

CHURCHILL

MANUFACTURED BY **LUFKIN**

BEAM BALANCED PUMPING UNITS



INSTALLATION MANUAL B-04



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



INDUSTRIES, INC.

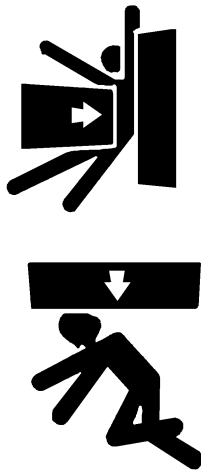

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WARNING

The Beam Balanced Pumping Units are 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="256 1247 521 1310">MOVING LOADS OR PARTS</p>	<p data-bbox="672 968 889 1031">Will cause severe injury or death.</p>	<p data-bbox="959 701 1349 764">Do Not allow personnel to stand under moving loads or parts.</p> <p data-bbox="959 785 1390 911">Set brake, and chain walking beam during installation and maintenance to prevent movement of beam weights and cranks.</p> <p data-bbox="959 932 1357 1031">Keep clear of beam weight and crank swing area and other parts that may start moving.</p> <p data-bbox="959 1052 1390 1115">Do Not operate pumping units without proper guards in place.</p> <p data-bbox="959 1136 1406 1199">Do Not service well without removing the horsehead.</p> <p data-bbox="959 1220 1325 1283">Properly install the horsehead latch bolt.</p>
 <p data-bbox="233 1619 545 1650">ELECTRICAL CONTACT</p>	<p data-bbox="646 1520 919 1583">Can cause severe injury or death.</p>	<p data-bbox="959 1402 1373 1465">Keep pumping units at least 10 feet away from all overhead wires.</p> <p data-bbox="959 1486 1284 1549">Lockout/tagout ALL energy sources.</p> <p data-bbox="959 1577 1349 1640">All electrical work must be performed by a qualified electrician.</p>

FOREWORD

The Beam Balanced pumping unit is a Class I lever system having beam counterbalance. The Beam Balanced unit may be operated in either direction of rotation. The four bar lever system converts rotational motion at the crank to reciprocating motion at the horsehead and in turn to the down hole pump.

Beam Balanced 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 almost a century of LUFKIN INDUSTRIES' experience can bring to you. Your Beam Balanced 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: is the well head (horsehead) end.

Rear: is the prime mover end.

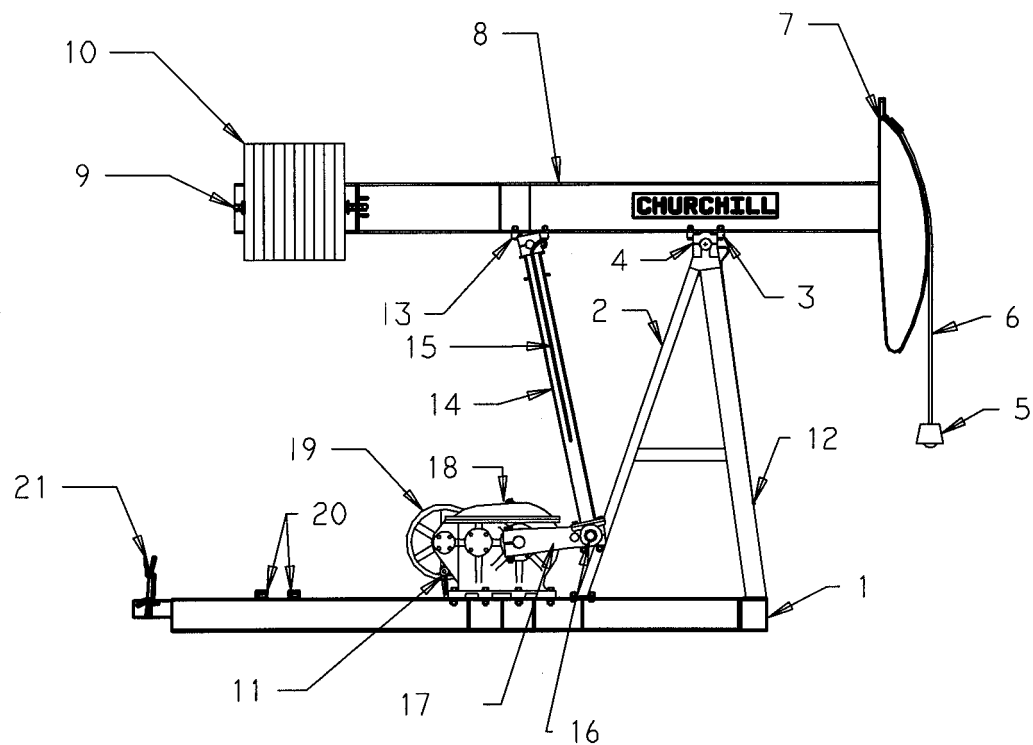
Left & Right: are determined by standing at the rear of the pumping unit and facing the well head.

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

NOTE: Some of the photographs and illustrations used in this manual are representative and may not look exactly like the parts with which you are working.

Churchill Pumping Unit Nomenclature

1. Base
2. Samson Post
3. Center Bearing
4. Clamp Block
5. Carrier Bar
6. Wireline Assembly
7. Horsehead
8. Walking Beam
9. Counterbalance Adjustment Screw Assembly
10. Beam Weights
11. Brakeshoe w/Lever Assembly
12. Saddle Bearing Lube Line
13. Tail Bearing
14. Pitman
15. Tail Bearing Lube Line
16. Crank Pin Bearing Assembly
17. Crank Arm
18. Gear Reducer
19. Sheave
20. Motor Rails
21. Brake Lever



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INSTALLATION MANUAL
BEAM BALANCED 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 moving parts. Even a temporarily stationary pumping unit has components which can start moving from the effect of gravity. Times of particular danger are during unit installation, stroke change, counterbalance change, general unit maintenance, well servicing and while taking dynamometer card readings.

Whenever performing maintenance on, or working around the pumping unit, always lockout/tagout all energy sources and secure the beam and cranks against rotation. All personnel must stay alert and keep clear of the crank swing area, counterweight area, horsehead area and other potential moving parts.

