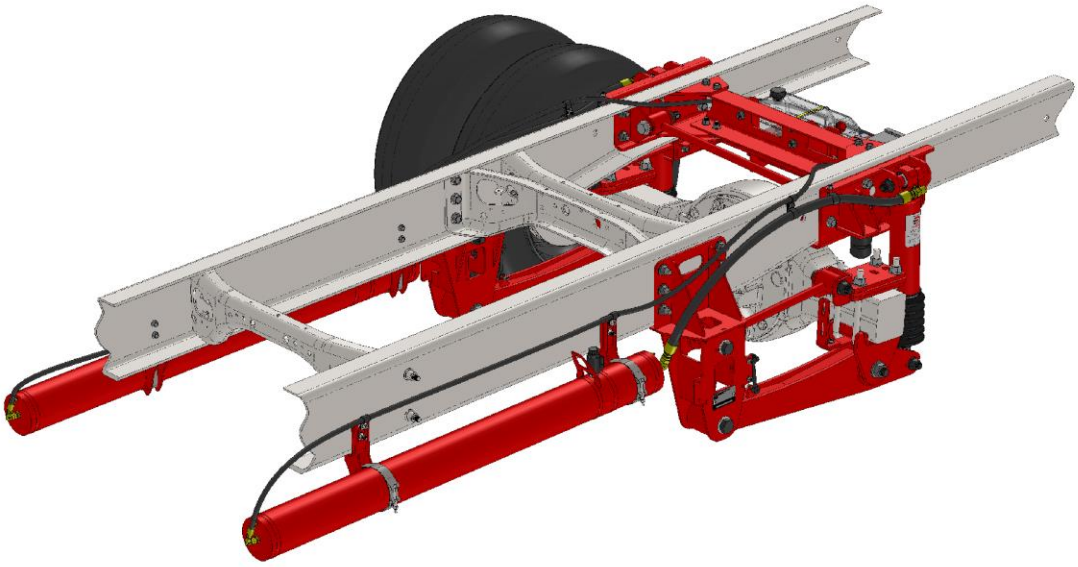
DS155NDLP

DS155NDLP

Rear Axle Suspension System
for International Durastar 4300
Low Profile and International
MV60H-LP (MV607 Low Profile)



LIQUIDSPRING™ LLC

Installation / Operator Manual

D11308 REV M 6/19

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Introduction

This manual provides installation information for the LiquidSpring CLASS® DS155NDLP series of rear axle suspension systems for the low profile DuraStar 4300 and MV60H-LP Cab Chassis.

Before you begin installation of the suspension system:

1. Read and understand all instructions and procedures prior to installation of 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 proper tools when required to help avoid serious personal injury and damage to components.

Throughout this manual, important product information is indicated. These terms are defined as follows:

NOTE: Includes additional information to enable accurate and easy performance of procedures.

IMPORTANT: Includes additional information that if not followed could lead to hindered product performance and/or product failure.

CAUTION: A caution indicates procedures that must be followed exactly. Damage to equipment or suspension components and personal injury can occur if the procedure is not followed.

WARNING: A warning indicates procedures that must be followed exactly. Serious personal injury can occur if the procedure is not followed.

LiquidSpring LLC reserves the right to modify the suspension and/or procedures and to change specifications at any time without notice and without incurring obligation.

Suspension Application and Rating

Model	Model Years	Rear Axle[1] GAWR	Engine	Brakes	OEM Susp.	LiquidSpring Kit	LiquidSpring Suspension Rating (lbs)	**WARNING: Overloading suspension system may result in abnormal handling characteristics and premature wear of components.**
4300 Low Profile Frame	2008 – Current	15500 Dana 17060S, Dana S140 (17-140) Meritor MS-17-14X	MaxxForce	Hyd. Only	Steel Leaf 14SAE 14SAH	DS155NDLP-S	15,500	
			Cummins			DS155NDLP-SC	15,500	
MV60H-LP			MaxxForce	Hyd./ Air	IROS Air 14TBM 14TBN	DS155NDLP-A	15,500	
			Cummins			DS155NDLP-AC	15,500	

Serial Number Tag Information

The serial number is found on an aluminum tag riveted to the Left Hand Suspension Hanger as shown in Figure 2. This information will aid you when contacting the chassis manufacturer or LiquidSpring LLC.

Figure 1. Suspension Identification

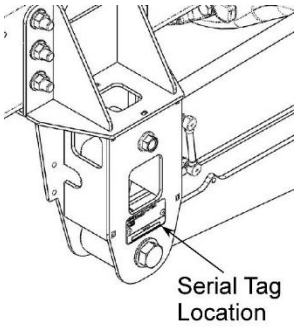


Figure 2. Serial Number Tag Location

Vehicle Towing and Jacking Information

Before attempting any type of towing procedures, contact the Chassis OEM or Vehicle Manufacturer for instructions.

NOTE: Before towing vehicle, check with local authorities, such as Department of Transportation, for permissible towing methods. Some states do not permit towing vehicles by chains or towing straps.

Do not attach tow apparatus (hooks, chains, straps, etc.) to the suspension components.

WARNING: Attaching towing equipment to improper locations and failure to utilize Chassis OEM or Vehicle Manufacturer recommended towing methods could result in one or more of the following:

Damage to the suspension and/or vehicle,
Loss of vehicle control,
Possible disconnect from the vehicle.

WARNING: Do not apply jack to bottom of front hanger or other suspension components. Appling a jack to improper locations can result in damage to the suspension and/or vehicle and severe personal injury.

Abbreviations

The following abbreviations will be used throughout the manual.

HCS	Hex Cap Screw (also HB)
HFB	Hex Flange Bolt
SHCS	Socket Head Cap Screw
SFHS	Serrated Flange Hex Screw
STS	Self Tapping Screw
HN	Hex Nut, Non-locking
LHN	Locking Hex Nut
LFN	Locking Flange Nut
HFW	Hardened Flat Washer
SLW	Spring Lock Washer
FW	Flat Washer
SAE	SAE O-Ring Fitting
37°	SAE or JIC 37° Flare Fitting (F – Female)
LH	Left Handed Part
RH	Right Handed Part
UCA	Upper Control Arm
LCA	Lower Control Arm
USM	Upper Strut Mount
PM	Power Module

Hydraulic Fitting Assembly

SAE O-Ring Adjustable Fittings

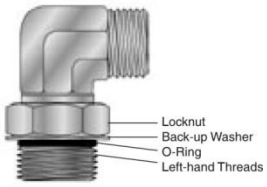


Figure 3. Adjustable SAE fitting

1. Inspect components to ensure that male and female port threads and sealing surfaces are free of burrs, nicks and scratches, or any foreign material.
2. If O-ring or seal is not pre-installed to fitting male port end, install proper size O-ring or seal, taking care not to damage it.
3. Lubricate O-ring with light coat of the system fluid or a compatible lubricant to help the O-ring slide smoothly into the port and avoid damage.

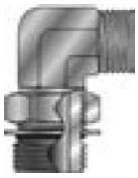


Figure 4. Locknut completely backed off.

4. Back off lock nut as far as possible. Make sure back-up washer is not loose and is pushed up as far as possible.
5. Screw fitting into port until the back-up washer or the retaining ring contacts face of the port. Light wrenching may be necessary. Over tightening may damage washer.
6. To align the tube end of the fitting to accept incoming hose assembly, unscrew the fitting by the required amount, but not more than one full turn.
7. Using two wrenches, hold fitting in desired position and tighten locknut to the proper torque value:
   -4 fitting: **14-16 ft-lbs (168-192 in-lbs)**
   -12 fitting: **75-83 ft-lbs.**
8. Inspect to ensure that O-ring is not pinched and that washer is seated flat on face of port.

SAE O-Ring Non-Adjustable Fitting

1. Inspect components to ensure that male and female port threads and sealing surfaces are free of burrs, nicks and scratches, or any foreign material.
2. If O-ring or seal is not pre-installed to fitting male port end, install proper size O-ring or seal, taking care not to damage it.

3. Lubricate O-ring with light coat of the system fluid or a compatible lubricant to help the O-ring slide smoothly into the port and avoid damage.
4. Screw fitting into port and tighten to proper torque:
   -4 fitting: **26-28 ft-lbs (310-341 in-lbs)**
   -12 fitting: **75-83 ft-lbs.**

JIC 37° Fitting

1. Inspect components to ensure that male and female threads and sealing surfaces are free of burrs, nicks and scratches, or any foreign material. Annular tool marks of 100µin with the thread are permissible.
2. Lubricate the threads and the entire surface of the cone with system fluid.
3. Align mating components for hand connection and turn flare nut until sealing surfaces make full contact.
4. Using two wrenches, hold fitting in desired position and tighten to the proper torque:

-4 fitting: **9-12 ft-lbs**	-10 fitting: **36-63 ft-lbs**
-8 fitting: **27-39 ft-lbs**	-12 fitting: **65-88 ft-lbs**

Pre-Installation

1. Check the vehicle wheel alignment prior to installation to insure pre-existing conditions do not exist.
2. It is suggested, but not required, to remove the attached body to ease installation.
3. A chassis lift can be used in assistance of the installation of the suspension system.
4. Measure and record the wheelbase and tire-to-frame dimensions on each side prior to disassembly.

Frame Preparation

1. Chock the front tires.
2. Jack up the rear frame of the vehicle to remove the load from the rear leaf springs.
3. Place jack stands under the frame and block the rear tires from moving.

Note: Jack stands can be placed under the axle and the tires removed for ease of access. It is recommended to place an additional jack stand under the pinion to prevent the axle from rotating.

4. Depressurize the air system using dump switch inside cab or by bleeding at the air tank on OEM Air ride vehicles.
5. Disconnect the negative vehicle battery cable.
6. Remove the OEM shock absorbers and frame mounted shock brackets.
7. Remove Air Bags and Height control valves on air ride vehicles.
8. Remove the OEM Trailing arm and axle clamp components on air ride vehicles.
9. Remove the OEM Axle Stop Bumpers.
10. Remove the forward leaf hanger brackets.
11. Remove the Rear leaf shackle and hanger brackets on OEM steel spring vehicles.

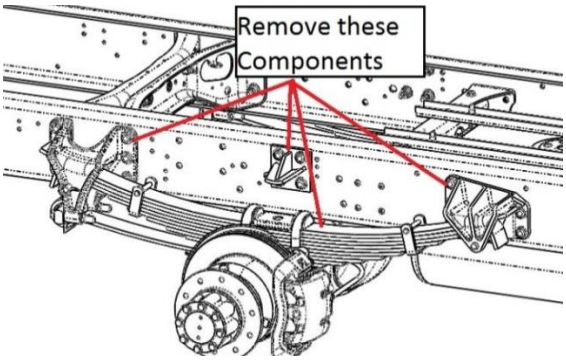


Figure 5, OEM Components to remove, Steel Spring vehicles

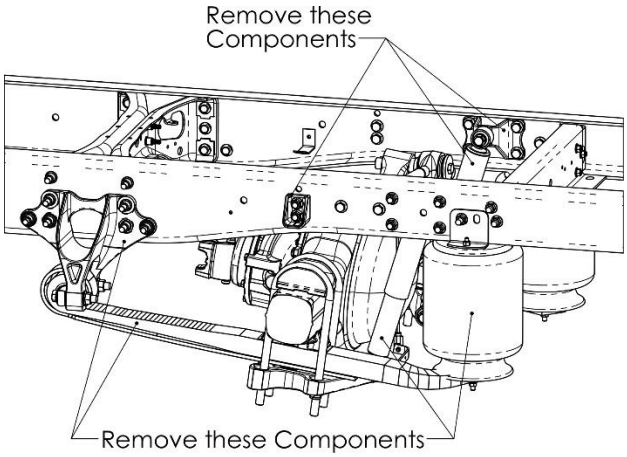


Figure 6. OEM Components to remove, Air Ride Vehicles

12. Remove air lines routing from the rear air tank to the height valves. Install a port plug into the tank where air hose was removed.

Note: Do not remove the transverse torque rod.

13. [DS155NDLP-A and -AC Suspension] Locate the two upper strut mounts and place along the frame as shown in Figure 7 and Appendix C: Frame Drilling Locations, Figure A 1 and Figure A 2.

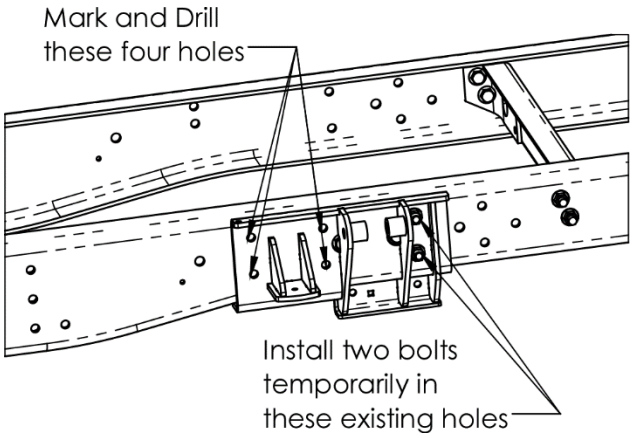


Figure 7. Location of Drilling Template on Driver Side of Frame (Air Ride Conversion)

14. [DS155NDLP-S and –SC Suspension] Locate the Frame drilling template and place along the frame as shown in Figure 8 and Appendix C: Frame Drilling Locations, Figure A 3, and Figure A 4

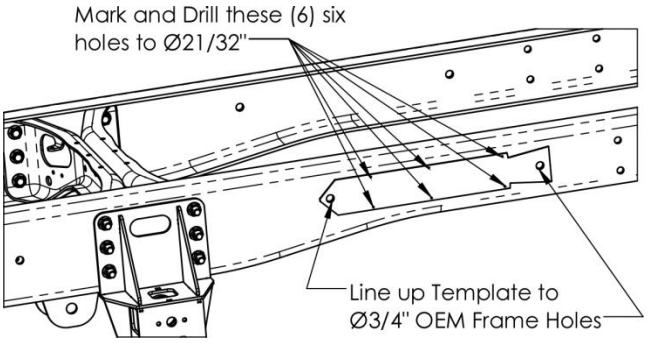


Figure 8. Location of Drilling Template on Driver Side Frame (Steel Leaf Spring Conversion)

15. Center punch or mark the holes indicated in Appendix A.
16. Drill the holes as indicated.
17. Locate the Volume Mounting Brackets and place along frame as shown in Appendix C: Frame Drilling Locations, Figure A 5.
18. Mark the four holes and drill as indicated.

Axle Preparation

Note: DuraStar 4300's and MV60H-LP are equipped with either Meritor or Dana rear axles.

Axle	Template (label on template)	Track Rod Mount
Dana 17060S	10811-017 "Dana 17060S"	10951-005 "Meritor"
Dana S17-140	10811-017 "Dana 1760S"	10951-005 "Meritor"
Meritor MS-17-14X	10811-016 "Meritor MS-17"	10951-005 "Meritor"

Do not use suspension on Dana S16-130 axles.

1. Move any Parking Brake Cables and wiring from top of axle and position away from the axle.
2. Remove the two axle differential bolts as shown in Figure 9.

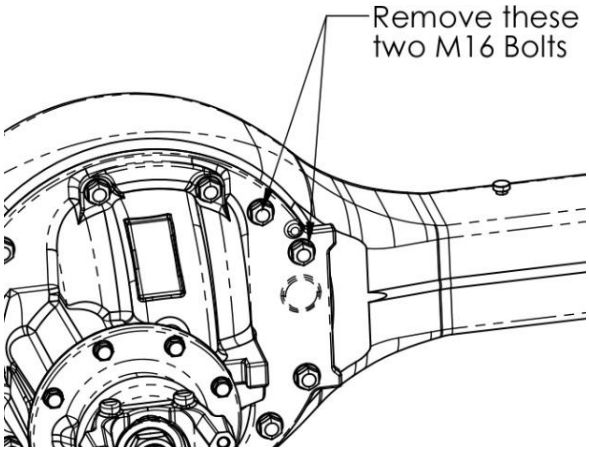


Figure 9, Removal of Axle Bolts.

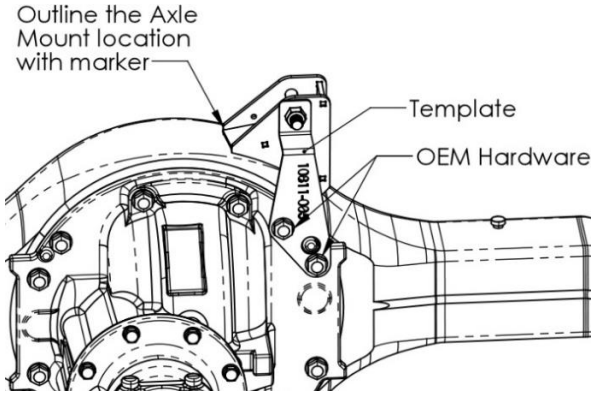


Figure 10, Position Axle Mount using Template

3. Temporarily attach the template to the axle using the two differential bolts. Using 7/8" hardware, fasten the Axle Mount to the template in the position shown in Figure 10.
4. Outline the axle mount with a visible paint marker.
5. Remove the axle mount from the axle and grind away the outlined area to bare metal.

Note: Make sure axle housing is free of paint 1/2" beyond the perimeter of the axle mount.

Note: Make sure the axle mount is free of powder coat 1/2" up from bottom edge around the perimeter.

6. Reattach the axle mount to the template after axle tube is clean and prepped for welding.
7. Tack weld all 4 sides of the axle mount to the axle housing as shown in Figure 11

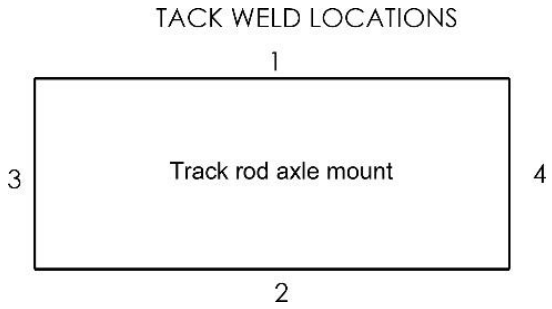


Figure 11, Tack Welding Axle Mount

8. Remove the template from the axle.
9. Position axle for a flat weld. The axle must be pivoted fore and aft for welding front and rear faces.

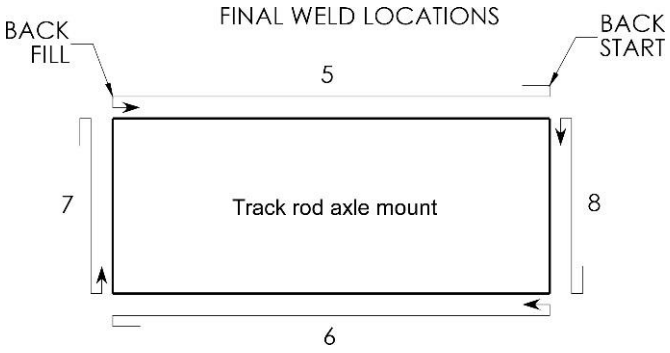


Figure 12, Final Welding on Axle Mount

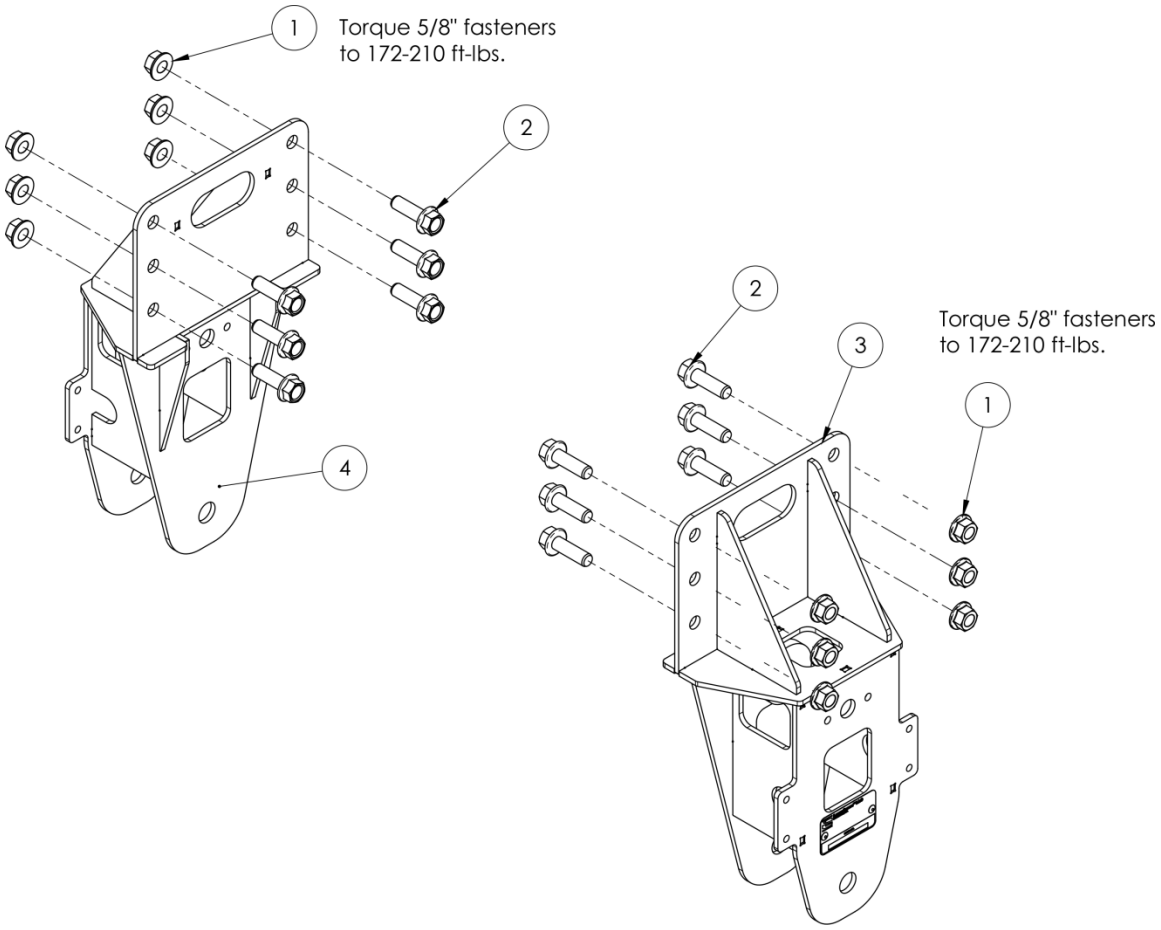
10. Beginning at the indicated location, back step the start of the weld from 0.315-0.512" to prevent a cold start.
11. Lay a full fillet in a single pass: Fillet size 0.375-0.50".
12. Back fill the end of the weld 0.315-0.512" to eliminate craters.
13. Complete the welding on all sides of the bracket using Steps 9-12.
14. Once the axle has cooled, Re-install the two M16 differential bolts to the axle re-applying medium strength loctite and torque to 200 ft/lbs.
15. Apply touch up paint to any bare metal showing on the axle mount and housing.

IMPORTANT: If welding equipment is not capable of welding a single pass as specified, multiple passes will be required.

Note: When welding multiple passes, the first pass should be centered over the fit-up line. The second pass should be placed slightly above the first. Blend the weld smoothly with the axle mount and the first pass. The third pass should penetrate the lower half of the second pass to the edge of the axle housing. When making the second and third passes the direction should be reversed. Refer to steps above for back start and back fill. Clean weld before each pass.

Installation

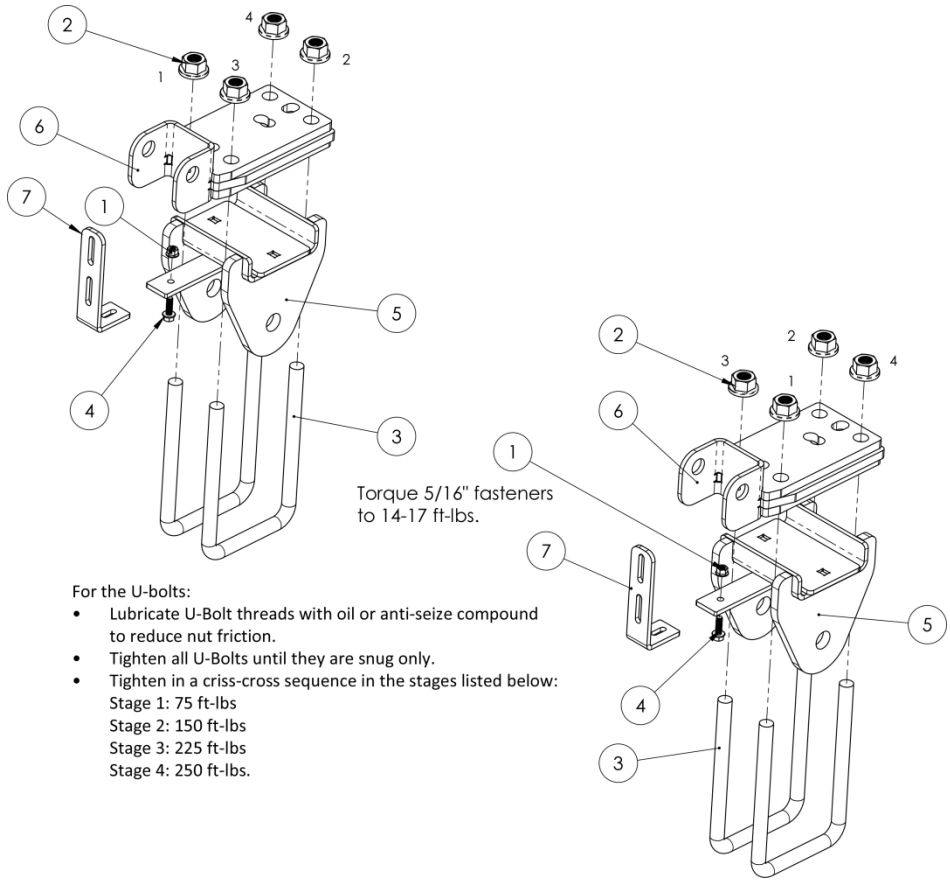
Front Hangers



ITEM	QTY.	PART NUMBER	DESCRIPTION
1	12	10012-008	LFN 5/8-11 Gr. G
2	12	10874-002	HFB 5/8-11 x 2” Gr. 8
3	1	10943-002	Left Hand Front Hanger
4	1	10944-002	Right Hand Front Hanger

1. Install the Left Hand Front Hanger (with the serial tag) on to the driver side of the frame.
2. Verify that the hanger is level to the framerail.
3. Torque fasteners as specified above.
4. Repeat for the Right Hand Front Hanger (without the serial tag) on to the passenger side of the frame.

