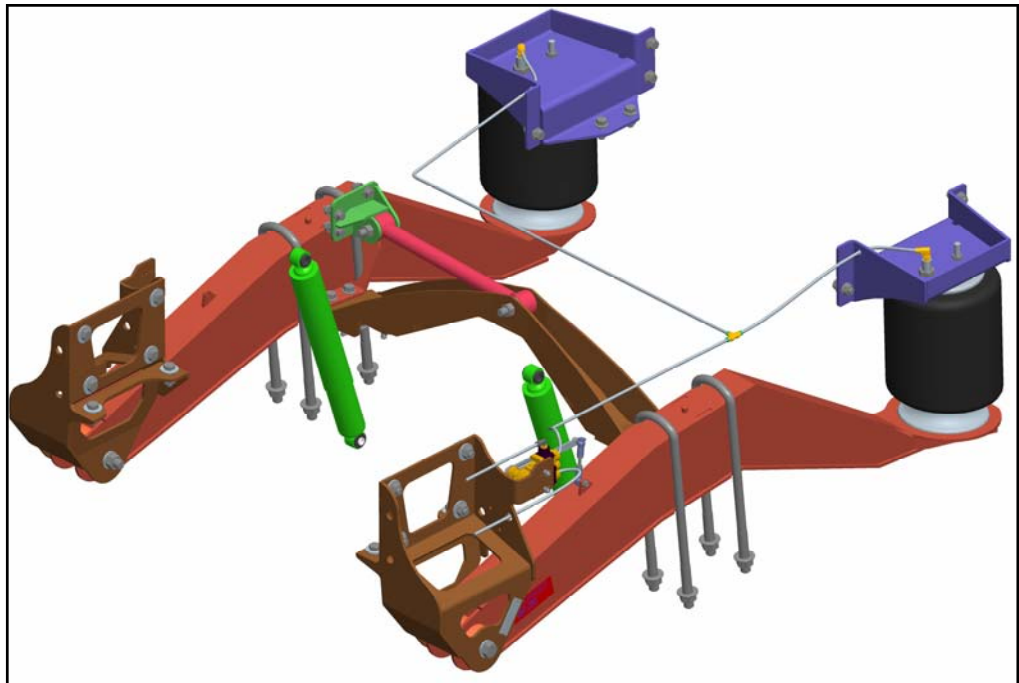


OWNERS MANUAL

FORD F450/550
SUPER DUTY CHASSIS CABS
1999-NEWER MODELS
(Link Part No. 8M000054: Complete Suspension)



Link Mfg. Ltd.
223 15th St. N.E.
Sioux Center, IA USA
51250-2120

(712) 722-4874
Fax (712) 722-4876

**QUESTIONS?
CALL CUSTOMER
SERVICE
1-800-222-6283**

PROUDLY INSTALLED BY :

COMPANY : _____

INSTALLER SIGNATURE : _____

050105
80001086

INSTALLATION INSTRUCTIONS INDEX

1. INTRODUCTION
2. LATERAL CONTROL ROD AXLE BRACKET INSTALLATION
3. LATERAL CONTROL ROD FRAME BRACKET INSTALLATION
4. DRIVER SIDE DISASSEMBLY
5. DRIVER SIDE ASSEMBLY
6. PASSENGER SIDE DISASSEMBLY
7. PASSENGER SIDE ASSEMBLY
8. LATERAL CONTROL ROD
9. SHOCKS AND BRAKE LINE ROUTING
10. AIR SYSTEM ASSEMBLY
11. ELECTRICAL
12. FINAL INSPECTION & OPERATION
13. SERVICE & MAINTENANCE

1. INTRODUCTION

IMPORTANT! It is important that the entire installation instructions be read thoroughly before proceeding with suspension installation.




WARNING! A correct installation must result in the suspension and axle being “loaded” within the range specified by axle and suspension manufacturers. Please check vehicle specifications and intended usage to insure axle will be within Gross Axle Weight Rating (GAWR). No alteration of any suspension component is permitted. Link Mfg. Is not responsible for damages from improper installation or operations beyond design capability. Link Mfg. In its sole discretion shall determine whether or not any product is defective or otherwise covered by warranty.

PRODUCT INSTALLER RESPONSIBILITIES

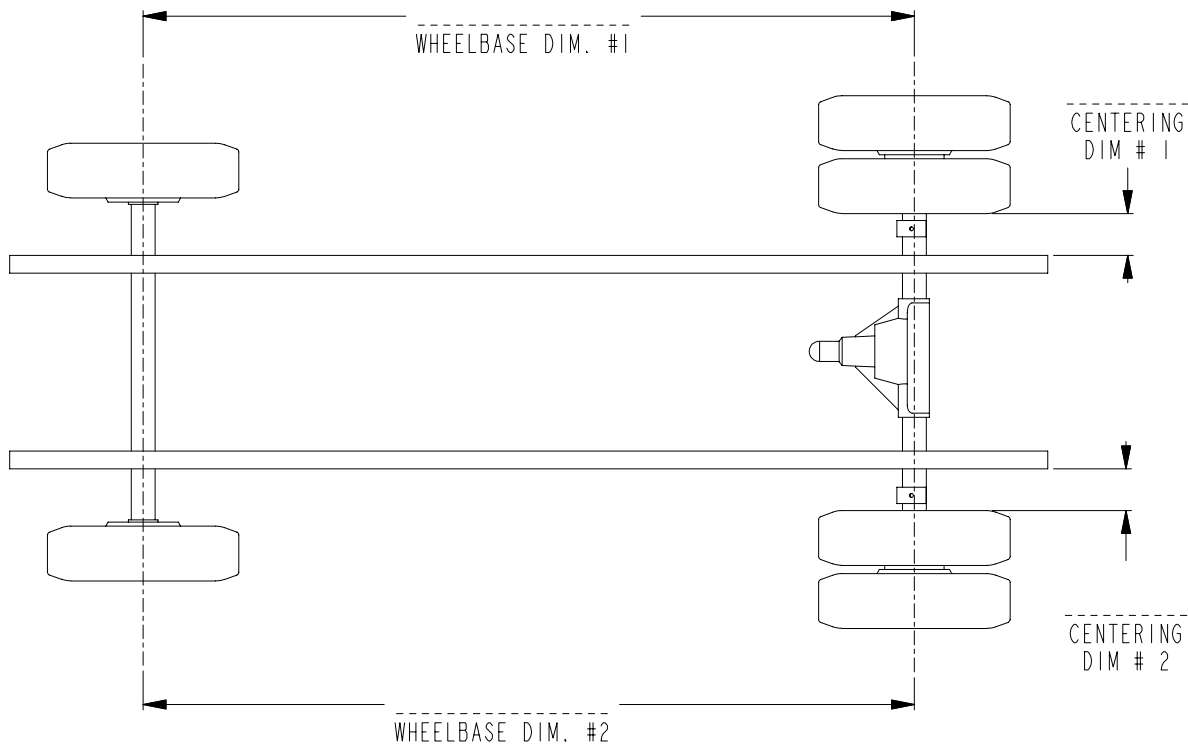
- ❑ Installer is responsible for installing the product in accordance with Link Mfg. specifications and installation instructions.
- ❑ Installer is responsible for providing proper vehicle components and attachments as well as required or necessary clearance for suspension components, axles, wheels, tires, and other vehicle components to ensure a safe and sound installation and operation.
- ❑ Installer is responsible for advising the owner of proper use, service and maintenance required by the product and for supplying maintenance and other instruction as readily available from Link Mfg..

INSTALLATION NOTES:

- ❑ Proper tightening of U-Bolt nuts and mounting nuts are required for proper operation. **Need for proper Torque value is indicated by wrench symbol and values will be found in Table 13-1 in Maintenance section of the instructions.** Failure to maintain proper torque can cause component failure resulting in accident with consequent injury. 
- ❑ **Drilling of new frame holes is required** for installation of the suspension.
- ❑ **Exhaust modification is required** for this suspension installation. Parts and modifications are not included with the suspension.
- ❑ The Ford F450 UltraRide is shown throughout these installation instructions, there is no difference for the F550. It will follow the same sequence and setup as depicted.