- Never stand under the walking beam or horsehead during their installation or removal. Double check the horsehead for proper installation on the walking beam, including the installation of the latch bolt before rotating the unit.

Remove the horsehead before servicing the well, remembering to first remove latch bolt.

- Do not stand under moving parts or loads being lifted. Always attach guide ropes to parts to aid in 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 units in motion without warning.
- LUFKIN does not recommend installing nor performing 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 beam weight, horsehead or crank swing area to chain the beam or engage the brake.

Always install the unit and perform maintenance with the cranks at the 6 o'clock position when possible. If the cranks are straight down, no rotation will start if the carrier bar is not attached to the polished rod, or if the polished rod has been securely clamped at the stuffing box to hold the well load 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/tagout procedure.

1.3.1 Chaining the Walking Beam and Horsehead (Figure 1)

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.



Figure 1

Attach a sturdy (never less than 3/8 Grade 8 alloy) chain from the bottom of the horsehead to the base and a second chain from the rear of the walking beam to the base. Use a safe come-a-long or ratchet-boomer to tighten chains.

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 purpose of guards is to 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 type of guarding needed is known only by the user who must choose the proper guarding. 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 (see Figures 2 and 3). Under normal operating circumstances, the 48" open rail guards would be considered minimum guarding for people who are familiar with pumping units and who are accustomed to working around them. Basically, this type guard simply keeps workers from accidentally wandering or falling into the beam weight or crank areas. The 61" and 83" wire mesh guards would normally be considered adequate guarding for people familiar with the operation of pumping units and accustomed to working around them, as well as smaller animals who might be able to move through the guards described above. Custom built guards are available to meet customer requirements.

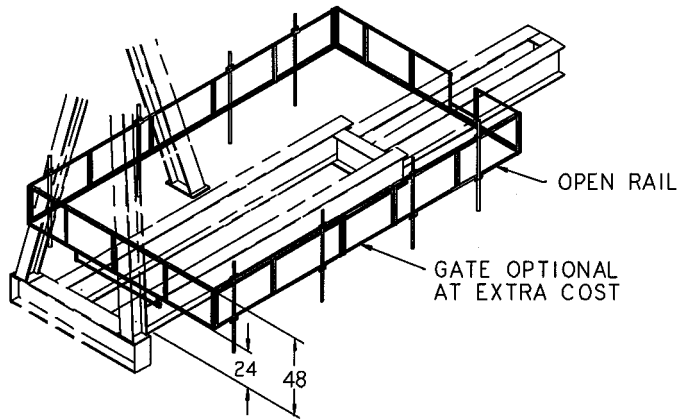


Figure 2

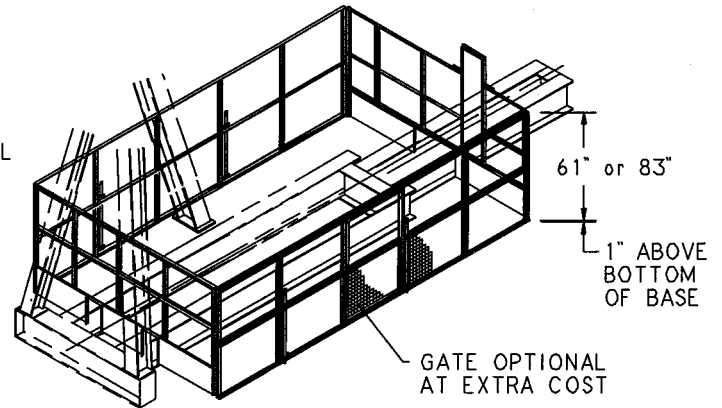


Figure 3

1.4.2 Horsehead Guards

Horsehead guards (see Figure 4) are available from LUFKIN. This guard is designed to keep people who are familiar with the operation of pumping units from accidentally wandering into the area below the horsehead and carrier bar. This type guard is required where the horsehead or carrier bar descends to 7 ft. or less from grade or work platform (Refer to API11ER).



Figure 4

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. Guards are available from LUFKIN. These guards are designed to keep people who are familiar with the operation of pumping units from accidentally walking or falling into the flywheel.

1.5 PROPER CLOTHING AND TOOLS

Snug fitting clothing is recommended. Remove jewelry. Wear hard hats, side-shield safety glasses and safety shoes (see Figure 5).

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



Figure 5

Anytime you perform work at such a height that a fall could possibly inflict injury, you should wear a safety harness. When possible, use a manlift 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. Training also provides the knowledge necessary to maximize the performance of your equipment. LUFKIN INDUSTRIES, INC. recognizes the importance of training and conducts training schools to help familiarize your 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 CHARTS

The following charts are a general guide to assist in selecting the proper equipment for installing your Beam Balanced pumping unit. If there are further concerns or questions about the weight of a part, contact LUFKIN. An example for using the charts on the next page would be as follows:

What is needed to set a CH-50-89-54 pumping unit?

- (1) In the top section of Table I, go to the 50D unit size to see that the minimum hook height needed would be 16'. Also, account for any additional height needed due to the bottom of the pumping unit base setting above ground level.

- (2) To determine the heaviest lift required, refer to the third column in the top section of Table 1.
- (3) If you are moving a reducer with cranks attached, refer to the lower section of Table 1, third column.

Table I

Approximate Weight and Hook Data for Installation Purposes

UNIT SIZE	+MINIMUM HOOK HEIGHT	UNIT WEIGHT TABLE (INCLUDES BASE, GEAR REDUCER AND CRANKS)		
		T-BASE ELEC. (LBS.)	PORT-BASE ELEC. (LBS.)	PORT-BASE GAS (LBS.)
6.4D*	11' - 6"	660	775	---
10D*	12' - 6"	780	900	---
13D*	13' - 6"	933	1,050	---
16D	15' - 6"	1,450	1,695	1,740
25D	16' - 0"	2,000	2,335	2,470
40D	16' - 0"	3,400	3,945	4,205
50D	16' - 0"	3,500	4,100	4,300
57D	16' - 6"	3,630	4,175	4,435
80D	16' - 6"	4,175	5,210	5,675

- + Height of unit plus standard flat bed trailer
- * Units are shipped complete with walking beam and horsehead assembled

<u>REDUCER SIZE</u>	<u>WEIGHT WITH OIL (LBS)</u>	<u>WEIGHT W/CRANKS AND OIL</u>
6.4D	175	190
10D	225	255
13D	375	395
16D	380	420
25D	455	555
40D	830	990
50D	845	1,005
57D	1,700	1,795
80D	1,715	1,805

3. FASTENERS

3.1 "METAL-TO-METAL" GRIP

Bolting is a vital part of an oil field 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, which are properly tightened during unit installation and retightened about a week later, will retain their grip under normal operating conditions. Improperly tightened bolts will break in fatigue and may cause serious failures and injury to personnel. Table II gives recommended tightening torques.

