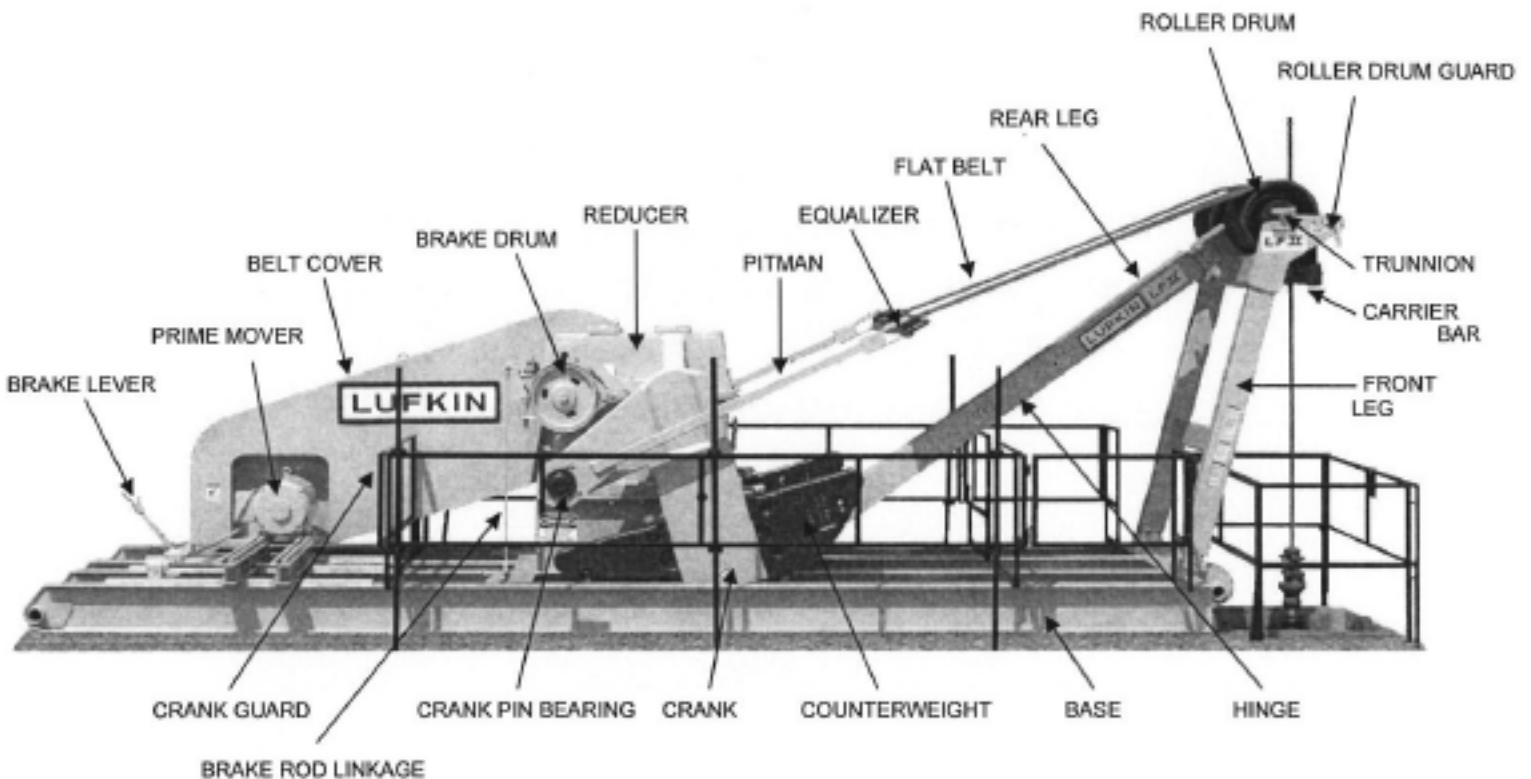


# LUFKIN

## LOW PROFILE II PUMPING UNIT INSTALLATION MANUAL LP11-09



**WARNING:** Failure to use this manual for guidance could result in injury to personnel and/or damage to equipment.

# LUFKIN

## INDUSTRIES, INC.



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# WARNING

The LUFKIN Low Profile II Pumping Unit is designed to give many years of dependable service. Like all machines with moving parts, there are “potential” hazards associated with its use. These hazards can be reduced if the machine is properly installed, operated and maintained. All personnel who install, operate or maintain the unit must read this manual and must be trained to use the machine in an appropriate and safe manner. Should any questions arise concerning the maintenance or operation of the machine, contact LUFKIN Industries, Inc. at 1-936-634-2211.

POTENTIAL HAZARD	EFFECT	PREVENTION
 <p data-bbox="228 1339 581 1373">ELECTRICAL CONTACT</p>	<p data-bbox="672 1100 878 1157">Will cause severe injury or death.</p>	<p data-bbox="938 821 1321 884">Do Not allow personnel to stand under moving loads or parts.</p> <p data-bbox="938 915 1382 1037">Set brake, engage pawl and chain brake drum during installation and maintenance to prevent movement of cranks and counterweights.</p> <p data-bbox="938 1073 1386 1163">Keep clear of carrier bar, equalizer, counterweight and crank swing area and other parts that may start moving.</p> <p data-bbox="938 1199 1354 1262">Do Not operate pumping units without proper guards in place.</p> <p data-bbox="938 1293 1377 1388">Do Not service well without retracting the rollers and Samson post assembly.</p>
 <p data-bbox="228 1703 581 1736">ELECTRICAL CONTACT</p>	<p data-bbox="646 1604 911 1667">Can cause severe injury or death.</p>	<p data-bbox="938 1482 1360 1545">Keep pumping units at least 10 feet away from all overhead wires.</p> <p data-bbox="938 1577 1360 1608">Lockout/tagout ALL energy sources.</p> <p data-bbox="938 1640 1377 1703">All electrical work must be performed by a qualified electrician.</p>

## FOREWORD

The LUFKIN Low Profile II pumping unit is a rear mounted, crank actuated pumping unit employing a flat belt system to convert rotational motion into reciprocating motion. The Low Profile II is designed for operation in both clockwise and counterclockwise directions of rotation.

The purpose of the Low Profile II pumping unit is to permit the pumping of wells located on irrigated farmland. The lower height of the unit allows it to pump while the traveling irrigation boom is moving over the unit.

LUFKIN pumping units have been designed to rigid LUFKIN standards and exceed API (American Petroleum Institute) standard requirements for pumping unit design. In addition, all individual components of the unit and the unit as a whole represent the very best engineering design, production facilities, quality and field experience that nearly a century of LUFKIN INDUSTRIES' experience can bring to you. Your LUFKIN unit will give many years of dependable service when properly installed, maintained and operated within its load and torque ratings.

To avoid confusion, some of the more common terms used concerning pumping units are defined as follows:

Front refers to the well head (rollers) end of the pumping unit

Rear refers to the prime mover end of the pumping unit

Left & Right are determined by standing at the rear of the pumping unit and facing the well head

Crank Sweep or Crank Swing is the circular area centered about the crankshaft where the cranks and counterweights will rotate when in motion

Rollers are the cylindrical drums located at the end of the front leg of an LP II pumping unit. The Low Profile II pumping unit does not have a walking beam or horsehead due to its specialized design. The rollers rotate to allow the flat belts to raise and lower the rod string.

NOTE: Different size units have varied component designs. Therefore, some of the photographs and illustrations used in this manual are representative only and may not look exactly like the parts with which you are working.

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# INSTALLATION MANUAL

## LUFKIN LOW PROFILE II PUMPING UNITS

### 1 SAFETY

Before proceeding with the installation, operation or maintenance of a pumping unit, familiarize yourself with federal, state and local laws, your company's safety regulations and the safety section of this manual. For your protection and to prevent equipment damage, please heed the product safety signs attached to the pumping unit.

#### 1.1 HAZARD IDENTIFICATION

**DANGER:** Indicates an imminently hazardous situation which, if not avoided, will result in serious injury or death.

**WARNING:** Indicates a potentially hazardous situation which, if not avoided, could result in serious injury or death.

**CAUTION:** Indicates a potentially hazardous situation which, if not avoided, could result in minor or moderate injury or damage to the unit.

#### 1.2 SOME POTENTIAL HAZARDS

Failure to heed the following **WARNINGS** could result in severe bodily injury or death to personnel:

- Pumping units have large and heavy rotating parts. Even a temporarily stationary pumping unit has components that can start moving due to gravity. Times of particular danger are during unit installation, stroke change, counterbalance change, general unit maintenance, well servicing and while taking dynamometer card readings.
- When performing maintenance on or working around the pumping unit, always lockout/tagout all energy sources and secure the cranks against rotation. All personnel must stay alert and keep clear of the crank swing area and other potential moving parts.
- Relocate the roller drums and front legs before servicing the well. Since the roller drums are approximately aligned with the polished rod, the rear leg must be folded to allow the drums to relocate away from the wellhead.
- Do not stand under moving parts or loads being lifted. Always attach guide ropes to parts to aid in the initial alignment of parts or assemblies.
- All electrical work must be performed by a qualified electrician. Regularly inspect and maintain electric motors, automatic timers or any other electrical device.

- Be aware of power line locations, keeping unit and service equipment at least ten feet away.
- Do not assume a stationary unit is not operational. Automatic timers can start a unit in motion without warning.
- LUFKIN does not recommend the installation of or maintenance on pumping units during thunderstorms. Exercise extreme caution during icy conditions and other inclement weather.

### 1.3 COMMONLY USED SAFETY PROCEDURES FOR SECURING CRANKS

**DANGER:** Do not enter the crank swing area to chain the drum or engage the pawl.

Always install the unit and perform maintenance with the cranks at the five o'clock position when possible. In this position, the cranks will not rotate as long as the carrier bar is not attached to the polished rod or the polished rod has been securely clamped at the stuffing box and all energy sources have been locked-out/tagged-out.

It is essential to prevent rotation of the cranks stopped in any position. Never use the brake alone as a safety stop. Always use as many other methods as possible for back-ups along with your company's lockout or tagout procedure.

#### 1.3.1 Installing the Brake Pawl

Set the brake with the cranks in the desired position.

**CAUTION:** Abrupt braking may damage the gear teeth in the reducer. A slow, even pull on the brake lever is recommended.

On units equipped with the positive stop brake, the pawl must be engaged in a notch in the drum to prevent crank rotation. Inspect the pawl and drum prior to engagement for possible damage caused by previous misuse. Engage the pawl only after the unit is no longer in motion, see Figure 1.

**CAUTION:** Do not allow the well load to rest on the pawl tooth. If this is done, a crane will be needed to lift the well load to disengage the pawl.