PRE-INSTALLATION CHECKLIST

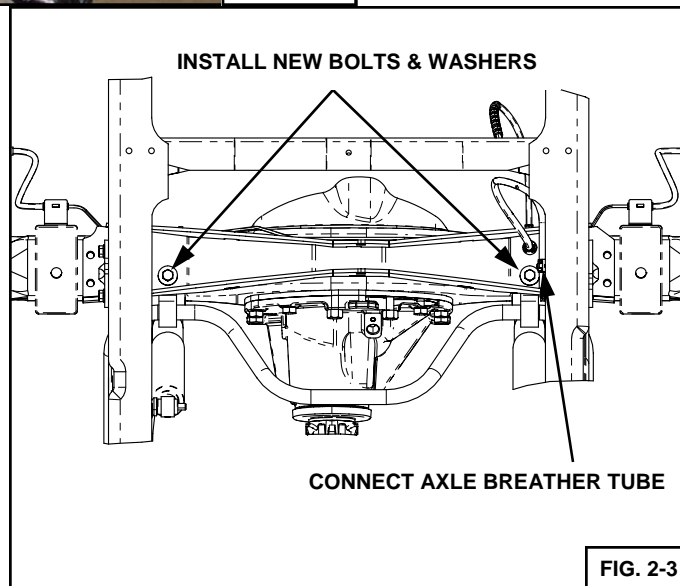
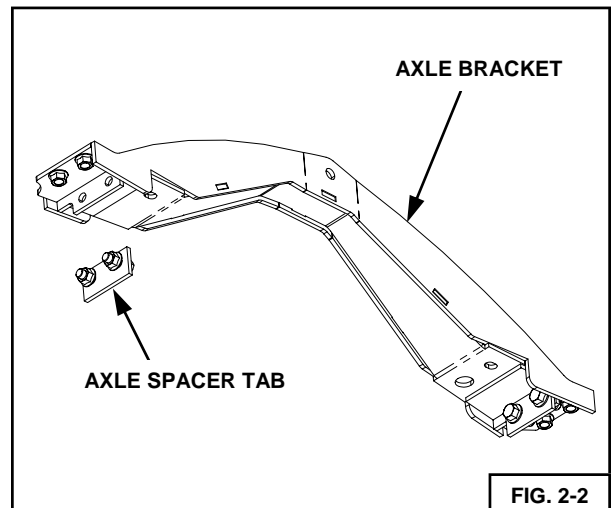
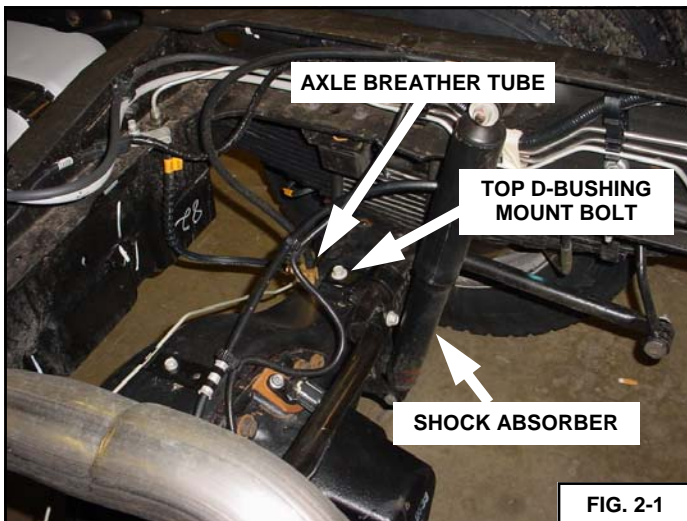
- ❑ Check the vehicle wheel alignment prior to installation to insure no precondition already exists; record the information for verification.
- ❑ Remove the attached body, if applicable. Remember to disconnect all electrical connections to the body, and fuel filler tube, before removing the body. The installation can also be completed using a lift to raise the vehicle. If using a lift, chassis body removal may not be necessary but removal of rear wheels will aid in installation.
- ❑ If not using a lift, block the front wheels and apply the emergency brake so the vehicle cannot roll.
- ❑ Jack up the rear frame of the truck in order to unload the rear leaf springs (or use an overhead hoist). Do not lift the wheels off the ground (if not using a lift to install the suspension). Do not jack on the axle itself.
- ❑ Install the suspension in the listed sequence. Install one side of the suspension at a time. First, install the driver side completely, then install the passenger side. Removal of the rear wheels may aid in installation, but it is not necessary.
- ❑ Measure & record the wheelbase and centering dims before beginning installation.



2. LATERAL CONTROL ROD

AXLE BRACKET INSTALLATION

1. Remove and discard the OEM shock absorbers, but retain the mounting fasteners (bolts & nuts) for re-use.
2. Remove the top d-bushing mount bolts and disconnect the axle breather tube (See Figure 2-1).
3.  If the truck is equipped with an S110 4.25" X 4.25" square axle (most F450s and F550s), install both axle spacer tabs on the axle bracket using (4) 1/2 x 1 1/4 UNC FLANGE BOLTS and (4) UNC TOP LOCK FLANGE NUTS. (See Figure 2-2).
4. **Loosely** fasten the axle bracket to the axle as shown in Figure 2-3 using (2) M12 x 1.75 x 40 METRIC BOLTS and (2) 1/2" WASHERS.
5. Reconnect the axle breather tube to the axle.



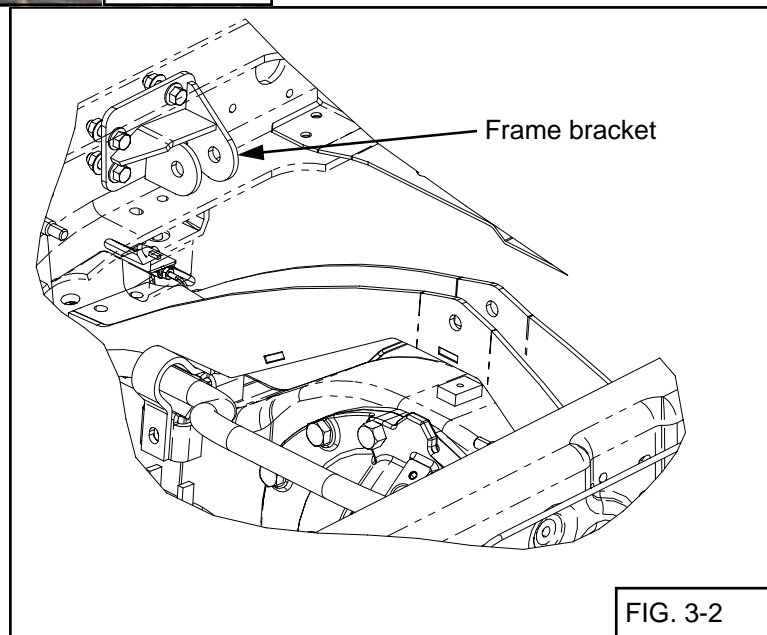
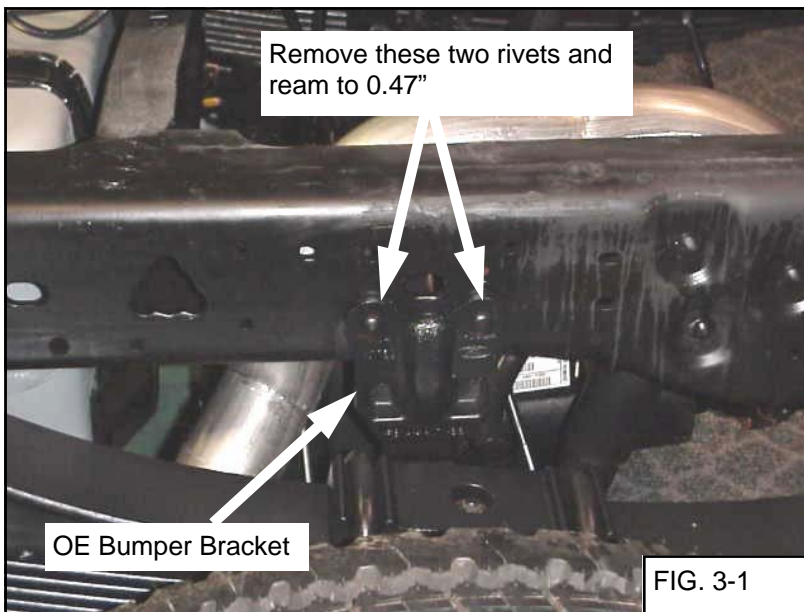
3. LATERAL CONTROL ROD (LCR) FRAME

BRACKET INSTALLATION

1. On the PASSENGER side, remove the two top rivets from the OE bumper bracket and ream the holes to 0.47" (See Figure 3-1)



2. Install the frame bracket as shown in Figure 3-2 using (4) 7/16 UNC TOP LOCK FLANGE NUTS.



4. DRIVER SIDE DISASSEMBLY

1. With weight taken off the rear springs, as noted in pre-installation checklist, remove the rear leaf spring hanger. Removal of the rear overload spring bracket is optional. See Figure 4-1.



CAUTION: Be careful that the leaf spring does not spring out of its hanger, or off the frame.

2. Remove the front spring hanger bracket and the front overload spring bracket. (See Figure 4-2).
3. Remove existing U-bolts that attach the axle to the leaf spring and keep the OE U-bolt plate for later use. (See Figure 4-3) After this is done, the axle, spring, and hanger will be loose. Remove and discard the spring and hangers from the axle.

