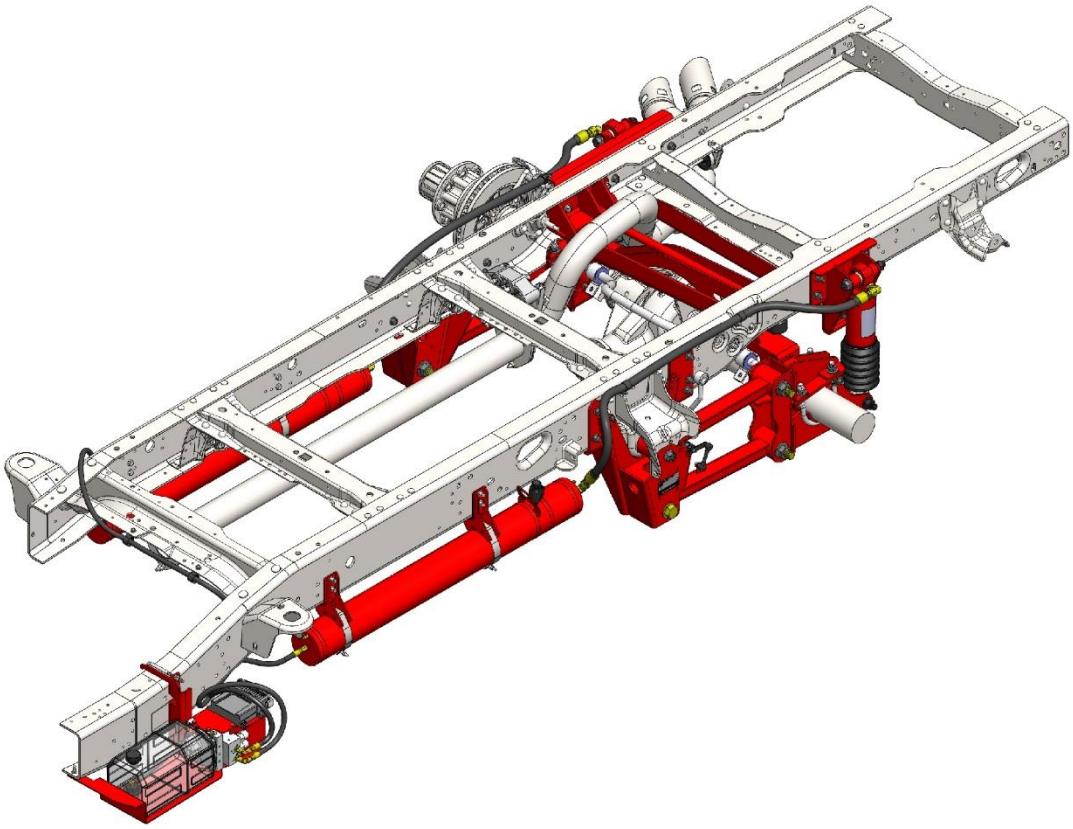
DS98F®

DS98F

Drive Axle Rear Suspensions
for F350 4x2 and 4x4 Cab Chassis
(Ambulance Prep Package)



LIQUIDSPRING™ LLC

Installation / Maintenance Manual

D11125 Rev M 7/19

Contents

Introduction

This manual provides installation information for the LiquidSpring CLASS® DS98F series of rear axle suspension systems for the Ford F350 SuperDuty 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 special tools when required to help avoid serious personal injury and damage to components.

Throughout this manual, important product information is proceeded by the terms "NOTE", "IMPORTANT", "CAUTION", and "WARNING". 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 Rating

The LiquidSpring DS98F suspension is rated for **9,750 lbs.**

WARNING: Overloading suspension system may result in abnormal handling characteristics and premature wear of components.

Serial Number Tag Information

The suspension model, serial number, and maximum axle capacity are found on an aluminum tag that is 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.

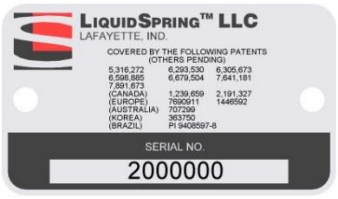


Figure 1. Suspension Identification

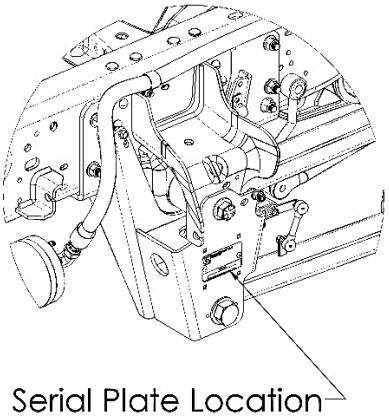


Figure 2. Serial Number Tag Location (view may not represent suspension in kit)

Vehicle Towing and Jacking Information

Before attempting any type of towing procedures, the OEM/Coach Builder must be referred to for the recommended towing methods.

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 OEM/Coach Builder 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.

Hydraulic Fitting Assembly

SAE O-Ring Adjustable Fittings

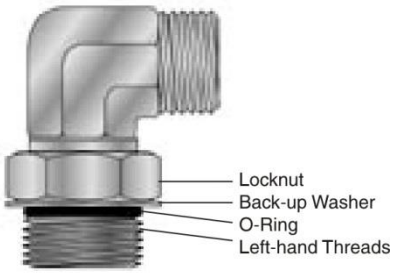


Figure 3. Adjustable SAE fitting

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.

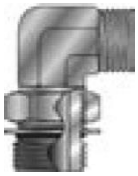


Figure 4. Locknut completely backed off.

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**
   -8 fitting: **27-39 ft-lbs**
   -10 fitting: **36-63 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. Disconnect the negative cable from the vehicle battery.
5. Remove the OEM shock absorbers.
6. Remove the OEM leaf springs and rear shackles.
7. If equipped with the midship fuel tank, dropping the tank may ease installation, but not necessary.
8. Remove the OEM Axle Stop Bumpers from under the frame. Retain for 4x4 vehicles.
9. Remove the driver and passenger side Parking Brake Cable wire form brackets and position the cable and conduit aside.
10. Remove the overload pads.
11. Remove the driver side shock mount.

Note: Do not remove sway bar or sway bar mounting components.

12. Locate the drilling template and follow the instructions in Appendix A: Drill Locations, page 46, for drilling holes in the framerail.

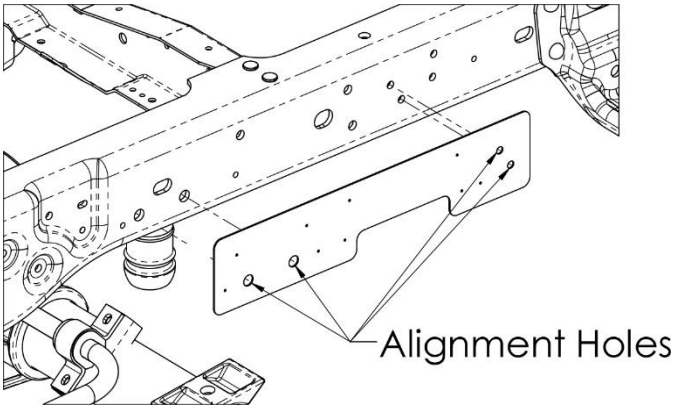


Figure 5. Location of Drilling Template on Driver Side Frame.

Note: See secondary volumes, page 20, for additional frame drill requirements.

Parts List Information

Abbreviations

HCS	Hex Cap Screw	HTCN	Hex Thin Castle Nut
HFB	Hex Flange Bolt	HFW	Hardened Flat Washer
SHCS	Socket Head Cap Screw	SLW	Spring Lock Washer
SFHS	Serrated Flange Hex Screw	SAE	SAE O-Ring Fitting
HN	Hex Nut, Non-locking	37°	SAE or JIC 37° Flare Fitting
LHN	Locking Hex Nut	LH	Left Handed Part
LFN	Locking Flange Nut	RH	Right Handed Part
CHN	Castle Hex Nut		

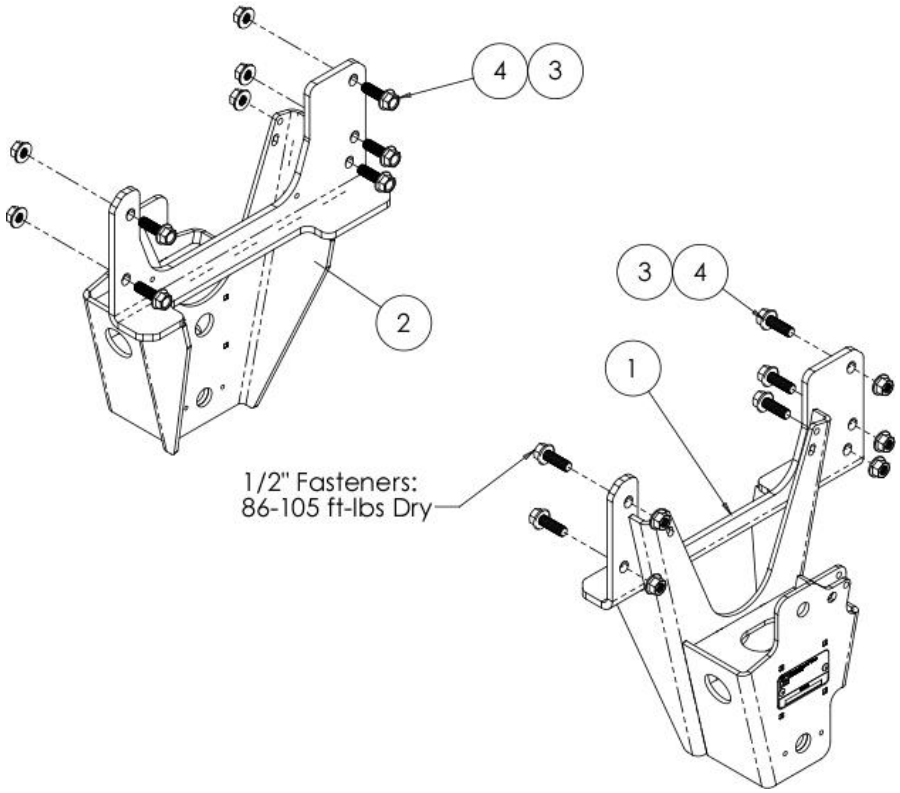
Special Tools

The following tools can assist in installation of the LiquidSpring system.

Bleed Kit (Actron 7840 shown, others similar).

Installation

Front Hangers



ITEM	QTY	PART NUMBER	DESCRIPTION	ITEM	QTY	PART NUMBER	DESCRIPTION
1	1	10538-004	Front Hanger, LH	3	10	10012-007	LFN 1/2-13, Gr. G
2	1	10539-008	Front Hanger, RH	4	10	10885-150	HFB 1/2-13 x 1.50”, Gr. G

1. Temporarily align hangers to OEM Ford Hangers using 3/4"-10 hardware.
2. While making sure hangers are flush to the bottom of the frame: mark holes to be drilled, remove hangers, and drill marked holes to Ø17/32”.

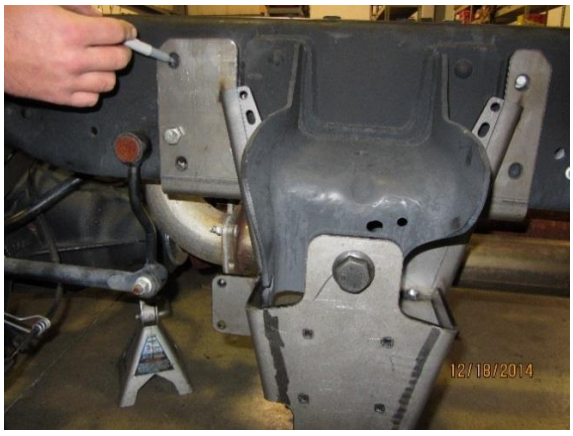
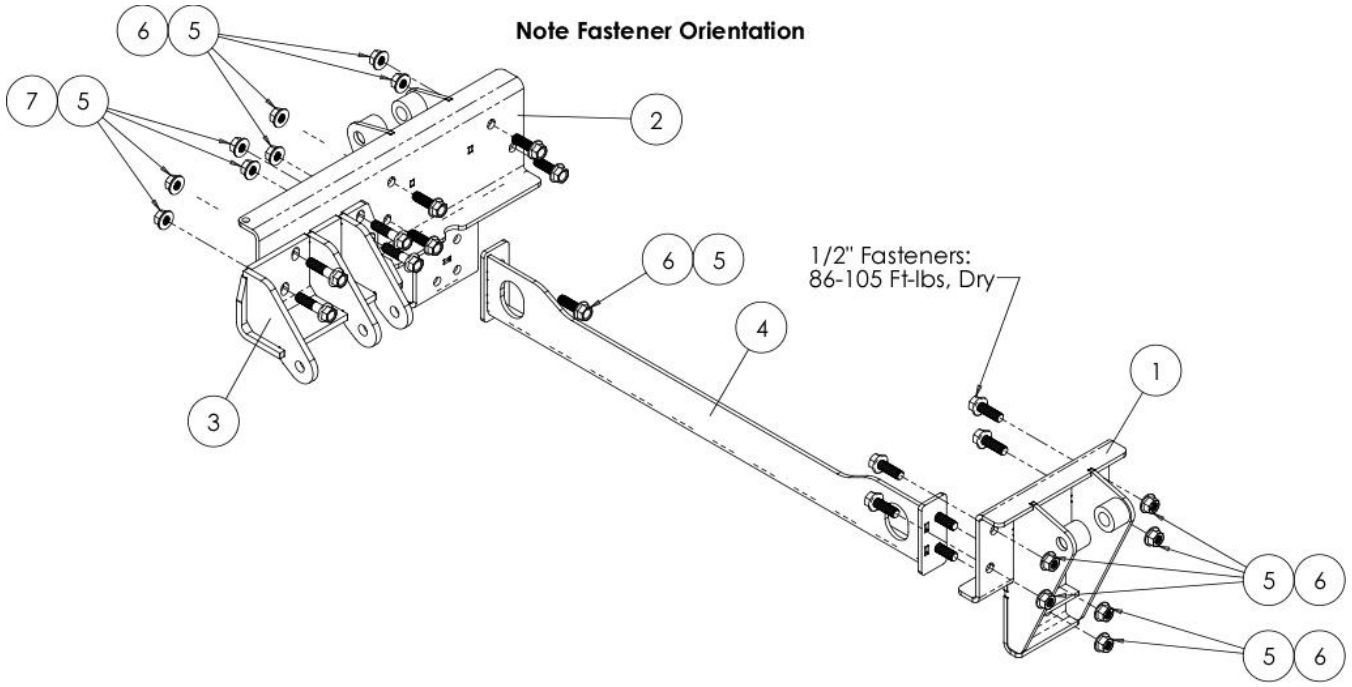


Figure 6: Passenger side hanger shown, marking holes for drilling

3. Reinstall the hangers with supplied fasteners.
4. Torque 1/2"-13 nuts to **86-105 ft-lbs.**

Upper Strut Mounts



ITEM	QTY	PART NUMBER	DESCRIPTION
1	1	10790-014	USM, LH
2	1	10790-015	USM, RH
3	1	10789-010	Track Rod Mount
4	1	10782-007	Crossmember Reinforcement

ITEM	QTY	PART NUMBER	DESCRIPTION
5	16	10012-007	LFN 1/2-13, Gr. G
6	12	10885-150	HFB 1/2-13 x 1.50”, Gr. 8
7	4	10885-200	HFB 1/2-13 x 2.00”, Gr. 8

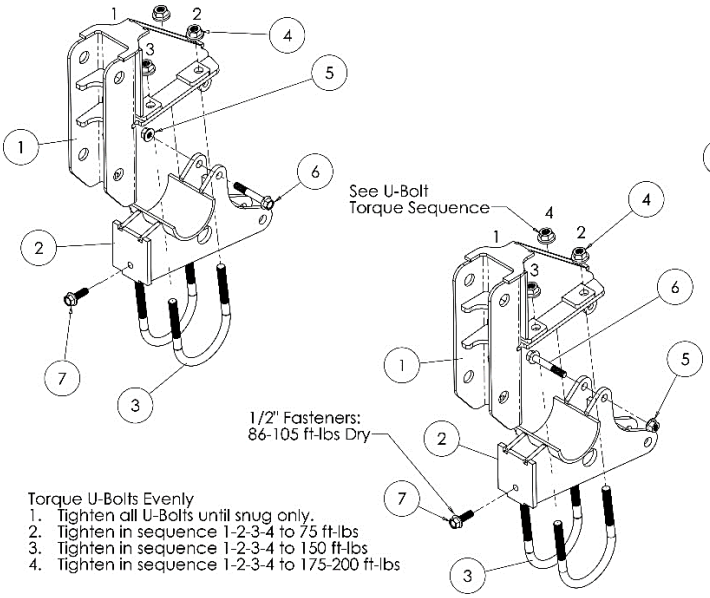
1. Loosely attach all components through previously drilled holes in frame.

