

# SLX Manual Lock Ram BOP User's Manual



Prepared For:

**Gulf Drilling International**

**Rig: Gulf 4**

**Sales Order #: 812659**

**Doc. P/N: 29101209**

**NOV** NATIONAL OILWELL VARCO



Sales Order  
812659

Gulf  
Drilling  
International

Rig: Gulf 4

SLX Ram BOP  
User's Manual



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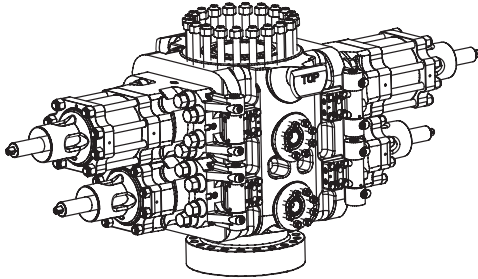
Gulf  
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NATIONAL OILWELL VARCO



# User's Manual

## SLX Manual Lock BOP

Customer Name <b>Gulf Drilling International</b>
Rig Name <b>Gulf Rig 4</b>
Sales Order Number <b>812659</b>

Reference <b>29101209</b>	Reference Description <b>SLX Manual Lock BOP</b>
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# General Information

This manual is intended for use by field engineering, installation, operation, and repair personnel. Every effort has been made to ensure the accuracy of the information contained herein. Varco® International, Inc., will not be held liable for errors in this material, or for consequences arising from misuse of this material.

## Conventions

### Notes, Cautions, and Warnings

Notes, cautions, and warnings provide readers with additional information, and to advise the reader to take specific action to protect personnel from potential injury or lethal conditions. They may also inform the reader of actions necessary to prevent equipment damage. Please pay close attention to these advisories.

#### Note:



The note symbol indicates that additional information is provided about the current topics.

#### Caution:



*The caution symbol indicates that potential damage to equipment or injury to personnel exists. Follow instructions explicitly. Extreme care should be taken when performing operations or procedures preceded by this caution symbol.*

#### Warning:



**The warning symbol indicates a definite risk of equipment damage or danger to personnel. Failure to observe and follow proper procedures could result in serious or fatal injury to personnel, significant property loss, or significant equipment damage.**

## Illustrations

Illustrations (figures) provide a graphical representation of equipment components or screen snapshots for use in identifying parts or establishing nomenclature, and may or may not be drawn to scale.

For component information specific to your rig configuration, see the technical drawings included with your Varco documentation.

## Safety Requirements

Varco equipment is installed and operated in a controlled drilling rig environment involving hazardous situations. Proper maintenance is important for safe and reliable operation. Procedures outlined in Varco manuals are the recommended methods of performing operations and maintenance.



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*To avoid injury to personnel or equipment damage, carefully observe requirements outlined in this section.*

---

## Personnel Training

All personnel performing installation, operations, repair, or maintenance procedures on the equipment, or those in the vicinity of the equipment, should be trained on rig safety, tool operation, and maintenance to ensure their safety.



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*Personnel should wear protective gear during installation, maintenance, and certain operations.*

---

Contact the Varco Drilling Equipment training department for more information about equipment operation and maintenance training.

## Recommended Tools

Service operations may require the use of tools designed specifically for the purpose described. Varco recommends that only those tools specified be used when stated. Ensure that personnel and equipment safety are not jeopardized when following service procedures or using tools not specifically recommended by Varco.

## General System Safety Practices

The equipment discussed in this manual may require or contain one or more utilities, such as electrical, hydraulic, pneumatic, or cooling water.



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*Read and follow the guidelines below before installing equipment or performing maintenance to avoid endangering exposed persons or damaging equipment.*

---

- ❑ Isolate energy sources before beginning work.
- ❑ Avoid performing maintenance or repairs while the equipment is in operation.
- ❑ Wear proper protective equipment during equipment installation, maintenance, or repair.

## Replacing Components

- ❑ Verify that all components (such as cables, hoses, etc.) are tagged and labeled during assembly and disassembly of equipment to ensure correct installment.
- ❑ Replace failed or damaged components with Varco certified parts. Failure to do so could result in equipment damage or injury to personnel.

## Routine Maintenance

Equipment must be maintained on a routine basis. See the service manual for maintenance recommendations.



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*Failure to conduct routine maintenance could result in equipment damage or injury to personnel.*

---

## Proper Use of Equipment

Varco equipment is designed for specific functions and applications, and should be used only for its intended purpose.

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# Overview

## General Description

The National Oilwell Varco manual lock Model SLX ram blowout preventer provides a rugged, reliable preventer that is easily serviced in the field. Special features include:

- ❑ New door design is a lighter and shorter profile than earlier models. The simple SLX door design provides less stress and easy maintenance.
- ❑ Doors on the BOP are interchangeable.
- ❑ Booster assemblies can be added easily to the new design.
- ❑ Flat doors to simplify ram changes.
- ❑ New design cartridge seal assembly employs a radial seal to pressure-assist a face seal and prevent extrusion. This feature allows reduced door bolt torque.
- ❑ Hinge bracket redesign has added needle roller thrust bearings. The force required to move the door from open to close and vice versa has been reduced significantly.
- ❑ Body design utilizes a space-saving ram cavity design. BOP heights and weights have been optimized using finite element analysis. Body to door interface surfaces are polymer coated to minimize corrosion.
- ❑ Ram shafts are nickel plated for corrosion and improved wear characteristics.
- ❑ Standard internal H<sub>2</sub>S trim.
- ❑ Lip-type ram shaft seals to hold the wellbore pressure and the opening hydraulic pressure.
- ❑ Secondary ram shaft seals to permit injection of plastic packing if the primary lip-type seal ever fails.

The manual lock SLX BOP is available in single and double models. (Contact NOV Sales for special configurations.) This manual provides the installation, operation, and maintenance procedures for the SLX BOP model with 15.25" manual locking cylinders. See Figure 2-1 on Page 2-2

These BOPs are designed for drilling and workover service. They are hydraulically operated and can be manually locked by turning handwheels. The standard trim unit is suitable for internal H<sub>2</sub>S environments. Units can be manufactured for Arctic (to -75° F or -59° C) and full H<sub>2</sub>S environmental services. Standard units can be retrofitted for full environmental H<sub>2</sub>S service. Shaffer preventers are manufactured in accordance with the American Petroleum Institute (API) specification 16A (third edition) and the National Association of Corrosion Engineers (NACE) document NACE Standard MR 01 75.

Hydraulic pressure of 1,500 psi (103 bar) will close any model SLX ram BOP with its rated wellbore pressure or less. Maximum of 3,000 psi (207 bar) can be used.

The specifications and dimensions given are for the 13 <sup>5</sup>/<sub>8</sub>" 10,000 psi manual lock SLX. The Shaffer model SLX ram BOP can be supplied with booster cylinders if required. See Figure 2-1 on Page 2-2.

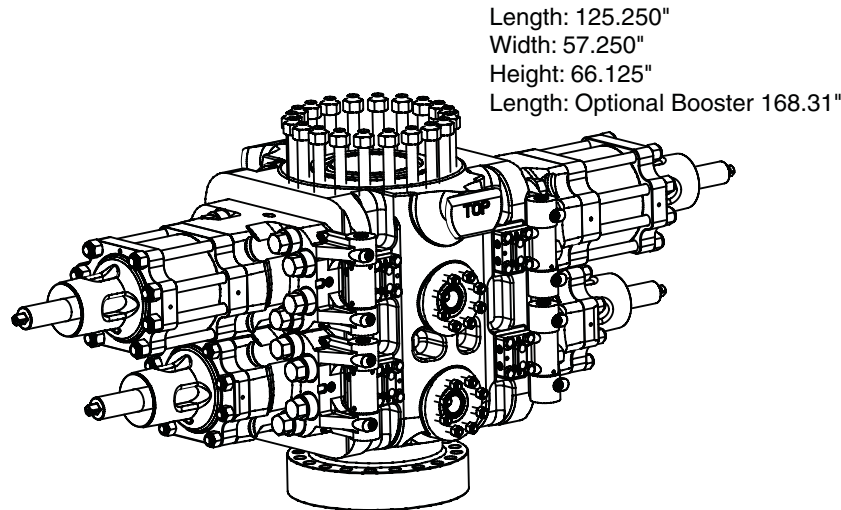


Figure 2-1. 13<sup>5</sup>/<sub>8</sub>” 10,000 psi Manual Lock SLX BOP with Optional Booster Cylinders

## Safety Precautions

Exposure to the daily hazards of drilling can lead rig crews and service personnel to disregard or overlook hidden hazards. The safety precautions listed below should be observed at all times.

### Equipment Repairs or Adjustments

Turn off the system power and bleed all pressure prior to making any repairs or adjustments that do not require system power.

### Hydraulic Lines

Hydraulic lines carrying fluids at high pressures can inflict potentially fatal injuries if the pressure escapes. Protect hydraulic lines from cutting, scraping, pinching, or other physical damage. Always wear hard hats and safety glasses when working around hydraulic lines. Bleed the pressure from any hydraulic line prior to disconnecting any fittings. Respect the prescribed ASME code minimum bend radius for hydraulic lines. Bending around too short a radius can rupture the line.

### Welding and Cutting

Do not weld or operate acetylene-cutting torches near unprotected electrical cable, flexible hose, or hose bundles. Weld spatter can seriously damage the hose or cable. Ensure no slag or spatter enters the hydraulic system.

### Replacement Parts

Many of the BOP components, though apparently similar to commercial hardware, are manufactured to system design specifications. To avoid possible hazardous failures, use only exact replacement parts or assemblies. (See Chapter 5 for more information.)

# Installation and Operation

## Inspection

The inspection process includes the activities listed below.

- ❑ Thoroughly clean the SLX manual lock blowout preventer (BOP) before installation. Refer to the table titled "SLX Ram BOP Cleaning and Lubricating Instructions" on page 4-42.
- ❑ Clean and inspect the sealing surface of the ring groove for minor pits and scratches. Remove these with emery cloth. If there is excessive damage, call a Shaffer service representative.
- ❑ Clean and inspect studs and nuts. Replace any that are damaged.
- ❑ Ensure the correct size rams are in each cavity. The part number is stamped into the block of each ram.
- ❑ Thoroughly clean and grease the inside of the SLX BOP.

## Condition of BOP is Unknown

If the condition of the BOP is unknown, e.g., stored for some length of time, has not been maintained on a scheduled maintenance program, etc., perform a three-month maintenance check as described in the section titled "Three-Month Preventive Maintenance" on page 4-4. A three-month maintenance check includes:

- ❑ Visually inspecting and thoroughly greasing the inside of the BOP
- ❑ Performing a field wellbore pressure test as described in the section titled "Field Wellbore Pressure Test" on page 4-6
- ❑ Performing an hydraulic pressure test as described in the section titled "Hydraulic Pressure Test" on page 4-8
- ❑ Operating the manual locks as described in the section titled "Manual Locking" on page 3-11

## BOP Maintained on a Scheduled Maintenance Program

If the BOP has been properly maintained (scheduled maintenance program), a monthly maintenance check (the section titled "Monthly Preventive Maintenance" on page 4-3) is all that is required. A monthly maintenance check includes:

- ❑ Performing a field wellbore pressure test per the section titled "Field Wellbore Pressure Test" on page 4-6
- ❑ Checking for external hydraulic leaks while pressure testing



Cleaning, inspection and testing of the SLX BOP immediately after completion of drilling operations reduces installation time on the next well (see the section titled "Cleaning and Storage of the SLX BOP" on page 4-37).

## Installation Instructions

### Install BOP Right-Side-Up

- ❑ Some models have 'Top' or 'This Side Up' cast into the BOP housing.
- ❑ Some models have lifting lugs above the mud flange outlets (see Figure 3-1).

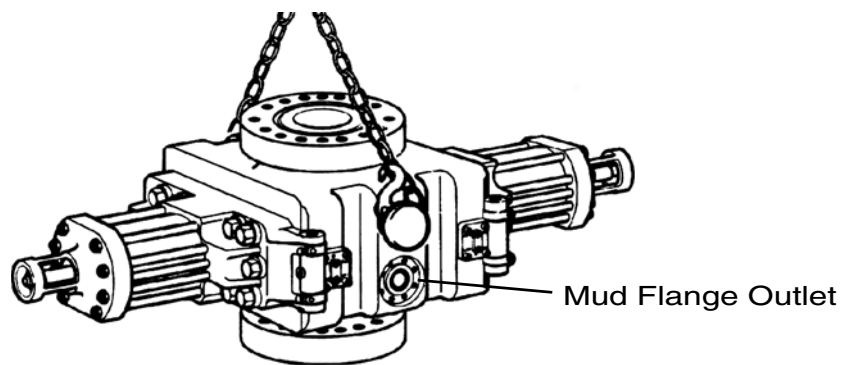


Figure 3-1. Lifting A Typical SLX BOP

- ❑ On all models and on models without a stamping or lugs:
  - ❑ Externally, the side outlets for the choke and kill lines are below the rams
  - ❑ Internally, the skids in the ram compartments are below the rams, and ram sealing seats are located in the top of the ram cavity



**If the BOP is installed upside-down, it will not contain wellbore pressure.**

### Lift the SLX Manual Lock BOP

On models with lifting lugs cast into the body, the BOP is lifted by wrapping a chain, strap or cable of sufficient strength around the lug (see Figure 3-1).