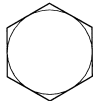
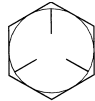
Since high-capacity torque wrenches are not commonly available, the larger size bolts are usually hammered tight. Use a box-end wrench with a striking face and tighten the bolts until the hammer blows feel solid. Bolts will fail in fatigue from inadequate tightening rather than from being pulled in two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

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

TABLE II

Proper Tightening Torques

Nuts and Cap Screws with "Metal-to-Metal" Grip

	Grade 2		Grade 5	
3/8 - 16 NC	19	to	21 ft.lb.	30 to 32 ft.lb.
1/2 - 13 NC	47	to	51 ft.lb.	71 to 79 ft.lb.
5/8 - 11 NC	92	to	102 ft.lb.	143 to 157 ft.lb.
3/4 - 10 NC	164	to	180 ft.lb.	253 to 279 ft.lb.
7/8 - 9 NC	159	to	176 ft.lb.	409 to 451 ft.lb.
1 - 8 NC	238	to	262 ft.lb.	612 to 676 ft.lb.
1 1/8 - 7 NC	336	to	372 ft.lb.	866 to 958 ft.lb.
1 1/4 - 7 NC	475	to	525 ft.lb.	1064 to 1176 ft.lb.
1 1/2 - 6 NC	826	to	912 ft.lb.	1849 to 2049 ft.lb.

3.2 “ELASTIC” GRIP

The 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 torques needed in these applications are extremely variable; however, they should be about two-thirds of the values given in Table II. Bolts should always be over tightened rather than under tightened.

4. FOUNDATION

4.1 GENERAL

The foundation should be constructed to accommodate the soil conditions in your area. The foundation layout shipped with the unit is only a recommendation for block sizes and hole locations.

Grade the foundation site to provide a level foundation and adequate drainage. Poor drainage usually results in the foundation setting unevenly. Depending on the soil type and its compaction, precast blocks may settle more in the front over the first few months of operation. The foundation must settle level front-to-back and never low in the front, or the reducer bearing lubrication may be effected. To accommodate for this, the front portion of the block may need to be set higher. Field experience will tell you how much, depending on your soil conditions. The foundation must be level side-to-side as well as front-to-back to prevent undue stress in the unit base, bearings, wireline and polished rod. Refer to API RP11G for additional information about the installation of pumping units.

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

NOTE: For applications where units are elevated above grade, field modifications to crank guards will be required per API RP11ER. Upon your request, LUFKIN will design special guards and ladders based upon your special needs.

4.2 TYPES OF FOUNDATIONS

Poured concrete - poured on site	Precast concrete block
Board mat	

4.3 WELL HEAD CLEARANCE

Carrier bar clearance from the bottom of the steel base is shown on the foundation layout. This should be considered when the grade height of the foundation is established. At the bottom of the stroke, there should be at least 6 inches between the carrier bar and the top of the stuffing box.

The polished rod should be vertical to minimize stuffing box wear and to aid in the alignment of the unit.

4.4 ALIGNMENT MARKS (Figure 6)

Mark a centerline from the front to the rear of the foundation which 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 layout 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. The initial alignment involves matching the center lines on the base and foundation and placing the base the proper distance from the polished rod.

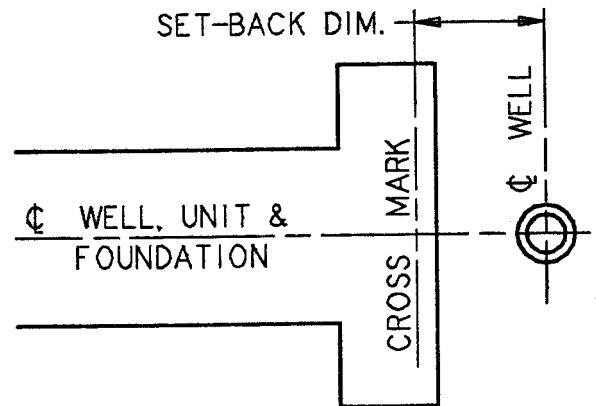


Figure 6

5. UNIT INSTALLATION

CAUTION: Before proceeding with the installation of a pumping unit, you and your crew should fully discuss the job to be done. Make sure everyone is aware of the dangers involved (see Figure 7). Review the Safety Section (Section 1) of this manual.



Figure 7



Figure 8

While assembling the unit, clean all bolted joints of foreign materials, including paint, to insure good contact between the parts.

The Beam Balanced unit is shipped partially assembled to reduce the installation time required (See Figure 8). Some units are shipped completely assembled where the overall height of the load does not exceed highway limits.

The following picture and written description of the installation of a Beam Balanced pumping unit gives the general sequence to be followed, along with precautions and alignment checks.

5.1 BASE INSTALLATION (Figure 9)

WARNING: Do not stand under the load while installing base.

Lift the unit in a level position and place on the foundation. Align the center line marks on the bottom flanges of the front and rear crossmembers with the center line mark on the foundation. Position the front crossmember of the base the correct distance from the center of the well head.



Figure 9

If you have a two piece base (unit base and prime mover base), the prime mover base will be positioned next. Remove the bolts from the joint plates. Join the bases together, tightening the bolts according to the recommendations given in Section 3. Locate and install foundation hold-down clamps and bolts. Snug tighten. Final tightening of the foundation bolts will be done after unit alignment (procedure 5.11).