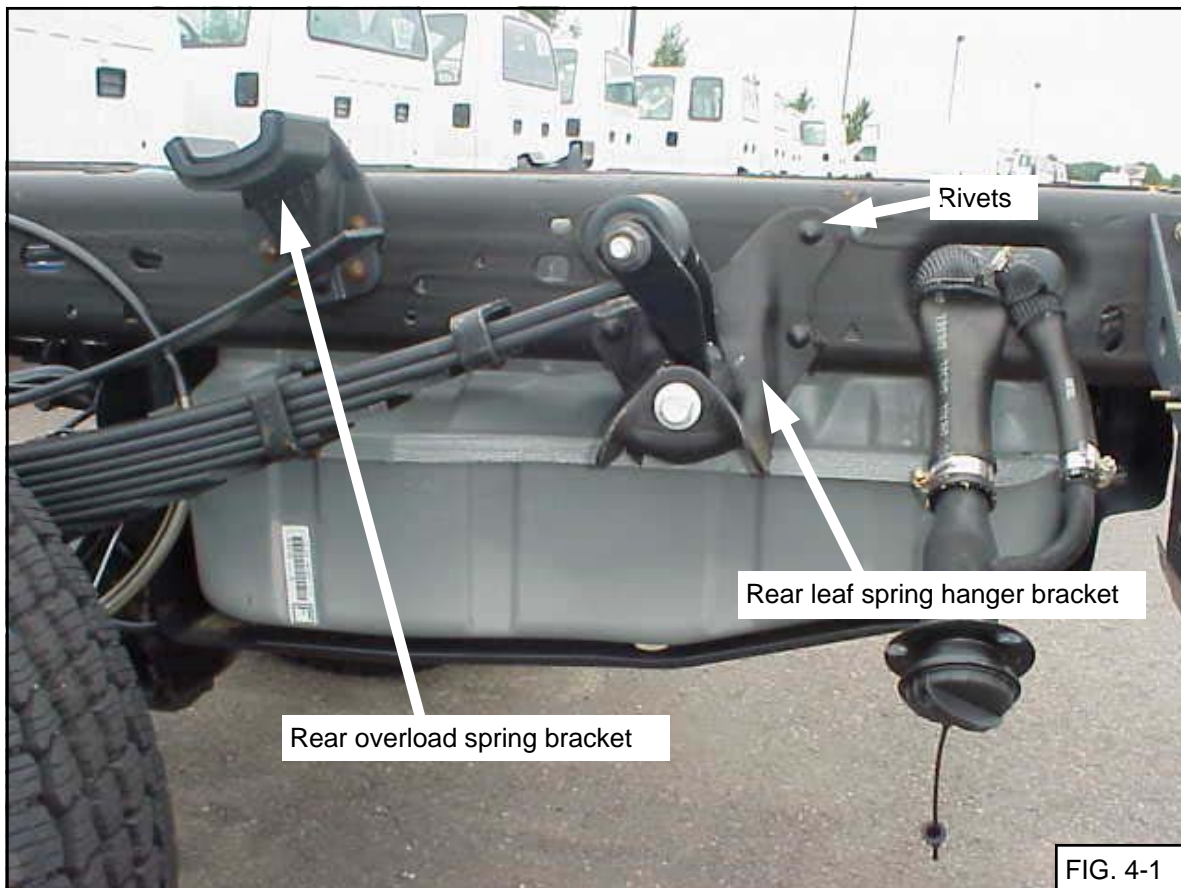
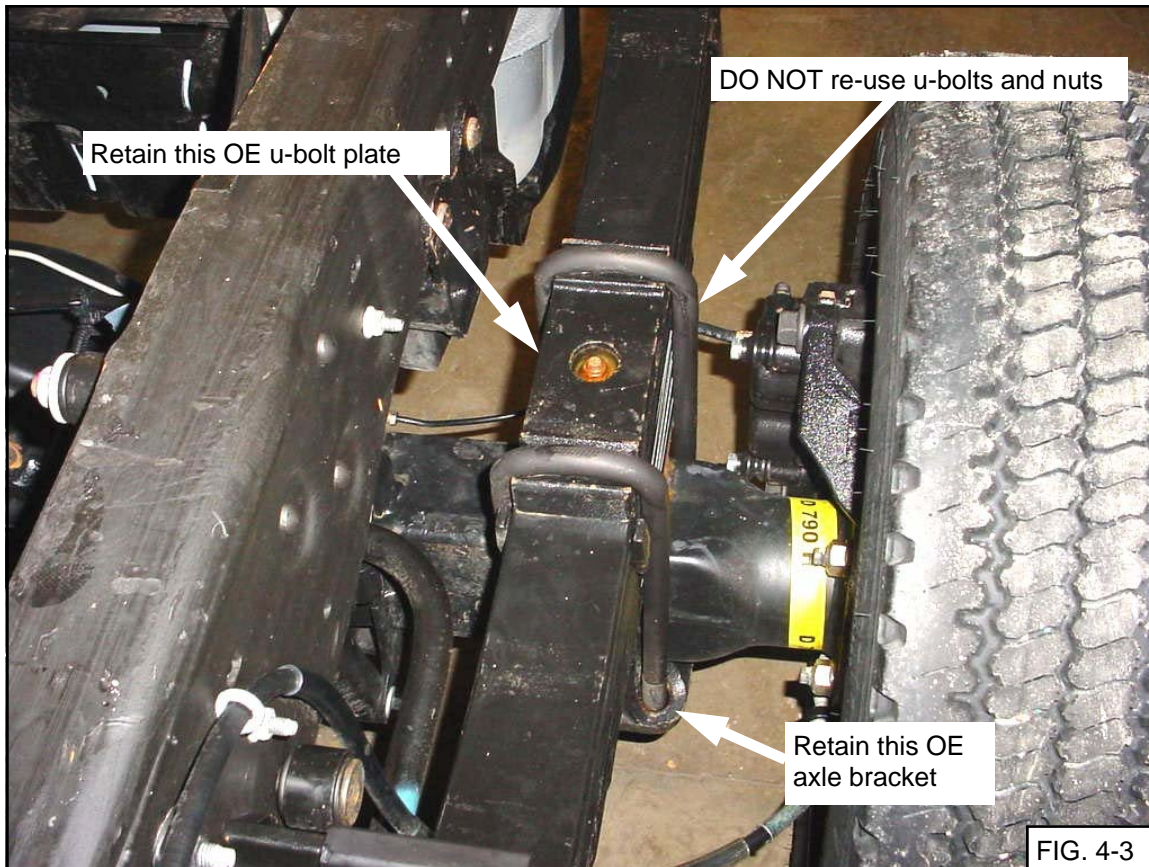
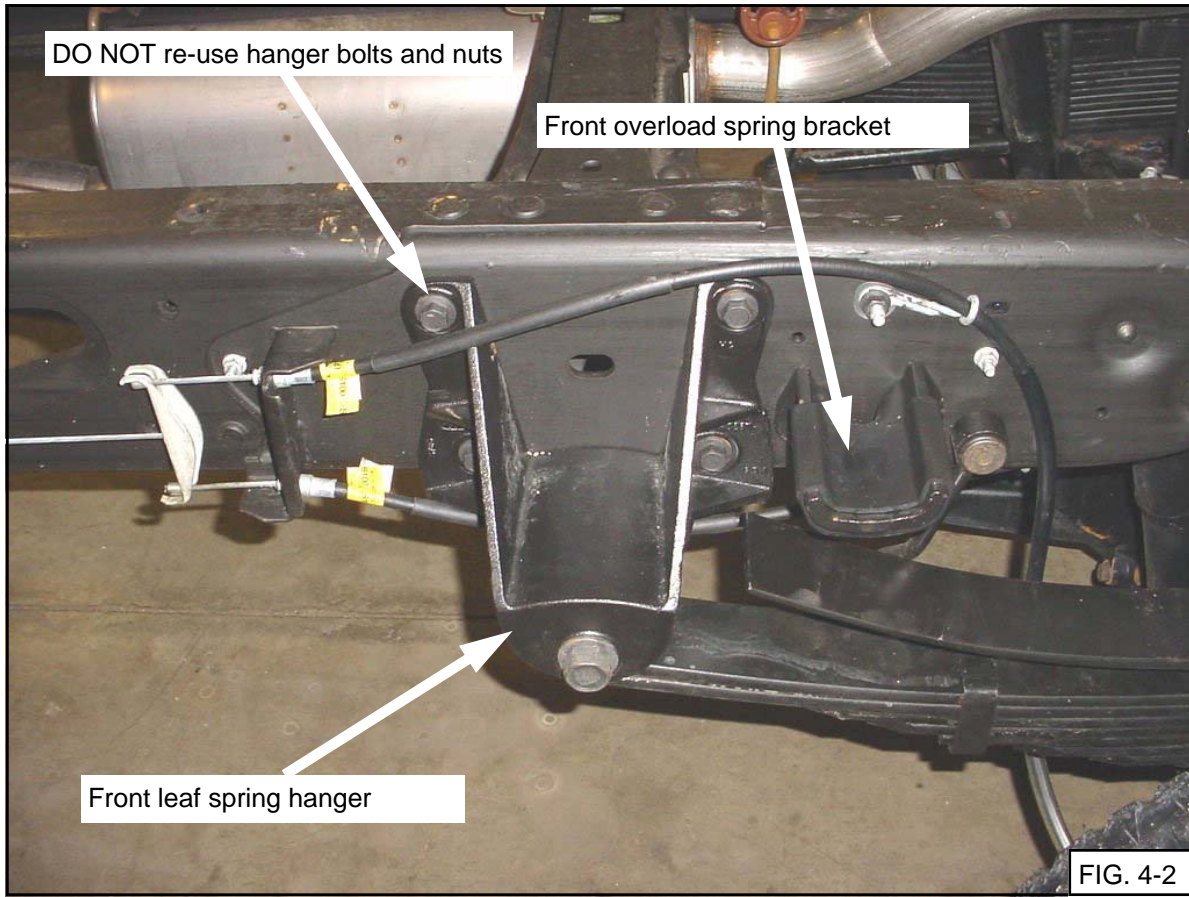


FIG. 4-1



5. DRIVER SIDE ASSEMBLY

1. Review Figure 5-1 & Figure 13-2 to acquaint yourself with the various parts of the UltraRide suspension.



2. Fasten the Front Hanger to the frame using (6) 9/16 x 1-1/2 UNF BOLTS, (6) 9/16 UNF NUTS, and (12) 9/16 FLAT WASHERS. Route the parking brake cables through the corresponding holes on the Front Hanger.



3. Assemble the Suspension Arm to the axle using (2) M20 X 2.50, 79 X 425 METRIC U-BOLTS, (4) M20X2.5 METRIC NUTS, and original OE top plate and axle bracket. Make sure the arm/axle locating pin is properly inserted into the mating hole on the axle pad and that the bottom side of the arm rests evenly on the axle pad.

4. Insert the Bolt Spacer Tube into the arm bushing and **loosely** fasten the arm to the front hanger using (1) 3/4 X 7 UNF BOLT, (1) 3/4 UNF NUT, (2) 3/4 WASHERS, and (2) plastic wear washers.

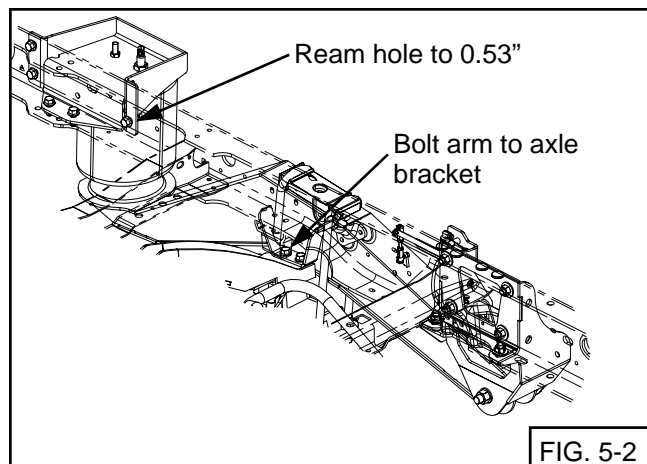
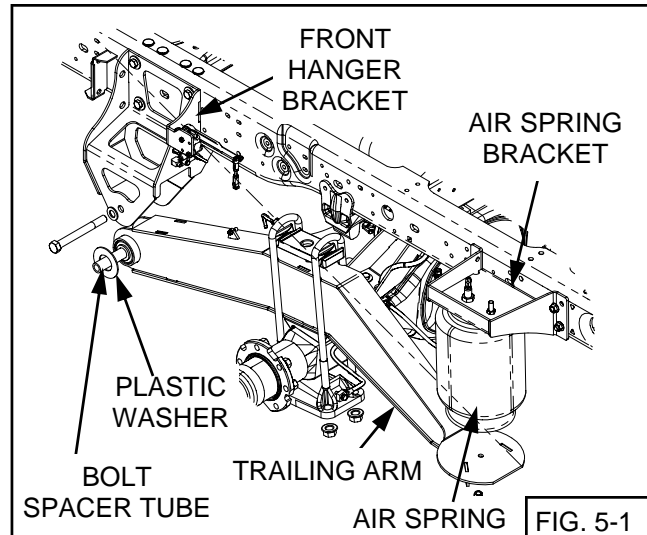
5. **Loosely** fasten the Lateral Control Rod Axle Bracket to the Arm using (2) 1/2 X 1-1/4 UNC FLANGE BOLTS (See Figure 5-2).