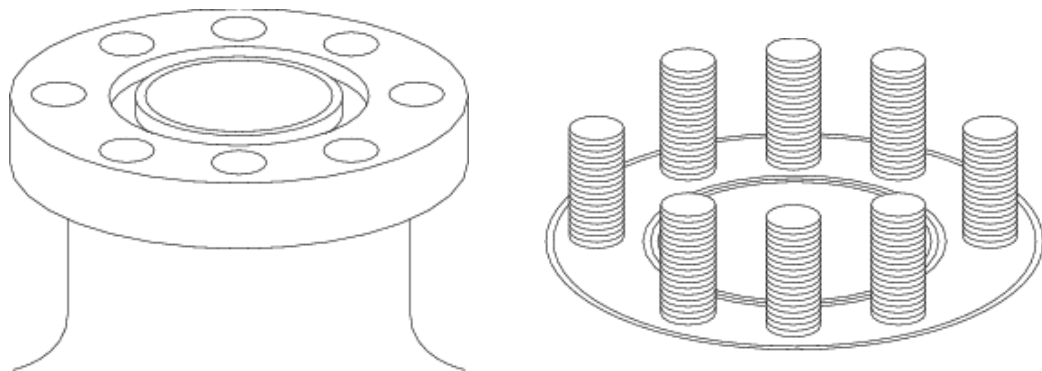
*Do not lift the BOP by the cylinders. This will damage the cylinders, piston assembly and/or the ram shaft and prevent the BOP from working correctly.*



See Page 5-1 titled BOP Characteristics for the weight of the BOP. Use a chain, strap or cable capable of lifting the weight given.

### Flanged and Studded Connections

(see Figure 3-2)



**Figure 3-2. End Connections**

1. Install the ring gasket dry. See the table titled "API Ring Gaskets" on page 5-12, for the proper part number.
2. Install the BOP on the mating flange.
3. Lubricate the stud threads and nut faces with grease specified in API BUL RP 5A3: Thread Compounds for casing, tubing, and line pipe.

4. Install the studs and/or nuts. See the table titled "API Nuts" on page 5-10 and the table titled "Tap End Studs for API Flanges" on page 5-11 for the proper part number.



Use extreme care during the removal and installation of studs and nuts. Inspect the threads of the studs and the stud hole for damage such as deformation, stripping or burns. Do not over torque studs when installing in studded flange.

Use specified lubricants.

Do not use loctite or similar compounds.

5. Tighten all nuts uniformly in a diametrically staggered pattern as shown in Figure 3-3. See the table titled "API Bolting Data" on page 3-5 for proper torque specifications.

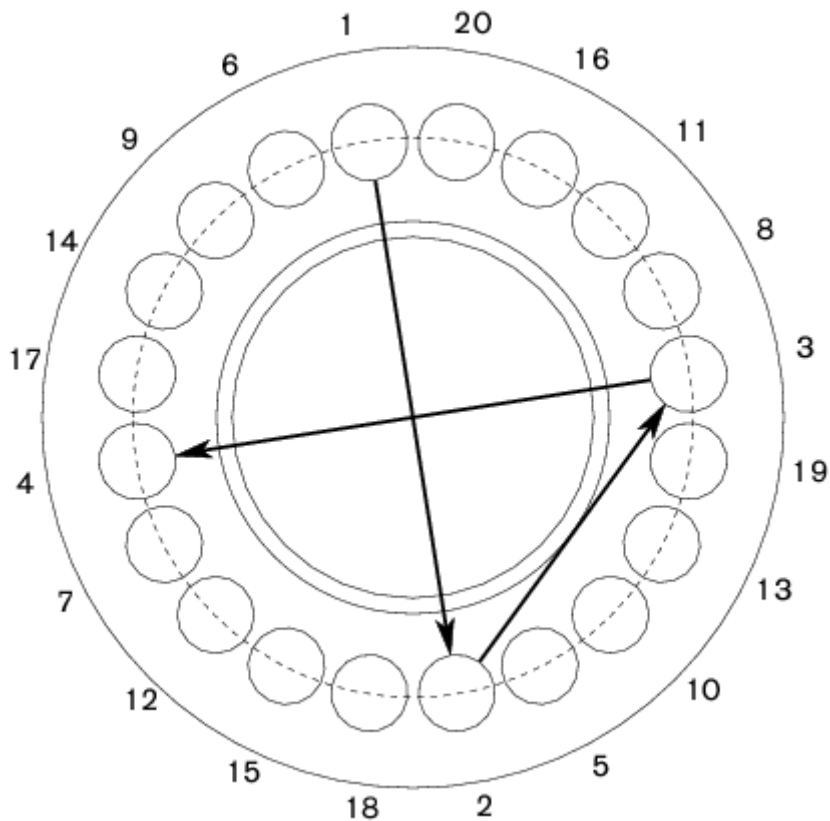


Figure 3-3. Flange Bolting Sequence

**API Bolting Data**

Working Press. (psi)	Flange Size	API Stud, Nut Size	Wrench Size	Torque (ft-lbs)*	Number of Studs	Ring Gasket
15,000	18 <sup>3</sup> / <sub>4</sub> "	3"	4 <sup>5</sup> / <sub>8</sub> "	7479	20	BX-164
	13 <sup>5</sup> / <sub>8</sub> "	2 <sup>1</sup> / <sub>4</sub> "	3 <sup>1</sup> / <sub>2</sub> "	3149	20	BX-159
	11"	2"	3 <sup>1</sup> / <sub>8</sub> "	2209	20	BX-158
	3 <sup>1</sup> / <sub>16</sub> "	1 <sup>1</sup> / <sub>8</sub> "	1 <sup>13</sup> / <sub>16</sub> "	386	8	BX-154
10,000	21 <sup>1</sup> / <sub>4</sub> "	2 <sup>1</sup> / <sub>2</sub> "	3"	4324	24	BX-166
	18 <sup>3</sup> / <sub>4</sub> "	2 <sup>1</sup> / <sub>4</sub> "	3 <sup>1</sup> / <sub>2</sub> "	3149	24	BX-164
	16 <sup>3</sup> / <sub>4</sub> "	1 <sup>7</sup> / <sub>8</sub> "	2 <sup>15</sup> / <sub>16</sub> "	1818	24	BX-162
	13 <sup>5</sup> / <sub>8</sub> "	1 <sup>7</sup> / <sub>8</sub> "	2 <sup>15</sup> / <sub>16</sub> "	1818	20	BX-159
	11"	1 <sup>3</sup> / <sub>4</sub> "	2 <sup>3</sup> / <sub>4</sub> "	1476	16	BX-158
5,000	21 <sup>1</sup> / <sub>4</sub> "	2"	3 <sup>1</sup> / <sub>8</sub> "	2209	24	BX-165
	18 <sup>3</sup> / <sub>4</sub> "	2"	3 <sup>1</sup> / <sub>8</sub> "	2209	20	BX-163
	16 <sup>3</sup> / <sub>4</sub> "	1 <sup>7</sup> / <sub>8</sub> "	2 <sup>15</sup> / <sub>16</sub> "	1818	16	BX-162
	13 <sup>5</sup> / <sub>8</sub> "	1 <sup>5</sup> / <sub>8</sub> "	2 <sup>3</sup> / <sub>4</sub> "	1180	16	BX-160

\* Recommended torque values apply when using NOV recommended thread lubricants:

- Select-A-Torque 503 Moly Paste (or equivalent friction coefficient = 0.067) - NOV P/N 7403582
- Felpor Moly Paste (formerly Felpro - C-670)



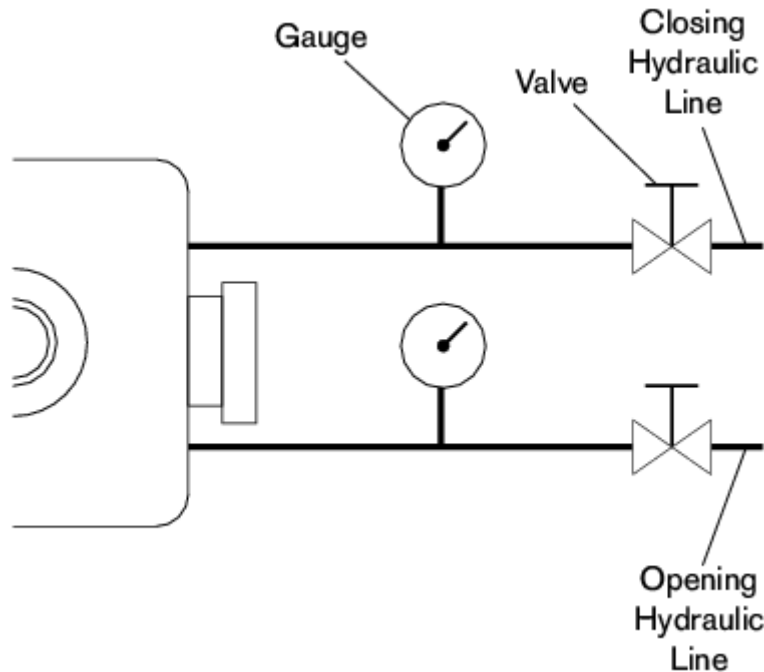
**Torque values change according to different thread lubricants and their friction coefficient.**

**Connect the Side Flanges**

Connect the side flanges as in items 3 through 5 under "Flanged and Studded Connections".

### Connect the Hydraulic Lines from the BOP Closing Unit

Connect the hydraulic lines from the BOP closing unit to the 'Open' and 'Close' ports of the BOP. Make sure all connections are clean and tight. Each set of rams requires one opening and one closing line (see Figure 3-4).



**Figure 3-4. Recommended Hydraulic Line Hookup**



Two opening and two closing hydraulic ports are clearly marked on the back (hinge) side of the BOP (see Figure 3-6). The extra hydraulic ports are provided to facilitate hydraulic hookup and only one opening port and one closing port is to be used.

A gauge and valve should be included in the opening and closing hydraulic lines to the BOP. This will facilitate testing procedures (see Figure 3-4).

### Handwheel

A universal joint and handwheel can be purchased for each locking shaft. Handwheel extensions can be cut from standard weight 2" (50.80 mm) pipe furnished by the customer.

Fabricate a handwheel extension for each locking shaft. Attach a handwheel to one end of each extension. Attach a universal joint to the other end of each handwheel extension (see Figure 3-5).

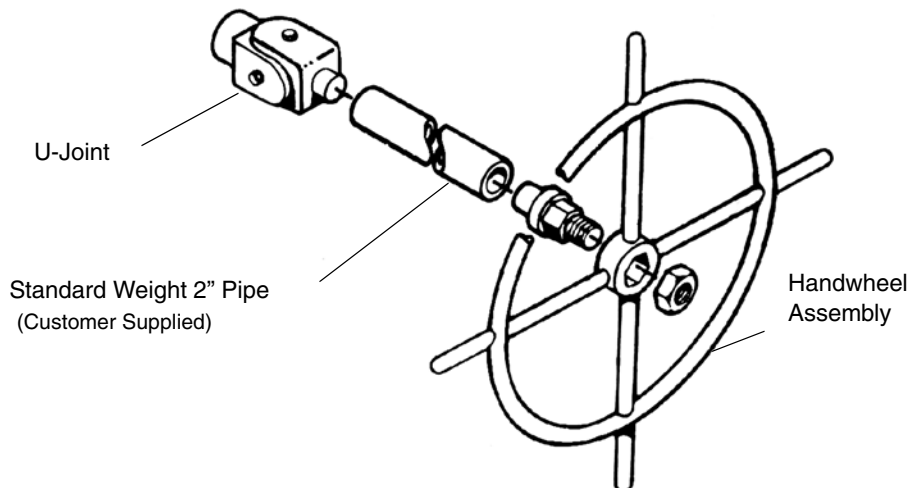


Figure 3-5. Manual Lock Handwheel Assembly



Handwheel extensions can be tack-welded or pinned to the universal joints and handwheels.

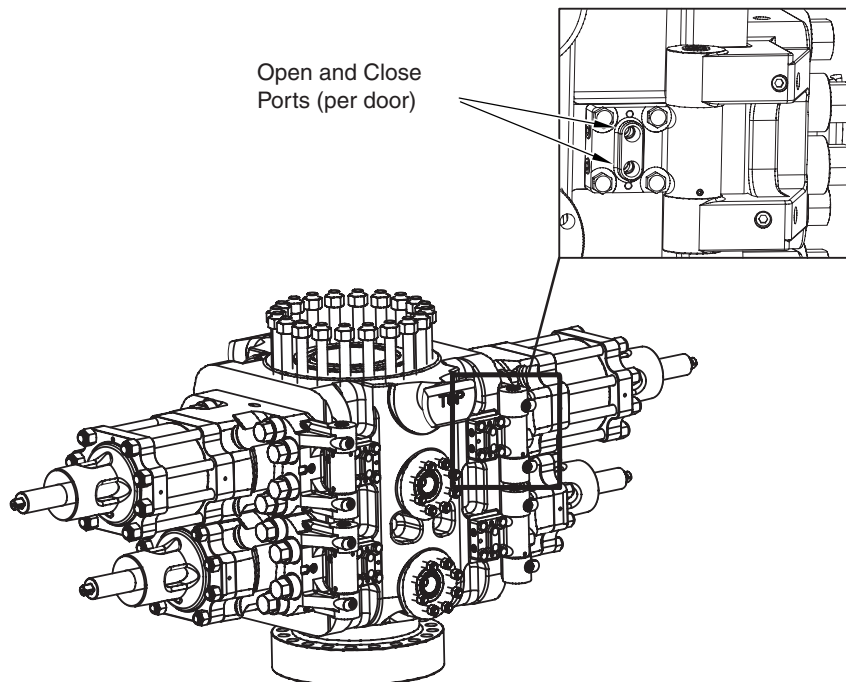


Figure 3-6. Open and Close Hydraulic Ports (typical)

**Perform a Field Wellbore Pressure Test**

See the section titled "Field Wellbore Pressure Test" on page 4-6.