Axle Clamp Hangers and Seat



ITEM	QTY	PART NUMBER	DESCRIPTION	ITEM	QTY	PART NUMBER	DESCRIPTION
1	2	10012-010	LFN 5/16-13 Gr. G, Black	5	2	10947-010	Lower Axle Clamp Hanger
2	8	10012-012	LFN ¾-16 , Gr. G	6	2	10949-006	Upper Axle Seat
3	4	10064-005	U-Bolt ¾-16 x 9.03 Tri-8	7	2	11147-001	S-Cam Bracket
4	2	10886-100	HFB 5/16-13 x 1.500, Gr. 8,				

IMPORTANT: Item number's 1, 4, and 7 are for air brakes only.

1. Loosely Install the Axle Seat on to the Drivers Side axle spring seat. The Axle Seat should be flush to the top of the axle with the axle stud is in the slot closest to axle centerline. Reference Figure 13 and Figure 14 for correct orientation.

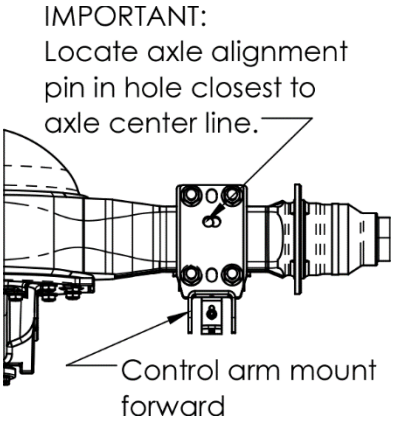


Figure 13, Aligning Axle Seat on Axle Stud

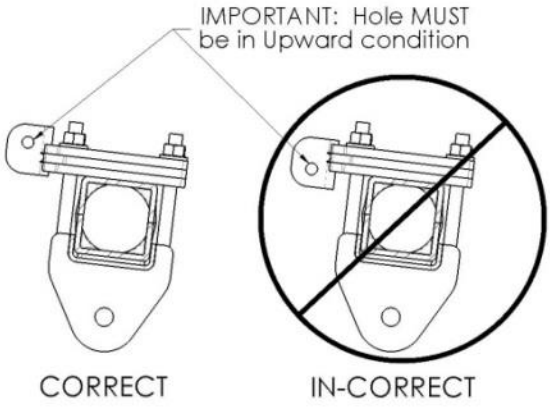


Figure 14, Axle Seat Orientation

2. Repeat for the Right Hand Axle Seat, Axle Hanger, and 3/4" U-bolts.
3. While U-Bolts are still loose, move on to the Control Arm Installation

IMPORTANT: Do not tighten U-Bolts at this time. This will ease control arm installation.

4. **For Air Brakes only**. Remove old bracket holding the S-Cam. Save OEM U-bolts and nuts.
5. Attach S-Cam bracket to the S-Cam mounting Bracket using 5/16-13 bolt and nut. Torque to **14-17 ft-lbs**. Use OEM U-bolt and nuts to clamp the bracket to the S-cam. Torque to **14-17 ft-lbs**.

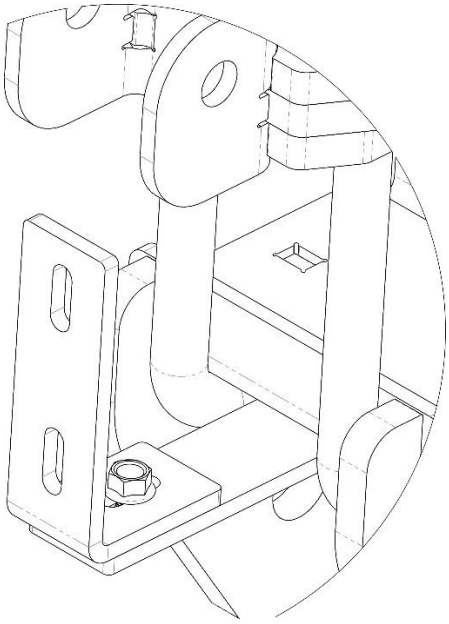
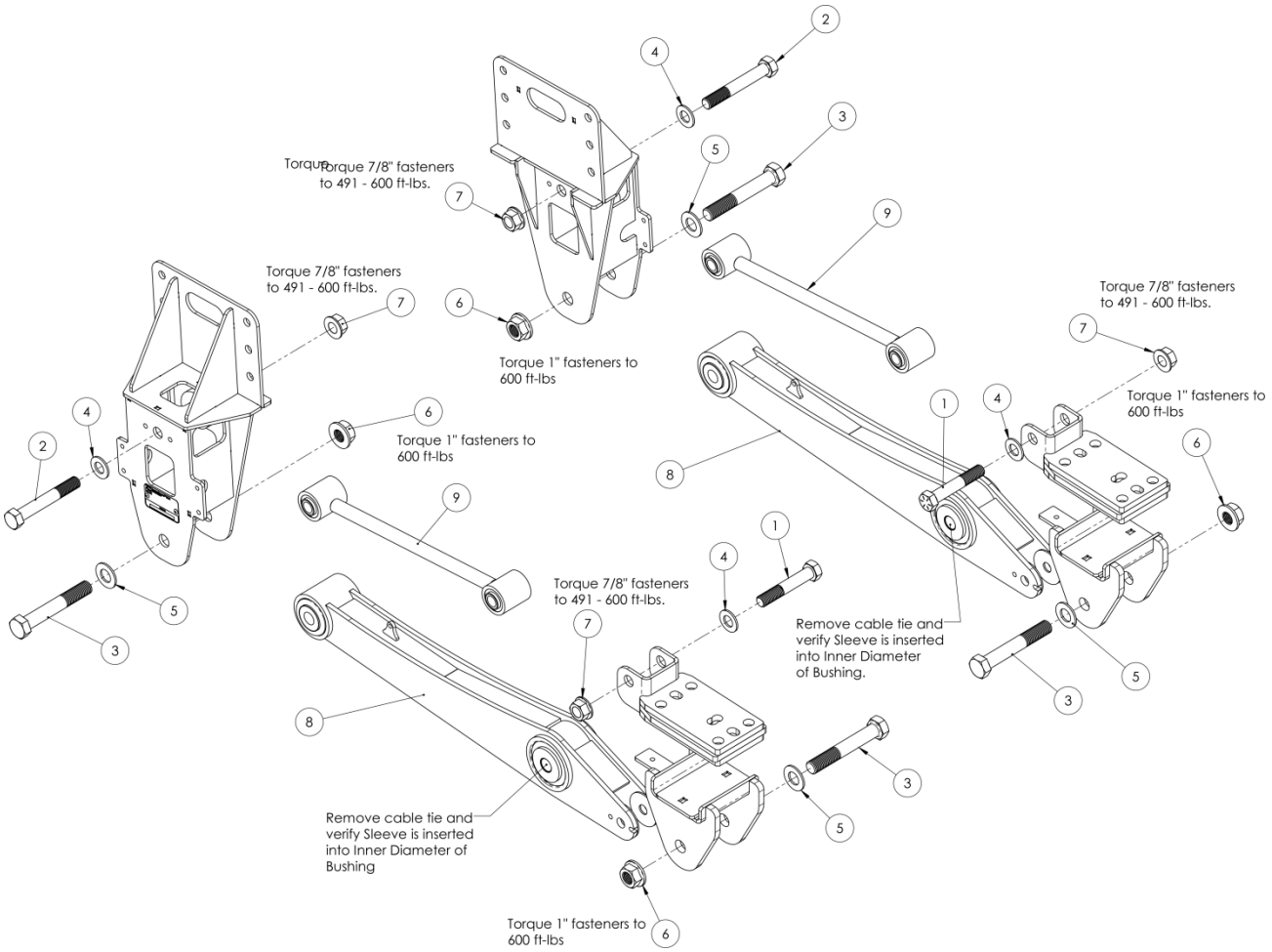


Figure 15 S-Cam Bracket

Figure 16 U-Bolt Attachment

Control Arms



ITEM	QTY	PART NUMBER	DESCRIPTION	ITEM	QTY	PART NUMBER	DESCRIPTION
1	2	10002-500	HCS 7/8-9x5” Gr 8	6	4	10012-003	LFN 1-8, Gr. G
2	2	10002-600	HCS 7/8-9x6” Gr 8	7	4	10012-017	LFN 7/8-9 Gr. G
3	4	10003-004	HB 1-8 x 6-1/2”, Gr. 8	8	2	10953-008	Lower Control Arm
4	4	10006-003	HFW 7/8”	9	2	11198-005	Upper Control Arm
5	4	10006-004	HFW 1”				

1. Install the upper and lower control arms between the driver side front hanger and axle seat / axle hangers loosely with hardware shown above.
2. Remove the cable tie and verify the Sleeve is inserted into the inner diameter of the Lower Control Arm bushing at the axle connection.

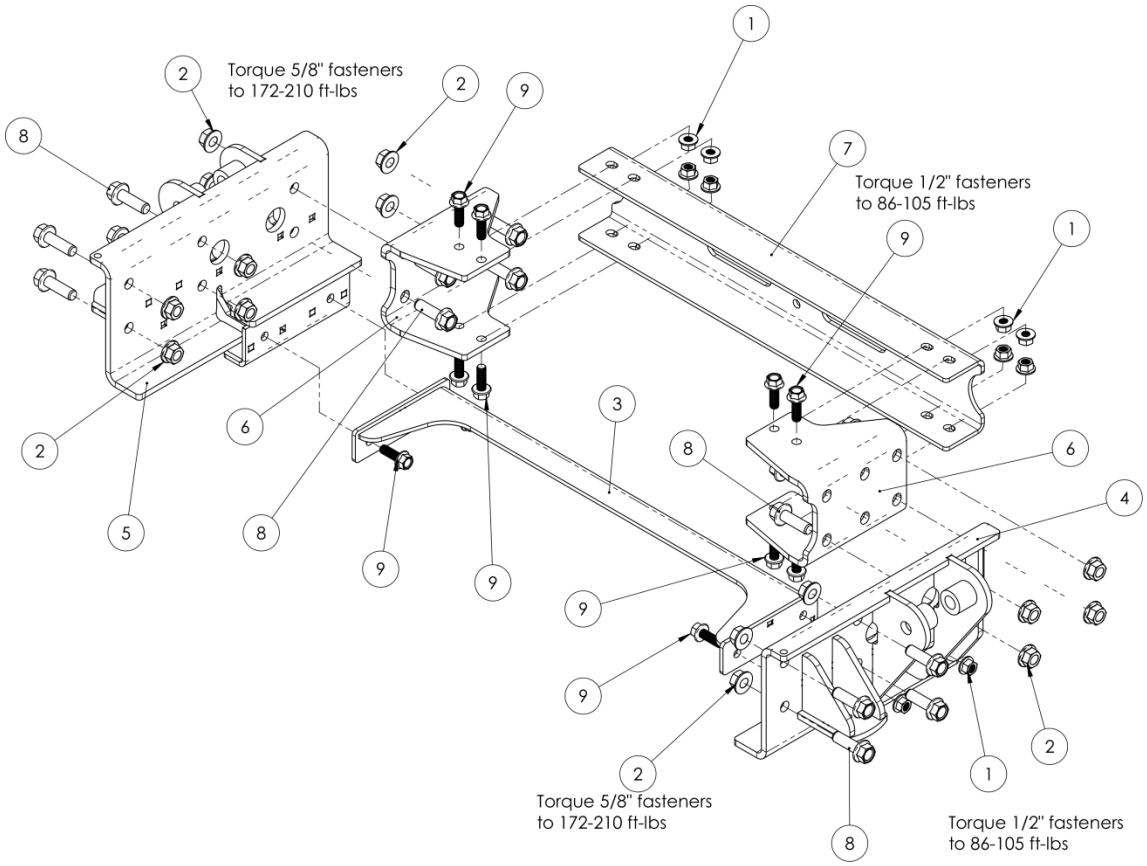
Note: Orientate the lower control arms with the height sensor linkage tabs pointing upward.

IMPORTANT: Bolts inserted at the axle seat must point outboard (towards tire). Orienting the bolts incorrectly may result in damage to the frame rail

3. Torque U-Bolts as specified in **Axle Clamp Hangers and Seat** section, page 9.
4. Do not tighten control arm fasteners until track rod is in place and vehicle is set to ride height in Upper Strut Mounts, see Figure 18, page 13.

Note: Axle must be held at ride height for tightening control arm bolts to prevent preloading the bushings.

Upper Strut Mounts [DS155NDLP-A and -AC,. Factory Air Ride Conversion]



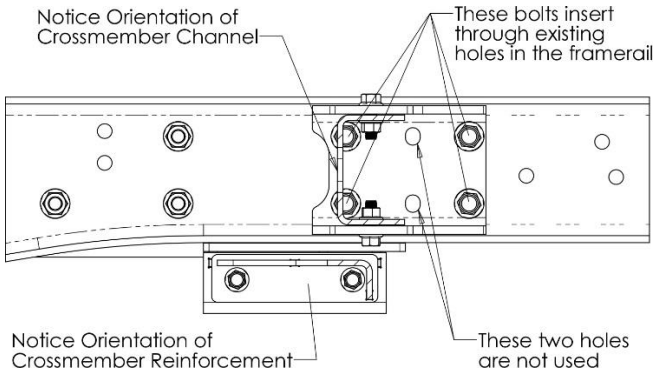
ITEM	QTY	PART NUMBER	DESCRIPTION	ITEM	QTY	PART NUMBER	DESCRIPTION
1	12	10012-007	LFN 1/2-13, Gr. G	6	2	10795-005	Cross-member End Channel
2	16	10012-008	LFN 5/8-11 Gr. G	7	1	10796-004	Cross-member Channel
3	1	10782-006	Cross-member Reinforcement	8	16	10874-200	HFB 5/8-11x2", Gr. 8
4	1	10790-031	LH Upper Strut Mount	9	12	10885-150	HFB 1/2-13x1-1/2", Gr. 8
5	1	10790-032	RH Upper Strut Mount				

Loosely attach the LH Upper Strut Mount and Cross-member End Channel to the frame located just behind the axle. The rearmost USM holes line up with the foremost two cross-member end channel holes.

1. Repeat with RH Upper Strut Mount and Cross-member End Channel.
2. Install the Cross-member Channel inside the End Channels with 1/2"-13 hardware with nuts inside the channel as shown.

IMPORTANT: Bolts must be installed in directions as shown to provide clearance to the Struts and other Moving parts.

3. Install lower Cross-member Reinforcement using 1/2"-13 hardware with bolts facing outward.



Section A-A, Detail of Cross-member Orientation

IMPORTANT: Before tightening fasteners, verify the top of each upper strut mount is level with the top of the frame.

4. Torque all 5/8"-11 nuts to **172-210 ft-lbs**.
5. Remove OEM aft of axle cross-member as shown in Figure 17.

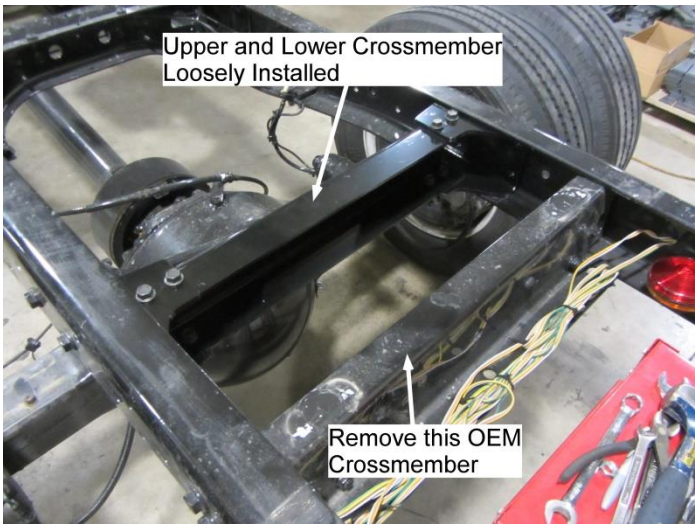


Figure 17. Removing OEM Aft of Axle Cross-member

6. Torque Lower Cross-member Reinforcement 1/2”-13 nuts to **86-105 ft-lbs.**
7. Torque Upper Cross-member and OEM Cross-member 1/2”-13 nuts to **86-105 ft-lbs**.
8. Jack each side of the axle until approximately design ride height position. See Figure 18

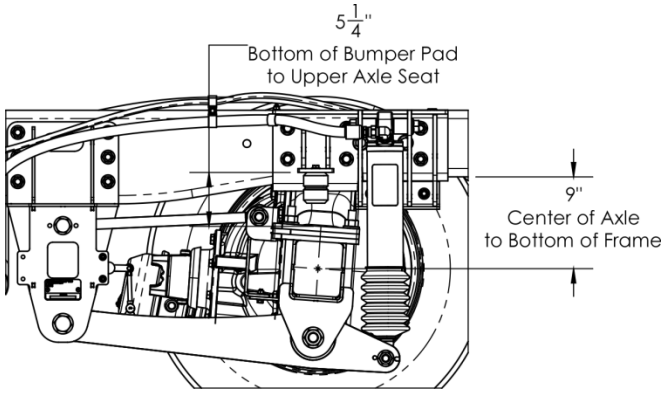
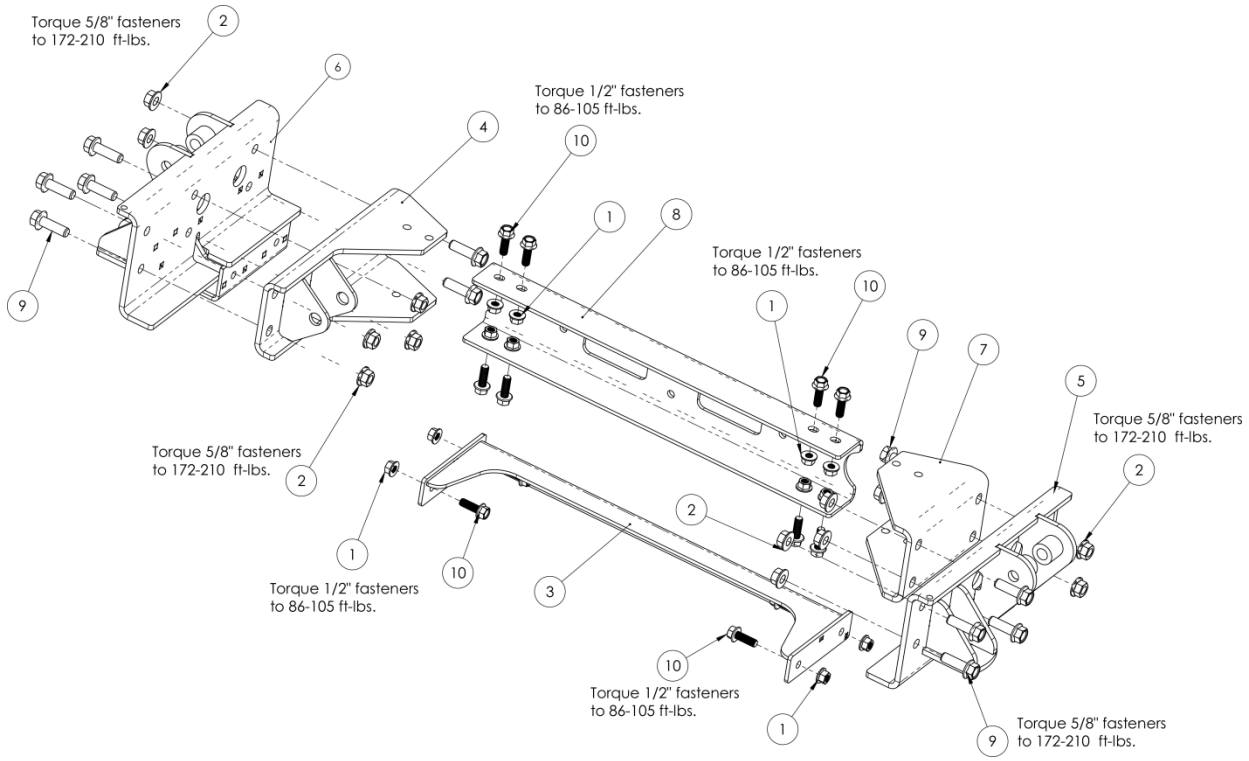


Figure 18, Lift axle to Design Ride Height.

9. Torque the four (4) 1” Control Arm mounting bolts to **600 ft-lbs.**
10. Torque the four (4) 7/8” Control Arm mounting bolts to **491-600 ft-lbs.**

IMPORTANT: Torque all control arm fasteners while axle is at approximate ride height.

Upper Strut Mounts [DS155NDLP- S and, -SC. Factory Leaf Spring conversion]



ITEM	QTY	PART NUMBER	DESCRIPTION	ITEM	QTY	PART NUMBER	DESCRIPTION
1	12	10012-007	LFN 1/2-13, Gr. G	6	1	10790-032	RH Upper Strut Mount
2	12	10012-008	LFN 5/8-11 Gr. G	7	1	10795-006	Cross-member, End Channel
3	1	10782-006	Cross-member Reinforcement	8	1	10796-004	Cross-member Channel
4	1	10789-014	Track Rod Mount	9	12	10874-200	HFB 5/8-11x2", Gr. 8
5	1	10790-031	LH Upper Strut Mount	10	12	10885-150	HFB 1/2-13x1-1/2", Gr. 8

1. Loosely attach the LH Upper Strut Mount and Cross-member End Channel to the frame located just behind the axle. The rearmost USM holes line up with the four cross-member end channel holes.
2. Repeat with RH Upper Strut Mnt and Track Rod Mnt.
3. Install the Cross-member Channel inside the End Channels with 1/2"-13 hardware with nuts inside the channel as shown.

IMPORTANT: Bolts must be installed in directions as shown to provide clearance to the Struts and other Moving parts.

4. Install lower Cross-member Reinforcement using 1/2"-13 hardware with bolts facing outward.

IMPORTANT: Before tightening fasteners, verify the top of each upper strut mount is level with the top of the frame.

5. Torque all 5/8"-11 nuts to **172-210 ft-lbs**.
6. Loosen OEM Crossmember as shown in Figure 19.

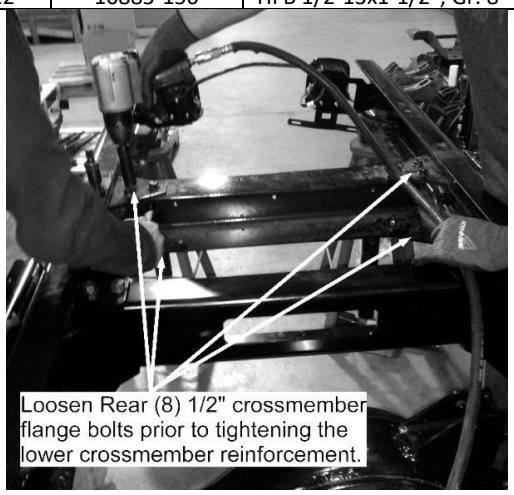
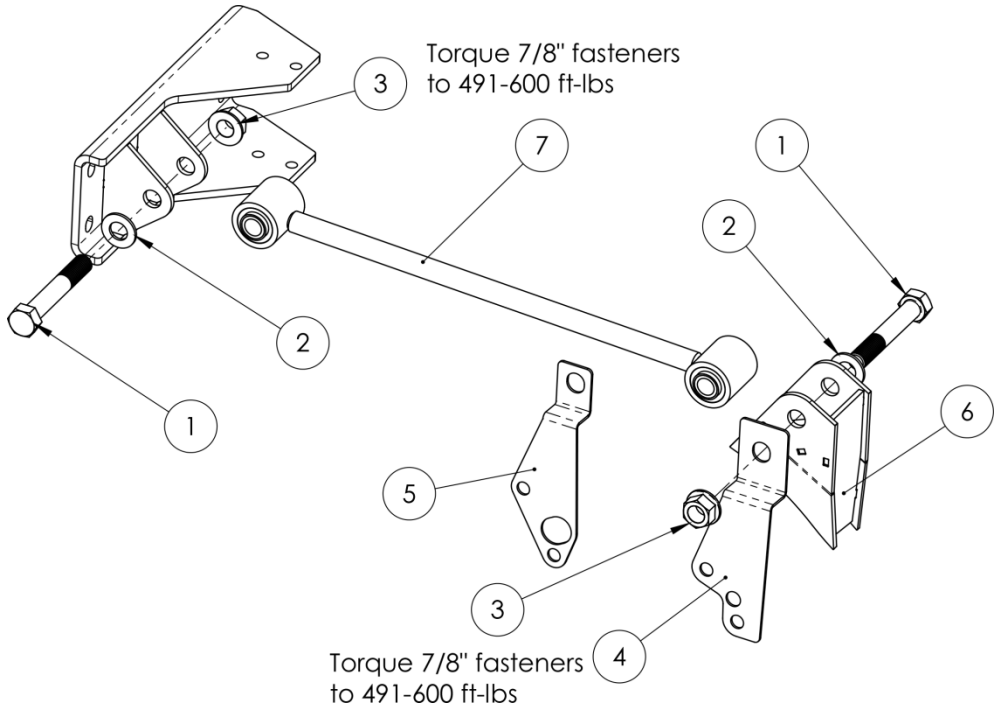


Figure 19. Loosen OEM Rear Crossmember

7. Torque Lower Crossmember Reinforcement 1/2"-13 nuts to **86-105 ft-lbs.**
8. Torque Upper Crossmember and OEM Crossmember 1/2"-13 nuts to **86-105 ft-lbs**.

