

# **WHIP INDUSTRIES, INC.**

## **INSTALLATION, OPERATION & MAINTENANCE MANUAL**

### **TWO POST ABOVE GROUND OVERHEAD LIFT**

**10,000 LBS CAPACITY MODELS**  
**WA102E, WAS102E & WS102E WA102E-12,  
WAS102E-12 & WS102E-12**  
**WA102E-18, WAS102E-18 & WS102E-18**  
**WA102E-24, WAS102E-24 & WS102E-24**  
**&**

**11,000 LBS CAPACITY MODELS**  
**WA112E, WAS112E & WS112E WA112E-12,  
WAS112E-12 & WS112E-12 WA112E-18,  
WAS112E-18 & WS112E-18 WA112E-24,  
WAS112E-24 & WS112E-24**

**WHIP INDUSTRIES, INC**  
3010 S MAIN ST.  
FORT WORTH, TEXAS 76110  
PH (800) 256-7391 FAX (817) 289-1412  
E-MAIL: [WhipInd@whipindustries.com](mailto:WhipInd@whipindustries.com)

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## **IMPORTANT INFORMATION**

- 1. IMPORTANT - Read the installation manual before installing the lift.**
2. The floor where the lift is to be installed must be a minimum of 4” thickness of concrete. Concrete must be reinforced with steel rebar with a minimum compressive strength of 3,000 PSI. Failure by the purchaser to provide the recommended mounting surfaces could result in personal injury, property damage and/or unsatisfactory lift performance. For seismic loads or other requirements, consult a qualified person.
3. This lift is only approved for indoor installation only. Outdoor installation is prohibited.
4. Read anchoring tips information before drilling and installing the anchor bolts.
5. This lift is an overhead lift which requires a ceiling height of a minimum 12’ -0”.
- 6. Bleed air from hydraulic cylinders before raising vehicle with lift. Air in cylinder may damage seal.**
7. Do not raise a vehicle with the lift until the lift has been correctly installed and adjusted as described in this manual.
8. Do not remove a suspension assembly, transmission or other heavy item from the front of a front wheel drive vehicle unless the vehicle is adequately supported in the rear.

## **CAUTIONS AND WARNINGS**

**MOTORS AND ELECTRIC CONTROLS ARE NOT SEALED AGAINST WEATHER OR MOISTURE. DAMAGE OR ELECTRICAL SHOCK MAY OCCUR IF INSTALLED UNPROTECTED OUTDOORS.**

**FACTORY MUST BE NOTIFIED WITHIN 30 DAYS OF DELIVERY IF THERE ARE ANY PARTS MISSING FROM SHIPMENT.**

**RECOMMENDED OIL: HYDRUALIC MEDIUM OIL SAE-10 OR EQUIVALENT. MAY USE TRANSMISSION FLUID DEXRON II OR III ATF.**

**ALL BOLTS PLACED IN THE COLUMN MUST BE PLACED FROM THE INSIDE FACING OUTWARD.**

**TWO POST LIFTS ARE DESIGNED TO PICKUP VEHICLES WITH ALL FOUR LIFTING PADS ENGAGING THE FRAME OF THE VEHICLE OR DESIGNATED LIFTING POINT. IT IS VERY DANGEROUS TO PICK UP A VEHICLE USING LESS THAN THE FOUR LIFTING PADS. LIFTING A VEHICLE INCORRECTLY**

REGARDLESS OF THE WEIGHT OR THE HEIGHT MAY CAUSE BODILY INJURY TO THE OPERATOR OR DAMAGE THE LIFT AND VEHICLE.

**DANGER - RISK OF EXPLOSION**

**THIS EQUIPMENT HAS INTERNAL ARCING OR PARTS THAT MAY SPARK AND SHOULD NOT BE EXPOSED TO FLAMMABLE VAPORS. MOTOR SHOULD NOT BE LOCATED IN A RECESSED AREA OR BELOW FLOOR LEVEL. NEVER EXPOSE MOTOR TO RAIN OR OTHER DAMP ENVIRONMENTS. DAMAGE TO MOTOR CAUSED BY WATER IS NOT COVERED UNDER WARRANTY.**

## **IMPORTANT SAFETY INSTRUCTIONS**

When using your garage equipment, basic safety precautions should always be followed, including the following:

1. Read all instructions
2. Care must be taken as burns can occur from touching hot parts.
3. Do not operate equipment with a damaged cord or if the equipment has been dropped or damaged - until it has been examined by a qualified service person.
4. If an extension cord is necessary, a cord with a current rating equal to or more than that of the equipment should be used. Cords rated for less current than the equipment may overheat. Care should be taken to arrange the cord so that it will not be tripped over or pulled.
5. To reduce the risk of fire, do not operate equipment in the vicinity of open containers of flammable liquids (gasoline).
6. Keep hair, loose clothing, fingers, and all parts of body away from moving parts.
7. To reduce the risk of electric shock, do not use on wet surfaces or expose to rain.
8. Use only as described in this manual. Use only manufacturer's recommended attachments.
9. ALWAYS WEAR SAFETY GLASSES. Everyday eyeglasses only have impact resistant lenses, they are not safety glasses.

**SAVE THESE INSTRUCTIONS**

## ANCHORING TIPS

1. Anchor must be at least 5" from the edge of the slab or any seam.
2. Use a concrete hammer drill with a 3/4" carbide bit.
3. Do not use a worn bit.
4. Drill in a perpendicular line with the hole.
5. Do not apply excessive pressure to the drill. Let the drill do the work.
6. Lift the drill up and down occasionally to remove residue and to reduce binding.
7. Drill the hole depth equal to the length of the anchor, or completely through the slab.
8. For better holding power, blow all dust and residue from the hole before driving anchor into hole.

Place a flat washer over threaded end of anchor. Spin nut 1/4" down past end of anchor. Carefully tap anchor into the concrete until nut and flat washer are against base plate. Do not use an impact wrench to tighten. Tighten 3/4"-10UNC x 5 1/2" anchors to 125 ft-lbs. of torque.

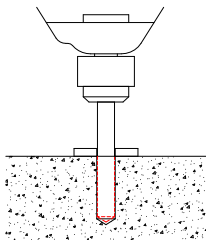


FIG. #1

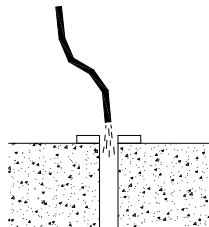


FIG. #2

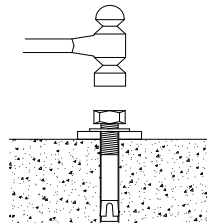


FIG. #3

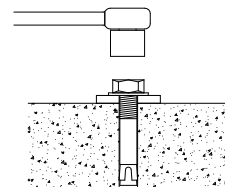


FIG. #4

## **TOOLS REQUIRED**

Concrete rotary hammer drill with ¾" carbide bit

Open End Wrenches: 7/16", 1/2", 5/8", 11/16", 3/4", & 1 1/8"

Ratchet Driver

Sockets: 11/16", 3/4" X 1/2" deep

12" Crescent Wrench

3/16 Allen Wrench

Hammer

Needle Nose Pliers

Electrical Pliers

Level

Fish Tape

25' Tape Measure

Chalk Line

Small Drift Punch

Step Ladder

3 gallons of hydraulic medium oil SAE-10 or Dexron II or III ATF.

## **INSTALLATION REQUIREMENTS**

- 1) Standard lift requires a minimum of 12' ceiling height. If ordering lift with extension, then add addition length of extension.
- 2) Minimum distance required beyond either side of the lift to the nearest obstacle is 6"
- 3) Minimum of 8'-0" is required in front of the lift to the nearest obstacle.
- 4) Minimum of 12'-0" is required in the rear of the lift to the nearest obstacle.
- 5) The floor where the lift is to be installed must be a minimum of 4" thickness of concrete. Concrete must be reinforced with steel rebar with a minimum compressive strength of 3,000 PSI .
- 6) Leg assemblies should be mounted on a maximum slope not to exceed 1/16" per foot.
- 7) Before installing see FIG. #1A, #1B and #1C for lift specifications.

## **INSTALLATION INSTRUCTIONS**

- 1) After unpacking lift, inspect lift for any damages due to transport and check shipping list for any missing parts.
- 2) Steps #3 thru #5 are pre-assembly before standing and installing lift.
- 3) Assemble the overhead cross bridge assembly with the hardware and parts as shown in FIG. #2A or FIG #2B. If one person is installing the lift then Shut Off Bar Assy. and Switch Assy. may be installed after bolting Cross Bridge to lift.
- 4) Assemble the Carriage Stops ALIF-209-019-XX to the Mainside and Offside Leg ALIF-210-090L/R using (4) 3/4-16UNC x 1 1/2 bolts and (4) 3/4-16UNC nylon locknut as shown in FIG. #5A & #5B. **\*\*IMPORTANT: NYLON LOCKNUTS MUST BE ON THE OUTSIDE OF LIFT. IF NYLON LOCKNUTS ARE ASSEMBLED TO THE INSIDE OF LIFT THEY WILL INTERFERE WITH CARRIAGE.**
- 5) Locate the (2) 3/8" x 30'-4 1/2" equalizing cables. While the legs are laying horizontal install one end of the 3/8" cables in the carriage. Slide the carriage about 36" from the bottom of the leg up towards the top and thread the cable to the appropriate gusset. (The three gussets with holes inside each carriage are adjustment for the cable depending on the width of the lift. For the maximum width of lift use lower gussets on carriages). Turn the nylon lock nut half way down the threaded stud

of the cable and pull the slack. Run the other end of the cable down and under pulley located at the base of the leg. Repeat the same procedure for the other leg assembly.

- 6) Layout lift location using FIG. #1B. Maximum width of lift is 11'-6 1/2" and minimum is 10'-6 1/2". Lift moves in at 6" increments.
- 7) Leg assemblies should be mounted on a CONCRETE FLOOR ONLY with a minimum thickness of 4 inches and a maximum slope not to exceed 1/16" per foot.
- 8) Stand leg assemblies up and position as shown in FIG. #1B.
- 9) Make sure the 9'-7" inside measurement leg to leg is maintained. DO NOT ANCHOR AT THIS TIME. Depending on customers preference, lift may be moved in 6" increments to 8'-7" inside measurement.
- 10) **NOTE:** One leg has a power unit bracket. This is the leg (Mainside) that the pumping unit will mount to and the electrical service will be wired to. **FACTORY RECOMMENDED LOCATION IS TO THE REAR PASSENGER SIDE OF VEHICLE.**
- 11) Check leg (with pump mount bracket) for plumpness using a good spirit level in both directions. Use shims (1/16" x 1 x 2 1/2" and 1/4" x 1" x 2 1/2") provided as necessary for proper leveling. (Do not exceed 1/2" total shim height). DO NOT ANCHOR NON-POWER COLUMN AT THIS TIME.
- 12) Drill and set 3/4" anchor bolts. (Ref. Anchoring Tips) Use washers when final tightening is done. Make sure all bolts are properly set and meet 125 ft. lbs of torque. DO NOT USE AN IMPACT.
- 13) Check inside measurements between both columns at top and bottom to insure they are parallel.
- 14) Lift Cross Bridge Assembly as shown in FIG. #2A or #2B to the top of the leg assemblies with Switch Box assembly on the side of the power unit. Secure assembly as shown in FIG.#3 using the (4) 7/16-14UNC x 1 1/2" bolts, (8) 7/16 flat washers, (4) lock washers and (4) 7/16-14UNC hex nuts. Bolts heads are to be placed on the outside with the nuts on the inside.
- 15) Next assemble and install the Single Point Release Pulley Bracket as shown in FIG.#3 with the LH/RH Single Point Rel. Weldm't., (4) 1/4 flat washer, (2) Pulley Sheave, (2) 1/16" Cotter Pin, (2) 7/16-14UNC x 1 1/2" bolts, (4) 7/16 flat washers, (2) lock washers and (2) 7/16-14UNC hex nuts.
- 16) Attach the power unit to the main side leg using the (4) 5/16-18UNC x 1" bolts, (8) 5/16-18UNC hex nuts, and (4) 5/16 lock washers.
- 17) Next locate lock release handle, 7/8" retainer rings, 1/16" wire rope (25'-0"), 1/16" wire rope clip and (1) 1/16" oval sleeves. Switch out shipping pin with handle on safety latch bracket, which is located on the back of the main side leg. Secure in place



with 7/8" retainer ring see FIG. #5D. Install 1/16" wire rope on the offside legs single point release by looping wire rope through one of the holes in the 3/8" clevis pin, which ever holes lines up best and securing it with oval sleeve see FIG. #4. Crimp oval sleeve. Run wire rope to other side, connect it to lock release handle (hole farthest away from the leg) and clamp using 1/16" wire rope clip see FIG. #4. Wire rope should not have any slack but locks on both legs should also touch leg backsides in their normal position. If cable is loose, adjust wire rope using wire rope clip.

- 18) Locate and install the 53", 348" (396") and 13 1/2" hydraulic hoses see FIG. #6. Manually raise both carriage assembly about 18" for hose installation. The 53" hydraulic hose connect the 90 deg. adapter at the bottom of the mainside leg to the bulk head tee. Next attach the Hose Bracket (ALIF-209-275-XX) with the Grommet (2772-BLK) to the MS & OS Leg assemblies as shown in Fig. #3. Now thread hose through pipe loops in leg assembly. The 348" hydraulic hose connects the 90 deg. adapters at the bottom offside leg to the bulk head tee on the mainside leg. Thread the hydraulic hose through pipe loops of offside leg, hose brackets, cross bridge and mainside leg. Leave the hose bracket loose and adjust the bracket to take up the slack of the hydraulic hose. Use 3/8 JIC nut to secure bulk head tee to main side leg. The 13 1/2" hydraulic hose connects the straight adapter of the power unit to the bulk head tee. Do not lower carriage assemblies. Leave carriage raised to install equalizer cables.
- 19) Next route the two 3/8" equalizing cables x 30'-4 1/2" for WA/WS/WAS102E & 112E) as shown in FIG. #4. (The three gussets with holes inside each carriage are adjustment for the cable depending on the width of the lift. For the maximum width of lift use lower gussets on carriages.) Run the cable down and under pulley located at the base of the leg. Next run cable back up through the carriage to the top of leg over the pulley (at the top of leg) and across to the other leg, over pulley and down through the bracket located at the top left side of carriage see FIG. #4. Secure in place with nylon lock nut.
- 20) Repeat step 19 for installing cable on the other leg.
- 21) Adjust nuts evenly until cables are tight.
- 22) Next installing swing arm, rotate & slide swing arms to the center of lift to see if lift pads are at the same height. If pads are not at the same height then shim lift forward, backward or sideways to level lift pads. Leg of lift may become out of plumb. If lift pads are more than 1" from being level call manufacture for further instructions.
- 23) Fill pumping unit with hydraulic medium oil SAE-10 or equivalent. It will take approximately 3 US gallons. Automatic transmission fluid may be substituted.
- 24) Use plastic ties to secure slack in hydraulic hose and electrical cable. Slack of the hydraulic hose is where the cross bridge and legs are connected.
- 25) Power requirements: 230 Volt, single-phase power, 12-amp. Use separate circuit for each unit and protect each circuit with 30-amp time delay fuse or circuit breaker.