## Operation

### Hydraulic Operation

The rams can be hydraulically closed and manually locked.

### Operating Pressure

Under normal operating conditions, 1,500 psi (103 bar) hydraulic pressure is recommended. This operating pressure will close the manual locking SLX BOP with its rated wellbore pressure. Normal hydraulic operating pressure may be increased to 3,000 psi (207 bar) on any SLX BOP if desired.

The Table provides cylinder size and gallons to open and close per cylinder.

#### SLX Fluid Volume Requirements, Manual Lock

Working Pressure	Bore Size	Piston Size	Gallons to Open (per cyl.)	Gallons to Close (per cyl.)
10,000 psi	13 <sup>5</sup> / <sub>8</sub> "	15.25"	6.10	6.22
10,000 psi	13 <sup>5</sup> / <sub>8</sub> "	*15.25 x 15.25	12.09	12.21

\*Optional Booster

## Hydraulic Fluid

Hydraulic fluid under pressure drives the pistons, which open and close the rams. Hydraulic fluid should have the following characteristics:

- ❑ Non-freezing in cold climates
- ❑ Lubricity to reduce wear
- ❑ Chemical compatibility with the elastomer seals
- ❑ Corrosion inhibitors for metal surfaces

### Recommended Hydraulic Fluid

#### (In Order of Preference)

1. Hydraulic oil with viscosity between 200 and 300 SSU at 100 °F (38 °C). In the SLX closed hydraulic system, there is no waste of oil and fluid costs are negligible.
2. Where pollution due to accidental spillage of hydraulic fluid is a problem, use a water soluble oil or premix control fluid.

To prevent freezing at lower temperatures, ethylene glycol without any additives is recommended. Do not use commercial antifreeze mixes.

## Emergency Fluid Recommendations

In an emergency where hydraulic fluid is lost, and the BOP must be operated, the fluids listed below can be substituted.

1. When using hydraulic oil:
  - Add motor oil (SAE 10W is recommended but heavier oils can be used)
  - Add water if motor oil is not available, but after the emergency, the hydraulic system must be flushed and refilled with hydraulic oil
2. When using a water soluble mixture or premix fluid, add more water.

After the emergency, replace the fluid in the system with the proper mixture.



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*Do not use diesel fuel or kerosene as these fluids will cause the rubber goods to swell and deteriorate.*

*Do not use drilling mud as the grit in this fluid will cause the pistons and cylinders to wear and gall rapidly.*

---

## Closing and Opening the Rams

### Closing Rams

Apply 1,500 psi (103 bar) closing hydraulic pressure (see the section titled "Manual Locking" on page 3-11). Verify that the rams close by observing the inward movement of the handwheels or locking shaft (see Figure 3-7 on Page 3-10).

### Opening Rams

Apply 1,500 psi (103 bar) opening hydraulic pressure. Verify that the rams open by observing the outward movement of the handwheels or locking shafts (see Figure 3-7 on Page 3-10).



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**Do not open the rams under high wellbore pressure conditions. Failing to heed this warning may result in damage to the ram assemblies.**

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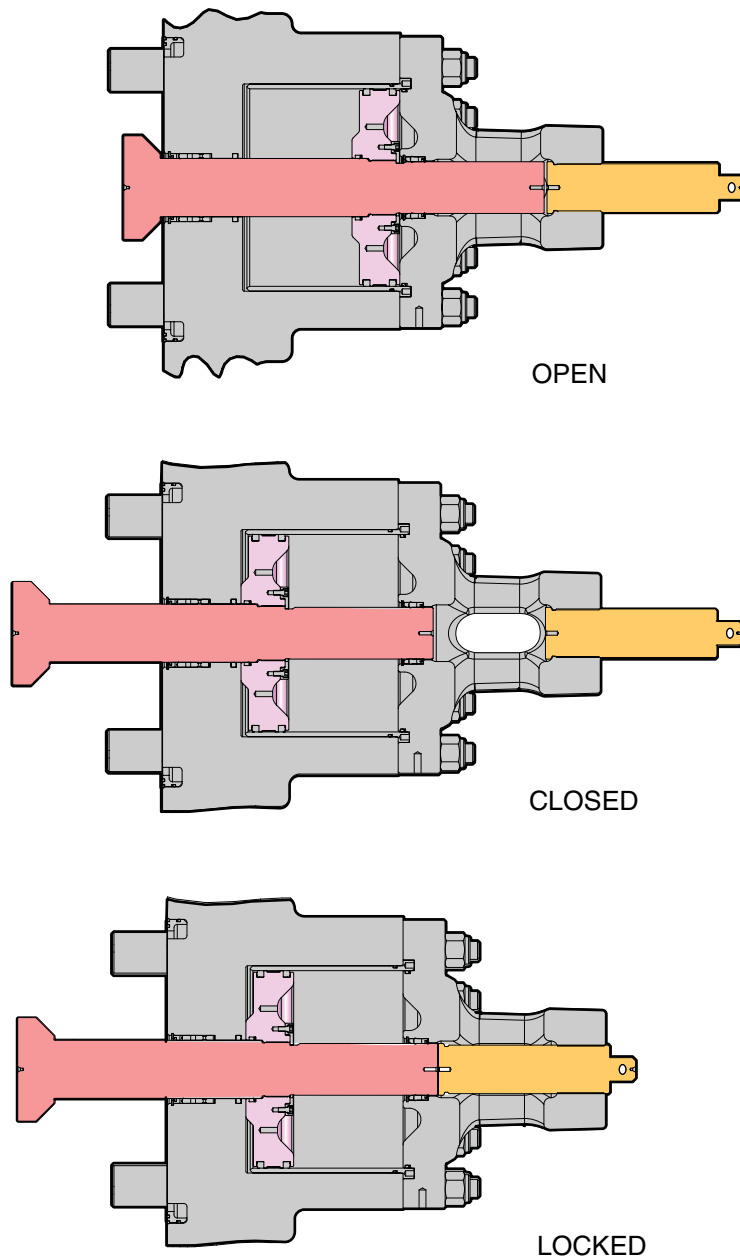


Figure 3-7. Manual Lock Rams



*Before opening the rams, turn both handwheels counter-clockwise to ensure that the rams are unlocked. If the rams are partly locked, the locking shaft threads may be damaged when the rams are hydraulically opened.*



## Manual Locking

1. Apply 1,500 psi (103 bar) closing hydraulic pressure.
2. Rotate each locking shaft clockwise until it locks; each locking shaft will move inward until it stops against the end of the ram shaft.
3. Do not overtighten to avoid shaft damage.
4. Control system pressure may now be removed.



---

*Do not over tighten. If over tightened, the locking shaft can be damaged.*

---

## Unlocking Operation

1. Apply 1,500 psi (103 bar) hydraulic closing pressure.
2. Rotate the locking shaft counterclockwise until it stops.
3. Rotate  $\frac{1}{8}$  of a turn clockwise to prevent temperature changes from jamming the locking shaft in the unlocked position.



---

*Do not apply opening hydraulic pressure while the BOP is manually locked. This may damage the locking shaft threads.*

---

4. See the section titled "Opening Rams" on page 3-9.



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# Maintenance

## Maintenance Schedule

The purpose of this maintenance schedule is to detect wear in an Shaffer manual lock Model SLX BOP so that it can be repaired before a failure occurs in a drilling emergency. The inspection sequence avoids repetition of work so that minimum time is required for a thorough maintenance program.

Additional information is available in the following publications:

- API Spec. 6A, 16A
- API RP5A3
- Shaffer General Catalog

## When to Call a Service Representative

Repairs are performed by either the rig crew or a Shaffer service representative. This section describes the repairs normally performed by the rig crew and provides guidelines to determine when a service representative should be called.

The rig crew normally performs the following:

- Changing rams to different pipe sizes
- Running wellbore pressure tests and hydraulic pressure tests
- Replacing worn ram rubbers and door seals
- Chasing damaged threaded holes on preventer body
- Buffing out minor scratches on the ram sealing seat and door sealing area of the body

A Shaffer service representative can be called to make any repairs, which require the hydraulic system to be opened, including but not limited to the following:

- Re-packing the ram shaft
- Replacing piston seals
- Replacing cylinder seals
- Replacing manifold pipe seals
- Replacing hinge seals
- Re-packing the locking shaft
- Run yearly inspections to determine if the BOP needs to be sent to a repair facility for major rework

The annual inspection includes wellbore pressure tests, hydraulic pressure tests, inspection and measurement of the ram cavities.

**Maintenance Schedule, Manual Lock Ram BOP<sup>1</sup>**

Performed			
Interval <sup>2</sup>	At	By	Summary
Daily	Rig	Rig Personnel	Operate all rams. Look for external hydraulic leaks (see "Daily Maintenance").
Monthly	Rig	Rig Personnel	Do not open doors. Run a field wellbore pressure test. Look for external hydraulic leaks (see the section titled "Monthly Preventive Maintenance" on page 4-3).
Three Months	Rig	Rig Personnel	Open doors and inspect visually. Run a field wellbore pressure test and an internal hydraulic pressure test. Operate manual locks (see the section titled "Three-Month Preventive Maintenance" on page 4-4).
Yearly <sup>3</sup>	Rig	Shaffer Service Representative	Open doors. Measure rams and ram cavity. Do field repairs as needed. Run a field wellbore pressure test and an internal hydraulic pressure test. Operate manual locks (see the section titled "Yearly Preventive Maintenance" on page 4-5).
Three Years <sup>4</sup>	Service/ Repair Facility	Shaffer Service Personnel	Completely disassemble. Repair or replace all parts as required. Replace all seals. Run a field wellbore pressure test and an internal hydraulic pressure test. Operate manual locks (see the section titled "Three-Year Maintenance" on page 4-5).

1. *Specific data is required for ordering parts. See the section titled "SLX BOP Data Location" on page 4-39 for location and explanation of BOP data (serial number, heat treat lot number, etc.).*
2. *These intervals are typical and serve as convenient designations to separate the simpler from the more complex inspections.*
3. *Some operators use the yearly maintenance inspection as a rig acceptance test.*
4. *Three-year maintenance will be performed only after a yearly inspection indicates the need for it.*

**Daily Maintenance**

The procedure described below should be performed daily.

1. All rams should be functioned to verify that they operate properly. If possible, watch the rams move by using a mirror to obtain a reflected image of the rams. If this is not possible, observe the movement of the handwheels or locking shafts.



Pipe rams should be closed on pipe. Blind rams should be closed and opened when the pipe is out of the hole.

2. Check the locking shaft seal areas, cylinder head o-ring areas, manifold pipe seals, door seal areas, weep holes, hinges, hydraulic connections, and the socket head pipe plug for possible leakage of hydraulic fluids (see Figure 4-1).



To observe if the ram shaft packings are leaking, the weep hole plugs must be removed on each door.

3. Check areas for possible leakage of well fluid and/or hydraulic fluid (see Figure 4-1).

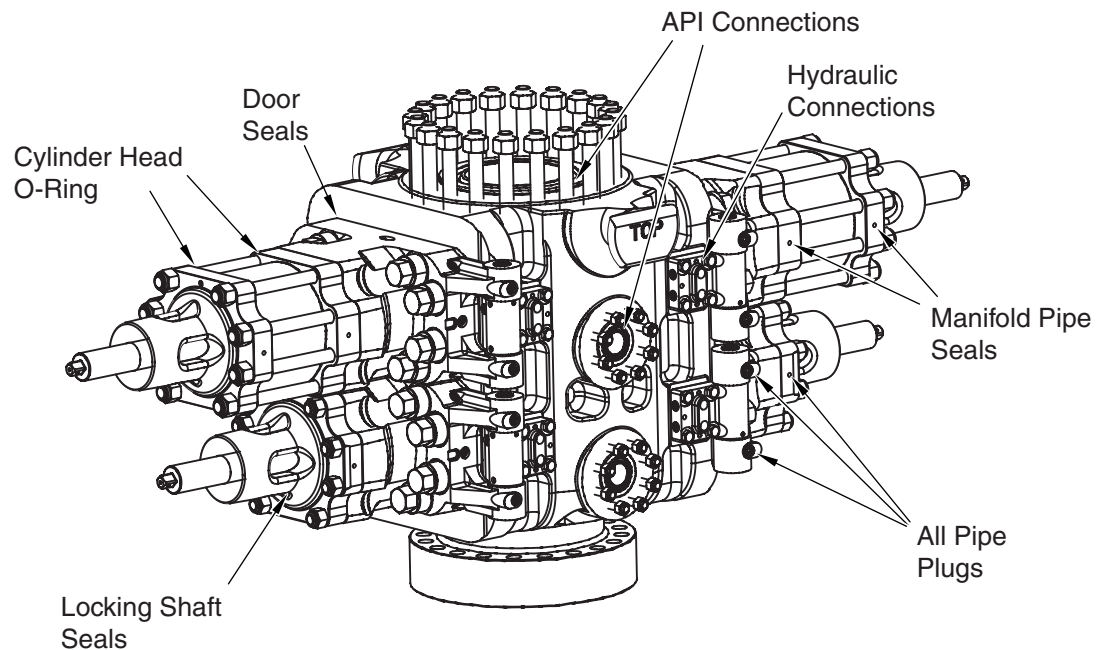


Figure 4-1. Possible Leak Areas

## Monthly Preventive Maintenance

Run this test series before starting a new well and at least monthly while drilling.