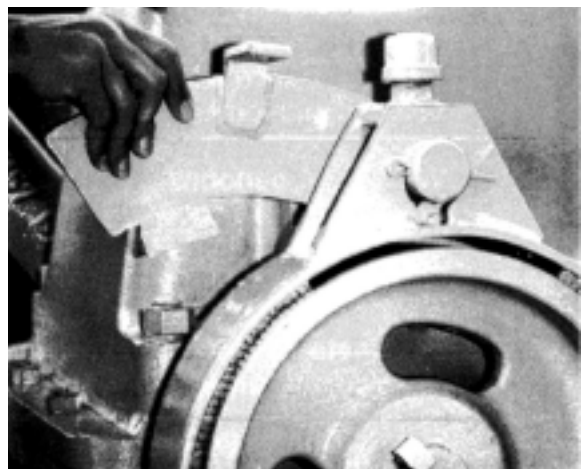


Figure 1



### 1.3.2 Chaining the Brake Drum

Thread a sturdy (never less than 3/8" grade 8 alloy) chain through the hole in the brake drum nearest the trunnion and then around the trunnion itself (Figure 2). Snug up the chain and attach the hook end around a link. Be sure the chain is working against the direction of rotation.

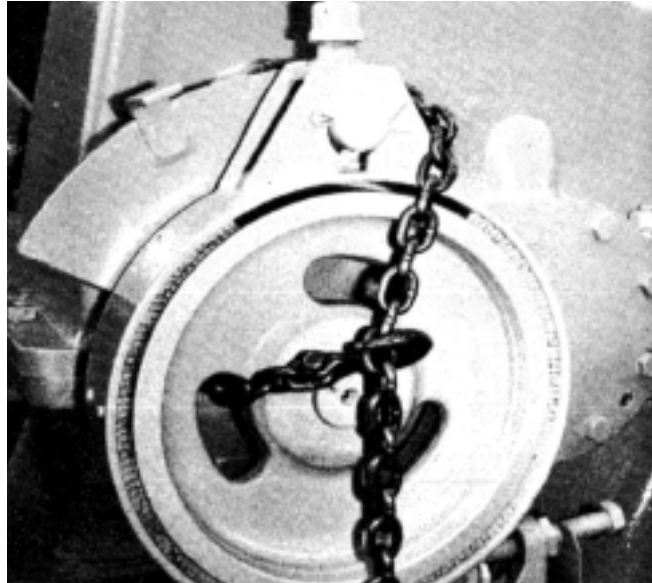


Figure 2

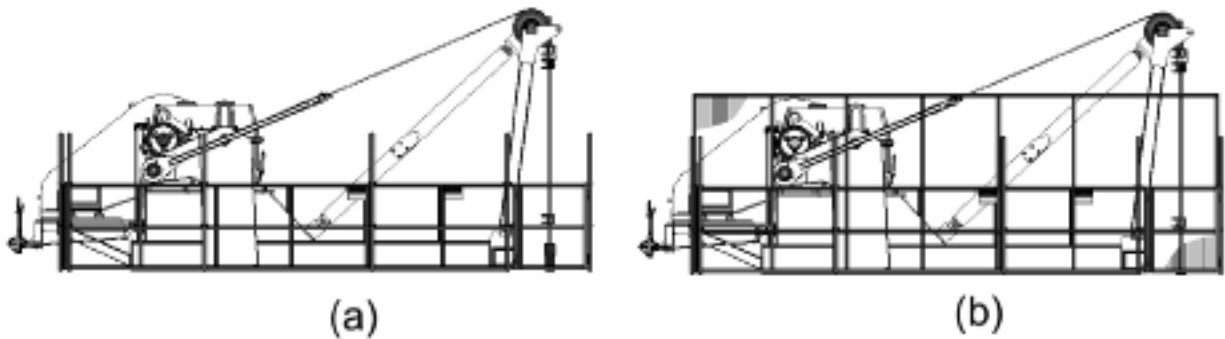
**WARNING:** Faulty chains and slings could fail and cause severe bodily injury or death.

### 1.4 Guarding of Units

**DANGER:** Contact with large moving parts will cause severe injury or death. Do not operate pumping units without proper guards in place. The guards provide a safety barrier between the moving parts of the pumping unit and people who are familiar with the operation of pumping units. They also provide a barrier between the moving parts and animals. When pumping units are operated where they are accessible to the general public, it may be necessary to place the pumping unit with guards in an enclosed area with a locked entrance. The enclosure must prevent entry of unauthorized persons. Federal, state and local regulations may require specific types of guarding, dependent upon the location of your unit; therefore, the user must determine the type of guarding needed. It is essential that the user of the pumping unit comply with all applicable safety requirements. For additional information on guarding of pumping units, refer to API RP11ER

### 1.4.1 Crank Guards

Crank guards are available from LUFKIN. Under normal operating circumstances, the open rail guard (see Figure 3a) would be considered minimum guarding for people who are familiar with pumping units and who are accustomed to working around them. This type of guard keeps workers from accidentally wandering or falling into the crank sweeps. The wire mesh guards (see Figure 3b) would normally be considered adequate guarding for people familiar with the operation of pumping units and accustomed to working around them, as well as for smaller animals that might be able to move through the guards described above. Custom built guards are available to meet customer requirements.



**Figure 3**

### 1.4.2 Roller Drum Safety Bars

Roller drum safety bars are a standard part of the Low Profile II pumping unit. For your protection, these safety bars must be installed prior to operating the unit. These bars are inserted in front of the roller drums as a preventive measure. They keep the flat belts and carrier bar properly restrained if the load is removed from the carrier bar without it being secured (due to a rod part, for instance).

### 1.4.3 Belt Guards

Belt guards are furnished with each unit. They are designed to cover exposed sheaves and belts and to provide a barrier between these items and people who are familiar with the operation of pumping units. Replacement belt guards are available from LUFKIN.

### 1.4.4 Prime Mover Guards

Exposed flywheels of prime movers must be guarded. These guards are designed to keep people who are familiar with the operation of pumping units from accidentally walking or falling into the flywheel. Prime mover guards are available from LUFKIN.

## 1.5 PROPER CLOTHING AND TOOLS

Snug-fitting clothing is recommended. Remove jewelry, wear a hard hat, side-shield safety glasses and safety shoes when around the pumping unit (see Figure 4).

Use proper tools for the job. Tools are designed for specific purposes and must be used accordingly. Always keep tools clean and in good working condition.



**Figure 4**

Anytime work is performed at a height where a fall could possibly inflict injury, a safety harness should be worn. When possible, use a man-lift or some other type of approved safety basket.

Refer to your company's safety regulations concerning clothing and tools.

## 1.6 TRAINING

It is essential that only properly trained personnel, under competent supervision, be allowed to work with this equipment. Training programs are an important part of safe and correct operation of pumping units. Training also provides the knowledge necessary to maximize the performance of your equipment. LUFKIN recognizes the importance of training and conducts training schools to help familiarize personnel with safe operating and maintenance procedures. These training schools are held at corporate headquarters in Lufkin, Texas. There is a small charge for this service. The dates for each school are available upon request by contacting your nearest LUFKIN sales office (see back cover of this manual).

## 2 INSTALLATION EQUIPMENT SIZING CHART

The following chart is a general guide to assist in selecting the proper equipment for installing your LUFKIN pumping unit. If there are further concerns or questions about the weight of a part, contact LUFKIN.

Table 1. Approximate Weight and Hook Data for Installation Purposes

Unit	*Maximum Weight (lbs)	**Hook Height
LP11-114-173-54	29500	10' - 0"
LP11-160D-173-64	29500	10' - 0"
LP11-228D-173-74	31000	10' - 0"
LP11-320D-246-86	37000	12' - 0"

\* Maximum weight includes largest unit sheave, wide portable gas engine base and the heaviest possible counterweights and auxiliary weights.



\*\* Hook height was determined by the distance from the bottom of the steel base to the top of the flat strap on the roller drum. Extra allowance may be required, depending on grade height.

### 3 FASTENERS

#### 3.1 "METAL TO METAL" GRIP

Bolting is a vital part of an oilfield pumping unit. The surfaces under the bolt head, nut and the contacting surfaces must be flat, clean and free of burrs so the bolted members join in "metal to metal" contact. Bolts that are properly tightened during unit installation and re-tightened a week later will retain their grip under normal operating conditions. Improperly tightened bolts will break in fatigue and may cause serious failures, as well as injury to personnel. Table 2 gives the recommended tightening torque for bolts used in pumping units.

Table 2. Proper Tightening Torque Nuts and Cap Screws

Bolt Size	Torque (ft-lb)			
	Grade 2 		Grade 5 	
	Min	Max	Min	Max
3/8 - 16 NC	19	21	30	32
1/2 - 13 NC	47	51	71	79
5/8 - 11 NC	92	102	143	157
3/4 - 10 NC	164	180	253	279
7/8 - 9 NC	156	176	409	451
1 - 8 NC	238	262	612	676
1 1/8 - 7 NC	336	372	866	958
1 1/4 - 7 NC	475	525	1064	1176
1 1/2 - 6 NC	826	912	1849	2049

Since high capacity torque wrenches are not commonly available, larger size bolts are usually hammered tight. Use a box end wrench with a striking face and tighten the bolts until the hammer blows feel solid. Bolts will fail in fatigue from inadequate tightening rather than being pulled in two from excessive tightening torque. Therefore, if in doubt, bolts should always be over-tightened rather than under-tightened.

**WARNING:** Proper eye protection must be worn when tightening bolts as flying metal could cause damage to the eyes.

#### 3.2 "ELASTIC" GRIP

Bolt grip is not always "metal to metal". In applications such as foundation bolts, heel clamp bolts and bolts used on various brackets, the fasteners will be subjected to cyclic loading. The tightening torque needed in these applications varies greatly. However, a safe and reasonable torque is roughly two-thirds of the maximum value given in Table 2. If in doubt, bolts should always be over-tightened rather than under-tightened.

## **4 FOUNDATION**

### **4.1 GENERAL**

The foundation should be constructed in accordance with the foundation drawing shipped with the unit. The foundation drawing gives the minimum foundation required for soil with a minimum bearing strength of 1500 pounds per square foot. Consideration should be given to increasing the size and depth of the foundation in areas where the soil conditions are abnormally poor.

Grade the foundation site to provide a level foundation and adequate drainage. Poor drainage usually results in the foundation setting unevenly, causing undue stresses in the unit base, bearings, and polished rod. Refer to API RP11G for additional information on pumping unit installations.

**CAUTION:** Poor preparation of the site and/or concrete can cause the pumping unit base to break.

**NOTE:** For applications where units are not at grade level, field modifications to all guards will be required per API RP11ER. Upon your request, LUFKIN will design special guards based upon your needs.

### **4.2 TYPES OF FOUNDATIONS**

- Poured concrete - poured on site
- Fabricated steel pads - two-part units only
- Precast concrete blocks
- Board mat – portable and low profile units

**CAUTION:** Specially designed bases for two-point pumping units require support only at the front and rear of the unit. Only units that are designated as two-point are suitable for two-point foundations. Refer to the foundation drawing shipped with the unit or contact LUFKIN.