Install electricity to lift coming from snap action switch to power unit. Use FIG. #11 for wiring diagram.

- 26) Before operating lift visually inspect lift to make sure the cable and hoses are not rubbing or in the way of hardware or lift parts. Especially in cross bridge or legs.
- 27) Next purge air from hydraulic lines. Raise lift until carriages rise off of safety locks. Crack bleeder plug located at the top of cylinder. Listen for air to escape and tighten when hydraulic fluid starts coming out. Now raise lift to the top and lower. Repeat cycle until no air is in the hydraulic system..
- 28) The above procedure may have to be repeated several times to ensure all the air has been bled from the system.
- 29) Refill tank with hydraulic oil.
- 30) Raise lift and make sure that safety locks are synchronized as lift goes up. If locks are not synchronized then tighten the cable on the side that is lagging.

## **POST INSTALLATION CHECK-OUT PROCEDURE**

- Posts properly shimmed and secure
- Anchor bolts tightened
- Pivot/sheave pins properly attached
- Carriage stop bolts torqued to 2-3 ft-lbs
- Electric power supply confirmed
- Cables adjusted properly
- Safety locks functioning properly
- Confirm no hydraulic leaks
- Confirm correct oil level
- Lubricate all critical components
- Check for overhead obstructions
- Lift arms level
- Confirm all screws, bolts, and pins are secure
- Surrounding area is clean
- Confirm operation, maintenance and safety manuals are on site.

## **INSPECTION AND MONTHLY MAINTENANCE**

- 1) Inspect the cable, (6) cable pulleys and shaft for wear. Lifting cables should be replaced every three - five years or when visible signs of damage are present. If cable can't be adjusted, then the cable has stretched more than 4". DO NOT USE LIFT WITH DEFECTIVE/WORN CABLES. Contact qualified lift service personnel.
- 2) Grease bearing surfaces in leg assembly minimum every 30 days or as required depending use of lift.
- 3) Check equalizer cables regularly for proper tension and adjustment. Locks must be synchronizes as lift goes up.
- 4) Inspect adapters and pads for damage or wear. Replace if necessary.
- 5) Grease swivel arm pins to insure ease of operation.
- 6) Inspect all hydraulic cylinders, lines and fittings for leaks and tighten if necessary.
- 7) Check locking latches and releases for proper operation.
- 8) Check arm lock device for proper operation.
- 9) Check hydraulic fluid level in power unit.
- 10) Torque anchor bolts to 125 ft. lbs.
- 11) Replace worn, damaged or broken parts with approved manufacture's parts. Parts shall be replaced by qualified lift service personnel.
- 12) The maximum operating hydraulic pressure developed upon lifting the rating capacity is 2800 PSI.
- 13) Reference ANSI/ALI ALOIM –Safety Requirements For Operation, Inspection and Maintenance and the Automotive Lift Safety Tips.
- 14) Reference ANSI/ALI ALIS - Safety Requirements for Installation and Service of Automotive Lifts.

## OPERATION INSTRUCTIONS

- Reference ANSI/ALI ALOIM –Safety Requirements For Operation, Inspection and Maintenance and the Automotive Lift Safety Tips. Vehicles Lift Points for Frame Engaging Lifts.
- **NEVER LIFT ANY VEHICLE IN ANY MANNER WITH LESS THAN ALL FOUR (4) LIFT ARMS. RATED CAPACITY OF EACH LIFT ARM IS NO GREATER THAN ONE FOURTH (1/4) OF THE OVERALL LIFT CAPACITY.**

### **RAISING THE LIFT**

- Read operating and safety manuals before using lift.
- Always lift a vehicle according to the manufacturer's recommended lifting points.
- Position vehicle between posts.
- Adjust swing arms so that the vehicle is positioned with the center of gravity midway between pads.
- **NEVER** use lift pad assemblies without rubber slip over pads in place.
- Use truck adapters as needed. Never exceed 9" of pad height.
- Raise the vehicle by depressing button until the vehicle just lifts off the ground. Re-check to make sure the vehicle is secure and all locking pins are locked in place.
- Raise the vehicle to desired height. Lower vehicle to nearest safety.
- Always ensure safeties are engaged before any attempt is made to work on or near vehicle.

### **LOWERING THE LIFT**

- First raise the lift in order to disengage the safeties.
- Release safeties by pushing on the safety handle.
- Be sure tool trays, stands and personnel are cleared from under the vehicle.
- Lower vehicle by activating lowering handle on power unit.
- Before removing vehicle from lift; position lift arms and supports to provide an unobstructed exit.
- **NEVER** drive over lift arms.

## **OWNER/EMPLOYER RESPONSIBILITIES**

**SAVE THESE INSTRUCTIONS** and deliver them to the owner/operator/employee along with all other materials sent with this lift.

Demonstrate the operation of the lift to the owner/operator and review correct and safe lifting procedures referencing ALI/SM-Lifting It Right.

### **The Owner/Employer:**

- Shall ensure that lift operators are qualified and that they are trained in the safe use and operation of the lift using the manufacturer's operating instructions: ALI/SM01-1, ALI Lifting it Right safety manual; ALI/ST-90 ALI Safety Tips card; ANSI/ALI ALOIM-2000, American National Standard for Automotive Lifts-Safety Requirements for Operation, Inspection and Maintenance; ALI/WL Series, ALI Uniform Warning Label Decals/Placards; and in the case of frame engaging lifts, ALI/LP-GUIDE, Vehicle Lifting Points/Quick Reference Guide for Frame Engaging Lifts.
- Shall establish procedures to periodically inspect the lift in accordance with the lift manufacturer's instructions or ANSI/ALI ALOIM-2000, American National Standard for Automotive Lifts-Safety Requirements for Operation, Inspection and Maintenance; and The Employer shall ensure that lift inspectors are qualified and that they are adequately trained in the inspection of the lift.
- Shall establish procedures to periodically maintain the lift in accordance with the lift manufacturer's instructions or ANSI/ALI ALOIM-2000, American National Standard for Automotive Lifts-Safety Requirements for Operation, Inspection and Maintenance; and The Employer shall ensure that lift maintenance personnel are qualified and that they are adequately trained in the maintenance of the lift.
- Shall maintain the periodic inspection and maintenance records recommended by the manufacturer or ANSI/ALI ALOIM-2000, American National Standard for Automotive Lifts-Safety Requirements for Operation, Inspection, and Maintenance.
- Shall display the lift manufacturer's operating instructions; ALI/SM 93-1, ALI Lifting It Right safety manual; ALI/ST-90 ALI Safety Tips card; ANSI/ALI ALOIM-2000, American National Standard for Automotive Lifts-Safety Requirements for Operation, Inspection and Maintenance; and in the case of frame engaging lifts, ALI/LP-GUIDE, Vehicle Lifting Points/Quick Reference Guide for Frame Engaging Lifts; in a conspicuous location in the lift area convenient to the operator.

- Shall not modify the lift in any manner without the prior written consent of the manufacturer.
- Shall provide necessary lockout/tagout means for energy sources per ANSI Z244.1-1982 (R1993), Safety Requirements for the Lockout/Tagout of Energy Sources, before beginning any lift repairs.

## **LIFT OPERATION SAFETY**

- 1) Do not raise a vehicle on the lift until the installation is completed as described in this manual.
- 2) Operators should be trained to use and care for the lift by familiarizing themselves with the publications listed above. The lift should never be operated by an untrained person.
  - “INSTALLATION AND OWNERS MANUAL”
  - “ALI/SM - LIFTING IT RIGHT”
  - “ALI/ST - SAFETY TIPS”
  - “ALI/LP - VEHICLE LIFTING POINTS FOR FRAME ENGAGING LIFTS”
  - “ANSI/ALI ALOIM - SAFETY REQUIREMENTS FOR OPERATION, INSPECTION, AND MAINTENANCE”
- 3) Always position the arms and adapters properly out of the way before pulling the vehicle into or out of the bay. Failure to do so could damage the vehicle and/or the lift.
- 4) Do not overload the lift.
- 5) Positioning the vehicle is very important. Only trained operators should position the vehicle on the lift. Never allow anyone to stand in the path of the vehicle as it is being positioned.
- 6) Position the arms to the vehicle manufacturer’s recommended pickup points. Raise the lift until contact is made with the vehicle. Make sure that the arms have properly engaged the vehicle before raising the lift to a working height.
- 7) Keep everyone clear of the lift when the lift is moving, the locking mechanism is disengaged, or the vehicle is in danger of falling.
- 8) Inspect the lift daily. The lift should never be operated if it has damaged components or is malfunctioning. Only qualified technicians should service the lift. Replace damaged components with manufacturer’s parts or equivalent.
- 9) Keep the area around the lift clear of obstacles.
- 10) Never override the self returning lift controls.
- 11) Use safety stands when removing or installing heavy vehicle components.

12) Avoid excessive rocking of the vehicle when it is on the lift.

13) To reduce the risk of personal injury, keep hair, loose clothing, fingers, and all body parts away from moving parts.

14) The troubleshooting and maintenance procedures described in this manual can be done by the lift's owner/employer. Any other procedure should only be performed by trained lift service personnel. These restricted procedures include, but are not limited to, the following: cylinder replacement, carriage and safety latch replacement, leg replacement, overhead structure replacement.

15) Anyone will be in the vicinity of the lift when it is in use should familiarize themselves with the following: Caution, Warning and Safety related decals supplied with the lift and replace them if they are illegible or missing.



<p><b>⚠ CAUTION</b></p>  <p>Lift to be used by trained operator only.</p>	<p><b>⚠ CAUTION</b></p>  <p>Authorized personnel only in lift area.</p>
<p><b>⚠ CAUTION</b></p>  <p>Use vehicle manufacturer's lift points.</p>	<p><b>⚠ CAUTION</b></p>  <p>Always use safety stands when removing or installing heavy components.</p>
<p><b>⚠ CAUTION</b></p>  <p>Use height extenders when necessary to ensure good contact.</p>	<p><b>⚠ CAUTION</b></p>  <p>Auxiliary adapters may reduce load capacity.</p>

The messages and pictographs shown are generic in nature and are meant to generally represent hazards common to all automotive lifts regardless of specific style.

Funding for the development and validation of these labels was provided by the Automotive Lift Institute, PO Box 33116 Indialantic, FL 32903.

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<p><b>⚠ WARNING</b></p>  <p>Clear area if vehicle is in danger of falling.</p>	<p><b>⚠ WARNING</b></p>  <p>Position vehicle with center of gravity midway between adapters.</p>
<p><b>⚠ WARNING</b></p>  <p>Remain clear of lift when raising or lowering vehicle.</p>	<p><b>⚠ WARNING</b></p>  <p>Avoid excessive rocking of vehicle while on lift.</p>
<p><b>⚠ WARNING</b></p>  <p>Do not override self-closing lift controls.</p>	<p><b>⚠ WARNING</b></p>  <p>Keep feet clear of lift while lowering.</p>

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# TROUBLE SHOOTING GUIDE

## POSSIBLE PROBLEM

## POSSIBLE CAUSE & SOLUTIONS

1. MOTOR DOES NOT RUN

- A) Breaker tripped or fuse blown
- B) Check micro-switch on shut off bar.
- C) Check thermal overload in starter.
- D) Defective control switch, replace
- E) Faulty wiring connections. Call electrician.

2. MOTOR RUNS BUT THE LIFT WILL NOT RAISE OR HOLD A LOAD

- A) A foreign object under check valve. Push handle down and push “raise” switch. Foreign matter should release under pressure.
- B) Remove check valve. Clean and replace.
- C) Oil level low: check oil reservoir. With carriage in the down position, pump reservoir should be full.

3. MOTOR RUNS BUT THE LIFT PICKS UP PARTIAL LOAD ONLY.

- A) Relief valve setting is too low. Remove back hexcap on pump and adjust valve clockwise.
- B) Hydraulic seals damaged (call factory for instructions)
- C) Check voltage must have a minimum of 208 volts.

4. OIL BLOWS OUT BREATHER

- A) Oil reservoir overfilled
- B) Lift lowered too quickly while under heavy load.

5. LIFT MAKES A GROANING SOUNDING WHEN RAISING OR LOWERING.

- A) Bleed cylinder manually.
- B) Add an ounce of oil to the air side of the piston.

6. LIFT RAISES UNEVENLY

- A) Cables are not properly adjusted or tightened.
- B) Use lighter weight oil in the pump.

7. LIFT LOWERS SLOWLY OR  
NOT AT ALL

- A) Cylinders binding
  - Contact WHIP Industries customer support
- B) Release Valve Clogged -
  - Clean release valve with solvent and blow out with air.
  - Check oil - Use clean 10-WT hydraulic oil or Dexron-III automatic transmission fluid only. If ATF is contaminated, replace with clean ATF and clean entire system.
  - Replace with new part.
  - Return for repair.
- C) Pressure fitting too long
  - Replace fitting with short thread lead.