6. Bolt the Air Spring Bracket Assembly to the frame using (5) 1/2 X 1-1/4 UNC FLANGE BOLTS and (5) 1/2 UNC TOP LOCK FLANGE NUTS. One frame hole will need to be reamed to 0.53" on each side. See Figure 5-2.



7. Bolt the Air Spring to the Suspension Arm using (1) 1/2 UNC JAM NUT. Make certain the air spring is not twisted or creased after tightening the nut.

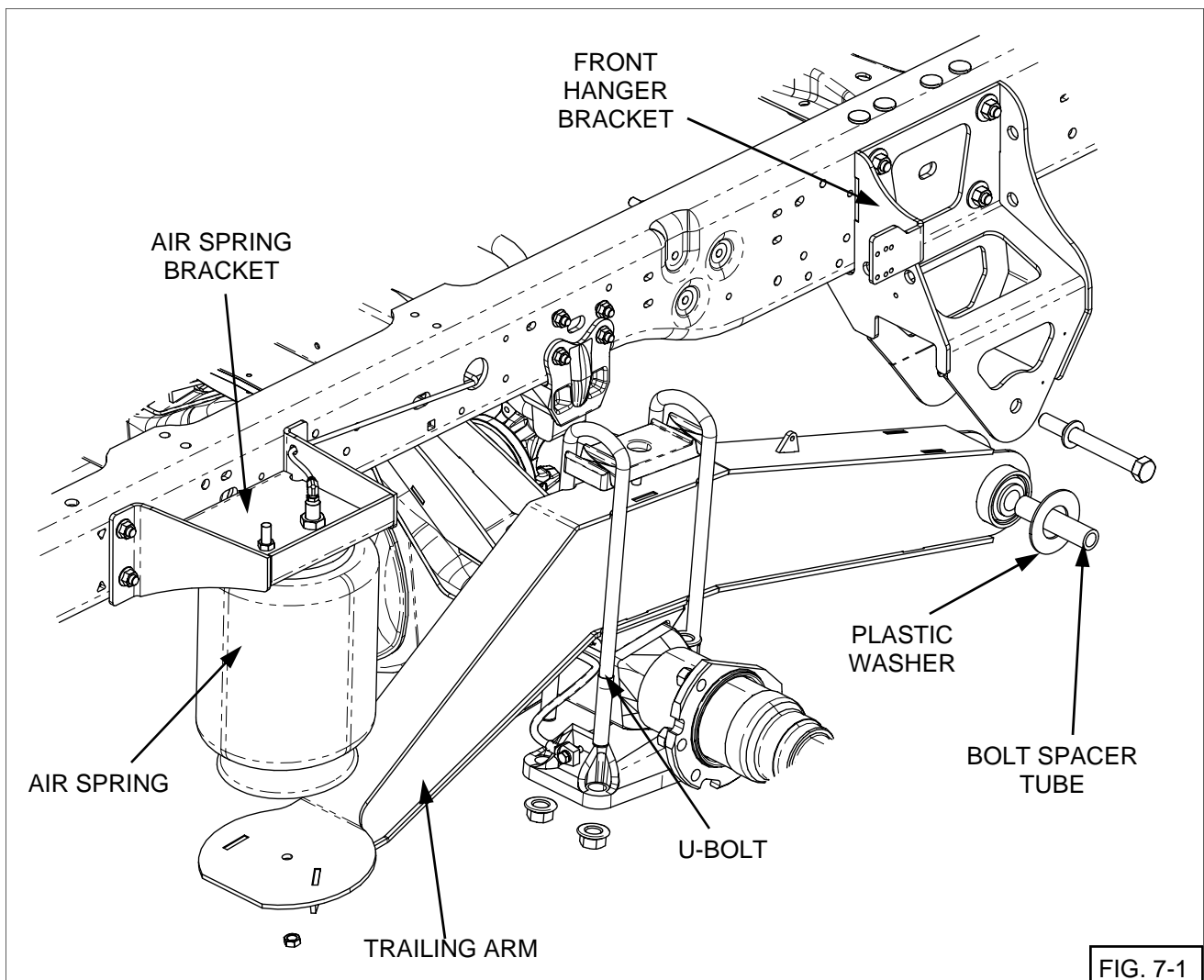


6. PASSENGER SIDE DISASSEMBLY

1. Repeat Section 4 for the passenger's side of the truck.

7. PASSENGER SIDE ASSEMBLY

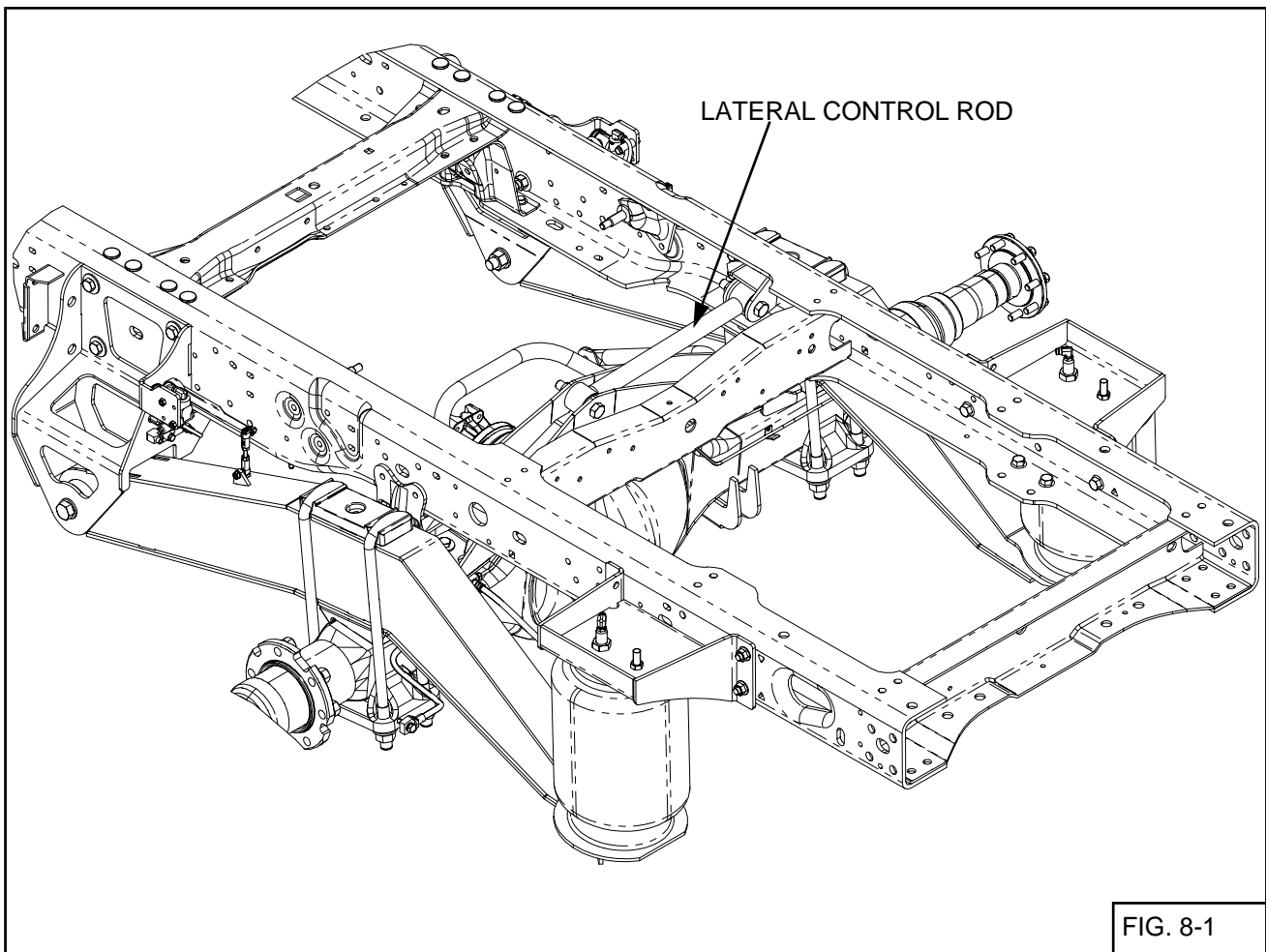
1. Repeat Section 5 for the passenger's side of the truck.
2. Double-check all fasteners for proper torque. Check all clearance points and all alignments. See Figure 7-1 for details.



8. LATERAL CONTROL ROD

1. Prior to the assembly of the Lateral Control Rod and Brackets, the exhaust will need to be cut either ahead of or above the axle.
2. **Loosely** install the Lateral Control Rod using (2) 5/8 X 4 1/2 UNF BOLTS and (2) 5/8 UNF TOP LOCK NUTS.

IMPORTANT: Inspect Lateral Control Rod for any interference with other components, paying close attention to clearance with any flexible components such as brake and fuel lines.



9. SHOCKS AND BRAKE LINE ROUTING

1. Install the new Shock Absorbers using the same orientation as factory, and factory hardware.
2. **IMPORTANT: Route the brake cable away from the air spring and any other moving components.** It may need to be tied, or slightly repositioned.

10. AIR SYSTEM ASSEMBLY



CAUTION! Route all airline away from exhaust, moving parts, and sharp objects. Be careful not to crimp the edges of the tubing. When installing the airline, fully insert into fitting and give a slight pull to seat properly and to be sure airline will not pull out.

1. Mount the Air Control Box to the vehicle as directed in the Air Control Kit installation instructions.

2. Route the (5) airlines as shown in Figure 10-1, 10-2 and 10-3.

- ❑ Route AIRLINE 1 from the supply port of the Height Control Valve to the lower outlet port of the Air Reservoir Solenoid.
- ❑ Route AIRLINE 2 from the dump port in the Height Control Valve to the top elbow on the Air Reservoir Solenoid.
- ❑ Route AIRLINE 5 from the del port of the Height Control Valve to the union tee supplying the Air Springs.
- ❑ Route AIRLINES 3 & 4 from the Union Tee to the Air Springs.