**NOTE:** The installation procedure shown in the following illustrations is for a precast concrete pad. Some units will use a board mat foundation that requires a leveled and packed installation site as well as a below-ground wellhead and stuffing box.

**WARNING:** Do not stand under any load while installing the pad.

### **4.3 WELL HEAD CLEARANCE**

The Low Profile II unit will function properly with a standard wellhead and stuffing box height if set on a typical concrete foundation. If this type of foundation is used, the foundation print for the unit will give the carrier bar's location and maximum height from the bottom of the

base. If a board mat foundation is used, a below-ground wellhead and stuffing box will be required to obtain proper clearances. The polished rod should be vertical to minimize stuffing box wear and aid in the alignment of the unit.

#### **4.4 ALIGNMENT MARK**

Set the pad in place to the correct distance from the well head and in proper alignment with the center of the well. Make certain that the pad is level both across and along the length of the pad.

Mark a centerline from the front to the rear of the foundation that extends from the center of the well through the center of the foundation. Place a cross mark perpendicular to the center line the distance shown on the foundation drawing from the center of the well to the front cross member of the unit base. This distance is normally referred to as the set-back dimension. The steel base has center marks on the edges of the bottom flanges of the front and rear cross members.



**Figure 5**

The initial alignment involves matching the centerlines on the base and foundation and placing the base the proper distance from the polished rod (see Figure 5).

### **5 UNIT INSTALLATION**

**CAUTION:** Before proceeding with the installation of a pumping unit, the installation crew should fully discuss the job to be done (see Figure 6). Ensure that each person is aware of the dangers involved. Review the Safety Section (Section 1) of this manual.

During unit installation, clean all bolted joints of foreign materials, including paint, to ensure good contact between the parts. The following pictorial and written description of the installation of a Low Profile II pumping unit give the general sequence to be followed, along with precautions and alignment checks.



**Figure 6**

#### **5.1 UNIT BASE INSTALLATION**

The Low Profile II units will ship completely or partially assembled where the overall height of the load does not exceed highway limits, thereby reducing the installation time required (see Figure 7). While many Low Profile II units are shipped fully assembled, these

instructions will detail the steps required to assemble a unit that has been shipped unassembled.



**Figure 7**

Properly attach chains or slings to the unit base, as shown in Figure 8, and set the base on the foundation. Align the center line marks on the front bottom flanges and rear cross members with the center line mark on the foundation.



**Figure 8**

Position the front cross member of the base the correct distance from the center of the well head. Measure the dimension from each corner of the base to the polished rod to ensure that the unit is properly aligned (see Figure 9). These measurements should be within 1/8" of each other.



**Figure 9**

**DANGER:** If installing a fully assembled unit, do not lift the unit by attaching the chains to any part of the front or rear legs, including the rotational sections that attach to the unit base or sub base. The bolts restraining the Samson posts are not meant to support the full weight of the unit and could fail. Attach chains to the lifting points/lugs on the front and rear of the base. Follow the lifting diagram. Never stand beneath the unit (base) as it is being unloaded.

## 5.2 REDUCER ASSEMBLY

**WARNING:** Be certain that the brake and pawl are engaged and the cranks are secured against rotation before removing the reducer assembly from the trailer for installation. Do not stand under the load while installing the reducer.

Properly attach chains or slings, as shown in Figure 10. Before lifting the assembly, check to ensure that the chains or slings are not bearing against the slow speed shaft oil seals or failure will result. Clean the top of the subbase and the reducer's mounting surface.



**Figure 10**

Place the reducer on the subbase and install the bolts from the bottom, leaving them loose so the reducer can be shifted for alignment. Once the reducer assembly is seated and bolted onto the unit base (Figure 11), check the alignment of the reducer by measuring the distance between the slow speed shaft on each side of the unit and the polished rod. Also check the distance between the slow speed shaft and the corners of the front cross beam of the base. The alignment of the reducer and base is critical to the proper operation of the unit. Once proper alignment is achieved, tighten the bolts following the recommendations given under “Fasteners” in Section 3.



**Figure 11**



### 5.3 BRAKE SYSTEM INSTALLATION AND ADJUSTMENT

**WARNING:** The brake is not intended as a safety stop but rather is intended for operational use only. When maintenance is to be conducted on or around the pumping unit, the cranks and counterweights must be securely fixed in a stationary position (refer to Section 1.3 of this manual).

LUFKIN's Low Profile II units are shipped with the modified type "B" brake (Figure 12). These units have a fabricated trunnion located horizontally from the high-speed pinion. Unlike most type "B" brakes, the Low Profile II units use a solid linkage system versus the usual flexible brake cable.

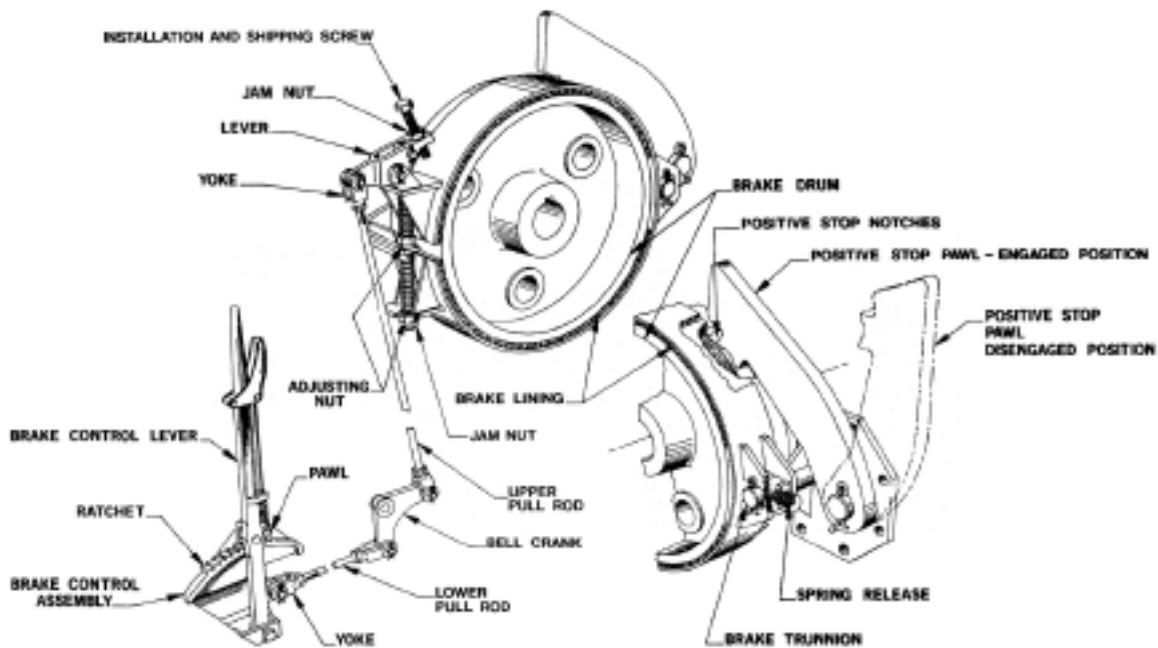


Figure 12

Features of the modified type "B" brake are:

- An installation and shipping screw used for locking the brake for shipping
- Two adjusting nuts to adjust each lining independently

The following procedure outlines the installation of the brake control lever and brake rods and the adjustment of the brakes.

LUFKIN LPII pumping units are shipped from the factory with the brake linings engaged against the drum and the positive stop pawl engaged in the drum. The brake linkage and brake control assembly are also installed on the unit base at the factory. The following procedure outlines the installation of the brake assembly:

- Attach the threaded brake linkage on the right hand side of the unit to the yoke on the upper brake shoe, seen in Figure 13. Only thread the linkage two or three turns, as proper adjustment will be made later. The locking nut will also be tightened later in the installation process, after final adjustments are made.



**Figure 13**

- With the installation and shipping screw backed out flush with the lever, adjust the position of both linings with the adjusting nuts until they just clear the drum. The spring release on the trunnion should pull the lining away from the drum near the trunnion.
- Using the brake control lever, engage the brake. Full engagement should occur with several notches of the ratchet on the brake assembly still remaining to compensate for subsequent lining wear. Further adjustment to meet this condition may be made by changing the engagement length of the linkage (as seen above) by rotating the linkage as needed.
- Verify that the lower cross member of the brake linkage is not contacting the unit base, as seen in Figure 14.



**Figure 14**

- Check the brake lining clearance after all adjustments are complete and readjust if needed.
- Make sure the brake drum key is tight.
- Set the brake, engage the pawl, chain the drum and lockout/tagout all energy sources before continuing.

## 5.4 HOLD-DOWN CLAMPS

After proper alignment has been achieved, the foundation hold-down clamps are installed at the front and rear of the unit base. Snug-tighten the hold-down clamps. Final tightening of the foundation bolts will be done after unit alignment. Hold down clamps at the front of the unit must be pushed as far forward as possible (see Figure 15) in order to allow the folding rear leg to fully retract.



Figure 15

## 5.5 COUNTERWEIGHTS

**WARNING:** Do not stand under any part of the load while installing the primary or auxiliary counterweights. Be sure to remain outside the crank sweep and ensure that the brake has been fully engaged and the cranks are secured against rotation.

**NOTE:** It is recommended that counterweights be installed on the unit prior to installation of the Samson post assembly.

Secure the cranks at preferably the six o'clock position to reduce the severity of a pinch point when adjusting counterweight bolts. Set the brake, lockout/tagout all energy sources, engage the pawl and chain the brake drum (refer to Section 1.3 of this manual for proper procedures). Slide the counterweight bolts into the T-slots of the cranks to the approximate position of the counterweight set point. Lift the counterweights to the cranks and align the bolts with the bolt holes in the counterweight bases.

**WARNING:** Adjusting the counterweight bolts while lowering the counterweights presents a major pinch hazard. Be careful not to pinch your hands beneath the counterweights.

Once the counterweights are positioned over the bolts, slowly adjust the counterweights to their final position on the cranks. Tighten the counterweight bolts per Section 3.

Auxiliary counterweights should be mounted on the inside surface of the counterweights in order to clear all parts of the pumping unit. Support the weight of the auxiliary counterweight

by looping the chain through one of the mounting bolt holes, then lower the weight until a bolt hole lines up with the corresponding hole in the primary counterweight. Insert a bolt and lower the weight until the other holes line up with the remaining holes in the primary counterweight. Install the other bolt(s). Remove the chain and install the last bolt through the hole that was used to support the auxiliary counterweight. Tighten all bolts according to the recommendations per Section 3.

#### 5.5.1 Optional bolt-on crank weights for LPII 114-173-54

To install/remove these weights when the auxiliary weights are already installed, the cranks should be positioned at the twelve o'clock position. Set the brake, lockout/tagout all energy sources, engage the pawl and chain the brake drum (refer to Section 1.3 of this manual for proper procedures). The crank weights can then be lifted vertically on or off of the crank with a chain using the lifting holes provided on the crank weights. If there are no auxiliary weights installed, the crank weights can be installed/removed with the crank positioned at the three o'clock position or the nine o'clock.