Track Rod and Mount [DS155NDLP-S and -SC Versions only]

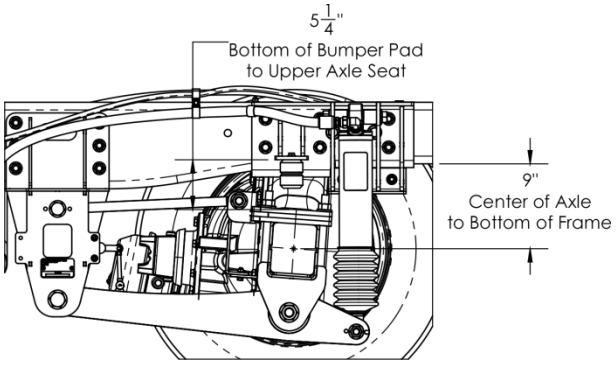


ITEM	QTY	PART NUMBER	DESCRIPTION	ITEM	QTY	PART NUMBER	DESCRIPTION
1	2	10002-550	HCS 7/8-9 x 5.5" Gr 8	5	1	10811-017	Template, Dana
2	2	10006-003	HFW 7/8"	6	1	10951-005	Axle Mount
3	2	10012-017	LFN 7/8-9 Gr G	7	1	11198-001	Track Rod Assembly
4	1	10811-016	Template, Meritor				

Note: DuraStar 4300's are equipped with either Meritor or Dana rear axles. For Meritor MS-17 series axles, use the template 10811-016, marked "Meritor MS-17". For Dana 17060S rear axles, use the template 10811-017, marked "Dana 17060S". Both axles use the 10951-005 track rod mount marked "Meritor".

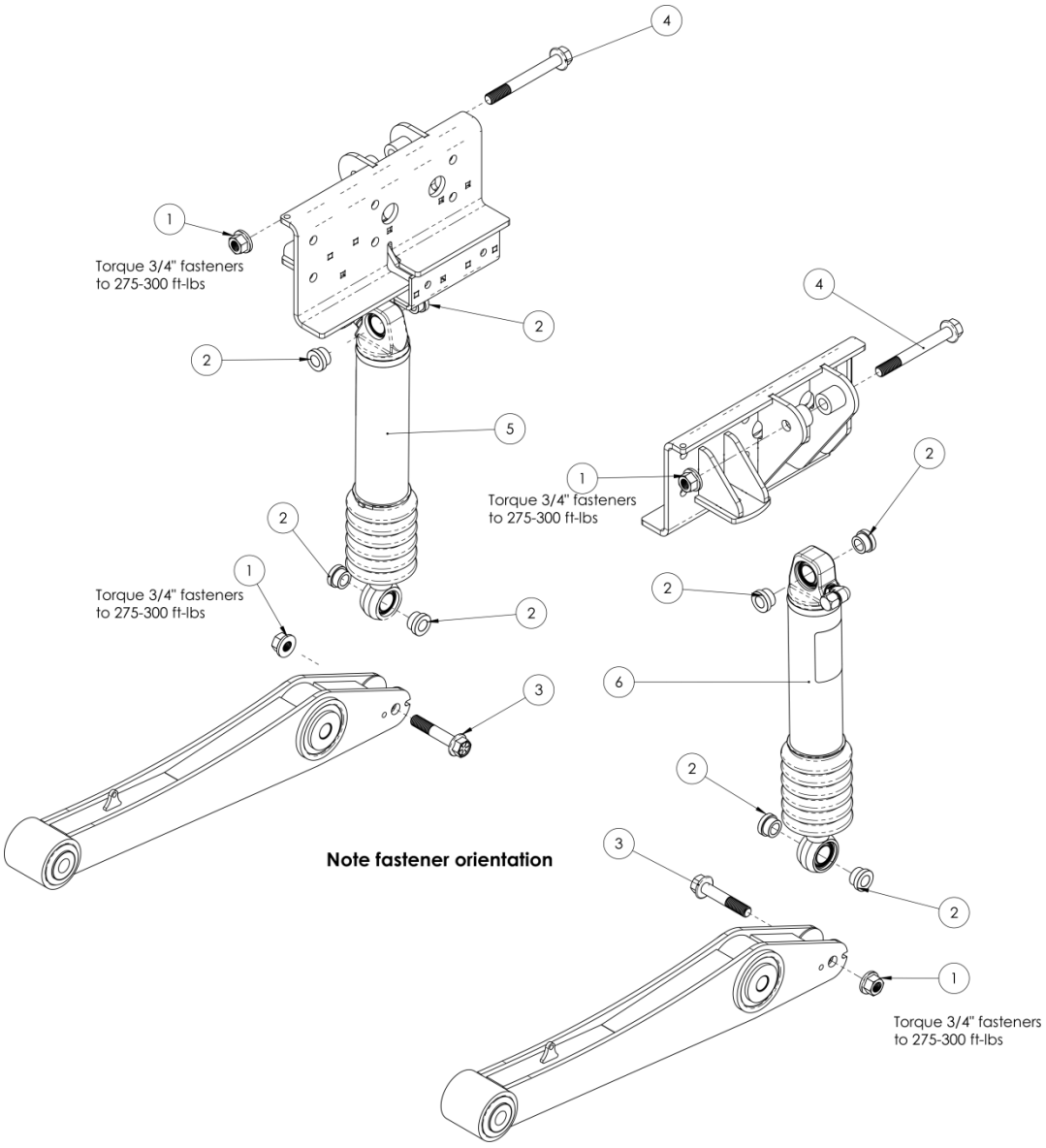
Note: Remove template before attaching the track rod.

1. Install Track rod frame mount inside passenger side framerail and torque to **172-210 ft-lbs**.
2. Loosely attach the Track Rod Assembly to the Track Rod Axle Mount and to the Frame Mount.
3. Jack each side of the axle until approximately design ride height position. See **Error! Reference source n ot found.**.
4. Torque the two (2) 7/8" Track Rod mounting bolts to **491-600 ft-lbs.**
5. Torque the eight (4) 1" Control Arm mounting bolts to **600 ft-lbs.**
6. Torque the four (4) 7/8" Control Arm mounting bolts to **491-600 ft-lbs.**
7. Lubricate U-Bolt threads and torque in stages up to **250 ft-lbs**.



IMPORTANT: Torque all control arm fasteners while axle is at approximate ride height.

Strut Assembly Installation



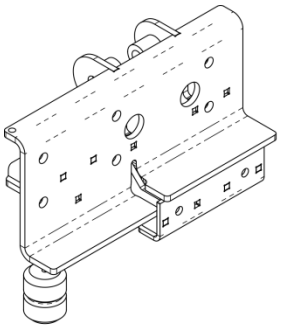
ITEM	QTY	PART NUMBER	DESCRIPTION	ITEM	QTY	PART NUMBER	DESCRIPTION
1	4	10012-014	LFN 3/4-10 Gr G	4	2	11102-650	HFB 3/4-10 x 6-1/2" Gr 8
2	8	10640-005	Bearing Spacer	5	1	11185-003	Strut Assembly, RH
3	2	11102-400	HFB 3/4-10 x 4" Gr 8	6	1	11185-004	Strut Assembly, LH

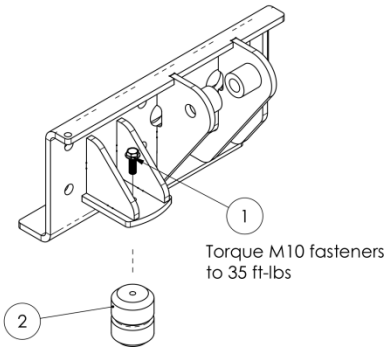
1. Install the Left Hand Strut Assembly as shown making sure to install bearing spacers on lower connection and tube spacer on upper connection.

Note: Point strut hydraulic port forward.

2. Repeat for installation of Right Hand Strut Assembly, Bearing Spacers, and Hardware.
3. Torque Upper and Lower strut fasteners to **275-300 ft-lbs**. *Do not over torque.*

Jounce Bumpers

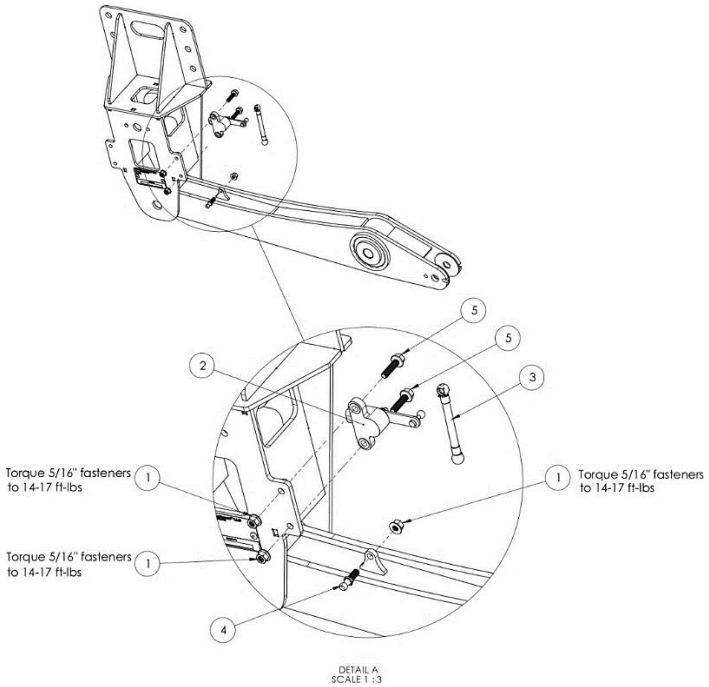




ITEM	QTY	PART NUMBER	DESCRIPTION
1	2	10502-001	HFB M10-1.5 x 30 CL 10.9
2	2	10867-003	Jounce Bumper

1. Install Jounce Bumpers as shown to Upper Strut Mounts.
2. Torque M10 fasteners to **35 ft-lbs**.

Height Sensors



(Driver Side Only Shown)

ITEM	QTY	PART NUMBER	DESCRIPTION	ITEM	QTY	PART NUMBER	DESCRIPTION
1	6	10012-010	LFN 5/16-18, Gr. G	4	2	10591-003	Ball Stud 5/16-18 x .75L
2	2	10586-001	Height Sensor Assembly	5	4	10886-125	HFB 5/16-18 x 1.25, Gr. 8
3	2	10587-009	Linkage Assembly				

IMPORTANT: Strut assemblies must be installed prior to the installation of the height sensors.

1. Install Height Sensor components and hardware as shown. Be sure to attach the ball stud to the inboard hole on the control arms as shown above.
2. Torque all 5/16 hardware to **14-17 ft-lbs.**
3. Snap the Linkage Assemblies to the ball studs attached to the lower control arms and to the ball studs on the Height Sensor arms. Refer to **Figure 20 or Figure 21** for detail of linkage**.**

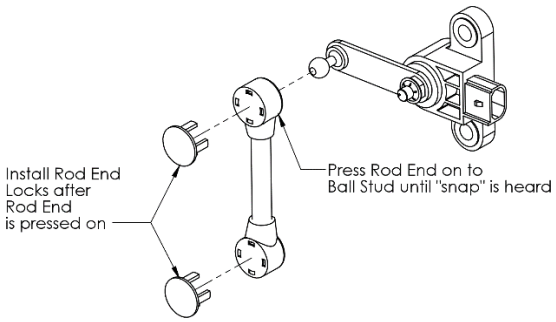


Figure 20. Height Sensor Plastic Linkage End Installation.

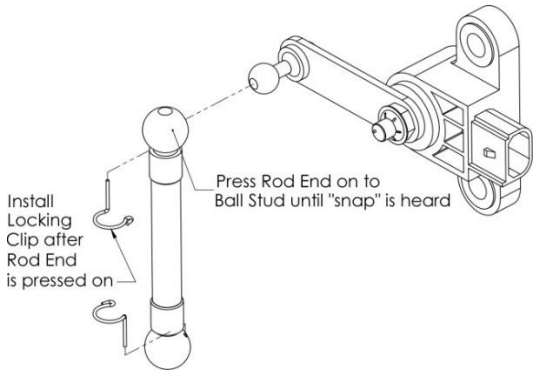
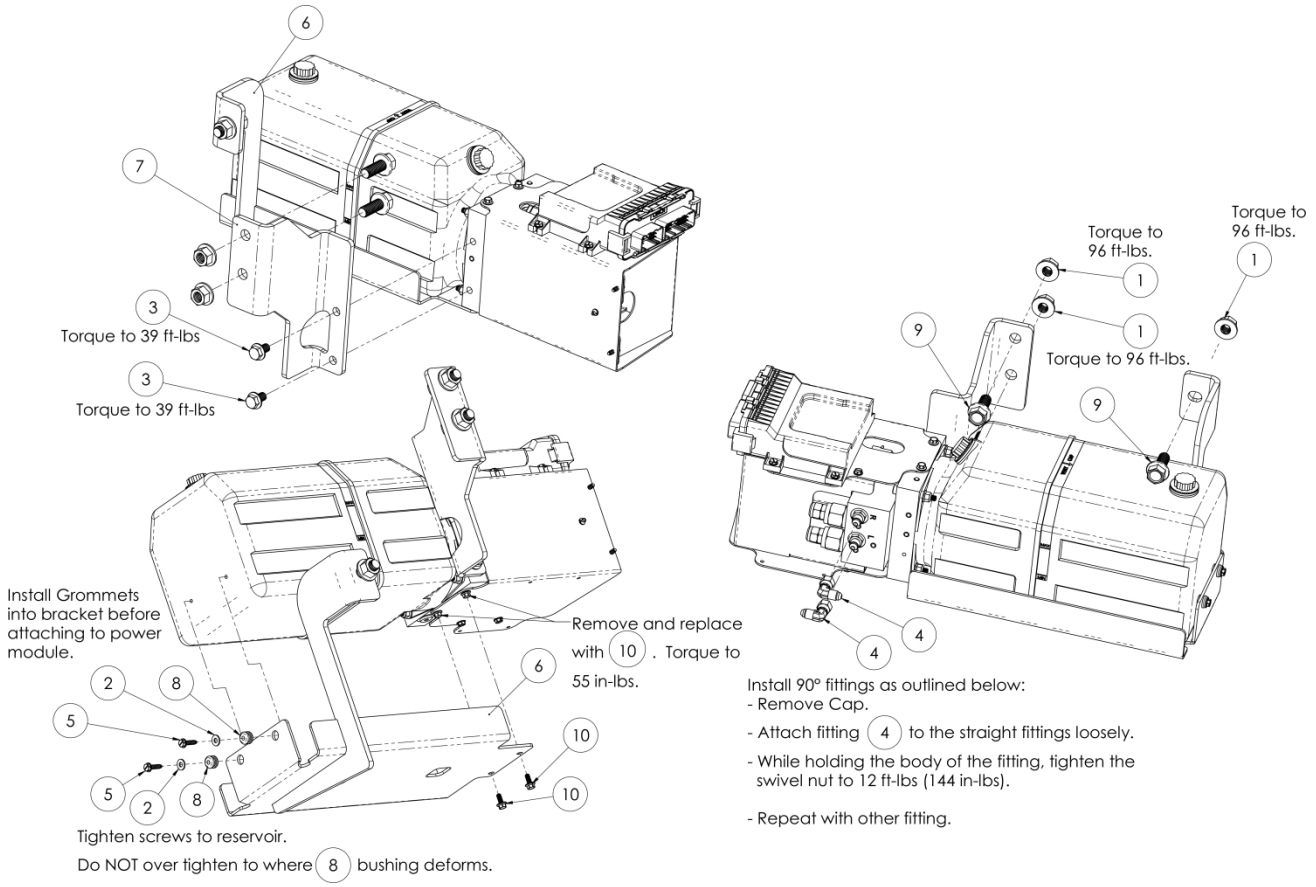


Figure 21. Height Sensor Metal Linkage End Installation.

Power Module Installation.

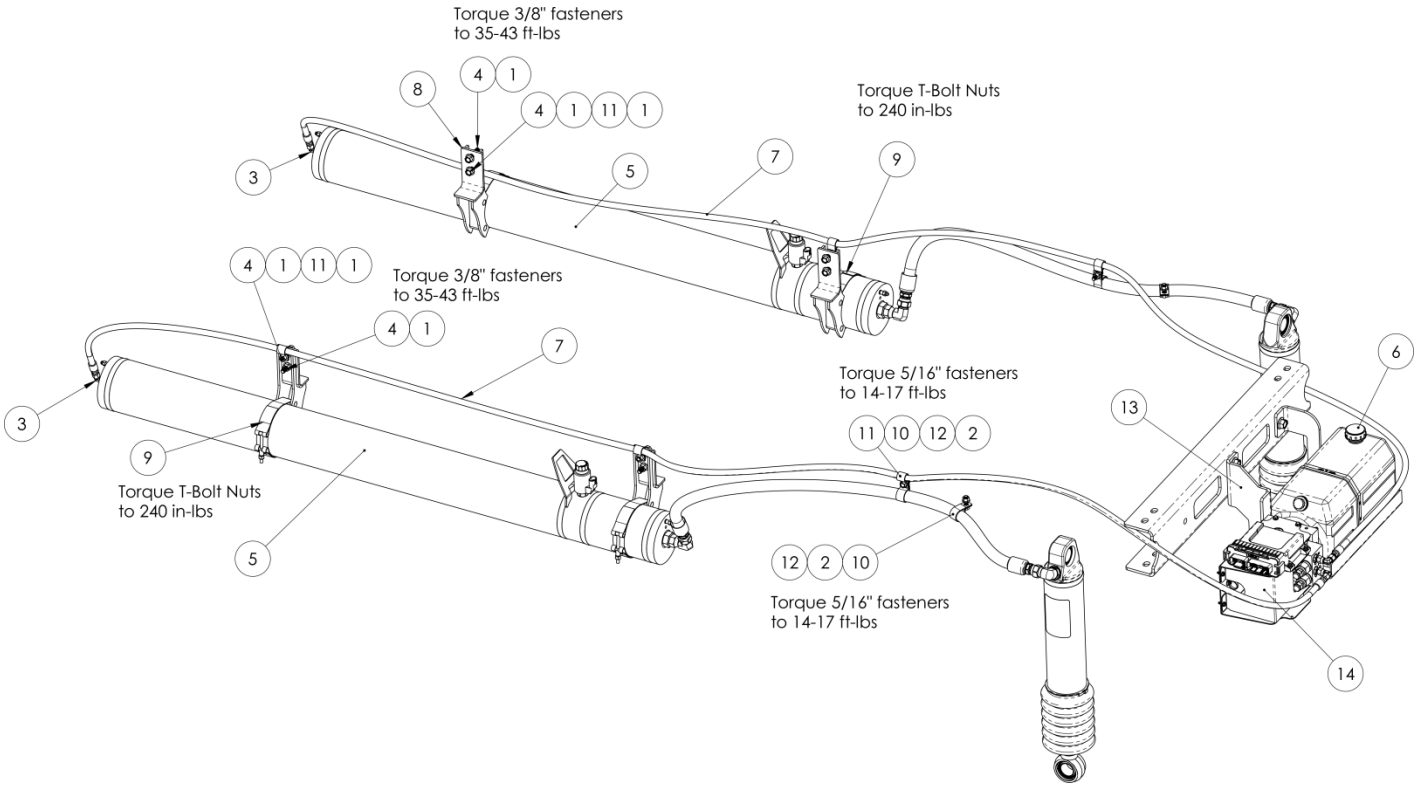


ITEM	QTY	PART NUMBER	DESCRIPTION	ITEM	QTY	PART NUMBER	DESCRIPTION
1	3	10012-007	LFN 1/2-13 Gr G	6	1	10798-024	Reservoir Mount
2	2	10088-001	FW #10	7	1	10799-021	Manifold Mount
3	2	10252-003	SFHS 3/8-16 x 5/8” Gr 8.2	8	2	10805-004	Grommet
4	2	10322-021	Hyd. Fit. 90, -4 37 x -4 37 F	9	3	10885-125	HFB 1/2-13 x 1-1/4” Gr 8
5	2	10510-002	STS #10-16 x 3/4” Hex Head	10	2	11207-002	HFB M5-0.8x12mm CL10.9

1. Locate the Power Module Assembly and Power Module Mounting Kit.
2. Attach the power module to the manifold and reservoir mounts as shown above.

   Do not over tighten the self tapping screws such that the rubber bushing deforms.
3. Attach the power module mounts to the installed cross member, located just behind the rear axle (see *Secondary Volumes* section for installed view).
4. Torque 1/2”-13 fasteners to **96 ft-lbs**.

Secondary Volumes



ITEM	QTY	PART NUMBER	DESCRIPTION
1	12	10012-005	LFN 3/8-16 Gr G
2	4	10012-010	LFN 5/8-18 Gr G
3	2	10322-021	Hyd Fit 90, -4 37 x -4 37 F
4	8	10501-150	HFB 3/8-16 x 1-1/2" Gr 8
5	2	10597-083	Volume Asy
6	1	10614-001	Breather/Fill Cap
7	2	10675-015	Hose Asy, -4 x 138-3/8"L
8	4	10830-015	Volume Mount Weldment

ITEM	QTY	PART NUMBER	DESCRIPTION
9	4	10843-003	T-Bolt Clamp
10	4	10855-002	Vinyl Coated Loop Clamp 1"
11	6	10855-003	Vinyl Coated Loop Clamp 5/8"
12	4	10886-100	HFB 5/16-18 x 1" Gr 8
13	1	11302	Power Module Mount Kit
14	1	11013-009	Power Module DS155NDLP-x
		11013-010	Power Module DS155NDLP-xC

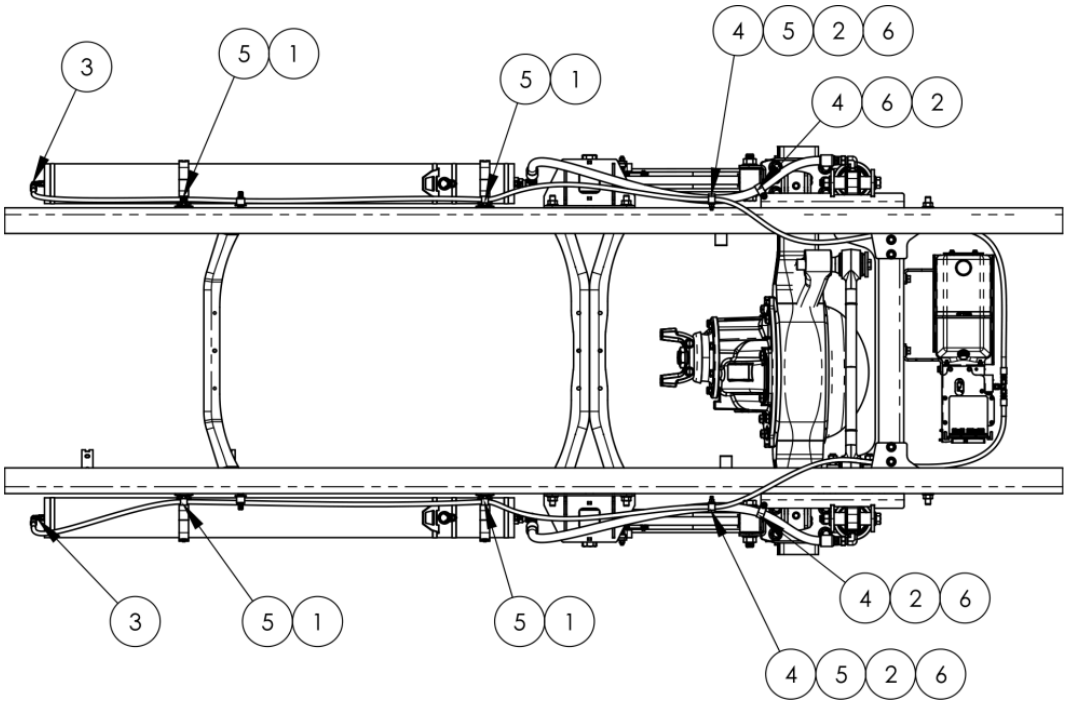
WARNING: Each Volume Assembly is heavy (in excess of 100 lbs). Use of a portable lift, crane, or suitable jack is recommended to support the Volume Assembly during installation.

1. Locate (2) Volume Mounts.
2. Place the mounts against the driver side frame, forward of the front hanger. Appendix C: Frame Drilling Locations, on **Page 51,** shows the suggested locations

Important: Locate the mounts such that the distance between two mounts as wide as possible. Avoid partially drilling through existing frame holes and inside fuel line mounts.

3. Verifying the mounts are held flush to the bottom of the frame and utilizing the mount hole pattern, mark the locations of the mounting holes and drill (2) Ø7/16" holes per mount.
4. Attach the two mounts with 3/8" Flange Bolts and Nuts. Torque to **35-43 ft-lbs**. Note: Orientate nuts outboard.
5. Repeat with Volume Mounts on the passenger side of the frame.
6. Locate the Volume Assembly.
7. Raise the volume assembly until the volume contacts both mounts. Rotate the volume assembly until the bleed screws are located to the top and as vertical as possible.
8. Locate (2) T-Bolt Clamps, open the clamps, and place them in the mounts around the two pegs.
9. Secure both clamps around the volume and torque the T-Bolt nut to **240 in-lbs**.
10. Repeat with opposite side. Note, the -10 90° Elbow connected to the volume may have to be loosened and re-orientated as necessary.

Hydraulic Hose Attachment and Routing



ITEM	QTY	PART NUMBER	DESCRIPTION	ITEM	QTY	PART NUMBER	DESCRIPTION
1	10	10012-010	LFN 5/16”-18 Gr G	4	2	10800-004	Tube, .69OD x .42ID x 5/8”L
2	2	10855-002	Vinyl Coated Loop Clamp, 1”ID	5	4	10886-125	HFB 5/16-18 x 1-1/4” Grade 8
3	10	10855-003	Vinyl Coated Loop Clamp, 5/8” ID	6	2	10886-175	HFB 5/16-18 x 1-3/4” Grade 8

CAUTION: Attachment of the hydraulic hoses may result in some spillage of fluid. Use of oil absorbent mats is recommended.

1. Locate -10 hose on Left Hand (driver side) Secondary Volume.
2. Route hose to strut area, over front hanger and axle.
3. Locate 3/16” ID PVC Tubing (not included with kit). Note: Alternatively, a bleed kit similar to the Actron 7840 Bleed Kit can be used.
4. Attach the PVC tubing to the bleed screw on the -10 hose side of the Left Hand Secondary Volume Assembly and place the other end in a bucket.

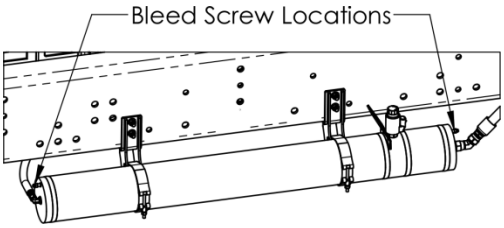


Figure 22. Bleed screw locations.

