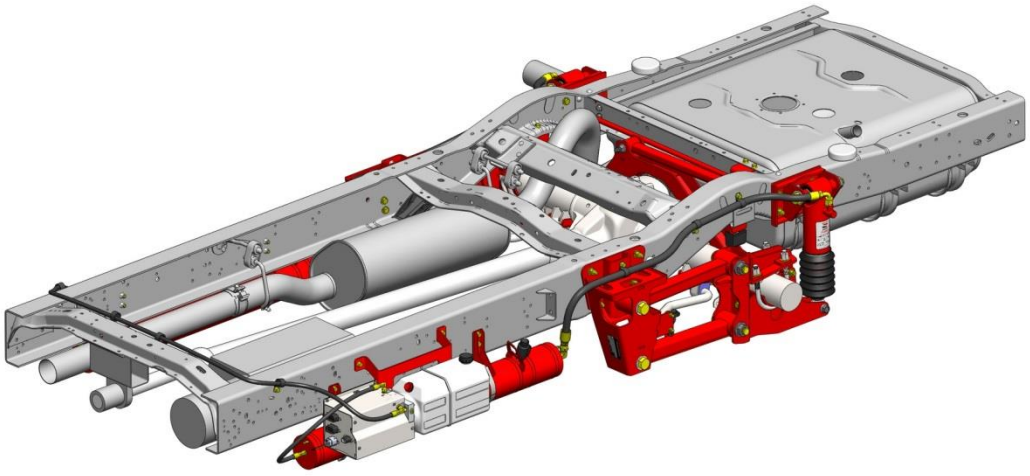
DS96F

DS96F-A
DS96F-B2

Rear Axle Suspension System
for Ford E450



LIQUIDSPRING™ LLC

Operator Manual

D10898 Rev V 4/2017

Contents

Introduction

This vehicle is equipped with the LiquidSpring **CLASS®** suspension system DS96F series of rear axle suspension system for the Ford E450 Cutaway Chassis.

The system provides the following performance benefits:

- Reduced Impact Harshness
- Improved Road Isolation
- Improved High-Speed Stability
- Improved Handling Response
- Better Control of Body Ride Motions
- Maintained Optimized Ride Height

Throughout this manual, important product information is preceded 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 DS96F suspension is rated for **9600 lbs.**

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

Serial Number Tag Information

The serial number is found on an aluminum tag that is riveted to the Left Hand Suspension Hanger as shown in Figure 1. This information will aid you when contacting the chassis manufacturer or LiquidSpring LLC.

Figure 1. Suspension Identification

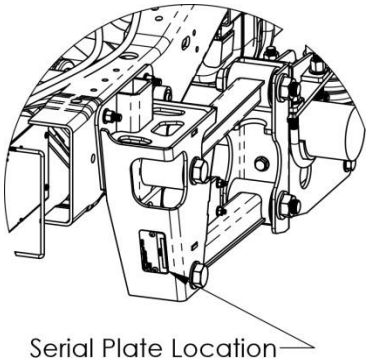


Figure 2. Serial Number Tag Location

Vehicle Towing and Jacking Information

Before attempting any type of towing procedures, 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

Torque Specifications

Most of the fasteners used in this suspension are graded fasteners. These fasteners have the strength and hardness properties required for their particular function. If replaced, they must be replaced with fasteners of the same grade, size, and form as the original in order to prevent failure.

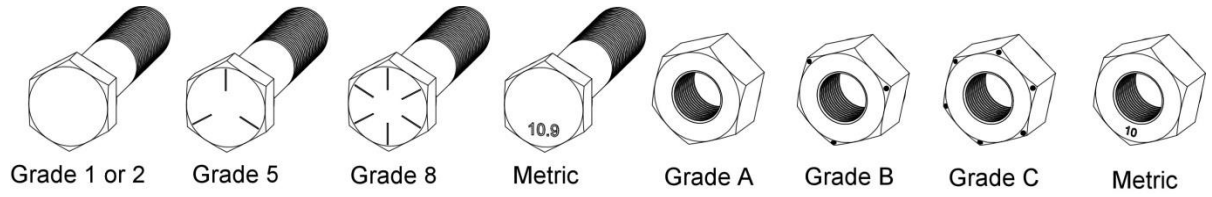


Figure 3. Identification of fastener grades.

Description	Size	Grade	Torque Specification	
			Lb-ft	Nm
Axle clamp attachment nuts	1/2”-13	C	85-105	115-142
Axle clamp u-bolt nuts	5/8”-18	8	175-200	237-271
Bleed Screws	3/8-24	N/A	13-18	1-2
Control arm attachment nuts	1”-8	G	600	815
Cross-member reinforcement bolts	1/2”-13	8	85-105	115-142
Front hanger mounting nuts	1/2”-13	C	85-105	115-142
Height sensor linkage ball stud nuts	5/16”-18	C	14-17	19-23
Height sensor mount nuts	5/16”-18	C	14-17	19-23
Hose Connections, -10	7/8-14	N/A	36-63	4-7
Hose Connections, -4	7/16-20	N/A	12	1
Jounce bumper attachment bolts	M10-1.5	10.9	25-35	34-47
Lower strut mount nuts	5/8”-11	C	175-200	237-271
Power module attaching u-bolt nuts (DS96F-A and DS96F-M)	1/4”-20	2	60-85 in-lbs	7-10
Power module frame bracket to frame nuts (DS96F-B2)	3/8”-16	G	35-43	47-61
Power module mount bracket to frame bracket (DS96F-B2)	3/8”-16	G	35-45	47-61
Power module mount bracket to reservoir	#10-16	N/A	Snug only	Snug only
Power module mounting bracket to pump head manifold	3/8”-16	8	35-43	47-61
Replacement cross-member button head cap screw	M12-1.75	10.9	75-92	102-125
Secondary volume mount clamps	5/16”-24	N/A	240 in-lbs	27
Secondary volume mount nuts	3/8”-16	C	35-43	47-58
Steering sensor attachment screws	#8-18	n/a	9 in-lbs	1
Track rod attachment nuts	5/8”-11	C	175-200	237-271
Track rod mount to axle bolts	M10-1.5	10.9	25-35	34-47
Track rod mount to frame nuts	3/8”-16	C	35-45	47-61
Upper strut mount nuts	1/2”-13	C	85-105	115-142
Upper strut mount nuts	1”-8	C	600	815

Hydraulic Fitting Assembly

SAE O-Ring Adjustable Fittings

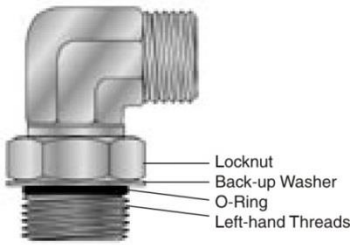


Figure 4. Adjustable SAE fitting

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.

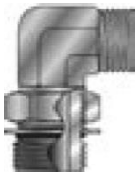


Figure 5. Locknut completely backed off.

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

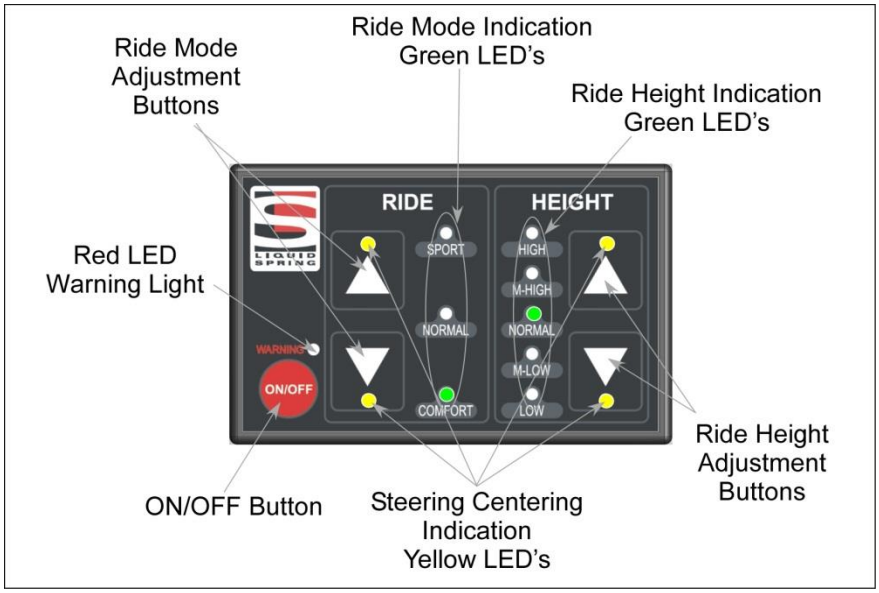
1. Inspect components to ensure that male and female port threads and sealing surfaces are free of burrs, nicks and scratches, or any foreign material.
2. If O-ring or seal is not pre-installed to fitting male port end, install proper size O-ring or seal, taking care not to damage it.
3. Lubricate O-ring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

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 disable the suspension system (turns off all indicator lights) or enables the system (turns on all indicator lights). It is recommended leaving the system ON at all times.

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 Section.

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 desired ride height.
- A blinking green LED will indicate active leveling is occurring and the current ride height. When a single

solid green LED is shown, desired ride has been achieved.

- If LOW or HIGH ride heights are selected while the vehicle is in motion less than 10 mph, suspension ride height is either lowered or raised.
- If LOW or HIGH ride heights are selected while the vehicle is in motion greater than 10 mph, NORMAL ride height will be maintained and the selected ride height will be remembered for 2 minutes. If speed drops below 10 mph during the 2 minutes, the suspension ride height is adjusted accordingly. If speed is not dropped below 10 mph during the 2 minute time frame, the selection is erased and NORMAL height is maintained. Two solid LEDs are lit, indicating the selected and current ride heights.
- At speeds greater than 15 mph, the system will level to NORMAL ride height, regardless of prior selection.