5.2 REDUCER INFORMATION

Reducers are shipped installed on the base with the brake shoe engaged against the sheave. Also, all crank pins are shipped mounted in the cranks. Should any of the crank pins need to be replaced, refer to Procedures 8.4 and 8.5

5.3 BRAKE SYSTEM ADJUSTMENT FOR CHURCHILL MODELS 16 THROUGH 80

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

These units are shipped from the factory with the brake pre-adjusted. Over a period of time, however, the brake will need to be adjusted and the following procedure should be used:

- Step 1. Loosen the yoke lock nut on the brake rod (Figure 10).
- Step 2. Remove the cotter pin and clevis pin that holds the yoke to the brake lever.
- Step 3. Turn the yoke so as to shorten the brake rod thereby closing the gap between the brake shoe and the sheave (Figure 11).
- Step 4. Replace clevis pin and cotter pin. Retighten yoke lock nut on the brake rod.



Figure 10



Figure 11

NOTE: The brake shoe should not be adjusted so tight that the shoe drags on the sheave during operation, nor so loose that the brake lever is out of operational range of stopping the unit should an emergency arise. A clearance of .020" to .030" between the brake pad and sheave is recommended.

5.4 SAMSON POST INSTALLATION

Most units will ship with the Samson post installed. Some units require Samson post installation on location as follows:

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



Figure 12

Clean the surfaces between the unit base and footplates of the Samson post.

Lift the post assembly with a sling attached near the top of the assembly. This will hang the post in a near level position for easy attachment to the base, as shown in Figure 12.

Attach the front and rear post members to the base by installing the bolts from the bottom so the nuts will be on the topside. Tighten bolts according to recommendations in Section 3.

5.5 BEAM WEIGHT INSTALLATION

WARNING: This machinery is made up of heavy parts that can rotate unexpectedly. Extreme care must be exercised when working around the sweep of the cranks and walking beam.

When the walking beam and horsehead are installed on location, block the beam level per your company's safety policy and install the beam weights (Figures 13 and 14). Clean the mounting surfaces of the weights of any foreign materials. Install all thread weight bolts on the walking beam (Figure 13).

If installing weights on previously assembled units, locate the walking beam horizontal. Set the brake and chain the walking beam (See Figure 1). Clean the mounting surfaces of the weights of any foreign materials. Install all thread weight bolts on the walking beam (Figure 13).



Figure 13



Figure 14

WARNING: Do not stand under any part of the load while installing beam weights. To avoid injury to fingers and hands, hold the bolts with large channel lock pliers or other suitable tool.

Lift beam weights into place by putting a chain through the hole in the top of the weight and slowly swing the weight into position. Install nuts on the all thread and tighten according to the recommendations given in the Section 3. Install a second nut as a jam nut and tighten.

WARNING: Improperly tightened weight bolts can allow the weights to move on the walking beam. Impact movement of the weights could break the weight and bolts and damage the unit or cause serious injury or death.

5.6 HORSEHEAD/WIRELINE
INSTALLATION

Lift the horsehead over the front of the walking beam and place the radius plate of the horsehead behind the head plate of the walking beam. The radius plate should rest on the beam and against the head plate (See Figure 15). Adjust the bolt on top of the head so the wireline will fit on the wireline ring. Loop the wireline around the wireline ring at the top of the head (See Figure 16). Stretch out the wireline by pulling the carrier bar until the carrier bar is parallel with bottom of the horsehead and the wireline is against the ring. Tighten the bolt above the ring to hold the wireline on the ring and set the lock nut. Position lifting chains on the walking beam to insure a level lift. Lift the beam assembly so the horsehead is off the ground. Visibly align the horsehead vertically. Install and snug tighten the throat bolt (See Figure 17). Proper alignment of the horsehead will be performed in Section 5.10.



Figure 15



Figure 16



Figure 17

5.7 WALKING BEAM INSTALLATION

WARNING: Do not stand under any part of the load while moving walking beam.

All units ship with the center and equalizer bearings installed on the unit. Not all units ship with walking beams bolted to these bearing assemblies.

Clean the surfaces between the bearings and walking beam. be sure these contacting surfaces are metal-to-metal. Lift walking beam and position over center bearing on Samson post. Insert bolts and hand-tighten (Figure 18). Position and align the pitman and equalizer bearing assembly (Figure 19) with the selected set of holes on the walking beam (For maximum stroke, use hole nearest center bearing. See stroke change, Section 8.) Install the bolts and hand-tighten. Measure the distance between the end of the center bearing shaft and the end of the equalizer bearing shaft on both sides. (For proper alignment, these distances should be the same.)

After obtaining the alignment, tighten the bolts between the center bearing and the walking beam and the equalizer bearing and walking beam per Section 3. Secure the walking beam and cranks from rotation. See Section 1.3.

CAUTION: Improper tightening of the center bearing to walking beam bolts can result in broken bolts which in turn will cause severe damage to the pumping unit.



Figure 18



Figure 19

5.8 EQUALIZER BEARING LUBRICATION AND HOSE INSTALLATION

On units using ground lubrication, attach the lubrication hose to the lubrication line on the pitman and fill with grease as specified in Section 12.3. Then attach the hose to the equalizer bearing housing (Figure 20). Only one line is needed for equalizer bearing lubrication. Check the equalizer bearing lubrication per Section 5.16.



Figure 20



Figure 21

5.9 CENTER BEARING LUBRICATION & HOSE INSTALLATION

On units using ground lubrication, attach the lubrication hose to the lubrication line, which is located on the leg of the Samson post, and fill the hose/line assembly with a grease recommended in Section 12.3. Attach the hose to the center bearing (Figure 21). Check the center bearing lubrication per Section 5.16.



Figure 22

5.10 HORSEHEAD ALIGNMENT

With the walking beam in a horizontal position, use a level or a plumb bob to check the vertical alignment of the horsehead. The horsehead may be adjusted by using a pry bar or mallet to move the horsehead to right or left as required to properly align (Figure 22). Make sure throat bolt is properly tightened.

NOTE: It is essential that the user of the pumping unit comply with all applicable safety requirements concerning the guarding of horseheads. Refer to API RP11ER. Guards are available from LUFKIN.