5. Open the bleed screw slightly to relieve any residual pressure.
6. After pressure is relieved, close the bleed screw and torque to **13-18 ft-lbs.**
7. Remove the cap from the strut port.
8. Raise the end of the -10 (5/8”) hose, attached to the volume assembly, above the secondary volume to prevent fluid loss.
9. Remove the plug from the end of the hose.
10. Attach the hose end (-10 JIC fitting) to the strut port.
11. Torque to **36-63 ft-lbs.**
12. Secure hose with clamps as shown in Figure 23. Drill attaching Ø3/8” holes as necessary.
13. Repeat with the opposite side. Note, the -10 90° Elbow connected to the volume may have to be loosened and re-orientated as necessary.

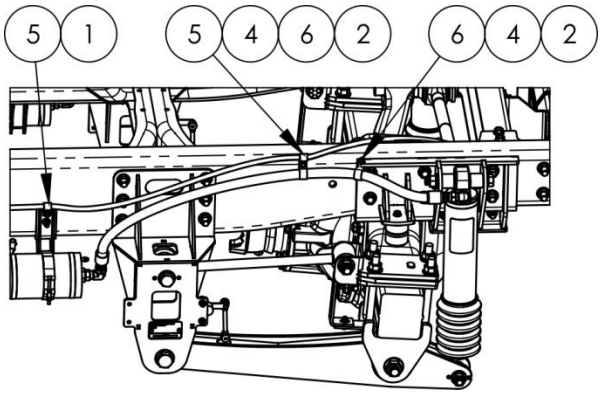


Figure 23. Driver side outboard hose routing.

14. Use hose clamps to secure hoses from movement and chafing.

CAUTION: Make sure the hose is not chafing or in contact with any sharp edges.

15. Attach the PVC tubing to the bleed screw on the -4 hose side of the Left Hand Secondary Volume Assembly and place the other end in a bucket.
16. Open the bleed screw slightly to relieve any residual pressure.
17. After pressure is relieved, close the bleed screw and torque to **13-18 ft-lbs.**
18. Locate the -4 90° Elbow and -4 hose.
19. Loosely attach one end of the hose to the elbow.
20. Remove the -4 Cap from the -4 fitting on the forward end of the Left Hand volume.
21. Attach the elbow to the fitting. Tighten fittings as per Hydraulic Fitting Assembly, JIC 37° Fitting on Page 5.
22. Route the Left Hand (Driver side) -4 (1/4") hydraulic hose to the Power Module as shown in previous page. Use hose clamps to secure the hose from movement or chafing.

CAUTION: Make sure the hose is not chafing or in contact with any sharp edges.

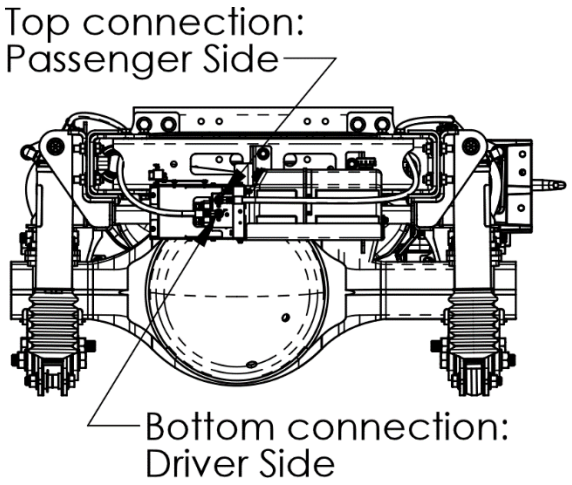
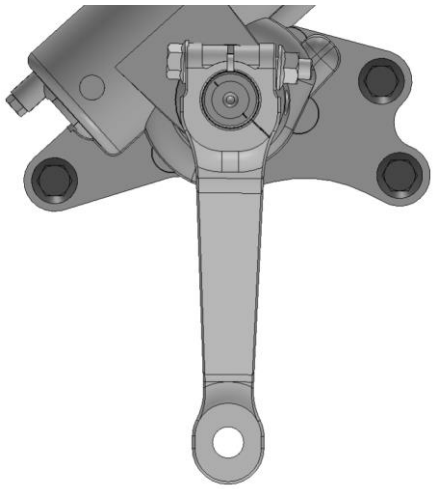


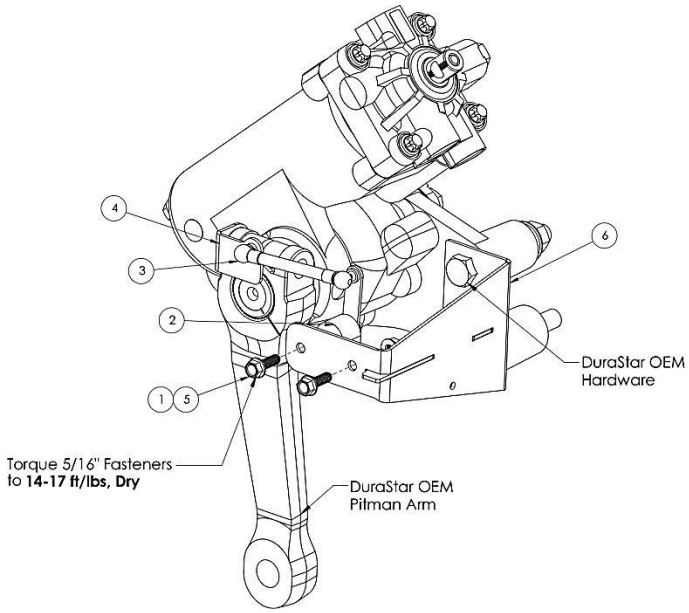
Figure 24. Driver side and Passenger side -4 Hose routing.

23. Attach the hose end to the fitting in the port marked "L". Torque to **12 ft-lbs. Do not over tighten.**
24. Repeat with the opposite side.
25. Attach the hose end to the fitting in the port marked "R". Torque to **12 ft-lbs. Do not over tighten.**
26. Clean up any fluid spillage

Steering Bracket Installation (TRW TAS40 Gearbox)

Note: The International DuraStar is available with several different steering gearboxes. Mounting components and instructions are included in the DS155NDLP kits for the **TRW TAS40**, **TRW THP45**, **Sheppard M100** and **Sheppard HD94** gearboxes. Use the build sheet or pictures provided in each section to correctly identify the gearbox equipped on the truck.





TRW TAS40 Steering Pitman Arm and Steering Gearbox

ITEM	QTY	PART NUMBER	DESCRIPTION	ITEM	QTY	PART NUMBER	DESCRIPTION
1	2	10012-010	LFN 5/16-18, Gr. G, Black Phos	4	1	10733-004	Wldmnt, Steering Linkage Mnt.
2	1	10586-002	Asy, Steering Sensor	5	2	10866-100	HFB 5/16-18 x 1.000, Gr. 8, BO
3	1	10587-006	Asy, Linkage, 3.938" SS	6	1	11138-001	Wldmnt, Steering Mnt.

1. Be sure to check what type of power steering gearbox is on the truck. This bracket is for a **TRW TAS-40 Steering Gearbox**.
2. Remove the hex bolt, lock nut, and washer from the pitman arm.
3. Install the Steering Linkage Mount using the provided 3/4"-16 x 4-1/2" Hex Bolt and Locking Flange Nut. **Torque to 215-245 ft-lbs.**

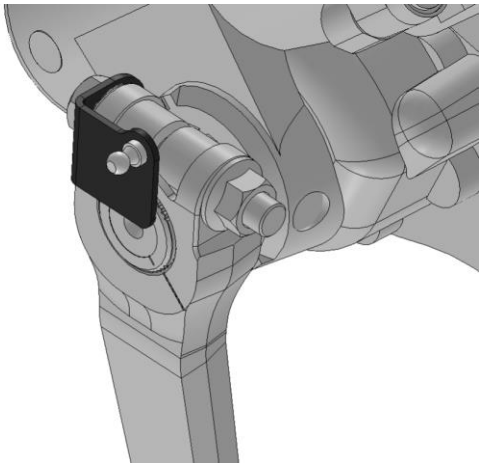


Figure 25. Steering Linkage Mount Installation.

4. Remove the upper bolt attaching the steering gear box to the frame. Retain bolt for reuse. Back the lower bolt out 1/4".
5. Place Steering Mount in place as shown in Figure 25. Reattach bolts to secure Steering Mount to the steering gear box. **Torque to 120-140 ft-lbs.**

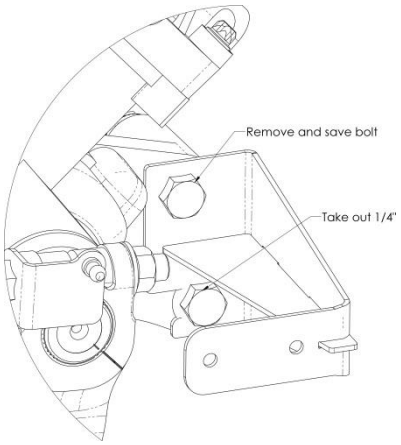


Figure 26. Steering Mount installation.

6. Install the Steering Sensor as shown in Figure 26. Using the 5/16"-18 fasteners.

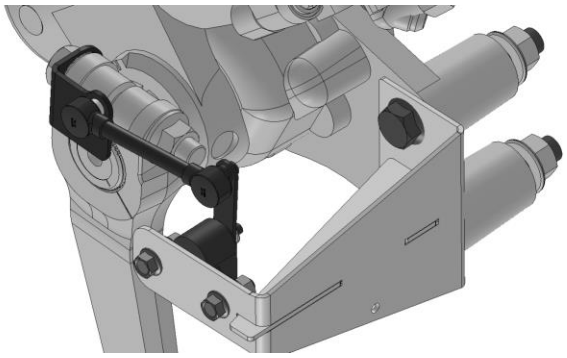


Figure 27. Sensor Installation.

7. Torque to **14-17 ft-lbs.**
8. Snap the Linkage Assembly to the Steering Linkage Mount and to the ball stud on the sensor arm. Refer to **Figure 28 or Figure 29** for detail of linkage.

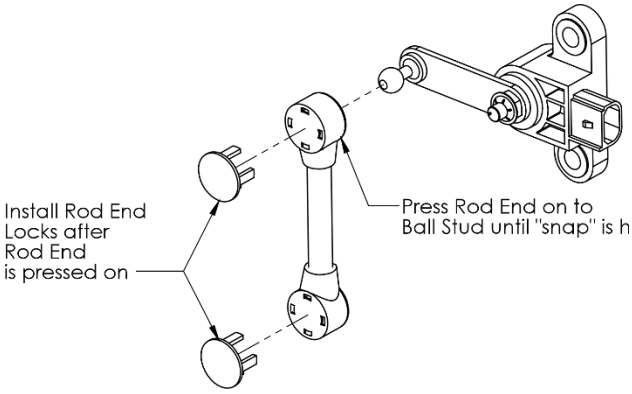


Figure 28. Sensor Plastic Linkage End Installation

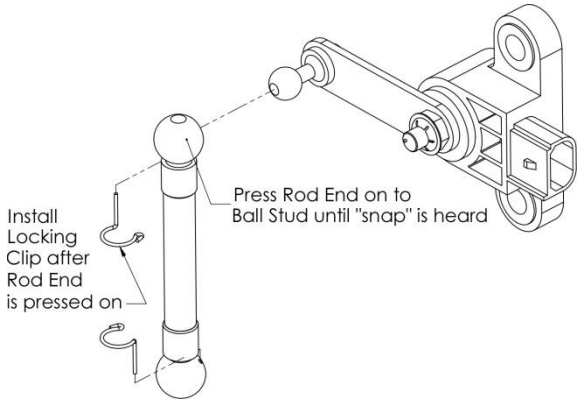
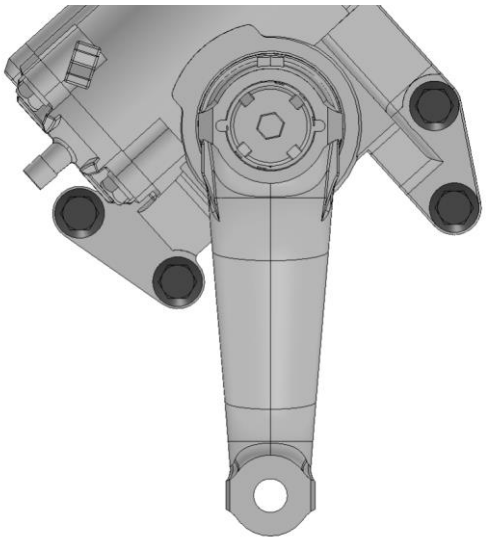
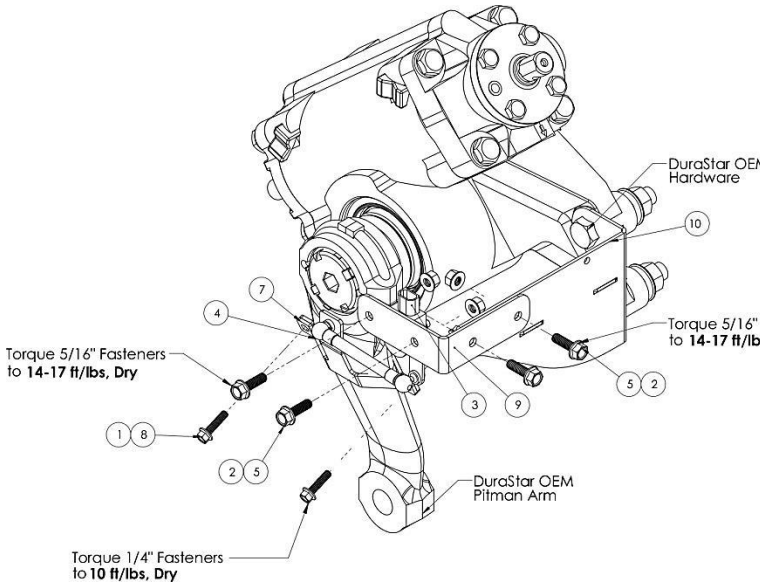


Figure 29. Sensor Metal Linkage End Installation

Steering Bracket Installation (Sheppard M100 and HD94 Gearbox)

Note: The International DuraStar is available with several different steering gearboxes. Mounting components and instructions are included in the DS155NDLP kits for the **TRW TAS40**, **TRW THP45**, **Sheppard M100** and **Sheppard HD94** gearboxes. Use the build sheet or pictures provided in each section to correctly identify the gearbox equipped on the truck.





Sheppard M100 Steering Gearbox and Pitman Arm. Sheppard HD94 similar.

Note: Sheppard HD94 Gearboxes require bracket p/n 11136-007 to be ordered separately.

ITEM	QTY	PART NUMBER	DESCRIPTION	ITEM	QTY	PART NUMBER	DESCRIPTION
1	2	10012-009	LFN 1/4-20, Gr. G, Black Phos	7	1	10904-017	Wldmnt, Ball Stud Bracket
2	4	10012-010	LFN 5/16-18, Gr. G, Black Phos	8	2	10989-100	HFB 1/4-20x1.000, Gr. 8, BO
3	2	10586-002	Asy, Steering Sensor	9	1	11136-002	Steering Mount Bracket
4	1	10587-006	Asy, Linkage. 3.938" SS	10	1	11136-003	Steering Mount Bracket (M100)
5	4	10886-100	HFB 5/16-18"x1.000, Gr. 8, BO		1	11136-007	Steering Mount Bracket (HD94, available separately)
6	1	10904-015	Ball Stud Bracket				

1. Be sure to check what type of power steering gearbox is on the truck. This bracket is for a **Sheppard Steering M100 and HD94 Gearbox**.
2. **Important: HD94 Gearboxes required the use of the 11136-007 bracket, not included in the kit and must be ordered separately.**
3. Remove the upper bolt and lower bolt attaching the steering gear box to the frame. Retain bolts for reuse.
4. Place Steering Mount on gear box as shown in Figure 30. Reattach bolts to secure Steering Mount to the steering gear box. **Torque to 120-140 ft-lbs.**

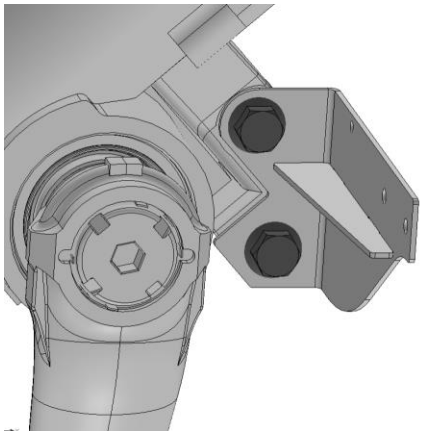


Figure 30. Steering Bracket Mounting.

5. Attach the second Steering Mount Bracket to the first Steering Mount Bracket with 2 5/16" fasteners. As shown in Figure 31. **Torque to 14-17 ft-lbs.**

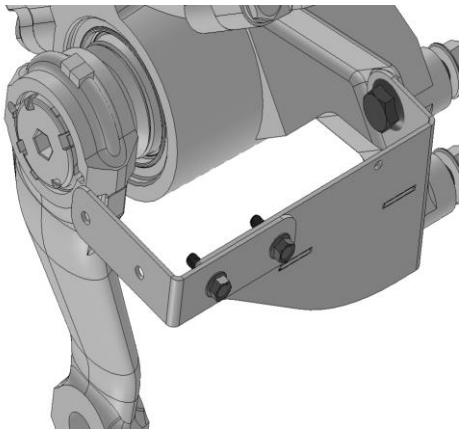


Figure 31. Attaching Steering Bracket.

6. Install the Steering Sensor using the 5/16”-18 fasteners. **Torque to 14-17 ft-lbs.**
7. Attach Ball Stud Bracket and Wldmnt, Ball Stud Bracket to the Pitman Arm using 1/4-20 fastners. Place 1 3/4" from center of Pitman Arm to center of Ball Stud as shown in Figure 32. **Torque 1/4-20” bolts to 10 ft-lbs.**

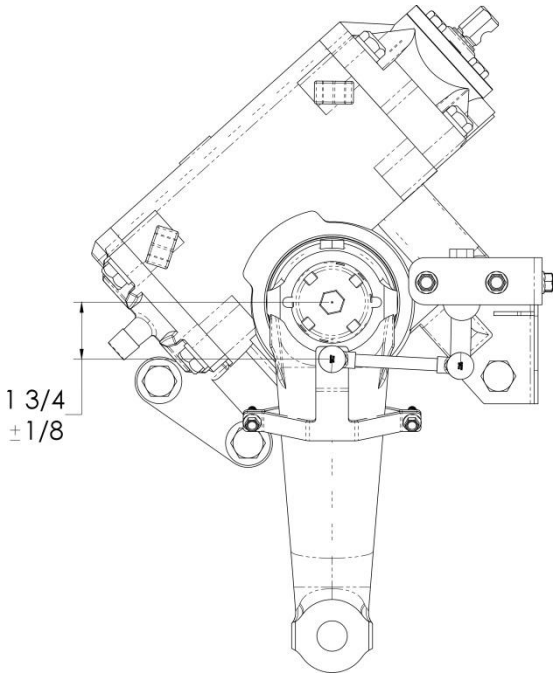


Figure 32. Placement of Ball Stud Bracket.

8. Snap the Linkage Assembly to the ball stud of the pitman arm bracket and to the ball stud on the Sensor arm. Refer to **Figure 33 or Figure 34** for detail of linkage.

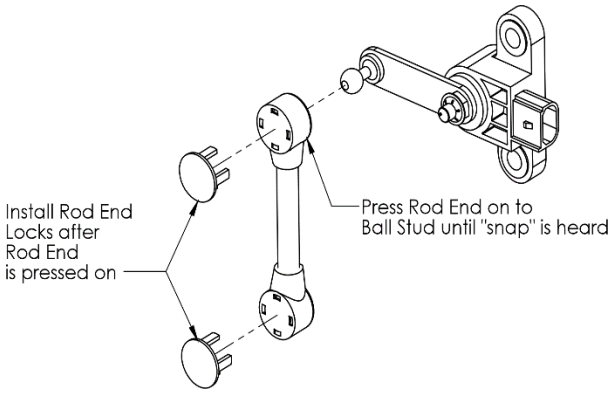


Figure 33. Sensor Plastic Linkage End Installation

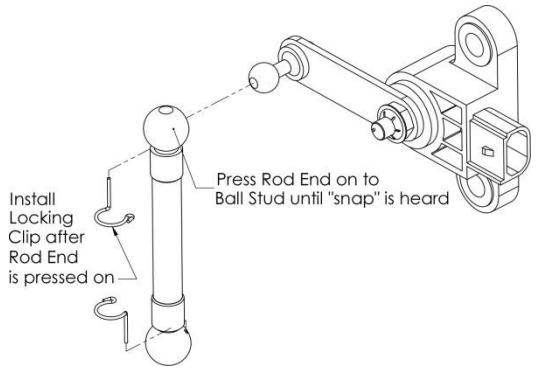
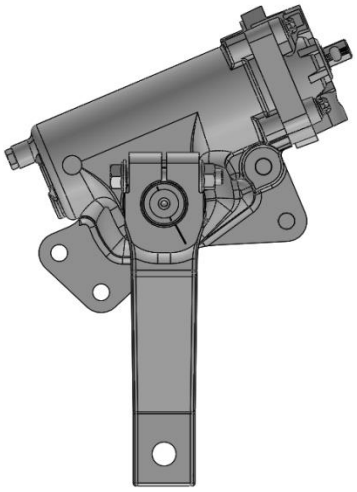


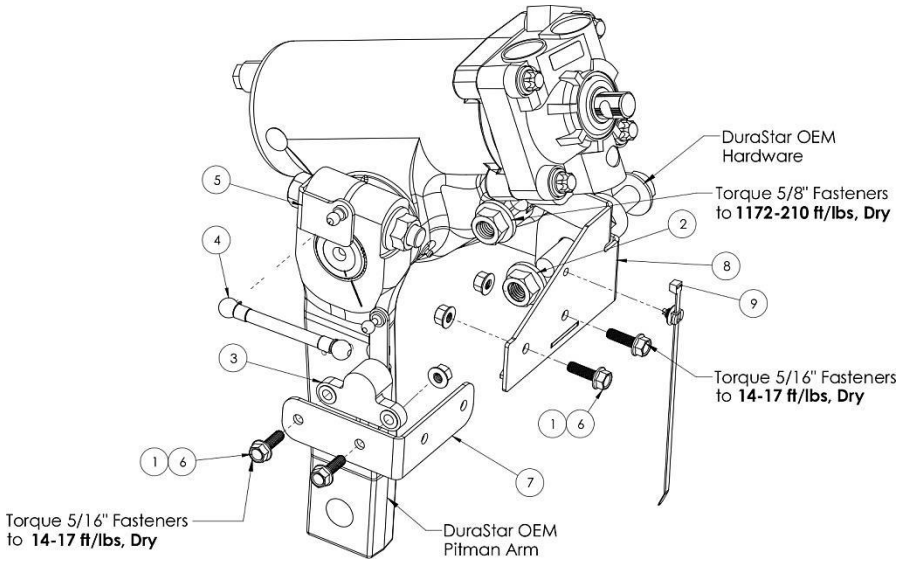
Figure 34. Sensor Metal Linkage installation

Steering Bracket Installation (TRW THP45 Gearbox)

Note: The International DuraStar is available with several different steering gearboxes. Mounting components and instructions are included in the DS155NDLP kits for the **TRW TAS40**, **TRW THP45**, **Sheppard M100** and **Sheppard HD94** gearboxes. Use the build sheet or pictures provided in each section to correctly identify the gearbox equipped on the truck.



TRW THP45 Steering Gearbox and Pitman Arm.



ITEM	QTY	PART NUMBER	DESCRIPTION	ITEM	QTY	PART NUMBER	DESCRIPTION
1	4	10012-010	LFN 5/16-18, Gr. G, Black Phos	6	1	10733-006	Steering Linkage Mount
2	2	10012-013	LFN 5/8-18, Gr. G, Black Phos	7	4	10886-100	HFB 5/16-18"x1.000, Gr. 8, BO
3	1	10325-003	Cable Tie	8	1	11136-003	Steering Mount Bracket
4	1	10586-002	Asy, Steering Sensor	9	1	11138-003	Steering Mount
5	1	10587-006	Asy, Linkage. 3.938" SS				

1. Be sure to check what type of power steering pump is on the truck. These brackets are for a **TRW THP45 Steering Gearbox**.
2. Place the Steering Mount on the gear box. Reattach the 5/8" nuts to secure Steering Mount to the steering gear box as shown in Figure 35. **Torque to 172-210 ft-lbs.**

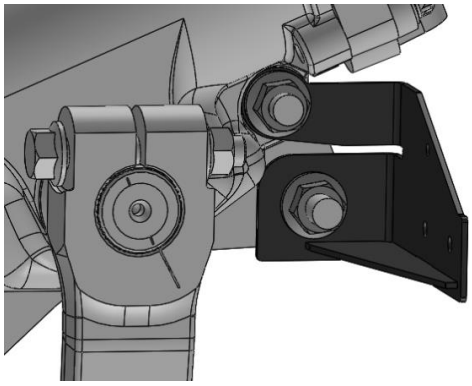


Figure 35. Secure Steering Mount to Gear Box.

3. Attach the Steering Mount with 2 5/16" fasteners. As shown in Figure 36. **Torque to 14-17 ft-lbs.**

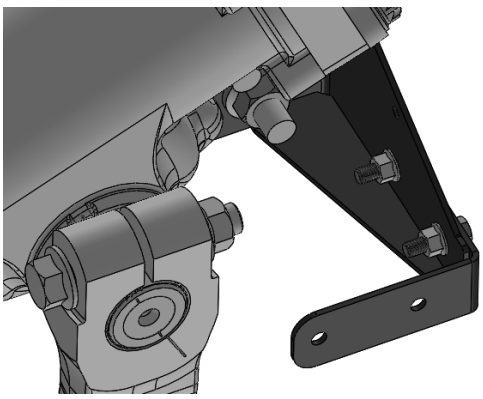


Figure 36. Steering Sensor Bracket Installed.