Do not open the BOP doors.

1. Ensure all door cap screws are properly torqued.
2. Run a field wellbore pressure test as described in the section titled "Field Wellbore Pressure Test" on page 4-6.
3. While running the field wellbore pressure test, look for external hydraulic leaks (see Figure 4-1).
4. Check the universal joints to ensure that they are tight on the locking shaft and grease if equipped with alamite fittings.
5. Grease the hinges.

## Three-Month Preventive Maintenance

1. Before opening the doors, run a field wellbore pressure test as described in the section titled "Field Wellbore Pressure Test" on page 4-6 and a hydraulic pressure test as described in the section titled "Hydraulic Pressure Test" on page 4-8. This information will be very helpful in the following inspections. Also, a Shaffer service representative can be called at this time if hydraulic system repairs are required.
2. While the rams are closed, turn the handwheels approximately two turns clockwise and then turn them back to the fully unlocked position. This will verify that the manual locks function satisfactorily.
3. Disconnect the universal joints from the locking shafts.
4. Open the rams with 1,500 psi (103 bar).
5. Bleed all hydraulic pressure.
6. Open the doors and remove the rams (see the section titled "Ram Assembly Removal and Inspection Procedures" on page 4-30).
7. Clean and inspect rams (see the section titled "Ram Assembly Removal and Inspection Procedures" on page 4-30).
8. Wash out the inside of the BOP so that it can be inspected.
9. If any door cap screw was excessively hard to remove, chase the thread in the body with a tap. Replace any cap screw, which has damaged threads.
10. Remove minor pits and scratches from the seat sealing surface with emery cloth.
11. Smooth any deep gouges and scratches on the skids and side pads. These are not sealing surfaces so remove only enough material to allow the rams to slide smoothly over them.
12. Check the bore for accidental damage. Smooth as required. Occasionally the drill pipe will rotate against the bore and cause excessive wear. Measure the maximum bore diameter and estimate the maximum wear on any side. If any radius is more than  $\frac{1}{8}$ " (3.18 mm) oversize, send the BOP to a Shaffer repair facility for a complete rework.
13. Check the door sealing area on the BOP body for pits and scratches. Remove pits and scratches with emery cloth.
14. Inspect the shafts.
  - Apply reduced closing hydraulic pressure to fully extend both ram shafts for inspection.
  - Visually check the OD of each ram shaft for pits and scratches. The ram shafts should be replaced by a Shaffer service representative if pits or scratches are visible.
  - Visually check the end of each ram shaft for cracks in the neck between the end and the shaft. The ram shafts should be replaced by a Shaffer service representative if cracks are visible.
15. Inspect the locking shafts.
  - Rotate the locking shafts counterclockwise to extend the locking shafts.
  - If a locking shaft is bent or cracked, it should be replaced. If replacement is necessary, call a Shaffer service representative.
16. Inspect the door seal grooves.
  - Remove the door seals (see Figure 4-2).

- Inspect the grooves. Smooth minor pits with emery cloth.
  - Replace the door seals if extruded, brittle, cut, or nicked (see the section titled "Door Cartridge Seal Corrective Maintenance" on page 4-9 and the section titled "Troubleshooting" on page 4-38).
17. Reinstall the rams (see the section titled "Installation of Rams" on page 4-32).
  18. Run a final field wellbore pressure test (see the section titled "Field Wellbore Pressure Test" on page 4-6) before the BOP is returned to service.

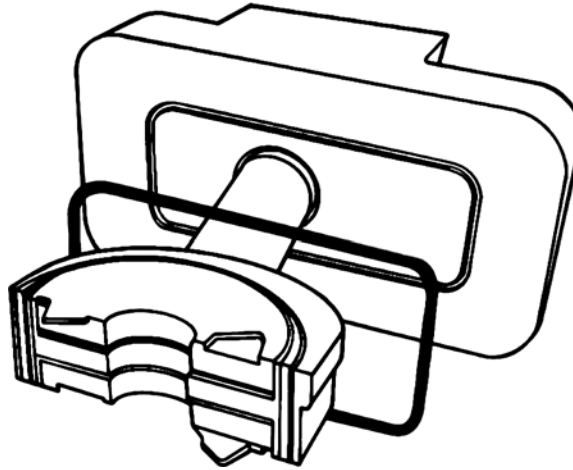


Figure 4-2. Remove Door Seal

## Yearly Preventive Maintenance

Yearly maintenance is performed by a Shaffer service representative. The purpose of the yearly maintenance operation is to evaluate wear in the BOP so that a major overhaul (three-year maintenance) can be scheduled at a convenient time, but before a failure occurs. The yearly maintenance includes:

- Wellbore pressure test
- Hydraulic pressure test
- Inspection and measurement of cavity for wear and damage
- A complete review of BOP performance to determine if the BOP should be sent to a Shaffer repair facility for a major overhaul

## Three-Year Maintenance

Three-year maintenance is performed in a Shaffer repair facility after a yearly maintenance check determines it is necessary. The BOP is completely disassembled, cleaned, and inspected. All elastomer seals are replaced and all parts are repaired or replaced as required. Hydraulic and wellbore pressure tests are run and the BOP is returned to service.



All elastomer seals should be replaced after three years regardless of condition.

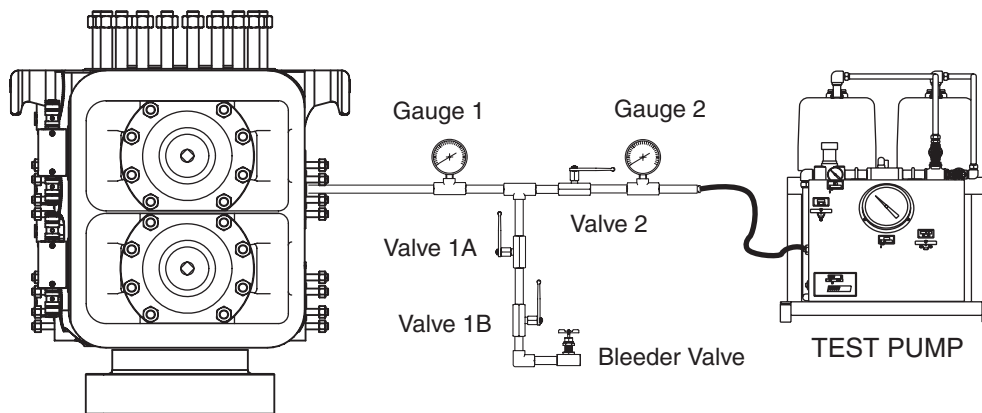
## Field Wellbore Pressure Test

The final details of the test sequence will be established by the operator and contractor; therefore, modifications to this procedure may be required. See API Spec. 6A, 16A and API RP5A3 for possible additional information.

### Equipment Required

Connect the listed equipment as shown in Figure 4-3:

- ❑ Two pressure gauges
- ❑ Three valves
- ❑ A test pump



BOP (w/ hinges removed)

Figure 4-3. Recommended Field Wellbore Pressure Test Equipment Set-up

### Test Locations

The BOP can be tested in any of the following locations:

- ❑ In a wellhead mounted stack
- ❑ On a test stump
- ❑ On a blind flange

### Test Pressure

The test pressure should not exceed the lowest rated working pressure of any component or connection pressurized during the test. This includes one or more of the following:

- ❑ BOP(s)
- ❑ Wellhead
- ❑ Casing string, if it will be pressurized during the test or if a leak in the test tool could cause it to be pressurized
- ❑ All connections



## Test Fluids

The recommended wellbore pressure test fluid is cold water, but drilling fluid may be used.

1. Fill the BOP with water or drilling fluid.
2. Close the pipe rams on an appropriate test tool using 1,500 psi (103 bar) hydraulic pressure (3,000 psi or 207 bar is optional).

## Pressure Test

1. Close valves #1A and #1B. Open valve #2 (see Figure 4-3).
2. Apply 200-300 psi (14-21 bar) wellbore pressure below the rams. Close valve #2. Hold test pressure for a minimum of 3 minutes. Check for low-pressure leaks. Monitor gauge #1.
3. Open valve #2. Increase the wellbore pressure to the test pressure determined in "Test Pressure."
4. Close valve #2.
5. Hold the pressure for a minimum of 3 minutes.
6. Check for leaks on pressure gauge #1, the BOP exterior at the API connections, the door seals, the ram shaft weep holes, and at the rams if they are visible (see Figure 4-1 on page 4-3).



**WARNING: Do not look into the ram bore while pressure is under the rams. Use a mirror to obtain a reflected image of the rams.**

7. Bleed wellbore test pressure to 0 psi (0 bar).
  - Fully open valve #2.
  - Open valve #1A.
  - Open valve #1B.
8. Repeat steps 1-7 for the second pressure holding period.
9. If leaks are detected, see the table titled "Troubleshooting – SLX Manual Lock BOP" on page 4-40.

## Leak Repair

To repair leaks, reduce all hydraulic pressure and wellbore pressure to 0 psi (0 bar).

- API connection-tighten bolts or replace ring gasket as required (see the section titled "Installation Instructions" on page 3-2).
- Door Seal-replace door seal (see the section titled "Door Cartridge Seal Corrective Maintenance" on page 4-9).
- Ram Shaft Weep Hole-call a Shaffer service representative. For an emergency repair, see the section titled "Emergency Ram Shaft Packing Repair" on page 4-16. As soon as possible after the emergency, repack the ram shaft or call a Shaffer service representative to repair.

- Ram-replace the ram rubbers (see the section titled "Changing Pipe and Blind Ram Rubbers" on page 4-32).

## Hydraulic Pressure Test

The final details of the test sequence will be established by the operator and contractor; therefore, modifications to this procedure may be required. See API Spec. 6A,16A and API RP5A3 for possible additional information.



**NOTE:** If the hydraulic system was opened before this test, close and open the rams three times to purge air from the system.



**CAUTION:** Pipe rams should always be closed on pipe to avoid excessive ram rubber wear. Closure on a tool joint will damage the block.

*Blind rams should only be closed on an open hole. Closing on pipe will damage the rubber and possibly the block.*

## Opening Hydraulic Pressure Test

The opening hydraulic pressure test is performed according to the steps listed below.

1. Vent hydraulic closing pressure to zero psi (zero bar).
2. Apply 1,500 psi (103 bar) (3,000 psi or 207 bar optional) opening pressure.
3. Close the valve in the opening hydraulic line (see Figure 3-4 on page 3-6).
4. Observe the gauge between the valve and the BOP.
5. If there is no pressure drop, end the test.
6. If there is a pressure drop, perform the steps listed below.
  - a. Check for external leaks at the following locations (see Figure 4-1 on page 4-3):
    - Hinge pins – If leaking, tear down and repair or call a Shaffer service representative
    - Weep holes for ram shaft seal leaks – If leaking, apply secondary seals or tear down and repair or call a Shaffer service representative
    - Cylinder seal leaks – If leaking repair or call a Shaffer service representative
    - Door seal leaks – If leaking see the section titled "Door Cartridge Seal Corrective Maintenance" on page 4-9
  - b. Check for internal leaks past the pistons in the following manner:
    - Disconnect the closing hydraulic line. A small amount of fluid will flow out of the BOP initially and stop. If fluid continues to flow out of the BOP, it is leaking past the piston and repairs are required.

- Bleed off, tear down and replace piston seals.
- Or call a Shaffer service representative to repair the leak.

## Closing Hydraulic Pressure Test

The closing hydraulic pressure test is performed according to the steps listed below.

1. Vent hydraulic opening pressure to zero psi (zero bar).
2. Apply 1,500 psi (103 bar) (2,250 psi or 155 bar optional) closing pressure.
3. Close the valve on the closing hydraulic line (see Figure 3-4 on page 3-6).
4. Observe the gauge between the valve and the BOP.
5. If there is no pressure drop, end the test.
6. If there is a pressure drop, perform the steps listed below.
  - a. Check for external leaks at the following locations (see Figure 4-1 on page 4-3):
    - Hinge pins – If leaking, tear down and repair or call a Shaffer equipment service representative.
    - Cylinder head seals – If leaking, tear down and repair or call a Shaffer service representative.
    - Locking shaft seals – If leaking, tear down and repair or call a Shaffer service representative.
    - Manifold pipe seals – If leaking, tear down and repair or call a Shaffer service representative.
  - b. Check for internal leaks past the pistons in the following manner:
    - Disconnect the opening hydraulic line. A small amount of fluid will flow out of the BOP initially and stop. If fluid continues to flow out of the BOP, it is leaking past the piston and repairs are required.
    - Bleed off, tear down and replace piston seals.
    - Or call a Shaffer service representative to repair the leak.

