

Ramirez



**TRICO CRANK BALANCED  
PUMPING UNIT**

**INSTALLATION, OPERATION  
& MAINTENANCE**

# CONTENTS

	Page
I. INTRODUCTION .....	1
II. FOUNDATION.....	1-2
A. TYPES	
1. <u>Poured-In-Place Concrete</u> .....	1
2. <u>Pre-Cast Concrete Portable</u> .....	1
3. <u>Timber Mat</u> .....	1
B. BASE ALIGNMENT .....	1-2
III. ERECTION .....	2-5
A. REQUIRED EQUIPMENT.....	2
B. ALIGNMENT OF GEARBOX TO BASE .....	2
C. BRAKE INSTALLATION AND ADJUSTMENT.....	2-3
D. COUNTERWEIGHT INSTALLATION.....	3
E. SAMSON POST AND SAFETY LADDER INSTALLATION.....	3-4
F. WALKING BEAM, CENTER BEARING AND EQUALIZER INSTALLATION.....	4-5
G. GROUND OILING SYSTEM INSTALLATION.....	5
H. HORSEHEAD AND WIRELINE ASSEMBLY INSTALLATION .....	5
I. ALIGNMENT OF UNIT TO WELL .....	5
J. INSTALLING ACCESSORIES.....	5
K. LUBRICATION.....	5
IV. CRANK PIN INSTALLATION.....	5-6
V. CRANK PIN REMOVAL.....	6
VI. COUNTERBALANCE.....	6
A. GENERAL.....	6
B. DETERMINING REQUIRED COUNTERBALANCE	
1. <u>Electric Motor Prime Mover</u> .....	6
2. <u>Gas Engine Prime Mover</u> .....	6
3. <u>Dynamometer</u> .....	6
C. ADJUSTMENT.....	6
VII. MAINTENANCE.....	6-7
A. SCHEDULE.....	6
B. LUBRICATION SPECIFICATIONS.....	6
1. <u>Gear Reducers</u> .....	7
2. <u>Structural Roller Bearings</u> .....	7

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# ILLUSTRATIONS

Figure	Page
1. Checking levelness of timber mat foundation.....	1
2. Centerline marked on foundation.....	1
3. Position of front crossmember marked on foundation perpendicular to centerline.....	2
4. Positioning front crossmember on marked lateral line .....	2
5. Aligning gearbox to base .....	2
6. Installing counterweights.....	3
7. Attaching rear leg of samson post to front leg assembly.....	3
8. Installing safety ladder .....	3
9. Installing samson post.....	3
10. Tightening bolts on samson post.....	4
11. Installing hinge pin .....	4
12. Lubricating upper pitman box.....	4
13. Checking pitman arms for parallelism.....	4
14. Securing center bearing to samson post.....	5

# TABLES

	Page
1. Dimensions From Center of Well to Front Crossmember of Pumping Unit.....	7
2. Tightening Torques for Nuts With Metal-to-Metal Grip .....	7
3. Weights of Various Pumping Unit Components .....	8
4. Minimum Hook Height From Bottom of Base to Top of Head With Walking Beam in Level Position .....	8

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## I. INTRODUCTION

Your new Trico Crank Balanced Pumping Unit is a precision piece of machinery manufactured to the highest standards of the industry. It is designed in accordance with API Standards 11E and carries the API monogram. Your Trico Pumping Unit is also built utilizing a domestic gear reducer and domestic bearings.

Trico Industries, Inc. warrants your Trico Pumping Unit for a full two years. With proper installation and normal maintenance, your pumping unit will provide you with many years of dependable, trouble-free service.

This operator's manual sets forth the recommended erection and operation procedures and maintenance schedule for your Trico Pumping Unit.

Trico Industries, Inc. also has capable sales and servicemen throughout the oil producing areas of North America to serve you. These men are not only well versed in the proper sizing of pumping units, but they can provide any service that may be needed, be it routine maintenance or complete design and construction of turnkey production facilities. Contact the Trico sales office nearest you for more information.

In addition, a full line of replacement parts is available from several warehouse locations as well as the manufacturing plant in Cudahy, CA. When ordering replacement parts, be sure to include the pumping unit model number and serial number from the nameplate. A complete parts list is provided with your unit. Additional copies may be obtained from your Trico sales or serviceman.