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.

CAUTION: The DS96F-M Secondary Volume Assemblies are equipped with Normally-Closed Rate Valves, which separate the two chambers when power is not applied to the valve. Each chamber side must be bled separately.

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.

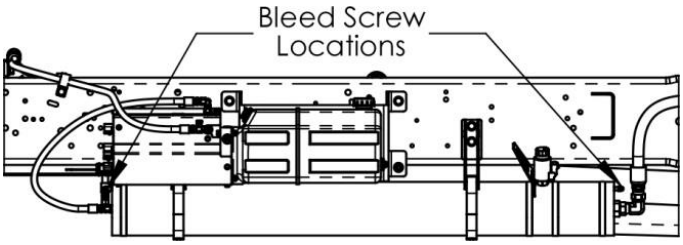


Figure 6. Bleed screw locations.

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.
12. [DS96F-M] Repeat with bleed screw on other end of volume.

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.

Bleeding the System

1. Verify system is turned OFF by either pressing the ON/OFF button on the driver interface until the lights are turned off or turning the ignition off.
2. 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.

3. 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.

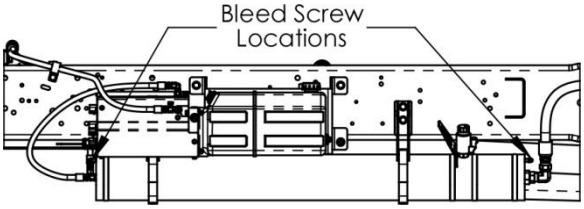


Figure 7. Bleed screw locations.

4. Open the bleed screw slightly.
5. After air bubbles are no longer present, close the bleed screw and torque to **13-18 ft-lbs.**
6. Repeat with remaining bleed screws. Note: the system may need to powered on and allowed to re-pressurize.
7. Repeat with other side.

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

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 Error light is not blinking.

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 lights on the driver display should go out.
5. Press and release the Red ON/OFF button a second time. The lights on the driver display should all flash then only show the four yellow arrow lights, one green ride mode indicator, and one green ride height indicator.
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, then press the Red ON/OFF button twice and verify the suspension system moves to the new and correct ride height.
10. Calibration is now completed.

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.

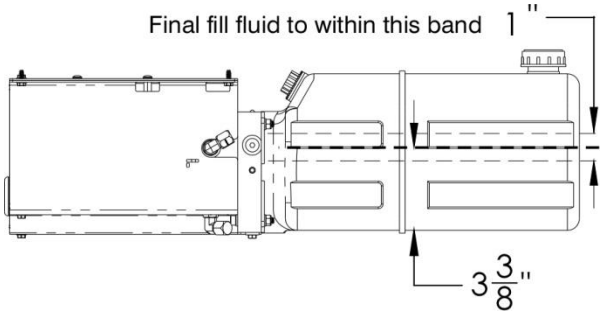


Figure 8. Final fill fluid level.

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 8.

   Note. LiquidSpring Compressible Fluid is shipped in 1 gallon containers compatible with hand pumps such as Autotec 57429.
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.

See Installation Manual for additional instructions.

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 *Ride Height Adjustment:* 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 u-bolts to assure they are properly torqued.
- Thoroughly inspect all hydraulic connections for signs of leakage.
- Inspect reservoir fluid level.

Maintenance Record

Date of Purchase	Name and Address of Dealer
Model of Vehicle	Vehicle Identification Number (VIN)
Suspension Model Number	Suspension Serial Number

Date	Mileage	Service Performed

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
		Low vehicle battery	Inspect and 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*

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 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

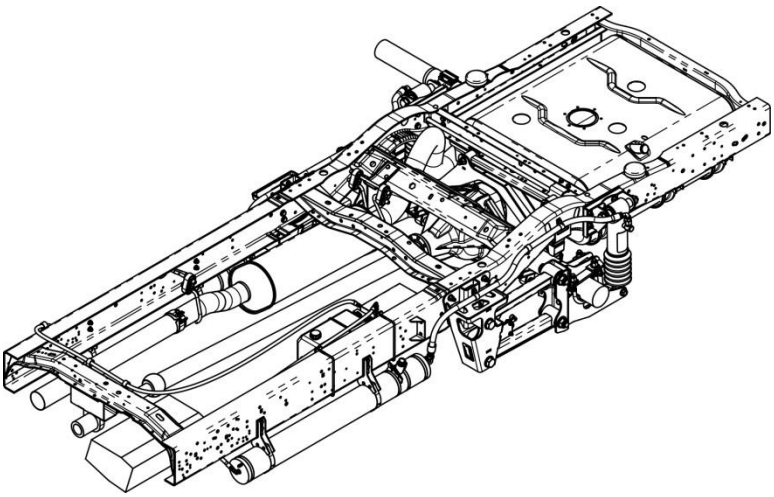
Issues with Strut Assembly

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

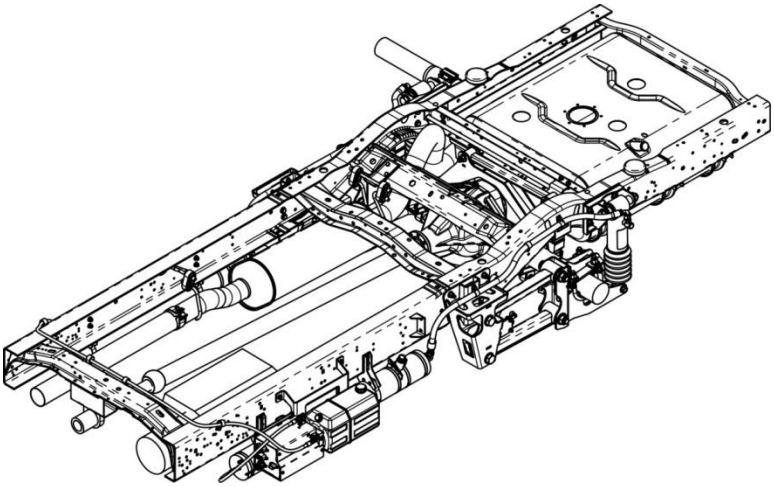
Issues with Secondary Volume Assembly

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

Model Identification



DS96F-A



DS96F-B2

Parts List Information

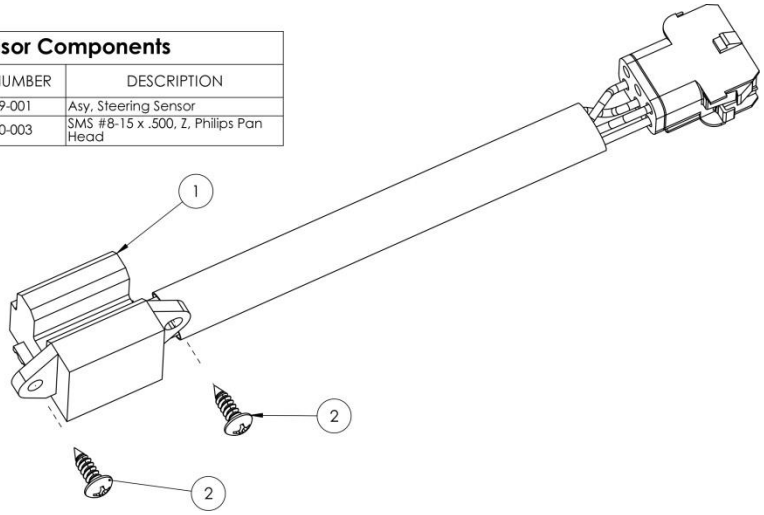
Abbreviations

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		

Part Identification

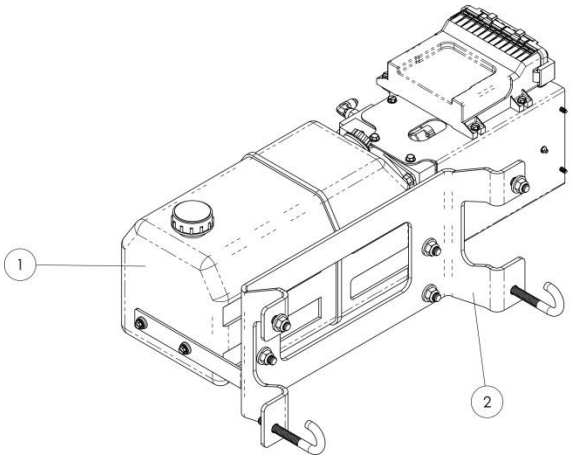
Steering Sensor Components

ITEM NO.	QTY.	PART NUMBER	DESCRIPTION
1	1	10649-001	Asy, Steering Sensor
2	2	10510-003	SMS #8-15 x .500, Z, Philips Pan Head