4. Remove the hex bolt and lock nut from the pitman arm. Retain the bolt and lock nut for reuse.
5. Install the Steering Linkage Mount using the OEM bolt and lock nut. **Torque to 215-245 ft-lbs.**

6. Install the Steering Sensor as shown in Figure 37. Using the 5/16”-18 fasteners and **Torque to 14-17 ft-lbs.**

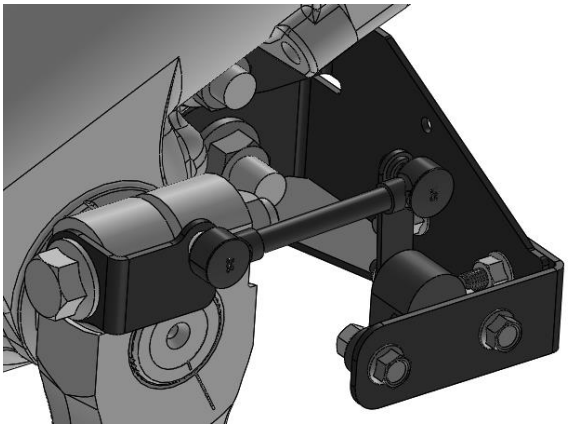


Figure 37. Installation of Steering Sensor and Linkage Arm.

7. Snap the Linkage Assembly to the Steering Linkage Mount and to the ball stud on the sensor arm. Refer to **Figure 38 or Figure 39** for detail of linkage.

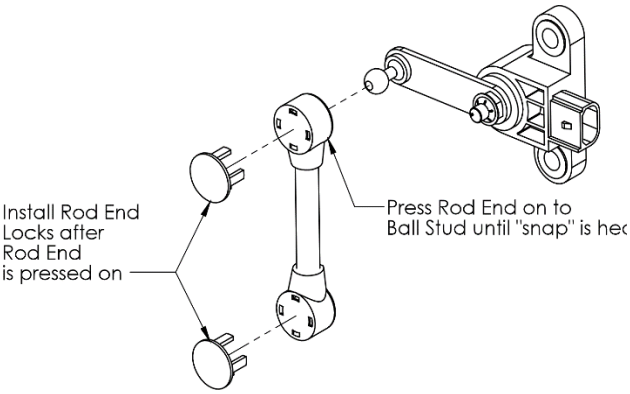


Figure 38. Plastic Linkage End Installation

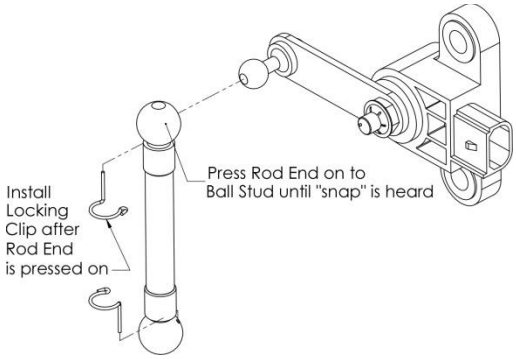


Figure 39. Metal Linkage End Installation.

8. Locate the Cable Tie and push it into the top most hole on the Steering Mount as shown in Figure 40.

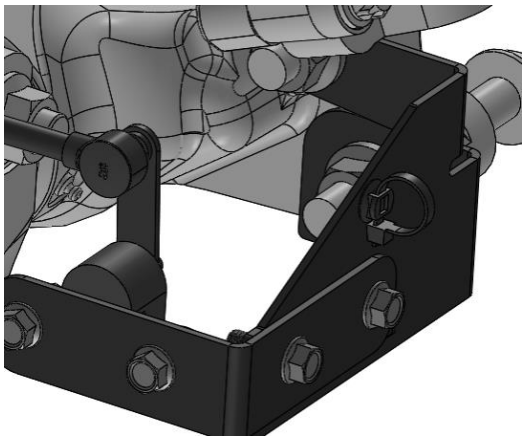


Figure 40. Install the Cable Tie to Steering Mount.

9. Use the Cable Tie to secure the wire harness and prevent it from being in the way of any moving components.

External Electrical Installation:

1. Locate the External Electrical Harness attached to the power module.
2. Unroll the wiring harness and using the External Electrical Harness wiring diagram, found in the Electrical Schematics section, and identify the connection ends.
3. Locate the trunk containing Height Sensor (J21 and J22) and the Rate Valve (J23 and J24) connections.
4. Route the trunk towards the height sensors and rate valves.

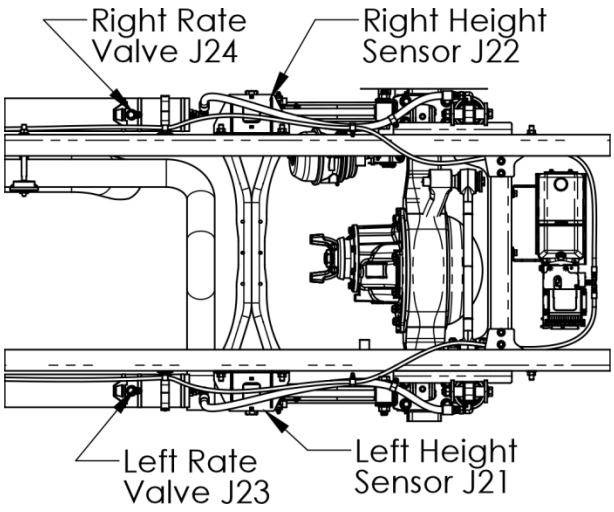


Figure 41. Rate valve and height sensor electrical connections.

5. Connect height sensor and rate valve connections. Note: Connection after routing the harness and prior to installing the height sensor may aid in electrical connection.
6. Secure harness to OEM harness on driver side. Use of plastic clips is recommended.
7. Locate the Black 8ga wire ground ring terminal, J30, branch near the power module.
8. Locate and drill Ø1/4" hole in frame. Remove frame coating(s) as needed to ensure metal-to-metal contact between the ring terminal and frame.
9. Attach the ground ring terminal, J30, to the chassis frame for grounding. Sealant should be applied after ring terminal is secured.
10. Route the remaining trunk (containing blunt wires, 8ga battery wire, and steering sensor J35 connection) towards the firewall. Secure to OEM wiring harness.
11. Route blunt cut wires through the firewall rubber pass through grommet on the driver side. You may need to create a hole in the grommet.
12. Route and connect the J35 connector to the steering sensor and secure along the way.
13. Locate the Red 8ga battery connection branch and route to the battery positive terminal.
14. Locate the Battery Fuse Lead containing the 80 amp fuse and crimp the fuse lead to the 8ga battery connection branch blunt end.
15. Melt the heat shrink on the crimped connection to seal the splice.
16. Remove the 80 amp fuse and retain.
17. Connect to the positive terminal post per OEM Upfitter wiring instructions.

Dash Harness Installation

1. Locate the dash harness.

2. Locate and identify the following 18ga wires in the two external wiring harness branches passed through the firewall:
   Red (Battery Power)
   Yellow (Ignition)
   Black (Ground)
   White (CAN High)
   White/Black (CAN Low)
   Yellow/Black (Park)
   Violet/White (Speed)
   Pink/Black (Brake)

3. Crimp each wire to the corresponding blunt wire in the dash harness. Match wire colors, crimp using butt splices, and install heat shrink.

4. Locate the 120" Red, Yellow, and Pink/Black 18ga wires in the dash harness. Route the wires to the passenger side fuse panel. It is advised to route along and zip tie to the OEM harness under the dash.

Note: On DuraStar's, the fuse panel is located behind the passenger side dash panel. On MV60H-LP, the fuse panel is located beneath the top dash panel on the passenger side. Remove fuse panel to access wires.

5. Make the following connections into the fuse panel: Crimp each wire using butt splices. Heat shrink sealing is recommended.

Liquidspring Dash Harness	→	Vehicle Fuse Panel
Red 18ga (BAT)	→	Red A14G Pigtail
Yellow 18ga (IGN)	→	Pink A13B Pigtail
Pink/Black 18ga (Brake)	→	Red A70BB (R3 Body Stop Relay)(DuraStar) Orange A70D or Orange A70TA (at R5 Body Stop Relay) (MV60H-LP)

Note: Instructions for Brake Signal (steps 6-8):

6. Locate the BodyBuilder Wiring for Stop/Tail/Turn lights. This will be a 3-Way connector; located behind the driver's seat, behind the cab, or at the end of the chassis.

Figure 42: BodyBuilder 3-Way Connector

7. Break out the pink/black wire from the LiquidSpring main harness where it goes under the dash and route the wire to the 3-Way connector. Use 1/4" loom to protect this wire and secure as needed to OEM wiring.

8. Find the wire for the Stop Light signal in the 3-Way connector. This should be a red wire labeled N70BB. Remove seal plug from connector in the red-position.

9. Attach both the Ground ring terminal (J32) and Park signal ring terminal (J31) from the dash harness to the firewall ground posts. See Figure 43.

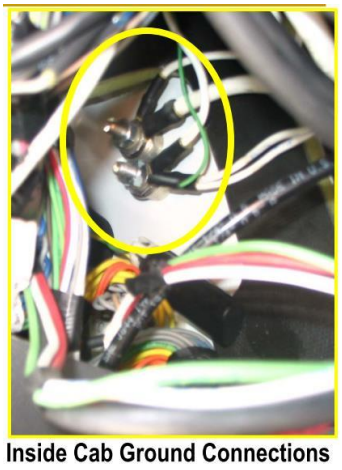


Figure 43. Inside Cab Ground Locations (circled).

Note: <u>For I6 and V8 International Engines</u>, Follow steps 10-11 for vehicles equipped with the 12VZA circuit, for wiring up the speed signal.

<u>For Cummins ISB Engines</u> follow steps 12-21 for wiring up the speed signal.

10. Locate the 96" violet/white wire in the dash harness. Route the wire through the firewall grommet and into the engine compartment. Route to the vehicle

12VZA Bodybuilder circuit connector near driver side firewall See Figure 44.

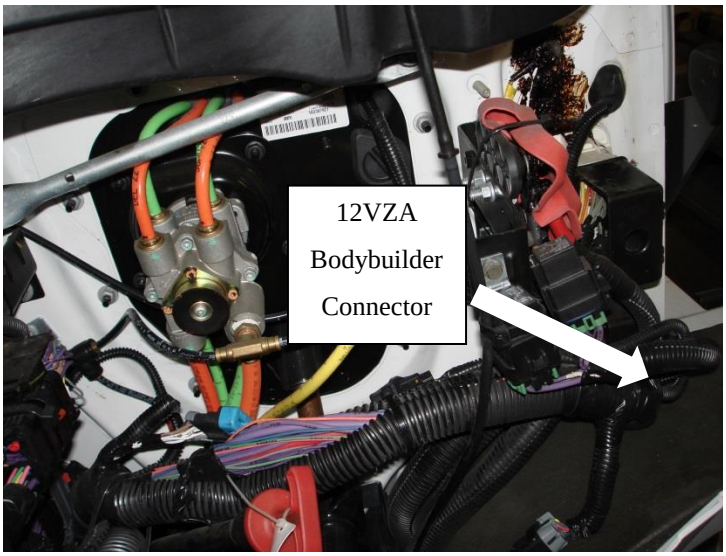


Figure 44, 12VZA Connector

11. Splice the violet/white wire to wire K47B (Vehicle Speed Output).

Note: If you have the proper tools to install the factory Deutsch terminal in the mating connector, this method is preferred, otherwise butt splice to the K47B wire behind the connector.

Figure 45, Closeup of 12VZA Connector

Note: Instructions for Cummins ISB engines (steps 9-18):

12. Locate the Transmission Control Module 7151 under the back of the cab.
13. Break out the violet/white wire from the Liquidspring main harness where it goes under the cab and route the wire to the TCM 7151 as opposed to routing to the engine firewall. Use 1/4" loom to protect this wire and secure as needed to OEM wiring.

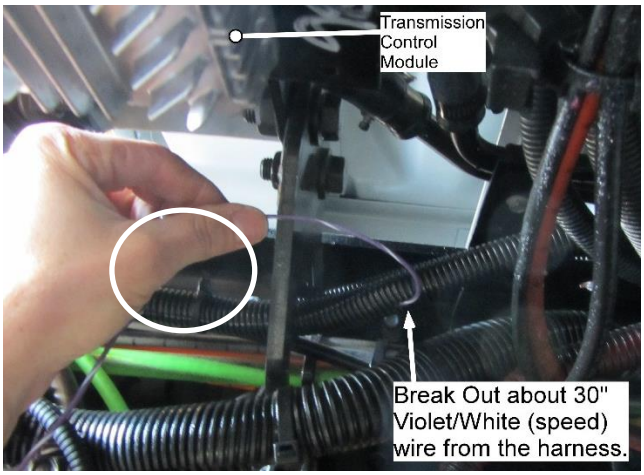


Figure 46: Break out speed wire

14. Remove the TCM cover and unravel the loom where the wire connector is located.
15. Locate Pin 25, wire 125. Splice the violet/white wire to this wire and seal the connection with heat shrink.

Note: If wire 125 is not available, install the violet/white wire to Pin 25 of the connector following the remaining steps.

16. If wire 125 (K47#125) is not present in Pin 25, you must install the violet/white (speed) wire using International terminal P/N: 3686945C1.
17. Remove the connector from the TCM and use a screwdriver to pry the terminal lock out. See Figure 47 and Figure 48.

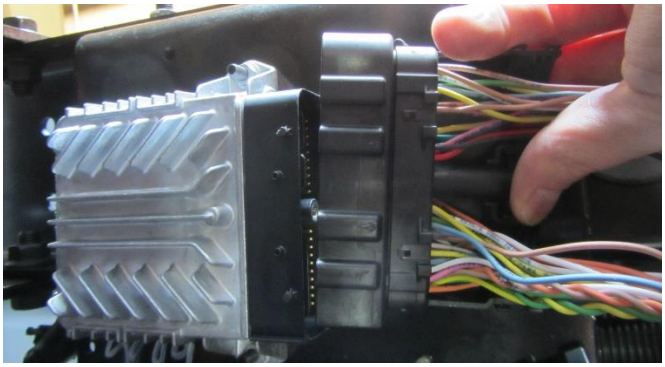


Figure 47: Remove TCM Connector

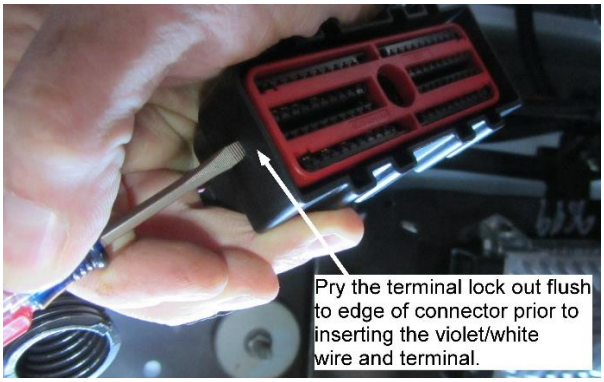


Figure 48: Pry the terminal lock out flush to connector

18. Insert the violet/white wire with terminal into pin 25.

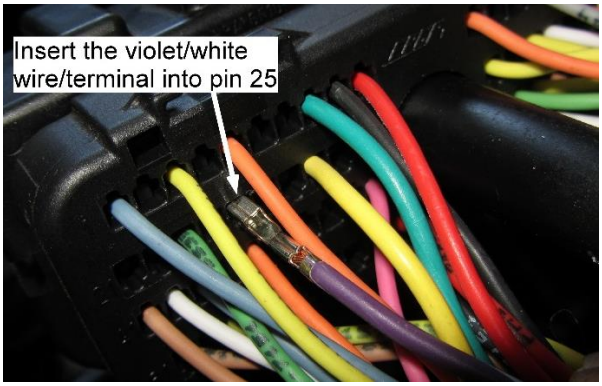


Figure 49: Insert Speed wire into TCM

19. Press down and lock the terminal lock back into place.

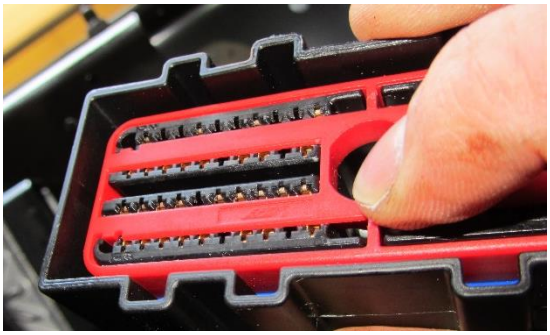


Figure 50: Press down to lock in place

20. Re-apply tape, loom, and secure harness in OEM locations.
21. Re-connect the TCM connector and TCM cover plate.

Driver Interface Installation:

1. Locate the Driver Interface.
2. Mount the Driver Interface to the dash in an appropriate location.
3. Route the Driver Interface harness to the dash harness connector, J12, and connect.
4. Secure all wires under the dash.
5. Replace the 80 amp fuse at the battery.

Optional Door Electrical Harness Installation:

The optional door harness can be used to remotely activate the system "kneeling" feature in which the suspension automatically lowers to a point slightly less than maximum jounce travel. The door harness can be utilized in two actuation methods.

IMPORTANT: Do not connect positive (12VDC) signal to either the W98 Tan/Blk or W93 Brown wires. Applying positive (12VDC) to either of these wires can result in ECU failure.

A. Single Wire - Ground Signal From Source

Ground is provided to the door harness Brown (W93) wire from a grounding source (e.g. multiplex signal, switch, etc.). If a remote switch is used, it is recommended to use a normally closed (NC) door switch which remains open when the door is closed (or closed when the door is opened). One side of the switch must be connected to a ground source and the other side routed to the door harness. If multiple switches are used, they should be wired in a parallel arrangement with the door harness. Requires single wire routed from source to door harness.

B: Dual Wire – Ground Signal From System

Ground is provided by the suspension system when the Brown (W93) wire is connected to the Tan/Black (W98) wire of the door harness. This arrangement requires a remote switch that is a normally closed (NC) door switch which remains open when the door is closed (or closed when the door is opened). One side of the switch needs to be connected to the door harness Brown (W93) wire and the other side to the door harness Tan/Black (W98) wire. Requires two wires routed from switch to door harness.

1. Door harness wires are located on the main external wiring harness as a branch near the power module.
2. Unwrap the door harness wires.
3. Based on the selected actuation method above, strip the end(s) of the door harness blunt wire(s) and connect the end(s) to the signal source using a heat shrinkable butt-splice. Crimp the connection(s) accordingly and apply heat to the insulator to seal the connection(s).

Initial System Fill

1. Install the wheels and tires. Torque wheel nuts to OEM specifications.
2. Reconnect the negative cable to the vehicle battery.
3. Verify that the front wheels are steered straight ahead.
4. Lower the vehicle to the ground and remove any jack stands from under the vehicle. The suspension should be in the kneeled position.
5. Locate the container of Compressible Fluid.
6. Remove the breather cap from the Power Module reservoir.
7. Fill the reservoir approximately 2/3 full.
8. Turn the ignition key to "Run" and ensure that the LiquidSpring driver display LEDs light up and that the red "Warning" LED is not lit. If the red "Warning" LED is lit, proceed to the Trouble Shooting Section.

WARNING: Do not run vehicle in an enclosed building without adequate ventilation or without ducting exhaust fumes outside. Operation of a vehicle inside an enclosed building can lead to serious injury or death.

9. Press and release the Red ON/OFF button on the driver display. All LEDs on the driver display should go out.
10. Press and release the Red ON/OFF button again. The LEDs on the driver display should all flash and then only the four yellow arrow LEDs, one green ride mode indicator LED, and one green ride height indicator LED should remain lit.
11. The green ride height indicator LED should indicate "Low" and begin flashing as the pump/motor starts. If pump/motor does not start, check Trouble Shooting Electrical Section.
12. Monitor the fluid level in the reservoir. If the level drops below 1/4 of the tank, press and release the Red ON/OFF button to shut off the system, refill the reservoir, and turn the system back on by pressing the Red ON/OFF button.
13. If the suspension system does not begin to rise to a preset ride height after 3 minutes, stop the system and check the following first and then repeat this step:
    a. Check for any fluid leaks.
    b. Check that the hoses are properly connected.

c. Completely depressurize the system. See Depressurizing the System section, under System Operation

14. After the suspension system stops leveling, check the fluid level in the reservoir. If low, fill to the indicated line.

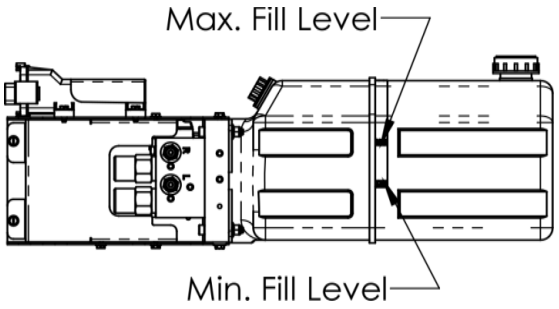


Figure 51. Final fill fluid level.

Bleeding the System

1. Locate 3/16" ID PVC Tubing (not included with kit). Note: Alternatively, a bleed kit similar to the Actron 7840 Bleed Kit or Lisle 19200 Brake Bleeding Kit (found at Sears) can be used.
2. Attach the PVC tubing to one of the upper bleed screws on the Left Hand Secondary Volume Assembly and place the other end in a bucket.

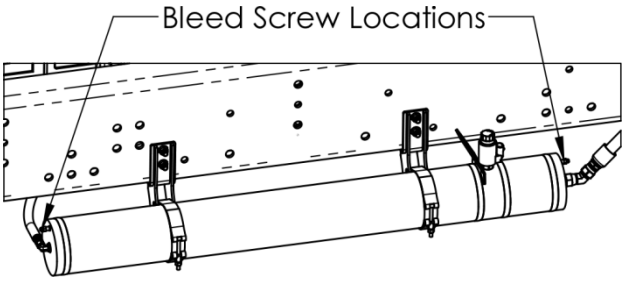


Figure 52. Bleed screw locations.

3. Open the bleed screw slightly.
4. After air bubbles are no longer present, close the bleed screw and torque to **13-18 ft-lbs.**
5. Repeat with remaining three bleed screws.

Calibrating the System

IMPORTANT: Proper calibration of the system must be conducted with the vehicle loaded to the as delivered condition with body installed. For calibration on an empty chassis cab, LiquidSpring recommends weight be added to the frame approximately equal to the planned body to allow for proper bushing deflections.

Note: The LiquidSpring Calibration routine will automatically determine maximum and minimum suspension ride height. Based on those ride heights, the system will determine the correct normal design ride height. The calibration system will also calibrate the steering sensor.

1. Verify that the front wheels are steered straight ahead.
2. Lower the vehicle to the ground and remove any jack stands and any other obstructions from under the vehicle.
3. To begin the calibration, turn the ignition key to "Run" and ensure that the LiquidSpring driver display lights up and that the red "Warning" LED is not lit or flashing.

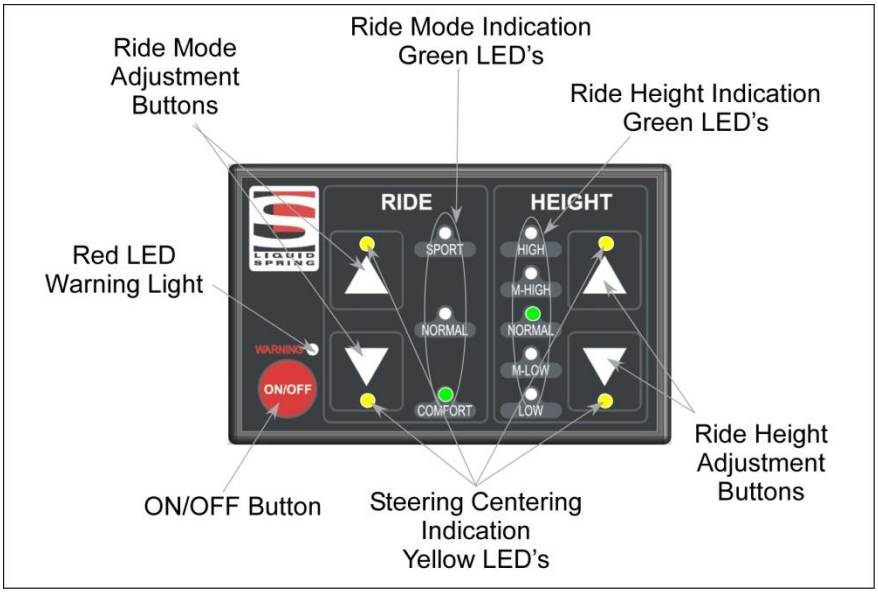
WARNING: Do not run vehicle in an enclosed building without adequate ventilation or without ducting exhaust fumes outside. Operation of a vehicle inside an enclosed building can lead to serious injury or death.

4. Press and release the Red ON/OFF button on the driver display. All LEDs on the driver display should go out.
5. Press and release the Red ON/OFF button again. The LEDs on the driver display should all flash and then only the four yellow arrow LEDs, one green ride mode indicator LED, and one green ride height indicator LED should remain lit.
6. Press and hold both Ride Height Adjustment Buttons simultaneously until the SPORT, COMFORT, HIGH, and LOW green LED's begin to flash. The suspension system will begin to rise to the full high position, and then lower to the full lowered position.
7. After the system completes the calibration routine, the suspension will return to the original ride height.
8. Turn off the ignition for at least 3 minutes. Note: The suspension system will not use the calibrated ride height settings until power has been cycled.

Note: Pressing the red ON/OFF button on the driver display does not cycle power to the LiquidSpring suspension system, but only will enable/disable the system.

9. Turn the ignition back to Run.
10. Press and release the Red ON/OFF button on the driver display. All LEDs on the driver display should go out.
11. Press and release the Red ON/OFF button again. The LEDs on the driver display should all flash and then only the four yellow arrow LEDs, one green ride mode indicator LED, and one green ride height indicator LED should remain lit.
12. Calibration is now completed.

System Operation



System Start Up:

- In most instances, the suspension system can be left alone to operate automatically.
- After startup, all the indicator lights will flash on for 1-2 seconds, and then the Green Ride Height Indication LED and Green Ride Mode Indication LED will light to show the current Ride Mode and Ride Height.
- The four yellow LED's will light up if the steering wheel is approximately 10°-20° each side of straight ahead, but will not light up when steering wheel exceeds 20° from center. If the vehicle is steered straight ahead and the four yellow LED's are not lit (and the red warning LED is not lit) see Calibrating the Steering Sensor Only.
- When the steering wheel is turned more than 20° off center, the four Yellow Steering Centering Indication LED will not be lit.