To get the most dependable service from your Trico Pumping Unit, it should be operated within its torque and structural ratings. Experience has shown, however, that many pumping units are often operated without their torque peaks being equal, and the reducers are often overloaded.

The pumping units are manufactured of cast iron and steel and consequently have large and heavy rotating parts. It is absolutely essential that all personnel involved in the erection, operation and maintenance of pumping units use extreme caution at all times. It is of the utmost importance to stop all moving and rotating parts during installation, adjustment or maintenance activities, and to support these parts with heavy timbers or with a crane.

**CAUTION:** STAY CLEAR OF ROTATING CRANKS AND COUNTERWEIGHTS AND PARTS THAT COULD START MOVING. SERIOUS PERSONNEL INJURY OR FATAL ACCIDENTS MAY OCCUR.

**NOTE:** Non-adherence to the specified working procedures may cause damage to your equipment.

## II. FOUNDATION

All pumping units require a solid foundation to deliver the most dependable service. A good foundation can minimize problems such as frame stress, cracking and excessive sucker rod wear caused by vibration and misalignment.

No attempt has been made to recommend the type of foundation to be used. This depends on the type of pumping unit base used and on the local soil conditions. A local contractor should be consulted about soil conditions and recommendations for the depth and shape of the foundation required. A certified foundation drawing is provided with each unit.

## A. TYPES

### 1. Poured-In-Place Concrete

Centerline holddowns should be imbedded at the proper locations. The concrete must be completely set-up before the unit base is positioned. The local contractor must be fully responsible for providing a foundation to handle the loads as shown on the certified foundation drawing.

### 2. Pre-Cast Concrete Portable Foundation

Centerline holddowns should be imbedded at the proper locations. With this type of foundation careful preparation of the soil is necessary and gravel is generally used between the foundation and the soil.

### 3. Timber Mat

With a portable unit base, this type foundation can be used. After careful soil preparation, timbers are placed crosswise to the unit base resting on an adequately prepared foundation of gravel or sand. Use of a portable deadman is recommended for anchoring the pumping unit to the foundation.

Regardless of the type of foundation used, care should be taken to assure that the foundation is perfectly level (Fig. 1).

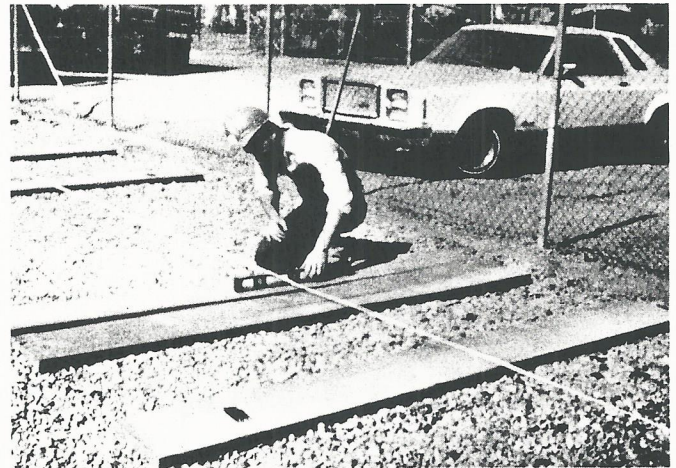


Figure 1 — Checking levelness of timber mat foundation.

## B. BASE ALIGNMENT

1. Snap chalk centerline on foundation, centering on wellhead (Fig. 2).

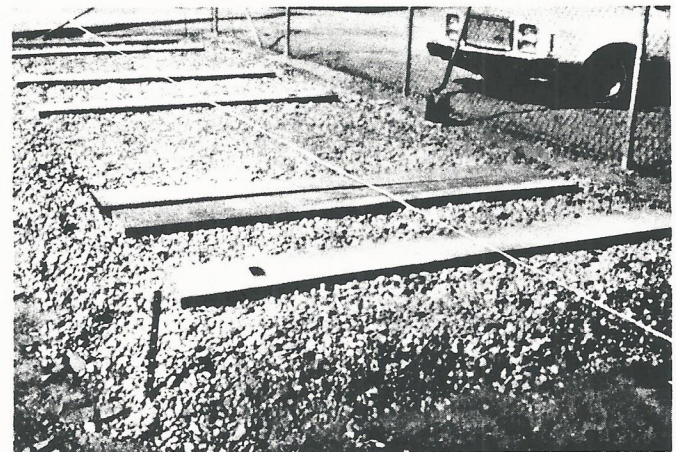


Figure 2 — Centerline marked on foundation.