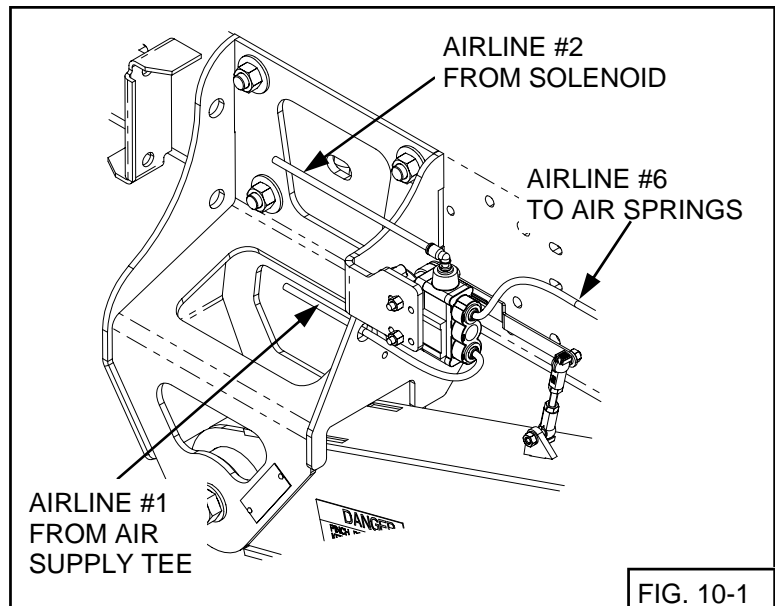


FIG. 10-1

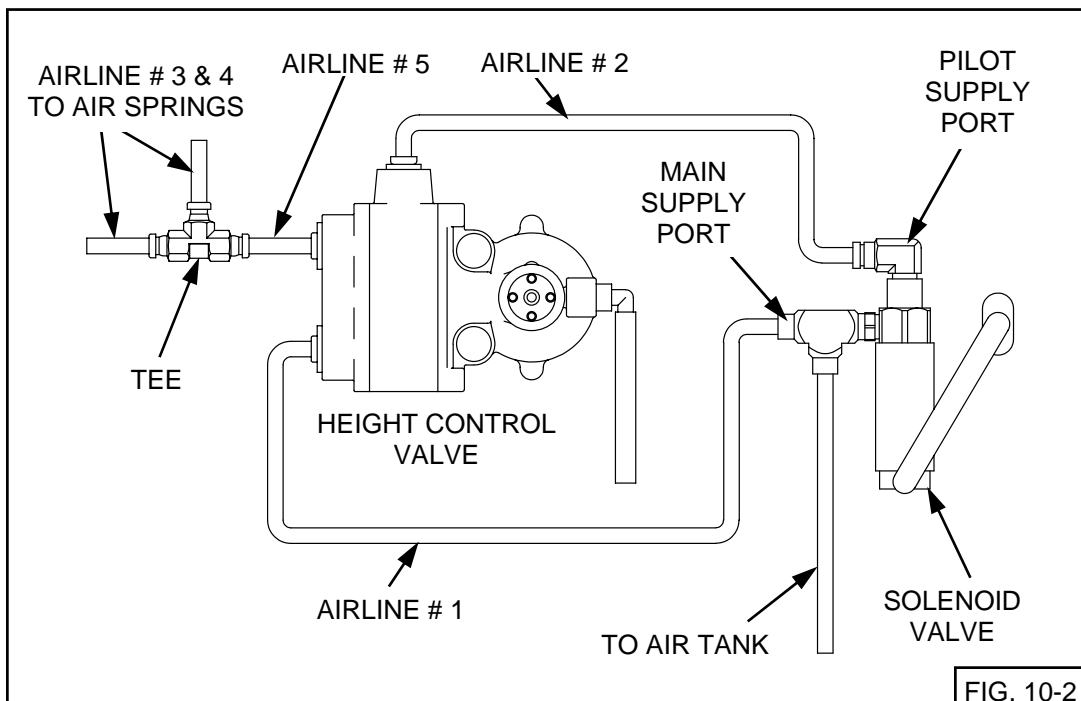
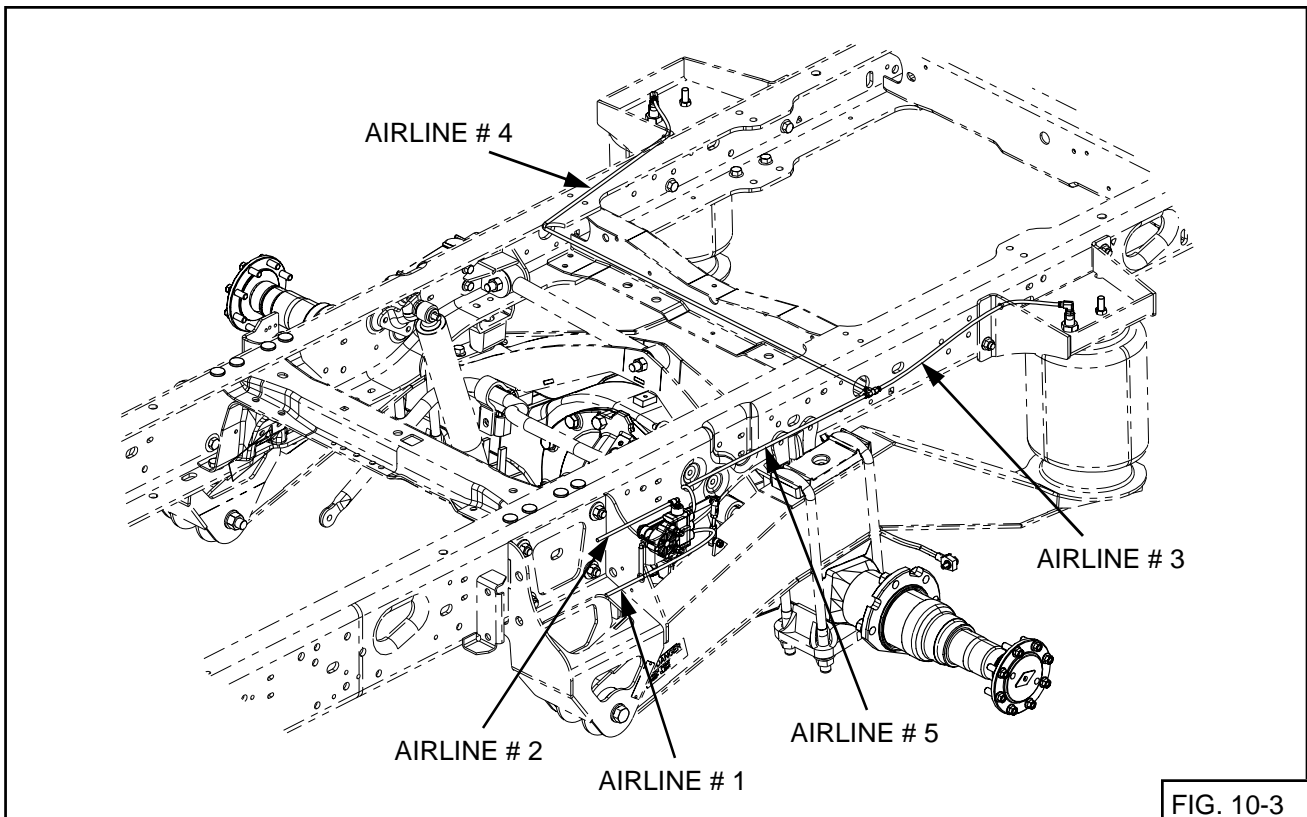


FIG. 10-2

3. Place supplied corrugated loom onto all airlines. Use supplied cable ties and airline clips to secure airline and to keep it away from all hazardous objects. See Figure 10-3 for details.



11. ELECTRICAL SYSTEM



CAUTION! All wiring should be routed and secured neatly to avoid any functional or visual issues. Under hood and under-body wire routings should be clear of sharp edges (3/4 inches minimum) and direct sources of heat (4 inches minimum). Wiring should not be routed through wheel well areas where it may be damaged by tire or road debris, and it should not be routed over the exhaust system. Wiring should not contact the brake lines or fuel lines. Disconnect the battery cables before servicing any electrical components.

1. Refer to **AIR CONTROL SYSTEM INSTALLATION INSTRUCTIONS** for further details on electrical system installation and parts list.

12. FINAL INSPECTION & OPERATION

1. Double check all electrical connections and wire routings.
2. Remove all jacks and air system up by either using the fill valve on the air tank or by starting the vehicle and switching the compressor switch to "ON". It is recommended to fill the air tank using the supplied schraeder valve to minimize compressor runtime.
3. Check for proper operation of the height control valves. With one end of the valve linkage disconnected rotate the valve arm down should exhaust from the air springs. Rotating the valve arm up should fill the air springs.
4. Set the "Design Height" of the air springs. The height should be as shown in Figure 12-1, and **measured at the middle of the air spring**. To adjust the design height, disconnect one end of the valve linkage and adjust accordingly (increasing the length will increase the Design Height, and vise-versa). Tighten the lock nuts on the valve linkage when complete. Once the design height is set, jostle the suspension up and down and then allow it to come back to design height. Recheck the height and adjust if needed. Note: **this procedure to set design height can be done when empty or under light load.**