**PARTS LIST FOR MODELS:**  
**WA102E, WS102E, WAS102E, WA102E-24, WS102E-**  
**24, WAS102E-24, WA112E, WS112E, WAS112E**  
**WA112E-24, WS112E-24 & WAS112E-24**

<b>PART NUMBER</b>	<b>DESCRIPTION</b>	<b>QTY.</b>
ALIF-210-284	Main side Leg Final Assy.	1
2502-06-04	#6MJIC X #4FP Adapter Fitting	1
4550K137	1/4 x 4 Nipple Sch 80	1
5315	7/16" Dia. x 1 1/4" Ext. Spring	1
5933	1/2 " Dia. x 2 1/8" Ext. Spring	1
7130K55	11 x .18 Nylon Cable Ties	1
90126A037	7/8" SAE Flat Washer	2
91102A029	1/4" Lock Washer	1
91309A537	1/4-20UNC x 1/2 Hex Head Bolt	1
92865A716	1/2-13UNC x 1 1/2 Hex Head Bolt Grd5	2
98330A185	5/16" Dia. x 3" Adj. Clevis Pin	1
98330A245	3/8" Dia. x 2 1/2" Adj. Clevis Pin	1
98338A140	3/32" x 1 Cotter Pin	3
98410A128	3/4 Ext. Retainer Ring	1
98410A131	7/8" Ext. Retainer Ring	2
AA2015010	2" Bore x 69" Stroke Hyd. Cyl.	1
ALIF-210-049	Carriage Assy.	1
90177A225	2 1/4 Dia Split Ring	2
98555A213-1.0	1 Dia. C-Retainer Ring	6
ALIF-210-050-XX	Carriage Weldm't.	1
ALIF-210-057	1 Dia. Arm Lock Pin	2
ALIF-209-107	Upper Arm Lock	2
ALIF-210-158	1 1/4 x 1/8 Comp. Spring x 7 1/4	2
ALIF-210-088	4" Pulley Assy.	1
ALIF-209-089	Lower Pulley Pin	1
ALIF-209-090R-XX	Main side Leg Weldm't.	1
ALIF-209-125-XX	Safety Latch (Mat'l. A514)	1
ALIF-209-126-XX	Single Point Release Cover	1
ALIF-209-162	7 3/4 Lg. Rubber Edging	2
GL-09-057	Nylon Rub Blocks	8
GL-09-079	Safety/Caution/ Warning Decals	1 Set
GL-09-143	Lift Capacity Sticker	1
GL-09-144	Lift Instruction Sticker	1

ALIF-210-285	Offside Leg Final Assy.	1
2502-06-04	#6MJIC X #4FP Adapter Fitting	1
4550K137	1/4 x 4 Nipple Sch 80	1
5933	1/2 " Dia. x 2 1/8" Ext. Spring	1
7130K55	11 x .18 Nylon Cable Ties	1
8901T11	3/4" Delrin Sheave	1
90126A037	7/8" SAE Flat Washer	2
91090A111	5/16" x 1 1/4 Fender Washer	2
91102A029	1/4" Lock Washer	1
91145A180	5/16" x 1/4 Nylon Spacer	1
91259A580	5/16" x 5/8 Shoulder Screw	1
91309A537	1/4-20UNC x 1/2 Hex Head Bolt	1
92865A716	1/2-13UNC x 1 1/2 Hex Head Bolt Grd5	2
98330A185	5/16" Dia. x 3" Adj. Clevis Pin	1
98330A245	3/8" Dia. x 2 1/2" Adj. Clevis Pin	1
98338A140	3/32" x 1 Cotter Pin	3
98410A128	3/4 Ext. Retainer Ring	1
98410A131	7/8" Ext. Retainer Ring	2
AA2015010	2" Bore x 69" Stroke Hyd. Cyl.	1
ALIF-209-049	Carriage Assy.	1
90177A225	2 1/4 Dia Split Ring	2
98555A213-1.0	1 Dia. C-Retainer Ring	4
ALIF-210-050-XX	Carriage Weldm't.	1
ALIF-210-057	1 Dia. Arm Lock Pin	2
ALIF-209-107	Upper Arm Lock	2
ALIF-210-158	1 1/4 x 1/8 Comp. Spring x 7 1/4	2
ALIF-210-088	4" Pulley Assy.	1
ALIF-209-089	Lower Pulley Pin	1
ALIF-209-090L-XX	Main side Leg Weldm't.	1
ALIF-209-125-XX	Safety Latch (Mat'l. A514)	1
ALIF-209-127-XX	Single Point Release Cover	1
ALIF-209-134	O.S. Safety Latch Pin	1
ALIF-209-162	7 3/4 Lg. Rubber Edging	2
GL-09-057	Nylon Rub Blocks	8
ALIF-210-168	Two-Piece Cross Bridge Assy.	1
90126A036	3/4 SAE Flat Washer	6
98410A128	3/4 Ext. Retainer Ring	2
ALIF-209-016-XX	3/4 Spacer	2
ALIF-210-088	4" Pulley Assy.	2
ALIF-209-159	Upper Pin	1
ALIF-209-159A	Upper Pin	1
ALIF-209-177	Inner Cross Bridge Weldm't.	1
ALIF-209-178	Outer Cross Bridge Weldm't.	1

ALIF-210-420/220	10/11K Sym. Swing Arm Assy.	2
91251A626	3/8-16UNC Socket Head Screw	6
ALIF-209/210-222-XX	Sym. Swing Arm Wldm't.	2
ALIF-209-082A	Lower Swing Arm Lock	2
ALIF-210-421/221L/R	Asym. Swing Arm Assy.	2
91251A626	3/8-16UNC Socket Head Screw	6
ALIF-210-423/223L/R-X	Asym. Swing Arm Wldm't.	2
ALIF-209-082A	Lower Swing Arm Lock	2
ALIF-210-426/226L/R	All-Sym. Swing Arm Assy.	2
91251A626	3/8-16UNC Socket Head Screw	6
ALIF-210-427/227L/R-X	All-Sym. Swing Arm Wldm't.	2
ALIF-209-082A	Lower Swing Arm Lock	2

### LOOSE PARTS & HARDWARE

ALIF210/211	Hardware Box Kit	1
0306-06	3/8 JIC Lock Nut	1
2703-06-06-06	Bulk Head Tee	1
2772-BLK	1 3/16" Grommet	2
30325T23	1/16 Wire Rope Clip	1
3434T36	Pulley Sheave	2
3896T1	1/16 Oval Sleeve Ferrule	2
6046K33	1" Dia. Ball Handle Knob	1
6400-06-06	3/8 O-ring x 3/8 JIC Straight Adapter	1
6921-0036	SPDT, 25 AMP, A/C Limit Switch	1
7130K55	11" x 3/16 Nylon Cable Ties	3
90126A029	1/4 SAE Flat Washer	4
90126A032	7/16 SAE Flat Washer	16
90190A144	#6 x 1/4 Phillip Head Pan Screw	4
90473A029	1/4-20UNC Hex Nut	4
90473A030	5/16-18UNC Hex Nut	8
90473A217	7/16-14UNC Hex Nut	8
90640A129	1/4-20UNC Nylon Lock Hex Nut	1
90640A133	1/2-13UNC Nylon Lock Hex Nut	8
91102A029	1/4 Lock Washer	5
91102A030	5/16 Lock Washer	4
91102A032	7/16 Lock Washer	8
91247A583	5/16-18UNC x 1 Hex Head Bolt	8
92865A537	1/4-20UNC x 1/2 Hex Head Bolt Grd 5	2

91309A540	1/4-20UNC x 3/4 Hex Head Bolt	2
91309A554	1/4-20UNC x 3 TAP Hex Head Bolt	1
91578A501	3/4-10UNC x 5 1/2 Wedge Anchor Sets	12
92865A671	7/16-14UNC x 1 1/4 Hex Head Bolt	8
92865A716	1/2-13UNC x 1 1/2 Hex Head Bolt	4
98355A010	1/16 Dia. x 1/2 Cotter Pin	2
AT527M	M12 x 1mm Thin Nut	2
ALIF-209-019-XX	Carriage Stop Weldm't.	2
ALIF-209-074-XX	Swing Arm Pad Adapter	4
ALIF-209-076-XX	2" Swing Arm Pad Extension	4
ALIF-209-077-XX	4" Swing Arm Pad Extension	4
ALIF-209-078-XX	6" Swing Arm Pad Extension	4
ALIF-209-086	Swing Arm Pad Assy.	4
90126A029	1/4 SAE Flat Washer	8
90473A029	1/4-20UNC Hex Nut	8
92670A744	1/4-20UNC Elevator Bolts	8
ALIF-209-080-XX	Pad Wldm't.	4
GL-09-013	Rubber Pad	4
ALIF-210-296	3/8 Dia. x 364.5" Lg. Steel Cable	2
ALIF-209-098	1/16 Dia. x 300"Lg. Wire Rope	1
ALIF-209-137-XX	Handle Wldm't.	1
ALIF-209-101	3/8 Hyd. Hose x 348" 6FJIC E/E	1
ALIF-209-102	3/8 Hyd. Hose x 53" 6FJIC E/E	1
ALIF-209-104	Silicone Foam Pad	1
ALIF-209-184-XX	Switch Box Cover	1
ALIF-209-185-XX	Switch Box Bracket	1
ALIF-209-186-XX	Shut Off Bar	1
ALIF-209-190L/R	Single Point Rel. Weldm't.	1/1
ALIF-209-191	3/8 Hyd. Hose x 13 1/2" 6FJIC90 E/E	1
ALIF-209-275-XX	Hose Bracket	2
AH-1006	3 1/2 Gal., 2 HP, 3940psi Power Unit	1
ALIF-210-094	Swing Arm Pins	4
GL-09-056	1/16 Shims, 1 1/16 x 2 3/4	16
GI-09-112	1/4 Shims, 1 1/16 x 2 3/4	8

\*\*\* Note: All hardware unless specified is grade 2.  
All hardware is zinc coated unless specified.

## OPTIONAL EQUIPEMENT

ALIF-210-12"EXT	12" Extension Kit	1
ALIF-209-207-XX	12" Height (Column) Extension	2
ALIF-210-29612	3/8" Dia. x 388.5" Lg. Steel Cable	2
ALIF-209-09812	1/16 dia. x 324.0" Lg. Wire Rope	1
ALIF-209-10112	3/8 Hyd. Hose x 372" 6FJIC E/E	1
ALIF-210-24"EXT	24" Extension Kit	1
ALIF-209-206-XX	24" Height (Column) Extension	2
ALIF-210-29624	3/8" Dia. x 412.5" Lg. Steel Cable	2
ALIF-210-098	1/16 dia. x 348.0" Lg. Wire Rope	1
ALIF-210-101	3/8 Hyd. Hose x 396" 6FJIC E/E	1
ALIF-210-167	One-Piece Cross Bridge Assy.	1
90126A036	3/4 SAE Flat Washer	8
98410A128	3/4 Ext. Retainer Ring	2
ALIF-209-016-XX	3/4 Spacer	2
ALIF-210-088	4" Pulley Assy.	2
ALIF-209-159	Upper Pin	2
ALIF-209-148	Truck Adapters (Frame Grabber)	4
ALIF-209-205-XX	10" Pad Extension.	4

LIFT SPECIFICATIONS FOR THE

WA102E, WA102E-24, WAS102E, WAS102E-24, WS102E, WS102E-24  
 WA112E, WA112E-24, WAS112E, WAS112E-24, WS102E, WS112E-24

SPECIFICATIONS

	<u>WA/WS/WAS102E</u>	<u>WA/WS/WAS112E</u>
REACH (FRONT ARM MAX.)	45 1/8"	45 1/8"
REACH (REAR ARM MAX.)	62"	62"
MIN. PAD HEIGHT	4 3/4"	4 3/4"
FIRST EXT. PAD HEIGHT	6 1/2"	6 1/2"
SECOND EXT. PAD HEIGHT	8 1/2"	8 1/2"
THIRD EXT. PAD HEIGHT	10 1/2"	10 1/2"
LIFT WIDTH	138 1/2" TD	138 1/2" TD
LIFT CAPACITY	126 1/2"	126 1/2"
MOTOR	10,000 LBS.	11,000 LBS.
VOLTAGE, SINGLE PHASE	2 HP	2 HP
SPEED OF RISE	208V-230V	208V-230V
CEILING HEIGHT REQUIRED	60 SEC.	60 SEC.
MAX. LOAD PER ARM	12'-0" 14'-0"<24">	12'-0", 14'-0"<24">
1ST. LOCKING HEIGHT	2,500 LBS.	2,750 LBS.
LAST LOCKING HEIGHT	16 1/2"	16 1/2"
LOCKING INCREMENTS	72 1/2"	72 1/2"
BAY DIMENSIONS	4"	4"
BAY WIDTH		
DIST. IN FRONT OF LIFT	6" PER SIDE	6" PER SIDE
DIST. IN REAR OF LIFT	8'-0"	8'-0"
	12'-0"	12'-0"