2. Draw line perpendicular to centerline marking distance from polished rod to front crossmember on base of unit (Fig. 3). See Table 1 for dimensions, center of well to front of unit.

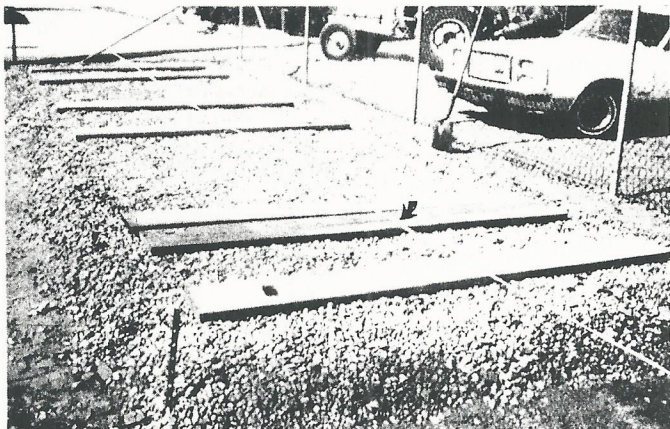


Figure 3 — Position of front crossmember on foundation perpendicular to centerline.

3. Match center marks on front and back crossmember of base of unit with centerline on foundation.
4. Place front crossmember of base on marked lateral line and gently release weight of unit (Fig. 4).

**NOTE:** Regardless of the type of foundation, and prior to erection of the unit, it is recommended that the unit base be adequately anchored to the foundation.

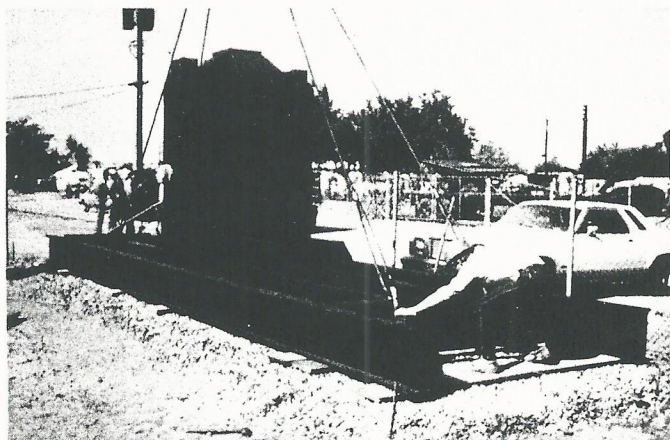


Figure 4 — Positioning front crossmember on marked lateral line.

5. If prime mover base is separate from unit base, install prime mover base at this time.
6. Install and tighten foundation on centerline with holddown bolts. Hammer tighten bolts. See Table 2 for proper tightening torques.

### III. ERECTION PROCEDURE:

#### A. REQUIRED EQUIPMENT

Use the height and weight shown in Table 3 to select the proper lifting equipment.

#### B. ALIGNMENT OF GEARBOX TO BASE

If gearbox is *not* mounted on base proceed to Step 1. If gearbox *is* mounted on base proceed to Step 4.

1. Engage brake shoe against drum by tightening adjusting nut.
2. Attach slings to gearbox and crank arms to stabilize assembly during lift onto base.
3. After gearbox has been set onto base and gearbox-to-base bolts have been installed, gradually loosen brake adjusting nut to allow cranks to slowly rotate to bottom dead center position.

**CAUTION:** ALL PERSONNEL SHOULD STAND CLEAR OF CRANK SWEEP DURING STEP 3 TO AVOID SERIOUS INJURY.

4. Loosen bolts and adjust gearbox on pedestal so that distance between main shaft and holes on base for front legs of samson post are equal. Use measuring tape (Fig. 5).

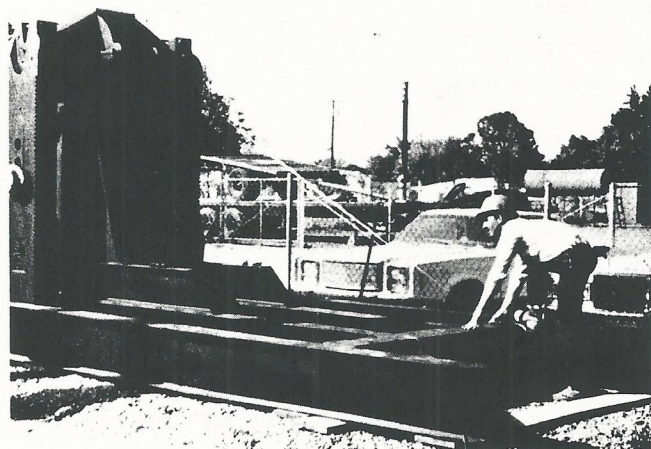


Figure 5 — Aligning gearbox to base.