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

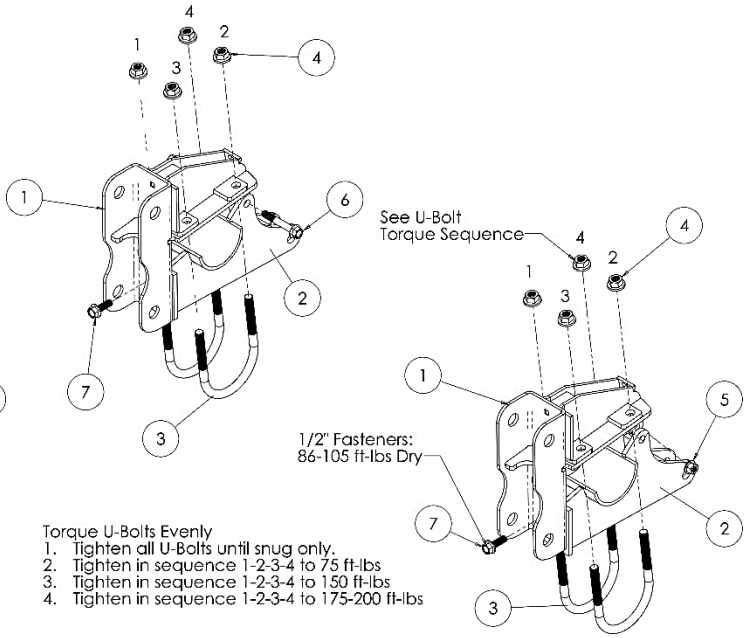
2. Torque all 1/2-13 nuts to **86-105 ft-lbs**.

Axle Clamp Hangers

4x4 Components



4x2 Components



ITEM	QTY	PART NUMBER	DESCRIPTION	ITEM	QTY	PART NUMBER	DESCRIPTION
1	2	10546-004	Axle Seat (4x4 Version)	4	8	10012-013	LFN 5/8-18, Gr. G
		10546-003	Axle Seat (4x2 Version)	5	2	10012-007	LFN 1/2-13, Gr. G
2	2	10552-003	Axle Cradle (4x4 Version)	6	2	10885-325	HFB 1/2-13 x 3.25, Gr. 8
		10552-002	Axle Cradle (4x2 Version)	7	2	10885-150	HFB 1/2-13 x 1.50, Gr. 8
3	4	10642-001	U-Bolt 5/8-18 x 7.00 Gr. 8	8	2	10804-001	Spiral Cable Wrap 3/8 OD x 12" L

1. Detach the hydraulic brake line flexible hose bracket from both the driver and passenger side axle seats and where it tee's at the middle of the axle. Retain clip under splitter Tee.

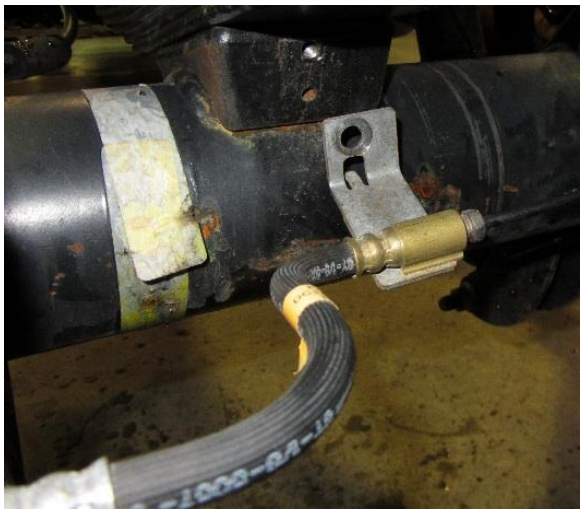


Figure 7. Driver side brake line bracket to detach.

Figure 8. Middle Tee bracket to remove.

2. Place the Axle Seat on to the Drivers Side axle spring seat. The Axle Seat should be flush to the top of the axle spring seat.
3. Place the Axle Cradle under the axle tube and loosely attach to the Axle Seat using the (1) 1/2" -13 x 3.25" Hex Flange Bolt and (1) 1/2"-13 Locking Hex Nut at the rear connection point. Use (1) 1/2"-13 x 1.50" Hex Flange Bolt at the front connection point.

4. Slip the 5/8” U-bolts into position. Lightly tighten u-bolts. Repeat to install the Right Hand Axle Seat Weldment, Axle Cradle, and 5/8” U-bolts.
5. **Torque, the U-bolt nuts evenly in an X-type pattern in 4 stages:**
   - **Stage 1: Tighten snug only.**
   - **Stage 2: Torque to 75 ft-lbs.**
   - **Stage 3: Torque to 150 ft-lbs.**
   - **Stage 4: Torque to 175-200 ft-lbs].**
6. Torque the 1/2” Fasteners to **86-105 ft-lbs.**
7. Reinstall the brake flexible line mounting brackets to back of the Axle Seat Weldments using 5/16” hardware provided in kit.

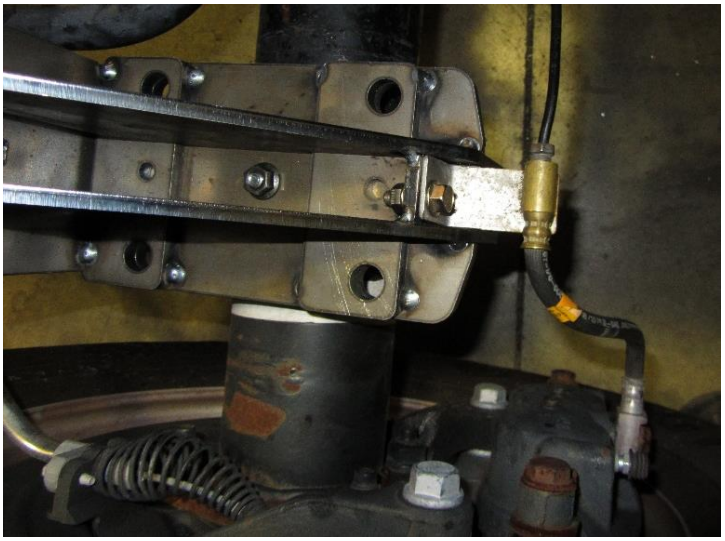


Figure 9. Attachment of driver side brake flexible line.

8. Install brake line relocation plate to splitter Tee as shown in Figure 10 using OEM C-clip and 1/2" hardware provided in kit and torque to **60 ft-lbs.**

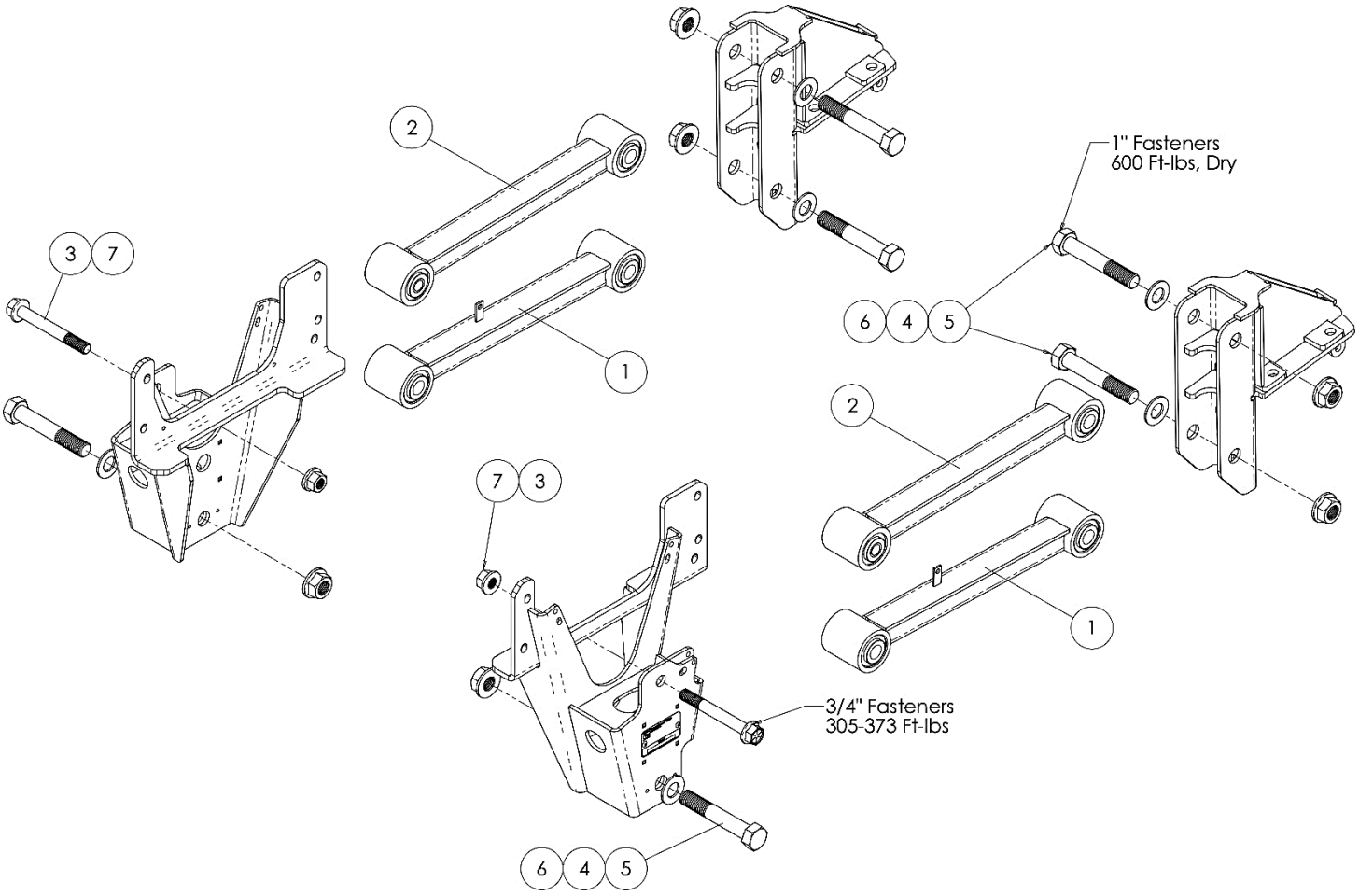
Note: The relocation plate is used to prevent bind in the hard brake line going to the driver side caliper.

Figure 10. Attachment of relocation plate to splitter tee.

Figure 11: Top-Down view of Rear Brake Splitter

9. Torque 5/16” hardware to **24 ft-lbs**.
10. Install Spiral wrap around brake line where contacts bridge. See Figure 11

Control Arms



ITEM	QTY	PART NUMBER	DESCRIPTION	ITEM	QTY	PART NUMBER	DESCRIPTION
1	2	10720-006	LCA	5	6	10003-003	HB 1.00-8 x 6.00, Gr. 8
2	2	10720-005	UCA	6	6	10012-003	LFN 1-8, Gr G
3	2	11102-600	HFB 3/4-10 x 6, Gr. 8	7	2	10012-014	LFN 3/4-10, Gr. G
4	6	10006-004	HFW 1.00				

1. Locate control arms and install as shown.

   Note: Upper Control arm must be installed with reducing spacer in front hanger.

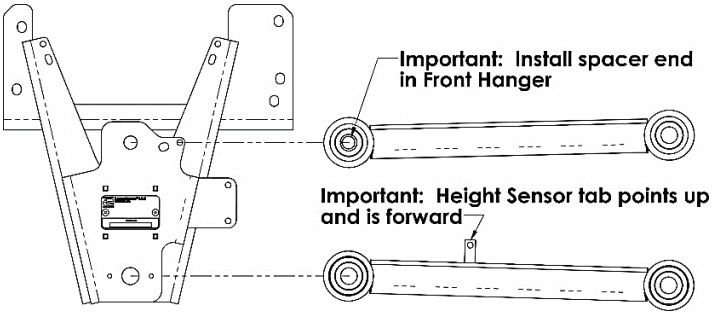
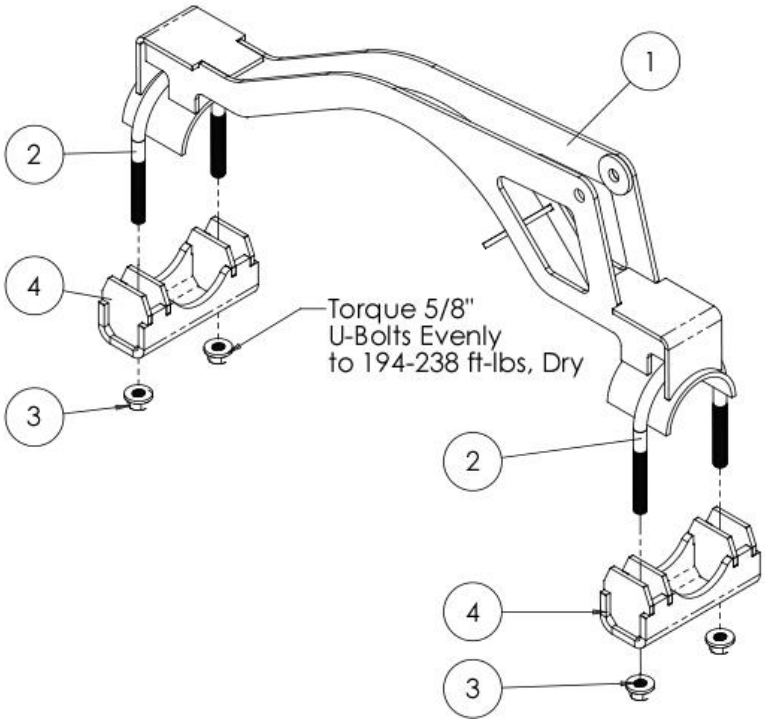


Figure 12: Orientation of Control Arms

2. Do **Not** Torque fasteners at this time. Torque after track rod is installed and axle is held at ride height.

Bridge



ITEM	QTY	PART NUMBER	DESCRIPTION	ITEM	QTY	PART NUMBER	DESCRIPTION
1	1	10762-006	Bridge	3	4	10012-013	LFN 5/8-18, Gr. G
2	2	10642-001	U-Bolt 5/8-18 x 7.00	4	2	11122-001	U-Bolt Saddle Clamp

1. Install Bridge as shown above.
2. The Bridge should be sitting approximately 90° to the frame. Tabs should locate the bridge in position as shown in Figure 13.

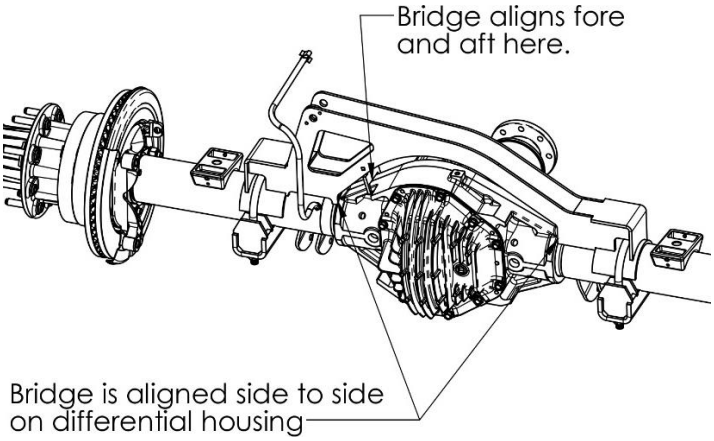


Figure 13: Bridge locating points

IMPORTANT: Make sure brake lines are clear when installing the bridge components.