ON/OFF Button:

Pressing the ON/OFF button will enable/disable the suspension. When the suspension is ON, relevant LED's are lit up. When the suspension is OFF, none of the LED's are lit. It is recommended to leave the suspension ON at all times unless the vehicle or suspension is being serviced.

IMPORTANT: After turning the vehicle ignition off, the suspension system will remain powered for 1 hour before shutting off.

Warning Light:

If the Red LED warning light is continuously illuminated along with one or more of the other indicator lights, please refer to the **Troubleshooting**

Ride Mode Adjustment:

Press the UP/DOWN arrow buttons to change the ride mode between SPORT, NORMAL, and COMFORT. The Green indicator light will show the set mode.

- **Comfort Mode** provides a smooth, soft ride. Use for normal city and highway driving.
- **Sport Mode** provides more "feel" or response to the road conditions. Use where road conditions or personal preference demand more control.
- **Normal Mode** is a balance between Comfort and Sport. Use where more control than Comfort is desired, but better ride than Sport.

The setting can be changed at any time. Based on road conditions, steering wheel angle, and the vehicle speed, the system automatically adjusts to provide the best handling while providing a smooth ride. All three settings will feel similar on a smooth road.

Ride Height Adjustment:

Press the UP/DOWN arrow buttons to change ride height from NORMAL to HIGH (body up) or LOW (body down).

- A solid green LED will indicate the selected height. A flashing green LED will indicate the current height and that height adjustment is

occurring. When a single solid green LED is lit, the selected height has been achieved.

- Two solid green LEDs will be lit if the current height is not the selected height and height adjustment is not occurring.
- If LOW or HIGH heights are selected while the vehicle is traveling at less than 10 mph or stopped, the suspension height is either lowered or raised.
- If LOW or HIGH heights are selected while the vehicle is traveling at greater than 10 mph, the suspension will ignore the selected height and remain in NORMAL height unless the vehicle speed goes below 10 mph within 2 minutes of selecting the height. In this instance, the NORMAL height green LED will flash and the selected height green LED will be lit solid until the speed goes below 10 mph within 2 minutes of selecting the height. If the vehicle speed doesn't go below 10mph within the 2 minute period, the suspension will remain in NORMAL height indicated by only the NORMAL height green LED lit solid.
- If LOW height is selected and the ignition is turned off before LOW height is achieved, the system will continue to lower to LOW height. When LOW height is selected the system will monitor and maintain the kneeled position by only lowering as needed for 1 hour after the ignition is turned off.
- If HIGH height is selected and the ignition is turned off before HIGH height is achieved, the system will stop adjusting ride height. When HIGH height is selected the system will monitor and maintain the current position by only lowering as needed for 1 hour after the ignition is turned off.
- The door switch function (if equipped) is disabled when the driver display LOW or HIGH height is selected before the door is opened on vehicles equipped with a door switch for kneeling.

IMPORTANT: While parked for an extended time with the vehicle and/or suspension system turned off, suspension ride will change with temperature change. Increases in ambient temperature or parking in direct sunlight can cause the suspension ride height to increase. As temperature lowers, the suspension ride height can decrease.

Depressurizing the System

1. Turn the ignition key to "Run" and ensure that the LiquidSpring driver display LEDs light up and that the red "Warning" LED is not lit. If the red "Warning" LED is lit, proceed to the Trouble Shooting Section.

WARNING: Do not run vehicle in an enclosed building without adequate ventilation or without ducting exhaust fumes outside. Operation of a vehicle inside an enclosed building can lead to serious injury or death.

1. Press and release the Red ON/OFF button on the driver display. All LEDs on the driver display should go out.
2. Press and release the Red ON/OFF button again. The LEDs on the driver display should all flash and then only the four yellow arrow LEDs, one green ride mode indicator LED, and one green ride height indicator LED should remain lit.
3. Press and release the HEIGHT DOWN arrow button to lower the vehicle to the LOW height.
4. Press and hold the HEIGHT DOWN arrow button for approximately 2 minutes.
5. Release the HEIGHT DOWN arrow button.
6. Press and release the ON/OFF button to disable the system.
7. Turn off the vehicle ignition.

If any of the hydraulic connected components is to be removed and serviced, it is recommended to also follow the following steps:

8. Locate 3/16" ID PVC Tubing. Note: Alternatively, a bleed kit similar to the Actron 7840 Bleed Kit can be used.
9. Attach the PVC tubing to one of the upper bleed screws on the Left Hand Secondary Volume Assembly and place the other end in a bucket.

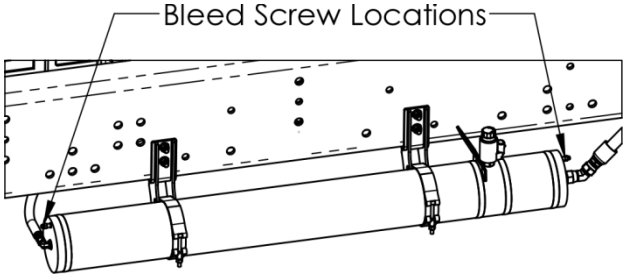


Figure 53. Bleed screw locations.

10. Open the bleed screw slightly to relieve any residual pressure.

11. After pressure is relieved, close the bleed screw and torque to 13-18 ft-lbs.

Notes:

- Jacking up the chassis of a lowered, depressurized chassis will cause a slight vacuum in the system and minimize fluid loss while disconnecting hoses.
- For service of non-hydraulic connected suspension components, the suspension system can be first raised to the HIGH height, appropriate jack stands placed under the chassis, then depressurized as listed above lowering the chassis onto the jack stands.

Calibrating the Steering Sensor Only

Note: The yellow lights only light up when the steering sensor indicates the center location. They will not be lit outside of 10°-20° off center.

IMPORTANT: The LiquidSpring CLASS® system includes an automatic self-centering routine. In conditions such as driving on highway with significant side wind, the yellow lights may temporarily not be lit when the steering wheel is exactly centered. Rotate slowly from center to full steering stop, then repeat the opposite direction. If the yellow lights momentarily light up during the travel in one or the other direction, the system is operating normally and the steering sensor does not need to be manually re-centered. Continue operating normally.

If the yellow lights do not light up at all during turning the steering wheel, following the instructions below.

1. Verify that the front wheels are steered straight ahead.
2. To begin the calibration, turn the ignition key to "Run" and ensure that the LiquidSpring driver display lights up and that the red "Warning" LED is not lit or flashing.

WARNING: Do not run vehicle in an enclosed building without adequate ventilation or without ducting exhaust fumes outside. Operation of a vehicle inside an enclosed building can lead to serious injury or death.

3. Press and release the Red ON/OFF button on the driver display. All LEDs on the driver display should go out.
4. Press and release the Red ON/OFF button again. The LEDs on the driver display should all flash and then only the four yellow arrow LEDs, one green ride mode indicator LED, and one green ride height indicator LED should remain lit.
5. Press and hold both Ride Height Adjustment Buttons simultaneously until the SPORT, COMFORT, HIGH, and LOW green LED's begin to flash.
6. As soon as the four green LED's begin to flash, press the ON/OFF button to stop the process.
7. Verify that the four yellow arrow LED's are lit.
8. Steering calibration is completed.

Calibrating the System (Full)

See Section *Calibrating the System*, on page 34

Checking Fluid Level

1. Turn the ignition key to "Run" and ensure that the LiquidSpring driver display LEDs light up and that the red "Warning" LED is not lit. If the red "Warning" LED is lit, proceed to the Trouble Shooting Section.

WARNING: Do not run vehicle in an enclosed building without adequate ventilation or without ducting exhaust fumes outside. Operation of a vehicle inside an enclosed building can lead to serious injury or death.

2. Press and release the Red ON/OFF button on the driver display. All LEDs on the driver display should go out.
3. Press and release the Red ON/OFF button again. The LEDs on the driver display should all flash and then only the four yellow arrow LEDs, one green ride mode indicator LED, and one green ride height indicator LED should remain lit.
4. After the suspension system stops leveling, check the fluid level in the reservoir. If low, fill to the indicated line.

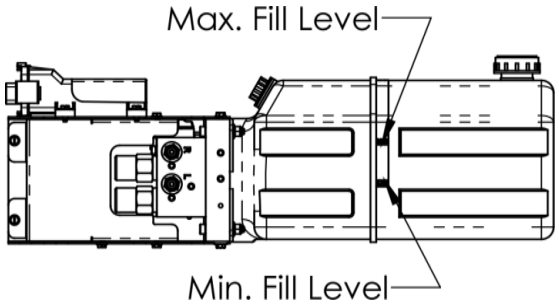


Figure 54. Final fill fluid level.

5. To add fluid, remove filler/breather cap on reservoir.
6. Locate a container of Compressible Fluid.
7. Add fluid to the reservoir until the fluid level is within the band shown in Figure 54.
8. Replace filler/breather cap and retighten.

Checking Fittings for Leaks

WARNING: The system operates under high fluid pressure (up to 3500 psi). Do not attempt to locate leaks by feeling with hands or any part of the body. High pressure fluids can penetrate the skin and cause severe tissue damage.

1. While system is at ride height and pressurized, visually examine fittings and hose connections for any source of leaks. Do not use hands to search for leak. If the source of the leak is a fitting or other component, depressurize the system and repair or replace as needed.
2. Tighten hose nuts if the leak is coming from the connection between the hose nut and a fitting. Depressurize the system before tightening anything. Replace hose if the leak is coming from anywhere else on the hose.

WARNING: Never tighten a hydraulic fitting or hose under pressure. Always depressurize the system before adjusting fittings and hoses.

3. Clean all fluid from hose and fittings to visually identify any leaks.

IMPORTANT: Over-tightening hoses and fittings can damage components and lead to leaks.

Service Intervals

Once Daily or Before Each Shift of Usage

- Check the suspension system to be sure it is fully operational.
    - After starting vehicle, verify all LED's on the driver display flash briefly, then the Green Ride Height and Ride Mode LED's are lit and the Red Warning LED does not stay on or flash.
    - Verify the four Yellow LED's are lit when the steering wheel is centered.
    - Verify that they system is at NORMAL ride height, with a steady green LED.
        - If the Driver Display indicates a blinking ride height LED, allow the system to complete leveling as indicated by a steady green LED.
        - If LOW or HIGH height is shown with a solid green LED, use the arrow buttons to raise or lower the suspension to NORMAL height.
        - Refer to Error! Reference source n ot found. section.
- Visually inspect struts, hoses, and fittings for signs of leakage.
    - For leakage resulting in fluid pooled on the floor greater than 1" in diameter, it is recommended to service the system immediately.
    - For signs of leakage or weeping that results in wetness on components or a single drop, it is recommended to monitor the leak and schedule repair service accordingly.

Initial 1,000 mile (1,600 km) Inspection

- Inspect bolts and nuts at the control arm pivots to assure they are properly torqued.
- Inspect u-bolts to assure they are properly torqued.
- Thoroughly inspect all hydraulic connections for signs of leakage.
- Inspect reservoir fluid level.

Routine Maintenance 25,000 miles (40,000 km) or 6 month maximum Interval

- Check all suspension components for any signs of damaged/broken components, looseness, or wear.
- Inspect bolts and nuts at the control arm pivots to assure they are properly torqued.
- Inspect bolts and nuts at both the frame and axle mount ends of the track rod to assure they are properly torqued.
- Inspect u-bolts to assure they are properly torqued.
- Thoroughly inspect all hydraulic connections for signs of leakage.
- Inspect reservoir fluid level.

Troubleshooting

The LiquidSpring CLASS® system includes on-board diagnostics to assist in pin-pointing potential issues. When a fault in the system occurs, the red warning light on the Drivers Interface will light along with one or more of the other lights on the interface.

Driver Interface Lights	Condition	Cause	Correction
Warning + RIDE: SPORT	Battery Voltage in excess of 16VDC	Vehicle charging system providing incorrect voltage.	Inspect and replace as necessary.
		LiquidSpring system not connected to 12VDC electrical system	Inspect and replace as necessary
Warning + RIDE: NORMAL	Pump Motor runs in excess of 3 minutes	See *Issues with Vehicle Raising/Pump Section*	See *Issues with Vehicle Raising/Pump Section*
Warning + RIDE: COMFORT	Battery Voltage below 9 VDC	Vehicle charging system providing incorrect voltage	Inspect and replace as necessary
		80A fuse blown / Loss of battery voltage on circuit W25	Inspect / Repair Replace as necessary
Warning + HEIGHT: HIGH	Issue with Right Hand Height Sensor	See *Issues with Height Sensors Section*	See *Issues with Height Sensors Section*
Warning + HEIGHT: NORMAL	System kneels in excess of 3 minutes without suspension movement	See *Issues with Vehicle Lowering/Dump Valve Section*	See *Issues with Vehicle Lowering/Dump Valve Section*
Warning + HEIGHT: LOW	Issue with Left Hand Height Sensor	See *Issues with Height Sensors Section*	See *Issues with Height Sensors Section*
Slow or Fast Blinking Warning Light	Driver Interface can not communicate with ECU.	See *Issues with Driver Interface*	See *Issues with Driver Interface*

Issues with Vehicle Raising/Pump

Condition	Cause	Correction
Vehicle Leveled, Pump continues to run	Pump motor shorted out.	Contact LiquidSpring for further instructions.
	Software issue	Turn off ignition, wait 30 seconds, restart vehicle.
	Excessive noise in height sensor	See *Issues with Height Sensors*
Vehicle Not Leveled (or Raised), Pump runs	Reservoir fluid level low	Fill reservoir to specified level.
	Hydraulic leak in system	Check for fluid leaks and repair or replace.
	Vehicle overloaded	Check vehicle loading and correct.
	Air in pump	Check fluid level in reservoir and fill accordingly. Fully depressurize system and restart leveling.
	Internal leak in power module	Replace power module.
	Height sensor error	See *Issues with Height Sensors*
Vehicle Not Leveled (or Raised), Pump does not run	System not turned on.	Turn system on.
	Blown fuse	Check system fuses
	Loss of electrical power	Check wiring between power module and battery.
Pump runs for short time then stops	Motor controller over temperature	Contact LiquidSpring for further instructions.
Pump runs intermittently	Loose connector or wiring	Check wiring harness connections and battery connections. Repair as necessary.

Issues with Vehicle Lowering/Dump Valve

Condition	Cause	Correction
Vehicle does not lower (kneel).	System not turned on	Turn system on
	Blown fuse	Check system fuses and replace as necessary
	Obstacle under vehicle frame	Remove obstacle
	Wiring harness disconnected	Check wiring harness connections and reconnect
	Loss of electrical power	Check wiring between power module and battery
	Power module filters plugged	Contact LiquidSpring for further instructions
	Internal power module blockage	Contact LiquidSpring for further instructions
Vehicle slow lowering (kneeling)	Partial internal power module blockage	Contact LiquidSpring for further instructions

Issues with One Corner Not Leveling Properly

Condition	Cause	Correction
One side will not raise or lower	Internal power module blockage	Contact LiquidSpring for further instructions
	Low voltage	Check battery voltage.
	Wiring harness disconnected	Check wiring harness connections and reconnect
	Obstacle under vehicle frame	Remove obstacle
	Power module filters plugged	Contact LiquidSpring for further instructions
	Height sensor error	See *Issues with Height Sensors*
One corner raises and lowers slower than other corners	Internal power module blockage	Contact LiquidSpring for further instructions
	Filter partially clogged	Contact LiquidSpring for further instructions

Issues with Height Sensors

Condition	Cause	Correction
Vehicle or corner stops leveling at incorrect height	Damaged height sensor and/or linkage	Inspect height sensor components. Replace as necessary.
	Incorrect calibration	Recalibrate vehicle – see System Operation section.
	Incorrect height sensor installation	Inspect height sensor components and correct.
Corner height where leveling stops is inconsistent	Sensor or Linkage loose	Inspect installation of height sensor and linkages and tighten if necessary
	Loose connector / wire	Inspect wiring between sensor and power module for loose connection
Vehicle will not level - no height sensor signal	Height Sensor wiring shorted, broken, or disconnected	Inspect wiring between sensor and power module.
	Malfunction in Sensor	Replace sensor.
No Height Sensor Signal change while driving	Linkage broken/disconnected	Inspect installation of height sensor and linkages. Correct and/or replace.

Issues with Ride/Handling

Condition	Cause	Correction
Vehicle rolls side to side excessively	System inactive (Drivers interface dark)	Turn system on (press On/Off button)
	No electrical power to system	Inspect and replace as necessary
	Strut bushings worn	Inspect and replace as necessary
	Control arm bushings worn	Inspect and replace as necessary
	Sway bar bushings worn	Inspect and replace as necessary
	Strut mounting loose	Inspect and replace as necessary
	Rate Valve wiring shorted, broken, or disconnected	Inspect wiring and correct/replace as necessary.
	Voltage to Rate Valve solenoid too low	Check battery voltage.
	Rate Valve Poppet Jammed open	Contact LiquidSpring for further instructions
	No vehicle speed signal	See Issues with Vehicle Speed Signal section.
Excessive stiffness when on flat, straight road	Short to Rate Valve	Check wiring between rate valve (on secondary volume) and power module for signs of shorts. Replace as necessary.
	Wiring to Rate Valve incorrect	Inspect wiring and correct as necessary

Issues with Steering Sensor

Condition	Cause	Correction
No steering signal (reduced roll control when cornering)	Steering sensor wiring broke or incorrect.	Inspect wiring to steering sensor and correct as necessary.
	Steering sensor malfunction	Replace sensor
	Steering sensor not installed correctly	Inspect installation and correct as necessary
Yellow lights on driver display not lit when steered straight ahead.	Zero point of steering sensor incorrect.	See *Calibrating the Steering Sensor Only.*
Intermittent steering sensor signal	Loose connector / wire	Check wiring between Steering sensor and Power module for loose connection.

Issues with Vehicle Speed Signal

Condition	Cause	Correction
System leveling excessively while driving.	Speed Sensor wiring shorted, broken, or disconnected	Inspect wiring and repair/replace as necessary
	Speed signal malfunction	Replace OEM speed sensor. See OEM service manual.
Intermittent speed sensor signal	Loose connector / wire	Check wiring between Speed sensor and Power module for loose connection.

Issues with Vehicle Brake Signal

Condition	Cause	Correction
Vehicle will not level	Brake signal wire not correctly tapped.	Inspect wiring and repair/replace as necessary.
	Brake switch malfunction	Replace OEM speed sensor. See OEM service manual.
Intermittent leveling	Loose connector / wire	Inspect wiring and repair/replace as necessary.

Issues with Door Switch

Condition	Cause	Correction
Vehicle will not kneel when rear door opened	Short or break in wiring between door switch and power module.	Inspect wiring and repair/replace as necessary.
	Door switch malfunction	Inspect door switch and repair/replace as necessary
Vehicle kneels whenever speed below 5mph	Short or break in wiring between door switch and power module.	Inspect wiring and repair/replace as necessary.
	Door Switch out of adjustment	Check installation of door switch and adjust as necessary
	Door switch malfunction	Inspect and replace per body builder instructions.
Intermittent door switch signal	Loose connector / wire	Inspect wiring and repair/replace as necessary.

Issues with Vehicle Ignition Signal

Condition	Cause	Correction
System does not turn on (no leveling or stiffness control)	No ignition signal to controller or driver interface	Inspect wiring and repair/replace as necessary.
	Ignition "sensor" malfunction	Inspect and replace per OEM service manual.
System does not turn off once ignition switched off	Signal side short to battery	Inspect wiring and repair/replace as necessary.
	Ignition "sensor" malfunction	Inspect and replace per OEM service manual.
System intermittently works	Loose connector / wire	Inspect wiring and repair/replace as necessary.

Issues with Vehicle Park Signal

Condition	Cause	Correction
System will start up but won't level when parked	No park signal to controller	Inspect wiring and repair/replace as necessary.
	Park sensor malfunction	Inspect and replace per OEM service manual.
System levels when stopped and not in park	Park signal always on	Inspect wiring and repair/replace as necessary.
	Park sensor malfunction	Inspect and replace per OEM service manual.
Intermittent leveling when stopped in or out of park	Loose connector / wire	Inspect wiring and repair/replace as necessary.

Issues with Driver Interface

Condition	Cause	Correction
Warning light blinks, system appears to level.	CAN wires crossed or not connected.	Inspect wiring and repair/replace as necessary.
	Malfunctioning Driver Interface	Inspect and replace as necessary.
Warning light blinks, system does not appear to operate (level)	No power to ECU (5A 18ga Red Wire)	Inspect wiring and repair/replace as necessary.
	No ignition signal to ECU (Yellow Wire)	Inspect wiring and repair/replace as necessary.
	CAN wires crossed or not connected.	Inspect wiring and repair/replace as necessary.

Issues with Power Module

Condition	Cause	Correction
Pump exhibits high pitch whine immediately after pump stops or when vehicle lowering	The Check Valve is stuck open	Replace Power Module
Pump running under heavy load and leveling slow	The Check Valve is only partially open	Replace Power Module
Pump running under heavy load and no leveling	The Check valve is stuck closed	Replace Power Module
Hydraulic fluid leaking from Power Module	O-ring failure	Replace O-ring
	Manifold cracked	Replace Power Module
	Fitting loose	Tighten fittings
	Valve loose	Tighten valves to correct torque
	Bolts between manifolds loose/broken	Replace and /or tighten bolts to correct torque
	Hydraulic line loose	Tighten hydraulic line correctly
	Bolts between reservoir and manifold loose/broken	Replace and/or tighten bolts to required torque
	Broken / cracked reservoir	Replace reservoir

Issues with Strut Assembly

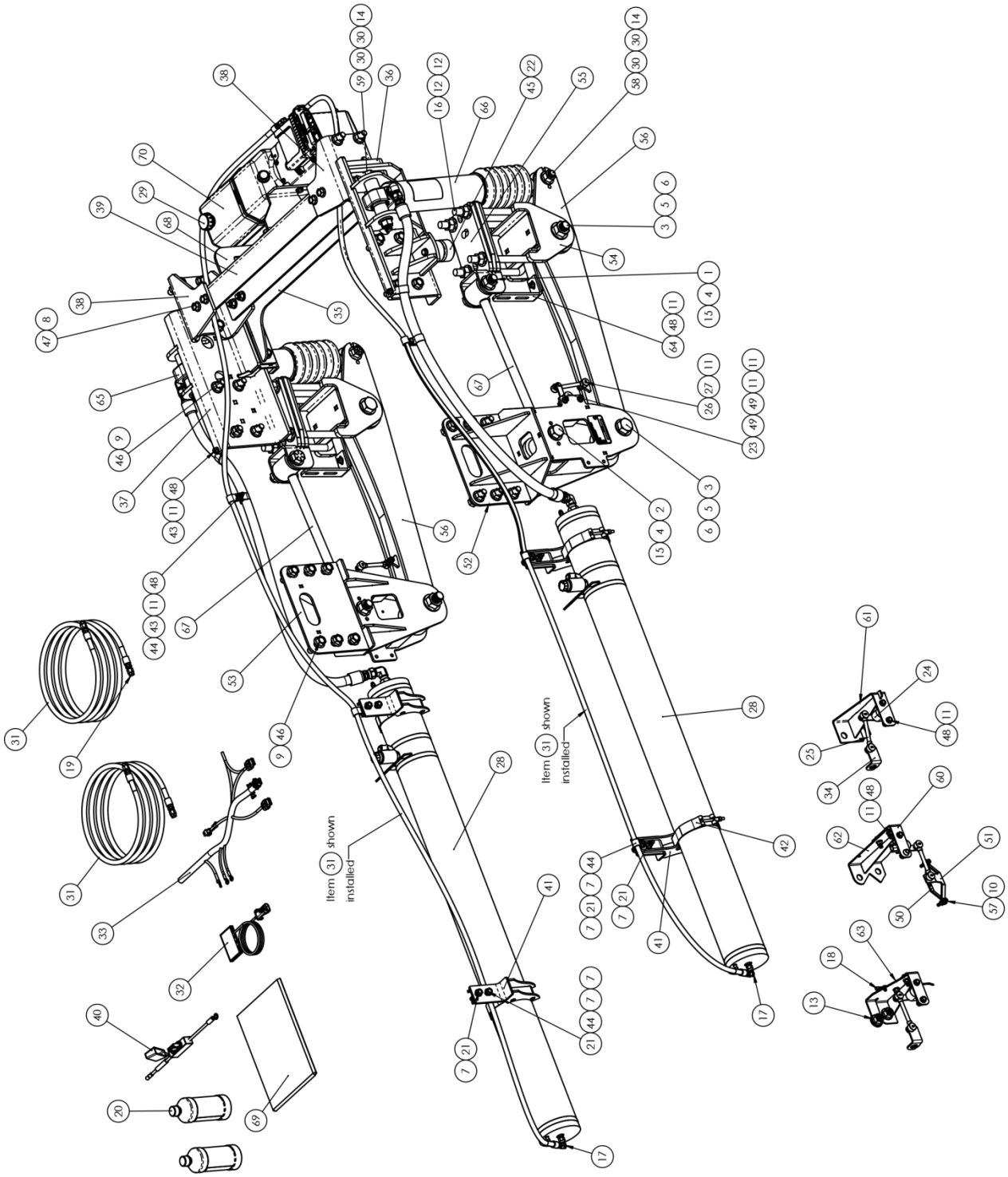
Condition	Cause	Correction
Hydraulic Leak	Weld failure between cylinder and end	Replace strut
	Cylinder fracture	Replace strut
	Threads stripped between cylinder and gland	Replace strut
	Seals worn out	Replace strut
	Rod severely scratched or dented	Replace strut
	Fitting loose	Tighten or replace fittings
	Hose failure	Replace failed hose
	Hose cut	Replace failed hose
Rod broken at bushing housing	Weld failure	Replace strut
Rod doesn't move freely in/out cylinder	Piston jammed in cylinder	Replace strut
Rod moves very easily in/out cylinder	Piston broken therefore no damping	Replace strut
Reduced damping level	Damping components broken/worn out	Replace strut
Strut upper mount not securely attached to frame or Strut	Bolts attaching bracket to frame broken / came out	Replace bolts and tighten to required torque
	Bolt attaching strut to bracket broke / came out	Replace bolts and tighten to required torque
	Weld Failure	Replace strut upper mount
	Structural failure	Replace strut upper mount
Strut lower mount not securely attached to axle or strut	Bolts attaching bracket to axle broken / came out	Replace bolts and tighten to required torque
	Bolt attaching strut to bracket broke / came out	Replace bolts and tighten to required torque
	Weld Failure	Replace strut lower mount
	Structural failure	Replace strut lower mount