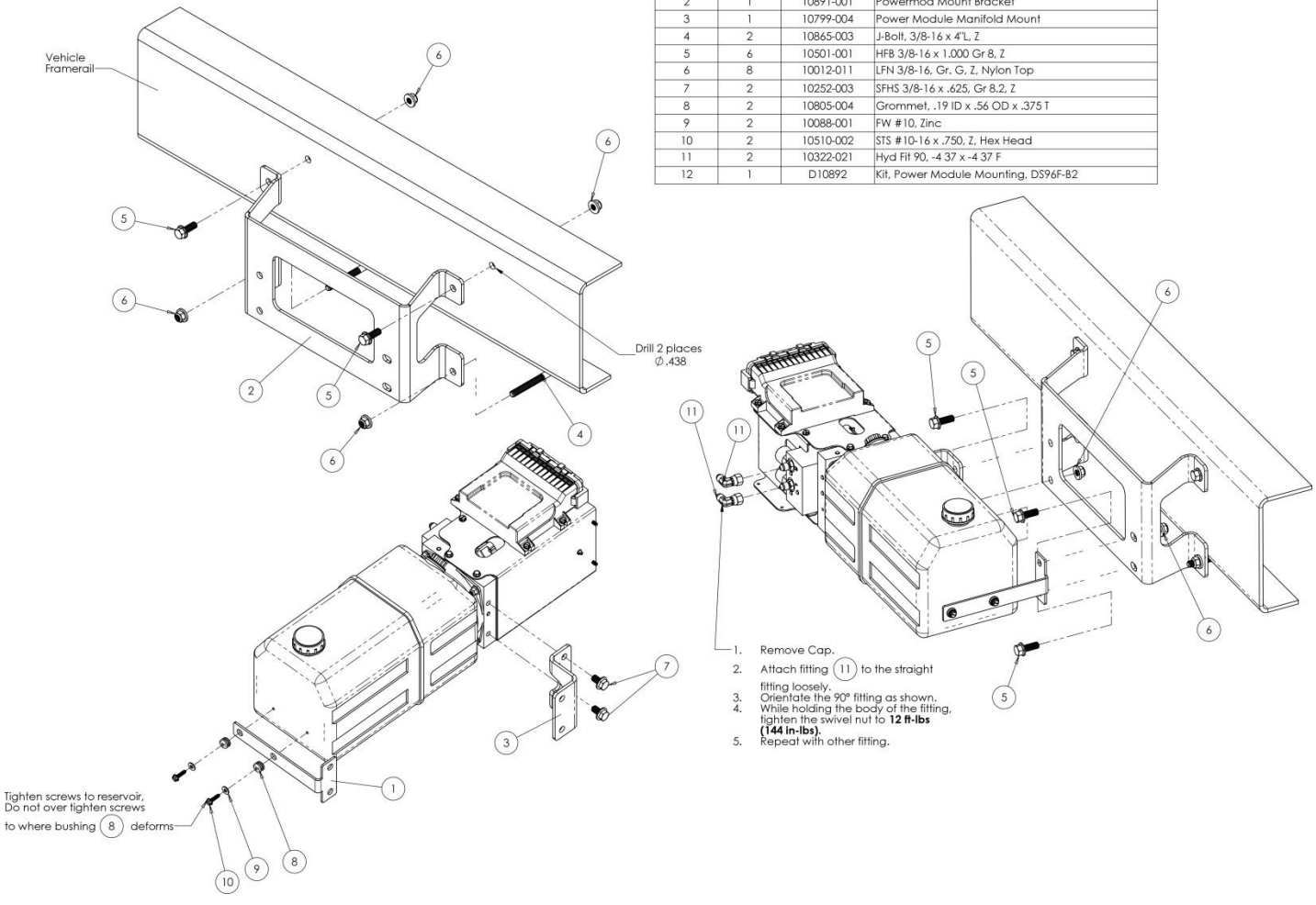


DS96F-B2 Power Module

Power Module Components			
ITEM NO	QTY.	PART NUMBER	DESCRIPTION
1	1	11013-001	Asy, Power Supply
2	1	10892	Kit, Power Module Mounting, DS96F-B2

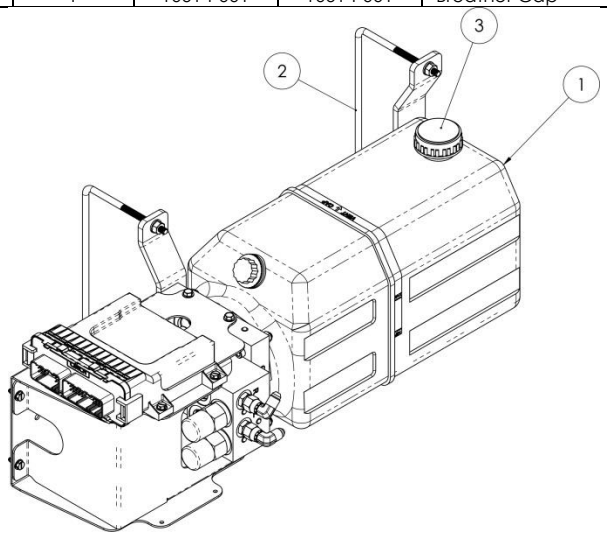


ITEM NO.	QTY.	PART NUMBER	DESCRIPTION
1	1	10798-004	Power Module Reservoir Mount
2	1	10891-001	Powermod Mount Bracket
3	1	10799-004	Power Module Manifold Mount
4	2	10865-003	J-Bolt, 3/8-16 x 4"L, Z
5	6	10501-001	HFB 3/8-16 x 1.000 Gr 8, Z
6	8	10012-011	LFN 3/8-16, Gr. G, Z, Nylon Top
7	2	10252-003	SFHS 3/8-16 x .625, Gr 8.2, Z
8	2	10805-004	Grommet, .19 ID x .56 OD x .375 T
9	2	10088-001	FW #10, Zinc
10	2	10510-002	STS #10-16 x .750, Z, Hex Head
11	2	10322-021	Hyd Fit 90, -4 37 x -4 37 F
12	1	D10892	Kit, Power Module Mounting, DS96F-B2

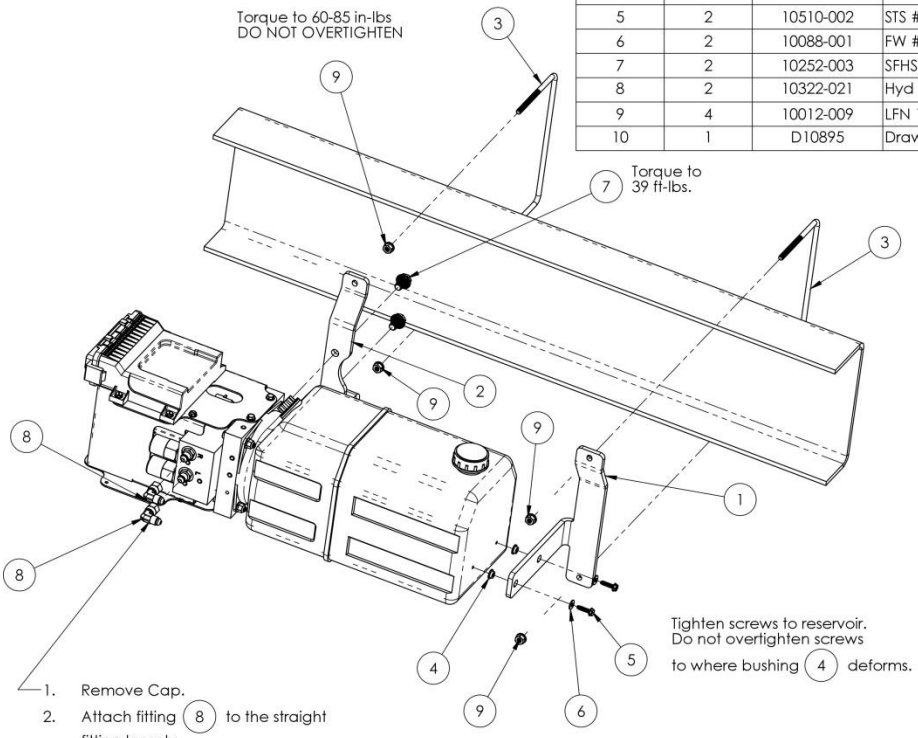


DS96F-A Power Module

Power Module				
ITEM NO.	QTY	DS96F-A PART NUMBER	DS96F-M PART NUMBER	DESCRIPTION
1	1	11013-001	11013-002	Asy, Power Supply
2	1	10895	10895	Kit, Power Module Mounting
3	1	10614-001	10614-001	Breather Cap

