Addendum for Gen 2 Pumping Units to Accompany Manual 200171760

Rod Lift Systems
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1. Foreword

The purpose of this document is to present information not found in the current release of the Lufkin Conventional and Reverse Mark Pumping Unit Installation Manual (Document 200171760). New definitions, instructions, and features pertaining to Gen 2 designs will be presented. The two documents are to be used in conjunction and if conflicting information between the manual and the addendum arises, the addendum shall take precedence. For additional information, please contact your local BHGE Service Center or BHGE Engineering.

2. Health, Safety, and Environment (HSE) Fundamentals Checklist

In an effort to provide a minimum recommendation for safely working on and around beam pumping units, Baker Hughes’ 5 Fundamentals and Stop Work Checklist is presented in this section. This checklist is not intended to supersede a company’s internal procedures.

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1. Hazard Identification

Rating (Check One):

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Note:

- General Questions
  - What are the hazards and risks associated with this job?
  - How do you assess them? Who was involved?
  - How did you communicate the risks and to whom?

- Focus Area Specific Questions
  - Have you evaluated risks associated with your journey prior to going to/from the job site?
  - Have you evaluated the tasks and are they within the scope of work?
  - Have you reviewed the job plan with your customer to identify any additional site specific concerns?
  - Is there a potential for dropped objects? What are they (e.g. storage, loading, etc.)? How do we secure loads being moved?
  - How do you remain clear of the line of fire and keep all other out of the potential red zone (e.g. forklift use, lifting)?
  - Tell me about the risks of working at height and how you prevent falls?
  - Please explain the risks related to the chemicals you are handling?
  - What spill risks have you identified? (e.g., chemical transfers, old/damaged hoses or equipment)?
  - What part of this operation/activity might impact the environment (i.e., air, land, and water)?
  - What critical risks have you identified (e.g., electrical, chemical, pressure, explosives, radiation, process safety)?
### 2. Hazard Control

#### General Questions
- What controls are necessary for this job?
- Did you verify if all the controls are implemented and in working order?
- Do you think any controls are missing for this job?
- How have you engaged the customer to manage site specific risks?

#### Focus Area Specific Questions
- What barriers are in place for this job? Have you verified they are working/effective?
- How are you controlling dropped objects risks (e.g., lifting guide, red zones, equipment certified/rated)?
- For fluid/chemical transfers, how do you ensure that you won’t overflow the receiving tank?
- What controls do you use to prevent spills (e.g., inspections, walk the line, double verify valve position, containment)?
- What are the additional precautions you are taking during line break activities (disconnecting hoses, opening valves)?
- What controls do you use related to critical risks including electrical, chemical, pressure, radiation, explosives, and process safety (Pressure testing enclosures, monitoring, voltmeters, equipment rating, ventilation, PPE etc.)?
- What are your emergency shutdown and response procedures?
- How are you handling waste and controlling air emissions from painting, coating, chemical transfers, sand blasting etc.?

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#### Notes

### 3. Understanding the Process

#### General Questions
- What tasks are you performing today? How have you been trained to perform these tasks?
- Where do you find the procedures for this job, can you show me?
- Do the procedures address the risks and controls for this job?

#### Focus Area Specific Questions
- What is your journey management process? Who do you call for approval?
- To what extent are you qualified to conduct critical activities (electrical, chemical, pressure, radiation, explosives, and process safety)?
- Tell me what procedures you use for lifting and rigging (to prevent drops, see lifting guide).
- Describe how you conduct pressure testing? What about unconventional pressure testing (outside of enclosure)?
- What are your procedures for barrier management?
- Are your procedures current/approved, how do you know?

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#### Notes
### 4. Manage Change

**General Questions**

- When do you use Management of Change (MOC) (e.g., changes in well conditions, different equipment / chemicals / people, etc.)?
- When the scope of work changes, what do you do?
- What is your Management of Change process?
- Why is it important to Manage Change?
- Where/how do you document the scope of work change? Who do you communicate the change to?
- How does everyone on this job know they have the duty and obligation to STOP WORK should job conditions change?

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**Notes**

### 5. Lessons Learned

**General Questions**

- Did you review any historical Lessons Learned (Alerts, Bulletins, etc.) relating to the job you are doing?
- Where do you find the Lessons Learned? Do you access them before the job?
- Do you check that controls suggested in lessons learned have been implemented for your job?
- How do you share your lessons learned with your peers?
- What was the last incident that was shared? What was the learning and the action you took?
- Did you share any learning with this customer?
- How would you share the learning with PL resources or technical support team to improve equipment processes or procedures?

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**Notes**
### General Questions
- When should you Stop Work? Give me examples.
- Do you feel empowered and supported by management to Stop Work?
- How would you go about getting the support you need to Stop Work if the customer says to keep going?
- Tell me about a time you used Stop Work. If never, was there a time when you could have used Stop Work?
- Where do you record your Stop Work actions?

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3. Definitions

**Legacy design:** Pumping units or components designed prior to 2016.

**Gen 2 Conventional:** New Conventional pumping unit designed for a global market. These units can be identified by the unit designation on the API tag; they will have a 'G' after the linkage type designation. For example, a 'CG-912D-365-168' is the Gen 2 version of the 'C-912D-365-168' unit.