5. Hammer tighten bolts. If necessary rotate cranks with hoist to gain access to nuts behind crank. Return cranks to bottom dead center before proceeding with erection.

#### C. BRAKE INSTALLATION AND ADJUSTMENT

The unit is shipped to the field with the shipping bolt and safety pawl engaged at the brake drum.

**CAUTION:** PITMAN ARMS SHOULD NOT BE ATTACHED TO CRANKPINS AND WELL LOAD SHOULD NOT BE ATTACHED TO CARRIER BAR.

1. Disengage safety pawl and loosen shipping bolt to allow cranks to rotate freely until they stop.
2. Engage safety pawl and attach brake control lever assembly.
3. Loosen installation and shipping bolt to release brake. Lock bolt with jam nut.
4. Adjust position of both brake shoes with adjusting nuts until lining clears drum at bottom and top.
5. Attach brake cable cover to base near brake lever using U-bolt provided.
6. Disengage brake and move brake control lever to maximum forward position.
7. Position clevis on end of brake cable so that it can be pinned to brake control lever.

- Engage brake using brake control lever.

**NOTE:** Full engagement should occur with several notches of the ratchet still remaining to compensate for lining wear and cable stretch. Further adjustment can be made by repositioning brake clevises.

- Re-check brake lining clearances after all adjustments have been made.

**CAUTION:** SUBSEQUENT ADJUSTMENTS SHOULD ONLY BE MADE AFTER STOPPING THE CRANKS IN A SAFE POSITION AND ENGAGING THE SAFETY PAWL. ALWAYS DIS-ENGAGE SAFETY PAWL BEFORE STARTING UNIT.

#### D. COUNTERWEIGHT INSTALLATION

- With cranks in vertical position, rig sling system to hang counterweights in vertical position (Fig. 6).

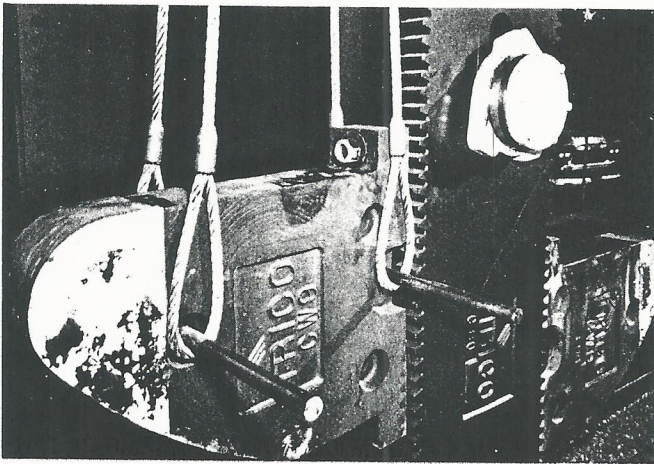


Figure 6 — Installing counterweights.

- Using special T-head bolts, fasten counterweights to cranks and adjust position of counterweights for desired effective counterbalance.
- Hammer tighten bolts.

**NOTE:** When fastening counterweights to cranks, those using two bolts should have curved side toward long end of cranks. Those with three bolts should have recess for adjusting handle towards long end of crank.

- If auxiliary counterweights are to be used, install them at this time.
- Hammer tighten bolts.

#### E. SAMSON POST AND SAFETY LADDER INSTALLATION

- Assemble rear leg of samson post to front leg assembly (Fig. 7). Leave bolts loose so that legs may be aligned with holes in unit base.
- Attach safety ladder to upper and lower ends of post (Fig. 8).
- Position samson post on base and check levelness. If shimming is necessary, shim-up under one front leg of post (Fig. 9).