5.11 UNIT ALIGNMENT (Figure 23)

Using a rope, hold the carrier bar away from the polished rod. Do not stand under the horsehead. Lower a plumb bob from the center of the top of the horsehead down beside the polished rod. Alignment is achieved when the distance from the string to the center of the polished rod is the same as the distance between the string and where the center of the

wireline will travel when connected to the well load. An alternate method can be used after complete unit assembly and before starting the unit. After applying the well load to the unit, use a level to check the vertical alignment of the polished rod in various stroke positions and in two planes at right angles to each other. Move the entire pumping unit on its foundation if adjustment is required.

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



Figure 23



Figure 24

5.12 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 rails near the reducer so the belts can be easily installed after positioning the prime mover. 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.

5.13 “V-BELTS” INSTALLATION AND ALIGNMENT

WARNING: Be certain the prime mover cannot be started during this procedure.

Install a matched set of belts. Use the inside grooves if either sheave has an excess number of grooves. Use a string to line up the inside faces of the sheaves as shown in Figure 24. Shift the prime mover as required and then tighten the bolts that attach the prime mover to the slide rails. Tighten the belts by using the adjustment screws to move the prime mover until the belt tension is uniform across the width of the belts. Check the tension by slapping the belts in the middle of the span. They should be lively and springy.



Figure 25

Tighten the bolts attaching the slide rails to the T-slots, following the recommendations given under “Fasteners” in Section 3.

5.14 BELT COVER INSTALLATION

WARNING: Be certain the prime mover cannot be started during this procedure.

Install the cover (Figure 25). The front support is securely fastened to the reducer. The rear belt cover support fits on the base. Check inside the cover to be sure the sheaves and belts have adequate clearance. The cover can be shifted sideways to adjust clearance but do not overshift and allow the sheaves to rub against the belt cover. Tighten all bolts following the recommendations given under “Fasteners” 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.

5.15 REDUCER LUBRICATION

See Section 12.1 for the lubrication specifications and the amount required. Check the oil level with the level indicator or sight gauge located on the side of the reducer (Figure 26). If the oil level is low, remove the filler plug and add oil to the proper level.



Figure 26

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

5.16 BEARING ASSEMBLY LUBRICATION (Figures 27, 28 and 29)

Crank pin, equalizer and center bearing assemblies are lubricated at the factory; however, it is a good practice to check the assemblies. The grease fitting for the crank pin bearing is located on the crank pin housing. The grease fitting for the equalizer bearing is located on one of the pitman arms. The grease fittings for the center bearing are located on the Samson post leg. Using a grease as specified in Section 12.3, pump grease into the bearing assembly until it overflows through the relief fitting. Lubrication lines are prelubricated; therefore, only a small amount of grease should be required for this check.

Pump the grease in slowly to avoid damage to the seals.

CAUTION: Damage will occur to the crank pin bearing, equalizer bearing or center bearing if the unit is operated with the improper amount or type of lubricant in the assemblies.

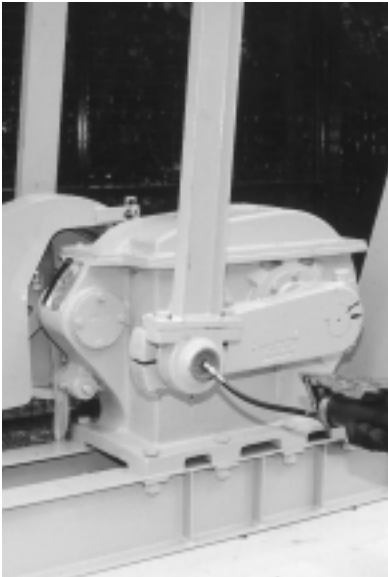


Figure 27



Figure 28



Figure 29

5.17 CRANK GUARD INSTALLATION (Figures 30 and 31)

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 beam weights and crank swing area while installing guards.



Figure 30

When crank guards are purchased from LUFKIN, a crank guard installation schematic is 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 between the Samson post legs, heel-clamps to the base beam flanges where possible (Figure 30). (Some bolt to front of Samson post.) 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. Whenever you choose to furnish your own guards in lieu of guards available from LUFKIN, insure they meet all Federal, State, and local laws.



Figure 31

5.18 ATTACHING THE WELL LOAD

Place horsehead at top of stroke. Hold the carrier bar away from the polished rod with a rope or chain. If necessary, attach a polished rod extension to the polished rod so it will rise above the horsehead. From above the horsehead, slowly lift the polished rod with the crane the length of the stroke.

WARNING: Always work the crane from above the horsehead. Catching the bottom of the horsehead with the crane could cause the horsehead to fall off the beam.

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. 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. Remove the rod clamp that was at the well stuffing box. Note: The pump may need to be respaced after running the unit.

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.

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, beam weights, horsehead and other moving parts while performing any of the following tasks.

6.1 DIRECTION OF ROTATION

The Beam Balanced pumping unit can operate equally well with the rotation in either direction. Whenever evidence of excessive wear or pitting of the gear teeth is noticed, the direction of rotation can be reversed. Reversing the rotation causes different contact surfaces of the gear teeth to be exposed to the load, which extends the life of the gear elements. If your prime mover is a three-phase electric motor, this can easily be done by reversing the leads on the motor.

WARNING: Electrical contact can cause serious injury or death. Electrical power must be locked out prior to performing any work on the electric motor. A qualified electrician must perform all electrical work.

6.2 FIRST CRANK REVOLUTION

DANGER: Contact with heavy rotating parts will cause serious injury or death. Stay clear of the crank swing, beam weights and horsehead areas.

Clear the crank swing area of all obstructions left on the unit and foundation. The first revolution of the crank should be as slow as possible. Check for proper clearance between the beam weights and cranks from the belt cover, crank guards and pitman side members. Bottom-hole-pump spacing should also be checked during the first revolution.

After slowly rotating the unit through several revolutions, stop the unit with the horsehead at the top of the upstroke. Set the brake. Lockout/tagout all energy sources. Install a polished rod clamp at the stuffing box.

Recheck all bolt connections for tightness. Refer to the Section 3 for bolt tightening recommendations.

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

Remove the polished rod clamp at the stuffing box. Reverse the lockout/tagout of all energy sources and release the brake. Operate the unit for 30 minutes and retighten the V-Belts.