**Gen 2 Reverse Mark:** New Reverse Mark pumping unit designed for a global market. These units can be identified by the unit designation on the API tag; they will have a 'G' after the linkage type designation. For example, a 'RMG-912D-365-168' is the Gen 2 version of the 'RM-912D-365-168' unit.

**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 and counterweights will rotate when in motion.

**Crank Orientation:** is the location of the cranks using the analogy of a 12-hour clock to describe angles and directions when viewed from the right side. For example, cranks oriented vertically downwards are at the 6 o’clock position.

**Direction of Operation:** Pumping unit operates in the clockwise direction when viewed from the right side and the well is on the right.

4. Technical Regulations and Standards (TRS) Compliance

Before proceeding with the installation, operation or maintenance of a pumping unit, identify all the site regulations and statutes associated with Federal, State and Local law including but not limited to, Electrical codes, Zoned area requirements, EMC, Noise and Air Emission Regulations, Environmental concerns, and Health and Safety regulations along with specific BPU hazards identified in this Operators Manual. For your protection and to prevent equipment damage, please heed the product safety signs attached to the pumping unit.
5. Weight and Hook Data – See 200171760 Section 3

Table 1. Gen 2 Pumping unit rigging heights.

<table>
<thead>
<tr>
<th>CG/RMG Maximum Stroke</th>
<th>Minimum Hook Height from Bottom of Unit Base</th>
<th>Top of Walking Beam to Bottom of Base</th>
</tr>
</thead>
<tbody>
<tr>
<td>240”</td>
<td>45’-8”</td>
<td>33’-3”</td>
</tr>
<tr>
<td>192”</td>
<td>42’-8”</td>
<td>30’-6”</td>
</tr>
<tr>
<td>168”</td>
<td>42’-7”</td>
<td>30’-6”</td>
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</tbody>
</table>

Table 2. Maximum weights, in pounds, of Gen 2 components. Samson Post column includes front and rear legs.

<table>
<thead>
<tr>
<th>Reducer Size</th>
<th>Reducer w/ Cranks</th>
<th>Horsehead</th>
<th>Walking Beam</th>
<th>Equalizer Assembly</th>
<th>Pitman</th>
<th>Samson Post</th>
<th>Center Bearing</th>
<th>Standard Unit Base</th>
<th>Crank Pin Assembly</th>
<th>High Prime Bracket</th>
</tr>
</thead>
<tbody>
<tr>
<td>MG1824D</td>
<td>36,700</td>
<td>3,300</td>
<td>7,100</td>
<td>2,250</td>
<td>935</td>
<td>5,000</td>
<td>1,735</td>
<td>12,335</td>
<td>278</td>
<td>875</td>
</tr>
<tr>
<td>MG1280D</td>
<td>30,900</td>
<td>3,300</td>
<td>7,100</td>
<td>1,950</td>
<td>935</td>
<td>5,000</td>
<td>1,735</td>
<td>12,335</td>
<td>278</td>
<td>875</td>
</tr>
<tr>
<td>MG912D</td>
<td>28,200</td>
<td>2,460</td>
<td>6,800</td>
<td>1,930</td>
<td>665</td>
<td>4,380</td>
<td>1,735</td>
<td>8,400</td>
<td>278</td>
<td>1465</td>
</tr>
<tr>
<td>MG640D</td>
<td>25,400</td>
<td>2,170</td>
<td>5,290</td>
<td>1,710</td>
<td>660</td>
<td>4,380</td>
<td>1,560</td>
<td>8,400</td>
<td>230</td>
<td>1465</td>
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</tbody>
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Table 3. Gen 2 counterweight designation and weight. See Section 14.

<table>
<thead>
<tr>
<th>Designation</th>
<th>Weight (lbs)</th>
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<tbody>
<tr>
<td>00F</td>
<td>3,900</td>
</tr>
<tr>
<td>6300</td>
<td>6,300</td>
</tr>
<tr>
<td>7800</td>
<td>7,800</td>
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6. Chain Selection

Please ensure that the appropriate size and type chain rigging is used. All lifting equipment should be inspected for defects prior to use.

7. Torque Wrench Recommendation – See 200171760 Section 5

The use of an accurate, calibrated torque tool is recommended to ensure that torque requirements at all possible locations are met. The use of an impact torque tool is not recommended as the final torque may vary significantly. Please refer to your torque tool operator manual for proper use. Refer to Table 6 of Section 5.1 of the Operator’s manual for bolt torque requirements. As a reminder, achieving proper bolt torque is paramount for bolted joints to perform as intended.

8. Wedge Locking Washers – See 200171760 Section 5

Wedge locking washers have been added to several bolted connections that have been identified as slip-critical, see Figure 1. These washers assist in mitigating the loosening effects of vibration on bolts. By design, one wedge locking washer is comprised of two halves as shown in Figure 2.
See Appendix document 200172441 for a listing of fasteners and other hardware used at the different bolted connections.