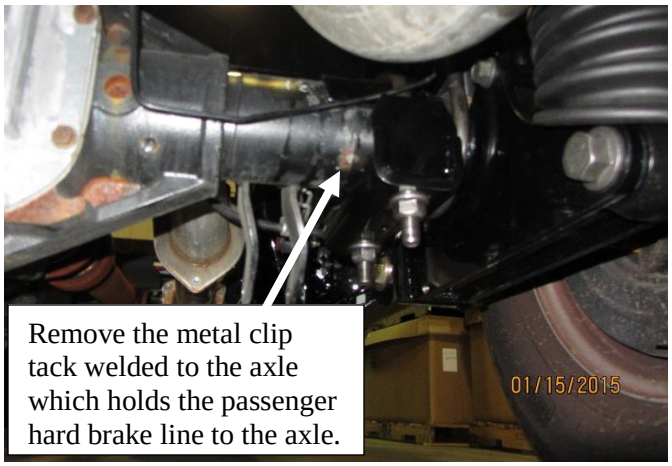
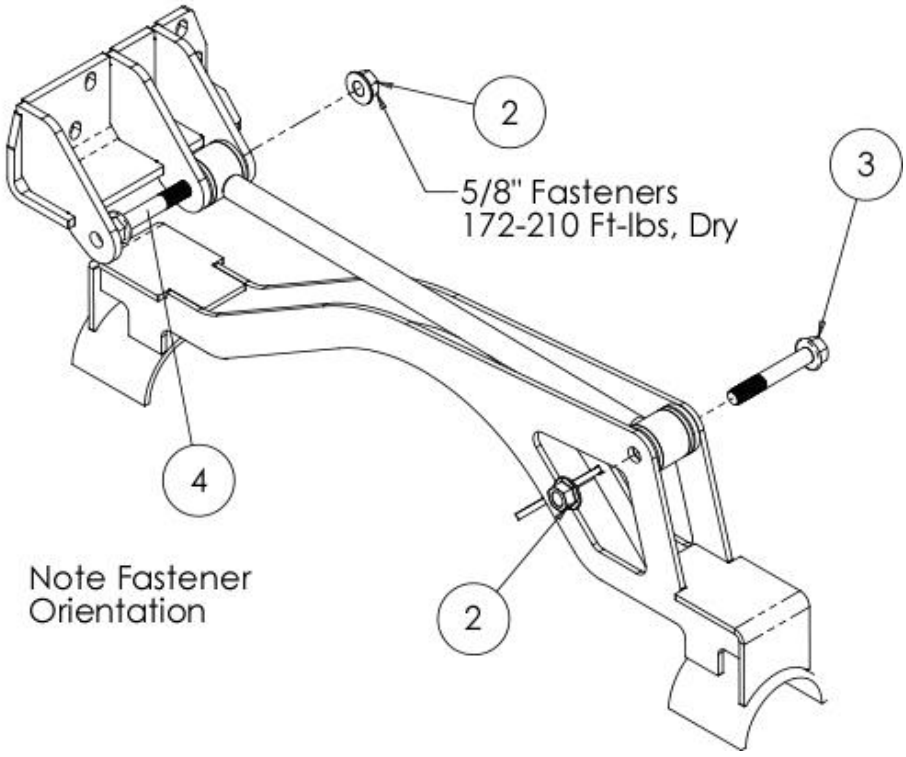


Figure 14: Remove passenger brake line clip on axle

3. Torque 5/8" U-Bolts to **194-238 ft-lbs**.

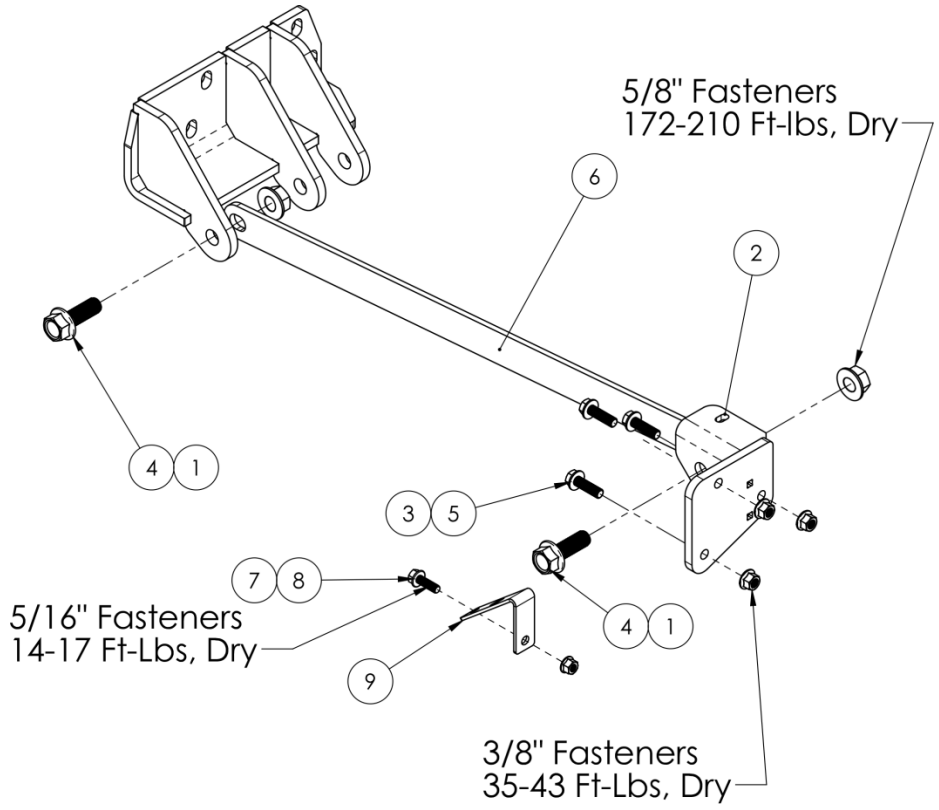
Track Rod



ITEM	QTY	PART NUMBER	DESCRIPTION	ITEM	QTY	PART NUMBER	DESCRIPTION
1	1	10786-001	Track Rod	3	1	10874-400	HFB 5/8-11 x 4.00, Gr. 8
2	2	10012-008	LFN 5/8-11, Gr. G	4	1	10874-375	HFB 5/8-11 x 3.75, Gr. 8

1. Install Track rod as shown above.
2. Raise or Lower Axle until Design Ride height is achieved. Ride Height is approximately when the track rod is horizontal.
3. Torque the two (2) 5/8” Track Rod mounting bolts to **172-210 ft-lbs.**
4. Final Torque the Control Arm mounting bolts.
   -3/4” Fasteners Torque to **305-373 ft-lbs**.
   -1” Fasteners Torque to **600 ft-lbs.**

Tie Bar Instalation



ITEM	QTY	PART NUMBER	DESCRIPTION	ITEM	QTY	PART NUMBER	DESCRIPTION
1	2	10012-008	LFN 5/8-11 Gr. G	6	2	10874-175	HFB 5/8-11 x 1.75, Gr. 8
2	1	11114-001	Tie Plate Mount	7	1	10012-010	LFN 5/16-18 Gr. G
3	1	11115-003	Tie Plate	8	1	10886-100	HFB 5/16-18 x 1.00, Gr. 8
4	3	10501-150	HFB 3/8-16 x 1.50, Gr. 8	9	1	10806-008	Fuel-Brake Line Relocation Bracket
5	3	10012-005	LFN 3/8-16, Gr. G				

1. Disconnect the (2) Factory Fuel and Brake line retainers, as circled in Figure 15, from the frame. Keep lines attached to the retainers.

Figure 15. Fuel and Brake Line Retainers to disconnect

2. Install Tie Plate Weldment where Driver side shock mount was previously located. The rearmost hole in the frame will need drilled out to clear the 3/8” bolt.

3. Install the Fuel-Brake Line Relocation Bracket into the same mount hole which the factory retainer, located in front of the shock absorber, was attached.

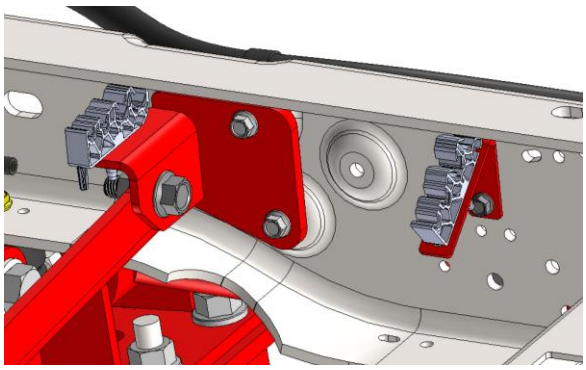


Figure 16. Relocation Bracket placement

4. Attach the factory retainers, with the lines attached, atop the Tie Plate Mount and Fuel-Brake Line Relocation Brackets as shown in Figure 16.

Figure 17 Fuel Lines route over top of Tie Bar Mount

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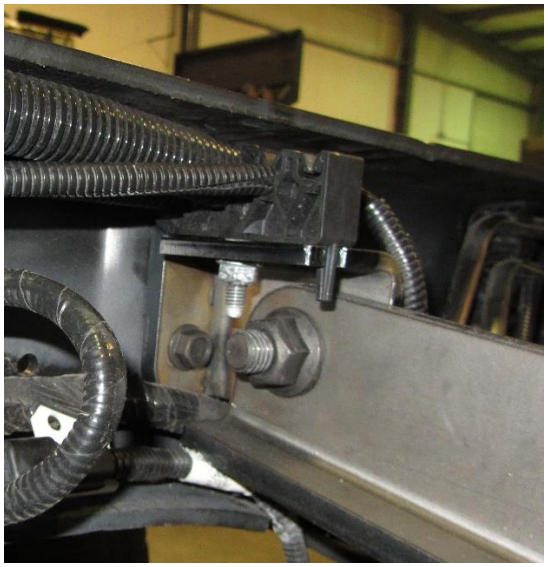
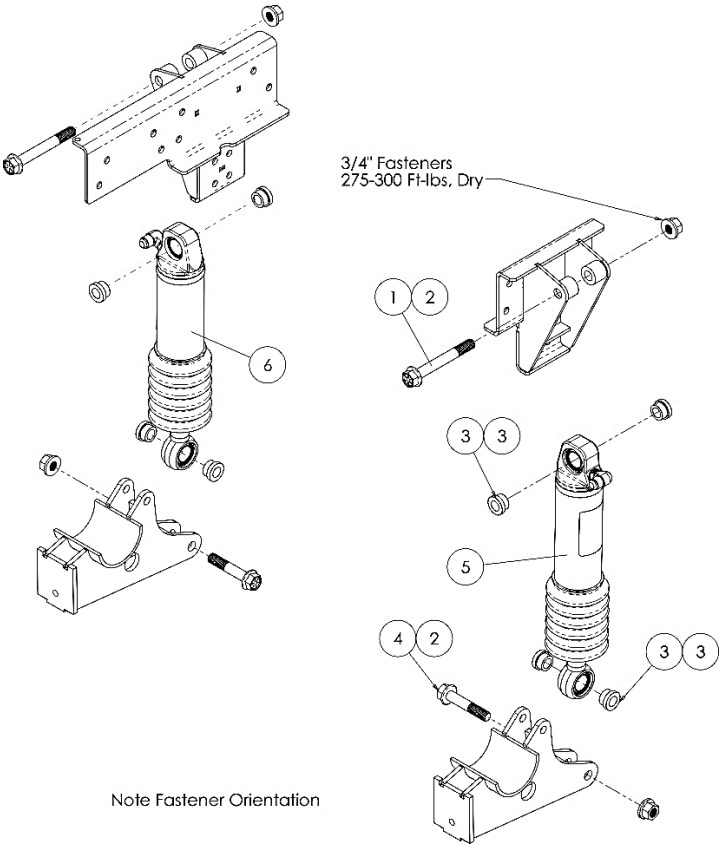


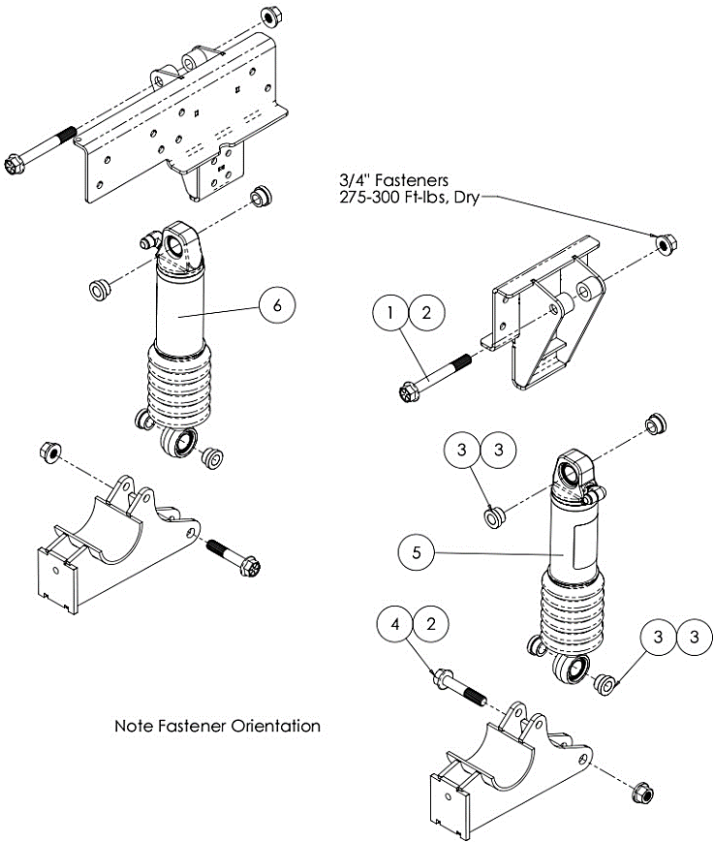
Figure 18 Fasten OEM Bracket to top of Tie Bar Mount

Strut Assembly Installation

4x4 Vehicle



4x2



ITEM	QTY	PART NUMBER	DESCRIPTION	ITEM	QTY	PART NUMBER	DESCRIPTION
1	2	11102-600	HFB 3/4-10 x 6 Gr. 8	5	1	11057-005	LH Strut Assembly (4x4)
2	4	10012-014	LFN 3/4-10 Gr. G			11057-001	LH Strut Assembly (4x2)
3	8	10640-005	Bearing Spacer, 1024 x .812 x .318	6	1	11057-006	RH Strut Assembly (4x4)
4	2	11102-400	HFB 3/4-10 x 4 Gr. 8			11057-002	RH Strut Assembly (4x2)

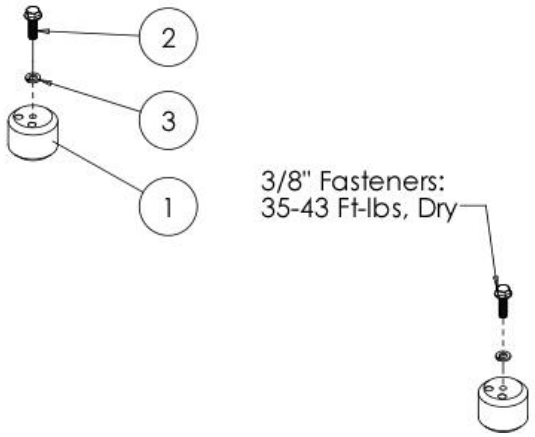
1. Install Struts as shown above.
2. Torque 3/4-10 fasteners to **275-300 ft-lbs, Dry**.
3. Included in the kit are two 8” sections of nylon spiral wrap (P/N: 10804-002). Install the spiral wrap as shown in **Error! Reference source not found.** to p rotect the hydraulic brake lines from chafing against the strut boots.