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 or stand under the beam weights or horsehead 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 increases with load which causes an apportionable 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 BEAM WEIGHT ADJUSTMENT

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

WARNING: Improperly tightened weight bolts can allow the beam weights to move on the walking beam. Impact movement of the weights could break the weight bolts and damage the unit or cause serious injury or death to personnel.



Figure 32

Rotate the unit and apply the brake so that the walking beam is horizontal. Set the brake, lockout/tagout all energy sources, and chain the walking beam (See Figure 32). (Refer to Section 1.3 of this manual for proper procedures.) Loosen the weight bolts. After positioning the weights in the desired location, tighten the beam weight bolts and install a second nut as a jam nut. Follow the recommendations given under “Fasteners” in Section 3.

8. STROKE CHANGE

WARNING: Extreme caution must be exercised during the following procedure to prevent serious personal injury. Before performing a stroke change, review Section 1 (the Safety Section) of this manual.

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

WARNING: Stay clear of the beam weights, horsehead and crank swing area while performing any of the following tasks.

Rotate the unit and apply the brake so that the walking beam is horizontal. Set the brake, disconnect or lockout/tagout all energy sources.

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

Place a polished rod clamp 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 and attach chains, come-a-longs or ratchet-boomers to secure both ends of walking beam in a horizontal position (See Figure 32). Snug both come-a-longs or ratchet-boomers to restrain possible movement or tilting of the walking beam which would occur once the crank pins are removed from the cranks or the equalizer is disconnected from the walking beam.

8.2 CHANGING STROKE LENGTH

Churchill model 6.4 has two adjustable stroke lengths. All other Churchill models have four adjustable lengths (See Figure 33 and Chart on Page 24).

Churchill Unit Size	Adjustable Stroke Lengths (inches)
6.4 28-12	12, 9
6.4-32-16	16,13
10-32-18	18,15,12,10
13-32-24*	24,19-1/2,16,13
16-40-24	24, 20-1/2,16,13-1/2
16-53-30	30, 24, 20,16
25-53-30	30, 25,19-1/2,16
25-67-30	30, 25,19-1/2,16
25-56-36	36, 29, 23,19
25-67-36	26, 29, 23-1/2,19
40-89-36	36, 31, 27, 24
40-76-42	42, 35, 32, 27
40-89-42	42, 35, 32, 27
40-76-48	48, 41, 37, 32
40-89-48	48, 40, 36, 31
50-89-42*	42, 35, 32, 27
50-89-48*	48, 41, 37, 32
50-89-54*	54,45, 41, 35
57-89-42	42, 35, 32, 27
57-95-48	48, 41, 37, 32
57-76-54	54,45, 41, 35
80-109-42	42, 35, 32, 27
80-109-48	48, 41, 37, 32
80-76-54	54, 45, 41, 35
80-76-64	64, 54, 49, 41

* Non API size.

EXAMPLE: 40-76-42: 42, 35, 32, AND 27

42" stroke: This is the maximum stroke and it is attained on assembly by positioning the pitman in the set of four holes closest to the saddle bearing.

35" stroke: This stroke length is attained on assembly by positioning the pitman in the set of four holes which are furthestmost from the saddle bearing.

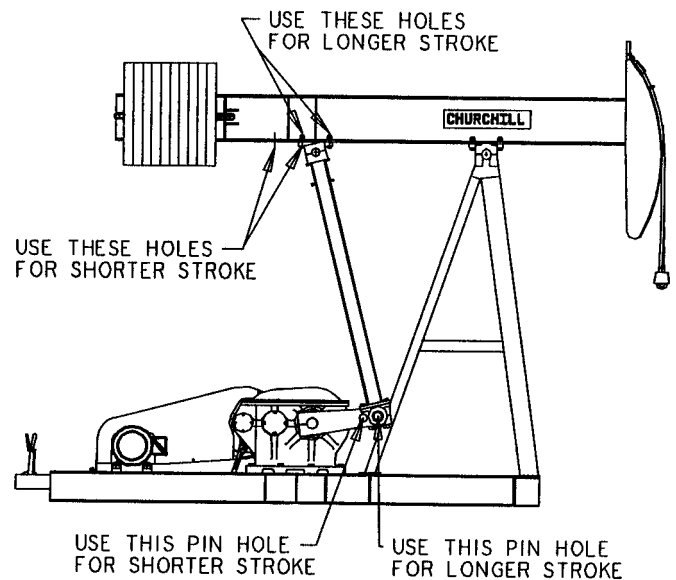


Figure 33

32" stroke: This stroke length is attained by positioning the pitman in the set of four holes closest to the saddle bearing, and placing the crank pin in the next hole closest to the crank shaft.

27" stroke: This is the minimum stroke length and it is attained by positioning the pitman in the set of four holes which are furthestmost from the saddle bearing, and placing the crank pin in the hole closest to the crank shaft.

8.3 MOVING EQUALIZER/PITMAN ON WALKING BEAM

Secure a chain around the equalizer and the walking beam to support the equalizer when it is disconnected. Allow enough slack in the chain for the equalizer/pitman assembly to move to the desired set of holes on the walking beam. Remove the bolts holding the bearing assembly to the walking beam. Reposition the equalizer/pitman assembly, reinsert bolts and tighten per recommendations given under "Fasteners" in Section 3.

8.4 CRANK PIN REMOVAL

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

Attach chains, come-a-longs or ratchet boomers to secure both ends of the walking beam in a horizontal position. Set the brake. Remove the bolts from the pitman to the crank pin. Remove the bolt or bolts on the crank which maintain pressure on the crank pin. Use a cold chisel to spread the crank slightly. Apply only enough pressure to remove the crank pin. Do not spread excessively or you will damage or break the crank.

8.5 CRANK PIN INSTALLATION

Use a safe solvent (per your company's safety regulations) to clean the crank pin, crank pin hole, and the surface of the crank against which the thrust washer will seat. Also, remove paint, burrs and other foreign matter from these areas.

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 cold chisel spreading the crank arm, insert the crank pin. Remove the chisel. Insert both bolts and tighten (if crank pin is in the hole closest to the crankshaft, snug tighten the outer bolt as overtightening will break the crank over the outer hole).

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

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.

8.6 PUTTING THE UNIT INTO OPERATION

With the brake engaged, remove the come-a-longs or ratchet-boomers.