Figure 1. Locations of bolted connections with wedge locking washers.

Figure 2. Wedge locking washer halves interlock.

Lock washers and flat washers should not be used in conjunction with the wedge locking washers. They will prevent the wedge locking washers from engaging properly.
For wedge locking washers to function as intended, the sides of the halves with larger wedges must face each other. REMINDER: A single wedge locking washer is comprised of two halves.

8.1 Wedge Locking Washer Installation

The application of wedge locking washers varies depending on the bolted joint configuration. Table 4 below provides guidance on where to mount wedge locking washers on joints in Gen 2 pumping units.

| Tapped Hole Assembly | 1. Place a washer under the bolt head directly on the contact surface. |
|                      | 2. Mount the bolt in the hole by hand until positioning is completed. |
| Through Hole Assembly| 1. Place a washer on both the bolt head and the nut. |
|                      | 2. Mount the bolt and the nut by hand until positioning is completed. |
| Counter-bore Assembly| 1. Place a washer on the bolt head, in the bottom of the counter-bore hole. |
|                      | 2. Mount the bolt into the threaded hole by hand, until positioning is completed. |
| Stud Bolt Assembly   | 1. Place the stud bolt and mount by hand until positioning in the tapped hole is completed. |
|                      | 2. Place a washer under the nut. |
|                      | 3. Mount the nut by hand until positioning is completed, i.e. the base of the nut is in contact with the upper washer. |

8.2 Tightening of Bolted Joints that use Wedge Locking Washers

For joints that use wedge locking washers, lubrication is required on the fasteners both on the threads and under the bolt head and/or nut. A light or penetrating oil can be used as lubricant. With adequate tools, tighten the fastener to the torque required in Table 6 of Section 5.1 in the Operator’s Manual.
As with every other bolted joint, it is recommended that the position of the elements be match-marked to facilitate future inspections.

9. **Spherical Washers – See 200171760 Section 5.4**

Spherical washers are used at the center bearing foot in the connection to the Samson Post as seen in Figure 3. These washers mitigate the bending in the bolt that would be present given the drafted surface in the center bearing casting. Ensure that the cone is located on top of the cup during installation as seen in Figure 4.

![Diagram of bolted joint stack at the center bearing to Samson Post connection. Note that the cone is facing the lock washer while the cup interfaces with the center bearing casting.](image)

*Figure 3. Bolted joint stack at the center bearing to Samson Post connection. Note that the cone is facing the lock washer while the cup interfaces with the center bearing casting.*

See Appendix document 200172441 for a listing of fasteners and other hardware used at the different bolted connections.
10. **Pumping Unit Setback – See 200171760 Section 7.1**

A notch in the base cross beam or T-head has been added to allow a consistent measurement for the unit setback dimension as seen in Figure 5. Please refer to the unit mounting plan for the correct setback dimension.

**NOTICE**

Legacy and Gen 2 pumping units with the same reducer size, structure rating, and stroke **do not** have the same setback dimensions.

If a Gen 2 unit base without a notch is encountered, search for a setback decal on top of T-head. It will indicate the location from where the setback will need to be measured.
11. **High Prime Assembly Installation – See 200171760 Section 7.1**

High prime brackets on Gen 2 CG-1280 and 1824 units are installed per legacy practices. The high prime bracket assembly on Gen 2 CG and RMG 912 and 640 units has a different order of assembly compared to the assemblies on Legacy units. More specifically, and while referring to Figure 6, the Gen 2 assemblies have a top sub-assembly (bubble 1), two separate braces (bubble 2), and a set slide rails (bubble 3). A detailed procedure is presented in the section below.

See Appendix document 200172441 for a listing of fasteners and other hardware used at the different bolted connections.

11.1 **Installation Procedure**

1. Assemble slide rails (3) to high prime bracket (1) with hand tightened bolts for motor adjustment later. Slide rails may already be preassembled.
2. Assemble braces (2) to unit base with hand tightened bolts.
3. Lift high prime bracket (1) and attach to unit base with hand tightened bolts. Fasten high prime bracket (1) to braces (2) with hand tightened bolts. Align high prime bracket assembly to where it is level with unit base and tighten all bolts.
4. Assemble brake bracket (4) and brake support (5) to high prime bracket (1) and tighten related fasteners.

![Figure 6. Exploded view of Gen 2 hi-prime bracket assembly.](image)
High prime braces (2) are standardized and will have holes in the footplate that do not have corresponding holes in the base itself. This was necessary to allow one brace to be used on both sides.

### 11.2 Alternate (Lowered) Hi-Prime Design

A hi-prime bracket design that installs at a lower position on the unit base as shown in Figure 7 is also available for CG/RMG 912 and 640 units. This design is installed using the same procedures as those used with legacy hi-prime brackets.

![Figure 7. Comparison of high prime brackets offered for CG/RMG 912 and 640 pumping units. The alternate (lowered) Gen 2 unit hi-prime bracket is next to bubble 1 while the original (taller) high prime bracket is next to bubble 2.](image)

The installation of the belt cover designed for the alternate (lowered) CG HP design differs from legacy practices. Namely, it is moved into place in a horizontal fashion instead of vertical.