## Door Cartridge Seal Corrective Maintenance

To determine whether the SLX BOP requires major repairs, a qualified hydraulics maintenance person must open the ram doors and inspect the cartridge seal and associated parts.

### Replacing the Door Cartridge Seal

The door cartridge seal is replaced using the following procedure.



**CAUTION:** Do not use the hydraulic system to open the doors. This will severely damage the ram shaft and holder. If the BOP is not flanged to a wellhead or securely fastened, only one door can be open at any one time. The weight of two open doors can tip the BOP over.

1. Open the doors.
2. Remove the door cartridge seal from its seat (see Figure 4-4).



**Figure 4-4. Remove Door Cartridge Seal**

3. Inspect the door cartridge seal seat for damage. Remove minor pits and scratches with an emery cloth. If the seat is badly damaged, call a Shaffer service representative.
4. Clean and lightly lubricate with SAE-10W oil, the door-sealing surface on the body.

### **Installing the Cartridge Assembly**

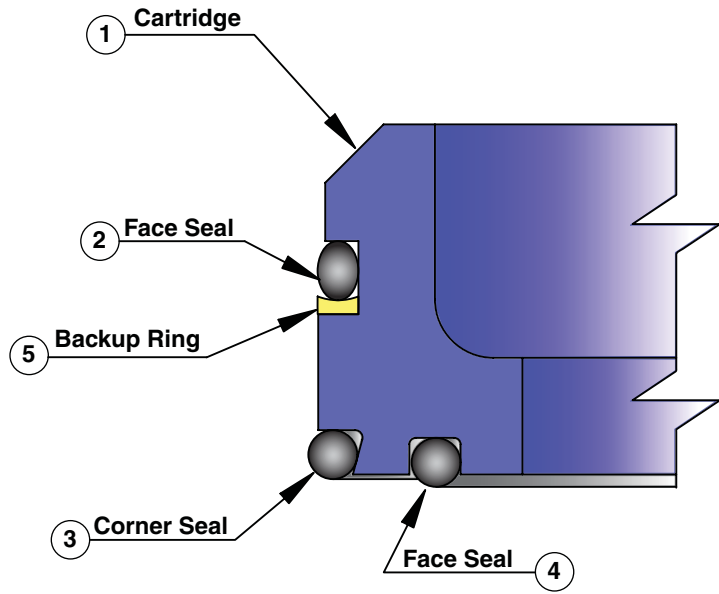
1. Lightly oil all O-ring grooves and sealing surfaces.
2. Install the door groove O-ring and back-up ring in their groove (see Figure 4-5).
3. Apply a light coat of grease to the outer edge.

### **Installing the Cartridge to the Door**

1. Insert the cartridge into the door groove.
2. Using a rubber mallet, lightly tap the seal assembly into the door groove until it is firmly seated. Keep cartridge as level as possible. Do not cantilever into groove
3. Install the corner seal (3) and face seal O-rings (4) onto the cartridge after the cartridge is seated. (see Figure 4-5).



**NOTE:** Care should be taken not to cut the face seal O-Ring (2) and backup ring (5) as it enters the door groove.



**Figure 4-5. Door Cartridge Seal Assembly**

4. The door seal cartridge is now installed in the door (see Figure 4-6).

**Cartridge Seal Components**

Item Number	Part Name	Part Number	Quantity
	Assembly	20020123	
1	Cartridge Seal	20020295	1
2	O-Ring, Door Groove	030947	1
3	O-Ring, Corner Seal	030947	1
4	O-Ring, Face Seal	030391	1
5	Back-Up Ring	030948	1

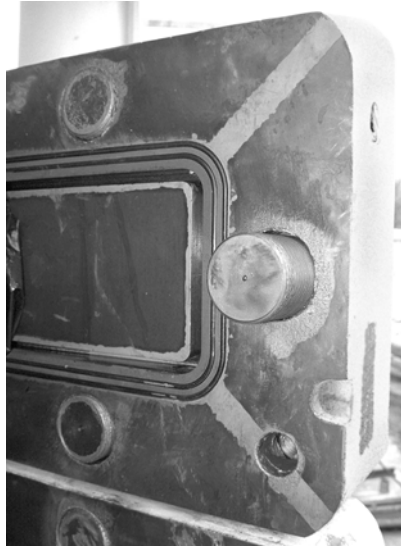


Figure 4-6. Install Door Seal Cartridge

## Corrective Maintenance of Door Hinge Assembly

To replace the SLX door hinge assembly, follow the steps listed below.

### Disassembly of Door Hinge

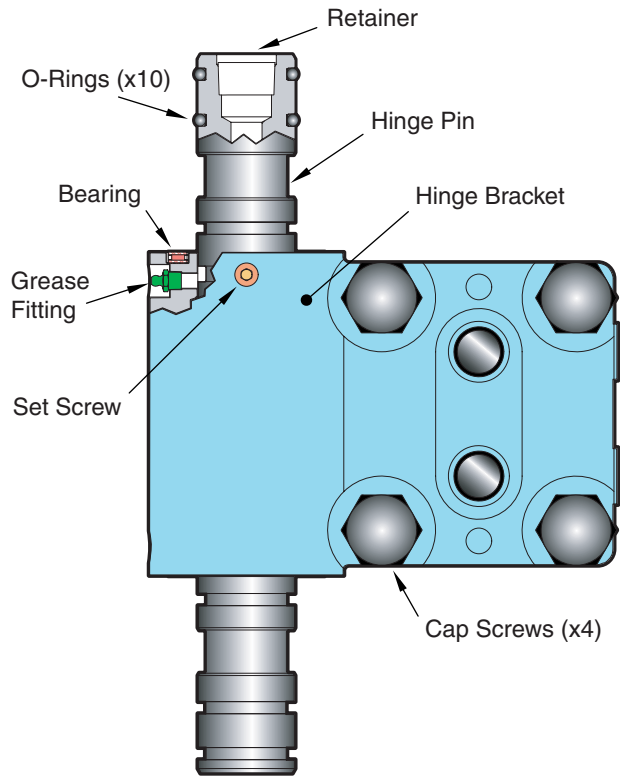
1. Remove the hinge pin retainer set screw located on the hinge bracket adjacent to the grease fitting. (See Figure 4-7.)



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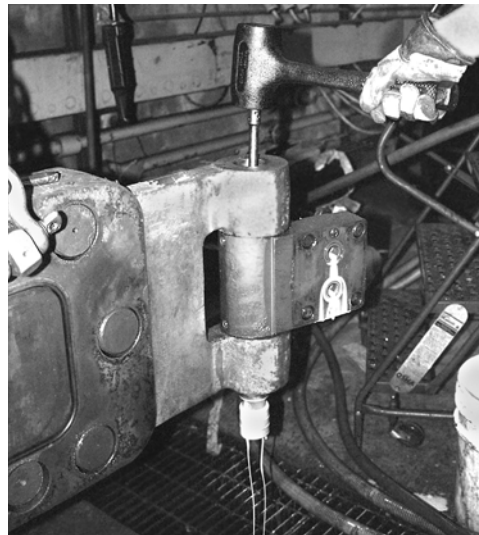
**CAUTION:** Failure to remove the hinge pin retainer will damage the hinge pin when attempting hinge pin removal in Step 3 below.

---



**Figure 4-7. Hinge Bracket and Pin**

2. Loosen the four hinge bracket cap screws.
3. Remove the hinge pin (see Figure 4-8). A threaded drive pin or bolt can be used to knock the pin through the door assembly.



**Figure 4-8. Remove Hinge Pin**

4. Remove the hinge bracket (see Figure 4-9).

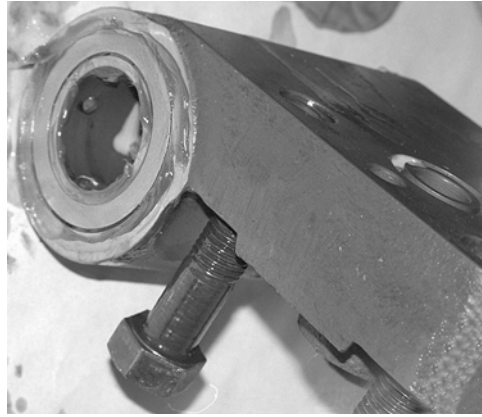


Figure 4-9. Hinge Bracket



**NOTE:** Take care not to lose the bearing races from the bottom side of the hinge bracket.

5. Clean the upper and lower bearing grooves of the hinge bracket and inspect the needle bearings and race. Replace the bearing assembly if necessary (see Figure 4-10 and Figure 4-11).



Figure 4-10. Bearing Assembly

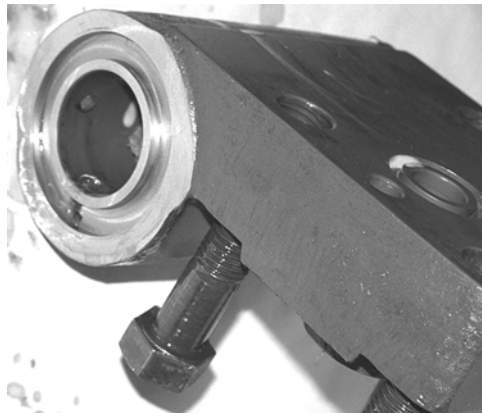


Figure 4-11. Clean Upper and Lower Bearing Grooves



## Reassembly of Door Hinge

1. Lubricate the bearing assembly with molydisulphide grease or good quality bearing grease and install bearing assembly into the hinge bracket (see Figure 4-12).
2. Reinstall the bearing and hinge bracket assembly on the body, leaving the four hinge bracket cap screws loose.
3. Replace all hinge pin O-rings. Lubricate the hinge pin with SAE-10W oil and install through the door hinge.



**WARNING:** Care should be taken not to cut the o-rings while inserting the hinge pin through the bracket.

4. Install the hinge pin retainer.
5. Tighten the four hinge bracket cap screws and pump grease into the fitting until the grease extrudes between the hinge bracket and door hinge.



**NOTE:** The door assembly may be removed with the bracket as shown, or the door may be left on the preventer body and the hinge bracket removed. Do not loosen the door bolts if only the hinge bracket is to be removed.



Inner Race



Bearing



Outer Race

Figure 4-12. Installing Bracket Bearing

## Emergency Ram Shaft Packing Repair

An emergency repair can be made by reducing the hydraulic pressure to 0 psi (0 bar) and activating the secondary ram shaft seal on the BOPs that have this feature. As soon as possible after the emergency, repack the ram shaft or call a Shaffer service representative.

1. Remove the pipe plug from the front of the door.

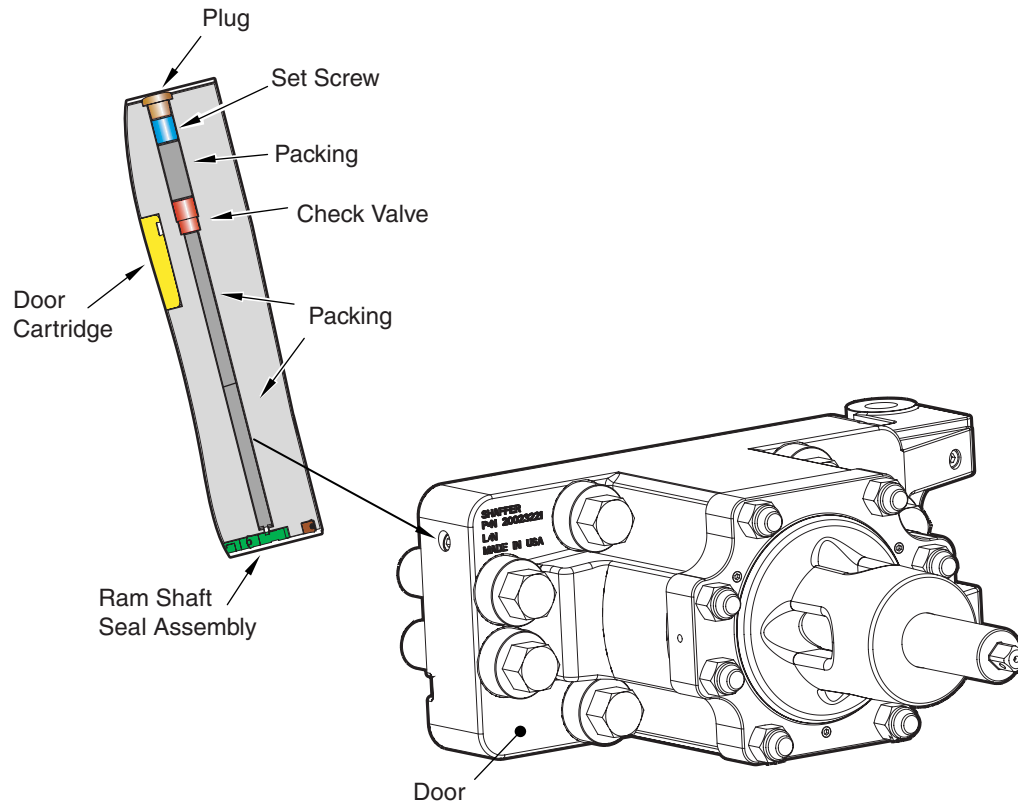


Figure 4-13. Secondary Packing



**NOTE:** Some preventers have a straight-in pipe plug while others have the pipe plug set in at an angle. All are located on the same door surface of the preventer.

2. With the pipe plug removed, a second socket head screw plug is exposed. Tighten this to inject the secondary ram shaft seal. See Figure 4-13.