Figure 19: Install spiral wrap around brake whip hoses, on Driver and Passenger sides

Jounce Bumpers (4x4 vehicles only)

1. Locate OEM bumpers previously removed.
2. Re-Install in factory locations and Torque nuts to **42 ft-lbs.**

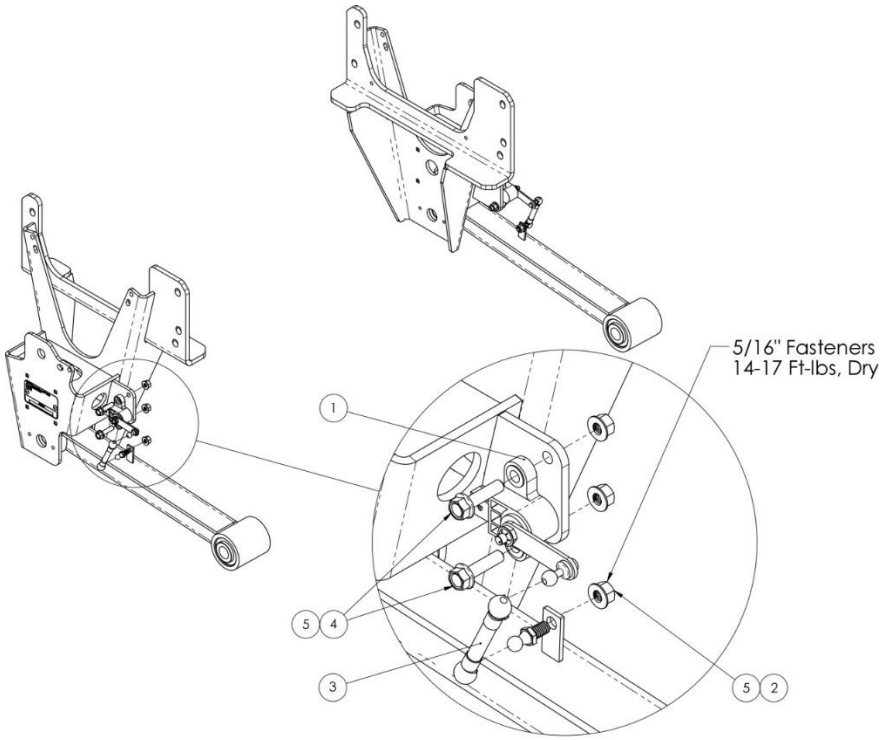
Jounce Bumpers (4x2 vehicles only)



ITEM	QTY	PART NUMBER	DESCRIPTION	ITEM	QTY	PART NUMBER	DESCRIPTION
1	2	10867-002	Jounce Bumper, 2.31" Dia x 1.88" T	3	2	10237-003	SLW 3/8
2	2	10501-002	HFB 3/8-16 x 1.25, Gr. 8				

1. Locate two jounce bumpers, two 3/8-16 flange bolts, and two split lock washers from the kit.
2. Install the new bumpers in the factory locations.
3. Torque to **42 ft-lbs, Dry**.

Height Sensors



Detail Of Assembly
Driver Side

ITEM	QTY	PART NUMBER	DESCRIPTION	ITEM	QTY	PART NUMBER	DESCRIPTION
1	2	10586-001	Height Sensor	4	4	10886-125	HFB 5/16-18 x 1.25, Gr. 8
2	2	10591-001	Ball Stud, 10mm x 5/16-18	5	6	10012-010	LFN 5/16-18, Gr. G
3	2	10857-005	Linkage				

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

1. Install Height Sensors as shown above. Refer to **Figure 20 or Figure 21** for detail of linkage.
2. Repeat with the Right Hand (Passenger Side).

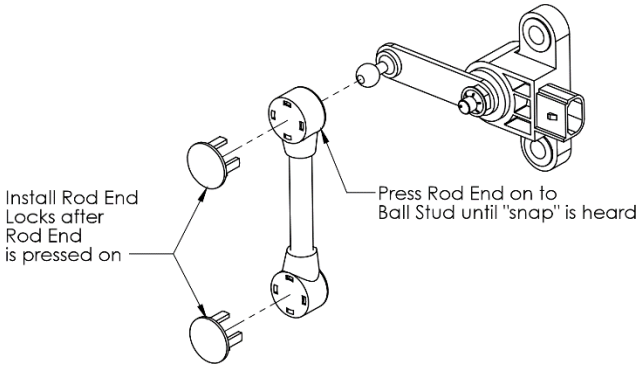


Figure 20. Height Sensor Plastic Linkage End Installation

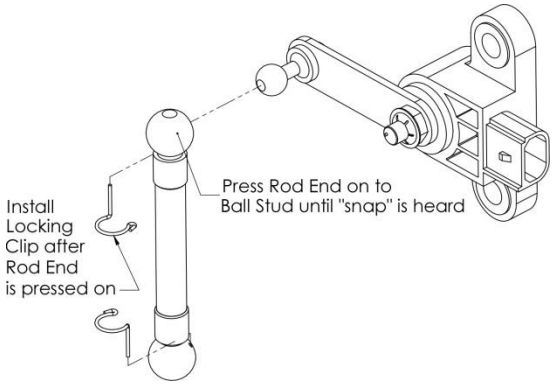
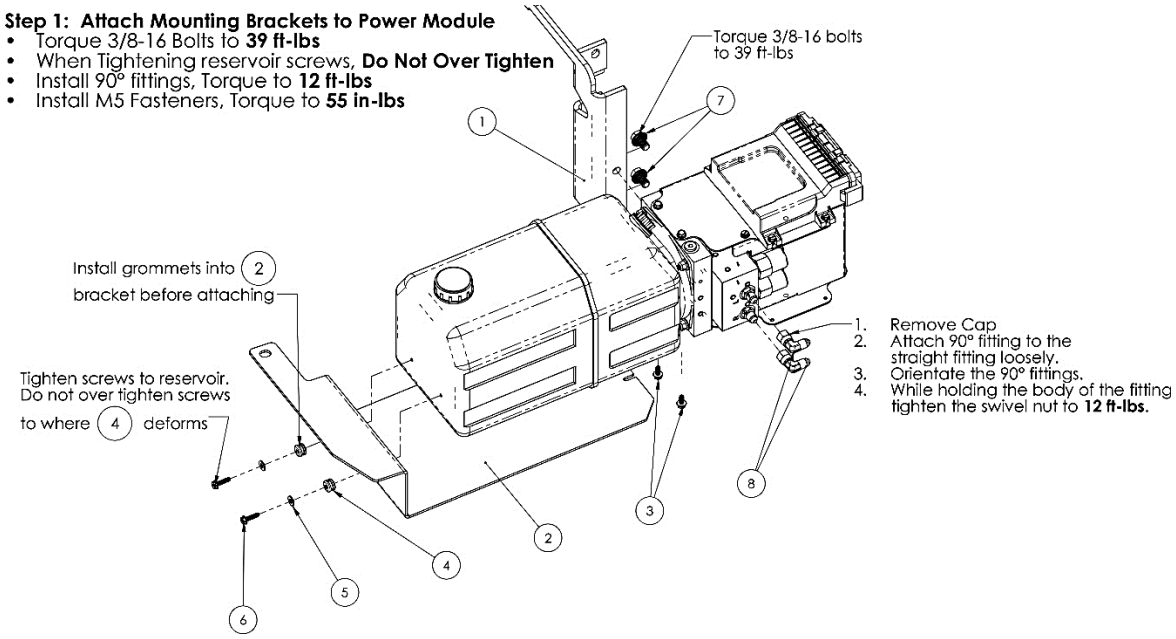
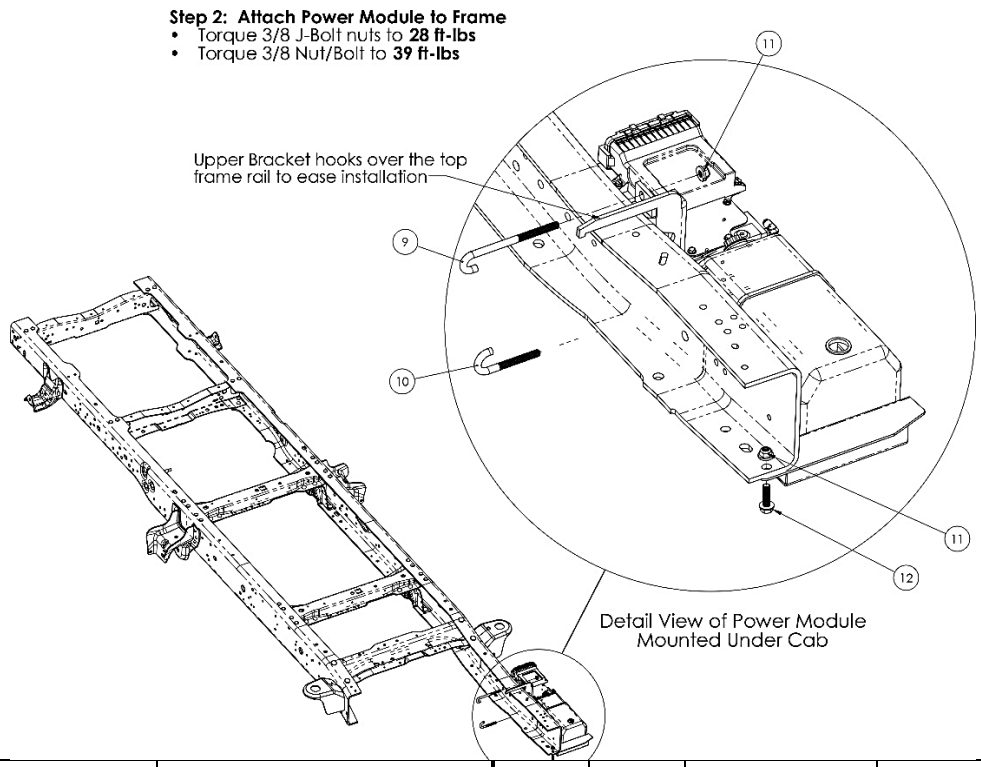


Figure 21. Height Sensor Metal Linkage End Installation.

Power Module Installation

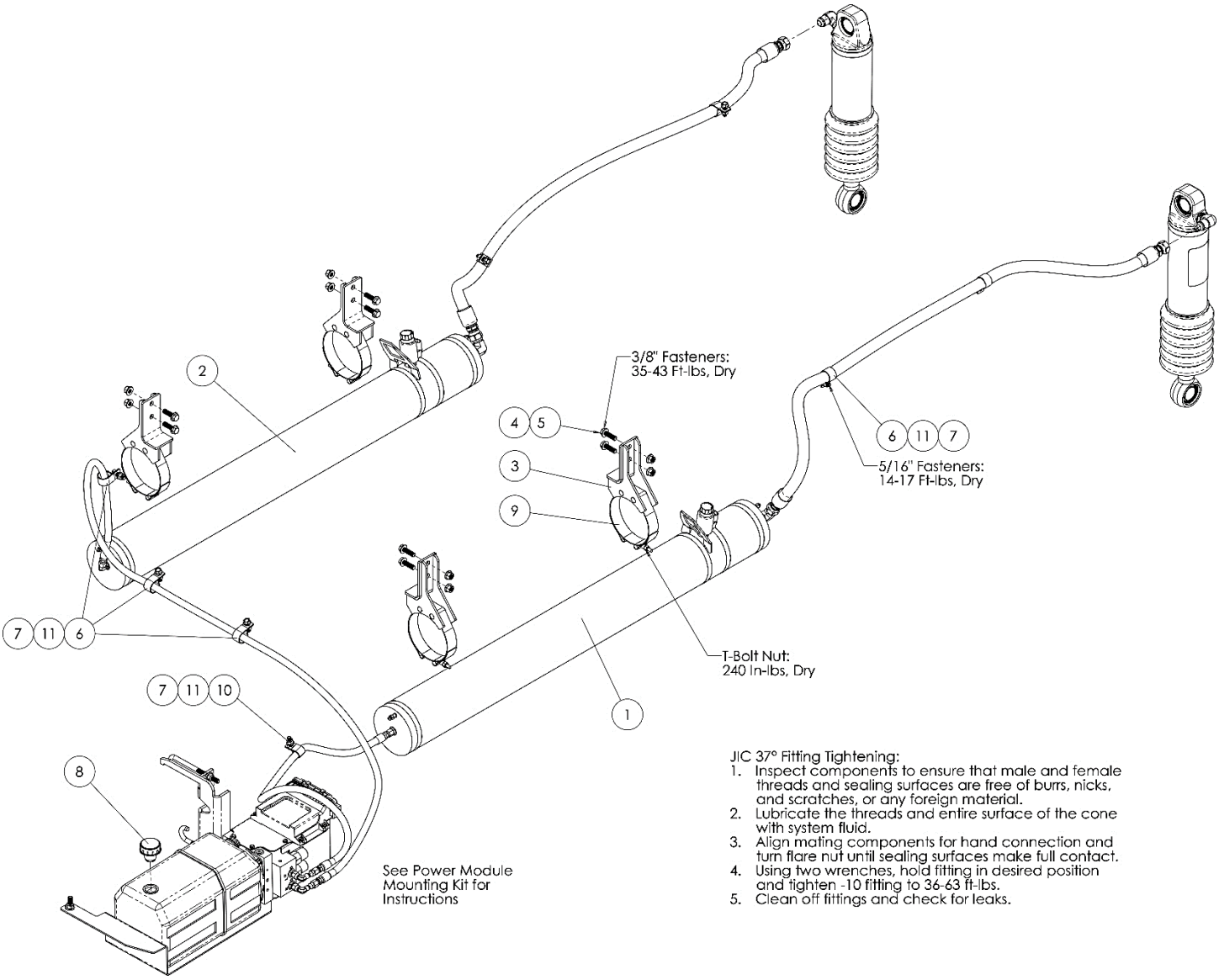




ITEM	QTY	PART NUMBER	DESCRIPTION	ITEM	QTY	PART NUMBER	DESCRIPTION
1	1	10799-014	Manifold Mount	7	2	10252-003	SFHS 3/8-16 x .625, Gr 8
2	1	10798-014	Reservoir Mount	8	2	10322-021	Hyd Fit 90, -4 37 x -4 37 F
3	2	11207-002	HFB M5-0.8 x 12 CL 10.9	9	1	10865-004	J-Bolt, 3/8-16 x 6" L
4	2	10805-004	Grommet, .19 ID x .56 OD x .375 T	10	1	10865-003	J-Bolt, 3/8-16 x 4" L
5	2	10088-001	FW #10	11	3	10012-011	LFN 3/8-16, Gr. G, Nylon Top
6	2	10510-002	STS #10-16 x .75, Hex Head	12	1	10501-002	HFB 3/8-16 x 1.25, Gr 8

1. Locate the Power Module Assembly and Power Module Mounting Kit.
2. Follow instructions supplied with the hardware for attaching brackets to the power module.

Secondary Volumes



ITEM	QTY	PART NUMBER	DESCRIPTION	ITEM	QTY	PART NUMBER	DESCRIPTION
1	1	10579-049	Asy, 2nd Volume, LH	7	7	10886-100	HFB 5/16”-18 x 1.00” Gr 8
2	1	10579-050	Asy, 2nd Volume, RH	8	1	10614-001	Breather Cap
3	4	10830-013	Volume Mount	9	4	10843-003	T-Bolt Clamp, Range 4.88-5.5
4	8	10501-150	HFB 3/8-16 x 1.50, Gr. 8	10	2	10855-003	Vinyl Coated Loop Clamp, 5/8” ID
5	8	10012-005	LFN 3/8-16, Gr. G	11	7	11012-010	LFN 5/16-18, Gr. G
6	7	10855-002	Vinyl Coated Loop Clamp, 1” ID				

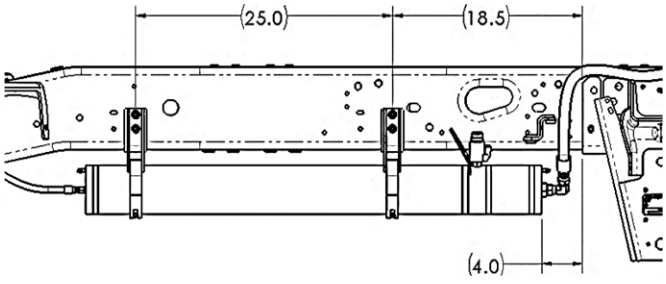
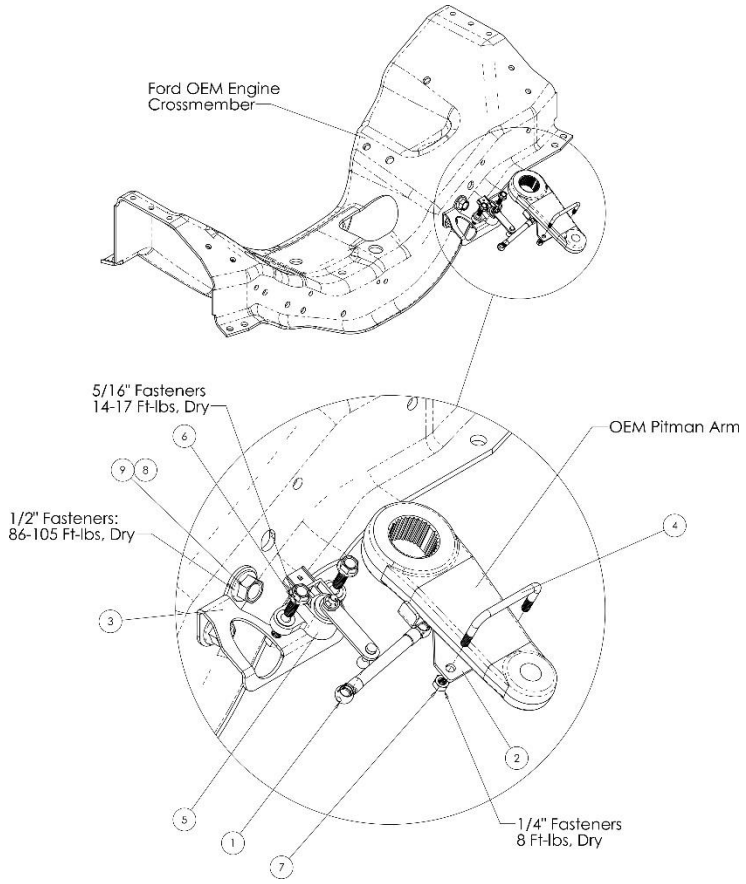


Figure 22. Secondary Volume mount locations

1. Place the mounts against the driver side frame, forward of the front hanger. Figure 22 shows suggested locations.
2. 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.
3. Repeat with (2) more Volume Mount Weldments on the passenger side of the frame.