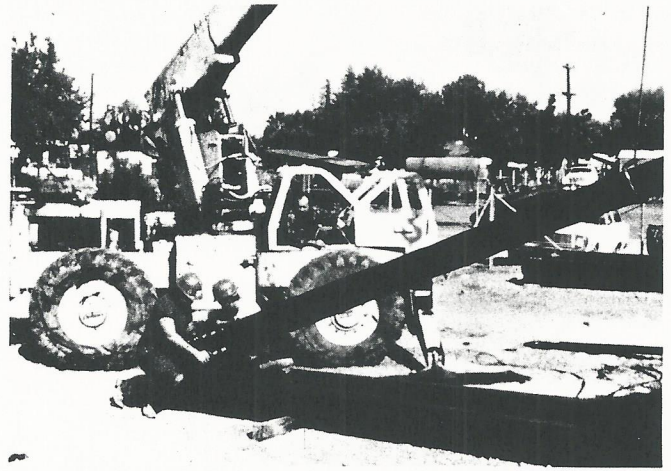


Figure 7 — Attaching rear leg of samson post to front leg assembly.

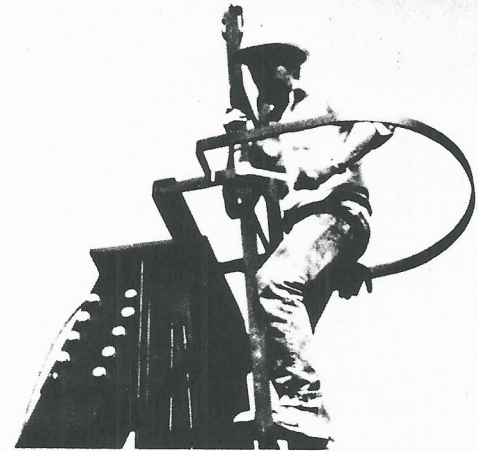


Figure 8 — Installing safety ladder.



Figure 9 — Installing samson post.

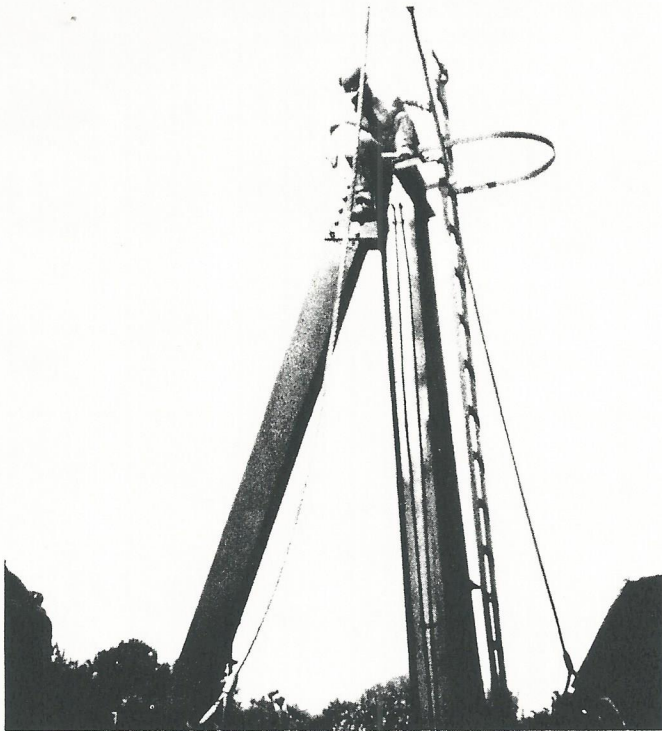


Figure 10 — Tightening bolts on samson post.

4. Hammer tighten bolts on all three post feet.
5. Tighten bolts at top of samson post (Fig. 10).

#### F. WALKING BEAM, CENTER BEARING AND EQUALIZER INSTALLATION

1. Attach center bearing to walking beam leaving bolts hand tight.
2. Loosen clamp bolts in equalizer connections on beam. Remove hinge pin and clean all contact surfaces.
3. Apply a coating of light oil on hinge pin.
4. Assemble equalizer to beam by setting beam on equalizer and inserting hinge pin (Fig. 11).