**NOTE:** Additional packing may be injected until the leak stops. Remove the set screw and insert additional packing sticks then retighten the set screw.

3. Once the leak has stopped, replace the socket head pipe plug removed in step 1.



**CAUTION:** At the proper time, tear down and replace the RSSA or call a Shaffer service representative to repack the ram shaft. Failure to heed this caution will damage the ram shaft.

## Removing the Ram Shaft Seal Assembly - Manual Lock Cylinders

If the well bore is under pressure and fluid is visible from the SLX door weep hole, this indicates the Ram Shaft Seal Assembly (RSSA) is leaking (see Figure 4-1 on Page 4-3).

To remove the ram shaft seal assembly, proceed as follows:

(All items in parenthesis refer to Figure 4-14 on Page 4-20 Door Assembly Components and associated parts list.)

1. Rams should be in the open position.
2. Vent all well bore pressure and operating hydraulic pressure to 0 psi (0 bar).
3. Loosen the door bolts (24), open the door and remove the ram assembly (see "Removal of Rams" on Page 4-31).



**NOTE:** If removing the ram shaft seal assembly from the lower operator on a double SLX Ram BOP, it is recommended to open the upper ram and remove the ram assembly. This may allow easier access of the necessary lifting equipment.

4. Remove the eight hex nuts (item 14) and install three ( $\frac{5}{8}$ -inch 11 UNC anti-seize lubricated) jacking bolts into the UNC threaded holes in the cylinder head (item 21).
5. Using the jacking bolts, tighten the bolts to pull the cylinder head from the door (item 1).

6. Install a lifting eye ( $\frac{5}{8}$ -inch 11 UNC) in both sides of the cylinder head to aid in the removal. Slide the cylinder head over the ram shaft (item 3) until the seal sub (item 19) can be removed without damage.
7. Remove the cylinder head and the locking shaft assembly over the ram shaft and set aside.



**NOTE:** The locking shaft (item 22) should stay inside the cylinder head during the removal. Be watchful of the locking shaft.

8. With the cylinder head and locking shaft removed, unscrew the two retainer bolts (item 5) in the piston and remove the anti-rotation retainer (item 4) from the piston and slide over the ram shaft
9. Install two bolts or eye bolts in the  $\frac{1}{2}$ -inch 13 UNC holes to be used to unscrew the piston assembly (item 15) from the ram shaft (3).
10. Remove the piston assembly (item 15).
11. The ram shaft can be removed through the door exposing the ram shaft seal assembly (item 7).
12. Remove the spiral retainer ring (item 3) and then remove the ram shaft seal assembly from the door (see Figure 4-15 on Page 4-22 and associated parts list on Page 4-23).
13. With the piston and ram shaft removed, two eye bolts can now be installed in the cylinder sleeve (item 2) so it can be pulled for inspection and O-ring seal and backup ring (items 9 and 10) replacement.

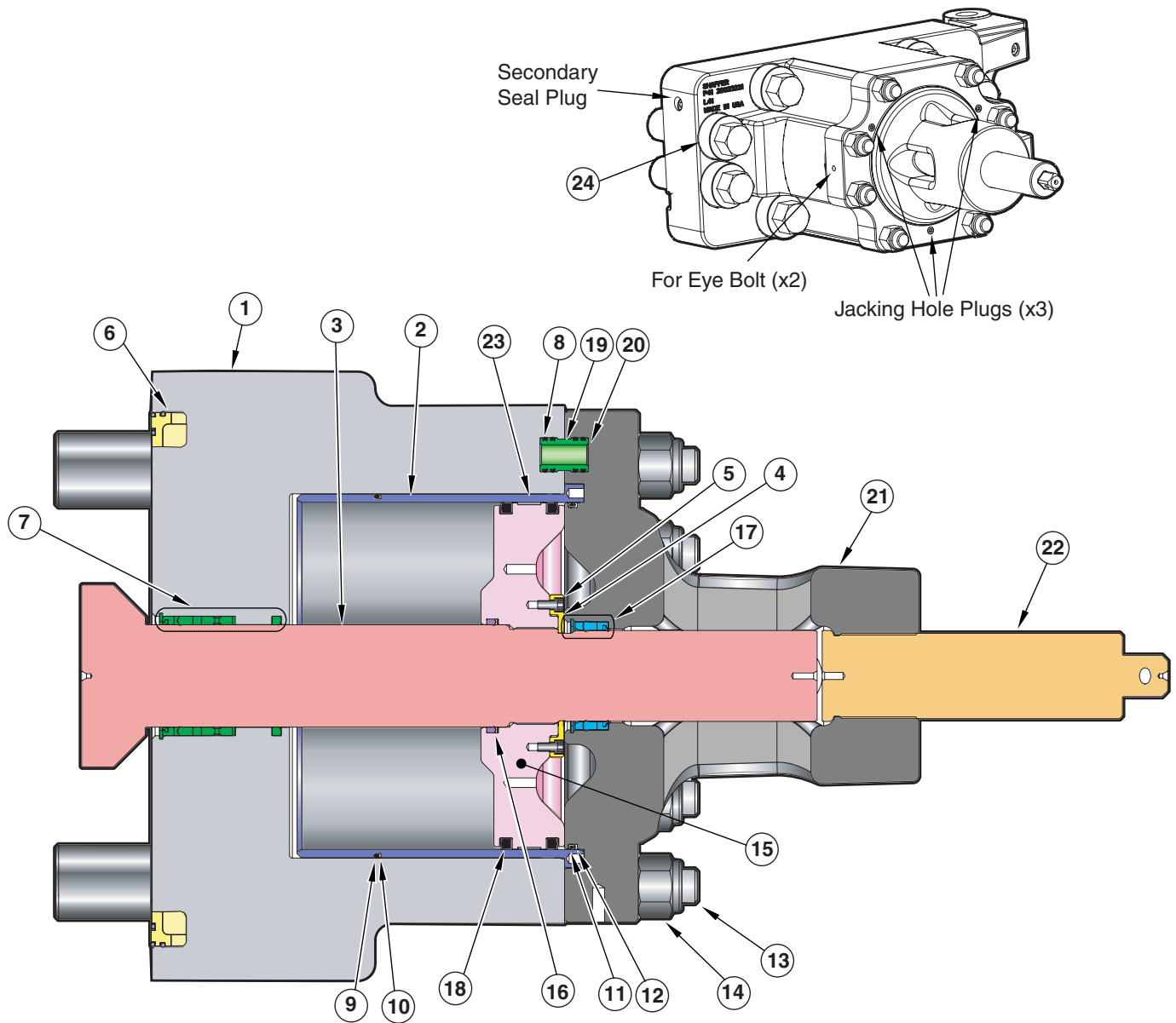


Figure 4-14. Manual Lock Door Components

**Components of Manual Lock Door Assembly**

<b>Item No.</b>	<b>Part Number</b>	<b>Description</b>	<b>Quantity</b>
1	20023561	Door	1
2	20020145	Main Cylinder Sleeve	1
3	20023577	Ram Shaft	1
4	20023578	Anti-Rotation Retainer	1
5	8002856	Retainer Bolts	2
6	20020123	Cartridge Seal Assembly	1
7	20023567	Ram Shaft Seal Assembly	1
8	030061	Seal Sub O-rings	6
9	20020129	Cylinder Sleeve O-ring	1
10	20020127	Cylinder Sleeve Back-up Ring	1
11	030645	Cylinder Head O-ring	1
12	20020128	Cylinder Head Back-up Ring	1
13	20023566	Cylinder Head Studs	8
14	020106	Cylinder Head Lock Nuts	8
15	20023252	Main Piston	1
16	20023478	Main Piston ID Seal	1
17	20023573	Locking Shaft Seal Assembly	1
18	20020124	Main Piston OD Seals	2
19	20020125	Seal Sub	1
20	20020286	Blank Seal Sub	1
21	20023580	Cylinder Head	1
22	20023580	Locking Screw	1
23	150613	Piston Wear Band (47.5")	1
24	116134	Door Bolts	8

## Replacing the Ram Shaft Seal Assemblies (RSSA)

To replace the ram shaft seal assembly requires the operator to be disassembled (see "Removing the Ram Shaft Seal Assembly" for each cylinder).

When replacing the RSSA it is recommended to replace the Locking Shaft Seal Assembly (LSSA) for manual locking cylinders (see the section titled "Replacing the Locking Shaft Seal Assembly (LSSA)" on page 4-24).

To replace the ram shaft seal assembly proceed as follows:

(All items in parenthesis refer to Figure 4-14 and Figure 4-15 and the associated parts lists.)



**NOTE:** The RSSA also includes one hydraulic opening pressure poly-pak seal, item 6 (see Figure 4-14 and Figure 4-15 - Ram Shaft Seal Assembly).

1. Clean the ram shaft seal assembly (RSSA) door cavity and clean the groove for the hydraulic opening pressure poly-pak seal with fine emery cloth.
2. Lubricate the RSSA and the door cavity with SAE 30 W oil and install the new RSSA complete with a new spiral retainer ring as shown on Figure 4-14 and Figure 4-15.

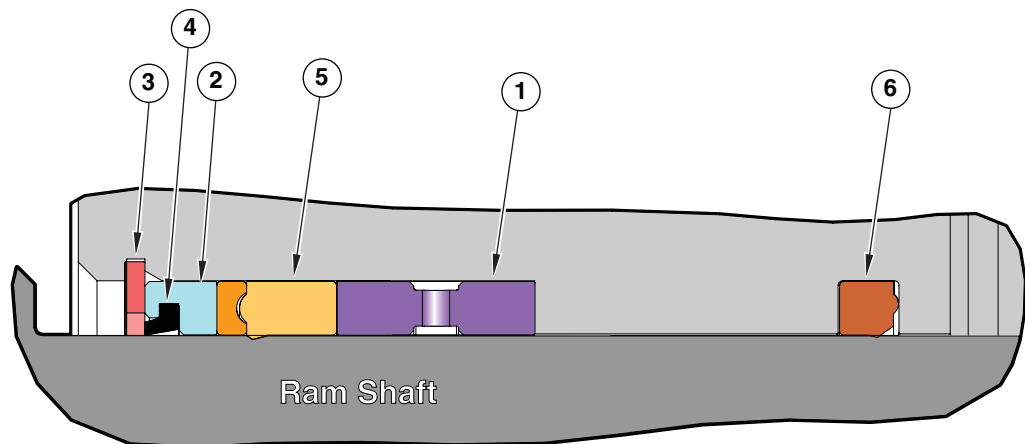


Figure 4-15. Ram Shaft Seal Assembly - Manual Lock

**Ram Shaft Seal Assembly Parts List (P/N 20023567)**

Item No.	Part Number	Description	Qty.
1	20023568	Packing Adapter	1
2	20023569	Holder, Wiper Ring	1
3	20023474	Retainer Ring	1
4	20023475	Wiper Ring	1
5	20023477	PIP Seal Assembly	1
6	20023480	Seal, Polypak,	1

**Reassembly of Operators**

Item numbers refer to Figure 4-14 on Page 4-20.

1. Install new polypak OD seals (items 18) onto the piston assembly (item 15) and new ID seals (item 16). Replace the wear band (item 23).



NOTE: Refer to the assembly drawings for the orientation of *all* seals.

2. Arrange a lifting strap on the ram shaft (3), lift the shaft and align with the opening of the door. Lubricate the inside of the door and RSSA with SAE 30W oil. Carefully stab the shaft into the RSSA, with a suitable hard wood block or rubber mallet tap the shaft into the RSSA taking care to support the shaft through the door. Continue to tap the shaft until it is fully entered into the RSSA area.
3. Lubricate the piston thread area of the ram shaft and screw the piston (15) onto the shaft (3).



NOTE: Make sure the piston is screwed completely onto the shaft.



**CAUTION:** Do not damage the piston ID seal (16) when installing the piston onto the Ram Shaft. Do not pinch or roll the seal.



4. Install new O-ring (item 9) and back-up (item 10) onto the cylinder sleeve (item 2). Lubricate the sleeve with SAE-10W oil and install over the piston and into the door cylinder cavity.



**NOTE:** The sleeve should slide into the door easily. Take care not to “cock” the sleeve in the door.

5. Once the piston and sleeve are installed, install the Anti-rotation retainer (4) and bolts (5) into the piston. The plate or piston can be rotated slightly to align the holes. The flat area of the plate must align with the flat portion of the ram shaft. Refer to the assembly drawings for installation information and torque values.
6. Install four new O-rings (item 8) on the seal subs (items 19 and 20). Lubricate with SAE 30W oil and install into the door.
7. Install a new back-up ring (item 12) and O-ring (item 11) into the cylinder head. Refer to the assembly drawings for seal orientation.
8. Using the lifting eyes in the side of the cylinder head, lift the cylinder head and align with the cylinder head studs. Slide the cylinder head on and install the hex lock nuts and torque in a criss-cross fashion to a maximum torque of 1,350 ft-lbs (1,830 Nm).
9. Close the door and tighten the bolts to proper torque.



**NOTE:** Refer to the assembly drawing for torque values.

## Removing the Locking Shaft Seal Assembly (LSSA)

If the SLX Ram BOP operator is under closing pressure and fluid is visibly leaking around the locking shaft, this indicates the Locking Shaft Seal Assembly (LSSA) is leaking (see figure 4-1 on Page 4-3).