**WARNING:** When the cranks are positioned in the twelve o'clock, three o'clock and nine o'clock positions, they are not at their lowest energy state. Personnel should use caution when working around the crank sweep of the unit when the cranks are not at the lowest energy state.

### 5.6 SAMSON POST ASSEMBLY

**WARNING:** Do not stand under any part of the load while installing the Samson post assembly.

It is recommended that the Samson post assembly be loosely fitted together prior to installation on the unit base. Prior to assembling, remove all paint or debris from the mating surfaces of the cradle on the front leg. With the front leg resting horizontally on the ground, lift the rear (folding) Samson post and settle it into the top cradle. Be sure that the posts are correctly oriented, as seen in Figure 16.



**Figure 16**

It is recommended that cradle surfaces be lightly lubricated with a standard oil or lubricant (such as WD-40), as seen in Figure 17a. Be sure to center the rear leg in its cradle as this is a critical part of alignment. If the rear leg is out of alignment, the assembly will not bolt onto the base properly.

Lightly tighten the trunnion latch bolts so that the assembly is securely connected but free to rotate, as seen in Figure 17b. When bolting the assembly to the base, it must have the ability to rotate for adjustment.



**Figure 17**

**CAUTION:** When installing the Samson post assembly, be careful not to strike the polished rod. The guard plates at the front of the assembly fit around the polished rod, but may make contact with it if the assembly is swinging during installation.

Once assembled, lift the Samson post assembly onto the front of the unit base. The Samson post assembly should be lifted using the lug welded to the top of the upper cross member of the front legs (between the rollers). Alternatively, the assembly can be lifted by wrapping a chain around the upper cross member of the front legs. Seat the rear leg into its appropriate cradle first, lightly tightening the trunnion latch bolts. Next, seat the front legs into their cradles on the front of the unit, again lightly tightening the trunnion latch bolts, see Figure 18.



**Figure 18**

Since the Samson post assembly will be rotated later, do not fully tighten the trunnion latch bolts once the assembly is in place. Lightly snug the bolts with a small wrench to reduce assembly movement without compromising adjustability.

## 5.7 ROLLER DRUMS

**WARNING:** Personnel must wear a fall arrestor harness, appropriately linked to the structure, when installing the roller drums on the front legs. Installation will require personnel to work at heights from which a fall could cause serious injury.

With the Samson post assembly connected to the unit base, the roller drums can now be fitted into place in their cradles on top of the front legs. Ensure that the drum is securely held with chains before lifting. It is recommended that the drum be raised as indicated in Figure 19, using the outer hoop edges as a lifting surface.

Raise the drum to the top of the front legs and then lower it gently into its cradle. The drum should be as centered as possible in its cradle. Tighten the trunnion latch bolts fully, per Section 3. Repeat the process for the other drum.



**Figure 19**

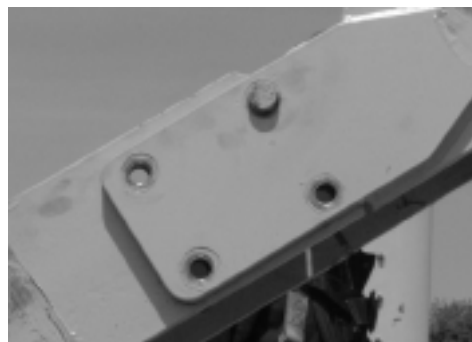
The roller drums' bearing carriers use Nord-Lock washers. If a bearing is replaced, a new, identical Nord-Lock washer must be used. As a reminder, bearings do not have to be greased; they are sealed.

## 5.8 PITMAN ARMS & FLAT BELT ASSEMBLY

**WARNING:** Loosening the bolts on the Samson post without crane support could cause the structure to fold suddenly, potentially injuring a person and/or damaging the pumping unit. When retracting the Samson post assembly, always use a crane to vertically support it, using the lug on top of the front legs as a lift point.

**CAUTION:** Do not hammer the pitman lower connection onto the crank pin bearing box. This could result in damage to the crank pin bearings.

In order to install the pitman arms and flat belt assembly, the rear leg must be retracted. Support the rear leg with a crane, using the lifting lug on the front leg as the attachment



**Figure 20**

point. Remove the lower three bolts on each side of the rear leg hinge section (Figure 20) then slightly loosen the remaining larger bolt on each side to allow the hinge to rotate. Be careful that the hinge does not rotate when you remove the last of the three bolts on each side.

Slowly lower the crane to allow the Samson post assembly to retract and settle lower into the unit base until it rests against the support inside the base (Figure 21).

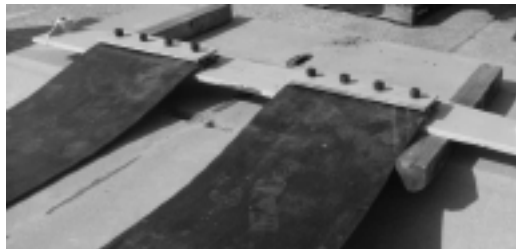


**Figure 21**

The flat belt assembly (two flat belts, carrier bar, and equalizer) and pitman arms must be preassembled prior to installation on the unit. Extend the flat belt assembly along the ground so that the equalizer is flat on the ground.

Attach the pitman arms to the appropriate ends of the equalizer, being sure to install the cotter pins to retain the bolts in the connection.

Bolts should be tightened per Section 3. In order to facilitate assembly, it is helpful to elevate the carrier bar and equalizer a few inches above the ground so that wrenches can be fitted underneath to tighten bolts (Figure 22).



**Figure 22**

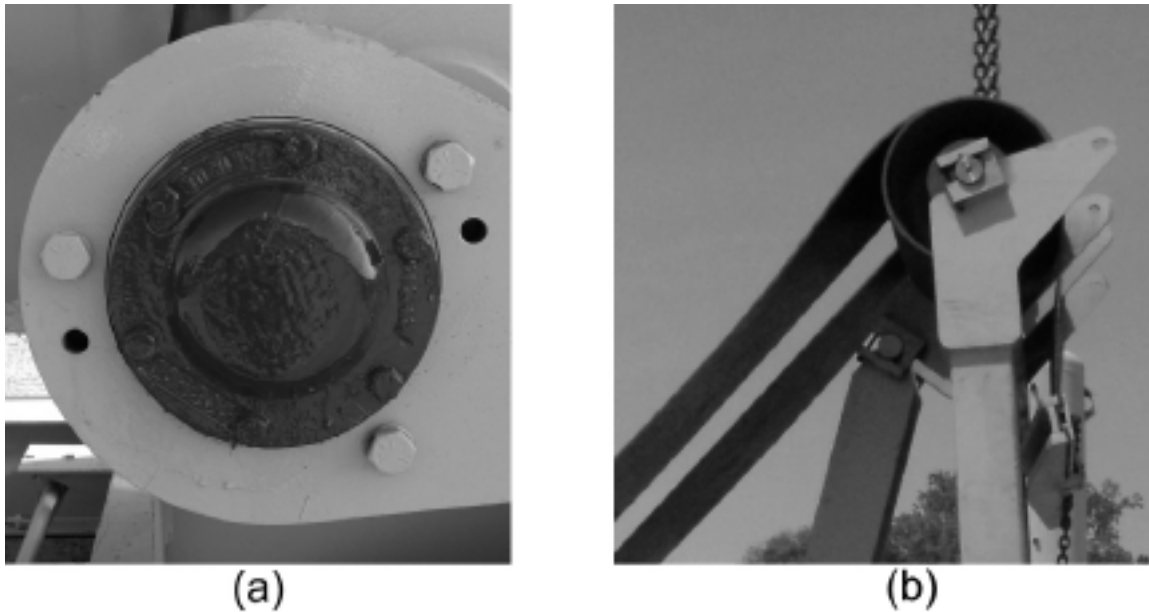
**WARNING:** Do not stand under any part of the load while installing the pitman arms and flat belt assembly.

Attach a chain to the carrier bar and raise the entire assembly over the unit (the pitman arms should be hanging downwards). Lower the assembly until the pitman lower connections are aligned with the crank pins mounted in the cranks. Use ropes to guide the pitmans to prevent contact with the crank pin or other parts of the unit.

**CAUTION:** Do not hammer the pitman lower connection onto the crank pin bearing box. This could result in damage to the crank pin bearings.

Clean the contact surfaces between the pitman lower connection and the crank pin bearing box. Remove the cap screws from the bearing housing outer flange. The pitman ends should fit easily on the crank pin bearing boxes (Figure 23a). Align cap screw holes, install the cap screws, and tighten them per Section 3.

Once the pitman arms are attached, slowly lower the rest of the assembly along the Samson post assembly, draping the flat belts over the front of the roller drums so that the carrier bar rests on the front legs (see Figure 23b).



**Figure 23**

Loosely chain the carrier bar to the front legs' cross beam. This will keep the flat belt assembly from slipping back over the roller drums when the Samson post assembly is raised, as well as keep the carrier bar from striking equipment near it.

Attach the crane to the rear leg lifting lug, then slowly lift the leg until it is completely straight (verify straightness with a level). Once straight, reattach and tighten all connecting bolts in the rear leg hinge section per Section 3. Recheck straightness with a level to ensure the leg did not shift during tightening.

Loosen the bolts, re-level, and retighten the hinge bolts as needed to ensure straightness in the rear leg. Tighten all trunnion latch bolts at the mounting points of the Samson post assembly on the structure, per Section 3. Install the roller drum safety bars in front of the roller drums (Figure 24).

As a final check of the installation of this assembly, measure the distance between the cranks and the pitmans on both sides of the reducer. The distances should be within 1/8" of each other. If the difference is greater than 1/8", the alignment of the reducer as well as the installation of the flat belt assembly must be inspected and potentially adjusted.



**Figure 24**



## 5.9 PRIME MOVER INSTALLATION

**WARNING:** Do not stand under any part of the load while installing the prime mover; do not place fingers and hands between the prime mover and the slide rails.

Place the slide rail bolts in the T-slots near the reducer end so the belts can be easily installed after positioning the prime mover. Guide the slide rails onto the bolts. Space the slide rails to match the mounting holes of the prime mover. Install and space the mounting bolts in the T-slots on the slide rails to match the mounting holes of the prime mover. Slowly lower the prime mover onto the mounting bolts. To prevent injury to fingers and hands, use pliers or other tools to position the bolts. Install the nuts but do not tighten until the belt alignment is completed.

Some bases are tailor made for a particular engine. Rather than using slide rails, the engine feet mount directly to the T slots on the base.

## 5.10 V-BELT INSTALLATION AND ALIGNMENT

**WARNING:** Be certain the prime mover cannot be started during this procedure. Lock-out/tag-out all electrical sources prior to installing the V-belts.