![Figure 8. Belt cover on alternate (lowered) high prime bracket.](image)

### 12. Crank Pin Assembly – See 200171760 Section 7.2

#### 12.1 General

All Gen 2 beam pumping unit crank pins now come with Superbolt tensioners as standard equipment. The Superbolt replaces the legacy castle nut shown in Figure 9.
12.2 Installation

With an emery cloth, remove any paint and foreign material from the crank pin, crank pin sleeve (both sides), crank pin hole and the mating surfaces between the crank and the crank pin nut. Clean these same areas with a solvent compliant with your company’s quality and HSE policies.

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.

With a 1 in. brush, apply three very light stripes of non-drying machinist blue equally spaced down the length of the pin. Remove any excess with a clean, lint-free cloth – a thick stripe will give a false indication of good contact. Install the crank pin bearing assembly in the crank pin hole without smearing the machinist blue by hand. Thread the crank pin nut onto the crank pin and tighten the nut using the following Superbolt procedure.

Remove the crank pin bearing assembly and inspect the crank pin sleeve. The large bore end of sleeve (hole) should display 100% contact over the first 2” into the bore. Small bore end of sleeve (hole) should display 100% contact over the first 1.5” into the bore. If it is less than this, contact your nearest Lufkin Service organization for advice.

Clean the crank pin as described above and apply a light coat of clean oil to the crank pin sleeve. Wipe away any excess with a clean hand. Line up the crank pin bearing assembly with the crank pin sleeve. Insert the assembly into the crank and thread the Superbolt onto the crank pin.

Do not install the crank pin without properly applying an oil film onto the bores and pin taper OD.

Proper eye protection must be worn; flying metal could cause damage to the eyes.
12.3 Superbolt Installation Procedure

1. Lubricate the hardened washer face and jackbolt tips with Superbolt JL-G lubricant. This lubricant is provided with each assembly.

2. Lubricate the thread of the main stud and slide the hardened washer onto the stud. Spin the tensioner onto the thread until it seats against the washer. Then back the tensioner off a 1/16” – 1/8” to provide a small gap between the nut body and the washer.

3. Tighten the jackbolts to 50% of the targeted torque, 91 LB-FT, use a cross pattern (12:00, 6:00, 9:00, 3:00). Note: jackbolts do not need to be stabilized at this time.

4. Use same cross pattern and tighten all jackbolts to 100% targeted torque, 183 LB-FT.

5. Repeat Step 4 until all jackbolts are stabilized (less than 10-degree rotation). This usually requires 2-4 additional passes.

Overtightening of any jackbolt will cause uneven load distribution in the supernut. If such a condition occurs, it may be necessary to back off all the jackbolts and repeat the process.

12.4 Superbolt Removal Procedure

1. Loosen each jackbolt 1/8 turn following a circular pattern around the tensioner (1 round only). As you move around and get back to the first jackbolt, it will be tight again. Do this for all studs on the joint prior to the next step.

2. Repeat a 2nd round as above for all studs, now loosening each jackbolt ¼ turn in a circular pattern.

3. Continue loosening ¼ turn for 3rd and successive rounds until all jackbolts are loose then remove the tensioner.

Jackbolts must be unloaded gradually. If some jackbolts are fully unloaded prematurely, the remaining jackbolts will carry the entire load and may be hard to turn. With extreme abuse, a jackbolt tip can deform, making removal difficult.

Prior to reuse, remove, clean & re-lubricate the jackbolts with the correct Superbolt lubricant. The washer may also be reused. Small depressions on the washer are normal.

Superbolt Installation and Removal instruction sheets are included with every Gen 2 unit. A sample installation sheet is shown in Figure 10.
13. Gearbox Installation – See 200171760 Section 7.3

Gen 2 unit gearboxes have integrated lifting lugs. A pair of lugs are in the front and rear of the gearbox as seen in Figure 11. The lugs are rated for lifting the gearbox and cranks without counterweights. Use legacy lifting practices if integrated lifting lugs are not present.
The gearbox lifting lugs are not rated to lift with counterweights installed. Remove any counterweights before use.

13.1 Shackle Selection

The lifting lugs were designed to suit a 1-3/4” or 2” Crosby G-209 shackle as shown in Figure 12.
All rigging equipment including chains, hooks, and shackles must be inspected prior to use.

14. Gen 2 Counterweights and Cranks – See 200171760 Section 7.6

Gen 2 counterweights have some features not present in Legacy counterweights. Namely, Gen 2 counterweights are no longer symmetric and will no longer need auxiliaries. As shown in Figure 13 and Figure 14, properly installed counterweights shall:

1. Have their sloping end oriented towards the end of the crank, and
2. Have the outboard face flush with the outboard face of the crank.

Figure 13. Counterweight orientation and placement relative to crank outboard face.
Using Gen 2 counterweights on Legacy units can cause crank sweep interference with the ground. It is recommended that you consult with Lufkin Sales to identify the usage limits of Gen 2 counterweights on legacy cranks.