FIG. #1A



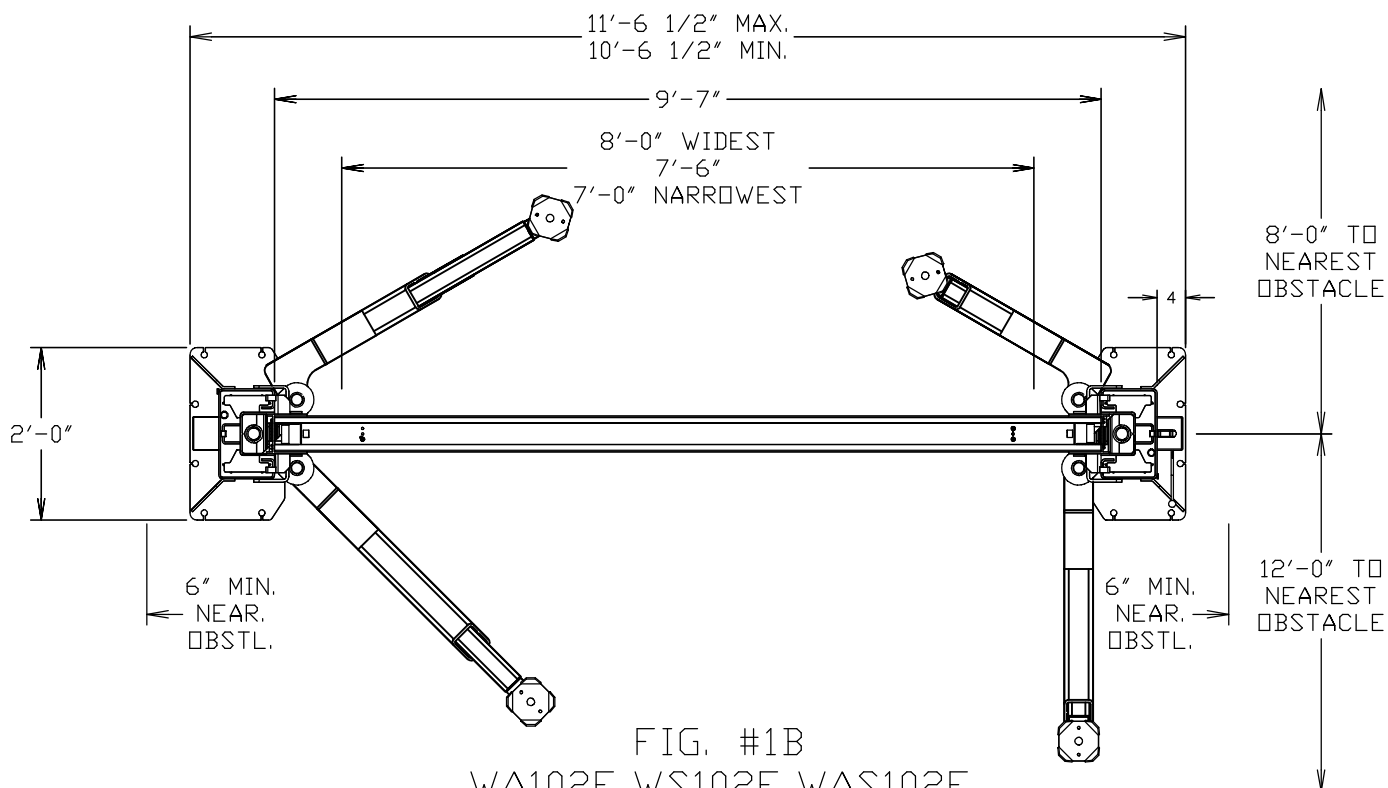
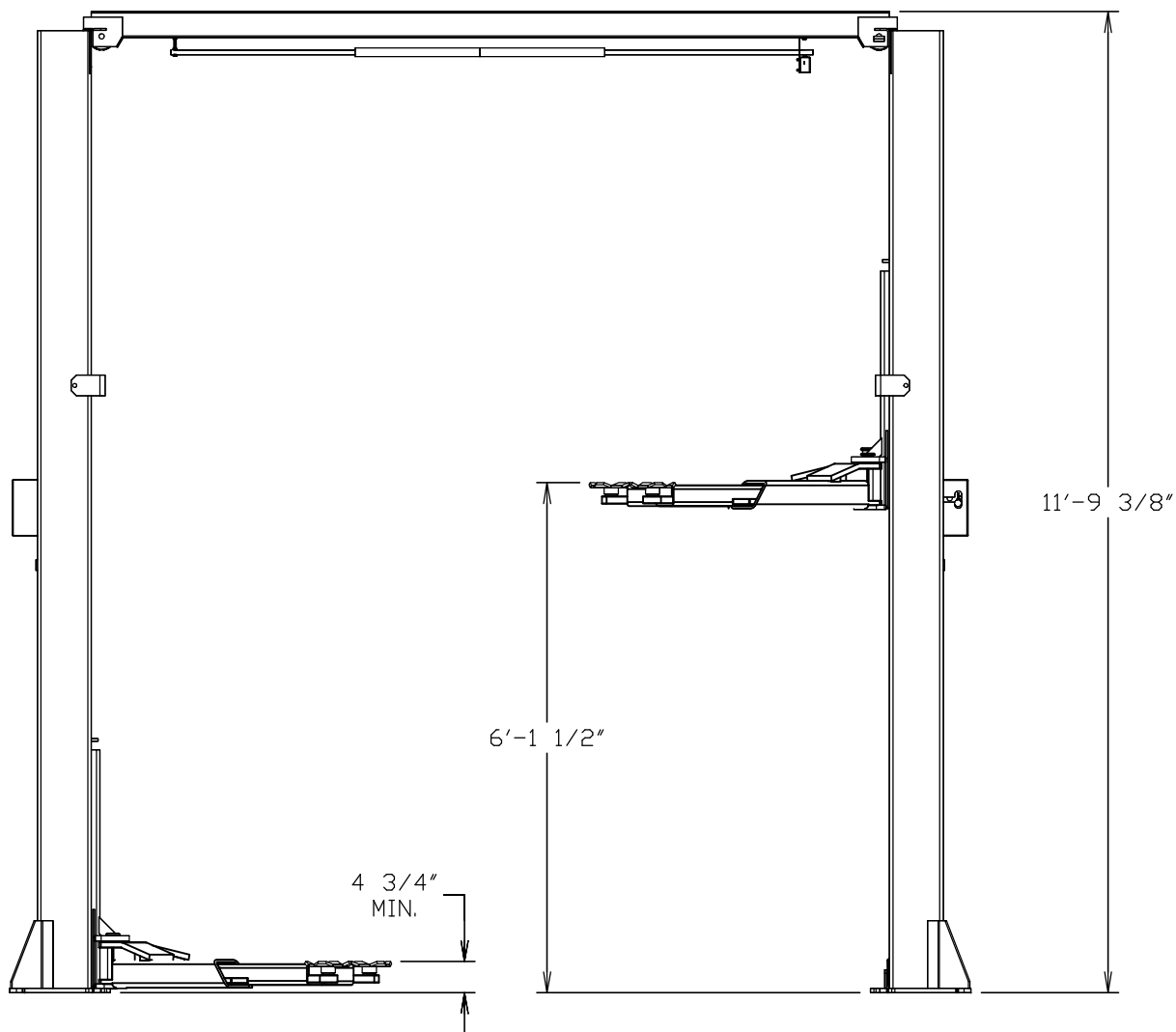


FIG. #1B  
 WA102E, WS102E, WAS102E  
 WA112E, WS112E, WAS112E  
 LIFT SPECIFICATIONS

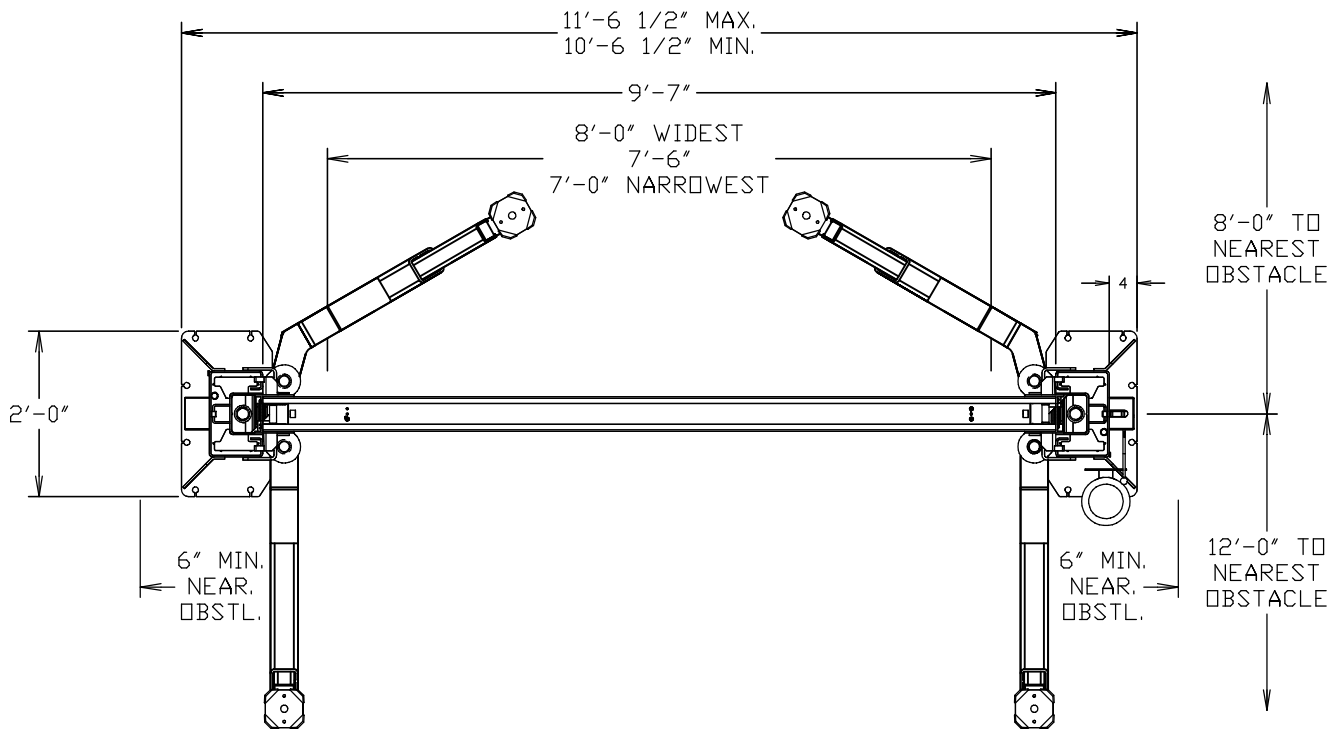
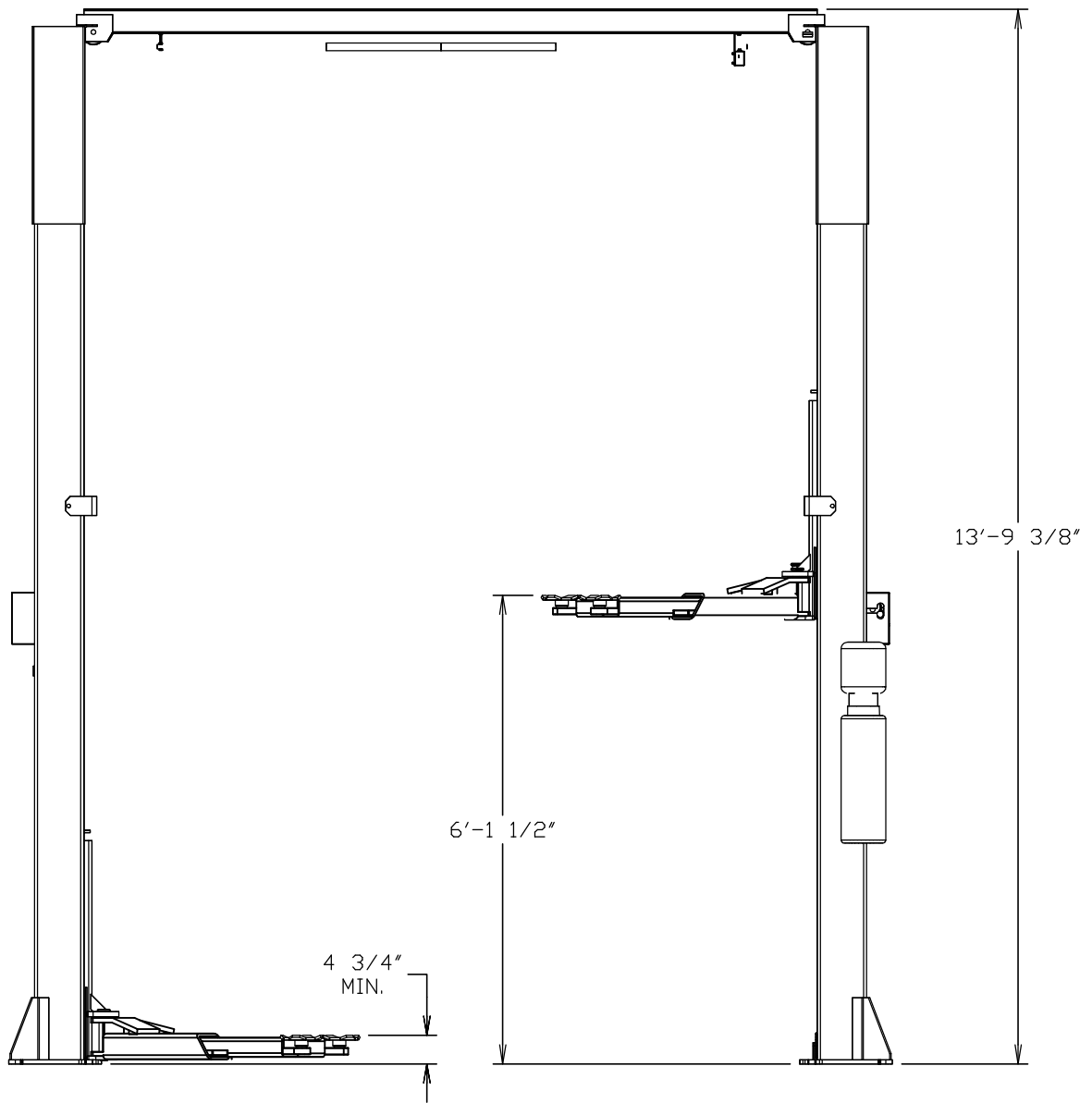