To replace the LSSA, proceed as follows:

(All items in parenthesis refer to Figure 4-14 on Page 4-20 Door Assembly Components.)

1. Rams should be in the open position.
2. Vent all well bore pressure and operating hydraulic pressure to 0 psi (0 bar).
3. Remove the eight hex nuts (item 14) and install three ( $\frac{5}{8}$ -inch 11 UNC anti-seize lubricated) jacking bolts into the UNC threaded holes in the cylinder head (item 21).
4. Using the jacking bolts, tighten the bolts to pull the cylinder head from the door (item 1).
5. Install lifting eyes in the side of the cylinder head. Slide the cylinder head off the ram shaft (item 3). The locking shaft will be removed with the cylinder head.
6. Place the cylinder head in a supported position and remove the spiral retainer ring (3) from the cylinder head and remove the LSSA. (See Figure 4-16 on Page 4-24.)

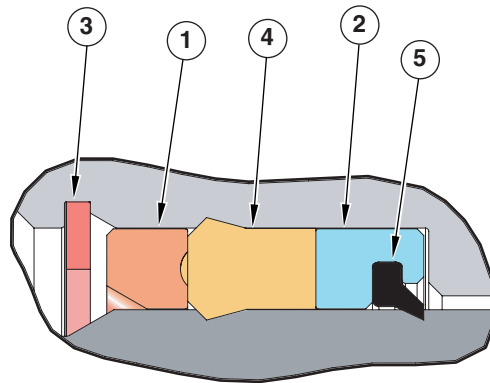


Figure 4-16. Locking Shaft Seal Assembly

### Locking Shaft Seal Assembly (P/N 20023573)

Item No.	Part Number	Description
1	20023571	Spacer Ring
2	20023574	Holder Ring
3	20020662	Retainer Ring
4	031362	Seal, Polypak
5	20023476	Wiper Ring

## Replacing the Locking Shaft Seal Assembly (LSSA)

Replacement of the Locking Shaft Seal Assembly (LSSA) requires the cylinder head to be removed from the SLX Ram BOP operator (see “Removing the Locking Shaft Seal Assembly” on Page 4-23).

To replace the Locking Shaft Seal Assembly proceed as follows:

(All items in parenthesis refer to Figure 4-14 on Page 4-19, Figure 4-16 above.)

1. Clean the LSSA cavity of the cylinder head (item 21) with fine emery cloth.
2. Lubricate the LSSA and the cylinder head cavity with SAE 30W oil and install the new LSSA complete with a new spiral retainer ring as shown on Figure 4-16- Locking Shaft Seal Assembly on Page 4-24.
3. Install four new O-rings (item 8) on the seal sub (item 19). Lubricate with SAE 30W oil and install into the door (item 1).
4. Install a new back-up ring (item 12) and O-ring (item 11) into the cylinder head (item 21). Lubricate with SAE 30W oil.
5. Using the lifting eyes in the side of the cylinder head, lift the cylinder head and align with the cylinder head studs. Slide the cylinder head on and install the hex lock nuts

(14) and torque in a criss-cross fashion to a maximum torque of 1,350 ft.-lbs. (1830 Nm)

## Removing the Middle Head Seal Assembly (MHSA)

If the SLX Ram BOP operator is under closing pressure and fluid is visibly leaking around the locking shaft, this indicates the Middle Head Seal Assembly (MHSA) is leaking (see figure 4-1 on Page 4-3).

To replace the MHSA, proceed as follows:

(All items in parenthesis refer to Figure 4-18 on Page 4-28 Door Assembly Components.)

1. Rams should be in the open position.
2. Vent all well bore pressure and operating hydraulic pressure to 0 psi (0 bar).
3. Remove the eight hex nuts (item 14) and install three ( $\frac{5}{8}$ -inch 11 UNC anti-seize lubricated) jacking bolts into the UNC threaded holes in the cylinder head (item 21).
4. Using the jacking bolts, tighten the bolts to pull the cylinder head from the door (item 1).
5. Install lifting eyes in the side of the cylinder head. Slide the cylinder head off the ram shaft (item 3). The locking shaft will be removed with the cylinder head.
6. Place the cylinder head in a supported position and remove the spiral retainer ring (3) from the cylinder head and remove the MHSA. (See Figure 4-17.)

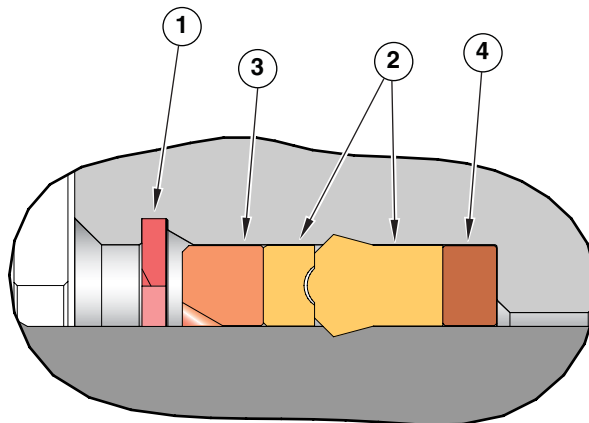


Figure 4-17. Middle Head Seal Assembly

**Middle Head Assembly (P/N 20023570)**

Item No.	Part Number	Description
1	20020662	Retainer Ring
2	20023479	PIP Seal
3	20023571	Spacer Ring
4	20023572	Back-up Ring

**Replacing the Middle Head Seal Assembly (MHSA)**

Replacement of the Locking Shaft Seal Assembly (MHSA) requires the cylinder head to be removed from the SLX Ram BOP operator (see “Removing the Middle Head Seal Assembly” on Page 4-25).

To replace the Locking Shaft Seal Assembly proceed as follows:

(All items in parenthesis refer to Figure 4-18 on Page 4-27 and Figure 4-17 on Page 4-25.)

1. Clean the MHSA cavity of the cylinder head (item 21) with fine emery cloth.
2. Lubricate the MHSA and the cylinder head cavity with SAE 30W oil and install the new MHSA complete with a new spiral retainer ring as shown on Figure 4-17- Middle Head Seal Assembly on Page 4-25.
3. Install four new O-rings (item 8) on the seal sub (item 19). Lubricate with SAE 30W oil and install into the door (item 1).
4. Install a new back-up ring (item 12) and O-ring (item 11) into the cylinder head (item 21). Lubricate with SAE 30W oil.

Using the lifting eyes in the side of the cylinder head, lift the cylinder head and align with the cylinder head studs. Slide the cylinder head on and install the hex lock nuts (14) and torque in a criss-cross fashion to a maximum torque of 1,350 ft.-lbs. (1830 Nm).

**Manual Lock Door with Booster Assembly (Optional)**

The SLX 15.25 inch manual lock door assemblies can be equipped with 15.25 inch Booster Cylinders. The Booster Assembly is primarily used in conjunction with shear rams and the shearing process. The basic door assembly is the same in both applications with the booster doors having an additional cylinder, piston and booster shaft added on top of the standard 15.25 inch door assembly.

The following is a basic procedure to access and maintain the booster assembly. Once the booster cylinder is accessed and maintenance has been performed, any additional work on the 15.25 inch door assembly can be accomplished at this point utilizing the previous procedures for the manual lock door assembly.

(All items in parenthesis refer to Figure 4-14 on Page 4-28 and Figure 4-16 on Page 4-28).

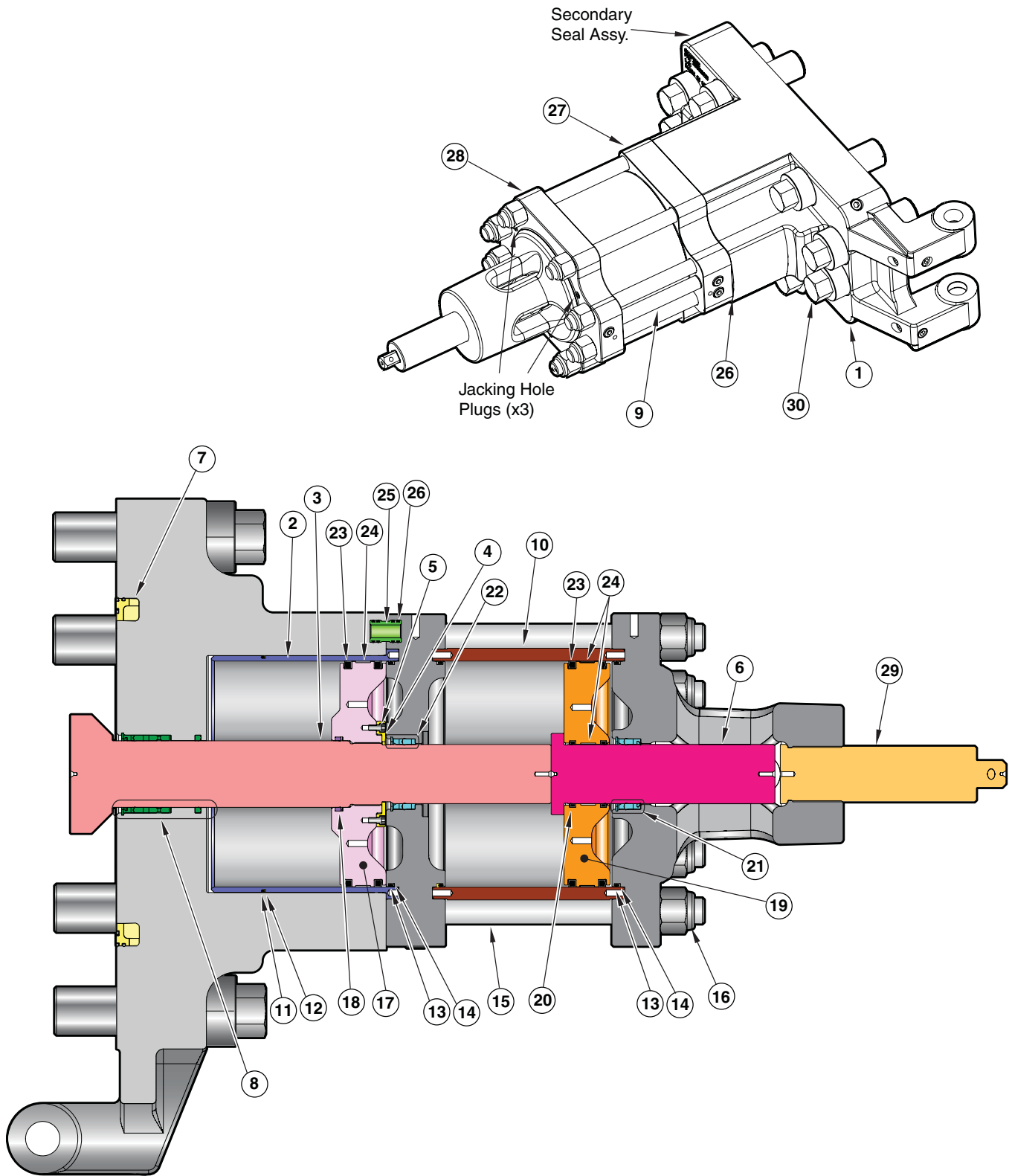


Figure 4-18. 15.25 inch Manual Lock Door with Booster Assembly

**Components of Manual Lock Door Assembly**

Item No.	Description	Item No.	Description
1	Door	21	Locking Shaft Seal Assembly
2	Main Cylinder Sleeve	22	Middle Head Seal Assembly
3	Ram Shaft	23	Main Piston OD Seals
4	Anti-Rotation Retainer	24	Piston Wear Band
5	Retainer Bolts	25	Seal Sub
6	Boost Shaft	26	Seal Sub O-rings
7	Cartridge Seal Assembly	27	Cylinder Head, Middle Booster
8	Ram Shaft Seal Assembly	28	Cylinder Head Booster
9	Cylinder Manifold	29	Locking Screw
10	Boost Cylinder	30	Door Bolts
11	Cylinder Sleeve O-ring		
12	Cylinder Sleeve Back-up Ring		
13	Cylinder Head O-ring		
14	Cylinder Head Back-up Ring		
15	Cylinder Head Studs		
16	Cylinder Head Lock Nuts		
17	Main Piston		
18	Main Piston ID Sea		
19	Boost Piston		
20	Boost Piston ID Seals		

**Removing Boost Cylinder and Piston**

Maintenance on the Booster Cylinder is performed in a similar manner as on the standard manual lock door.

1. Follow the following basic procedures. Rams should be in the open position.
2. Vent all well bore pressure and operating hydraulic pressure to 0 psi (0 bar).
3. Remove the booster cylinder head (item 28). Refer to previous procedures for the steps of removal. With the cylinder head removed, the locking shaft seal assembly (LSSA) can be replaced. See "Removing the Locking Shaft Seal Assembly (LSSA)" on page 23.
4. Remove the manifold (item 9).



**CAUTION:** Take care in moving the cylinder head (item 28) over and off the Boost Shaft (item 6).

5. Install two bolts or eye bolts in the  $\frac{1}{2}$ -inch 13 UNC holes to be used to pull the piston assembly (item 19) from the boost cylinder (10).
6. Remove the piston assembly (item 19) and the boost shaft (item 6).



**CAUTION:** If jacking bolts are not used, the cylinder (item 10) and cylinder head may slide away from the middle boost cylinder head as one unit. Care should be taken to ensure the cylinder and manifold do not fall from the cylinder head during the removal. Secure the cylinder to the lifting equipment by adding an additional choker strap.