In addition to geometric changes, threaded inserts have also been added to Gen 2 counterweights to facilitate the safe handling of counterweights that are lying flat. The threaded insert was designed to interface with swivel hoist rings that meet the following requirements:

- 10,000 lbs Working Load Limit
- 1 – 8 UNC, Grade 8 Alloy Socket Head Capscrew per ASTM A574
- Effective Thread Length of 2.35” minimum.

### 14.1 Counterweights on RMG Cranks

**NOTICE**

RMG units must be supplied with the Gen 2 counterweights. Legacy weights will not fit on the new RMG cranks.
14.2 Leading and Lagging Counterweight Position

For Legacy and Gen 2 pumping units, it is recommended to avoid an imbalance of counterweights on one side of your crank. For example, if only two weights are used, position them on opposite sides of your cranks as shown in Figure 15.

⚠️ CAUTION ⚠️

Counterweight positioning that induces a phase angle may impact your pumping unit’s performance.

Unlike Legacy designs, counterweights on the Gen 2 pumping units do not need to be placed at the end of the crank to achieve the maximum counterbalance effect (CBE).

⚠️ CAUTION ⚠️

Locating counterweights in incorrect locations can lead to overloading the unit structure and/or gearbox. Contact Lufkin Sales for information on where to locate counterweights on a crank.

Figure 15. The total weight of the leading counterweights should match the total weight of the lagging counterweights to avoid creating artificial crank phasing.

14.3 Gen2 Crank Features

Gen 2 cranks have some modifications that are not found in legacy unit cranks.
As seen in Figure 16, cranks are 15 inches longer than the commonly used 110 inch cranks (bubble 1), an integrated lifting hole has been added at the end of the crank to facilitate crank rotation (bubble 2), crank pin holes now have straight bores with tapered sleeves (bubble 3), and tick marks spaced every 5 inches have been added along the edges of the crank face (bubble 4).

Anytime it becomes necessary to rotate the cranks to another position, attach chains to both cranks. Use a long sling to minimize excessive stress on the sling and cranks. After the cranks are in the desired position, set the brake, engage the positive-stop pawl and chain the drum.

15. Rear Leg Features and Installation – See 200171760 Section 7.8

The top and bottom Samson post rear leg connections are critical to the proper installation and operation of the pumping unit. Slots were added to the connection plates, the top of the rear leg, and to the interface on the unit base sole plate to facilitate the installation of the rear leg and ensure metal-to-metal contact between the components.

Additionally, wedge locking washers were added to these slip-critical bolted connections to mitigate the possible loss of bolt preload. Refer to Section 8.2 for procedures on tightening bolted joints with wedge locking washers.

Oversized wedge locking washers are used in slip-critical connections. The use of standard size wedge locking washers or any size flat washers in slip critical joints is not allowed.

See Appendix document 200172441 for a listing of fasteners and other hardware used at the different bolted connections.
16. Gen 2 Walking Beam Features

Walking beams on Gen 2 units have been redesigned to accommodate the new unit’s linkage and include several design improvements.

16.1 Lifting Lugs

Two lifting lugs for use during installation have been added as a standard design feature. These shall be used as the primary method for upper structure (walking beam, equalizer, and pitmans) installation/removal. If lugs are not present, a set of appropriately sized beam clamps suitable for angled lifts shall be used. Walking beam lifting diagrams that provide weight and center of gravity information are available.

**CAUTION**

Inspect all lifting lugs for cracks in welds or material before use.

*It is a requirement to use the lifting lugs for installation. The new unit walking beams reach steeper angles than prior designs. The legacy “choke” rigging configuration shall never be employed due to the possibility that the beam may slip during installation.*

16.2 Walking Beam Horsehead Adjusting Plates and Horsehead Safety Bar Hole

The adjusting plates that the horsehead adjusting screws push from have been moved outside the beam section. The horsehead safety bar hole is now located on the beam web inside the head plate. These changes can be seen in Figure 17.

![Figure 17. Illustration of the forward end of a Gen 2 walking beam. (Right) Illustration of alternate horsehead adjusting plates on Gen 2 walking beam.](image-url)
16.3 Walking Beam Safety Cable

This is an optional feature that may be on your product. It can be used as a tie off point for a lanyard or harness during maintenance of the unit. If installed, please ensure that the turnbuckle torqued to 100-200 in-lbs prior to use.

![Figure 18. Illustration of safety cable installation on Gen 2 walking beams.](image)

16.4 Bolt-On Equalizer Hinge Pin Lugs

This connection was switched from a welded to a bolted configuration as seen in Figure 19. The lugs are pre-installed and will not need adjustment. They do not need to be removed during disassembly. If removed, please contact your local BHGE Service Center for instructions on reassembly and realignment. If difficulty with installing the hinge pin is experienced, look for possible movement between the lugs as unintended shifting may have occurred during disassembly.
This is a slip-critical connection that requires wedge locking washers. If hinge pin lugs are removed, the wedge locking washers must be re-installed.