FIG. #1C  
 WA102E-24, WS102E-24, WAS102E-24  
 WA112E-24, WS112E-24, WAS112E-24

# ONE-PEICE CROSS BRIDGE ASSEMBLY

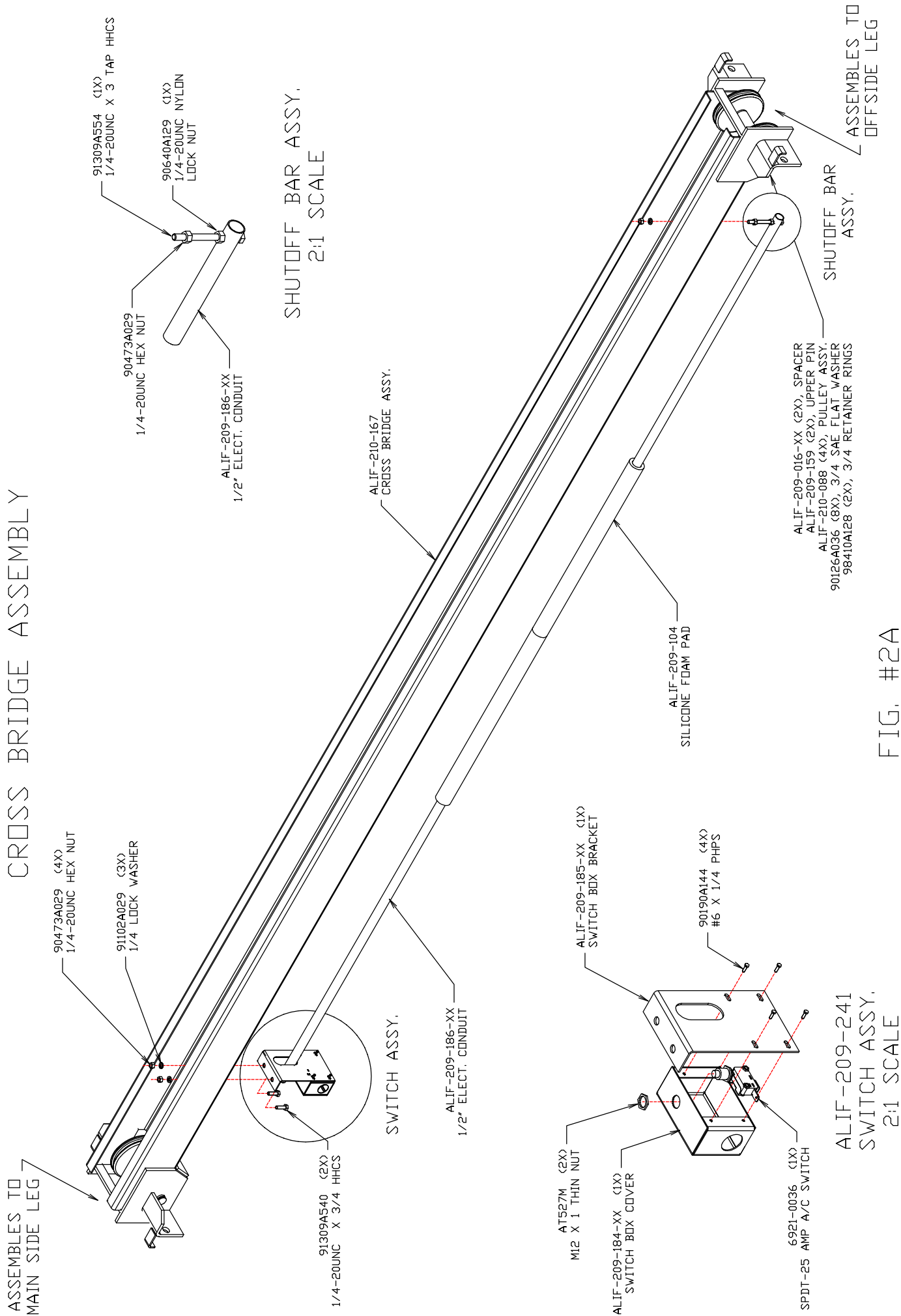


FIG. #2A

ALIF-209-241  
SWITCH ASSY.  
2:1 SCALE

# TWO-PEICE CROSS BRIDGE ASSEMBLY

ASSEMBLES TO  
MAIN SIDE LEG



## SHUTOFF BAR ASSY. 2:1 SCALE

91309A540 (2X)  
1/4-20UNC X 3/4 HHCS

SWITCH ASSY.

ALIF-209-186-XX  
1/2" ELECT. CONDUIT

AT527M (2X)  
M12 X 1 THIN NUT

ALIF-209-184-XX (1X)  
SWITCH BOX COVER

ALIF-209-185-XX (1X)  
SWITCH BOX BRACKET

90190A144 (4X)  
#6 X 1/4 PHPS

6921-0036 (1X)  
SPDT-25 AMP A/C SWITCH

ALIF-209-241  
SWITCH ASSY.  
2:1 SCALE

ALIF-209-104  
SILICONE FOAM PAD

FIG. #2B

# CROSS BRIDGE ASSY. & 24" EXTENSION TO LEG ASSY. DRAWING

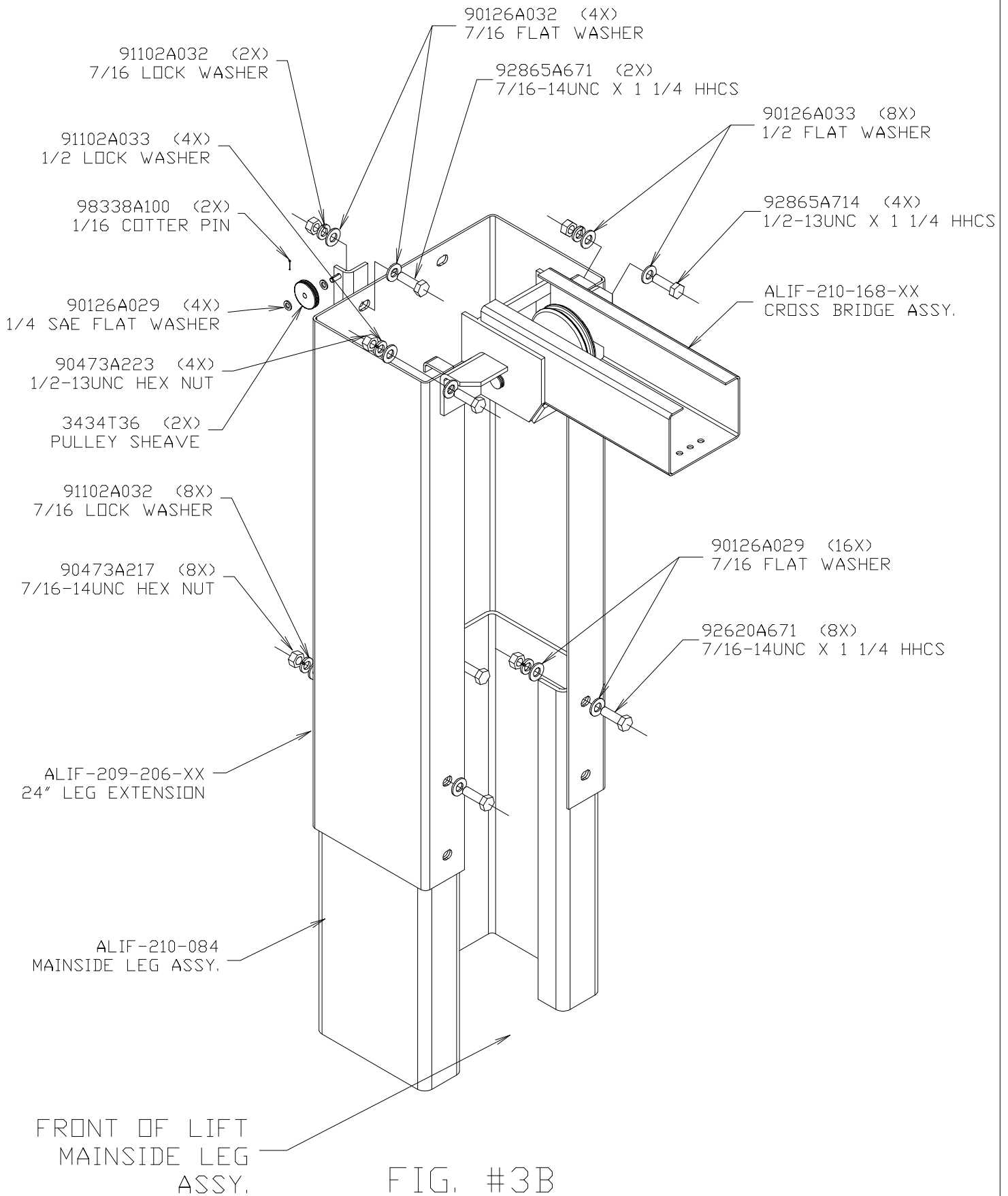


FIG. #3B

CABLE ROUTING, ALIF-210 & ALIF-211

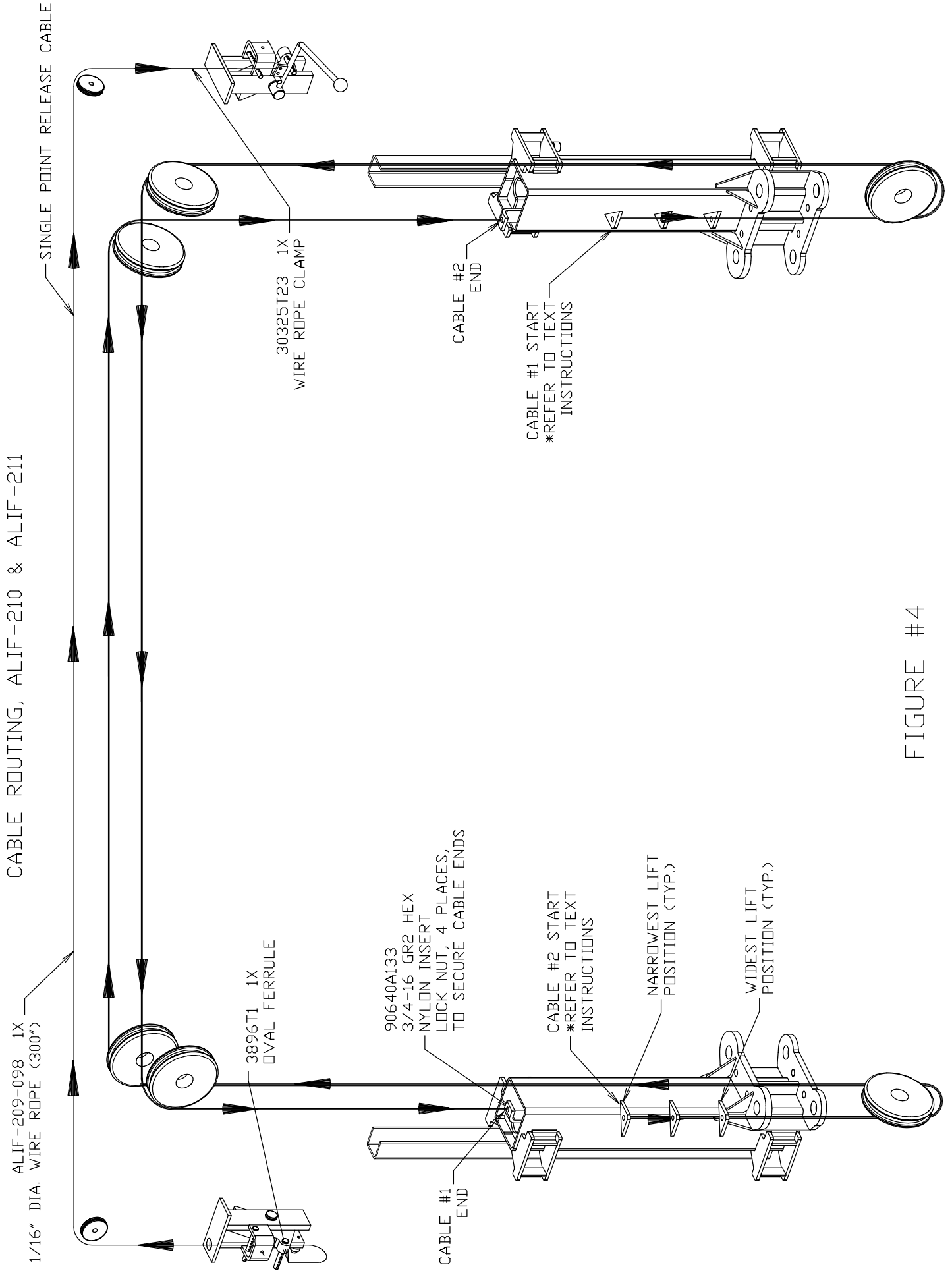


FIGURE #4

ALIF-210-284 - MAINSIDE LEG ASSY.

\*\*\* IMPORTANT: SCREWS TO  
GO FROM THE INSIDE TO OUTSIDE  
92865A716 (2X)  
1/2-13UNC X 1 1/2 HHCS

\*\*\* IMPORTANT: LOCKNUT MUST  
GO TO THE OUTSIDE  
90640A133 (2X)  
1/2-13UNC HEX NYLON  
LOCKNUT

ALIF-209-019-XX  
CARRIAGE STOP W/LDM'T.

HANDLE ASSY.  
6046K33 - 1 DIA. BALL KNOB  
ALIF-209-137-XX - HANDLE W/LDM'T.  
(ONLY ON MAINSIDE LEG)

98410A131 2X  
7/8 EXT. RETAINER RING

5315  
7/16 DIA. X 1.25 EXT. SPRING

POWER UNIT BRACKET  
ONLY ON MAINSIDE LEG

ALIF-DECL-SERIAL S.N. DECAL  
ALIF-DECL-UL UL DECAL  
(MAINSIDE LEG ONLY)

ALIF-DECL-CAUT CAUTION DECAL  
ALIF-DECL-SAFE SAFETY DECAL  
ALIF-DECL-WARN WARNING DECAL  
(MAINSIDE LEG ONLY)

ALIF-209-090R-XX - MAINSIDE LEG

ALIF-DECL-XXCAP  
LIFT CAPACITY STICKER

GL-09-144  
LIFT INSTRUCTION STICKER

98330A185  
5/16 DIA. X 3.0 ADJ. CLEVIS PIN

98338A140 3X  
3/32 X 1 COTTER PIN

90126A037 2X  
7/8 SAE FLAT WASHER

98330A245  
3/8 DIA. X 2.5 ADJ. CLEVIS PIN

ALIF-209-162 (2X)  
RUBBER EDGING

92865A537  
1/4-20UNC X 1/2 HHCS

91102A029  
1/4 LOCK WASHER

ALIF-209-126-XX  
MAINSIDE COVER

ALIF-209-125-XX  
SAFETY LATCH

5933  
1/2 DIA. X 2.13 EXT. SPRING

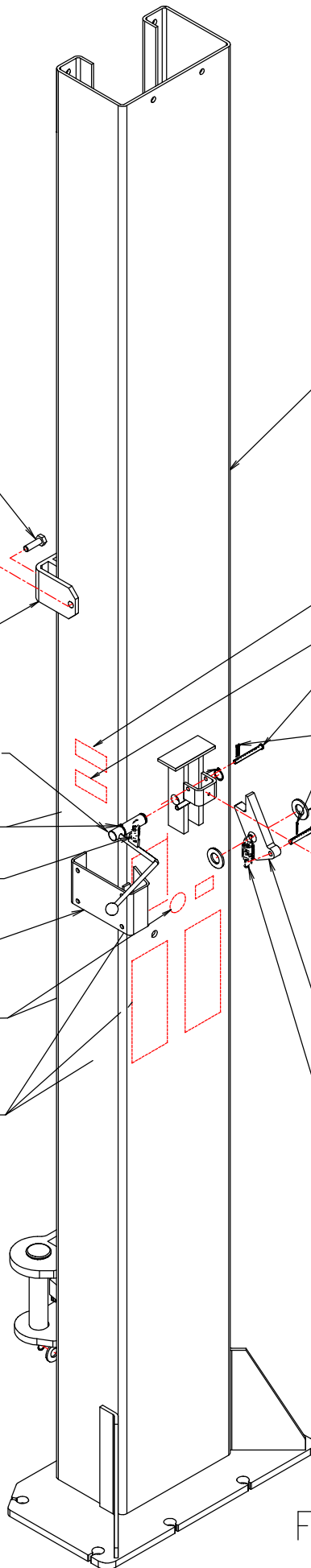


FIG. #5A

ALIF-210-285 - OFFSIDE LEG ASSY.