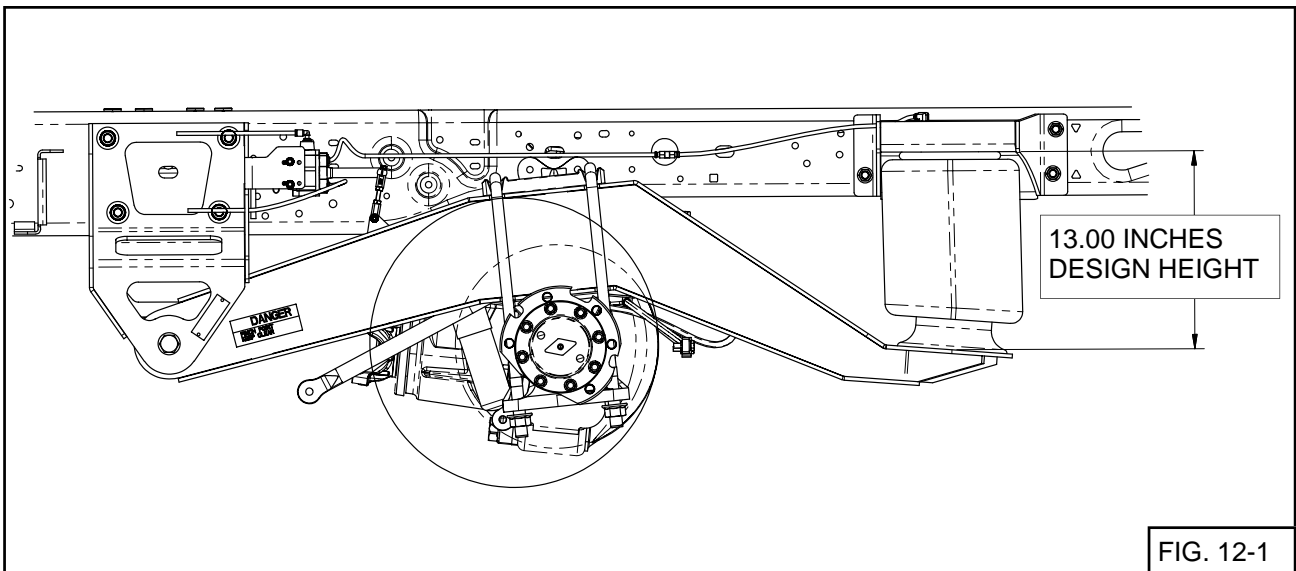


5. Center the lateral (side to side) location of the axle by adjusting the location of the axle bracket as necessary, moving it on the axle. Tighten the (6) axle bracket bolts to specified torque.
6. Torque all bushing pivot bolts at this time. This includes the front hanger bushing bolts and the lateral control rod bushing bolts.
7. Move the suspension throughout its entire range of motion, by inflating and deflating the air springs to achieve full travel. Check for any interferences with the lateral control rod, axle, shocks, exhaust, frame, brake lines (**especially on the driver side**), fuel lines, etc.
8. **IMPORTANT!** Check all fittings and airlines for air leaks.
9. Reinstall the chassis body (if applicable).
10. **IMPORTANT!** During servicing check tightness of all fasteners and for any air system leaks. Immediate corrective action should be taken if malfunctions occur.
11. After all final checks are complete, it is recommended to complete a full four- wheel alignment and drive line angle check. The pages following the installation instructions describe the proper method for checking driveline angles. Note: improper driveline angles may have a detrimental effect on ride, u-joints, and transmission. If any driveline vibration (or out of spec. angle measurement) occurs, use factory axle seat shims to modify driveline angle.
12. Check the kneel function. Toggling the Dump switch "ON" will exhaust all air from the air springs and lower the rear of the vehicle approximately 3-4 inches. Air springs will re-inflate when the switch is returned to the "OFF" position. **WARNING: Do not drive the vehicle while the Dump Switch is on and the air springs are deflated.**

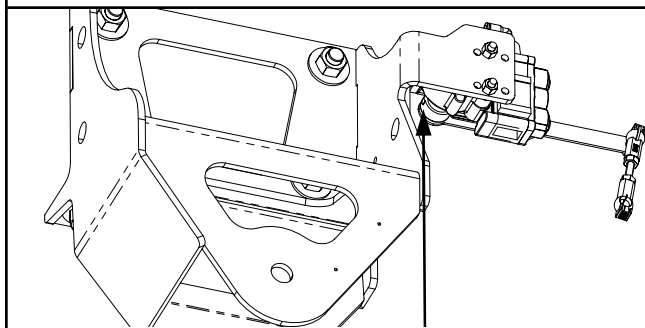


13. Recheck all fasteners for specified torque. (See Table 13-1 for appropriate Torque)

- ❑ The UltraRide Chassis Air Suspension is fully automatic in controlling the height of the chassis. No manual intervention to control air pressure or ride height is needed during the course of operation.
- ❑ The Compressor Switch must be on for the compressors to operate. During difficult starting circumstances, (i.e. extremely cold weather) it is recommended to turn the compressor switch off until the vehicle is running, to reduce current draw from the battery. The compressors are controlled by the pressure switch located in the Air Control Box. This switch automatically maintains the correct pressure in the air tank.
- ❑ The Low Pressure Warning Light indicates a severe drop in tank pressure (below 60 psi). Immediate corrective action should be taken to determine the cause of air loss. Compressor switch should be turned off if Low Pressure Warning Light is on, and remains on even after the compressors have run for a normal period of time. **NOTE:** The Low Pressure Warning Light could come on briefly when the “Dump” feature is being used.
- ❑ It is important to release any moisture contained within the air tank on a daily basis. Not



STANDARD DRIVER SIDE VALVE ORIENTATION



VALVE ALIGNMENT INDICATOR
ROTATED
“INLINE” WITH EXHAUST PORT

FIG. 12-2

releasing the moisture on a regular basis will cause the drain valve to not operate properly.

13. SERVICE & MAINTENANCE

The UltraRide suspension needs no lubrication and little maintenance. The following components should be checked at the time the truck is being serviced. However, immediate corrective action should be taken if a serious malfunction occurs. See Exploded Assembly on following page for details.



CAUTION! If maintenance or service is to be done on the air system, be sure to drain **all** air from system. Serious injury could occur if components are removed while system is full of air.

Note: It is important to release any moisture contained within the air reservoir on a daily basis. See Air Kit Manual for details. Not releasing the moisture on a regular basis will cause the drain valve to not operate properly, and may cause the valve to malfunction. Excess moisture in the system can also cause premature failure of other components including the tank itself.

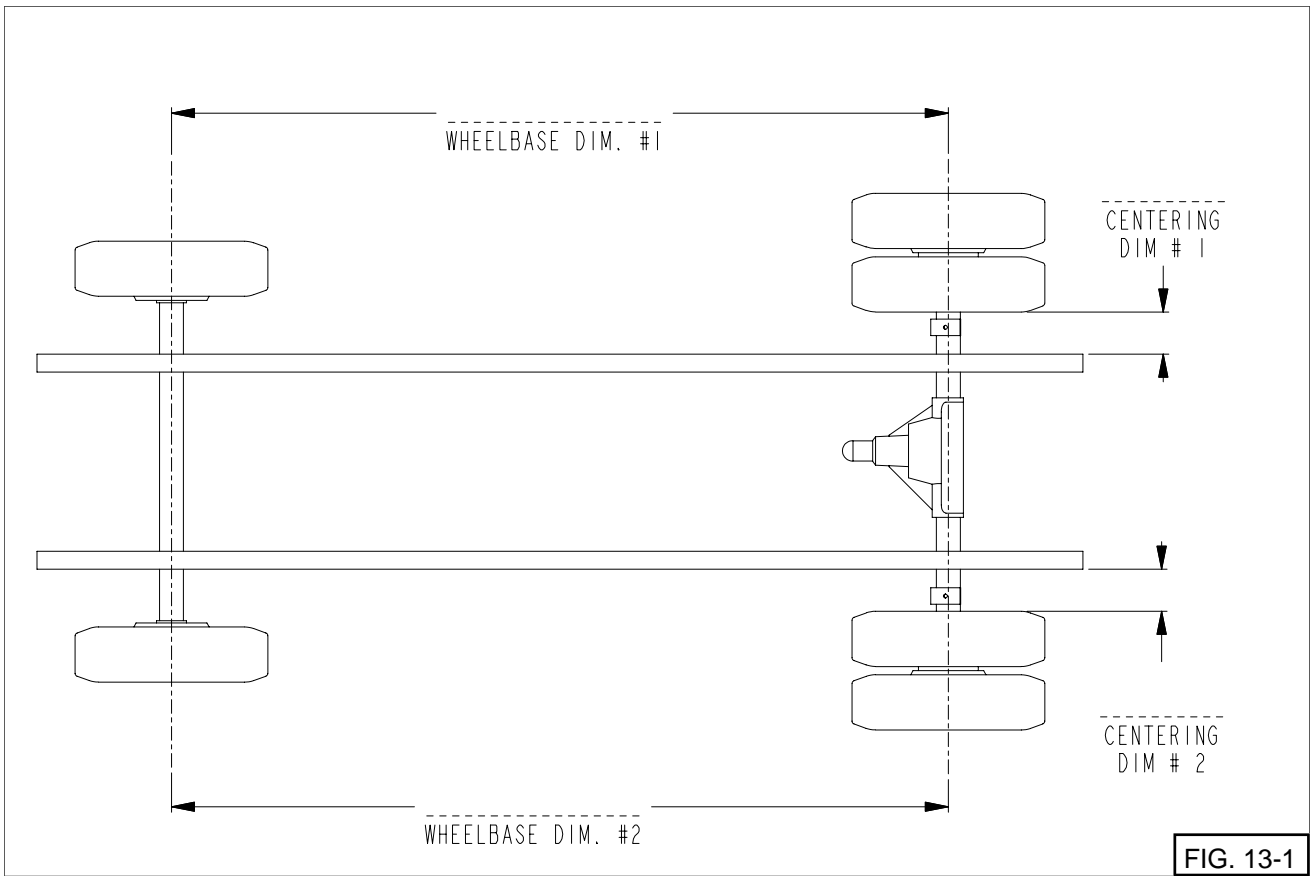
INSTALLATION & MAINTENANCE CHECK LIST

- Check and document OE rear axle alignment
- Set Design Height to 13.0 inches
- Verify suspension function via dump and reinflation
- Check for air leaks and system integrity
- Check clearances throughout suspension motion range
- Check driveline angle
- 4 wheel alignment
- Measure and record wheelbase and centering dims below.