16.4.1 Installation of Hinge Pin – See 200171760 Section 7.12.3
It is recommended that wedges be inserted into the hinge pin lug slots to facilitate the installation of the hinge pin. If excessive force is needed to move the hinge pin, remove the pin and check for axial alignment between the hinge pin lugs and equalizer bearing housing.

Avoid standing in the path and direction of installed wedges. Sudden or unintended movements may dislodge the wedges and turn them into projectiles.

Continued impacts to the face of the hinge pin may cause the surface to “mushroom”.

This permanent deformation will prevent the hinge pin from fully seating in the hinge pin lugs.

17. Walking Beam & Center Bearing Interface – See 200171760 Section 7.12.2
Metal-to-metal contact must be guaranteed to prevent slip in the joint. Ensure that all paint has been removed from the connecting surfaces. After center bearing installation, touch up any exposed metal areas with anti-rust paint to prevent corrosion.

See Appendix document 200172441 for a listing of fasteners and other hardware used at the different bolted connections.

18. Gen 2 Center Bearing Installation – See 200171760 Section 7.12
Installation of the center bearing assembly continues to be per standard operating procedures and the current installation manual with the following exceptions.
The OT1 center bearing on Gen 2 units shall be installed on the walking beam and samson post with the grease ports facing the well. With this location, the grease ports and street ell fittings are accessible in the preferred LOTO position with the cranks at 6 o’clock as seen in Figure 20. For additional reference, see Figure 21 and Figure 22. If grease ports are pointing to the rear of the unit, the cranks will need to be positioned horizontally or above before LOTO to easily access the street ells on the center bearing assembly.

The center bearing to Samson post connection requires the use of spherical washers. Refer to Section 9 for installation instructions.

If a unit with direct-greasing is ordered, the street ells and grease fittings should be installed pointing toward the well and parallel to the sweep of the saddle cap when finished to prevent contact during operation. See Figure 21 and Figure 22.
Figure 21. Incorrect orientation of street ell fitting

Figure 22. Correct orientation of street ell fitting.
The street ells on the center bearing assembly should be installed pointing toward the well and parallel to the sweep of the cap on units with ground greasing. This orientation prevents contact during operation. The hoses connecting the street ell to the grease pipe fitting on the Samson post should route as shown in Figure 23.

![Figure 23. Preferred routing of ground greasing hoses used on OT1 center bearings.](image)

19. **Gen 2 Equalizer Assembly Features – See 200171760 Section 7.12**

The equalizer beam now features bolted connections like the walking beam hinge pin lugs. The lugs are pre-installed as seen in Figure 24 and will not need adjustment. They do not need to be removed during disassembly. If removed, please contact your local Lufkin Service Center for reassembly and realignment.

**NOTICE**

This is a slip-critical connection that requires wedge locking washers. If the equalizer lugs are removed, the wedge locking washers must be re-installed.
19.1 OR Equalizer Bearing Assembly on RMG units

Due to the updated geometry of the RMG units, the equalizer assembly should be installed with the grease port on the bearing assembly facing the well, and the equalizer grease hose routes from the interior side. Since this installation is inverted from typical equalizer installs, keep in mind that the hose clip on the top of the equalizer beam and the pitman with the ground oiling pipe will need to be installed on the same side. See Figure 25.

Figure 24. Illustration of Gen 2 equalizer with bolted lugs.
20. **Gen 2 Horsehead Installation – See 200171760 Section 7.21**

For the horsehead to properly seat on the walking beam during installation, it is recommended to install with the walking beam at the horizontal position. The Gen 2 horseheads still employ a safety bar and adjusting screws for restraint and minor lateral positioning, respectively.

![Figure 25. Path of oiling hose for equalizer bearings on RMG units.](image)

Cranks will not be at a zero energy state when the walking beam is at the horizontal position. Ensure that all safety precautions are taken to prevent the cranks from moving during this installation phase. See 200171760 Section 2.3.

21. **Gearbox Lubrication**

21.1 **Gen 2 Gearbox Oil Capacity – See 200171760 Section 4.2**

The volume of oil used in the Gen 2 gearboxes is comparable to that used in similarly sized gearboxes on legacy Lufkin pumping units. The specific capacities of Gen 2 gearboxes are shown in Table 5.

<table>
<thead>
<tr>
<th>CG/RMG Gearbox Size</th>
<th>Capacity</th>
</tr>
</thead>
<tbody>
<tr>
<td>MG1824D</td>
<td>140 GAL</td>
</tr>
<tr>
<td>MG1280D</td>
<td>118 GAL</td>
</tr>
<tr>
<td>MG912D</td>
<td>103 GAL</td>
</tr>
<tr>
<td>MG640D</td>
<td>52 GAL</td>
</tr>
</tbody>
</table>
22. Mounting Plans

Starting in 2012, Lufkin began developing mounting plans to facilitate the installation of Lufkin pumping units. The appropriate mounting plan is included in the unit’s shipping packet.

Each plan contains the following information: Unit setback and standoff from concrete, overall unit dimensions, unit base loads going into the foundation, general foundation requirements, hold down clamp and associated hardware part numbers, and vertical wireline/carrier bar clearance information. As sample mounting plan can be seen in Figure 26. For additional information contact your local Lufkin sales or service representative.