Install a matched set of belts. Use the innermost grooves if either sheave has an excess number of grooves. Use a string to line up the inside faces of the sheaves.

Adjust the position of the prime mover as required for alignment then tighten the bolts that attach it to the slide rails (Figure 25).



**Figure 25**

Tighten the belts by using the adjustment screws to move the prime mover until belt tension is uniform across the width of the belts. Check belt tension by slapping the belts in the middle of the span. They should be lively and springy without any slop. Tighten the bolts attaching the slide rails to the T slots, following the recommendations given in Section 3.

### **5.11 BELT COVER INSTALLATION**

**WARNING:** Be certain the prime mover cannot be started during this procedure. Lockout/tagout all electrical sources prior to installing the belt cover.

Remove the bottom pan and install the belt cover over the prime mover shaft, V-belts, and sheaves. The front support fits over two slow-speed shaft studs on the reducer and is retained by the jam nuts that are located on the reducer studs. Check inside the cover to be sure the sheaves and belts have adequate clearance. The cover can be shifted sideways to adjust clearance; do not overcompensate and allow the sheaves to rub against the belt cover. Re-attach the bottom pan. Some belt covers are equipped with a center support or a wind brace, which should also be attached at this time. Tighten all bolts following the recommendations given in Section 3.

**NOTE:** It is essential that the user of the pumping unit comply with all applicable safety requirements concerning the guarding of belts and sheaves. For additional information concerning belt guards, see API RP11ER.

### **5.12 REDUCER LUBRICATION**

See Section 12.1 for the lubrication specifications and required quantities. Check the oil level with the dipstick located at the front of the reducer. If the oil level is low, remove the inspection cover and add oil until it reaches the proper level.

**CAUTION:** Damage will occur to the reducer if it is operated with the improper amount or type of lubricant.

### **5.13 BEARING ASSEMBLY LUBRICATION**

The crank pin and roller drums employ sealed bearing assemblies. As such, these bearings are not to be regularly lubricated. However, it is good practice to visually and aurally inspect them for wear or obvious defects such as wobble, excessive noise or leaks.

If a sealed bearing assembly defect is discovered, contact your Lufkin sales representative. Do not attempt to self-repair or maintain these assemblies.

### **5.14 ATTACHING THE WELL LOAD**

**WARNING:** Do not stand under the load being lifted while attaching the well load. Always work the crane from above the roller drums.

Attach a polished rod extension to the polished rod so it will rise above the roller drums. Undo the chain that was earlier placed on the carrier bar (to keep the belt assembly from slipping), then hold the carrier bar away from the polished rod with a rope or chain. From above the roller drums, slowly lift the polished rod with the crane approximately the length of the stroke.

Remove the gate from the carrier bar and position the slot in the carrier bar around the polished rod. Replace the gate and secure the gate latch in the notch provided. Install the rod clamp at the carrier bar and tighten the bolts according to the clamp manufacturer's torque recommendations. Unchain the drum, disengage the pawl and reverse the lockout/tagout procedures. Clear the crank swing area. Release the brake and slowly let the load down with the crane until the well load is on the unit and slack occurs in the chains. Reset the brake, engage the pawl, chain the drum and lockout/tagout all energy sources. Remove the rod clamp that was at the well stuffing box.

**WARNING:** Keep hands from between the polished rod clamp and the stuffing box in the event the polished rod clamp slips or the unit moves.

### **5.15 UNIT ALIGNMENT**

Unlike conventional units with a walking beam and horsehead, unit alignment for the Low Profile II pumping unit cannot be fully verified until the well load has been attached to the unit. The easiest way to check unit alignment is to verify that the polished rod is perfectly vertical after the well load has been attached to the pumping unit (Figure 26). After applying the well load to the unit, use a level to check the vertical orientation of the polished rod in various stroke positions. Move the entire pumping unit on its foundation if adjustment is required.



**Figure 26**

After establishing the final alignment of the unit to the well, be sure all foundation hold down clamps are installed. Fully tighten the foundation bolts and ensure all other bolts are tight. Refer to Section 3 for bolt tightening recommendations.

**WARNING:** Proper eye protection must be worn when tightening bolts as flying metal could cause damage to the eyes.

### **5.16 CRANK GUARD INSTALLATION**

Never operate pumping units without guards in place. Guards are available from LUFKIN. Refer to Section 1.4 of this manual.

**WARNING:** Stay clear of crank swing area and do not stand between the roller drum and Samson post while installing guards.

When crank guards are purchased from LUFKIN, a crank guard installation schematic and parts list are shipped with the unit. This shows the panel part numbers and their location relative to each other and to the well head. The front panel, located in front of the Samson post legs, is attached to the base beam by two angle brackets. Other than hi prime units, the rear panel has an opening for the belt cover and is heel clamped to the engine base

beam flanges where possible. The side panel is attached to the front and rear panels with hinges consisting of stationary hooks on the side panels and vertical pipe receptacles on the front and rear panels. Supplied with each set of guards are panels to install around the belt and carrier bar.

**DANGER:** Contact with the equalizer or crank swing will cause serious injury. Do not use this area as a walkway.

Whenever you choose to furnish your own guards in lieu of guards available from LUFKIN, ensure they meet all federal, state and local laws. One possible iteration of proper crank guards, belt cover and roller drum guards are illustrated in Figure 27.



Figure 27

## 6 PRE-OPERATION

**DANGER:** Before operating any unit, review the safety section (Section 1) of this manual. Exercise extreme caution to remain clear of the crank sweep, and other moving parts while performing any of the following tasks.

### 6.1 DIRECTION OF ROTATION

The LUFKIN Low Profile II pumping unit can rotate either clockwise or counterclockwise. Direction of rotation is dictated by the user, based on well conditions and other user-supplied information. Direction of rotation is referenced by looking at the unit from the side with the well head located to your right.

### 6.2 FIRST CRANK REVOLUTION

**DANGER:** Contact with heavy rotating parts will cause serious injury or death. Stay clear of the crank swing area.

Clear the crank swing area of all obstructions left on the unit and foundation. Unchain the drum, disengage the pawl and reverse all lockout/tagout procedures.

**WARNING:** Unchaining the drum and disengaging the pawl will require personnel to step inside the crank guards. Be certain that all personnel are aware of the situation and that all precautions are taken to ensure that the cranks do not move while personnel are inside guards.

Release the brake and intermittently engage the prime mover to slowly rotate the unit through its first stroke cycle. The first revolution of the crank should be as slow as possible. Check for proper clearance between the cranks and the belt cover, crank guards and pitman side members. Bottom hole pump spacing should also be checked during the first revolution.

Operate the unit for thirty (30) minutes and then tighten the V-belts.

**CAUTION:** To avoid damage to the unit, all bolts must be retightened after one week of operation.

## **7 COUNTERBALANCE ADJUSTMENT**

### **7.1 DETERMINING THE REQUIRED COUNTERBALANCE**

Efficient operation, minimum torque loading and maximum life of a pumping unit are all a result of proper counterbalance. Counterbalance requirements can be determined very accurately or estimated by several methods.

**DANGER:** Do not enter the crank swing area while performing any of the following tasks.

1. Polished rod dynamometer - A dynamometer card analysis is the most accurate method for determining loading and counterbalance. This involves using a dynamometer to record the well load through a stroke cycle and then using torque factors to determine the reducer torque and counterbalance required for balanced conditions.
2. Ammeter - A clip on ammeter may be used to compare the upstroke and down stroke current on electrically powered units. When the counterbalance is adjusted so the current peaks are equal, the unit will be approximately in balance.
3. Vacuum gauge - A vacuum gauge may be used to compare torque peaks on engine driven units much like the ammeter is used on electrically driven units. Vacuum pressure decreases as engine output increases.
4. Sound of the prime mover - A rough estimate of balance can be made by listening to the characteristic sound of the prime mover as it drives the unit. Some speed change will occur as the peak loads are approached; this speed change will cause the sound of the prime mover to change.
5. Tension in the belts - Belt tension and consequently belt stretch increase with load, causing a proportional amount of slack in the belts on the side opposite the direction of rotation of the prime mover. A visual comparison of the belt slack or sag on the upstroke and down stroke can be used to estimate counterbalance.

## 7.2 COUNTERWEIGHT ADJUSTMENT

**WARNING:** Stay clear of the crank swing area and do not stand under the load while adjusting counterweights.

Stop the unit with the cranks at the five o'clock position. Set the brake, lockout/tagout all energy sources, engage the pawl and chain the brake drum (refer to Section 1.3 of this manual for proper procedures). Attach chains to the counterweights through the lifting holes. Take up the slack in the chains with a crane. Loosen the counterweight bolts just enough to move the weights. Lift or lower the weights to the desired position and tighten the counterweight bolts. Install the second nut as a jam nut. Follow the bolting recommendations given in Section 3.

**WARNING:** Improperly tightened counterweight bolts can allow the counterweights to move on the crank. Impact movement of the counterweights could break through the stop on the crank end and damage the unit or cause serious injury or death to personnel. Proper eye protection must be worn when tightening bolts as flying metal could cause damage to the eyes.

## 8 STROKE CHANGE

**DANGER:** Before performing any task around a pumping unit, refer to the safety section of this manual (Section 1). All mechanical sucker rod pumping units, of necessity, have heavy rotating parts. Even a temporarily stationary pumping unit has components that can start moving from the effect of gravity. It is essential to prevent rotation of the cranks stopped in any position for the purpose of service or maintenance.

The following description of a stroke change is given while viewing the pumping unit from the side with the well head located to the right.

### 8.1 PREPARATION

Locate the cranks at about the 8 o'clock position, set the brake, and lockout/tagout the prime mover.

**CAUTION:** Abrupt braking may damage the gear teeth in the reducer. A slow, even pull on the brake lever is recommended.

Remove the stuffing box guards. Place a polished rod clamp on the polished rod at the stuffing box and tighten according to the clamp manufacturer's torque recommendations.

**WARNING:** Keep hands from between the polished rod clamp and carrier bar in the event the polished rod clamp slips or the unit moves.

Remove the crank guards. Attach chains to the long end of both cranks. Using a crane, remove the slack from the chains, being certain the load is equalized. Release the brake. Using the crane, raise the cranks pointing away from the well, until the crank pins are above the reducer. Set the brake. Be certain the well load is not resting on the carrier bar. Engage the pawl, chain the drum and lockout/tagout all energy sources.

Loosely chain the carrier bar to the front legs' cross member to keep it from moving too suddenly. Loosely chaining the carrier bar will allow you to shorten the stroke length by allowing some restrained movement while moving the pitman arms back along the cranks.

## **8.2 CRANK PIN REMOVAL**

Do not remove pitman arms from the crank pins during this procedure.