Reinstall the crank guards. After a stroke length 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 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.

9.1 PREPARATION

WARNING: Do not attempt to service the well without first removing the horsehead.

Looking at the unit with the well head to the right, stop the unit with the cranks in about the eight o'clock position and set the brake. Lockout/tagout all energy sources.

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 at the stuffing box and tighten according to the clamp manufacturer's torque recommendations.

Remove the crank guards.

Attach chains to the walking beam. See Notice in Section 1.3.1. Using the crane, remove the slack from the chains. Release the brake. Slowly lift the cranks until the walking beam is in a near level position. Reset the brake and chain the walking beam. (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 clamps slips or the unit moves.

Put a long rope or chain through the carrier bar and put the gate back into the carrier bar. Be sure the rope or chain is long enough so the carrier bar can be held without lifting a person off the ground.

9.2 HORSEHEAD REMOVAL

WARNING: Under no circumstances should well servicing be attempted without first removing the horsehead. Be certain to remove the latch bolt before attempting to remove the horsehead. Do not stand under any part of the load while lifting.

Set brake; lockout/tagout and secure the walking beam and cranks from rotation. Attach the crane to the horsehead. Remove the latch bolt. While holding the carrier bar away from the polished rod, slowly lift the horsehead from the beam. Place the horsehead on the ground a safe distance from the work area.

Keeping the brake engaged, remove the other safety precautions for securing the unit against rotation. Slowly release the brake to lower the cranks to the 6 o'clock position. Reinstall safety precautions to secure the unit against rotation before well servicing.

9.3 HORSEHEAD INSTALLATION

After well servicing is completed, attach the crane to the rear of walking beam. Remove safety precautions for securing the beam and cranks, and release the brake. Slowly lift the beam in a near horizontal position. Set the brake and chain the walking beam to secure from any rotation. Re-attach crane to the horsehead. Reinstall the head by reversing the removal procedure. Check the alignment of the horsehead as described in Section 5.10.

WARNING: The latch bolt must be installed and tightened at all times except during horsehead removal.

9.4 PUTTING THE UNIT INTO OPERATION

Remove the rope or chain from the carrier bar and attach the carrier 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.

With the brake engaged, unchain the walking beam. 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.

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 all right. With time, some components could work loose and present a potentially dangerous situation. Always approach operating units from the rear.

The following visual inspections are recommended before approaching the unit:

- (1) Look at both crank pins to see if they may have worked loose.
- (2) On units which are driven by slow-speed engines, look to see if the flywheel is loose.
- (3) Look at the beam weights to be sure they are tight.
- (4) Look at the center and tail bearings to be sure they have not worked loose.
- (5) 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. Check to see that the wireline is tracking properly on the horsehead. Also, look for obvious broken strands of wire fraying from the wireline. A change in alignment can be caused if the base shifts on the foundation due to loose hold-down bolts. Misalignment can also result from a foundation that has settled to an unlevel position.

- (6) Look 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 beam weights must be secured against moving.

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 and beam weights 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 by using the sight gauge located in the side of the housing or a 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 filler plug and add oil to the proper level. (Refer to Section 12.1 for lubricant specifications.)

11.1.2 Structural Bearing Assemblies

Visually check the crank pin bearings, equalizer bearing and center bearing for seal leaks. Do not confuse grease discharge from the bearing housing vents with seal leakage.

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 suggest running new belts 30 minutes and then retightening. (Consult your belt supplier.)

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 in 5.3 Brake System Adjustment.

11.2.3 Brake Sheave Drum

Inspect the brake drum for cracks around the hub and key area. Look for discoloration due to overheating. Replace the drum if any of these conditions exist. (Contact LUFKIN).

11.2.4 Brake Rods

Replace any brake rods that are bent.

11.2.5 Crank Phase Marks

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

11.3 SEMI-ANNUALLY

11.3.1 Reducer

Check the gear tooth condition 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:

- (1) 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 34).
- (2) 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 35 is usually caused by torque overload. Continued overload may result in gear tooth failures.

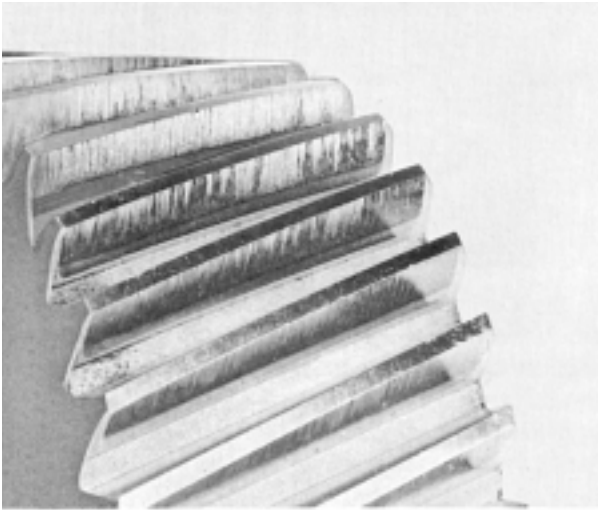


Figure 34

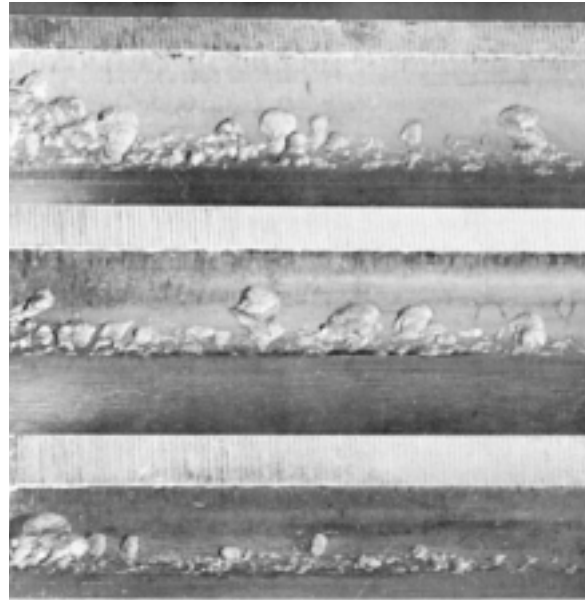


Figure 35

For more detailed descriptions, illustrations, causes, and remedies, see ANSI/AGMA Standard 110.04. Note also, Figures 34 and 35 were 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:

- (1) An acid or burned odor would indicate oxidation of the oil to the point that it should be replaced.
- (2) 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.
- (3) 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, then 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 12.1 of this manual.