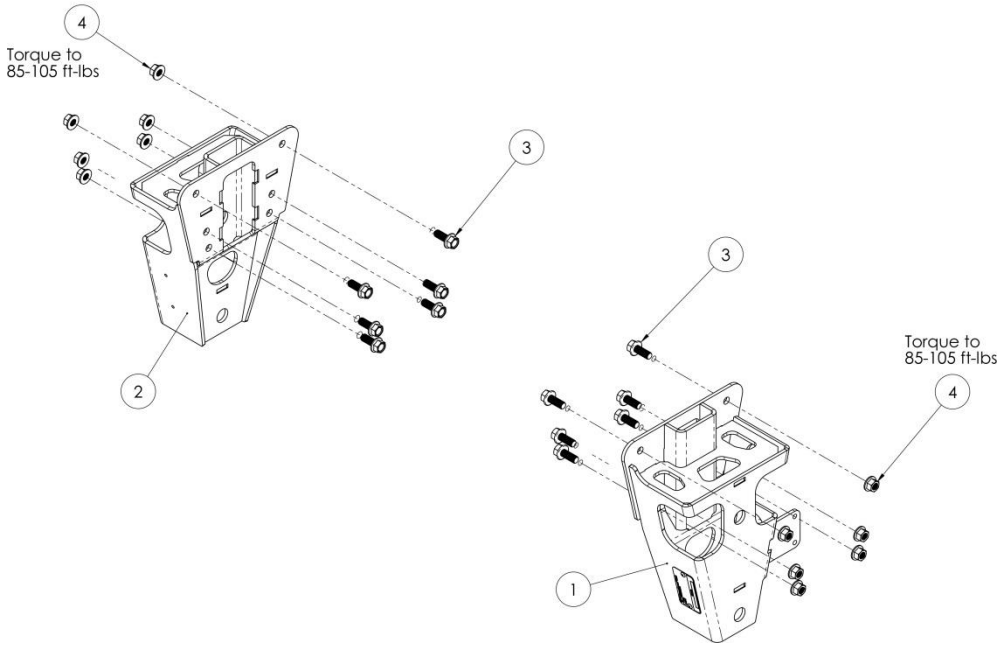


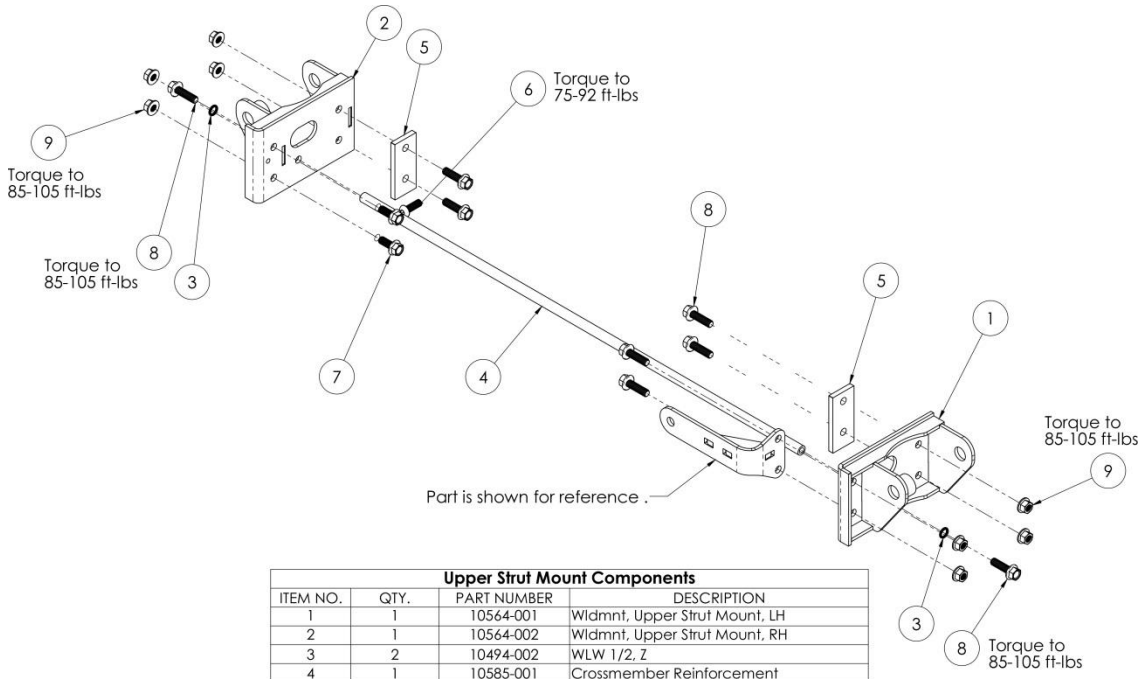
ITEM NO.	QTY	PART NUMBER	DESCRIPTION
1	1	10648-001	Power Module Reservoir Mount
2	1	10647-001	Power Module Manifold Mount
3	2	10669-001	U-Bolt
4	2	10670-001	Bushing, .189 ID x .175 T x.360 Mount
5	2	10510-002	STS #10-16 x .750, Z, Hex Head
6	2	10088-001	FW #10, Zinc
7	2	10252-003	SFHS 3/8-16 x .625, Gr 8.2, Z
8	2	10322-021	Hyd Fit 90, -4 37 x -4 37 F
9	4	10012-009	LFN 1/4-20, Gr. G, Black Phos
10	1	D10895	Drawing, Kit Installation



1. Remove Cap.
2. Attach fitting (8) to the straight fitting loosely.
3. Orientate the 90° fitting as shown.
4. While holding the body of the fitting, tighten the swivel nut to **12 ft-lbs (144 in-lbs)**.
5. Repeat with other fitting.

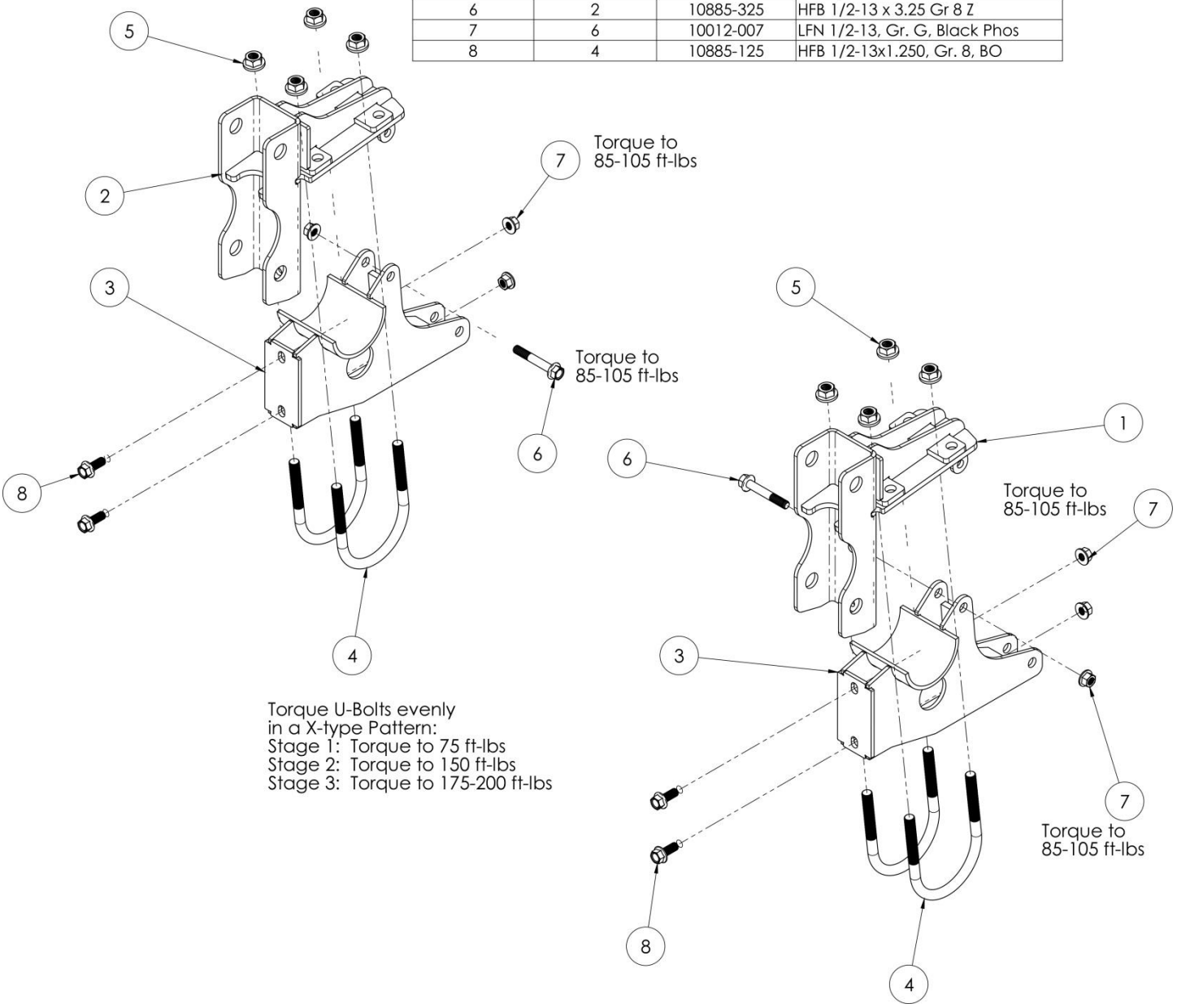
Front Hanger Components			
ITEM NO.	QTY.	PART NUMBER	DESCRIPTION
1	1	10538-001	Asy, Front Hanger, LH
2	1	10539-002	Weldment, Hanger, RH
3	12	10885-125	HFB 1/2-13x1.250, Gr. 8, BO
4	12	10012-007	LFN 1/2-13, Gr. G, Black Phos