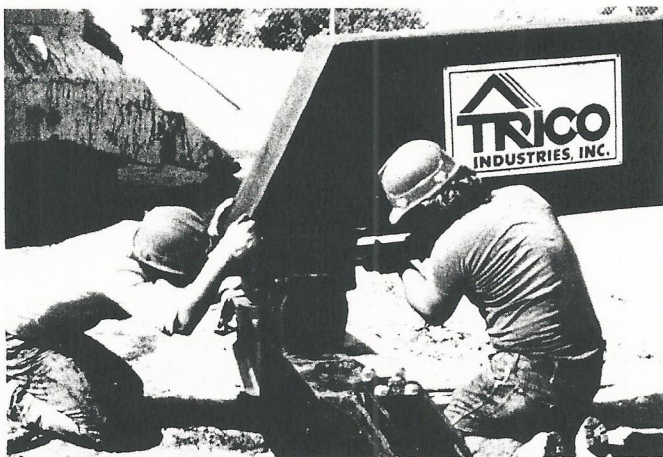


Figure 11 — Installing hinge pin.

5. Install collar and stop nut.
6. Tighten stop nut to remove tail bearing housing to lower connection end play.
7. Hammer tighten bolts on lower connections of beam.

8. Align center bearing to tail bearing by measuring distances on both sides. Shift center bearing assembly as needed.
9. Hammer tighten center-bearing-to-beam bolts.
10. Attach pitman arms to equalizer and hammer tighten bolts.
11. Lubricate hinge pin and upper pitman boxes (Fig. 12).
12. Lift the above assembled parts and position center bearing over samson post. Check pitman arms for parallelism (Fig. 13).



Figure 12 — Lubricating upper pitman box.



Figure 13 — Checking pitman arms for parallelism.



Figure 14 — Securing center bearing to samson post.

13. Install center-bearing-to-samson-post bolts and hand tighten (Fig. 14).
14. Clean machined surfaces of crank pin bearing housings and lower pitman connections.
15. Apply a coating of light oil to machined surface of crank pin bearing housing.
16. Install pitman ends onto crank pin bearing housing and secure with cap screws.

**CAUTION:** DO NOT HAMMER PITMAN LOWER CONNECTIONS ONTO THE CRANK PIN BEARING HOUSING. SEVERE CRANK PIN BEARING DAMAGE COULD RESULT.

17. Check to be sure that distance between end crank shaft and pitman arm is equal on both sides. If correction is needed, rotate center bearing on samson post and hammer tighten center-bearing-to-samson-post bolts.

#### G. GROUND OILING SYSTEM INSTALLATION

1. Attach flexible oil hoses to pipes on samson post and pitman arm.
2. Attach other ends to center bearing and equalizer bearing, respectively.
3. Fill oil pipes with lubricant. See Paragraph B, Section VII.

#### H. HORSEHEAD AND WIRELINE ASSEMBLY INSTALLATION

1. With horsehead on ground, remove wireline retainer. Form loop with wireline beyond equalizer sheave so retainer will easily go into place.
2. Replace retainer and tighten retainer-to-head bolt.
3. Pull carrier bar down until loop is tight against equalizer sheave.
4. Equal wireline lengths so carrier bar will be level.

**NOTE:** If wireline bail is furnished, install at this time.

5. Move horsehead onto beam and secure.

**NOTE:** Horsehead can hinge back when beam is in the up position.

6. Align horsehead to vertical using adjusting screws.
7. Tighten jam nuts on adjusting screws.

#### I. ALIGNMENT OF PUMPING UNIT TO WELL

1. Using a plumb bob, check alignment of pumping unit to center of wellhead.
2. When viewed from side, if unit is not properly positioned, loosen center-bearing-to-beam bolts and shift position of horsehead by using adjusting bolts on bottom of walking beam.
3. When viewed from front, if unit is not properly positioned, shift entire unit on foundation.

#### J. INSTALLING ACCESSORIES

Accessories should be installed in the following sequence:

1. Prime mover
2. V-belts and prime mover sheave
3. V-belt guard
4. Polished rod clamp
5. Crank guards (if furnished)

#### K. LUBRICATION

Structural bearings are lubricated at the factory, however, the ground lubrication system should be checked and all bearings should be lubricated at this time. Lubricant should be pumped slowly to avoid damaging the grease seals. Remove dirt or paint from relief fittings.

**NOTE:** Check all bolts to be sure they are tight.

### IV. CRANK PIN INSTALLATION

1. Position cranks in vertical position.
2. Set brake and engage safety pawl on brake drum.
3. Carefully clean crank pin, mounting hole in crank, and surface between nut and crank with solvent.
4. Remove any burrs, paint or foreign matter that might interfere with and/or prevent proper fit of crank pin.

**NOTE:** Inspect the crank and crank pin hole for any evidence of fretting. If contact surfaces are more than 10% fretted, contact your Trico serviceman.