Steering Sensor Installation



ITEM	QTY	PART NUMBER	DESCRIPTION	ITEM	QTY	PART NUMBER	DESCRIPTION
1	1	10587-006	Asy, Linkage 3.938" SS	6	2	10886-100	HFB 5/16-18 x 1.00, Gr. 8
2	1	10904-014	Ball Stud Bracket	7	2	10004-024	LHN 1/4-20, Gr. 2, Centerlock
3	1	10741-004	Steering Sensor	8	2	10012-007	LFN 1/2-13, Gr. G
4	1	10669-002	U-Bolt, 1/4-20 x 2.438 x 1.375, Gr 2	9	2	10885-150	HFB 1/2-13 x 1.50, Gr. 8
5	1	10586-002	Steering Sensor				

1. Raise the front end of the vehicle, per OEM instructions.
2. ***(4X4 Vehicles Only)*** Remove and retain Lower two of three nuts securing front track rod mount to cross member. See Figure 23.

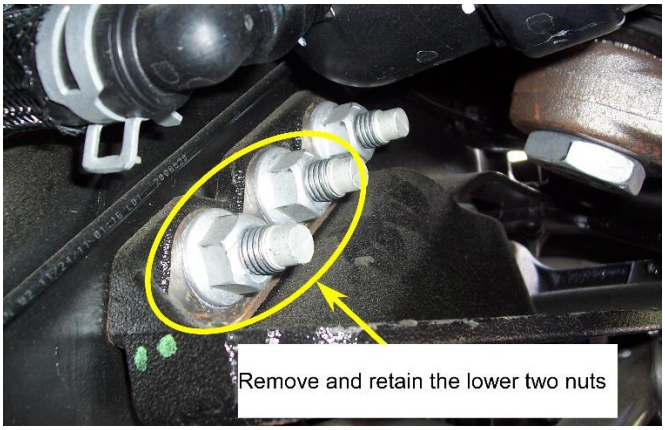


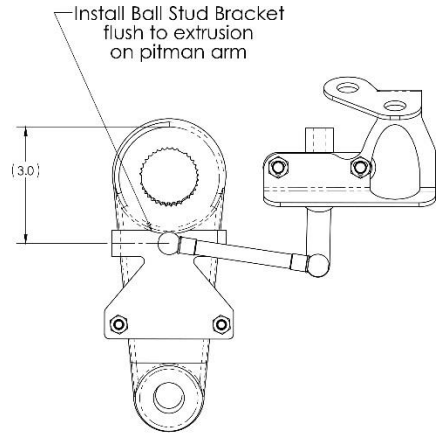
Figure 23. Track rod mount bolts to temporarily remove (4x4 Vehicles Only).

3. ***(4X4 Only)*** Install bracket over two bolts and reinstall nuts. Torque to **120 – 147 ft-lbs**

4. ***(4x2 Only)*** Install bracket over two provided 1/2" fasteners in Lower two holes shown. Torque to **86-105 ft-lbs.**
5. Route the steering sensor branch containing the J35 steering sensor connector.to the steering sensor.

Important: Verify the wiring harness does not contact heat source or moving components.

6. Connect the electrical connector to the steering sensor prior to installation of the Steering Sensor.
7. Install the steering sensor components.



Note: Underside View
of Steering Sensor Components

8. Turn steering wheel to full lock in either direction to check for any interference.

Parking Brake Cable

1. Loosely reinstall the driver side parking brake cable formed wire brackets as shown below. The Driver side cable bracket is relocated to the front hanger using supplied 5/16" hardware.
2. The Passenger side wire-formed bracket is relocated to the front hanger using supplied 5/16" hardware.

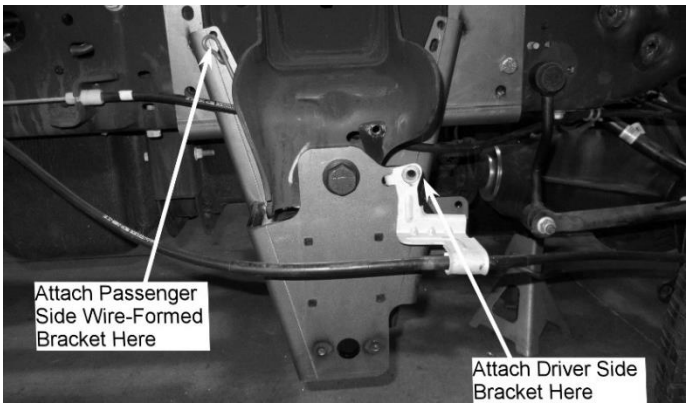


Figure 24. Reinstallation of the formed wire brackets.

Hydraulic Hose Attachment

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

CAUTION: During shipping, the fluid inside of the volume may have heated up causing increased pressure. Always open the bleed screw to relieve pressure prior to removing plugs in the hoses.

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.

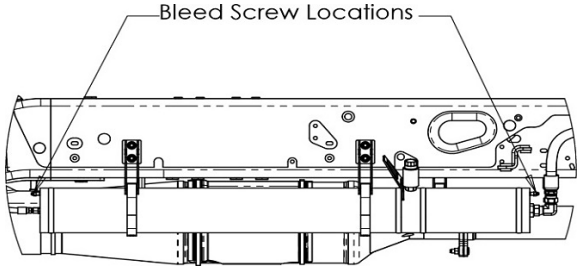


Figure 25. Bleed screw locations.

3. Open the bleed screw slightly to relieve any residual pressure.
4. After pressure is relieved, close the bleed screw and torque to **13-18 ft-lbs.**
5. Remove the cap from the strut port.
6. Raise the end of the -10 (5/8") hose, attached to the volume assembly, above the secondary volume to prevent fluid loss.

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

7. Remove the plug from the end of the hose.
8. Attach the hose end (-10 JIC fitting) to the strut port.
9. Torque to **36-63 ft-lbs.**
10. Repeat with the opposite side.
11. Route the Left Hand (Driver side) -4 (1/4") hydraulic hose, attached to the volume assembly, to the Power Module. Use of hose clamps is recommended to secure the hose from movement or chafing.

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

12. Remove the cap from the -4 JIC fitting mounted on the side of the power module assembly.
13. Remove the plug from the hose end.
14. Attach the hose end to the side mounted fitting. Torque to **12 ft-lbs. Do not over tighten.**
15. Route the Right Hand (Passenger side) -4 (1/4") hydraulic hose, over the frame, to the power module assembly. Use of hose clamps is recommended to secure the hose from movement or chafing.

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

16. Remove the cap from the bottom mounted -4 JIC fitting on the power module.
17. Remove the plug from the hose end.
18. Attach the hose end to the bottom mounted -4 JIC fitting. **Torque to 12 ft-lbs. Do not over tighten.**
19. Clean up any fluid spillage.
20. Re-install tires and wheels as per OEM instructions

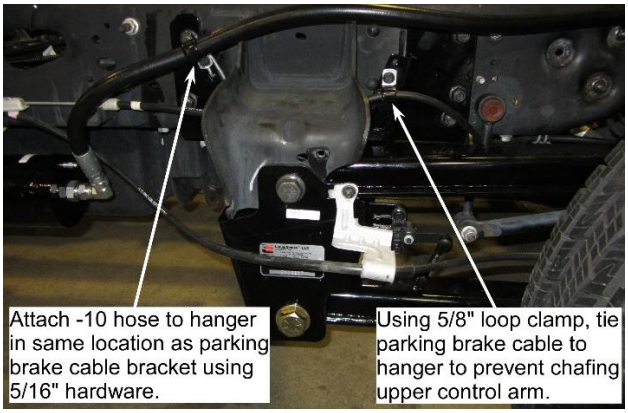


Figure 26. Hose and cable Routing at front hanger

External Electrical Installation:

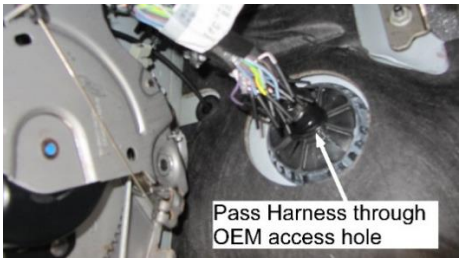
1. Locate the External Electrical Harness attached to the power module.
2. Unroll the wiring harness and using the External Electrical Harness wiring diagram, found in the electrical schematics section, and identify the connection ends.
3. Locate the trunk containing Height Sensor (J21 and J22) and the Rate Valve (J23 and J24) connections.
4. Route and make the following connections to the Height Sensors.

J21	→	Left Height Sensor
J22	→	Right Height Sensor

5. Route and make the following connections to the Rate Valves.

J23	→	Left Rate Valve
J24	→	Right Rate Valve

6. Secure harness to OEM harness. Use of plastic clips is recommended.
7. Locate the 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 may be applied after ring terminal is secured.
10. Route the remaining trunk (containing blunt wires and steering sensor connector) towards the firewall. Secure to OEM wiring harness.
11. Locate the existing firewall access hole under the dash, behind the brake pedal and just above the OEM customer access upfitter wiring.
12. Route the wiring harness branch containing the (8) 18ga blunt wires through the firewall access hole.



13. Locate the 8ga battery connection branch.
14. Route branch to the driver side battery positive terminal.
15. Locate the Battery Fuse Lead containing the 80 amp fuse.
16. Crimp the fuse lead to the 8ga battery connection branch blunt end.
17. Melt the heat shrink on the crimped connection to seal the splice.
18. Remove the 80 amp fuse and retain.
19. Connect to the positive terminal post per OEM Upfitter wiring instructions.

Figure 27. OEM Upfitter Driver Side Terminal Connection instruction.

Important: Do not connect to passenger side battery.

Dash Electrical Harness Installation:

1. Locate the dash harness.
2. Locate and identify the following 18ga wires in the external wiring harness branch passed through the firewall:
   Red (Battery Power)
   Yellow (Ignition)
   Black (Ground)
   White (CAN High)
   White/Black (CAN Low)
   Violet/White (Speed)
   Pink/Black (Brake)
3. Connect each wire to the corresponding wire in the dash harness using appropriate butt splices. Match wire colors. Heat shrink sealing is optional.

Figure 28. Accessing inside of side kick panel.

4. Remove outboard side kick panel, from around parking brake.
5. Locate dash harness.
6. Attach ring terminal J32 to ground screw.

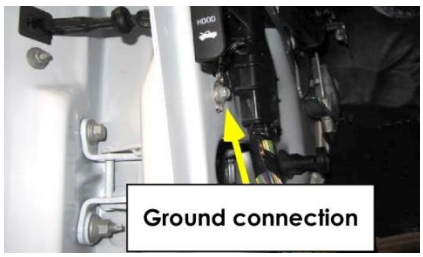


Figure 29. Location of ground connection.

7. Locate the OEM customer access upfitter wiring, under the dash, behind the brake pedal. Figure 30.

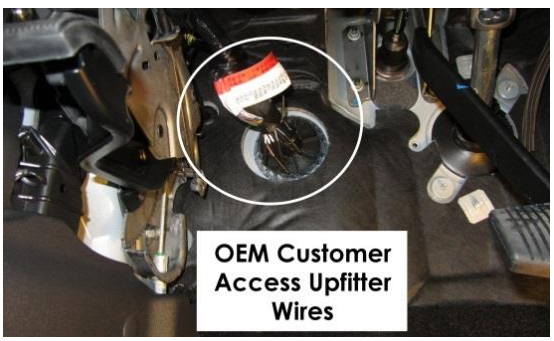


Figure 30. Customer Access wires.

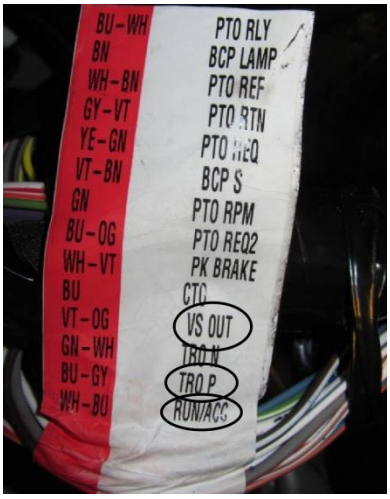


Figure 31. Customer access wires utilized.

8. Remove some of the electrical tape to reveal the blunt-cut wires.
9. In the OEM Upfitter wiring bundle, locate the "VS OUT", Violet/Orange, wire and strip end.
10. Splice the Violet/Orange to the dash harness Violet/White (W55) wire, using the appropriate butt splice and crimp. Reference the Dash Harness Schematic.
11. In the OEM upfitter wiring bundle, locate the "RUN/ACC", White/Blue, wire and strip end.
12. Splice the White/Blue end to the dash harness Yellow only (W58) wire, using the appropriate butt splice, and crimp. Reference the Dash Harness Schematic.
13. In the OEM upfitter wiring bundle, locate the "TRO P", Blue/Grey, wire and strip end.
14. Splice the Blue/Grey end to the dash harness Yellow/Black (W61) wire, using the appropriate butt splice, and crimp. Reference the Dash Harness Schematic.

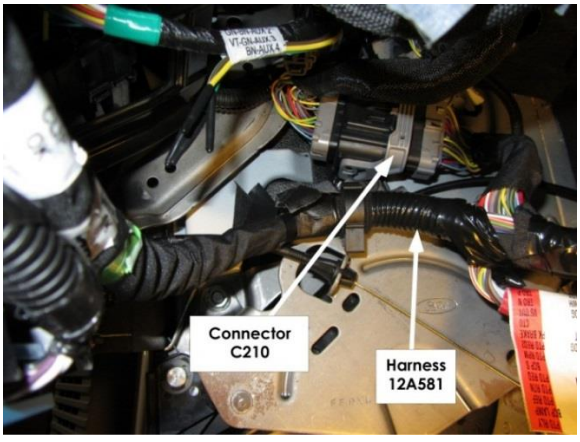


Figure 32. Wiring bundle to access (Diesel shown).

15. Locate the vehicle wire harness 12A581 under steering column. See Figure 32.

16. Remove the electrical tape from harness at Customer Access wire bundle junction. Pull back any sheathing to gain access to the White/Red wire in harness 12A581. See Figure 33

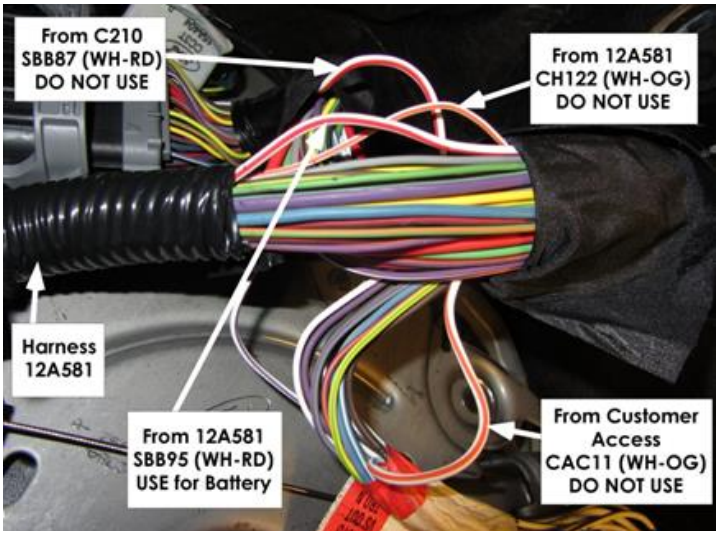


Figure 33: Identification of Battery wire to splice

CAUTION: Do not cut the White/Orange wire in harness 12A581. Do not cut the White/Red wire from connector C210. Do not cut the White/Orange wire from Customer Access bundle.