Figure 26. Sample mounting plan.
GEN2 STRUCTURAL JOINTS
This document is provided to assist in identification of the correct hardware configurations for each field installed structural joint on the Gen2 unit. The figures are included to enable effective communication but may not be an exact representation of your equipment.

Installation of the correct hardware and application of the specified torque is critical to ensure the reliable and safe operation of the beam pumping unit.
Table 1: Metal to Metal Tightening Requirements

<table>
<thead>
<tr>
<th>Bolt Size</th>
<th>Grade 5 Medium Carbon Steel Quenched and Tempered</th>
<th>Preload Torque [ft.-lbs.]</th>
</tr>
</thead>
<tbody>
<tr>
<td>3/4” – 10 UNC</td>
<td></td>
<td>253 - 279</td>
</tr>
<tr>
<td>7/8” – 9 UNC</td>
<td></td>
<td>409 - 451</td>
</tr>
<tr>
<td>1” – 8 UNC</td>
<td></td>
<td>612 - 676</td>
</tr>
<tr>
<td>1 1/8” – 7 UNC</td>
<td></td>
<td>755 – 834</td>
</tr>
<tr>
<td>1 1/4” – 7 UNC</td>
<td></td>
<td>1064 - 1176</td>
</tr>
<tr>
<td>1 1/8” – 6 UNC</td>
<td></td>
<td>1395 - 1542</td>
</tr>
<tr>
<td>1 1/2” – 6 UNC</td>
<td></td>
<td>1849 - 2049</td>
</tr>
</tbody>
</table>

For joints using wedge locking washers, apply a light penetrating oil such as WD-40 to the threads, under the bolt head, and under the nut.

Types of Washers

Wedge locking washer

Image source: [www.nord-lock.com](http://www.nord-lock.com)

One wedge locking washer is comprised of two halves. Wedge locking washers are used in joints where vibration or cyclic loading require enhanced resistance to loosening.

The outside faces have small, narrow ratchet ramps and the inside facing ratchets are larger. The wedge locking washers are usually shipped with a temporary adhesive to keep the two halves paired together but if they have become separated, verify they are oriented correctly.

Spherical washer

One spherical washer is comprised of two halves. These washers reduce the bending in the bolt that would be present given a drafted surface as may occur with certain castings.

Lock washer

Image source: [www.fastenal.com](http://www.fastenal.com)

Flat washer

Image source: [www.fastenal.com](http://www.fastenal.com)

Note: Do not install flat washer or lock washer next to wedge locking washer.
### FRONT LEG TO T-HEAD

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>BOLT, REGULAR HEX HEAD</td>
<td>8</td>
<td>1-1/4&quot;</td>
<td>1-1/4&quot;</td>
<td>1-1/4&quot;</td>
</tr>
<tr>
<td>WASHER, LOCK</td>
<td>8</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NUT, HEAVY HEX</td>
<td>8</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

See Table 1 for torque requirements.

### REAR LEG TO SUB BASE

<table>
<thead>
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<th></th>
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<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>NUT, HEAVY HEX</td>
<td>4</td>
<td>1-1/4&quot;</td>
<td>1-1/2&quot;</td>
<td>1-1/2&quot;</td>
</tr>
<tr>
<td>BOLT, REGULAR HEX HEAD</td>
<td>4</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>WASHER, WEDGE LOCK-oversized</td>
<td>8</td>
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<td></td>
<td></td>
</tr>
</tbody>
</table>

See Table 1 for torque requirements.
## FRONT LEG TO REAR LEG

<table>
<thead>
<tr>
<th></th>
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<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>117 NUT, HEAVY HEX</td>
<td>16</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>115 BOLT, REGULAR HEX HEAD</td>
<td>16</td>
<td>1-1/4”</td>
<td>1-1/2”</td>
<td>1-1/4”</td>
</tr>
<tr>
<td>557 WASHER, WEDGE LOCK-OVERSIzed</td>
<td>32</td>
<td></td>
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</tbody>
</table>

See Table 1 for torque requirements.

## CENTER BEARING TO S/POST*

<table>
<thead>
<tr>
<th></th>
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<th></th>
<th></th>
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<tbody>
<tr>
<td>89 BOLT, REG-HX HD</td>
<td>4</td>
<td>1-1/4”</td>
<td>1-1/2”</td>
<td>1-1/4”</td>
</tr>
<tr>
<td>90 WASHER, LOCK</td>
<td>4</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>91 WASHER, SPHERICAL</td>
<td>4</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>92 NUT, HEAVY HEX</td>
<td>4</td>
<td></td>
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</tbody>
</table>

See Table 1 for torque requirements.

This is the preferred orientation. However, See end of document for other acceptable assembly configurations.
CENTER BEARING TO WALKING BEAM

<table>
<thead>
<tr>
<th></th>
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<th></th>
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</thead>
<tbody>
<tr>
<td>BOLT, REGULAR SQUARE HEAD</td>
<td>4</td>
<td>1-1/2”</td>
<td>1-1/2”</td>
<td>1-1/2”</td>
</tr>
<tr>
<td>WASHER, WEDGE LOCKING</td>
<td>4</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NUT, HEAVY HEX</td>
<td>8</td>
<td></td>
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</tr>
</tbody>
</table>

See Table 1 for torque requirements.