TORQUE TABLE (Table 13-1)

LOCATION	FASTENER	TORQUE
AXLE BRACKET SPACER TABS	1/2 UNC NUTS	75 FT-LBS
LCR FRAME BRACKET	7/16 UNC NUTS	52 FT-LBS
FRONT HANGER BOLTS	9/16 UNF NUTS	128 FT-LBS
AXLE U-BOLTS	M20X2.5 NUTS	315 FT-LBS
FRONT HANGER BUSHING	3/4 UNF NUT	315 FT-LBS
LCR AXLE BRACKET	10 mm BOLTS	33 FT-LBS
LCR AXLE BRACKET	1/2 X 1-1/4 UNC BOLTS	80 FT-LBS
AIR SPRING BRACKETS	1/2 UNC NUTS	80 FT-LBS
BOTTOM OF AIR SPRINGS	1/2 UNC JAM NUTS	30 FT-LBS
LCR BUSHINGS	5/8 UNF NUTS	170 FT-LBS



UltraRide – F450&550 PARTS LIST

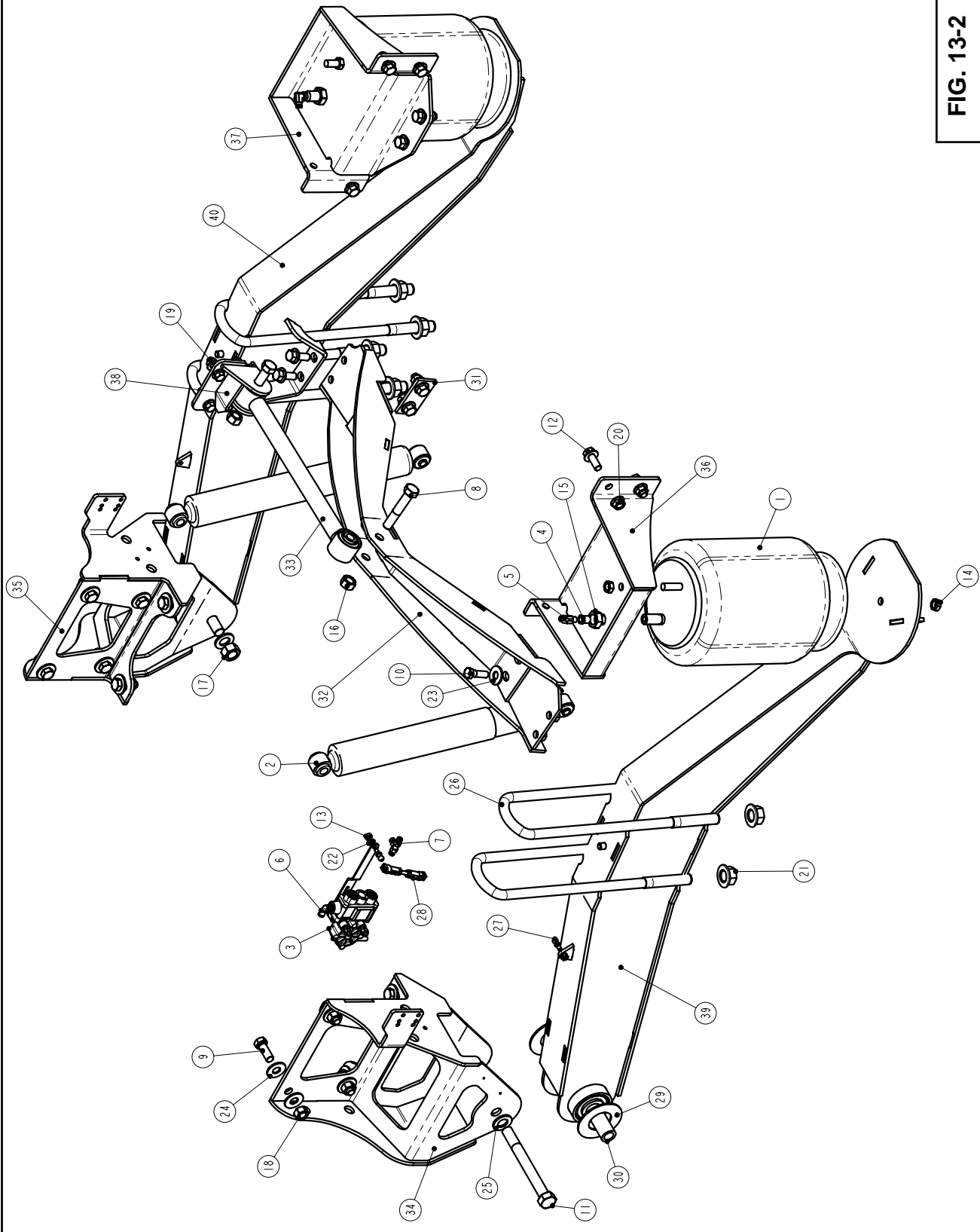
ITEM	PART NUMBER	DESCRIPTION	QTY
1	1103-0506	SPRING-AIR	2
2	1210-0509* OR 1210-0510*	SHOCK ABSORBER	2
3	1301-0062	VALVE-CONTROL, HEIGHT	1
4	1302-2014	REDUCER, 1/8 F-NPT 1/4 M-NPT	2
5	1302-5100	ELBOW, 1/4 TB 1/8 M-NPT, PUSH-IN DOT	2
6	1302-5499	ELBOW, 1/4 TB 1/4 PTC, PUSH-IN DOT	1
7	1302-5563	UNION TEE, 1/4 TB, PUSH-IN	1
8	1403-2028	5/8 X 3 1/2 UNF HEX CAP SCR (GR 5)	2
9	1404-1812	9/16 X 1 1/2 UNF HEX CAP SCR (GR 8)	12
10	1405-1208	HEX CAP SCR, M12 X 1.75 X 40, CLASS 8.8	2
11	140D-2456	3/4 X 7 UNF HEX CAP SCR (GR 8) O&P	2
12	141A-1610	1/2 X 1 1/4 UNC FLANGE BOLT (GR 8) O&P	18
13	1470-0800**	1/4 UNC HEX NUT (GR B)	2
14	1474-1600	1/2 UNC HEX JAM NUT	4
15	1475-2400	3/4 UNF HEX JAM NUT	2
16	1477-2001	5/8 UNF HEX TOP LOCK NUT (GR C)	2
17	1477-2406	3/4 UNF HEX TOP LOCK NUT (GR C) O&P	2
18	1477-1801	9/16 UNF HEX TOP LOCK NUT (GR C)	12
19	1480-1404	7/16 UNC TOP LOCK FL NUT (GR G) O&P	4
20	1480-1604	1/2 UNC TOP LOCK FL NUT (GR G) O&P	14
21	1480-2002	HEX TOP LOCK FLANGE NUT, M20 X 2.5, CLASS10	8
22	1485-0800**	1/4 LOCK WASHER	2
23	1487-1600	1/2 TYPE A PLAIN WASHER	2
24	1487-1800	9/16 TYPE A PLAIN WASHER	24
25	1488-2402	3/4 SAE HARDENED WASHER	4
26	1495-0021	U-BOLT, M20 X 2.50, 79 X 425	4
27	1500-0224**	BALL-PIVOT, THREADED	2
28	1500-0238	LINKAGE-VALVE, HEIGHT CONTROL (3.00)	1
29	8000-0130	WASHER-WEAR	4
30	8000-0135	SPACER-TUBE	2
31	8000-1085	SPACER - BUMPER, S110	2
32	800M0089	LCR BRACKET - AXLE	1
33	800M0090	LATERAL CONTROL ROD	1
34	810M0031	BRACKET-MOUNT, HANGER	1
35	810M0032	BRACKET-MOUNT, HANGER	1
36	810M0034	MOUNT-AIRSPRING	1
37	810M0035	MOUNT-AIRSPRING	1
38	810M0036	BRACKET-MOUNT, LCR, FRAME	1
39	820M0013	ARM	1
40	820M0014	ARM	1

*1210-0509 shock is for standard use vehicles; 1210-0510 shock is for vehicles with constant rear Gross Axle Weight.

** (1) 1500-0224, (1) 1470-0800, & (1) 1485-0800 are available together as a kit; part number: 2991-0024.

UltraRide – F450&550 PARTS LIST

FIG. 13-2



***UltraRide* - TROUBLE SHOOTING GUIDE**

COMPONENT	POSSIBLE PROBLEM	CORRECTIVE ACTION
Airlines	Air leaks	Replace airline
Fittings	Air leaks	Remove fitting and apply fresh joint compound. Reinstall fitting, but Do Not Over tighten. Do not use Teflon tape.
Air Springs	A. Improper height B. Air leakage	A. Adjust valve linkage to maintain proper air spring height. B. Replace air spring.
Height Control Valve	Air spring(s) will not inflate when weight is added to the chassis. OR Air spring(s) will not deflate when weight is removed from the chassis.	A. Inspect valves to insure alignment indicator is located correctly. The alignment indicator should be aligned with the exhaust port of the valve. If not, loosen lever nut (but do not remove completely) and pull lever loose from drive bearing, rotate drive bearing until the alignment indicator is in the correct position and re-secure lever by tightening lever nut. See Fig. 9-2 for orientation details B. Replace valve.
Shock Absorber	Insufficient damping effect	Replace shocks
Lateral Control Rod	A. Loose nuts on lateral control rod bolts B. Worn bushings	A. Tighten securely. B. Replace lateral control rod.

FORD F450/550 ULTRARIDE SERVICE &

MAINTENANCE GUIDELINES

The UltraRide suspension needs no lubrication and little maintenance. However, immediate corrective action should be taken if a serious malfunction occurs.



CAUTION! If maintenance or service is to be done on the air system, be sure to drain all air from the system. Serious injury could occur if components are removed while system is full of air.

PRODUCT OWNER RESPONSIBILITIES

- ❑ Owner is solely responsible for pre-operation inspection, periodic inspections, maintenance, and use of the product as specified in the particular LINK MFG. instructions available by product model, except as provided in this warranty, and for maintenance of other vehicle components. Of particular importance is the re-torque of fasteners including axle u-bolts, torque rod bolts and track rod bolts. This re-torque must be performed within 90 days of the suspension being put in service.
- ❑ Owner is responsible for “down time” expenses, cargo damage, and all business costs and losses resulting from a warrantable failure.

Note: It is important to release any moisture contained within the air reservoir on a **daily basis**. This can be done by pulling on the cable attached to the drain valve. Not releasing the moisture on a regular basis will cause the drain valve to not operate properly, and may cause the valve to malfunction. Excess moisture in the system can also cause premature failure of other components including the tank itself.

CHECK AT EVERY VEHICLE SERVICE INTERVAL:

- ❑ Check Design Height $\pm\frac{1}{4}$ "
- ❑ Check for air leaks around fittings
- ❑ Check air filter; replace if necessary

CHECK AFTER EVERY 10,000 MILES:

- ❑ Front hanger fastener torque
- ❑ Frame air spring bracket and control rod frame mount fastener torque
- ❑ Front hanger bushing fastener torque
- ❑ Axle bracket fastener torque

CHECK AFTER EVERY 30,000 MILES:

- ❑ Lateral control rod bushing torque
- ❑ Air spring bottom bolt torque
- ❑ Check arm pivot bushings and lateral control rod bushings for wear; replace if worn

Next 3 pages taken from Ford MVE Ship Thru Guide.