17. Cut White/Red wire in harness 12A581 near Customer Access wire junction bundle, Strip one end of the White/Red wire and insert into the heat shrinkable butt splice and crimp.

18. Strip the dash harness Red (W96) wire and the other end of the vehicle White/Red wire and twist together. Insert the twisted pair into the other end of the heat shrinkable butt splice and crimp.

19. Heat the insulation of the butt splice to seal the connection.

20. Re-sheath the vehicle wiring bundle and rewrap with appropriate electrical tape.

21. Locate the Pink/Black (Brake) wire in the dash harness and route behind the center dash, to the trailer brake control module. See Figure 34.

Figure 34: Trailer Brake Module in Dash

22. Remove the trailer brake controller from the dash panel. Remove tape around the wiring and locate the Blue/Orange (Brake signal) wire routed to the connector. See Figure 35

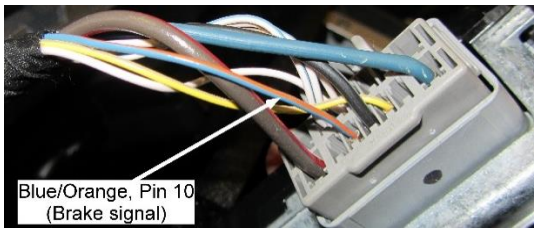


Figure 35: Brake signal wire at Trailer Brake Module

23. Splice the Pink/Black wire to the Blue/Orange wire on the trailer brake module as in Figure 36, and re-sheath with tape.

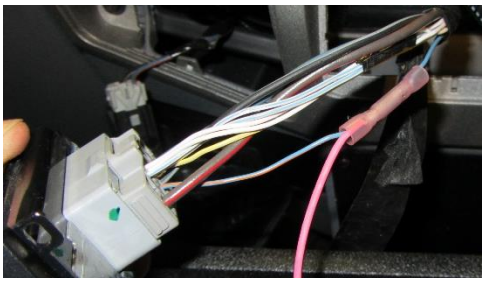


Figure 36: Brake signal splice

24. Reinstall the trailer brake controller to the dash.

Note: For optional Brake signal wiring without trailer brake controller, follow steps 25 through 36.

25. Route the Pink/Black wire to the passenger side kick panel area. See Figure 37

Figure 37. Passenger side kick panel to remove.

26. Locate connector C2280F (brown colored) on the Body Control Module (BCM). See Figure 38.

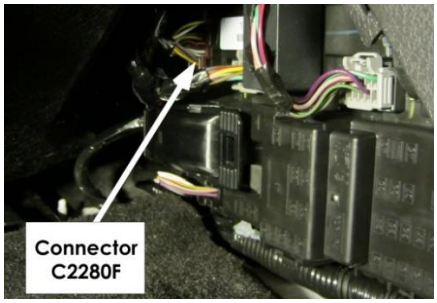


Figure 38. Location of Connector C2280F.

27. Disconnect connector C2280F from the BCM.
28. Remove the electrical tape to gain access to the Brake Signal wire (Blue/Orange) at Pin #19 in Connector C2280F. See Figure 39.

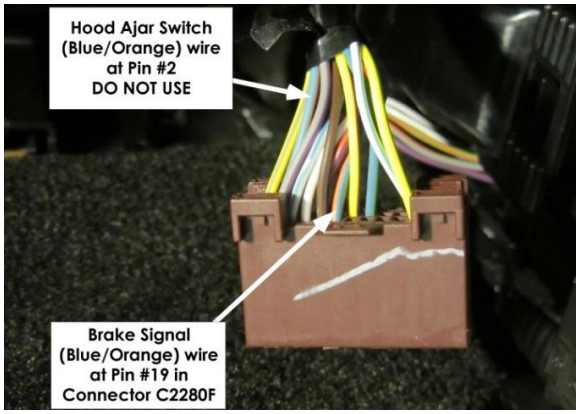


Figure 39. Wire to splice in Connector C2280F.

CAUTION: Do not cut Hood Ajar Switch wire (also Blue/Orange) at Pin #2 in Connector C2280F.

29. Cut the Brake Signal (Blue/Orange) wire at Pin #19 in Connector C2280F approximately 4" from the connector. See Figure 39.
30. Strip one end of the Brake Signal (Blue/Orange) wire and insert it into the heat shrinkable butt splice and crimp.
31. Strip the other end of the Brake Signal (Blue/Orange) wire and the dash harness Pink/Black (W59) wire and twist together. Insert the twisted pair of wires into the other end of the heat shrinkable butt splice and crimp.
32. Heat the insulation of the butt splice to seal the connection.
33. Refit any sheathing and apply appropriate electrical tape.
34. Reconnect connector C2280F to the BCM.

CAUTION: Connector C2280F must be connected to the Body Control Module before starting the vehicle or reconnecting the battery.

35. Replace the passenger side kick panel.
36. Replace the driver side plastic kick panel, weather stripping, and sill plate.

Driver Interface Installation:

1. Locate driver interface.
2. Mount the driver display in appropriate location according to Ford QVM/Body Builder Guidelines or Final Stage Manufacturer requirements. Use supplied Velcro to secure as needed.
3. Route and secure driver interface harness accordingly to connect to dash harness connector J12 underneath dash on driver's side.

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).

System Preparation

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 Silicone 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.

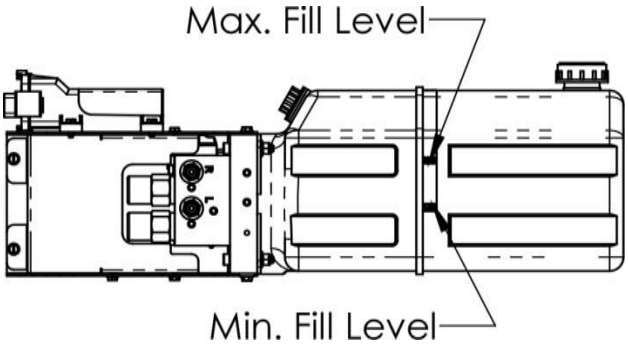


Figure 40. Final fill fluid level.

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.

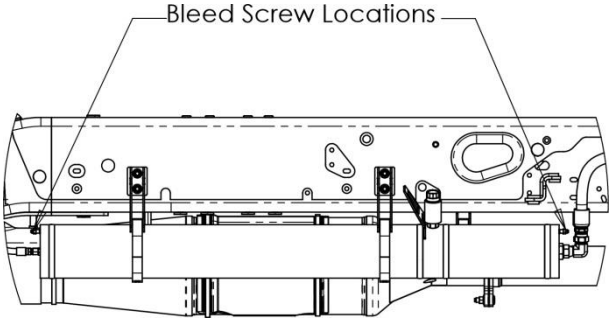


Figure 41. Bleed screw locations.

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.

Post Installation Welding

WARNING: Prior to any chassis welding conducted after the installation of the LiquidSpring suspension system, disconnect cables from battery, disconnect ECU Header connectors (see below), and Power Module ground connection (see below).

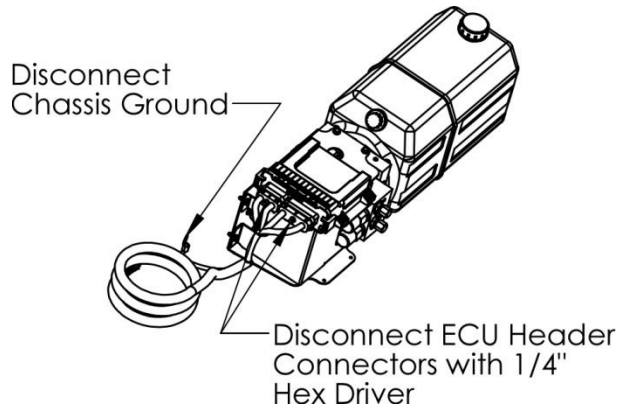
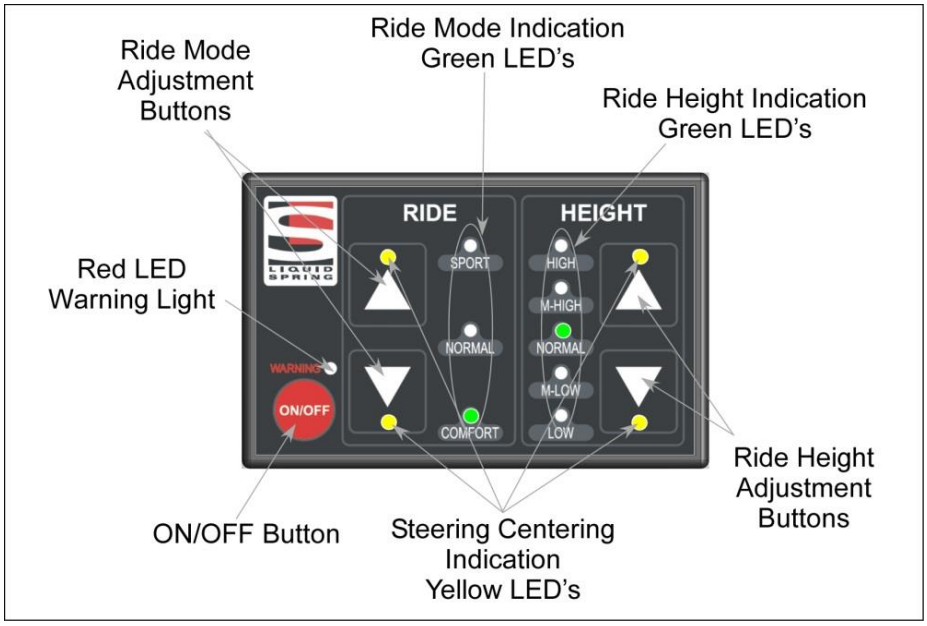


Figure 42. ECU disconnects prior to welding on chassis.

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 Error! Reference source not found. **S ection** on page 33

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.

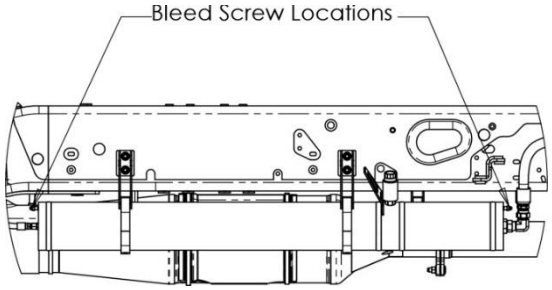


Figure 71. Bleed screw locations.

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.

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 cannot 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

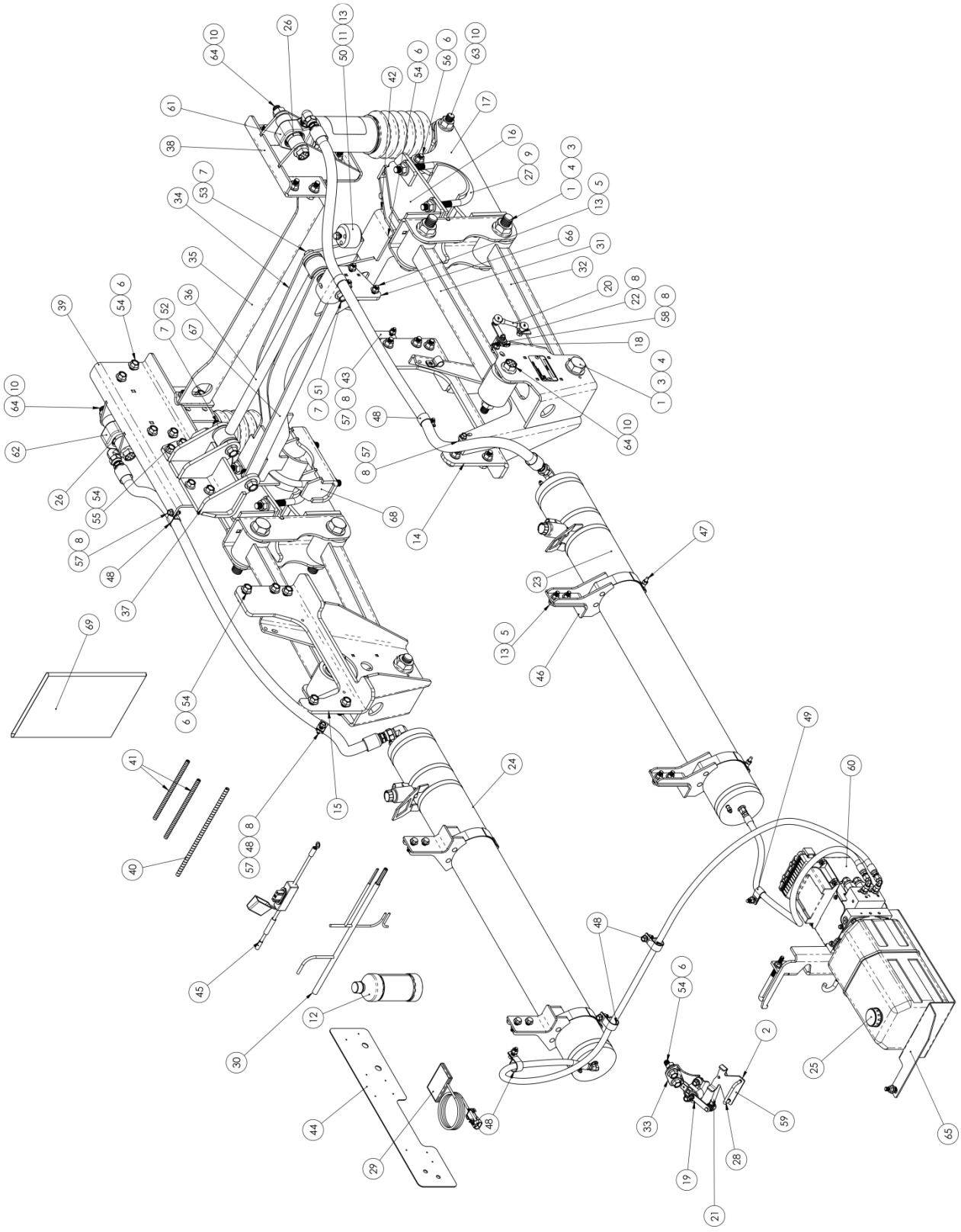
Condition	Cause	Correction
Hydraulic Leak	Weld failure between cylinder and end	Replace strut
	Cylinder fracture	Replace strut
	Threads stripped between cylinder and gland	Replace strut
	Seals worn out	Replace strut
	Rod severely scratched or dented	Replace strut
	Fitting loose	Tighten or replace fittings
	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