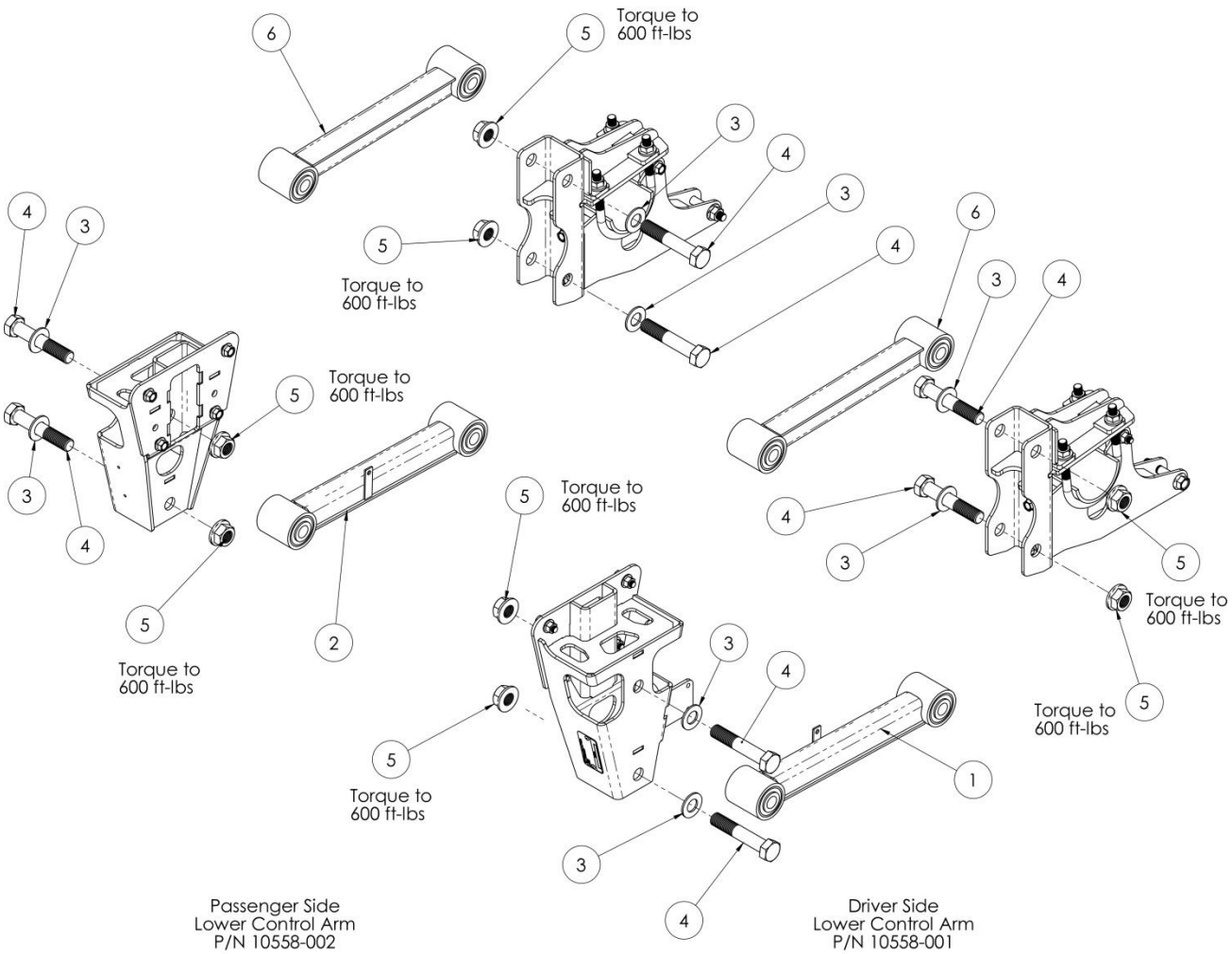
Upper Strut Mount Components			
ITEM NO.	QTY.	PART NUMBER	DESCRIPTION
1	1	10564-001	Wldmnt, Upper Strut Mount, LH
2	1	10564-002	Wldmnt, Upper Strut Mount, RH
3	2	10494-002	WLW 1/2, Z
4	1	10585-001	Crossmember Reinforcement
5	2	10569-001	Backing Plate
6	1	10512-001	BHCS M12-1.75x35 CL 10.9 BO
7	2	10885-125	HFB 1/2-13x1.250, Gr. 8, BO
8	8	10885-175	HFB 1/2-13 x 1.75, Gr 8, Z
9	8	10012-007	LFN 1/2-13, Gr. G, Black Phos

Axle Hanger Components			
ITEM NO.	QTY.	PART NUMBER	DESCRIPTION
1	1	10546-001	Wldmnt, Axle Seat, LH
2	1	10546-002	Wldmnt, Axle Seat, RH
3	2	10552-001	Weldment, Axle Cradle
4	4	10642-001	U-Bolt 5/8-18 x 7.00 Gr 8
5	8	10012-013	LFN 5/8-18, Gr. G, Black Phos
6	2	10885-325	HFB 1/2-13 x 3.25 Gr 8 Z
7	6	10012-007	LFN 1/2-13, Gr. G, Black Phos
8	4	10885-125	HFB 1/2-13x1.250, Gr. 8, BO



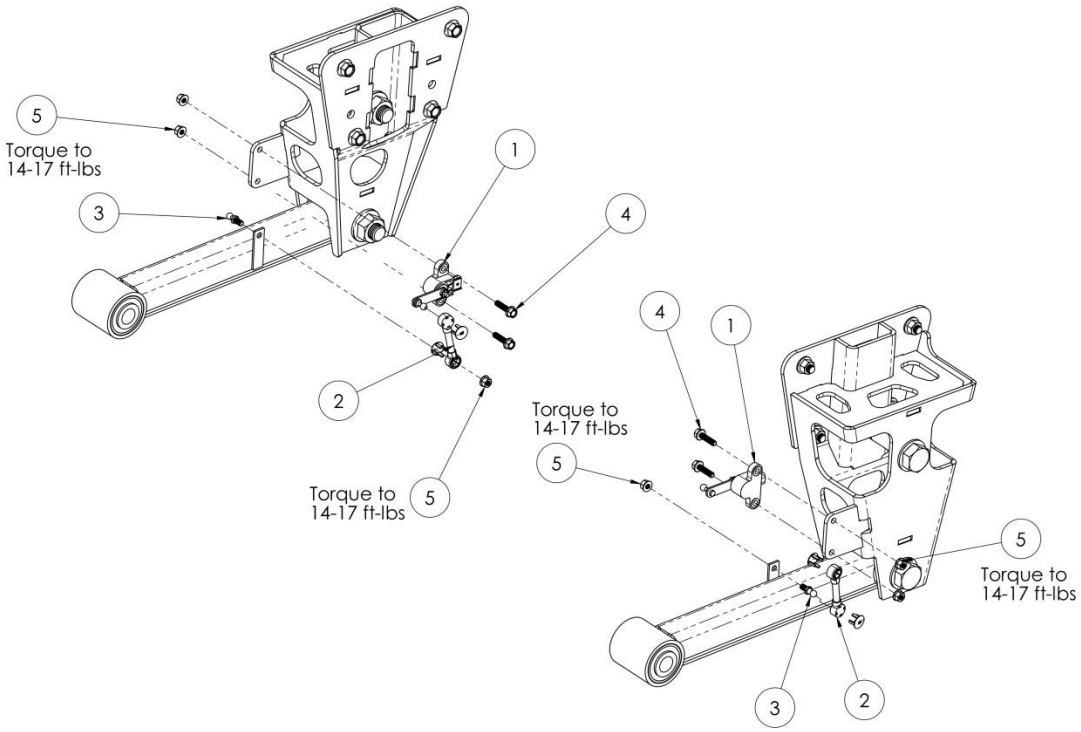
Control Arm Components			
ITEM NO.	QTY.	PART NUMBER	DESCRIPTION
1	1	10558-001	Asy, Control Arm, LH
2	1	10558-002	Asy, Control Arm, RH
3	8	10006-004	HFW 1.000, Zinc
4	8	10003-010	HCS 1-8x5.500, Gr. 8, Z
5	8	10012-003	LFN 1-8, Gr G, Z Top Lock
6	2	10720-001	Asy, Control Arm

Some Components shown for reference only.

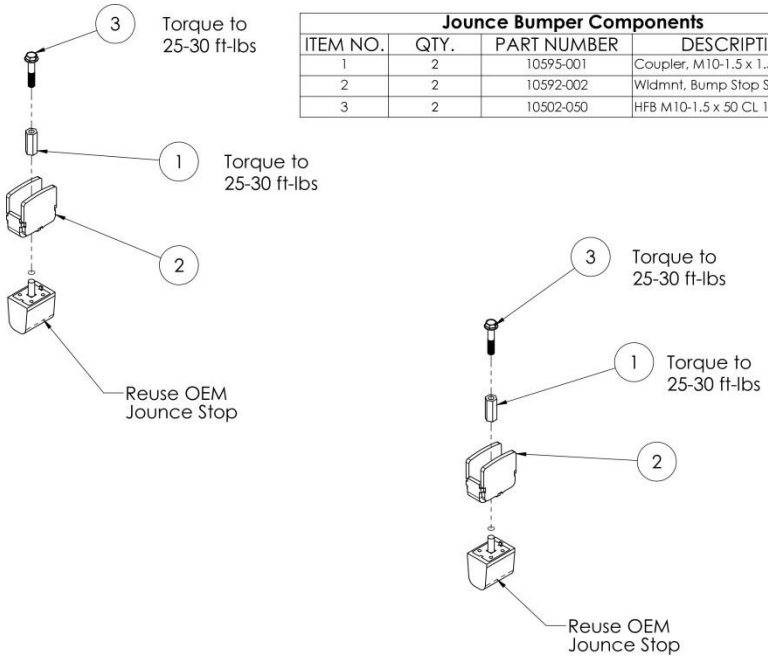


Height Sensor Components			
ITEM NO.	QTY.	PART NUMBER	DESCRIPTION
1	2	10586-001	Asy, Height Sensor
2	2	10587-001	Asy, Linkage
3	2	10591-001	Ball Stud, 10mm x 5/16-18
4	4	10886-125	HFB 5/16-18 x 1.25, Gr. 8, BO
5	6	10012-010	LFN 5/16-18, Gr. G, Black Phos

Some components shown for reference only.