**WARNING:** Proper eye protection must be worn when tightening bolts as flying metal may cause damage to the eyes.

Using a drive nut (furnished as an optional item) is the recommended way to drive out the crank pin. Remove the cotter pin. Remove the crank pin nut using a box-end hammer-wrench (furnished with a set of wrenches as an option) and at least a 14-pound sledge hammer with a full length handle. Then thread the drive nut onto the pin until it bottoms out. Hammer against the head of the drive nut until the pin is loose. When the pin is loose, do not remove it from the hole. Remove the drive nut and install the original nut 3 or 4 threads deep. Follow the same procedure on the opposite crank pin.

If a drive nut is not available, remove the cotter pin and loosen the crank pin nut as previously described. Do not remove the nut. Hammer as squarely as possible against the end of the pin. When the pin becomes loose, do not remove it from the hole. Follow the same procedure on the opposite crank pin.

Use the crane to support the pitman arms by hooking a chain on the middle section of each one. This prevents the pitman arms from falling when removing the crank pins.

To prevent the crank pins from falling or pulling up in a sudden motion when removed, adjust the chains so the crank pins are centered in the hole and not in a bind. Remove the nuts and pull the pitman arms away from the cranks to remove the crank pins. The pitman will support the crank pin bearing assembly until the pin is installed into another hole. Inspect the crank pin and hole surfaces from which the pin was removed for rust and wear. These conditions may indicate that the pin was loose and the hole is worn. If this condition exists, contact a LUFKIN representative. Apply rust preventive to the crank pin hole after the pin is removed.

## **8.3 CRANK PIN INSTALLATION**

With emery cloth, remove any paint and foreign material from the crank pin, crank pin hole and the mating surfaces between the crank and the crank pin nut. Clean these same areas

with an approved solvent (per your company's quality policy.)

**CAUTION:** Improper cleaning of the crank pin and crank pin hole, as well as improper tightening of the crank pin, can cause damage to the pumping unit.

Adjust come a longs or ratchet boomers simultaneously to line up the crank pins with the proper holes for the stroke length desired.

With a 1 in. brush, apply three very light stripes of non-drying machinist blue equally spaced down the length of the pin. Remove any excess with a clean, lint-free cloth – a thick stripe will give a false indication of good contact. Install the crank pin bearing assembly in the crank pin hole without smearing the machinist blue. Thread the crank pin nut onto the crank pin and use a hammer wrench to tighten the nut until it will no longer rotate. To ensure proper contact between the crank pin and crank pin hole, use a sledge hammer to turn the wrench one additional cotter pin notch.

Remove the crank pin bearing assembly and inspect the crank pin hole. Disregarding the area where the groove around the crank pin was not in contact with the crank pin hole, machinist blue should be present along 85% of the hole's length. If it is less than this, contact your nearest Lufkin Service organization for advice.

Clean the crank pin as described above and apply a light coat of clean oil to the crank pin hole. Wipe away any excess with a clean hand. Line up the crank pin bearing assembly with the crank pin hole. With a single motion, insert the assembly into the crank and thread the crank pin nut onto the crank pin.

**CAUTION:** Do not install the crank pin without properly applying oil film in the hole.

Using a hammer wrench and your body weight, tighten the crank pin nut until it will no longer rotate. Mark the location of the hole in the crank pin on the crank pin nut. Use at least a 14-lb sledge hammer to turn the nut two cotter pin notches. Watching carefully, hammer the wrench until the hole in the crank pin lines up with the third cotter pin notch. Continue to tighten only if the nut can be turned to the next notch.

**WARNING:** Proper eye protection must be worn; flying metal could cause damage to the eyes.

Install the cotter pin. Never back the nut off to insert the cotter pin. If you have turned the nut too far, remove the crank pin (Procedure 8.2) and repeat all of the installation procedure.

#### **8.4 PUTTING THE UNIT INTO OPERATION**

With the brake engaged, disconnect the crane from the pitman arms and remove the hoists/pullers. Clear the crank sweep area. Keeping the brake engaged, unchain the drum and disengage the pawl. Unchain the carrier bar from the front legs' cross member.



Reverse all remaining lockout/tagout procedures. Slowly release the brake and allow the carrier bar to slowly pick up the well load. Reset the brake and remove the polished rod clamp which was used at the stuffing box to clamp off the well load.

**WARNING:** Keep hands from between the carrier bar and polished rod clamp in the event the polished rod clamp slips or the unit moves.

Reinstall all guards. After a stroke change, check the bottom hole pump spacing. Also, the counterbalance should be checked and the weights repositioned as required for proper balancing. See Section 7 for counterbalance adjustment.

## 9 WELL SERVICING

**DANGER:** Before performing any task around a pumping unit, refer to the safety section of this manual (Section 1). All mechanical sucker rod pumping units, of necessity, have heavy rotating parts. Even a temporarily stationary pumping unit has components which can start moving from the effect of gravity. It is essential to prevent rotation of the cranks stopped in any position for the purpose of service or maintenance.

The following description is given while viewing the pumping unit from the side with the well head located to the right.

### 9.1 PREPARATION

**WARNING:** Do not attempt to service the well without first retracting the roller drums and Samson post assembly.

Stop the unit with the cranks in the six o'clock position (bottom dead center), set the brake and lockout/tagout the prime mover.

**CAUTION:** Abrupt braking may damage the gear teeth in the reducer. A slow, even pull on the brake lever is recommended.

To clamp off the well load, place a polished rod clamp on the polished rod at the stuffing box and tighten according to the clamp manufacturer's torque recommendations.

Remove the crank guards. Attach chains to both cranks. Using the crane, remove the slack from the chains, being certain that the load is equalized. Release the brake. Slowly lift the cranks until the well load is off the carrier bar (cranks at about 5 o'clock position). Reset the brake, engage the pawl, chain the drum and lockout/tagout all energy sources. (Refer to Section 1.3 of this manual for proper procedures.)

Disconnect the carrier bar from the polished rod.

**WARNING:** Keep hands from between the polished rod and carrier bar in the event the polished rod clamp slips or the unit moves.

## **9.2 ROLLER DRUM RETRACTION**

**WARNING:** Under no circumstances should well servicing be attempted without first retracting the roller drum and Samson post assembly. Do not stand under any part of the load while lifting.

Attach the crane to the lifting lug located on the rear folding Samson post. Remove the slack in the chains. Loosen all trunnion latch bolts. Remove the non-pivoting bolts on the rear leg splice plates (the six bolts that keep the rear leg from bending). While holding the carrier bar away from the polished rod, slowly lift the rollers while swinging it towards the rear of the unit, making sure the rear leg pivots in the middle toward the ground. The rear leg should rest securely on its supports in the unit base in a folded position. Once secure, well servicing can be performed.

## **9.3 RAISING THE ROLLER DRUMS**

After well servicing is completed, reverse the procedure to reposition the roller drum to the running position. Re-tighten the trunnion latch bolts and re-install the six splice plate bolts, tightening each per the requirements in Section 3. Remove the chains from the front legs and reattach the carrier bar to the polished rod.

**WARNING:** Keep hands from between the carrier bar and polished rod clamp in the event the polished rod clamp slips or the unit moves.

## **9.4 PUTTING THE UNIT INTO OPERATION**

With the brake engaged, unchain the drum, disengage the pawl and reverse the lockout procedures. Slowly release the brake to transfer the well load back to the carrier bar. Be sure the load is not on the polished rod clamp at the stuffing box. Reset the brake and engage the pawl.

Check the pitman alignment (See Section 5.8). If needed, adjust the alignment to within specification and retighten all bolts per Section 3.

Remove the polished rod clamp which was used at the stuffing box to clamp off the well load. Reinstall all guards before attempting to operate the pumping unit. Check the bottom hole pump spacing.

## **10 PREVENTIVE MAINTENANCE**

Preventive maintenance is essential to prolong the life of the unit and to prevent expensive failures. Many items can be checked by visual inspection and by listening for unusual noises. These items should be checked each time you go to the unit.

**CAUTION:** Never approach a pumping unit assuming that everything is in perfect operating condition. With time, some components could work loose and present a potentially dangerous situation. Always approach an operating pumping unit from the rear.

The following visual inspections are recommended before approaching the unit:

- Inspect both crank pins for looseness.
- On units driven by slow speed engines, check to see if the flywheel is loose.
- Observe the counterweights to ensure they are tight.
- Inspect the vertical alignment of the unit with the well. See if the polished rod is working to one side of the stuffing box. Also, visually compare the distance between the pitman side members and the cranks on each side of the unit. A change in alignment can be caused if the base shifts on the foundation or ground due to loose hold down bolts or unit vibration. Misalignment can also result from a foundation that has settled to an unlevelled position.
- Check for any obviously loose or missing bolts. Loose bolts will eventually fail in fatigue. This is the major cause of most pumping unit failures. Loose bolts can usually be located by looking for rust at the bolted joint and by checking for visual movement.

If any of the above conditions exist, the unit must be shut down immediately and the problem corrected.

**WARNING:** Do not perform any task on the unit until you review the safety section of this manual (Section 1). The cranks and counterweights must be secured against rotation.

## **11 SCHEDULED MAINTENANCE**

There are several items that need checking on a regular basis to help extend the life of your pumping unit.

**WARNING:** Always secure the cranks against rotation or movement before performing any maintenance or while working around the pumping unit. Review the safety section (Section 1) of this manual. Do not use only the brake as a safety stop. The brake is intended for operational use only.

### **11.1 MONTHLY**

#### **11.1.1 Reducer**

Check the reducer oil level. Remove the dipstick located at the front of the reducer. The oil level should be between the low and full mark on the dipstick. Loss of oil from the reducer is usually caused by seal leakage at the shafts or leakage at the parting line. If the oil level is low, remove the inspection cover and add oil to the proper level (refer to Section 12.1 for lubricant specifications).

### 11.1.2 Structural Bearing Assemblies

The crank pin and roller drum employ sealed bearing assemblies. As such, these bearings are not to be regularly lubricated. However, it is good practice to visually and aurally inspect them for wear or obvious defects such as wobble, excessive noise, or leaks.

If a sealed bearing assembly defect is discovered, contact your Lufkin sales representative. Do not attempt to self-repair or maintain these assemblies.

## **11.2 QUARTERLY**

### 11.2.1 Belts and Sheaves

Belt alignment and tension should be checked and adjusted to prolong belt life. Under normal use belts will stretch and wear. Belts need replacing once they have exceeded their allowable stretch. Belt manufacturers typically suggest running new belts for thirty minutes and then retightening (consult your belt supplier to verify this procedure). Also refer to Section 5.10 in this manual.

Also, check the sheaves for wear, chips and cracks. Replace them if any of these conditions exist. Keeping sheaves in good condition will prolong belt life.

### 11.2.2 Brake

Inspect the brake lining for wear and clearance adjustment. When the brake control lever is fully engaged, there should be several notches left on the ratchet. If adjustment is required, follow the instructions below to adjust the brake.

Low Profile II pumping units have the type "B" brake (Figure 28). Before adjusting the brake, refer to Section 1.3 of this manual for proper safety precautions.