PITMAN TO EQUALIZER

<table>
<thead>
<tr>
<th></th>
<th></th>
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<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>SCREW, CAP-HEX HEAD</td>
<td>8</td>
<td>7/8”</td>
<td>1-1/4”</td>
<td>1-1/4”</td>
</tr>
<tr>
<td>NUT, HEAVY HEX</td>
<td>8</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>WASHER, LOCK</td>
<td>8</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

See Table 1 for torque requirements.
# REDUCER TO UNIT BASE

<table>
<thead>
<tr>
<th></th>
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</thead>
<tbody>
<tr>
<td>4 BOLT, REGULAR HEX HEAD</td>
<td>varies by reducer</td>
<td>1-1/4”</td>
<td>1-1/2”</td>
</tr>
<tr>
<td>5 NUT, HEAVY HEX</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

See Table 1 for torque requirements.
MOTOR BRACKET – HIGH PRIME, STYLE 1

The first high prime style mounts to the sub-base and holds the motor at the same elevation as the gear reducer.

STYLE 1: HIGH PRIME BRACKET, HIGH PRIME BRACE TO FRAME (JOINT 1)

<table>
<thead>
<tr>
<th>Generic Description</th>
<th>Total Quantity</th>
<th>Diameter:</th>
</tr>
</thead>
<tbody>
<tr>
<td>NUT, HEAVY HEX</td>
<td>4</td>
<td>1-1/4”</td>
</tr>
<tr>
<td>BOLT, REGULAR HEX HEAD</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>WASHER, WEDGE LOCKING</td>
<td>8</td>
<td></td>
</tr>
</tbody>
</table>

See Table 1 for torque requirements.
### STYLE 1: HIGH PRIME BRACKET, HIGH PRIME TO BASE, BRACE (JOINT 2)

<table>
<thead>
<tr>
<th>Generic Description</th>
<th>Total Quantity</th>
<th>Diameter:</th>
</tr>
</thead>
<tbody>
<tr>
<td>197 NUT, HEAVY HEX</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>218 BOLT, REGULAR HEX HEAD</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>567 WASHER, LOCK</td>
<td>4</td>
<td>1-1/4”</td>
</tr>
<tr>
<td>568 WASHER, FLAT</td>
<td>4</td>
<td></td>
</tr>
</tbody>
</table>

See Table 1 for torque requirements.

### STYLE 1: HIGH PRIME BRACKET, HIGH PRIME TO BASE, FRAME (JOINT 3)

<table>
<thead>
<tr>
<th>Generic Description</th>
<th>Total Quantity</th>
<th>Diameter:</th>
</tr>
</thead>
<tbody>
<tr>
<td>197 NUT, HEAVY HEX</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>199 BOLT, REGULAR HEX HEAD</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>567 WASHER, LOCK</td>
<td>4</td>
<td>1-1/4”</td>
</tr>
</tbody>
</table>

See Table 1 for torque requirements.
**MOTOR BRACKET - HIGH PRIME, STYLE 2**

The second high prime style mounts to the sub-base and the base and holds the motor several feet below the elevation of the gear reducer.
### STYLE 2: HIGH PRIME BRACKET, HIGH PRIME TO SUB-BASE, BRACE (JOINT 1)

<table>
<thead>
<tr>
<th>Generic Description</th>
<th>Total Quantity</th>
<th>Diameter:</th>
</tr>
</thead>
<tbody>
<tr>
<td>218 BOLT, REGULAR HEX HEAD</td>
<td>4</td>
<td>1-1/4”</td>
</tr>
<tr>
<td>219 WASHER, LOCK</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>220 NUT, HEAVY HEX</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>568 WASHER, FLAT</td>
<td>4</td>
<td></td>
</tr>
</tbody>
</table>

See Table 1 for torque requirements.

![Diagram of Style 2 Joint 1](image)

---

### STYLE 2: HIGH PRIME BRACKET, HIGH PRIME TO BASE, FRAME (JOINT 2)

<table>
<thead>
<tr>
<th>Generic Description</th>
<th>Total Quantity</th>
<th>Diameter:</th>
</tr>
</thead>
<tbody>
<tr>
<td>195 SCREW, HEX HEAD</td>
<td>4</td>
<td>3/4”</td>
</tr>
<tr>
<td>196 WASHER, LOCK</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>197 NUT, HEAVY HEX</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>221 WASHER, FLAT</td>
<td>8</td>
<td></td>
</tr>
</tbody>
</table>

See Table 1 for torque requirements.

![Diagram of Style 2 Joint 2](image)
Alternative Center Bearing to Samson Post Configurations

The hardware configuration can be assembled in a different order than what is stated above so long as the spherical washer is still assembled with the cone adjacent to the joint hardware (nut, bolt head, or lock washer) and the cup contacting the surface being joined (top of the center bearing foot or the underside of the Samson Post top plate).