Guideline - Driveline Angles

After vehicle build is complete, the driveline angles must meet the following "rules", both at unloaded, and fully-loaded, vehicle attitudes.

Rule #1: The NET OPERATING ANGLE, at any individual joint, must be at least 1/2 degree, and not to exceed 3 degrees. The net operating angle at any individual joint on an F Super Duty (F250, F350, F450, or F550) must not exceed 4 degrees. The preferred maximum angle is 2 degrees.

The NET OPERATING ANGLE (e) at any one joint is the combination of the joint angles in both the side view and the plan (top) view. This NET OPERATING ANGLE (e) equals:

By example, using Figure 1:
The NET OPERATING ANGLE at **JOINT - A** = (ea) =

The NET OPERATING ANGLE at **JOINT - B** = (eb) =

The NET OPERATING ANGLE at **JOINT - C** = (ec) =

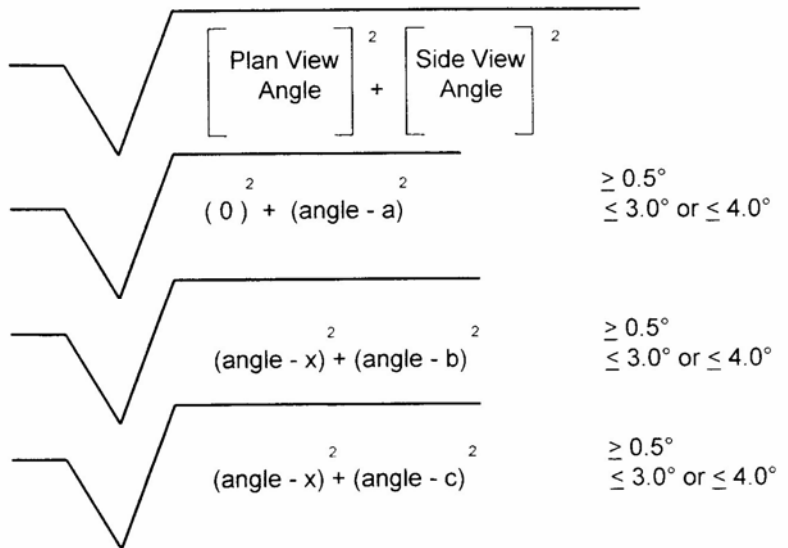
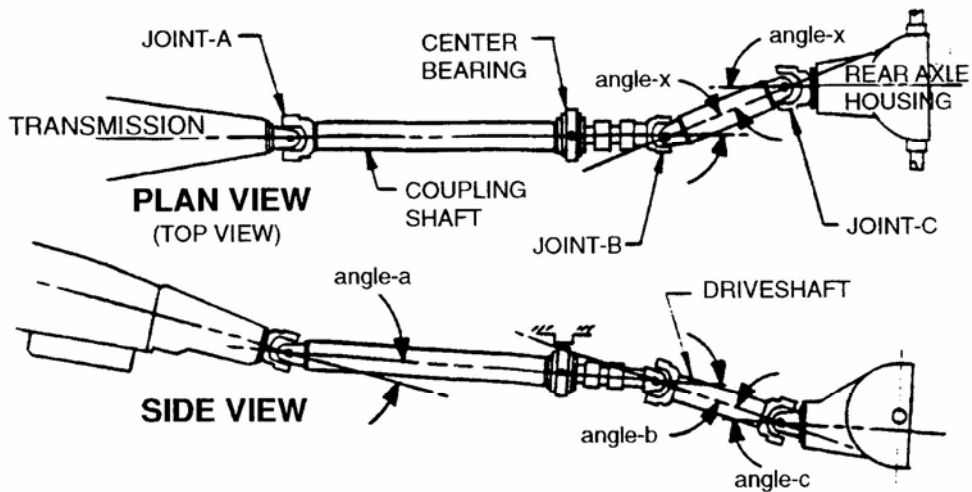
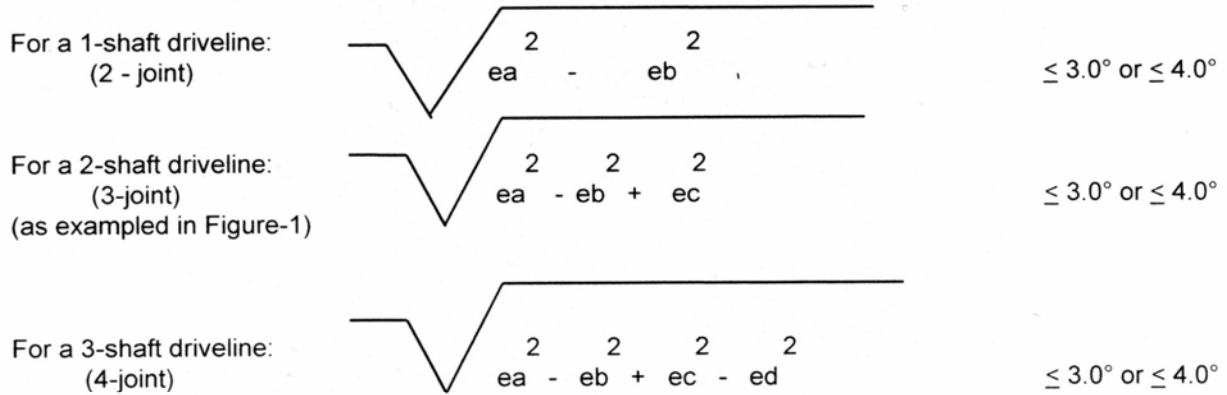


Fig. 1



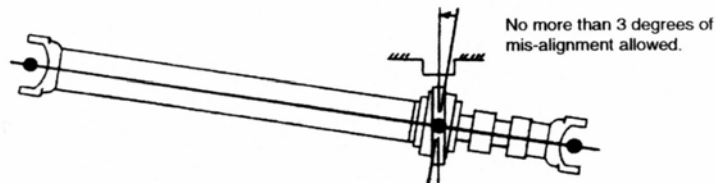
Guideline - Driveline Angles (Continued)

Rule #2: The combination of NET OPERATING ANGLES, throughout the whole driveline, **must** "cancel". It is preferred that the NET OPERATING ANGLES at either end of a shaft be within 1 degree of each other. However, at a minimum, the following formulas must be satisfied for sufficient "cancellation" to occur:

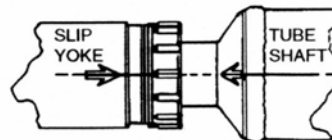
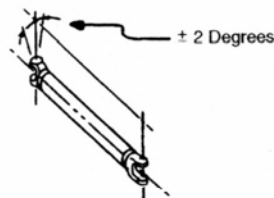


Rule #3: The center bearing mounting bracket, surrounding the rubber insulator, must be **90 ± 3 degrees** to the center bearing. In other words, no more than 3 degrees of mis-alignment can be absorbed by the rubber surrounding the center bearing. See Figure 2.

Fig. 2



- A. Ensure that u-joints are in-line to within ± 2 degrees.
- B. Ensure matching alignment arrows between slip yoke and tube shaft



Observe alignment arrows stamped on parts. If there are no alignments marks, then add them before disassembly to ensure proper phasing alignment of shaft and yoke.

GUIDELINE - DRIVELINE COMPONENT PHASING

MINIMUM UNIVERSAL JOINT OPERATING ANGLE:

A slight angle is required to prevent universal joints from brinelling. Therefore, a minimum operating angle of ½ degree is required.

MAXIMUM UNIVERSAL JOINT OPERATING ANGLE:

Universal joint operating angles can be quite high, sometimes as high as 12 degrees. But to get a vehicle to operate successfully above 3 degrees often requires larger universal joints, double cardan or constant velocity joints, or restrictions on operating speed. A reduction in universal joint life becomes noticeable when they are operated at more than 3 degrees if precautions are not taken. That having been stated, the F Super Duty series of trucks (F250, F350, F450, and F550) can tolerate angles up to 4 degrees. However, maximum angles of 2 degrees are preferable for all vehicles.

Two shafts connected with a single cardan joint and turning at a constant speed with no joint angle, have no angular acceleration that could cause a vibration. When there is an angle between them and the input shaft is turning at a constant speed, the driven shaft is forced to continuously accelerate and decelerate, twice per revolution, creating a vibration. If the speed changes are small, the vibration is not objectionable. The guidelines in this appendix limit driveline angular acceleration to a maximum of 400 radians per second per second. This is the requirement for all Ford light trucks. (SAE specifies 500.) Some modified drivelines have been measured at over 11,000 radians per second per second causing driveline failures at very low mileage.

DRIVELINE ANGLE MEASUREMENT:

Driveline angle measurements should be made with the vehicle supported by the tires and resting on a level surface. Avoid hoisting a vehicle by the frame since this will distort the chassis enough to make any measurements inaccurate.

MATCH MOUNTING DRIVESHAFTS TO THE REAR AXLE:

Runout is measured on OEM rear axle input shafts and the maximum measurement is marked with a yellow dot on the yoke or pilot bearing flange. The OEM driveshafts are also marked with a yellow dot on the "light" side. When the parts are assembled, the marks are aligned to aid the overall system balance. Vehicle modifiers should look for these dots and maintain this match when the drivetrain is reassembled after modification. Remanufactured or modified driveshafts should also have their "light" sides matched to the yellow dot.

DRIVELINE VIBRATION DAMPERS:

Driveline vibration dampers are sometimes added to driveshafts or axles to reduce noise, vibration, and harshness (NVH). If the chassis has these devices when it is received, they should be retained on the modified chassis.

USE OF DOUBLE CARDAN UNIVERSAL JOINTS FOR GREATER DRIVE ANGLES:

In general, the use of these joints can allow increased drive angles up to as much as 8 degrees. However, when used at the rear of a coupling shaft a double cardan universal joint will prevent cancellation from occurring at the forward end of the shaft. Therefore the single cardan joint must still be maintained at less than 3 degrees (or 4 degrees for the F Super Duty series).

GENERAL COMMENTS:

It is good practice, for any chassis that will have a driveline modification, to measure and record the driveline angles in each of the following conditions for later comparison.

- a. The chassis as first received from Ford (note that the drive angles may not conform exactly to this bulletin in this incomplete condition).
- b. The completed vehicle, unloaded.
- c. The completed vehicle loaded to GVWR with maximum front GAWR.
- d. The completed vehicle loaded to GVWR with maximum rear GAWR.