5. Insert crank pin into crank mounting hole.
6. Install castellated hex nut and tighten securely with crank pin nut wrench.
7. Using at least a 12-lb sledge hammer, rotate nut two castellations (notches) past cotter pin hole. Carefully tighten further until third castellation lines up with cotter pin hole. Install cotter pin.

**NOTE:** NEVER back nut off to insert cotter pin. If the nut is tightened too far, remove the crank pin and repeat Steps 5 through 7.

8. If crank pin was repositioned from another mounting hole, apply a coating of rust preventative or grease to the old hole.

**CAUTION:** DISENGAGE SAFETY PAWL BEFORE STARTING THE PUMPING UNIT.

## V. CRANK PIN REMOVAL

1. Clamp off weight of well and position cranks for convenience.

**NOTE:** Usually the best position for crank pin removal is with the cranks slightly below the horizontal position pointing towards the well. The crank pin nuts need to be accessible.

2. Place heavy timbers under crank or counterweight.
3. Set brake and engage safety pawl on brake drum.

**CAUTION:** CHAIN CARRIER BAR TO WELL-HEAD AND EQUALIZER TO BASE CROSSMEMBER TO PREVENT MOVEMENT OF WALKING BEAM ONCE CRANK PIN IS REMOVED.

4. Remove cotter pin and loosen nut using crank pin nut wrench and 12-lb sledge hammer. Remove nut.
5. Using knock-out nut and 12-lb sledge hammer, knock out crank pin.
6. If crank pin is to be shifted to another mounting hole, raise or lower walking beam to align crank pin with new hole. See Section IV, Steps 5 through 8 for crank pin installation procedures.

## VI. COUNTERBALANCE

### A. GENERAL

To obtain maximum service life from your Trico pumping unit it should be operated within its gearbox torque rating and within its structural capacities.

Counterbalance is a very important function of proper and trouble-free operation. In the pumping unit cycle there are two load peaks: 1) when the unit is lifting the load with the help of the counterweights and 2) when the unit is lifting the counterbalance. These two peaks should be relatively equal and within the torque rating of the gearbox.

## B. DETERMINING REQUIRED COUNTERBALANCE

### 1. Electric Motor Prime Mover

When the unit has an electric prime mover, an ammeter may be used to check current peaks. If the current peaks are equal then the gearbox peaks will be equal.

### 2. Gas Engine Prime Mover

When the unit has a gas engine as the prime mover, a vacuum guage may be used to check load on the engine. If the vacuum readings are equal then the gearbox peaks will be equal.

With either type, the sound of the prime mover during the pumping cycle will indicate the counterbalance condition. In the case of the gas engine, it will slow down on the torque side requiring more power and speed up on the other side. With the electric motor, generally this will produce a distinctive whine on the peak requiring more horsepower. In both cases, counterbalance adjustment will make these sounds equal.

### 3. Dynamometer

A dynamometer used to record the peaks at polished rod is a more accurate method of equalizing the counterbalance required to make the gearbox torque peaks equal.

## C. ADJUSTMENT

There are two methods that may be used to adjust the counterbalance on your Trico pumping unit.

1. Position cranks in vertical position and raise or lower counterweights with crane or come-along.
2. Position cranks in horizontal position and place heavy timbers under one crank or use crane to support crank. Relocate counterweights to required position using pinion handle provided with unit.

**CAUTION:** ALWAYS SET THE HAND BRAKE AND ENGAGE THE SAFETY PAWL IN THE BRAKE DRUM BEFORE MOVING COUNTERWEIGHTS.

3. Hammer tighten all nuts and lock nuts after relocating counterweights.

**WARNING:** IMPROPERLY TIGHTENED NUTS COULD ALLOW COUNTERWEIGHTS TO MOVE DURING OPERATION CAUSING SERIOUS INJURY TO PERSONNEL AND/OR DAMAGE TO THE PUMPING UNIT.

## VII. MAINTENANCE

### A. SCHEDULE

#### 1. After 1 Week of Operation

- a. Check oil level in gearbox
- b. Check V-belt tension
- c. Check unit for proper alignment
- d. Check for abnormal bearing or gearbox leaks
- e. Check and re-tighten all bolts.