\*\*\* IMPORTANT: SCREWS TO  
GO FROM THE INSIDE TO OUTSIDE  
92865A716 (2X)  
1/2-13UNC X 1 1/2 HHCS

\*\*\* IMPORTANT: LOCKNUT MUST  
GO TO THE OUTSIDE  
90640A133 (2X)  
1/2-13UNC HEX NYLON  
LOCKNUT

ALIF-209-019-XX  
CARRIAGE STOP WLDM'T.

ALIF-209-134  
SAFETY LATCH PIN  
(ONLY ON OFFSIDE LEG)

98410A131 2X  
7/8 EXT. RETAINER RING  
91259A580  
5/16 X 5/8 SHOULDER SCREW

3434T36-M313  
1 1/2" SHEAVE

91145A180  
5/16 X 1/4 NYLON SPACER

ALIF-209-090L-XX - OFFSIDE LEG

98330A185  
5/16 DIA. X 3.0  
ADJ. CLEVIS PIN

98338A140 3X  
3/32 X 1 COTTER PIN

90126A037 2X  
7/8 SAE FLAT WASHER

98330A245  
3/8 DIA. X 2.5 ADJ. CLEVIS PIN

ALIF-209-162 (2X)  
RUBBER EDGING

92865A537  
1/4-20UNC X 1/2 HHCS

91102A029  
1/4 LOCK WASHER

ALIF-209-127-XX  
OFFSIDE COVER

ALIF-209-125-XX  
SAFETY LATCH

5933  
1/2 DIA. X 2.13 EXT. SPRING

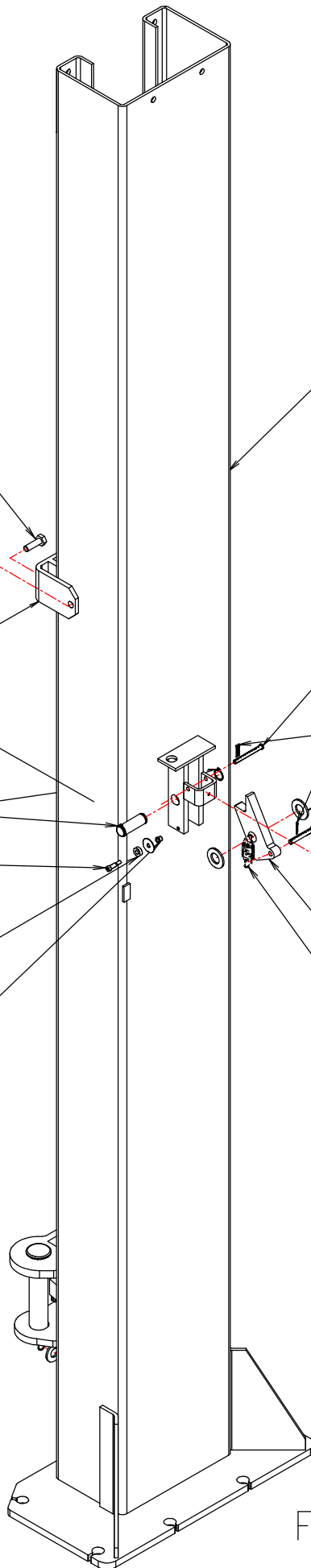


FIG. #5B



ALIF-210-284 - MAINSIDE LEG ASSY.  
ALIF-210-285 - OFFSIDE LEG ASSY.

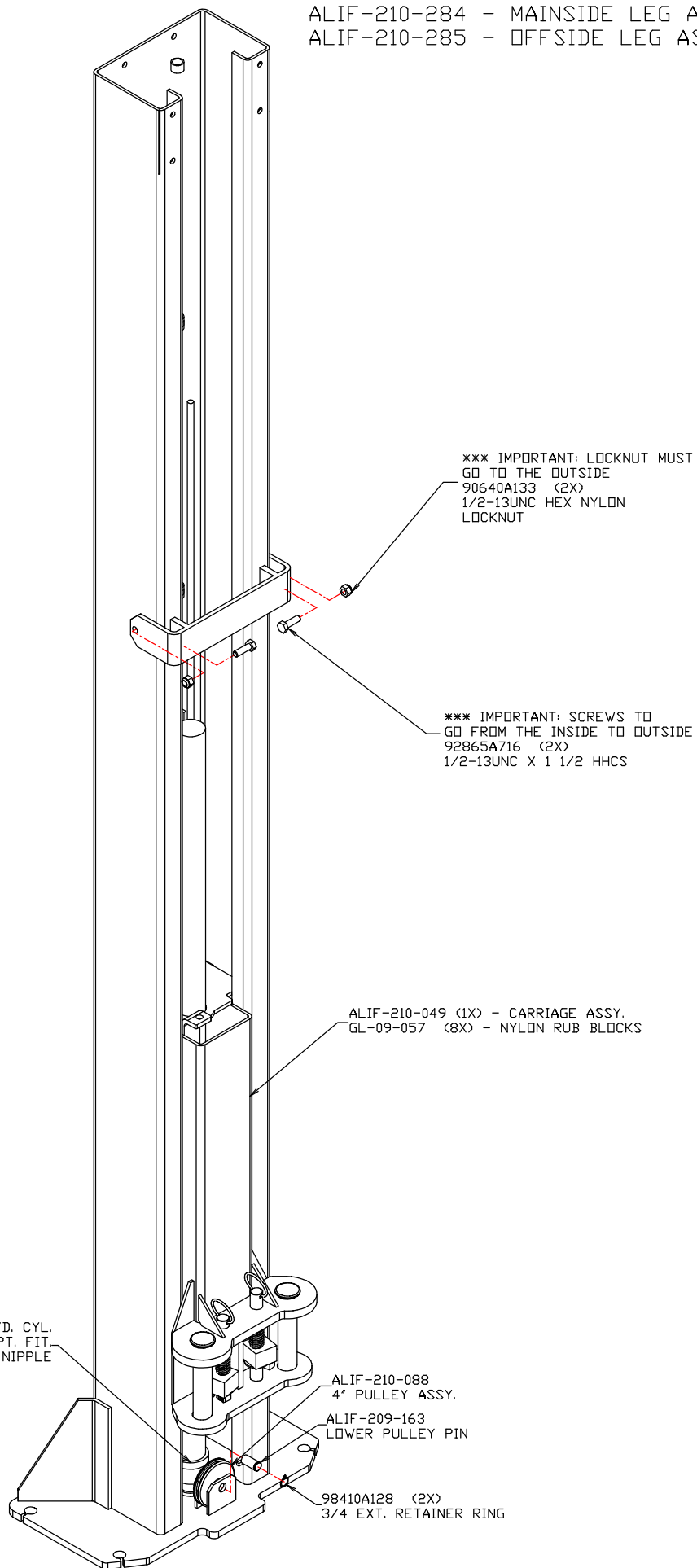


FIG. #5C

SINGLE POINT RELEASE ASSY.  
ALIF-210-284 - MAINSIDE LEG ASSY.

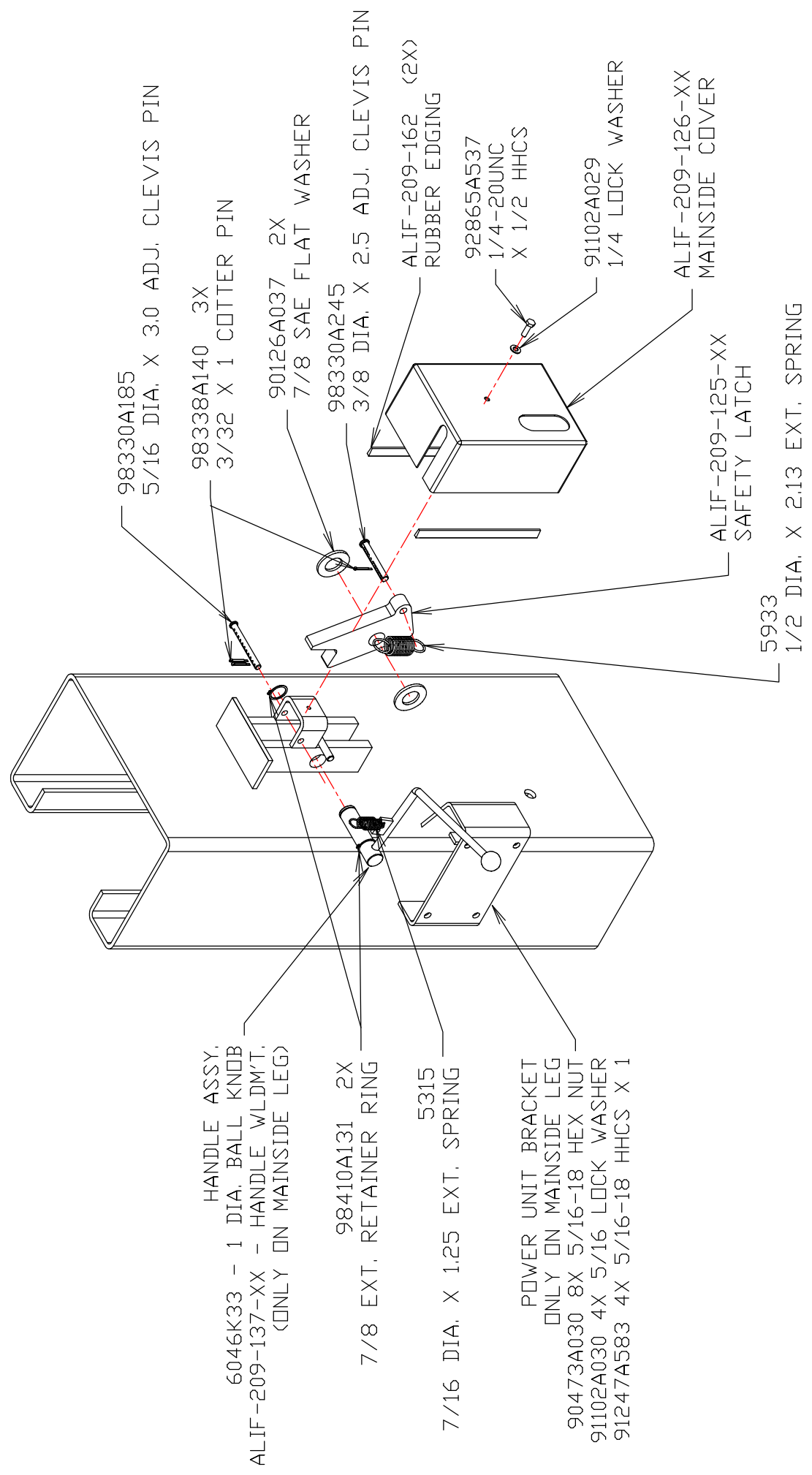


FIG. #5D

SINGLE POINT RELEASE ASSY.  
ALIF-210-285 - OFFSIDE LEG ASSY.