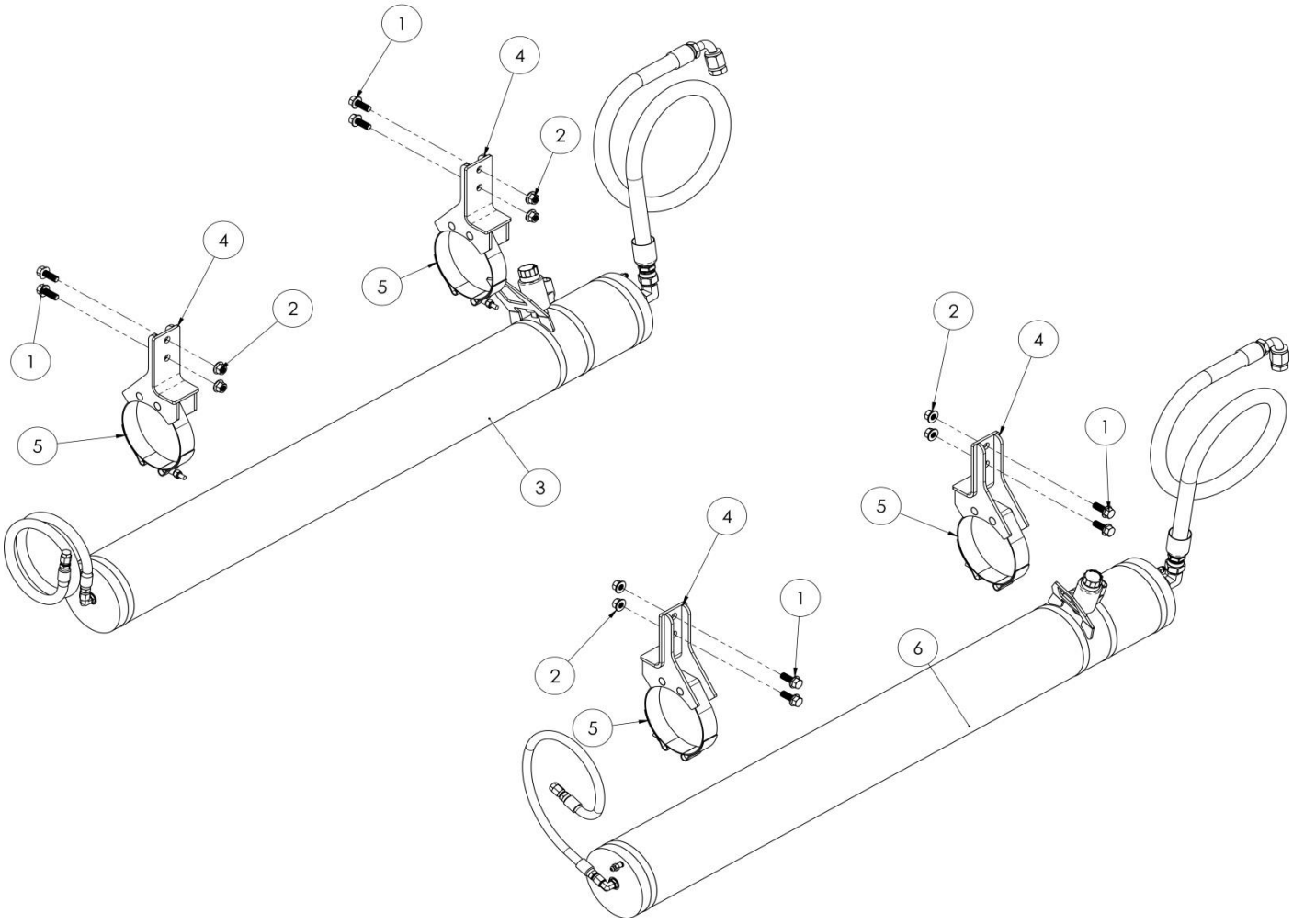


Jounce Bumper Components			
ITEM NO.	QTY.	PART NUMBER	DESCRIPTION
1	2	10595-001	Coupler, M10-1.5 x 1.500 in
2	2	10592-002	Wldmnt, Bump Stop Spacer
3	2	10502-050	HFB M10-1.5 x 50 CL 10.9 Z



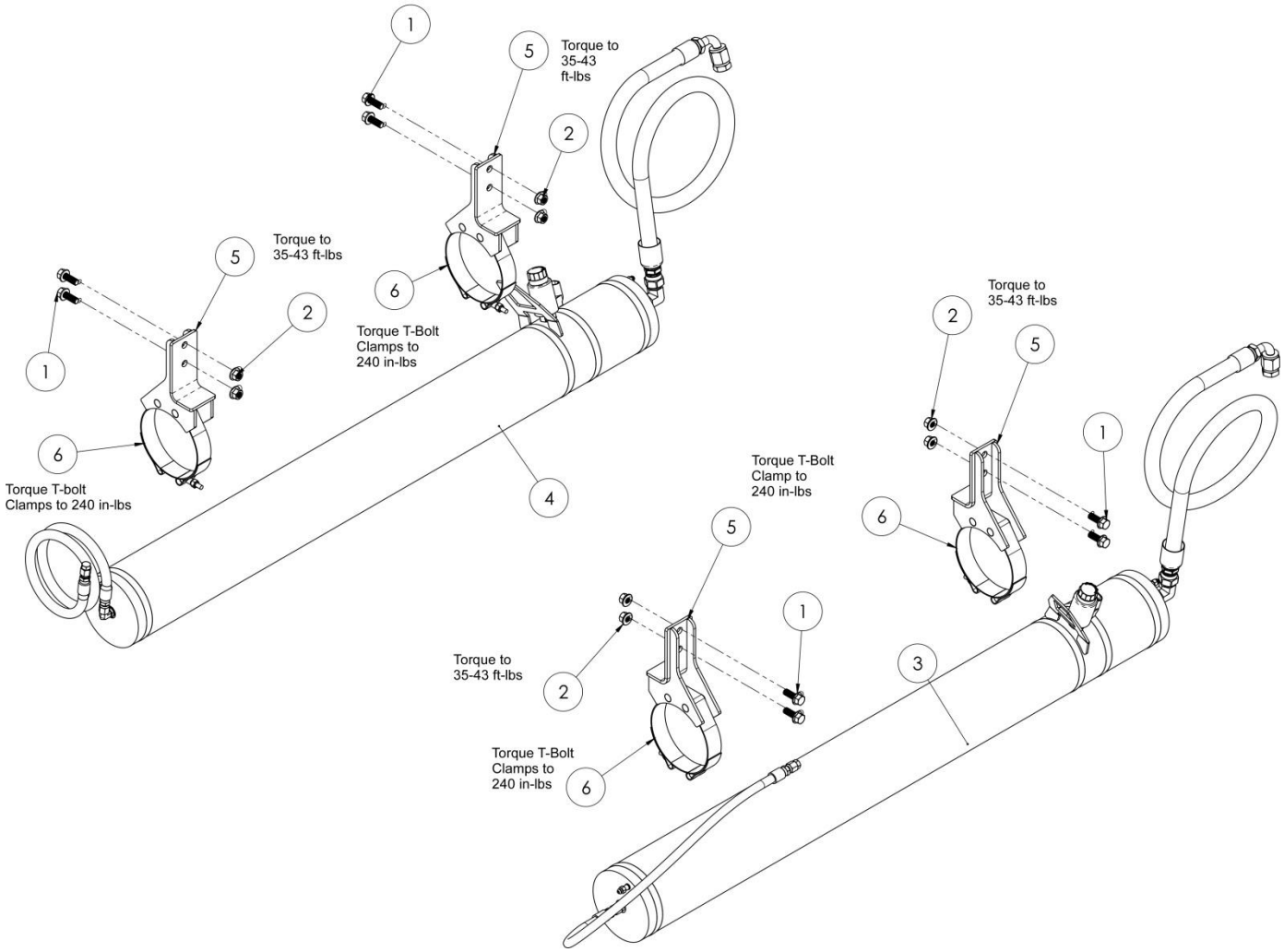
DS96F-A Secondary Volumes

Secondary Volume Components			
ITEM NO.	QTY.	PART NUMBER	DESCRIPTION
1	8	10501-001	HFB 3/8-16 x 1.000 Gr 8, Z
2	8	10012-005	LFN 3/8-16, Gr G, Z
3	1	10597-010	Asy, 2nd Vol 50 x 450, RH
4	4	10830-013	Wldmnt, Volume Mount, Bolt-on
5	4	10843-003	T-Bolt Clamp, Range 4.88-5.5
6	1	10597-020	Asy, 2nd Vol 50 x 450, LH