Issues with Secondary Volume Assembly

Condition	Cause	Correction
Hydraulic Leak	Weld failure between tube and end	Replace secondary volume welded assembly
	Weld failure between tube and manifold	Replace secondary volume welded assembly
	Cylinder fracture	Replace secondary volume welded assembly
	Bleed screw loose	Tighten bleed screws to appropriate torque
	Fitting loose	Tighten all fittings
	Hose failure	Replace failed hose
	Hose cut	Replace failed hose
loose or no longer attached	Bolts attaching bracket to frame broken / came out	Replace bolts and tighten to required torque
	Bolt attaching volumes to bracket broke / came out	Replace bolts and tighten to required torque
	Weld Failure	Replace brackets
	Structural failure	Replace brackets

Appendix A: Part Identification:

DS155NDLP-A and -AC

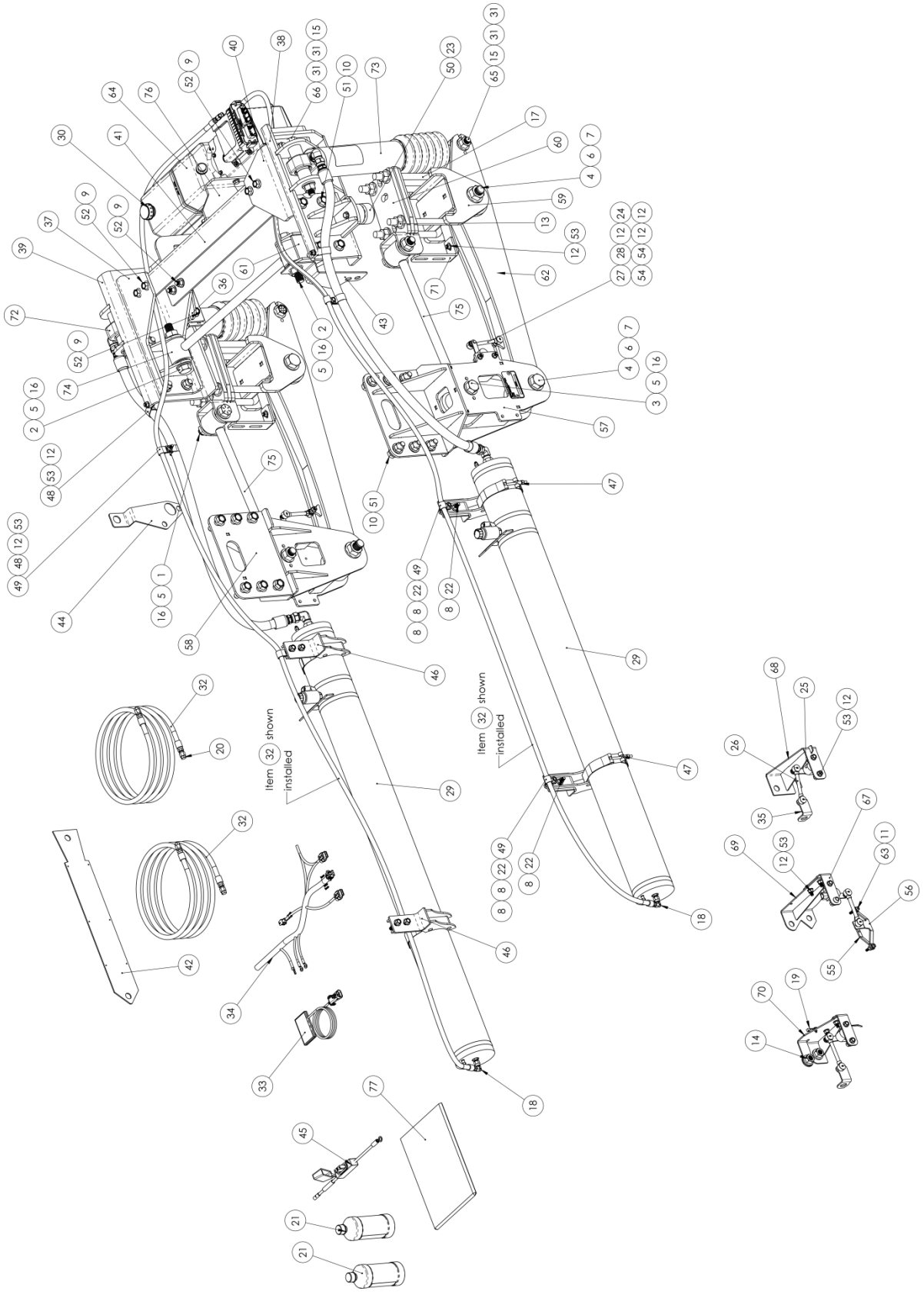


DS155NDLP-A and –AC BOM

DS155NDLP-A and -AC							
ITEM	QTY	PART NUMBER	DESCRIPTION	ITEM	QTY	PART NUMBER	DESCRIPTION
1	2	10002-500	HCS 7/8-9 x 5" Gr 8	36	1	10790-031	USM, LH
2	2	10002-600	HCS 7/8-9 x 6" Gr. 8	37	1	10790-032	USM, RH
3	4	10003-004	HB 1.000-8 x 6-1/2", Gr. 8	38	2	10795-005	Crossmember, End Channel
4	4	10006-003	HFW .875	39	1	10796-004	Crossmember Channel
5	4	10006-004	HFW 1.000	40	1	10815-001	Wiring Harness, Fused Battery
6	4	10012-003	LFN 1-8, Gr G	41	4	10830-015	Volume Mount
7	12	10012-005	LFN 3/8-16, Gr G	42	4	10843-003	T-Bolt Clamp
8	12	10012-007	LFN 1/2-13, Gr. G	43	4	10855-002	Vinyl-Coated Loop Clamp, 1"
9	28	10012-008	LFN 5/8-11 Gr G	44	6	10855-003	Vinyl-Coated Loop Clamp, 5/8"
10	2	10012-009	LFN 1/4-20, Gr. G	45	2	10867-003	Jounce Bumper
11	16	10012-010	LFN 5/16-18, Gr. G	46	28	10874-200	HFB 5/8-11x2.000, Gr. 8
12	8	10012-012	LFN 3/4-16, Gr. G	47	12	10885-150	HFB 1/2-13x1.500, Gr. 8
13	2	10012-013	LFN 5/8-18, Gr. G	48	10	10886-100	HFB 5/16-18 x 1.000, Gr. 8
14	4	10012-014	LFN 3/4-10 Gr G	49	4	10886-125	HFB 5/16-18 x 1.25, Gr. 8
15	4	10012-017	LFN 7/8-9, Gr. G	50	1	10904-015	Ball Stud Bracket
16	4	10064-005	U-Bolt 3/4-16 x 9.03 Tri-8	51	1	10904-017	Ball Stud Bracket
17	2	10322-021	Hyd Fit 90, -4 37 x -4 37 F	52	1	10943-002	LH Front Hanger
18	1	10325-003	Cable Tie, Fir Tree Mount	53	1	10944-002	RH Front Hanger
19	4	10331-011	Hyd. Fit Plug, -4 JIC	54	2	10947-010	Lower Axle Connection
20	2	10474-001	Silicone Oil, 16 oz. Bottle	55	2	10949-006	UCA Axle Mount
21	8	10501-150	HFB 3/8-16 x 1.500, Gr. 8	56	2	10953-008	Lower Control Arm
22	2	10502-001	HFB M10-1.5 x 30 CL 10.9	57	2	10989-100	HFB 1/4-20x1.000, Gr. 8
23	2	10586-001	Asy, Height Sensor	58	2	11102-400	HFB 3/4-10 x 4 Gr 8
24	1	10586-002	Asy, Steering Sensor	59	2	11102-650	HFB 3/4-10 x 6-1/2 Gr 8
25	1	10587-006	Asy, Linkage, 3.938" SS	60	1	11136-003	Steering Mount Bracket
26	2	10587-009	Asy, Linkage, 3.938" OP	61	1	11138-001	Steering Mount
27	2	10591-003	Ball Stud 5/16-18 x .75L	62	1	11138-002	Steering Bracket
28	2	10597-083	Volume Assembly	63	1	11138-003	Steering Mount
29	1	10614-001	Cap, Filler/Breather	64	2	11147-001	S-Cam Bracket
30	8	10640-005	Bearing Spacer	65	1	11185-003	Strut Assembly, RH
31	2	10675-015	Asy, Hose, -4 x 138-3/8" L	66	1	11185-004	Strut Assembly, LH
32	1	10680-001	Driver Interface	67	2	11198-005	Asy, Arm, 19.190L
33	1	10704-008	Wiring Harness, Dash	68	1	11302	Kit, Power Module Mount
34	1	10733-006	Steering Linkage Mnt	69	1	11307	Kit, Document, DS155NDLP
35	1	10782-006	Crossmember Reinforcement	70	1	See Table 1	Asy, Power Supply, Side Mount

Table 1: Power Module		
Unit	P/N of Item	Description of Item
DS155NDLP-A	11013-009	Power Module DS155NDLP-x
DS155NDLP-AC	11013-010	Power Module DS155NDLP-xC

DS155NDLP-S and -SC

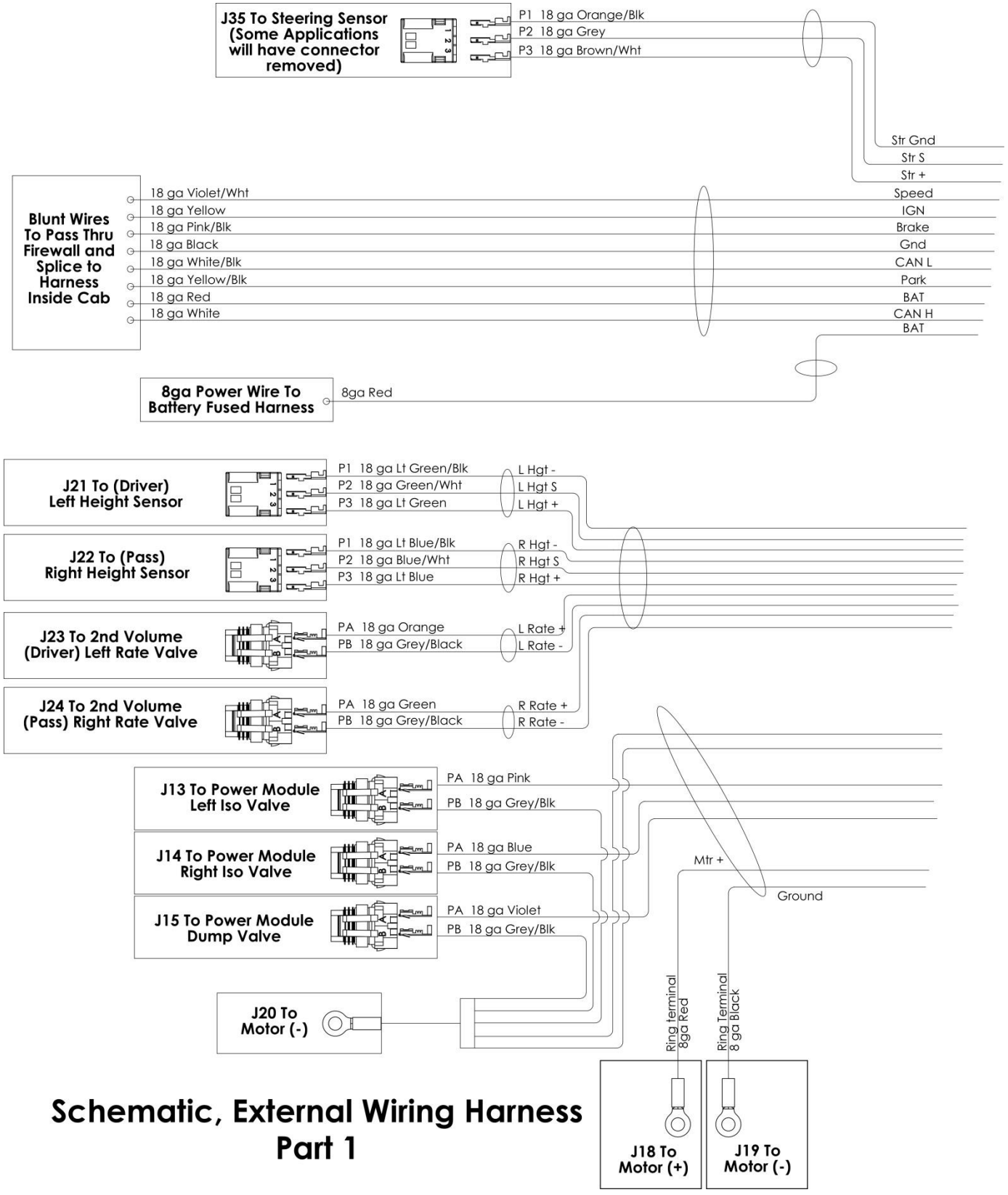


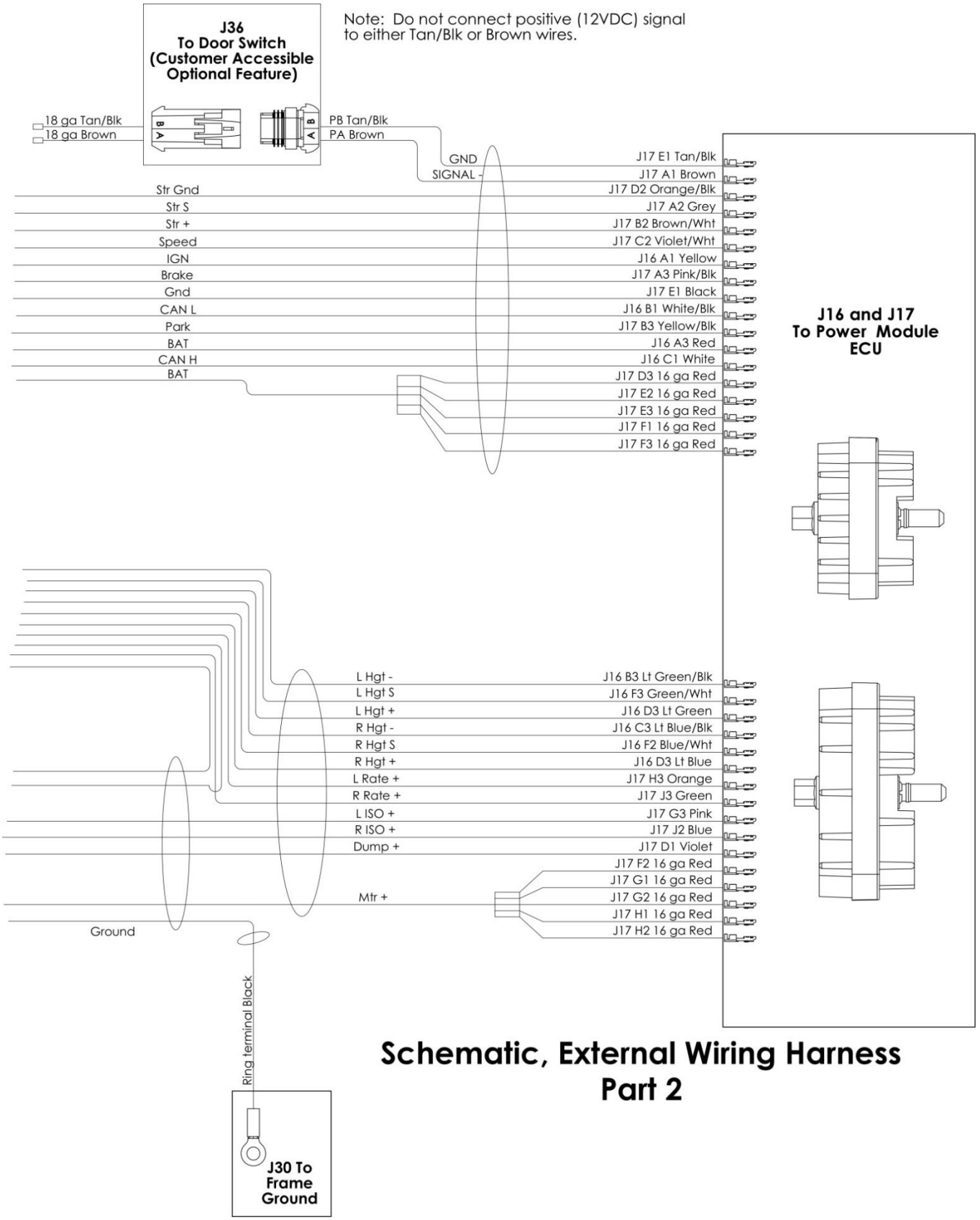
DS155NDLP-S and -SC BOM

DS155NDLP-S and -SC							
ITEM	QTY	PART NUMBER	DESCRIPTION	ITEM	QTY	PART NUMBER	DESCRIPTION
1	2	10002-500	HCS 7/8-9 x 5" Gr 8	40	1	10795-006	Crossmember, End Channel
2	2	10002-550	HB .875-9 x 5-1/2" Gr 8	41	1	10796-004	Crossmember Channel
3	2	10002-600	HCS 7/8-9 x 6", Gr. 8	42	1	10811-006	Template, Frame Drilling
4	4	10003-004	HB 1.000-8 x 6-1/2", Gr. 8	43	1	10811-016	Axle Mnt Template, Meritor
5	6	10006-003	HFW 7/8"	44	1	10811-017	Template, Axle Mnt 4300 Dana
6	4	10006-004	HFW 1"	45	1	10815-001	Wiring Harness, Fused Battery
7	4	10012-003	LFN 1-8, Gr G Top Lock	46	4	10830-015	Wldmnt, Volume Mount
8	12	10012-005	LFN 3/8-16, Gr G	47	4	10843-003	T-lt Clamp, Range
9	12	10012-007	LFN 1/2-13, Gr. G	48	4	10855-002	Vinyl-Coated Loop Clamp, 1"
10	24	10012-008	LFN 5/8-11 Gr G	49	6	10855-003	Vinyl-Coated Loop Clamp, 5/8"
11	2	10012-009	LFN 1/4-20, Gr. G	50	2	10867-003	Jounce Bumper
12	16	10012-010	LFN 5/16-18, Gr. G	51	24	10874-200	HFB 5/8-11 x 2", Gr. 8
13	8	10012-012	LFN 3/4-16, Gr. G	52	12	10885-150	HFB 1/2-13 x 1-1/2", Gr. 8
14	2	10012-013	LFN 5/8-18, Gr. G	53	10	10886-100	HFB 5/16-18 x 1", Gr. 8
15	4	10012-014	LFN 3/4-10 Gr G	54	4	10886-125	HFB 5/16-18 x 1-1/4", Gr. 8
16	6	10012-017	LFN 7/8-9, Gr. G	55	1	10904-015	Ball Stud Bracket
17	4	10064-005	U-lt 3/4-16 x 9.03 Tri-8	56	1	10904-017	Wldmnt, Ball Stud Bracket
18	2	10322-021	Hyd Fit 90, -4 37 x -4 37 F	57	1	10943-002	LH Front Hanger
19	1	10325-003	Cable Tie, Fir Tree Mount	58	1	10944-002	RH Front Hanger
20	4	10331-011	Hyd. Fit Plug, -4 JIC	59	2	10947-010	Lower Axle Connection
21	2	10474-001	Silicone Oil, 16 oz.	60	2	10949-006	UCA Axle Mount, DuraStar
22	8	10501-150	HFB 3/8-16 x 1-1/2", Gr. 8	61	1	10951-005	Axle Mnt, Meritor
23	2	10502-001	HFB M10-1.5 x 30 CL 10.9	62	2	10953-008	LCA
24	2	10586-001	Asy, Height Sensor	63	2	10989-100	HFB 1/4-20 x 1", Gr. 8
25	1	10586-002	Asy, Steering Sensor	64	2	11102-400	HFB 3/4-10 x 4" Gr 8
26	1	10587-006	Asy, Linkage, 3.938" SS	65	2	11102-650	HFB 3/4-10 x 6-1/2" Gr 8
27	2	10587-009	Asy, Linkage, 3.938" OP	66	1	11136-003	Steering Mount Bracket
28	2	10591-003	Ball Stud 5/16-18 x .75L	67	1	11138-001	Steering Mount
29	2	10597-083	Volume Assembly	68	1	11138-002	Steering Bracket
30	1	10614-001	Cap, Filler/Breather	69	1	11138-003	Steering Mount
31	8	10640-005	Bearing Spacer	70	2	11147-001	S-Cam Bracket
32	2	10675-015	Asy, Hose, -4 x 138-3/8" L	71	2	11185-003	Strut Assembly, RH
33	1	10680-001	Driver Interface	72	2	11185-004	Strut Assembly, LH
34	1	10704-008	Wiring Harness, Dash	73	1	11198-001	Asy, Track Rod
35	1	10733-006	Steering Linkage Mnt	74	2	11198-005	UCA
36	1	10782-006	Crossmember Reinforcement	75	1	11302	Kit, Power Module Mount
37	1	10789-014	Track Rod Mnt	76	1	11307	Kit, Document, DS155NDLP
38	1	10790-031	USM, LH	77	1	See Table 1	Asy, Power Supply, Side Mount
39	1	10790-032	USM, RH				

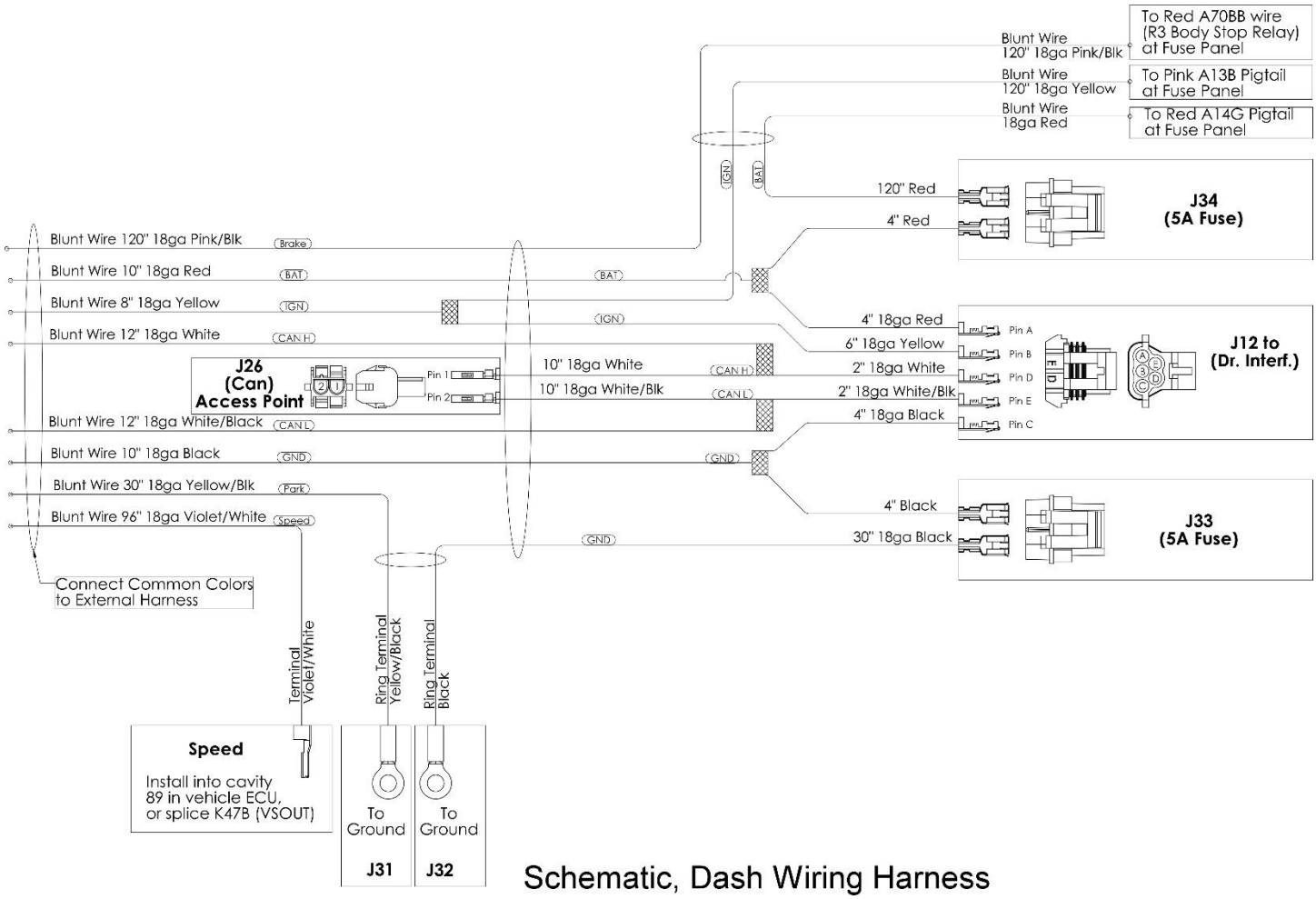
Table 1: Power Module		
Unit	P/N of Item	Description of Item
DS155NDLP-S	11013-009	Power Module, DS155NDLP-x
DS155NDLP-SC	11013-010	Power Module, DS155NDLP-xC