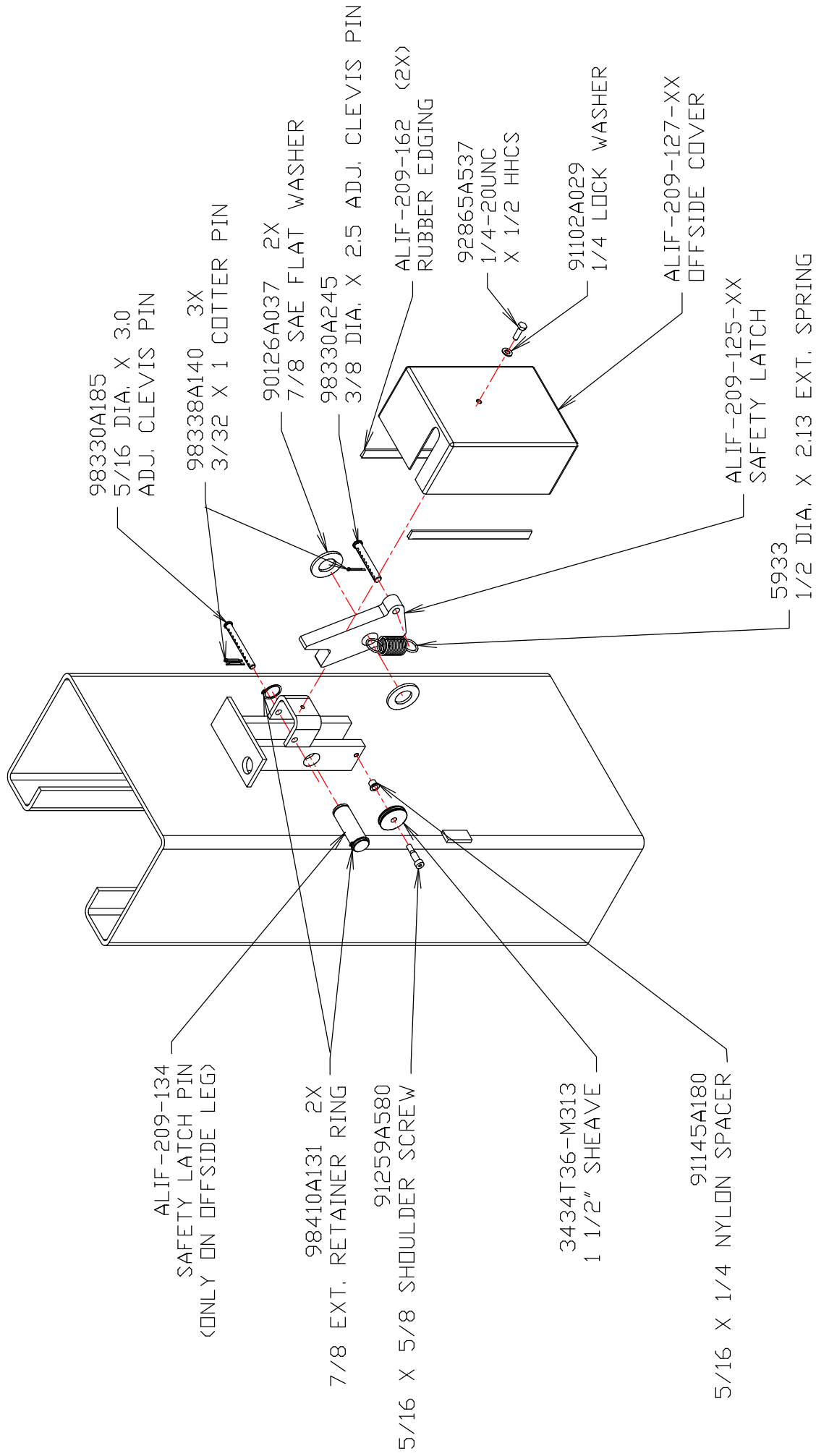
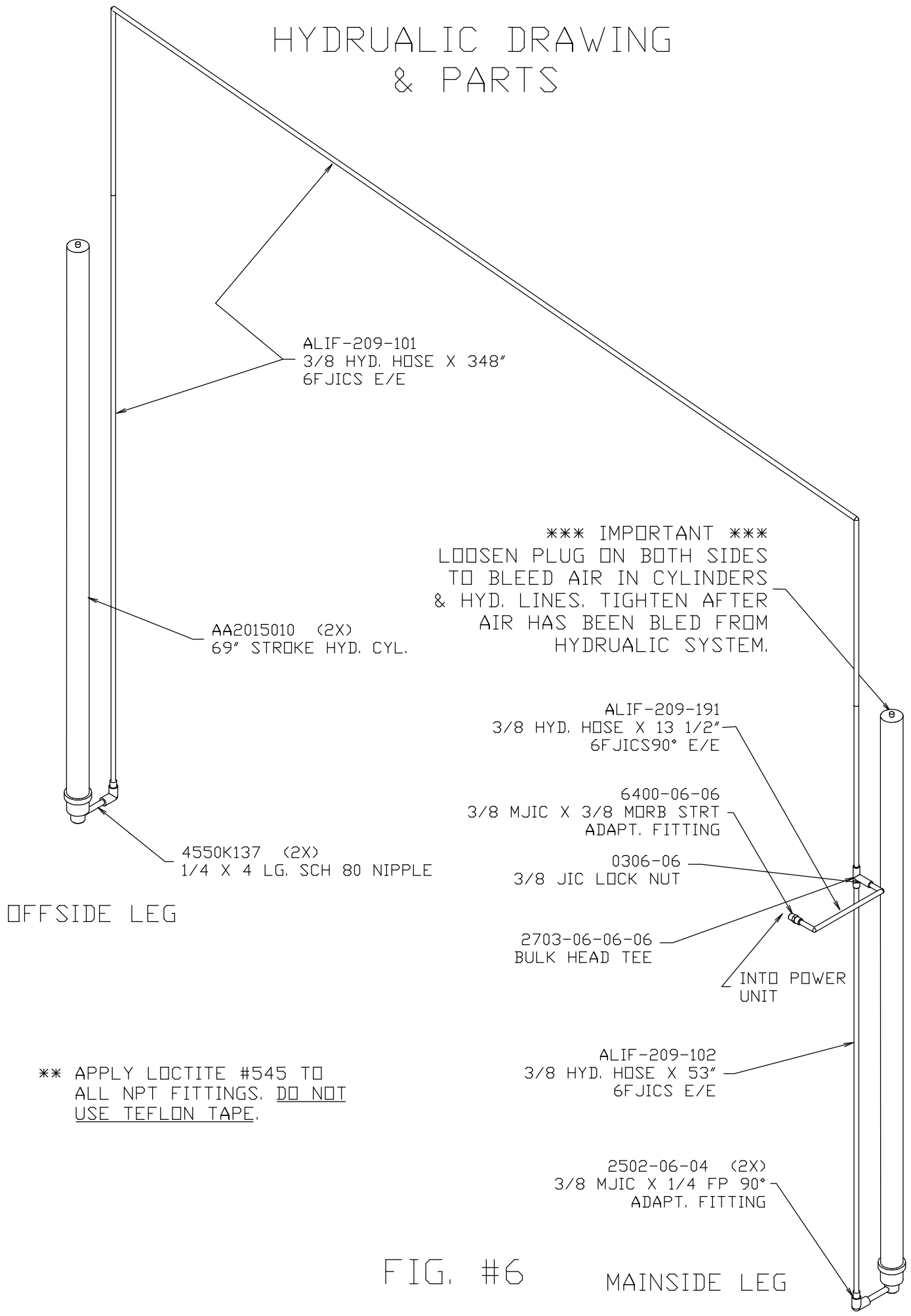


FIG. #5E

# HYDRUALIC DRAWING & PARTS



ALIF-209-101  
3/8 HYD. HOSE X 348"  
6FJICS E/E

AA2015010 (2X)  
69" STROKE HYD. CYL.

4550K137 (2X)  
1/4 X 4 LG. SCH 80 NIPPLE

OFFSIDE LEG

\*\*\* IMPORTANT \*\*\*  
LOOSEN PLUG ON BOTH SIDES  
TO BLEED AIR IN CYLINDERS  
& HYD. LINES. TIGHTEN AFTER  
AIR HAS BEEN BLED FROM  
HYDRUALIC SYSTEM.

ALIF-209-191  
3/8 HYD. HOSE X 13 1/2"  
6FJICS90° E/E

6400-06-06  
3/8 MJIC X 3/8 MORB STRT  
ADAPT. FITTING

0306-06  
3/8 JIC LOCK NUT

2703-06-06-06  
BULK HEAD TEE

INTO POWER  
UNIT

ALIF-209-102  
3/8 HYD. HOSE X 53"  
6FJICS E/E

2502-06-04 (2X)  
3/8 MJIC X 1/4 FP 90°  
ADAPT. FITTING

\*\* APPLY LOCTITE #545 TO  
ALL NPT FITTINGS. DO NOT  
USE TEFLON TAPE.

FIG. #6

MAINSIDE LEG

FINAL CARRIAGE ASSEMBLY  
10K/11K ALIF-210-049

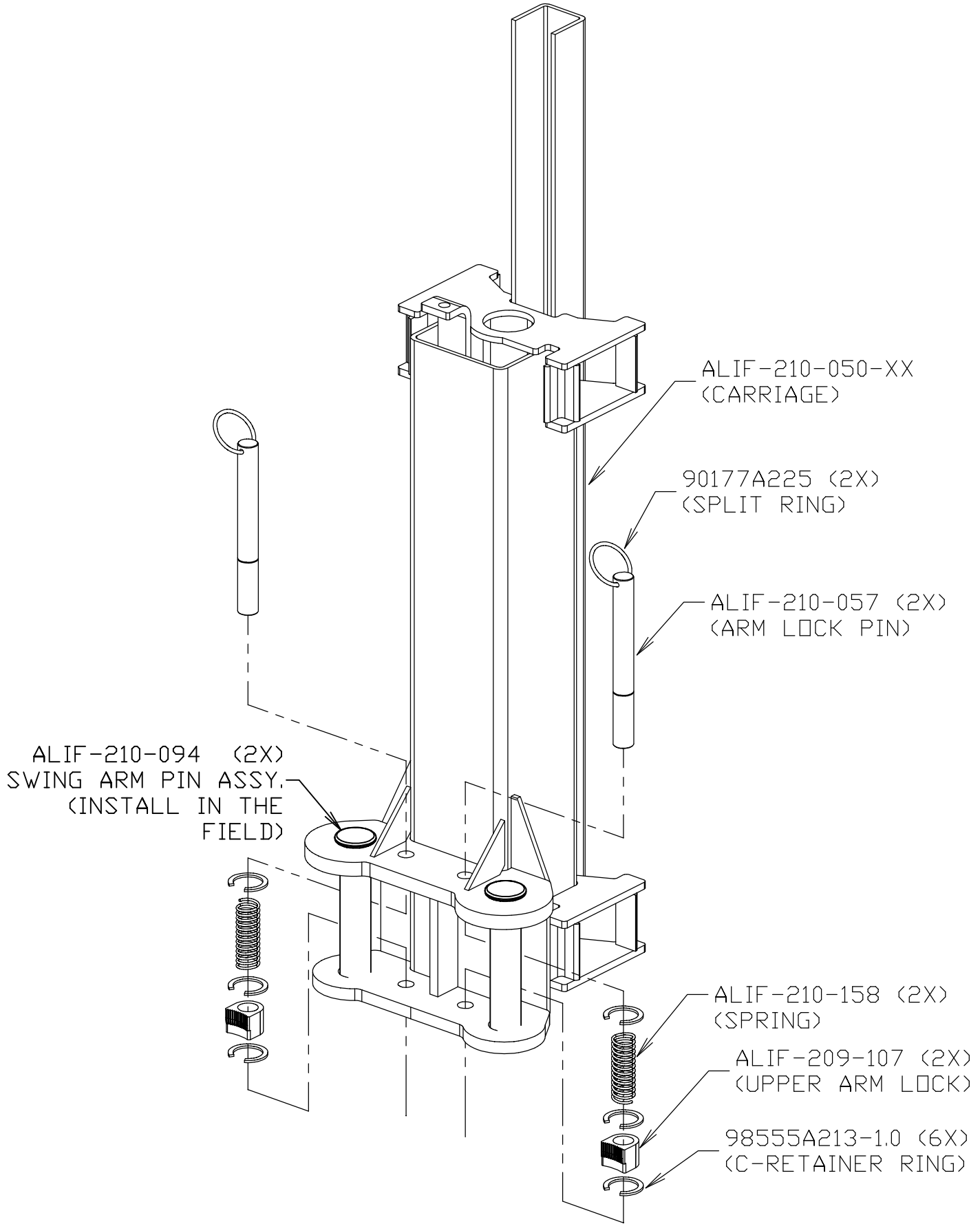
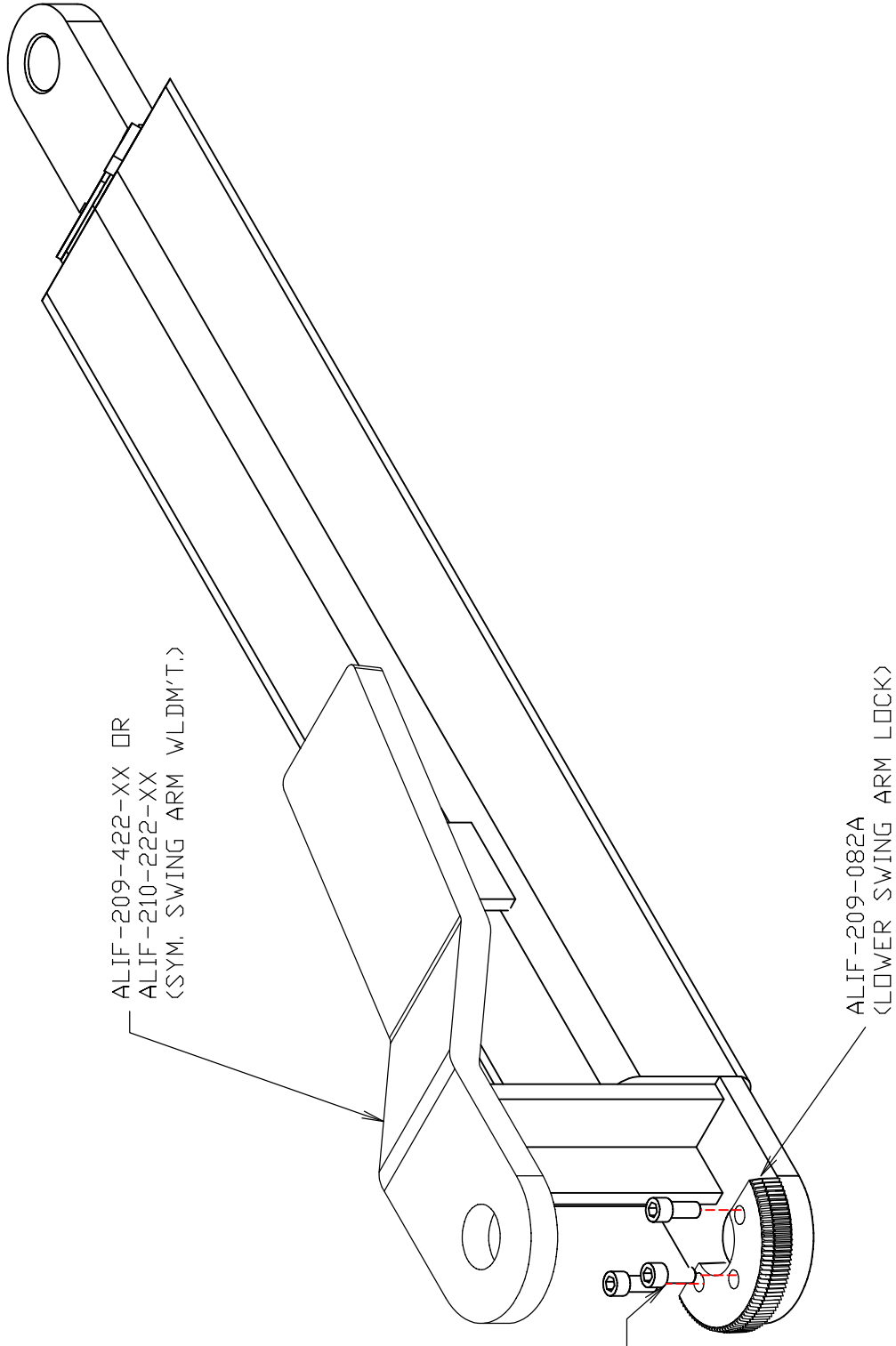


FIG. #7

ALIF-210-420 OR ALIF-210-220  
FINAL SYM. SWING ARM ASSY.