1. Stop the unit with the long end of the crank in the 5 o'clock position. Lockout/tagout all energy sources. Clamp the polished rod at the stuffing box. Engage the positive stop pawl. Chain the equalizer down to the sub-base.
2. Position the brake lever in its forward (or disengaged) position.
3. Adjust the position of both linings with the adjusting nuts until they just clear the drum. The spring release on the trunnion should pull the lining away from the drum near the trunnion.
4. Using the brake control lever, engage the brake. Full engagement should occur with several notches of the ratchet on the brake assembly still remaining to compensate for subsequent lining wear. Further adjustment to meet this condition may be made by repositioning the cable yoke on the brake control lever end.
5. Ensure the brake drum key is tight.

6. Unchain the equalizer, disengage the positive stop pawl and remove the polished rod clamp at the stuffing box before attempting to restart the unit.

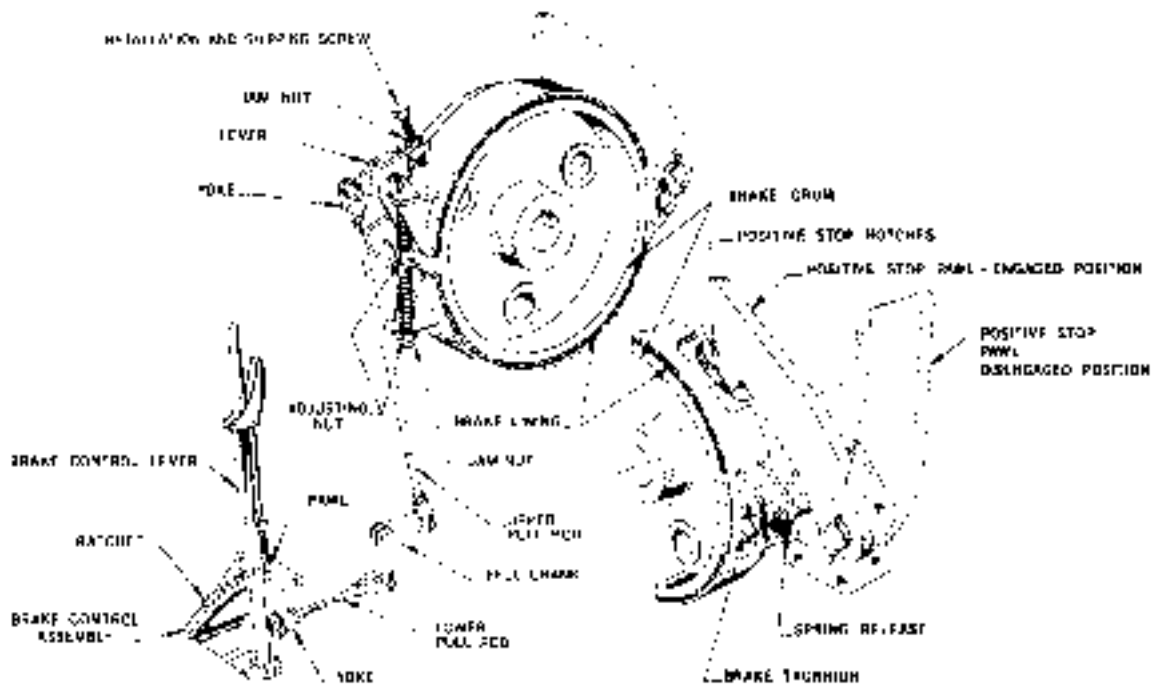


Figure 28

### 11.2.3 Brake Drum

Inspect the brake drum for cracks around the hub and key area. Also, visually inspect the brake pawl notches to see if any of them have been chipped, cracked or broken out. Contact LUFKIN to replace the drum if any of these conditions exist.

### 11.2.4 Crank Phase Marks

On the end of the crankshaft is a match mark placed partially on the shaft and partially on the crank. These should be lined up at all times. If for any reason they are not lined up, you should contact LUFKIN.

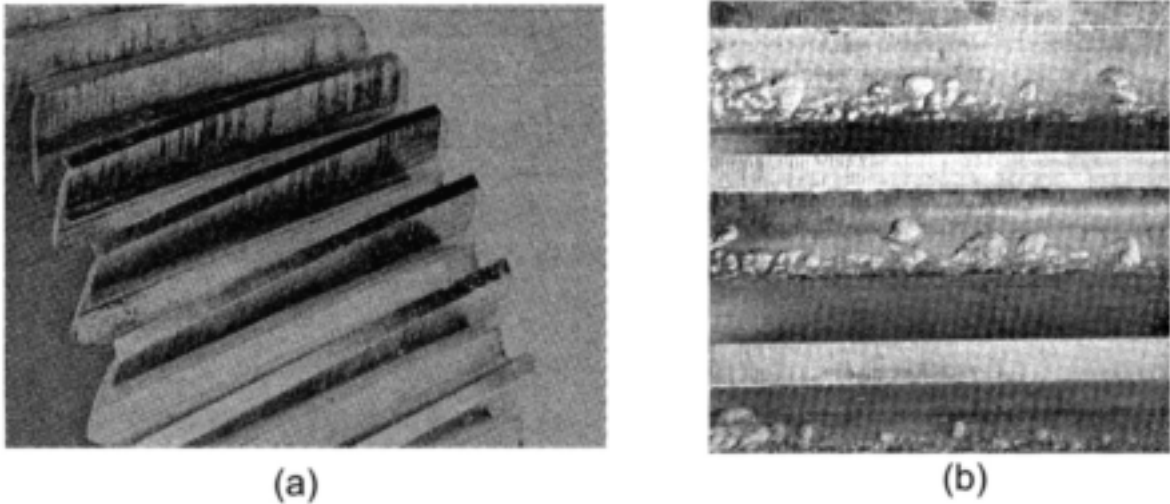
## 11.3 SEMI ANNUALLY

### 11.3.1 Reducer

Check the condition of gear teeth for abnormal wear. There are many modes of gear tooth failures. Only the most common are included in this section. The following is paraphrased from ANSI/AGMA 110.04, Nomenclature of Gear Tooth Failure Modes.

Score marks on the teeth are an indication that the film thickness of the oil is insufficient for the loads imposed. Score marks are vertical marks on the teeth from the top of the teeth to the root (see Figure 29a).

Pitting is a type of surface fatigue which occurs when the endurance limit of the material is exceeded. It shows up as small cavities along the surface of the teeth. The type of pitting shown in Figure 29b is usually caused by torque overload. Continued overload may result in gear tooth failures.



**Figure 29**

For more detailed descriptions, illustrations, causes, and remedies, see ANSI/AGMA Standard 110.04. Note also, Figure 29 was extracted from "AGMA Standard Nomenclature of Gear Tooth Failure Modes" (AGMA 110.04), with the permission of the publisher, The American Gear Manufacturer's Association, Suite 1000, 1901 North Fort Myer Drive, Arlington, Virginia 22209.

Before the reducer oil has a chance to settle, collect a typical sample (about a pint) in a transparent container. A visual inspection will expose possible dirt, sludge, water emulsion or other forms of contamination. Also, keep a sample of new oil for comparisons. If the lubricant has any of the following conditions, check with your oil supplier about replacement:

An acidic or burnt odor would indicate oxidation of the oil to the point that it should be replaced.

If sludge is observed in the used sample, the oil should either be replaced or filtered to remove the sludge. Sludge is usually found in gear units that have not had their lubricants changed in a long time.

If water is found in the sample, the water should be completely drained from the sump. The presence of water in used oil can be detected by placing a drop or two on a heated metal surface. Bubbling and spattering will occur with as little as 0.1% of water present in the oil. More than approximately 0.2% water by volume suggests an oil change.

If a rigorous laboratory test of the oil is not practical, replace the oil every 18 months as a precaution against a change in viscosity, a loss of the additive package or an increase in the acidic condition of the oil.

For lubricant specifications, see Section 12 of this manual.

### 11.3.2 Flat Belts

Look for cracks, tears, and other defects on the flat belts. A defective flat belt should be repaired or replaced immediately.

### 11.3.3 Bolts

Check all bolts for looseness. Retighten as recommended in Section 3 of this manual. Loose bolts will eventually fail through fatigue.

### 11.3.4 Safety Signs and Tags

LUFKIN uses safety signs and decals for your protection. In the event any of the signs or decals are destroyed, damaged or become unreadable for any reason, refer to Section 14 for replacement part numbers and their location on the unit.

## 12 LUBRICANT SPECIFICATIONS

### 12.1 REDUCER

For ambient temperatures down to 0°F use an AGMA No. 5 EP (ISO VG220) premium mild, extreme-pressure lubricant (preferably a sulfur-phosphorous type) with rust and oxidation inhibitors and an anti-foam agent. The pour point of the oil should be 5°F or lower. For extremely cold temperature applications (down to -30°F), use an AGMA No. 4 EP (ISO VG150) premium mild, extreme-pressure lubricant (preferably sulfur-phosphorous type) with rust and oxidation inhibitors and an anti-foam agent. The pour point of the oil should be 15°F or less.

Synthetic gear lubricant may be required when units are operated intermittently or shut down for periods of time while subjected to ambient temperatures below 0°F. In comparison to mineral-based products, the viscosity of synthetic oil is less sensitive to temperature changes. Like their conventional counterparts, these should also be extreme-pressure lubricants that contain additives to reduce corrosion and foaming. The higher cost associated with synthetics should be evaluated relative to the operator's need for these characteristics.

## **12.2 REDUCER OIL CAPACITY**

Table 3  
Reducer Oil Capacity

Model	Capacity (Gal)
320D	50
228D	34
160D	22
114D	17

## **12.3 STRUCTURAL BEARINGS**

**CAUTION:** Do not use soda-soap grease.

For ambient temperatures down to 0°F, use a premium NLGI No. 1 lithium, soap base grease with an extreme pressure additive and a base oil viscosity equivalent to AGMA No. 7(414-506 cSt. At 40°C.) For ambient temperatures down to 30°F, use a premium NLGI No. 0 lithium complex, soap base grease with an extreme pressure additive and a base oil equivalent to AGMA No. 5 (198-242 cSt. At 40°C.)

## **12.4 WIRELINE**

Clean the wire rope by wire brushing; do not use solvent. Apply a good wire rope lubricant that will penetrate and adhere to the rope.

**CAUTION:** Do not use crude oil or lubricants that may damage the wireline.

## **13 LUFKIN SERVICE**

### **13.1 PERSONNEL**

LUFKIN has capable sales and service personnel throughout the oil producing areas of the world. These people are competent and experienced, not only in the proper sizing of surface pumping units, but also in any service that may be needed. Contact the LUFKIN Sales Office nearest you to inquire about the availability of LUFKIN service.