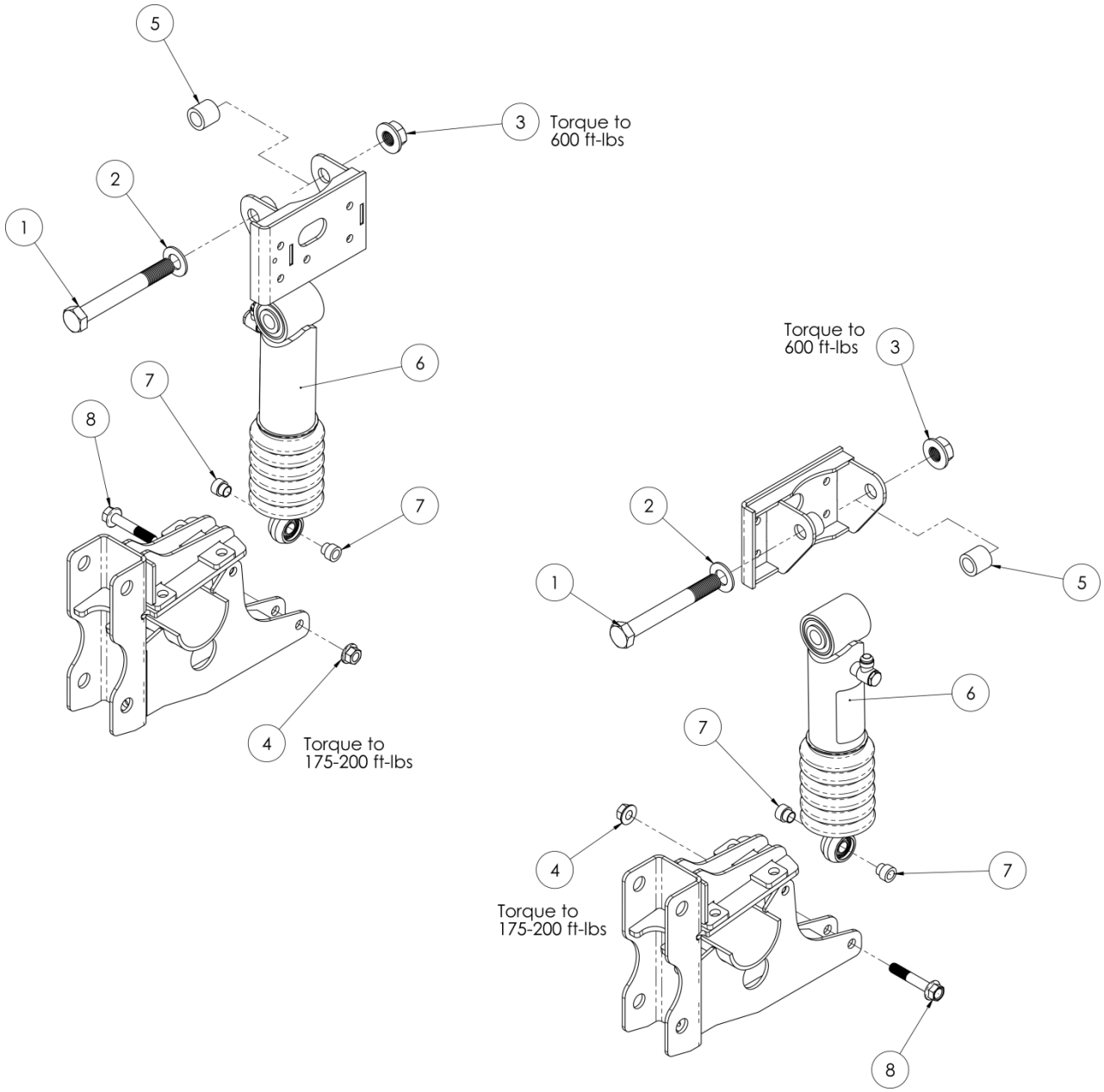


DS96F-B2 Secondary Volumes

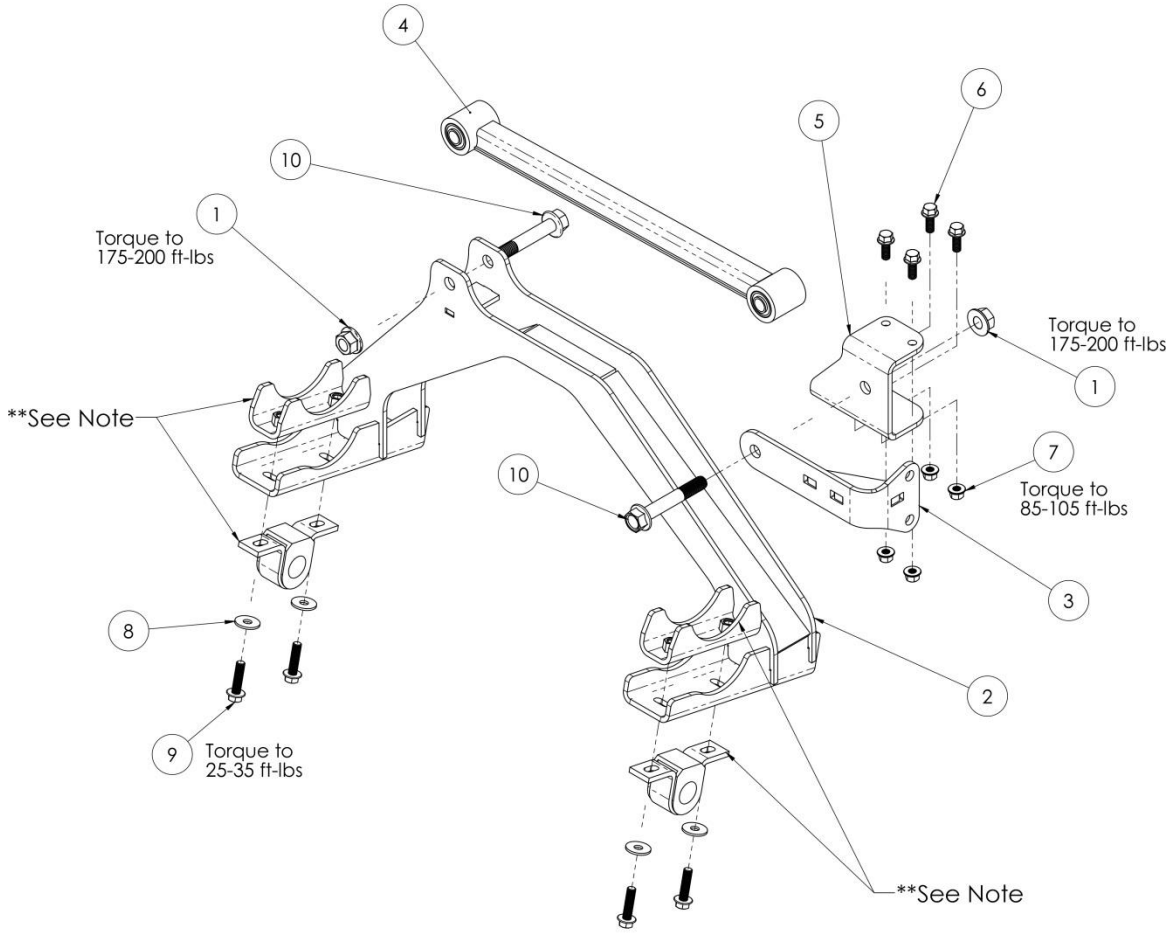
Secondary Volume Components			
ITEM NO.	QTY.	PART NUMBER	DESCRIPTION
1	8	10501-001	HFB 3/8-16 x 1.000 Gr 8, Z
2	8	10012-005	LFN 3/8-16, Gr G, Z
3	1	10597-009	Asy, 2nd Vol 50 x 450, LH
4	1	10597-010	Asy, 2nd Vol 50 x 450, RH
5	4	10830-013	Wldmnt, Volume Mount, Bolt-on
6	4	10843-003	T-Bolt Clamp, Range 4.88-5.5



Strut Components			
ITEM NO.	QTY	PART NUMBER	DESCRIPTION
1	2	10003-009	HCS 1"-8 x 8.000" Gr 8
2	2	10006-004	HFW 1"
3	2	10012-003	LFN 1"-8 Gr G
4	2	10012-008	LFN 5/8"-11 Gr. G
5	2	10567-002	Spacer, 1.5" OD x 1.06" ID x 1.355"
6	2	11071-001	Asy, Strut
7	4	10640-001	Bearing Spacer, 3/4" x 5/8" x 1/2"
8	2	10874-350	HFB 5/8"-11 x 3.500" Gr 8



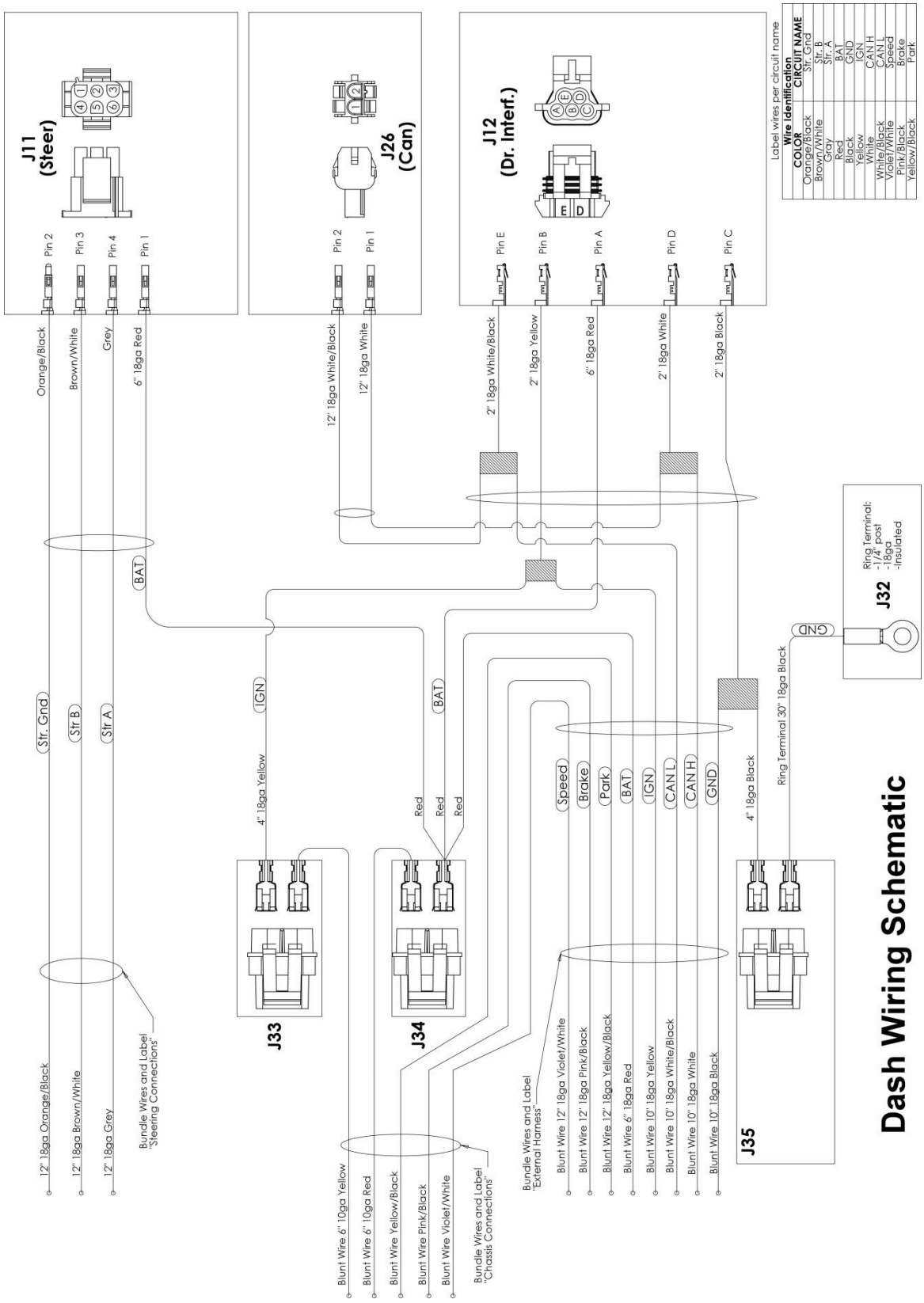
Track Rod Components			
ITEM NO.	QTY.	PART NUMBER	DESCRIPTION
1	2	10012-008	LFN 5/8-11 Gr G, Black Phos
2	1	10574-001	Wldmnt, Axle Bridge
* 3	1	10581-001	Wldmnt, Track Rod Mnt
* 4	1	10570-001	Asy, Track Rod
* 5	1	10584-001	Track Rod Mount
6	4	10501-001	HFB 3/8-16 x 1.000 Gr 8, Z
7	4	10012-005	LFN 3/8-16, Gr G, Z
8	4	10503-001	FW M10 30x10.5x2.5 Fender Z
9	4	10502-002	HFB M10-1.5x40 CL 10.9 Z
10	2	10874-400	HFB 5/8-11x4.00, Gr. 8, BO