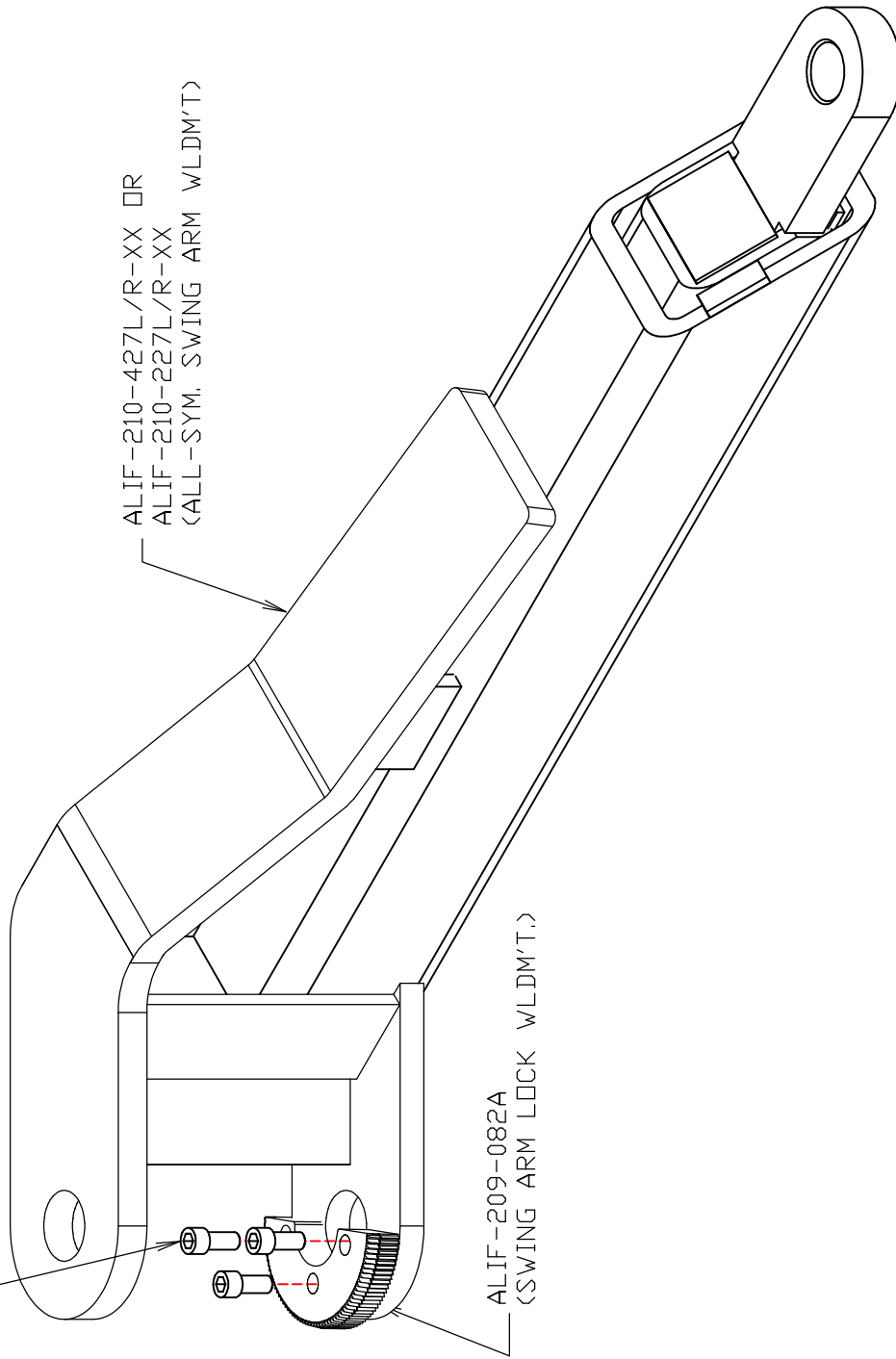


91251A626 (3X)  
(3/8-16UNC X 1 1/4 SHCS)  
\*\* APPLY LOCTITE #262 TO  
BOLT PRIOR TO INSTALLATION

FIG. #8

ALIF-210-426L/R OR ALIF-210-226L/R  
FINAL ALL-SYM. SWING ARM ASSY.

91251A626 (3X)  
(3/8-16UNC X 1 1/4 SHCS)

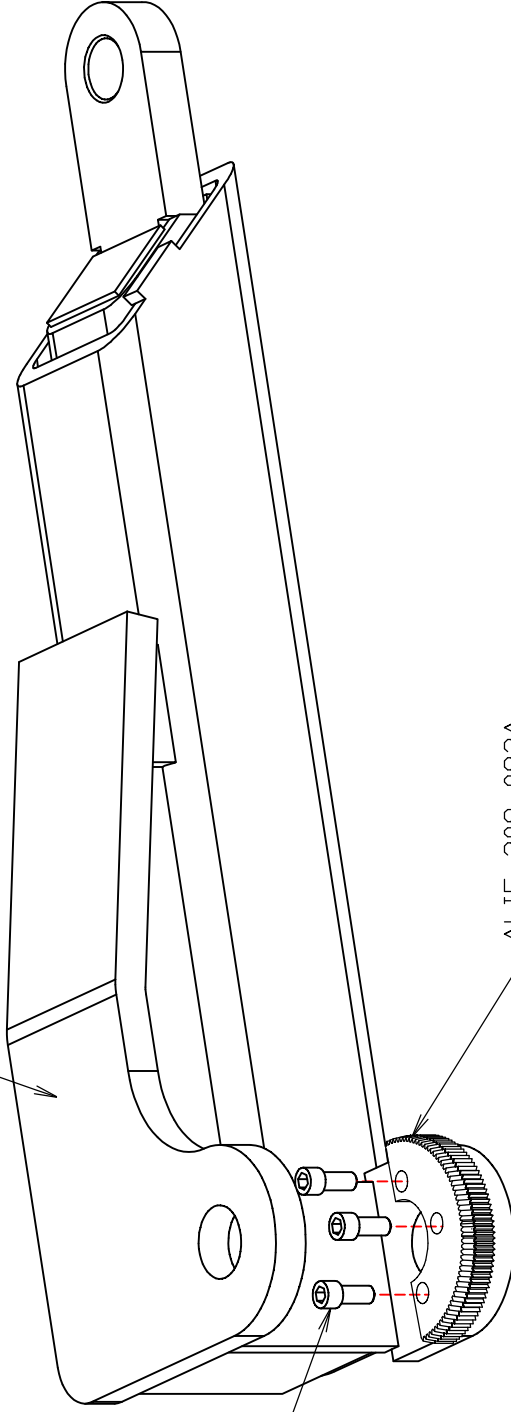


LH - AS SHOWN  
RH - OPPOSITE

FIG #9

ALIF-210-421L/R OR ALIF-210-221L/R  
FINAL ASYM. SWING ARM ASSY.

ALIF-210-423L/R-X OR  
ALIF-210-223L/R-X  
(ASYM SWING ARM W/LDM'T)



ALIF-209-082A  
(LOWER SWING ARM LOCK)

91251A626 (3X)  
(3/8-16UNC X 1 1/4 SHCS)  
\*\* APPLY LOCTITE #262 TO  
BOLT PRIOR TO INSTALLATION

LH - AS SHOWN  
RH - OPPOSITE

FIG #10



# Snap Action Switch Wiring Diagram

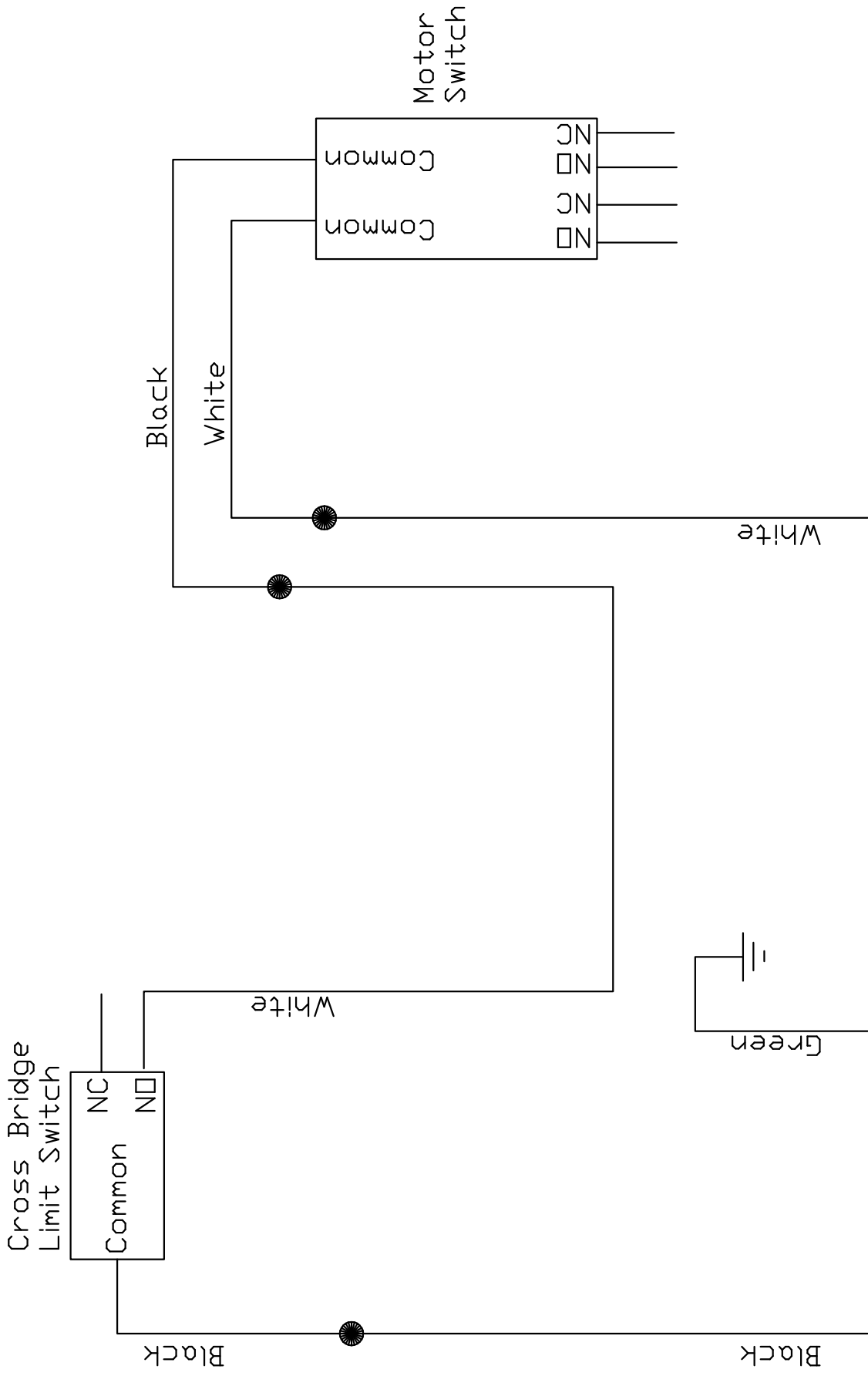
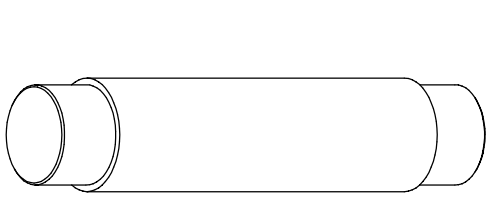


FIG. #11

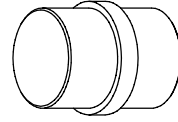
# LIFT PAD ASSY. & EXTENSIONS



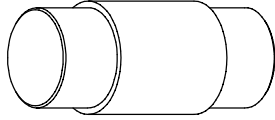
ALIF-209-078-XX  
6" EXTENSION  
4 PER ASSY.



ALIF-209-077-XX  
4" EXTENSION  
4 PER ASSY.



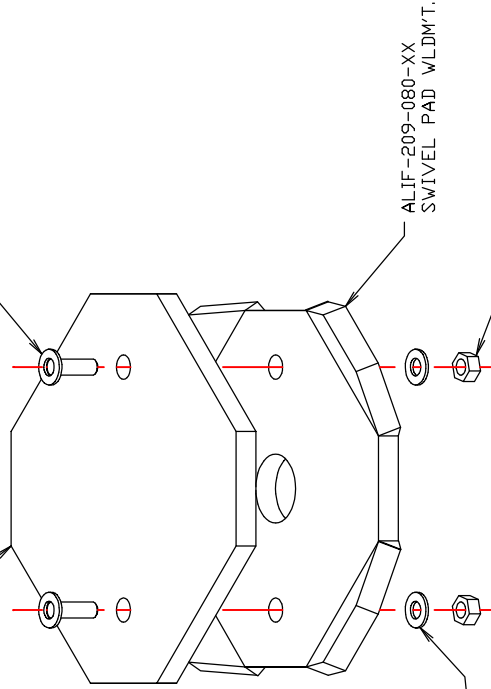
ALIF-209-074-XX  
4 PER ASSY.



ALIF-209-076-XX  
2" EXTENSION  
4 PER ASSY.

92670A744 (2X)  
1/4-20UNC X 1 1/4  
ELEV. BOLT #1

GL-09-013  
RUBBER PAD



ALIF-209-080-XX  
SWIVEL PAD WLDMT.

90473A029 (2X)  
1/4-20UNC HEX NUT

ALIF-209-086  
4 PER ASSY.

90126A029 (2X)  
1/4 SAE FLAT WASHER

STANDARD PARTS  
WITH EACH LIFT

FIG. #12