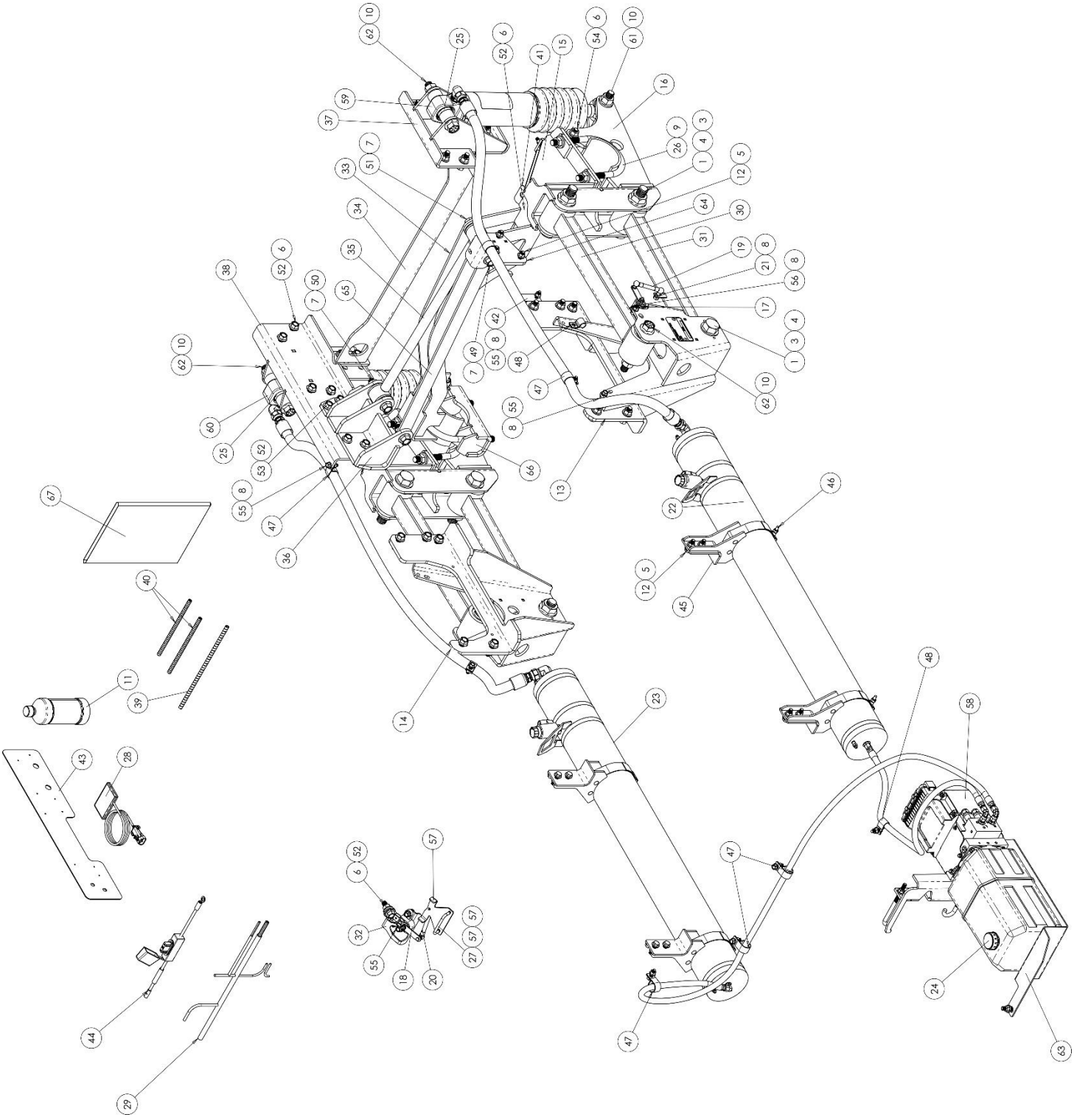
Part Identification:

DS98F2-A (4x2)



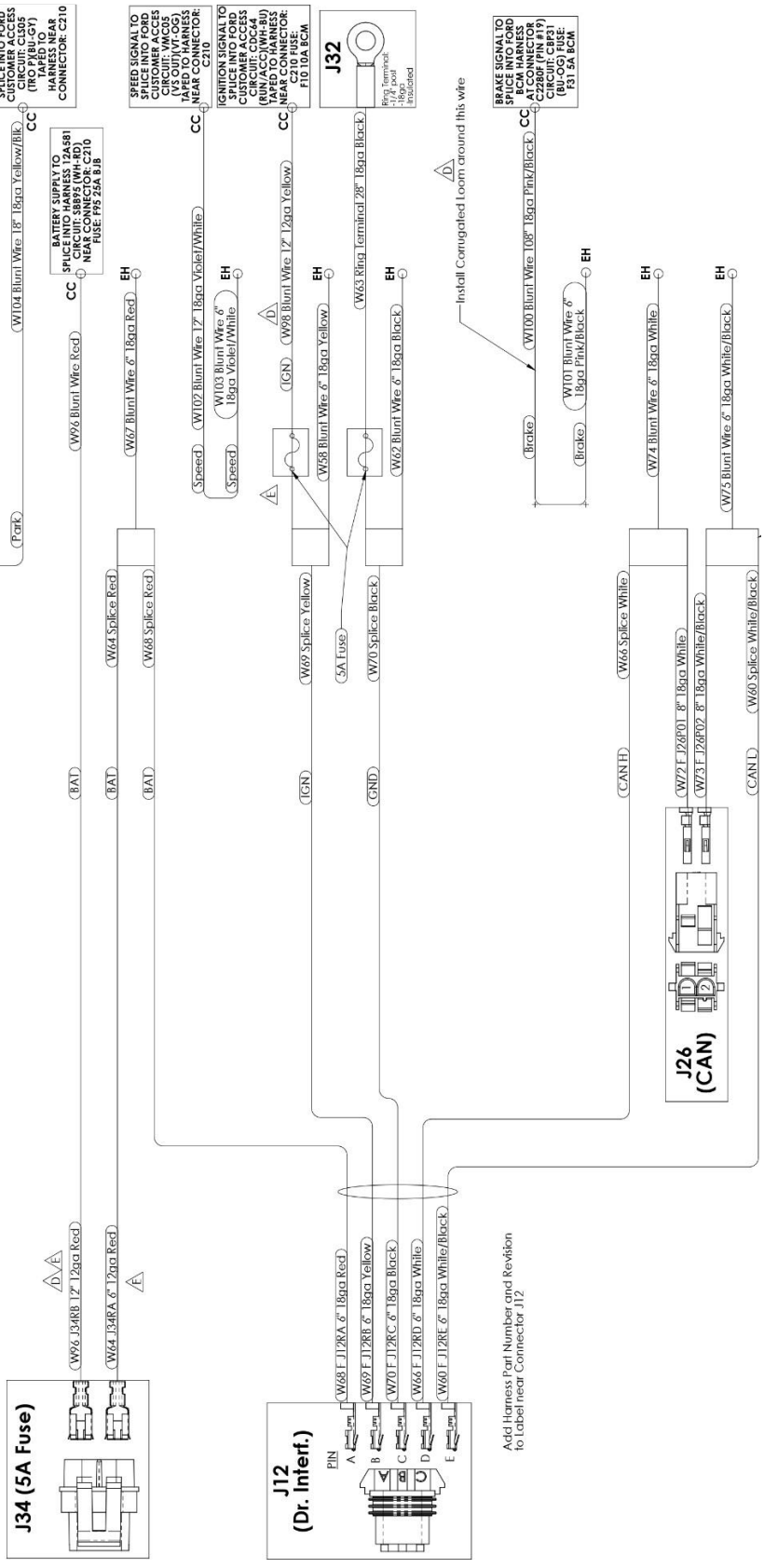
DS98F2-A (4x2)							
ITEM	QTY	PART NUMBER	DESCRIPTION	ITEM	QTY	PART NUMBER	DESCRIPTION
1	6	10003-003	HB 1.000-8x6.000, Gr. 8	36	1	10786-001	Track Rod
2	2	10004-024	LHN 1/4-20, Gr. 2, CntrLck	37	1	10789-010	Track Rod Mount
3	6	10006-004	HFW 1.000	38	1	10790-014	USM, LH
4	6	10012-003	LFN 1-8, Gr G, Top Lock	39	1	10790-015	USM, RH
5	11	10012-005	LFN 3/8-16, Gr G	40	1	10804-001	Spiral Cable Wrap, .375 OD x 12" L
6	31	10012-007	LFN 1/2-13, Gr. G	41	2	10804-002	Spiral Cable Wrap, .375 OD x 8" L
7	4	10012-008	LFN 5/8-11 Gr G	42	1	10806-003	Brake Line Relocation Plate
8	18	10012-010	LFN 5/16-18, Gr. G	43	1	10806-008	Fuel-Brake Relocation Bracket
9	12	10012-013	LFN 5/8-18, Gr. G	44	1	10811-007	Template, Frame Drilling, F350
10	6	10012-014	LFN 3/4-10 Gr G	45	1	10815-001	Fused Battery Lead
11	2	10237-003	SLW 3/8	46	4	10830-013	Volume Mount
12	1	10474-001	Silicone, 16 oz. Bottle	47	4	10843-003	T-Bolt Clamp, Range 4.88-5.5
13	13	10501-002	HFB 3/8-16 x 1.250, Gr 8	48	7	10855-002	Vinyl-Coated Loop Clamp, 1" ID
14	1	10538-004	Front Hanger, LH	49	2	10855-003	Vinyl-Coated Loop Clamp, 5/8" ID
15	1	10539-008	Front Hanger, RH	50	2	10867-002	Jounce Bumper, Ø2.313" x 1.875"T
16	2	10546-003	Axle Seat	51	2	10874-175	HFB 5/8-11x1.750, Gr. 8
17	2	10552-002	Axle Cradle	52	1	10874-375	HFB 5/8-11x3.750, Gr. 8
18	2	10586-001	Height Sensor	53	1	10874-400	HFB 5/8-11x4.00, Gr. 8
19	1	10586-002	Steering Sensor	54	27	10885-150	HFB 1/2-13x1.500, Gr. 8
20	2	10587-005	Linkage	55	4	10885-200	HFB 1/2-13x2.000, Gr. 8
21	1	10587-006	Linkage, 3.938" SS	56	2	10885-325	HFB 1/2-13 x 3.25 Gr 8
22	2	10591-001	Ball Stud, 10mm x 5/16-18	57	14	10886-100	HFB 5/16-18 x 1.000, Gr. 8
23	1	10597-049	Asy, 2nd Vol 50 x 450, LH	58	4	10886-125	HFB 5/16-18 x 1.25, Gr. 8
24	1	10597-050	Asy, 2nd Vol 50 x 450, RH	59	1	10904-014	Ball Stud Bracket
25	1	10614-001	Cap, Breather	60	1	10941-010	Power Supply
26	8	10640-005	Bearing Spacer, 1.24 x .812 x .318	61	1	11057-001	Strut, LH
27	6	10642-001	U-Bolt 5/8-18 x 7.00 Gr 8	62	1	11057-002	Strut, RH
28	1	10669-002	U-Bolt, 1/4-20 x 2.438 x 1.375 Gr 2	63	2	11102-400	HFB 3/4-10 x 4 Gr 8
29	1	10680-001	Driver Interface	64	4	11102-600	HFB 3/4-10 x 6 Gr 8
30	1	10704-003	Wiring Harness, Dash	65	1	11111	Kit, Power Module Mounting
31	2	10720-005	Upper Control Arm	66	1	11114-001	Tie Plate Mount
32	2	10720-006	Lower Control Arm	67	1	11115-004	Tie Plate
33	1	10741-004	Steering Sensor	68	2	11122-001	U-Bolt Saddle Clamp
34	1	10762-006	Bridge	69	1	11127	Kit, Documents, F350
35	1	10782-007	Crossmember Reinforcement				

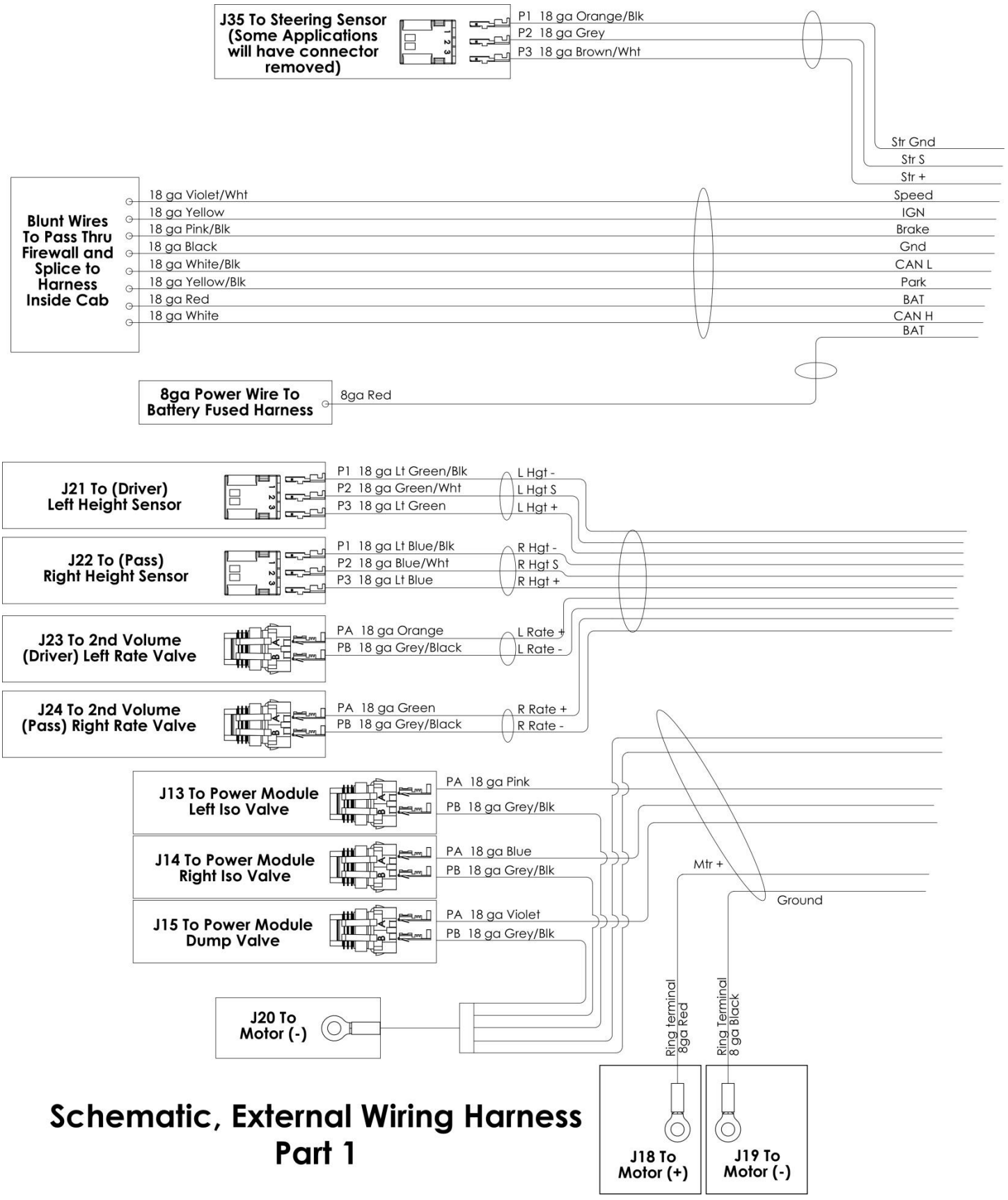
DS98F4-A (4x4)