11.3.2 Structural Bearings

Lubricate the structural bearings with grease as recommended in Section 12.3 of this manual. Grease fittings are located at ground level. Pump grease in slowly to avoid pushing out the oil seals. Discharge from the vents located on each bearing housing indicates that the housing is full.

11.3.3 Wireline

Look for broken strands of wire fraying from the wireline. A rusty wireline should be cleaned and coated with a wireline lubricant as specified in Section 12.4.

11.3.4 Bolts

Check all bolts. Retighten as recommended in Section 3 of this manual. Loose bolts will eventually fail, which is the cause of most pumping unit failures.

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

When units are operated intermittently or shut down for periods of time while subjected to ambient temperatures below 0°F, a synthetic gear lubricant may be required.

12.2 REDUCER OIL CAPACITY

<u>MODEL</u>	<u>CAPACITY</u>
6.4D	1.00 GAL.
10D	1.25 GAL.
13D	1.50 GAL.
16D	1.50 GAL.
25D	2.00 GAL.
40D	4.00 GAL.
50D	4.00 GAL.
57D	13.00 GAL.
80D	13.00 GAL.

12.3 STRUCTURAL BEARINGS

CAUTION: Do not use soda-soap grease.

For 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 extreme cold weather service (ranging from -30°F to 50°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

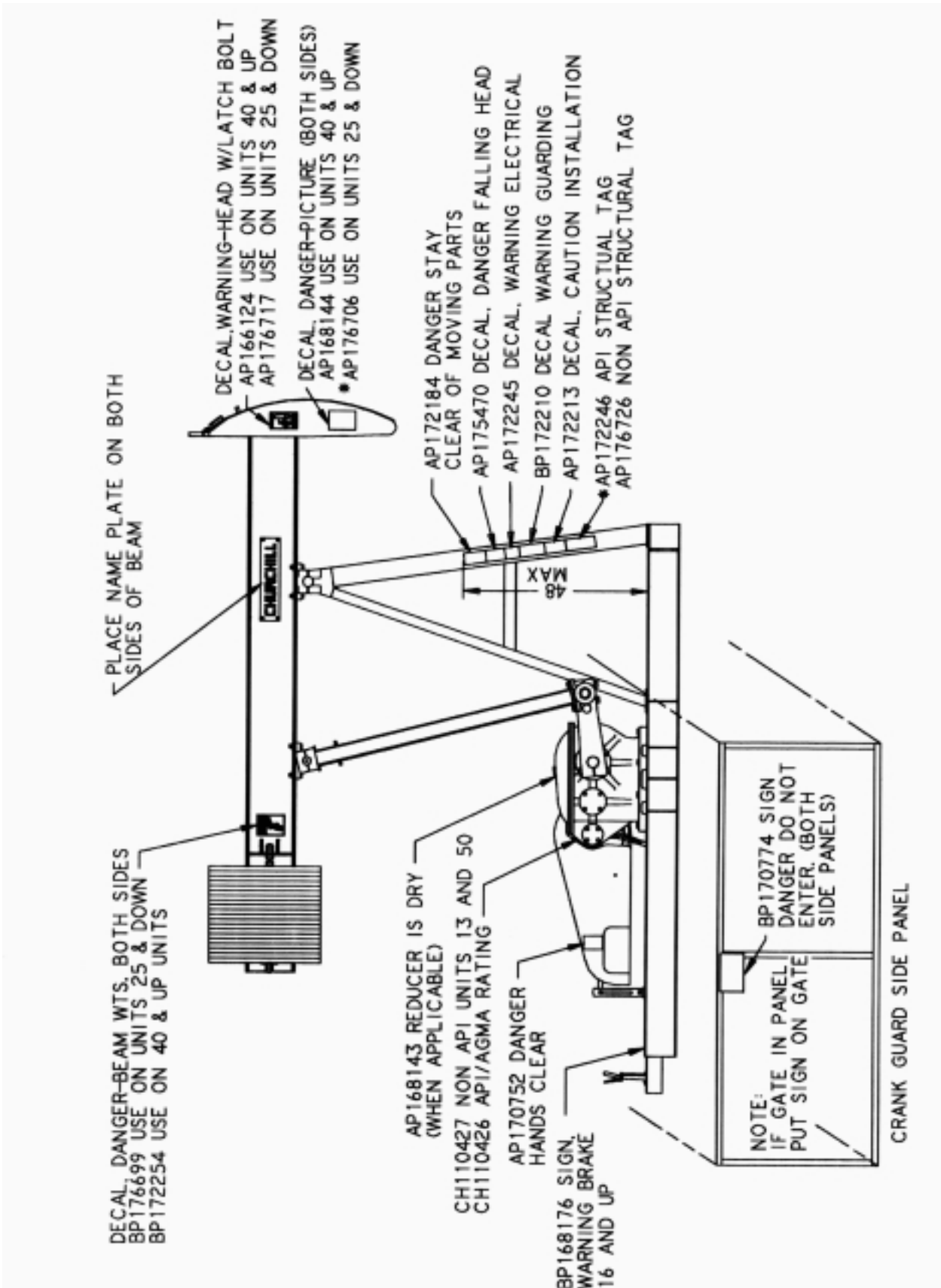
LUFKIN has capable sales and service personnel throughout the oil producing areas of the world. These people are competent and experienced, not only in the proper sizing of surface pumping units, but also in any service that may be needed. Contact the LUFKIN Sales Office nearest you to inquire about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

13.2 REPAIR AND REPLACEMENT PARTS

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

A complete line of repair and replacement parts is 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



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 OF DEALING, USAGE, OR TRADE and are exclusive 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 three (3) 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 OF 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 and 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, HERETOFORE OR HEREAFTER TAKEN, DONE OR OMITTED TO BE DONE IN CONNECTION WITH THIS TRANSACTION OR SUBSEQUENT RELATED TRANSACTIONS.

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