2. Monthly (Perform steps outlined in A1 above, and . . .)
- Listen for any abnormal sounds in the gearbox, structural bearings or other working components. Further checking of abnormal sounds could save expensive repairs or a possible breakdown of the unit.
  - Inspect your Trico pumping unit thoroughly for any misalignment, excessive oil leaks or abnormal rust that might indicate that a joint is working loose or fretting.
  - Check the safety brake to ensure all its components are in proper working order.

**CAUTION:** ALWAYS APPLY THE BRAKE SLOWLY TO AVOID DAMAGING THE GEARS AND BEARINGS.

- Relubricate structural bearings as required to ensure proper operation.
3. Every 6 Months (Perform steps outlined in A1 and A2 above, and . . .)
- Collect a sample of gearbox oil in a glass container. Visually inspect oil for any water emulsion, dirt, sludge or other contamination. If the gearbox oil has an abnormal odor or appearance, it should be replaced.

## B. LUBRICATION SPECIFICATIONS

### 1. Gear Reducers

- 0° to 125°F Operation — Use an oil with an AGMA lube number of 5EP. Pour point of the oil should be 5°F, or lower.
- 30° to +15°F Operation — Use an oil with an AGMA lube number of 4EP. Pour point of the oil should be -15°F, or lower.

**NOTE:** This oil is a premium-mild extreme pressure lubricant with rust and oxidation inhibitors and an anti-foam agent.

- Oil Capacity
  - 114 — 27 gal
  - 228 — 57 gal
  - 320 — 53 gal

### 2. Structural Roller Bearings

- 0° to 125°F Operation — Use a premium NLG1 No. 1 lithium soap base grease with a lead naphthanate extreme pressure additive.
- 30° to 0°F Operation — Use a premium NLG1 No. 0 grease with a lead naphthanate extreme pressure additive.

**CAUTION:** DO NOT USE A SODA SOAP GREASE.

**TABLE 1**

Dimensions From Center of Well  
To Front Crossmember of Pumping Unit

Unit	Dimension
C-114D-143-64	5'2-3/4"
C-114D-119-86	6'7"
C-228D-246-86	5'9-1/2"
C-228D-213-120	9'5-1/2"
C-320D-256-120	9'5-1/2"
C-320D-305-100	7'3-1/2"

**TABLE 2**

Tightening Torques for Nuts With Metal-to-Metal Grip

Diameter (in.)	Thread Size	Torque (ft-lb)	
		Grade 2	Grade 5
3/8	16NC	15	23
1/2	13NC	35	55
5/8	11NC	75	110
3/4	10NC	125	200
7/8	9NC	130	320
1	8NC	190	480
1-1/8	7NC	270	600
1-1/4	7NC	380	840
1-1/2	6NC	650	1,460

**NOTE:** The torque values listed are for bolts that are clean and plated but not lubricated. Bolt and nut base must be flat, clean and free of burrs.

**TABLE 3**

## Weights of Various Pumping Unit Components

Unit	Narrow Base With Pedestal (lb)	Gearbox With Cranks (lb)	Total* (lb)
C-114D-143-64	1,337	5,876	7,213
C-114D-119-86	1,846	6,956	8,802
C-228D-246-86	4,271	12,699	16,970
C-228D-213-120	4,271	12,747	17,018
C-320D-256-120	4,652	16,911	21,563
C-320D-305-100	4,652	16,911	21,563
Unit	Portable Base With Pedestal (lb)	Gearbox With Cranks (lb)	Total* (lb)
C-114D-143-64	3,517	5,876	9,393
C-114D-119-86	4,306	6,956	11,262
C-228D-246-86	8,608	12,699	21,307
C-228D-213-120	8,608	12,747	21,355
C-320D-256-120	8,734	16,911	25,645
C-320D-305-100	8,734	16,911	25,645
No. 9 Master Counterweight — 800 lb			
No. 9 Auxiliary Counterweight — 230 lb			
No. 10 Master Counterweight — 1,400 lb			
No. 10 Auxiliary Counterweight — 430 lb			

\*Total weight of base with pedestal and gearbox with cranks only.

**TABLE 4**Minimum Hook Height From Bottom of Base  
To Top of Head With Walking Beam in Level Position

Unit	Dimension
C-114D-143-64	17'4"
C-114D-119-86	19'7"
C-228D-246-86	23'7"
C-228D-213-120	27'7"
C-320D-256-120	27'7"
C-320D-305-100	24'4"

# TRICO PUMPING UNITS NOMENCLATURE