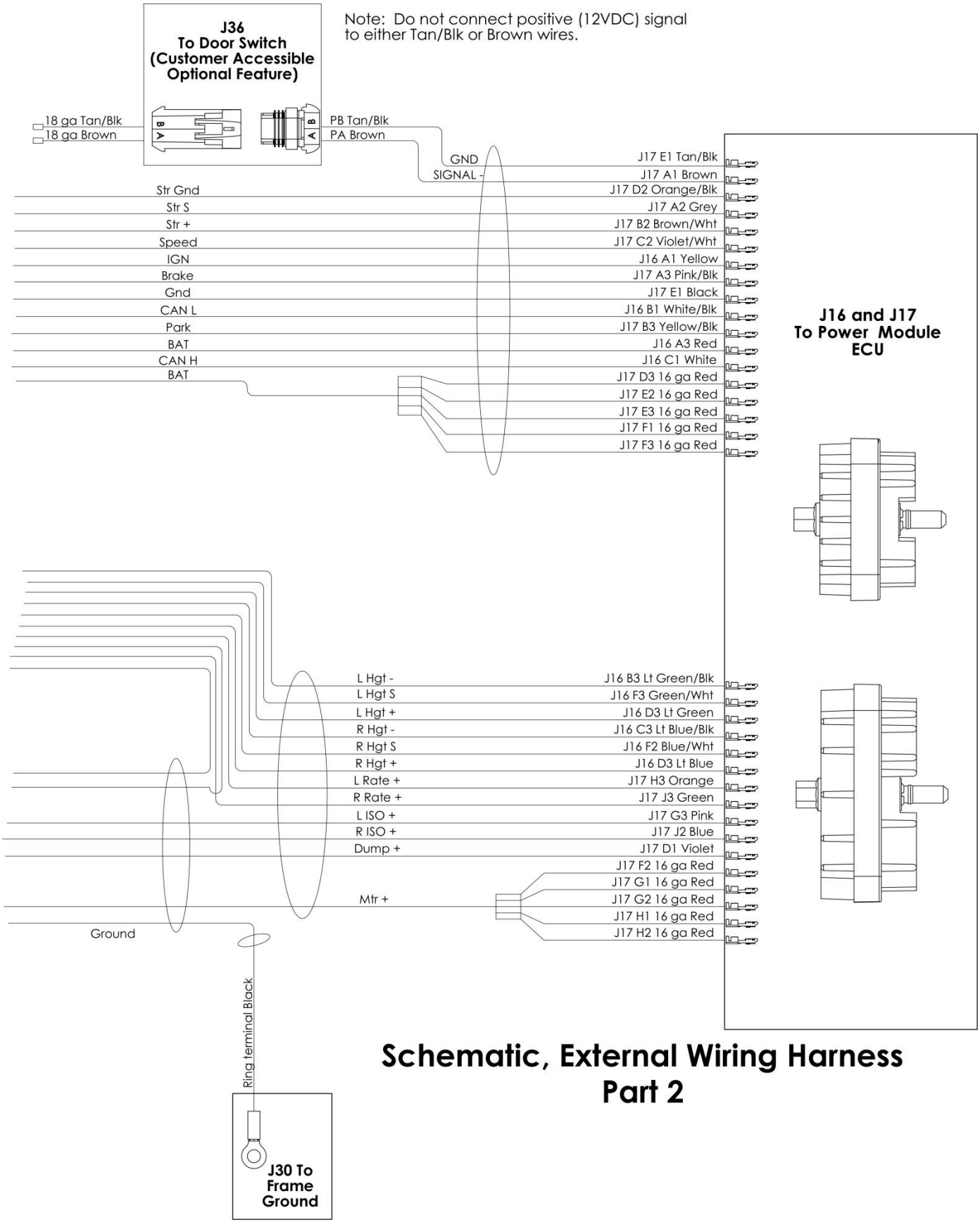
DS98F4-A (4x4)							
ITEM	QTY	PART NUMBER	DESCRIPTION	ITEM	QTY	PART NUMBER	DESCRIPTION
1	6	10003-003	HB 1.000-8x6.000, Gr. 8	35	1	10786-001	Track Rod
2	2	10004-024	LHN 1/4-20, Gr. 2, CntrLck	36	1	10789-010	Track Rod Mount
3	6	10006-004	HFW 1.000	37	1	10790-014	USM, LH
4	6	10012-003	LFN 1-8, Gr G, Top Lock	38	1	10790-015	USM, RH
5	11	10012-005	LFN 3/8-16, Gr G	39	1	10804-001	Spiral Cable Wrap, .375 OD x 12" L
6	29	10012-007	LFN 1/2-13, Gr. G	40	2	10804-002	Spiral Cable Wrap, .375 OD x 8" L
7	4	10012-008	LFN 5/8-11 Gr G	41	1	10806-003	Brake Line Relocation Plate
8	18	10012-010	LFN 5/16-18, Gr. G	42	1	10806-008	Fuel-Brake Line Relocation Bracket
9	12	10012-013	LFN 5/8-18, Gr. G	43	1	10811-007	Template, Frame Drilling, F350
10	6	10012-014	LFN 3/4-10 Gr G	44	1	10815-001	Fused Battery Lead
11	1	10474-001	Silicone, 16 oz. Bottle	45	4	10830-013	Volume Mount
12	11	10501-002	HFB 3/8-16 x 1.250, Gr 8	46	4	10843-003	T-Bolt Clamp, Range 4.88-5.5
13	1	10538-004	Front Hanger, LH	47	7	10855-002	Vinyl-Coated Loop Clamp, 1" ID
14	1	10539-008	Front Hanger, RH	48	2	10855-003	Vinyl-Coated Loop Clamp, 5/8" ID
15	2	10546-003	Axle Seat	49	2	10874-175	HFB 5/8-11x1.750, Gr. 8
16	2	10552-002	Axle Cradle	50	1	10874-375	HFB 5/8-11x3.750, Gr. 8
17	2	10586-001	Height Sensor	51	1	10874-400	HFB 5/8-11x4.00, Gr. 8
18	1	10586-002	Steering Sensor	52	25	10885-150	HFB 1/2-13x1.500, Gr. 8
19	2	10587-005	Linkage	53	4	10885-200	HFB 1/2-13x2.000, Gr. 8
20	1	10587-006	Linkage, 3.938" SS	54	2	10885-325	HFB 1/2-13 x 3.25 Gr 8
21	2	10591-001	Ball Stud, 10mm x 5/16-18	55	14	10886-100	HFB 5/16-18 x 1.000, Gr. 8
22	1	10597-049	Asy, 2nd Vol 50 x 450, LH	56	4	10886-125	HFB 5/16-18 x 1.25, Gr. 8
23	1	10597-050	Asy, 2nd Vol 50 x 450, RH	57	1	10904-014	Ball Stud Bracket
24	1	10614-001	Cap, Breather	58	1	10941-009	Power Supply
25	8	10640-005	Bearing Spacer, 1.24 x .812 x .318	59	1	11057-005	Strut, LH
26	6	10642-001	U-Bolt 5/8-18 x 7.00 Gr 8	60	1	11057-006	Strut, RH
27	1	10669-002	U-Bolt, 1/4-20 x 2.438 x 1.375 Gr 2	61	2	11102-400	HFB 3/4-10 x 4 Gr 8
28	1	10680-001	Driver Interface	62	4	11102-600	HFB 3/4-10 x 6 Gr 8
29	1	10704-003	Wiring Harness, Dash	63	1	11111	Kit, Power Module Mounting
30	2	10720-005	Upper Control Arm	64	1	11114-001	Tie Plate Mount
31	2	10720-006	Lower Control Arm	65	1	11115-004	Tie Plate
32	1	10741-004	Steering Sensor	66	2	11122-001	U-Bolt Saddle Clamp
33	1	10762-006	Bridge	67	1	11127	Kit, Documents, F350
34	1	10782-007	Crossmember Reinforcement				

Electrical Schematics

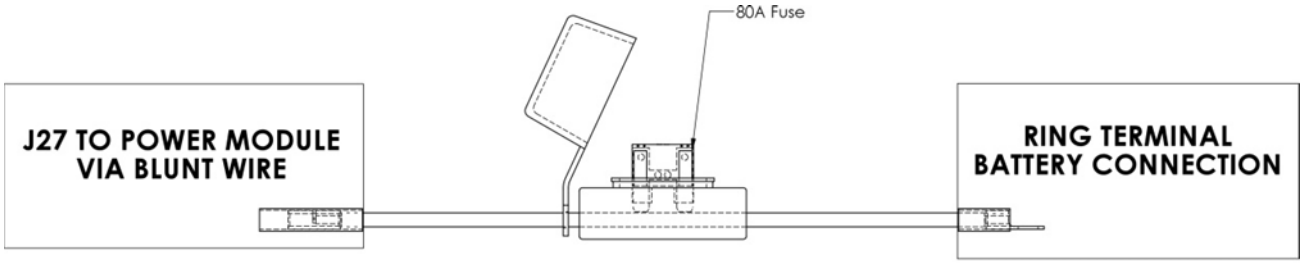




Schematic, External Wiring Harness Part 1



Schematic, External Wiring Harness Part 2



Schematic, Battery Fuse Lead

Appendix A: Drill Locations

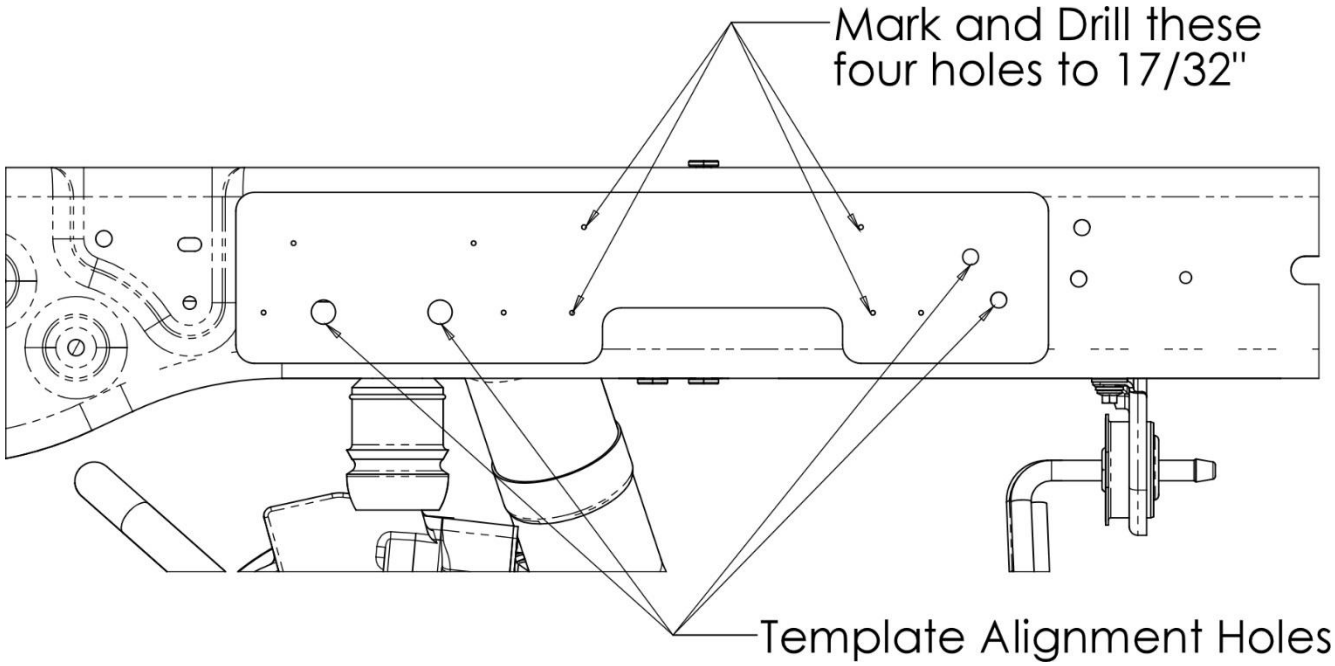


Figure 43. Driver Side Upper Strut Mount Frame Drilling

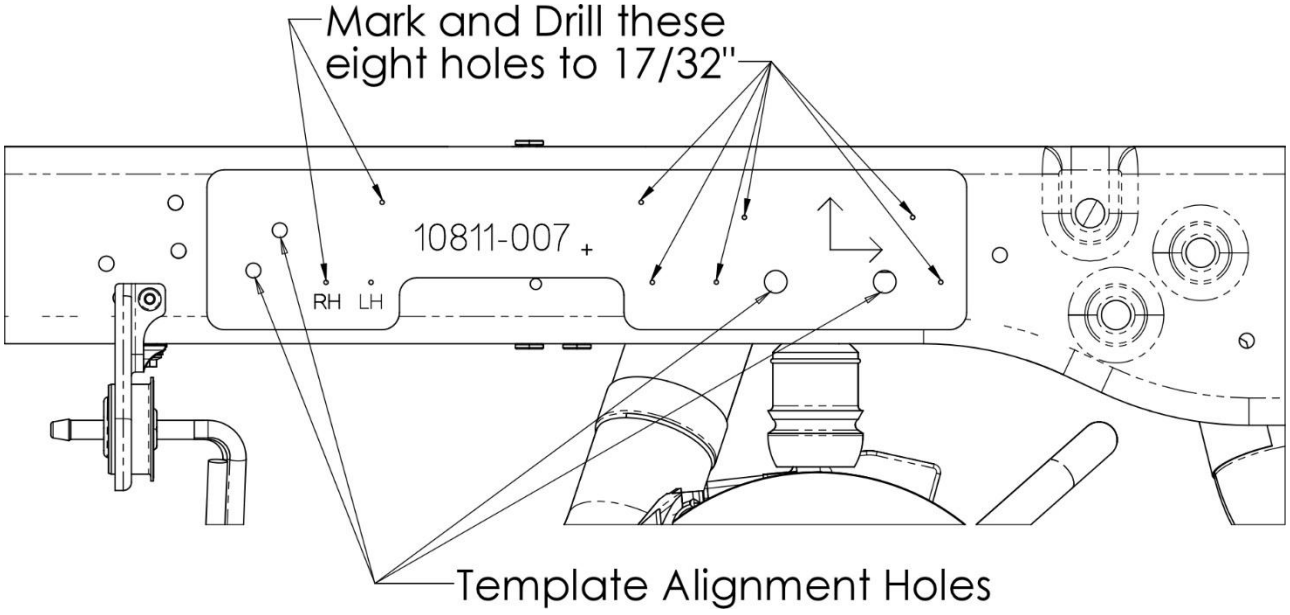


Figure 44. Passenger Side Upper Strut Mount Frame Drilling

LiquidSpring™ LLC
4899 E 400 S
Lafayette, IN 47905

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

INSTALLATION CHECK LIST

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

FRAME PREPARATION:
☐Battery Disconnected
☐Removed OEM Leaf springs, overload pads, and Driver side shock mount.
☐Remove OEM Jounce Bumpers (4x2 vehicles only)
☐Upper Strut Mount, Front Hanger, and Secondary Volume Assy holes drilled.

FRONT HANGER INSTALLATION:
☐1/2”-13 Nuts torqued to **86-105 ft-lbs**.

UPPER STRUT MOUNT/TRACK ROD MOUNT/CROSS MEMBER REINFORCEMENT:
☐Upper Strut Mounts level with frame.
☐Cross member Reinforcement orientated correctly.
☐Bolts oriented per Installation Manual Views.
☐1/2”-13 Nuts torqued to **86-105 ft-lbs**.

AXLE CLAMP INSTALLATION:
☐5/8”-18 U-Bolts torqued in stages up to **175-200 ft-lbs**.
☐1/2”-13 Nuts torqued to **86-105 ft-lbs**.

BRAKE LINE RELOCATION PLATE INSTALLATION:
☐Bracket attached to rear axle hydraulic brake splitter tee with 1/2"-13 hardware.
☐Driver and Passenger Brake caliper whip hoses attached to axle clamps with 5/16” hardware.
☐Install 3/8” Spiral Wrap around the flexible hydraulic brake line routing from the axle to the crossmember.
☐Install 3/8” Spiral Wrap around the flexible hydraulic brake lines at the brake calipers, both LH and RH.

CONTROL ARMS INSTALLATION:
☐Control Arms correctly orientated.
☐1”-8 Nuts torqued to **600 ft-lbs**, at ride height.
☐3/4”-10 Nuts torqued to **305-350 ft-lbs** at ride height.

BRIDGE INSTALLATION:
☐5/8”-18 U-Bolts evenly torqued to **194-238 ft-lb**.

TRACK ROD INSTALLATION:
☐5/8”-11 Nuts torqued to **172-210 ft-lbs** at ride height.

TIE BAR INSTALLATION:
☐5/8”-11 Nuts torqued to **172-210 ft-lbs** at ride height.
☐OEM Brake and fuel lines attached to Tie plate mount.
☐3/8”-16 Nuts torqued to **35-43 ft-lbs**.
☐Install Fuel-Brake Line Relocation Bracket and torque 5/16”-18 Nuts to **14-17 ft-lbs**.

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

JOUNCE BUMPER INSTALLATION (4x2 Vehicles Only):
☐3/8”-16 Bolts torqued to **35-43 ft-lbs**.

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

PARKING BRAKE CABLE INSTALLATION:
☐Parking brake cable rerouted through and attached to front Driver side hanger.
☐Wire formed brackets reattached

POWER MODULE/SECONDARY VOLUME INSTALLATION:
☐3/8”-16 Manifold Bolts torqued to **39 ft-lbs**.
☐3/8”-16 J-Bolt Nuts torqued to **28 ft-lbs**.
☐Reservoir Mount Self Tapping Screws tightened to **snug only**.
☐5/16”-24 Clamp Fasteners torqued to **240 in-lbs**.
☐3/8”-16 Nuts Torqued to **35-43 ft-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 and 5/16”-18 hardware.

STEERING SENSOR INSTALLATION:
☐OEM Nuts torqued to **120-147 ft-lbs.**
☐5/16”-18 fasteners torqued to **14-17 ft-lbs.**
☐1/4”-20 U-bolt nuts torqued to **60-85 in-lbs.**
☐Locking Clips installed.
☐Steering sensor harness attached and routed.
☐Steering wheel turned full left and full right and checked for clearance around sensor and linkage.

WIRING HARNESS INSTALLATION:
☐Dash harness installed
☐Dash harness Violet/White wire connected to VS OUT (Violet/Orange) upfitter wire.
☐Dash harness Yellow wire connected to RUN/ACC (White/Blue) upfitter wire.
☐Dash harness Yellow/Black connected to TRO P (Blue/Grey) upfitter wire.
☐Dash harness Red wire spliced into SBB95 (White/Red) in Harness 12A581.
☐Dash harness Pink/Black wire spliced into Brake Signal (Blue/Orange) wire in Connector C2280F, Pin #19.
☐Connector C2280F reconnected.
☐Driver Interface installed and connected to Dash Harness.
☐External harness installed and connected to Dash Harness.
☐External harnesses installed and connected to Rate Valves, Height Sensors, and Power Module.
☐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.