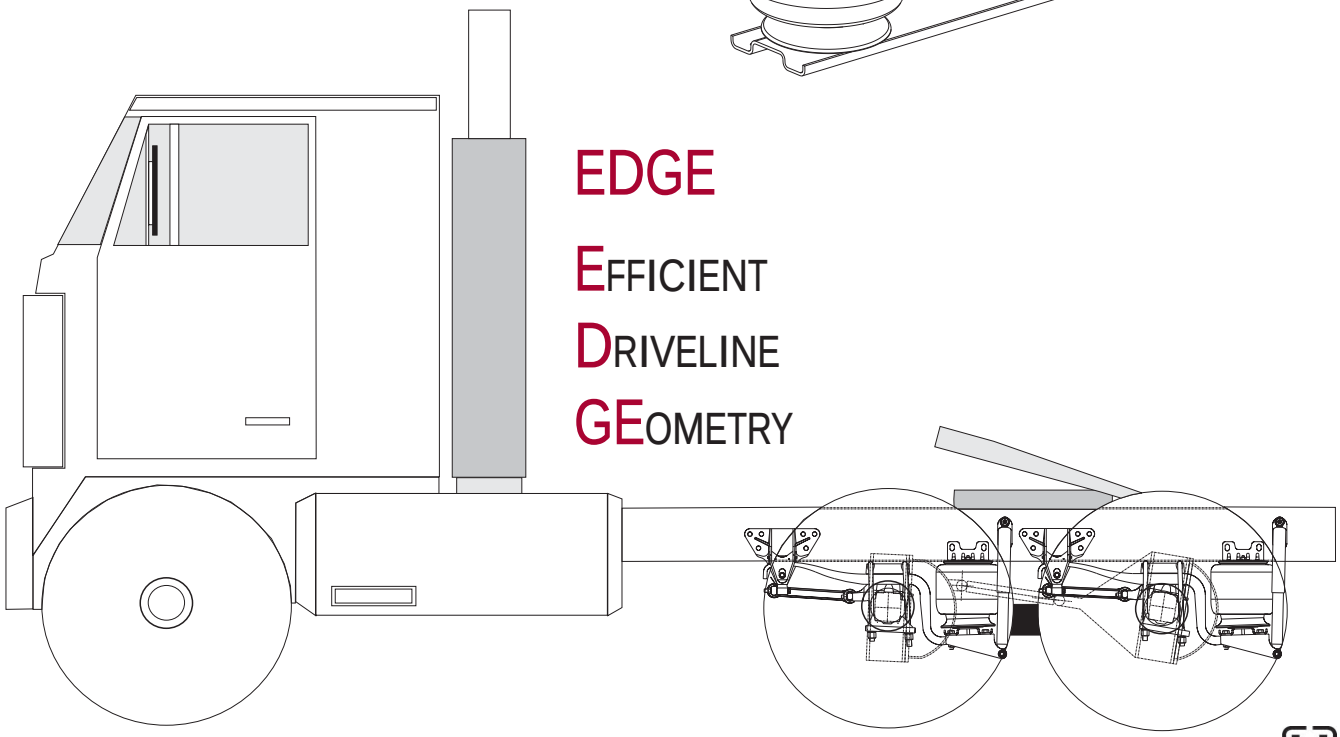
Subject 8
HAS AIR PLUMBING
DIAGRAM

Plumbing With NEW Height Control Valve

The new height control valve eliminates the need for a separate quick release dump valve (1996-Present).

Height Control Valve Part No. 57977-000
I/E – Intake/Exhaust
C1 – Delivery to Air Spring (Left Side)
C2 – Delivery to Air Spring (Right Side)





EDGE

EFFICIENT
DRIVELINE
GEOMETRY

Subject 9
TIGHTENING TORQUE SPECIFICATION CHART

Description	Part No.	Hendrickson Thread/Grade	Torque Ft./Lbs.
Spring Hanger to Vehicle Frame Bolts, Nuts, & Washers	None	Furnished & Installed by Truck Manufacturer	*
U Bolt Locknut	50765-000	7/8"-14 UNF-2B Grade C	400-450
Torque Rod Bar Pin Locknut	47764-000	5/8"-11 UNC-2B Grade C	150-205
Spring Seat Stud	50918-000	5/8"-11 UNC-2A Grade 8	60-70
Rebound Bolt Locknut	49846-000	1/2"13 UNC-2B Grade C	50-70
Shock Absorber Locknut/Upper	49846-000	1/2"-13UNC-2B Grade C	50-70
Shock Absorber Locknut/Lower	49842-000	3/4"-10 UNC-2B Grade C	50-70
Cross Channel to MSM Locknut	49842-000	3/4"-10 UNC-2B Grade C	260-320
Air Spring to Frame Hanger Locknut	17700-010	1/2"-13 UNC-2B Grade 5	20-30
Air Spring to Cross Channel Locknut	17700-010	1/2"-13 UNC-2B Grade 5	20-30
Transverse Rod Locknut	29749-000	1 1/4"-12 UNF-3B Grade 5	175-225
Extension Arm Jam Nut	17491-019	5/16"-24 UNF-2B Grade 5	100-150 IN/LBS.
Extension Arm Locknut	48948-000	5/16"-24 UNF-2B Grade C	100-150 IN/LBS.
Valve Arm Clamp	58969-000		Securely Fastened

All threads must be clean and lubricated with SAE 20 oil before assembly to obtain the correct relationship of torque and fastener tension.

To obtain maximum service life from the suspension system, mounting bolts and nuts should be checked at least once a year and tightened to specified torque.

IMPORTANT NOTE

*Torque values listed above apply only if Hendrickson supplied fasteners are used. If non-Hendrickson fasteners are used, follow torque specifications listed in vehicle manufacturer's service manual.

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