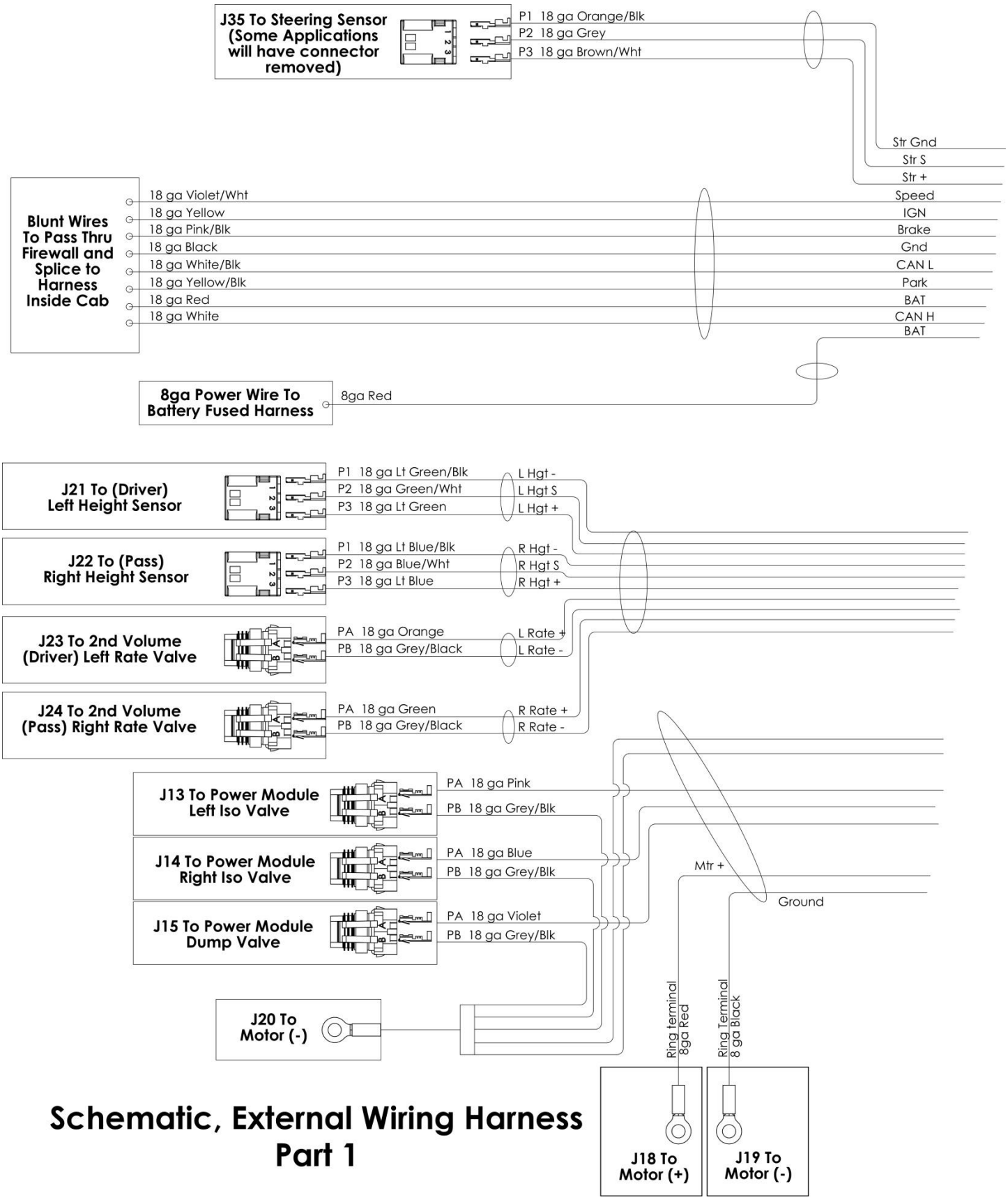


* Items (3), (4), and (5) may be loosely assembled.

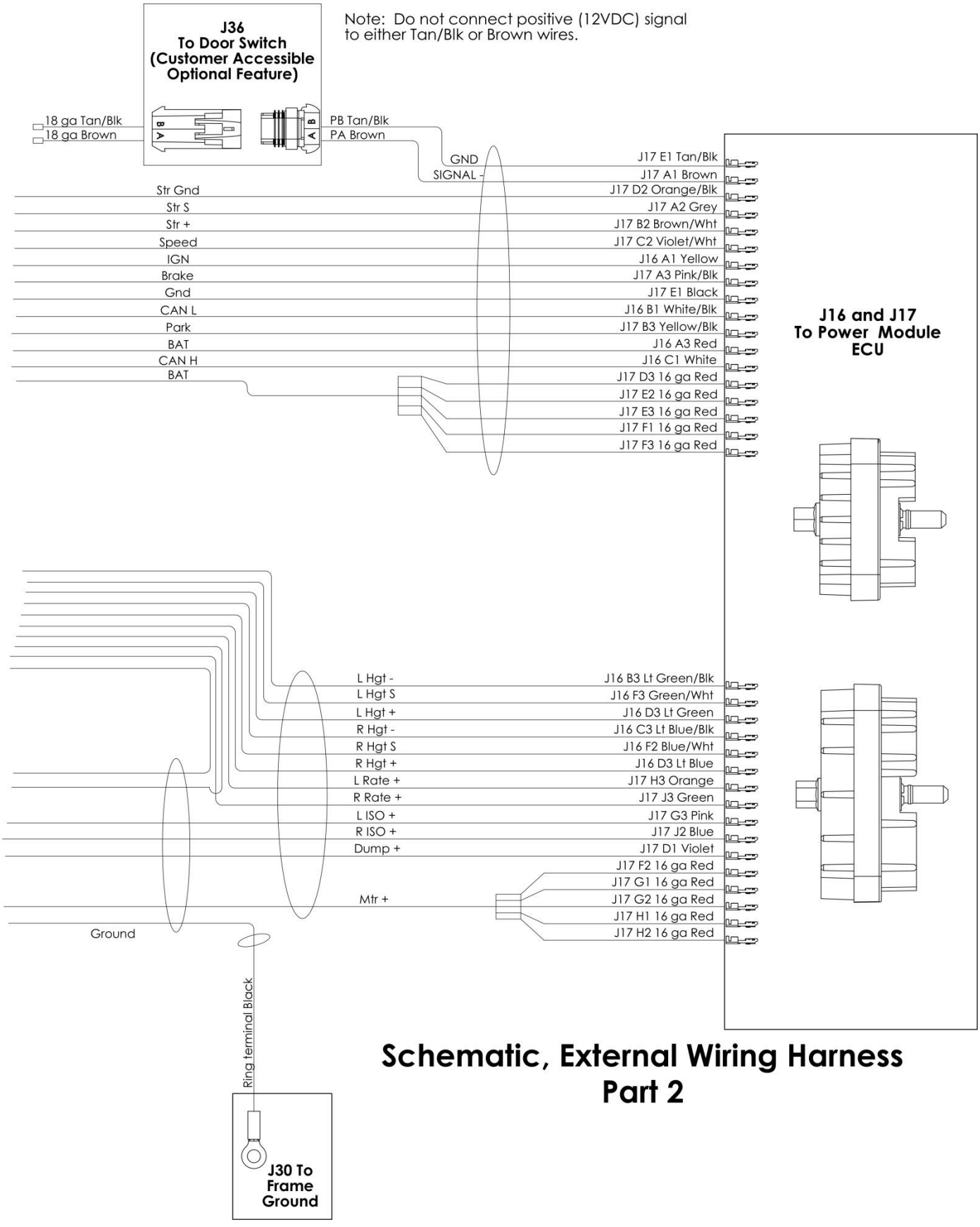
** OEM components, not supplied with kit.

Electrical Schematics

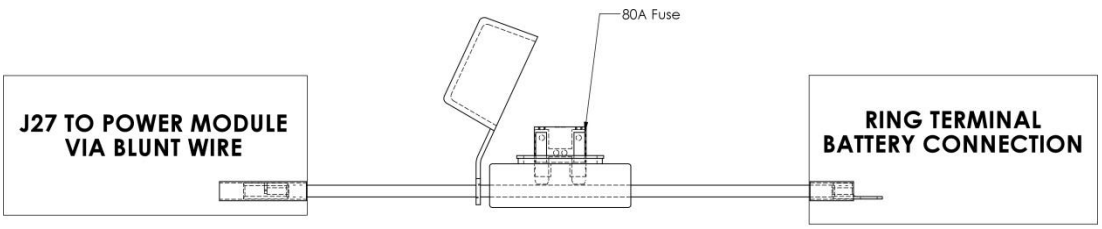




Schematic, External Wiring Harness Part 1



Schematic, External Wiring Harness Part 2



Schematic, Battery Fuse Lead

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