Appendix B: Electrical Schematics

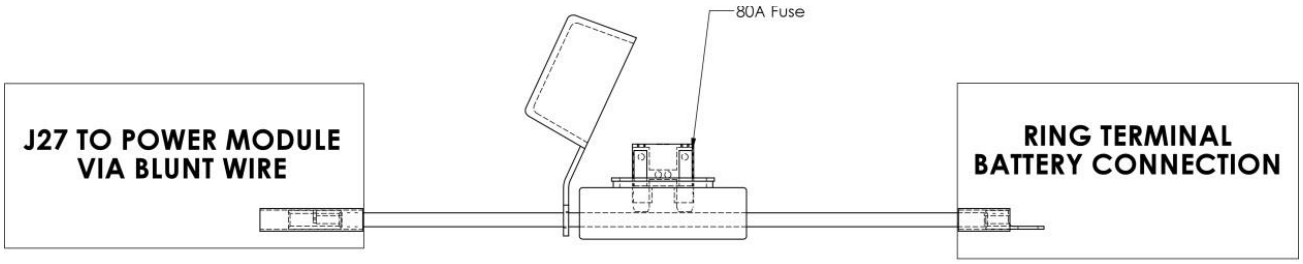




Schematic, External Wiring Harness Part 2



Schematic, Dash Wiring Harness



Schematic, Battery Fuse Lead

Appendix C: Frame Drilling Locations

[DS155NDLP-A and -AC Suspensions]

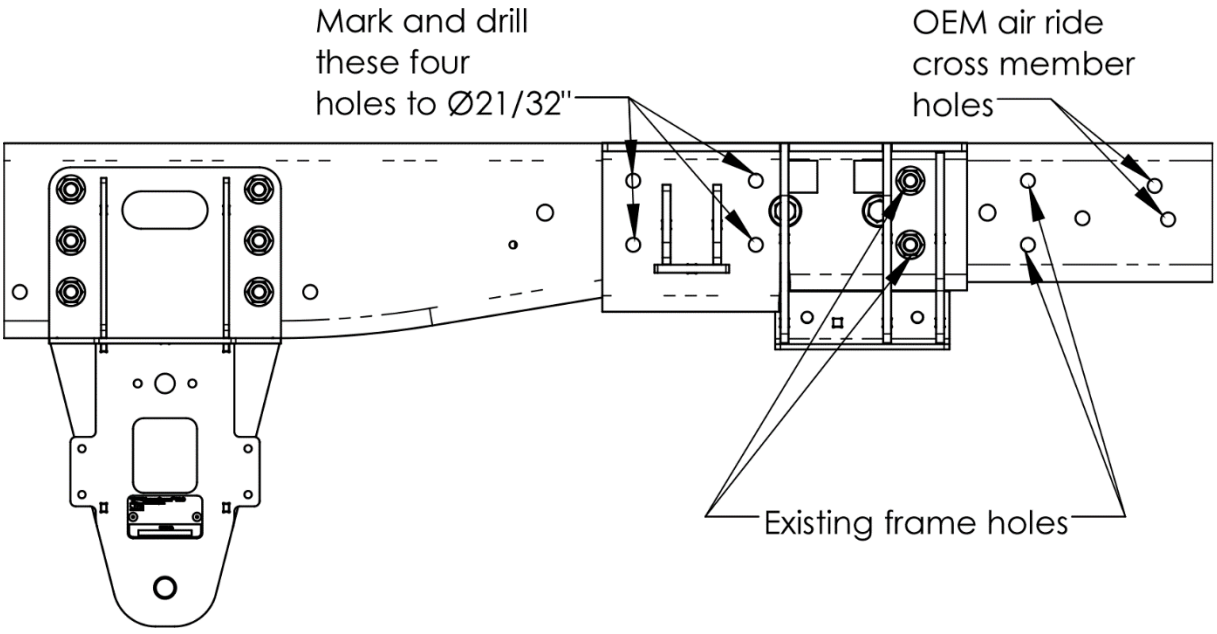


Figure A 1: [DS155NDLP-A and -AC Suspensions Only] Driver side template location for upper strut mount frame drilling

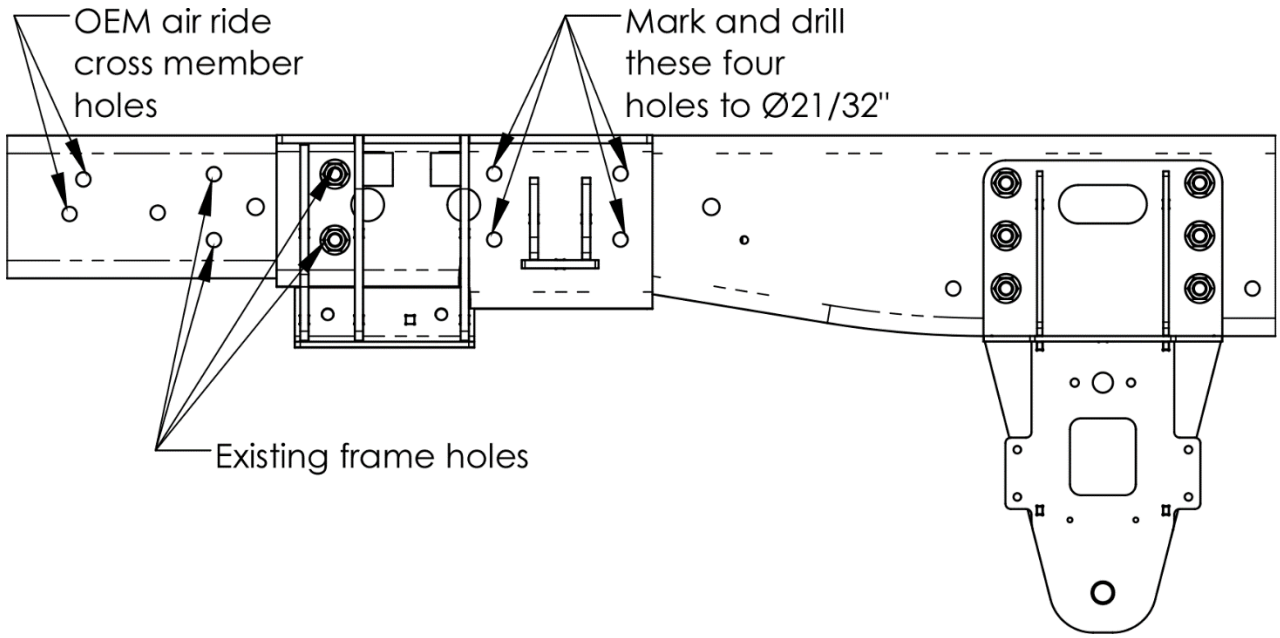


Figure A 2 [DS155NDLP-A and -AC Suspensions Only] Passenger side template location for upper strut mount frame drilling.

[DS155NDLP-S and –SC Suspensions]

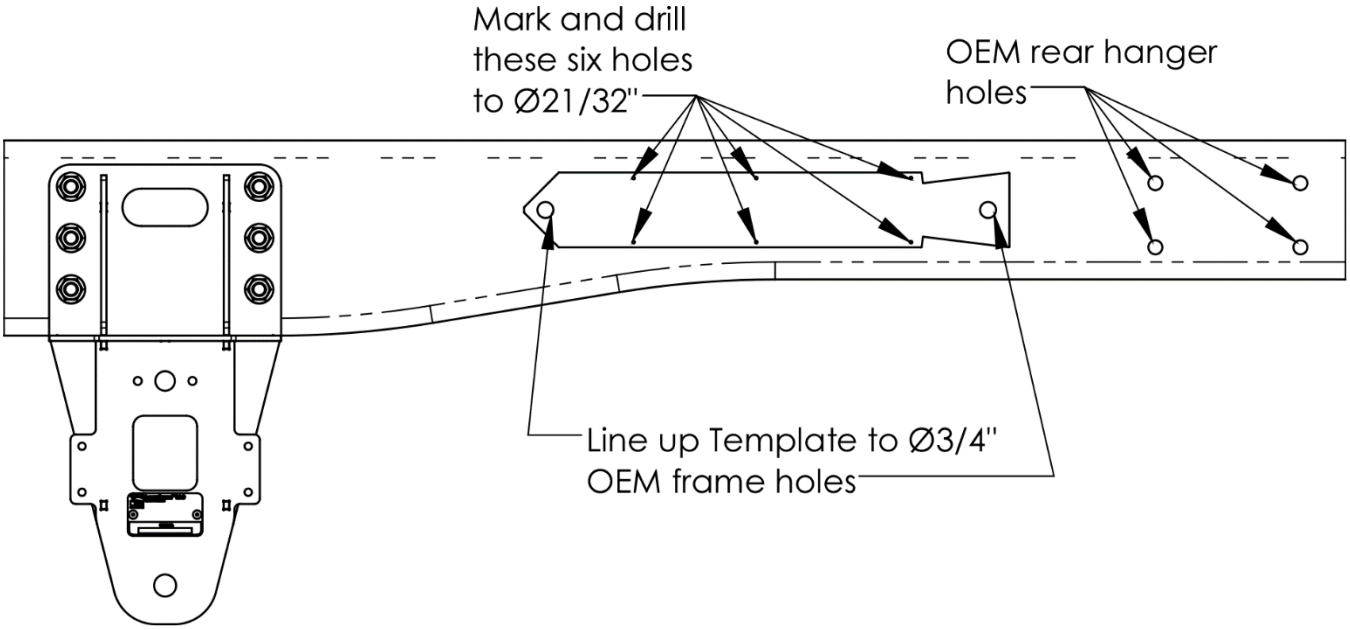


Figure A 3: [DS155NDLP-S and -SC Suspensions Only] Driver side template location for upper strut mount frame drilling

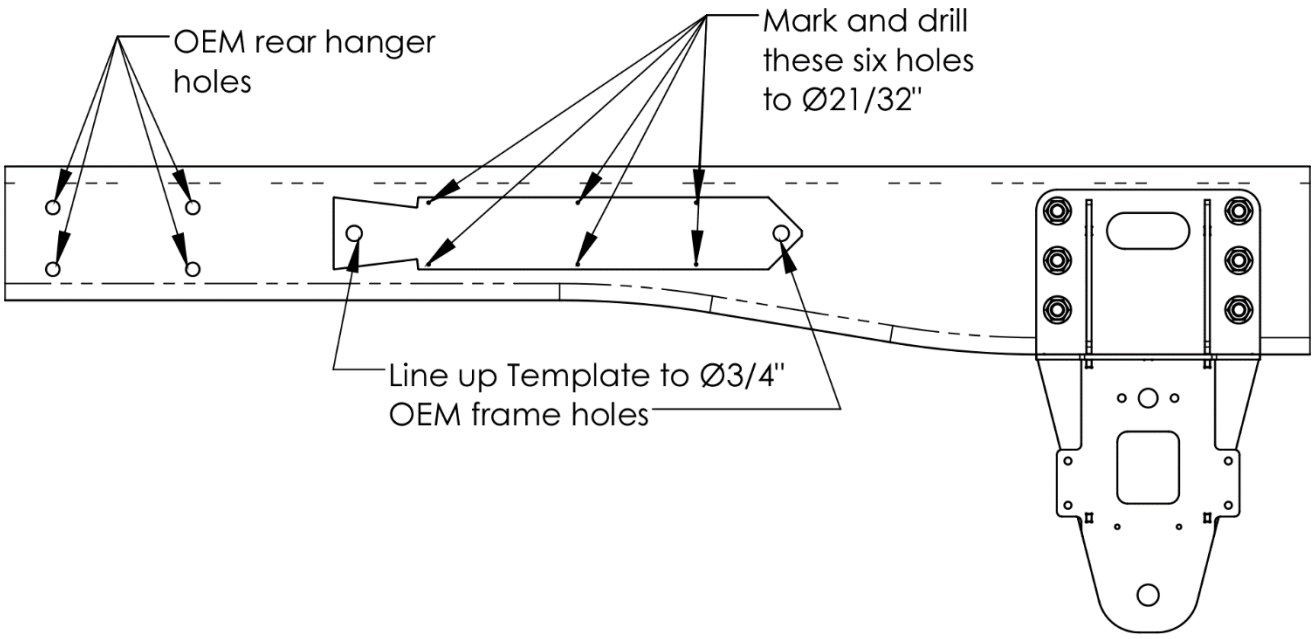


Figure A 4 [DS155NDLP-S and -SC Suspensions Only] Passenger side template location for upper strut mount frame drilling.

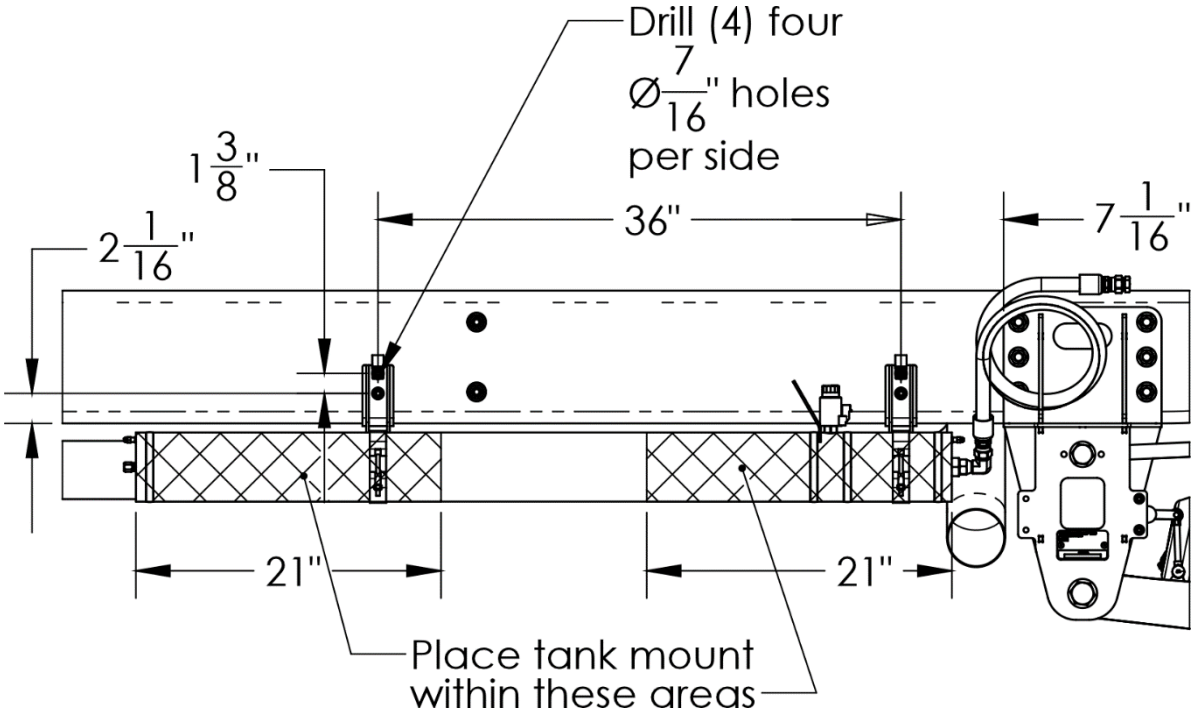


Figure A 5 Secondary volume recommended mount locations for drilling.

LIQUIDSPRING™ LLC

LiquidSpring™ LLC
4899 E 400 S
Lafayette, IN 47905

Phone: 765-474-7816
Fax: 765-474-7826
Web: www.liquidspring.com

Appendix D: Electrical Terminals

TABLE 1 The following wire connections to the vehicle are required.				
Wire	**Harness**	**Color-Size**	**Required Signal**	**OEM Location**
Battery	Dash	Red-18ga	12 VDC Hot all the time	Vehicle Fuse Panel
Ignition	Dash	Yellow-18ga	12 VDC with ignition ON 0 VDC with ignition OFF	Vehicle Fuse Panel
Speed	External	Violet/White-18ga	Frequency Signal (Hz/mph):	Bodybuilder Harness (International) Transmission Control Module (Cummins)
Brake	External	Pink/Black-18ga	12 VDC with brake ON 0 VDC with brake OFF	Vehicle Fuse Panel or Bodybuilder Harness
Ground	Dash	Black with Ring Terminal	Chassis Ground	Chassis ground in cab
Battery	Fused Battery Lead	Red-8ga	12 VDC hot all the time (up to 80 Amps)	Chassis battery
Ground	External	Black-8ga	Chassis Ground (up to 80 Amps)	Chassis ground to frame

TABLE 2 Terminal Connections.			
Wire	**OEM Location**	**OEM Circuit/Wire**	**Required Terminal P/N**
Battery	Vehicle Fuse Panel	Red A14G Pigtail	Butt-Splice Connector
Ignition	Vehicle Fuse Panel	Pink A13B Pigtail	Butt-Splice Connector
Speed	Transmission Control Module	Allison Circuit 125	MX150 Series Female Navistar: 3686945C1 Molex: 33012-2002
Brake	Bodybuilder Harness	3-Way Connector/Red N70BB	MetriPack 280 Series Male NaviStar: 2033912C1 Delphi: 12048159

CLASS® Product Limited Warranty

LIQUIDSPRING™ LLC
4899 E 400 S
LAFAYETTE, IN 47905
PH: 765-474-7816, FAX: 765-474-7826
WWW.LIQUIDSPRING.COM

Warranty Conditions

LiquidSpring LLC warrants that all **CLASS®** products shall be free of defects in material and workmanship provided the product has been properly assembled, installed by a designated/qualified installer, properly maintained, serviced, and used normally for the given application and within the rated capacities. The end user is responsible for operating, inspecting, and maintaining the product according to applicable product and vehicle owner's manuals and for instructing all operators and maintenance personnel on proper use and maintenance.

Coverage

The starting date for warranty coverage will be the earlier date of the date purchased by the first end user or when the vehicle is put into service and ends when the time period is reached in the warranty coverage period below. Proof of such date is the responsibility of the first end user. If the starting date cannot be satisfactorily determined, then the date of product manufacture based on the product serial number shall be used as the effective starting date.

Main Structural Components – 48 Months or 100,000 miles whichever occurs first.

Major structural components are defined as frame hangers, control arms, axle clamp group, transverse torque arm, axle and frame mounts, and secondary volumes. All wear items such as bushings and strut seals are excluded.

Other Components – 36 Months or 50,000 miles whichever occurs first.

Other components include all power module components, electrical components, wire harnesses, valves, hydraulic lines, and other wear items such as bushings and strut seals.

Labor – 12 Months

Estimated labor time and cost must be pre-approved prior to conducting warranty repair work for reimbursement consideration.

Claims

1. Review warranty conditions and coverage to determine if component is warrantable.
2. Locate product serial number, warranty starting date (see Coverage above), vehicle manufacturer, mileage, and VIN.
3. Contact LiquidSpring LLC to address claim.

Components must be returned to LiquidSpring LLC **Prepaid** and identified with a LiquidSpring LLC issued Returned Goods Authorization Number (RGA#) in order to qualify for reimbursement by LiquidSpring LLC. LiquidSpring LLC must authorize all warranty repairs at a cost determined and approved by LiquidSpring LLC **before any repairs are started**.

Warranty Contact: (765) 474-7816 (Option #1)
Service@liquidspring.com

Limitations and Exclusions

The liability of LiquidSpring LLC under this limited warranty is solely limited to the repair or replacement of defective material and workmanship by an authorized party. LiquidSpring LLC shall not be liable for use of non-LiquidSpring LLC components or for repairs performed by unauthorized parties. This warranty does not include any expense of or related to transportation of parts outside the Continental United States or compensation for inconvenience or loss of use while the product is being repaired. LiquidSpring LLC shall not be liable for any expense, loss, or damage (direct, incidental, consequential or exemplary – including, but not limited to towing expenses, travel expenses, vehicle rental, downtime expenses, incidental charges or any other losses arising in connection with the sale, use or inability to use the product) resulting from the warranty-covered component found to be defective.

No expressed warranty is given by LiquidSpring LLC with respect to its product except at specifically set forth herein. Any warranty implied by law, including any warranty of merchantability or fitness for particular purpose, is limited to the expressed warranty term provided in the warranty coverage. The expressed warranty does not apply in the event of: use of non-LiquidSpring LLC replacement components; improper installation, maintenance or repair; misuse, negligence, or abuse including but not limited to overloading, unauthorized alterations or modifications.

CLASS® Product Limited Warranty

LIQUIDSPRING™ LLC
4899 E 400 S
LAFAYETTE, IN 47905
PH: 765-474-7816, FAX: 765-474-7826
WWW.LIQUIDSPRING.COM

Warranty Labor Coverage

COMPONENT	ALLOWABLE LABOR HOURS (*)
Strut (each)	**0.75**
Wiring Harness (Rear Main)	**3.00**
Power module	**1.00**
Pressure Relief Valve/ Isolation Valve	**0.50****
ECU (External)	**0.50**
Hose Replacement (each)	**0.75**
Height Sensor	**0.50**
Steering Sensor	**0.75**
Rate Valve	**0.50**
Track Rod	**1.50**
One Control Arm	**1.50**
Pair of Control Arms	**2.00**
12V Motor	**1.00**
General Diagnostics	**Contact Customer Service**

(FOR ANY COMPONENT(s) NOT LISTED ABOVE, THE ALLOWABLE LABOR HOURS MUST BE APPROVED BY **LIQUIDSPRING LLC.** PRIOR TO THE WORK BEING PREFORMED.)

*LABOR HOURS BASED ON $85.00 PER HOUR.

*LABOR FOR DIAGNOSIS WILL NOT BE COVERED WITHOUT PRIOR CONSENT FROM **LIQUIDSPRING LLC.**

**0.50hr. FOR FIRST VALVE REMOVAL 0.25hr. FOR EACH ADDITIONAL

Obtaining Warranty Parts

1. Obtain **LiquidSpring LLC** suspension serial number
(Located on driver's side front hanger see Operator's Manual for details)
2. Obtain mileage of suspension
3. Obtain In-service date of suspension
4. Give a detailed description of the problem

Contact LiquidSpring LLC

Customer Service Dept. -- Phone: 765-474-7816 Email: Service@liquidspring.com

Installation Check List

Installer:	Installation Date:
Inspector:	Inspection Date:
Suspension S/N:	VIN:

FRAME PREPARATION:
☐Battery Disconnected
☐Upper Strut Mount and Secondary Volume Assy holes drilled.

AXLE PREPARATION [DS155NDLP-S and -SC Suspension]:
☐Weld Track Rod Mount to Axle
☐OEM M16 Bolts reinstalled and torqued to 200 ft-lbs.

FRONT HANGER INSTALLATION:
☐Front Hangers are level with framerail.
☐5/8”-11 Nuts torqued to **172-210 ft-lbs**.

UPPER STRUT MOUNT/UPPER AND LOWER CROSSMEMBER/TRACK ROD FRAME MOUNT*:*
☐Upper Strut Mounts level with top of frame.
☐Upper Cross member orientated correctly.
☐Cross member Reinforcement orientated correctly.
☐Bolts oriented per Installation Manual Views.
☐OEM Aft of Axle Cross-member removed (on Air Ride Vehicles).
☐5/8”-11 Nuts torqued to **172-210 ft-lbs**.
☐1/2”-13 Nuts torqued to **86-105 ft-lbs**.

AXLE CLAMP INSTALLATION:
☐3/4”-16 U-Bolts torqued in stages up to **295 ft-lbs**.
☐5/16”-18 Nut torqued to **14-17 ft-lbs**.

AXLE CLAMP INSTALLATION [AIR BRAKES ONLY]:
☐3/4”-16 U-Bolts torqued in stages up to **295 ft-lbs**.
☐1/2”-13 Nut torqued to **61-75 ft-lbs.**
☐5/16”-18 OEM Nut torqued to **14-17 ft-lbs.**

CONTROL ARMS INSTALLATION:
☐Lower Control Arms correctly orientated.
☐Verify the sleeve is inserted in the Lower Control Arm axle connection.
☐1”-8 Nuts torqued to **600 ft-lbs**, at ride height.
☐7/8”-9 Nuts torqued to **491-600 ft-lbs.** at ride height.

TRACK ROD INSTALLATION:
☐7/8”-9 Nuts Torqued to **491-600 ft-lbs**.

STRUT INSTALLATION:
☐3/4”-10 Upper Nuts torqued to **275-300 ft-lbs**.
☐3/4”-10 Lower Nuts torqued to **275-300 ft-lbs**.

JOUNCE BUMPER INSTALLATION:
☐M10-1.5 Bolts torqued to **35 ft-lbs**.

HEIGHT SENSOR INSTALLATION:
☐5/16”-18 Nuts torqued to **14-17 ft-lbs**.
☐Locking Clips installed.

POWER MODULE/SECONDARY VOLUME INSTALLATION:

☐1/2”-13 Nuts torqued to **86-105 ft-lbs**.
☐3/8”-16 Screws torqued to **39 ft-lbs**.
☐Reservoir Mount Self Tapping Screws tightened to **snug only**.
☐5/16”-24 Clamp Fasteners torqued to **240 in-lbs**.

HOSE INSTALLATION:

☐-4 Hose Fittings torqued to **12 ft-lbs.**
☐-10 Hose Fittings torqued to **36-63 ft-lbs.**
☐Bleed Screws closed and torqued to **13-18 ft-lbs.**
☐Hoses secured with loop clamps.
☐1/4-20 Nuts torqued to **11 ft-lbs**.

TRW TAS40 STEERING BRACKET INSTALLATION:

☐3/4”-16 OEM Pitman arm nut torqued to **215-245 ft-lbs.**
☐5/8”-18 OEM bolt torqued to **120-140 ft-lbs.**
☐5/16”-18 Nut torqued to **14-17 ft-lbs.**
☐Locking Clips installed.

SHEPPARD STEERING BRACKET INSTALLATION:

☐5/8”-18 OEM bolt torqued to **120-140 ft-lbs.**
☐5/16”-18 Nut torqued to **14-17 ft-lbs.**
☐1/4”-18 Nut torqued to **10 ft-lbs.**
☐ Locking Clips installed.

TRW THP45 STEERING BRACKET INSTALLATION:

☐3/4”-16 OEM Pitman arm nut torqued to **215-245 ft-lbs.**
☐5/8”-18 OEM bolt torqued to **120-140 ft-lbs.**
☐5/16”-18 Nut torqued to **14-17 ft-lbs.**
☐ Locking Clips installed.

WIRING HARNESS INSTALLATION:

☐Dash harness installed
☐All appropriate wiring splices made.
☐Driver Interface installed and connected to Dash Harness.
☐External harness routed and secured.
☐External harness connected to Rate Valves, Height Sensors.
☐Battery harness installed with Fuse Lead and connected to Battery and Power Module.
☐Door harness installed (if equipped with rear door switch).
☐All connections sealed.
☐All harnesses properly secured from chaffing, heat, and located away from moving parts.

INTIAL FILL/CALIBRATION:

☐Battery connected.
☐Suspension rose to ride height.
☐Reservoir at proper level.
☐Calibration completed.