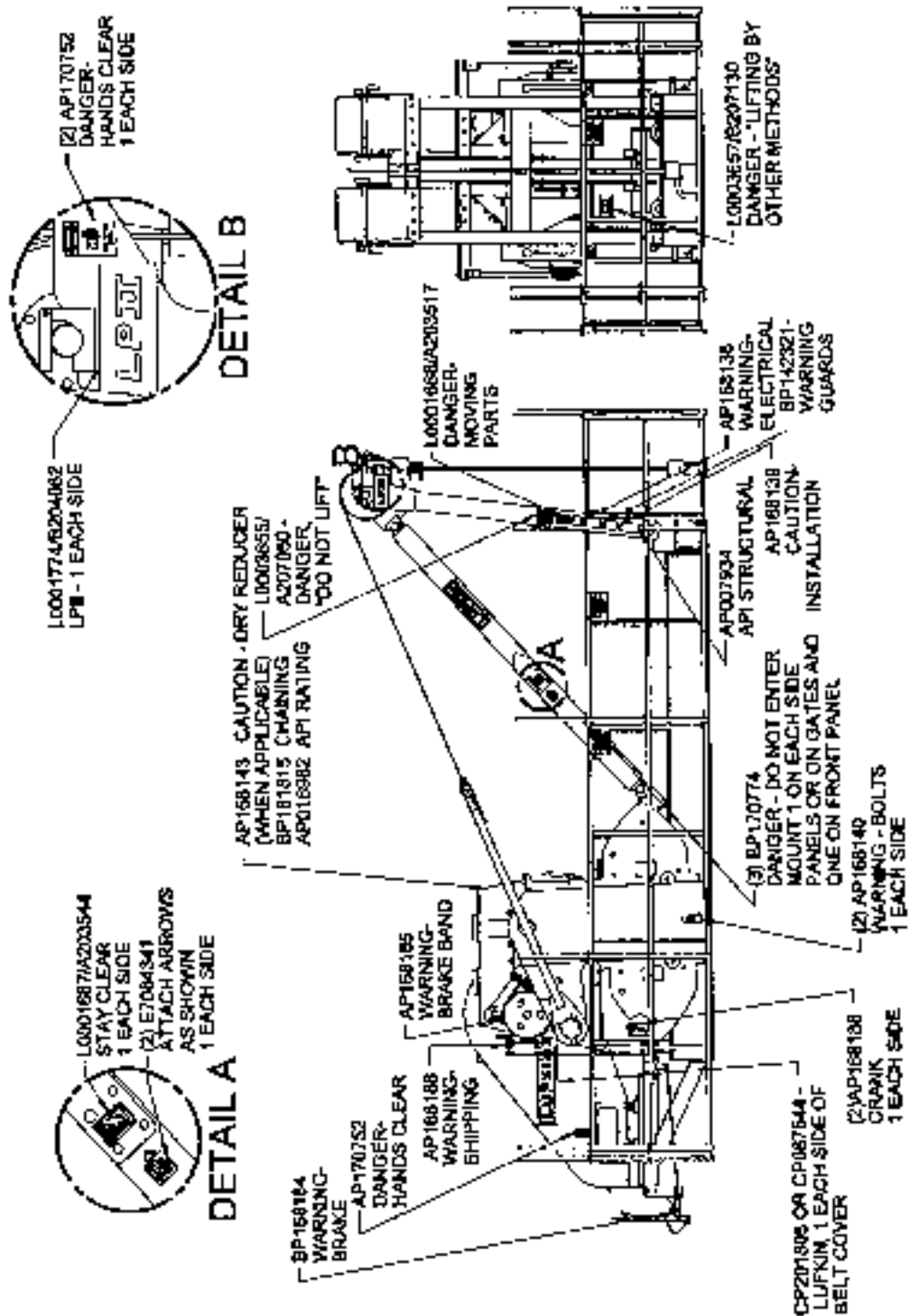
### **13.2 REPAIR AND REPLACEMENT PARTS**

**WARNING:** For repair or modification to a LUFKIN pumping unit, use only original LUFKIN parts that meet LUFKIN specifications (consult your nearest LUFKIN sales office).

A complete line of repair and replacement parts are available from several warehouse locations as well as our manufacturing plant in Lufkin, Texas. A parts list is available for most pumping unit assemblies. When parts are needed for a particular unit, furnish the complete unit designation, serial number and LUFKIN's shipping order number.



14 SAFETY SIGN REPLACEMENT



\*To replace these signs or decals, supply LUFKIN with the unit order number located on the API reducer plate or the API structural plate.

## LIMITED WARRANTY

All NEW LUFKIN INDUSTRIES, INC. ("LUFKIN") oilfield machinery and equipment ("products") are sold by LUFKIN or its dealer upon the following warranty and agreement given by LUFKIN or its authorized dealer. THE WARRANTIES SET FORTH ARE EXCLUSIVE AND IN LIEU OF ALL OTHER WARRANTIES AND CONDITIONS WHETHER STATUTORY, EXPRESS OR IMPLIED, INCLUDING WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE, AND WARRANTIES ARISING FROM COURSE OR DEALING, USAGE, OR TRADE and are exclusive to and in lieu of any other obligation on the part of LUFKIN or its authorized dealer. LUFKIN neither assumes nor authorizes any person to assume for it any other liability in connection with the sale of such products. The obligation of LUFKIN or its authorized dealer under this warranty, is limited to the following:

LUFKIN warrants to the ORIGINAL PURCHASER ("PURCHASER") of the pumping unit, subject to the conditions herein stated, that the pumping unit shall be, upon delivery, free from manufacturing defects. This Warranty shall run for a period of five (5) years from the date of shipment from LUFKIN's plant. In the event the pumping unit fails to operate properly due to a manufacturing defect (or) a manufacturing defect is discovered during the warranty period, LUFKIN shall only be obligated to repair or replace the pumping unit, at LUFKIN's option, free of charge, F.O.B. LUFKIN's plant, or other designated place of repair or replacement. Repair or replacement by LUFKIN shall not extend the warranty period. LUFKIN will have no liability under this warranty unless LUFKIN receives written notice from PURCHASER of the defect within thirty (30) days after discovery of the defect. LUFKIN may waive the requirement of written notice and accept oral notice of a timely reported defect. LUFKIN shall not be liable under this Warranty and this Warranty will be null and void if the pumping unit, or any part thereof, was damaged, subjected to abuse, altered, misused or if the pumping unit, or any part thereof, was improperly stored, installed, maintained, repaired, or operated. Repair or replacement of the pumping unit, or any part thereof, shall fulfill all obligations of LUFKIN. The Warranty provided in this paragraph is subject to the following exceptions

LUFKIN's warranty is limited to one (1) year (subject to the terms and conditions stated above) with respect to parts that are subject to wear under normal operating conditions (including, but not limited to contact type oil or grease seals, hoses, belts, elastomeric parts, wireline, brake lining, brake cables, etc).

LUFKIN extends no warranties with respect to the design of the pumping unit or the component parts, materials or accessories manufactured, furnished or supplied by individuals or entities other than LUFKIN (including, but not limited to prime movers, compressors, valves, electrical components, etc.). LUFKIN agrees that any warranty which is given to LUFKIN on such components by the manufacturer thereof shall be extended to the PURCHASER but only to the extent permitted by the terms of such warranties.

The remedies provided above are the exclusive remedies of PURCHASER for failure of LUFKIN to meet its warranty obligations, whether claims of PURCHASER are based on contract, in tort (including negligence) or otherwise. Upon expiration of the applicable warranty period, all obligations of LUFKIN for breach of warranty will terminate. The provisions of this warranty shall be governed in accordance with the laws of the State of Texas.

Subject to and without waiving the foregoing, PURCHASER agrees that neither LUFKIN nor its affiliates, vendors, suppliers, agents, or subcontractors, either individually or jointly, shall be liable to PURCHASER, its affiliates, or any other person or entity whether due to LUFKIN's negligence or otherwise, and will not be responsible to PURCHASER in contract, in tort (including negligence) or otherwise for loss of use of equipment or plant, loss of profits or revenues, claims of any customers of PURCHASER, or any special, indirect, incidental or consequential loss of damage whatsoever. The obligation of LUFKIN arising out of the work performed hereunder will be limited to remedies under the limited warranty set forth above. IN NO EVENT SHALL THE PURCHASER OR ANY OTHER PERSON OR ENTITY BE ENTITLED TO RECOVER FOR INDIRECT, SPECIAL, EXEMPLARY, INCIDENTAL OR CONSEQUENTIAL DAMAGES, INCLUDING BUT NOT LIMITED TO INCONVENIENCE, RENTAL OR REPLACEMENT EQUIPMENT, LOSS OF PROFITS OR OTHER COMMERCIAL OR ECONOMIC LOSS.

PURCHASER agrees to protect, defend, indemnify and save LUFKIN, its subcontractors and affiliates and their employees performing services under this Agreement harmless from and against all liabilities, loss, expense, claims, demands, and causes of action of every kind and character arising out of or in connection with this Agreement, or the work to be performed hereunder, without limit and without regard to the cause or causes of action thereof OR THE NEGLIGENCE OF ANY PARTY OR PARTIES, INCLUDING LOSSES ATTRIBUTABLE TO LUFKIN's NEGLIGENCE, arising in connection herewith in favor of purchaser or third parties on account of bodily injury, death or damage to property.

PURCHASER agrees that whenever any representative of LUFKIN shall be on the premises of PURCHASER or at any place other than LUFKIN's facility, for the purpose of inspecting, repairing or servicing of the equipment sold herewith, the PURCHASER shall indemnify and hold LUFKIN harmless from all claims, suits or actions arising from or growing out of the inspecting, repairing or servicing of such equipment from all expenses of defending against such claims, suits or actions.

PURCHASER acknowledges and agrees, on its own behalf and on the behalf of its assigns and successors, that the Texas Deceptive Trade Practices – Consumer Protection Act, Subchapter E of Chapter 17 of the Texas Business and Commerce Code (the "DTPA"), is not applicable to this transaction. As such, PURCHASER's and LUFKIN's rights and remedies with respect to this transaction, and with respect to all acts or practices of the other, past, present or future, in connection with this transaction, shall be governed by legal principles other than the DTPA. Accordingly, PURCHASER acknowledges and agrees as follows:

PURCHASER HEREBY IRREVOCABLY WAIVES, TO THE FULL EXTENT PERMITTED BY LAW, ANY AND ALL RIGHTS AND CLAIMS THAT PURCHASER MAY NOW HAVE, OR TO WHICH IT MAY OTHERWISE IN THE FUTURE HAVE BEEN ENTITLED, UNDER THE TEXAS DECEPTIVE TRADE PRACTICES – CONSUMER PROTECTION ACT, TEX. BUS. AND COM. CODE § 17.41 ET SEQ., ("DTPA"), ARISING OUT OF ANY ACT, CONDUCT, REPRESENTATION OR OMISSION OF LUFKIN, ITS EMPLOYEES OR AGENTS, THERETOFORE OR HEREAFTER TAKEN, DONE OR OMITTED TO BE DONE IN CONNECTION WITH THIS TRANSACTION OR SUBSEQUENT RELATED TRANSACTIONS.



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