7. With the boost piston and shaft removed, the OD piston seals (item 23) and wear band (item 24) can be replaced. Lubricate the seals with SAE 30W oil.
8. Remove the boost shaft from the piston and replace the ID seals (item 20).
9. Replace the back-up ring (item 14) and O-ring (item 13) in the cylinder head.
10. Replace the O-rings (item 26) on the manifold.
11. Once the components are clean and seals and O-rings replaced, the booster cylinder assembly can be reassembled in a reversed manner.
12. Install the boost shaft into the piston assembly.
13. Install the boost piston and shaft into the cylinder as far as possible.
14. Lift the cylinder head and locking shaft to align with the cylinder and manifold. Lubricate the manifold and the cylinder head O-rings with SAE 30W oil and slide the assembly over the cylinder studs (item 15), aligning the cylinder head until it covers the cylinder and the manifold.
15. Torque the cylinder stud lock nuts properly in a criss-cross fashion. Refer to the assembly drawings for values.



**NOTE:** If the cylinder was removed, install a new back-up ring (item 14) and O-ring (item 13) into the middle cylinder head (item 27)

## Continued Maintenance of the Booster Door Assembly (If supplied)

Maintenance can be continued on the balance of the door assembly with the cylinder head, boost piston and boost shaft removed in the previous procedures.

1. With the booster cylinder removed, the middle cylinder head (item 28) can be removed by sliding off the cylinder studs (item 15) and the ram shaft (item 3).
2. Removing the middle cylinder head provides access to the main piston (item 17), the ram shaft (item 3), the cylinder sleeve (item 2) and the ram shaft seal assembly (item 8). Maintenance procedures are covered in earlier sections of this chapter.



**NOTE:** Lubricate the seals and O-rings prior to installation.

Refer to the assembly drawings for seal and O-ring orientation.

## Ram Assembly Removal and Inspection Procedures

Procedures for removal and installation of pipe, blind and shear rams in the SLX BOP are the same.

### Removal of Rams

Remove the rams according to the steps listed below.



**CAUTION:** *The BOP door must be securely bolted prior to opening the rams with hydraulic pressure.*

1. Open the rams with 1,500 psi hydraulic pressure.
2. Bleed hydraulic pressure to 0 psi (0 bar) so that the door will swing open easily and to prevent possible damage to the hinge pin O rings.



3. Unscrew the door cap screws and open the door.



**CAUTION:** Do not use the hydraulic system to open the door. This will severely damage the BOP.

If the BOP is not flanged to a wellhead or securely fastened, open only one door at a time. The weight of two open doors can tip the BOP over.



**CAUTION:** Care should be taken to avoid turning the ram assembly and allowing it to slide off the ram shaft.

4. Install 1"-8UNC (or  $\frac{5}{8}$  - 8 UNC) eyebolt in the top of the ram as shown in Figure 4-19.
5. Slowly lift the ram to take the weight off the ram shaft and slide the ram horizontally as shown in Figure 4-19.

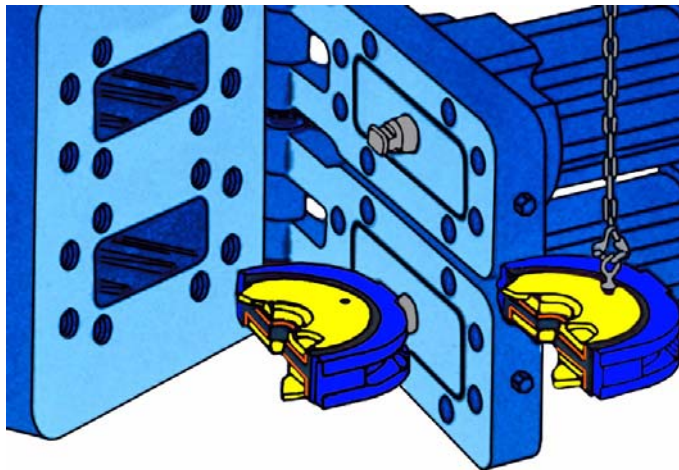


Figure 4-19. Install Eyebolt and Slide Ram Horizontally

### Cleaning and Inspection of Rams

1. Clean the rams.
2. Inspect the ram rubbers for damage such as cracking, gouging, chunking, or splitting. Replace the rubbers if damaged. (See the section titled "Changing Pipe and Blind Ram Rubbers" on page 4-32 and the section titled "Changing Shear Ram Rubbers" on page 4-36.)

## Installation of Rams

1. Thoroughly grease all ram exterior surfaces and the ram shaft.
2. Grease the inside of the BOP body at the following locations:
  - The ram shaft foot and bore area
  - The side pads in the body cavity
  - The skids in the bottom of the body cavity
  - The ram sealing seat in the top of the body cavity
3. Apply thread lubricant specified in API RP 5A3 to the door cap screws both on the threads and under the heads.
4. Clean and oil the door face and replace the door cartridge if damaged (see the section titled "Door Cartridge Seal Corrective Maintenance" on page 4-9).
5. Clean and lubricate the door sealing surface on the body with SAE-10W oil.



**CAUTION:** Do not use grease on door faces or sealing surfaces.

6. Swing the door of the preventer to the open position.
7. Install a 1"-8UNC (or  $\frac{5}{8}$ " - UNC) eyebolt in the top of the ram assembly.
8. Slowly lift the ram into position to slide the assembly horizontally onto the ram shaft foot. Make sure the ram assembly is centered within the front of the door.
9. Manually close the door of the preventer and torque the door cap screws.

## Changing Pipe and Blind Ram Rubbers

1. Clean the ram.
2. Remove the two ram block retracting screws as shown in Figure 4-20 on Page 4-34.

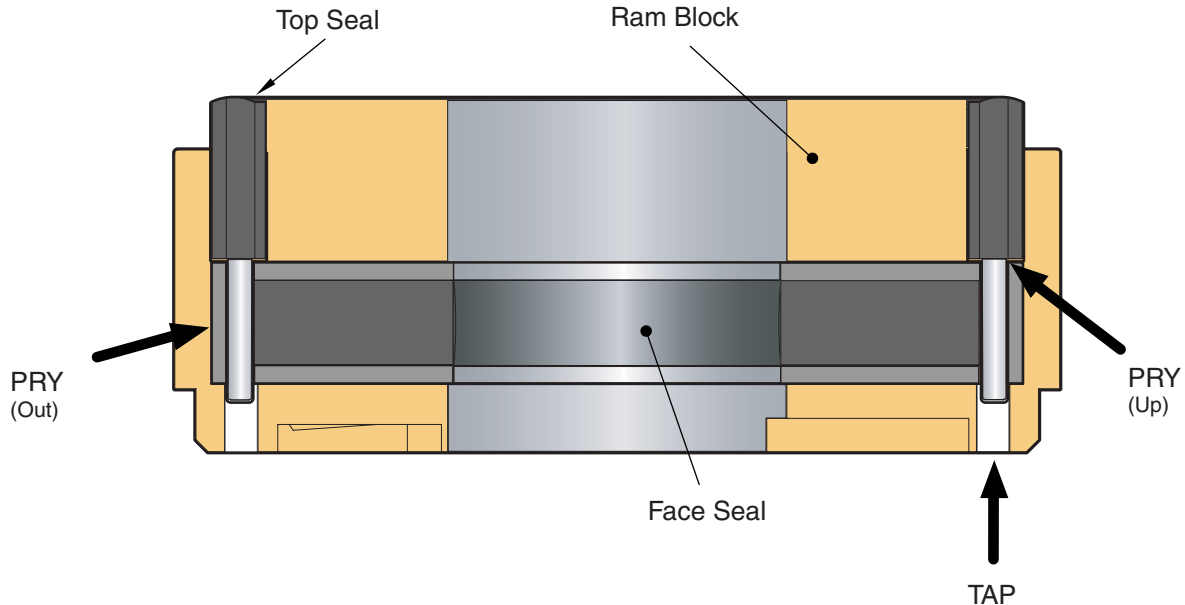


**Figure 4-20. Remove Retracting Screws**

3. Remove the ram holder by sliding it away from the block as shown in Figure 4-21.
4. Pry up between the face seal and the top seal to remove out of ram block as shown in Figure 4-22. The top seal can be tapped from the bottom with a small punch to help with the removal.



**Figure 4-21. Remove Holder**



**Figure 4-22. Prying Rubbers from the Block**

5. Insert screwdrivers or pry bars between the ram block and the face seal rubber and pry out way from the block as shown in Figure 4-22.
6. Prior to installing a new ram rubber into the ram block, clean the block and lubricate with oil. Install new face seal rubber
7. Place the rubber onto the block. Using a rubber mallet hammer the rubber until it bottoms in the ram block as shown in Figure 4-23.
8. With the face seal in place, lubricate and insert the top seal into the ram block and use rubber mallet to tap seal into mating holes on the face seal and firmly seat the rubber onto the block. Refer to Figure 4-22.
9. Place the ram holder into the block as shown in Figure 4-24.
10. Install the ram block retracting screws and tighten securely as shown in Figure 4-25.



Figure 4-23. Hammer Ram Rubber into Ram Block



Figure 4-24. Install Holder



Figure 4-25. Install Retracting Screws

## Changing Shear Ram Rubbers

### Disassembly of the Shear Ram

1. Clean the shear ram.
2. Lay the ram on a level surface and remove the retracting screws.
3. Pry the upper and lower shear rubbers from the blocks (see Figure 4-26).

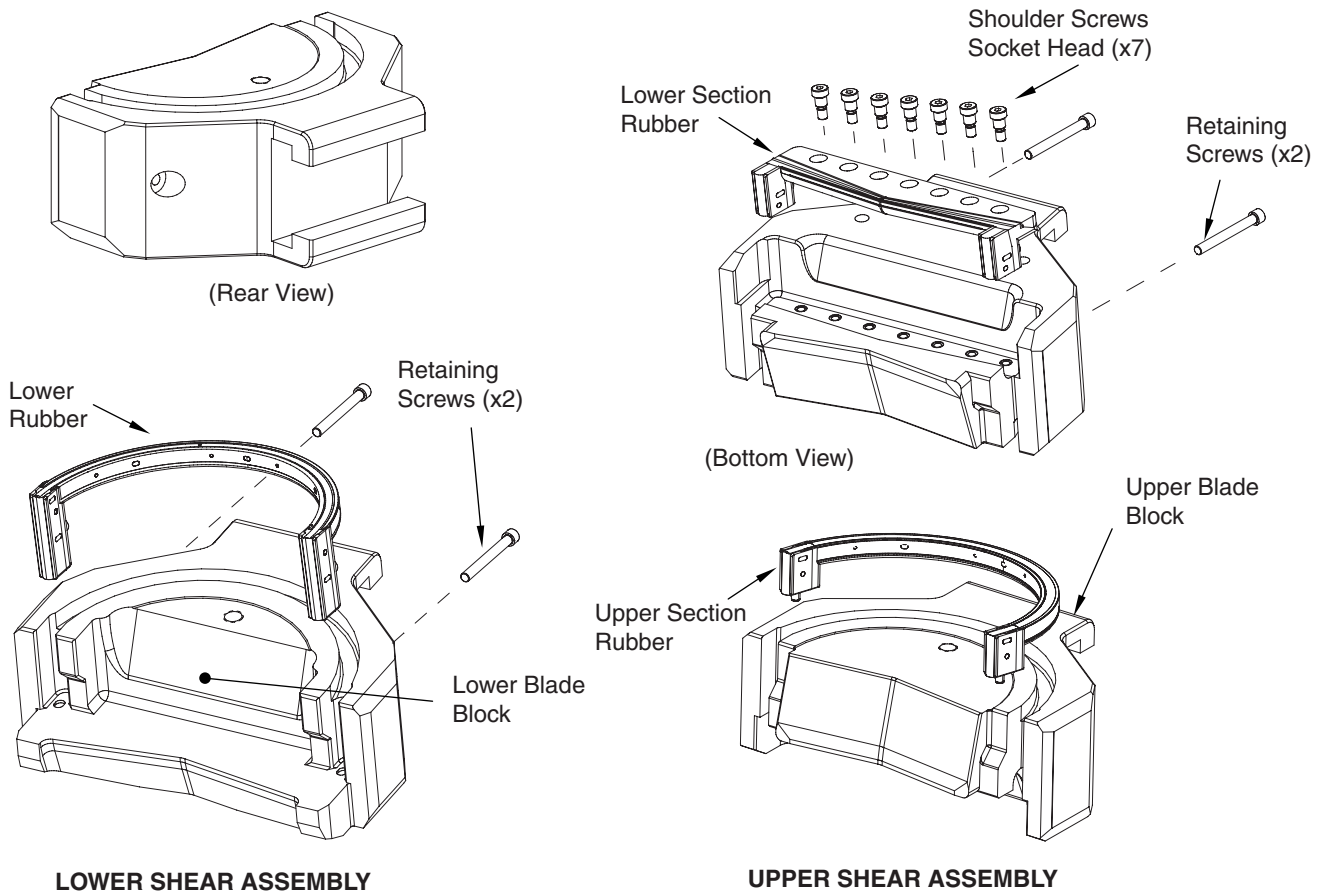


Figure 4-26. Shear Ram Assembly

4. Flip the upper shear ram over and inspect the lower shear rubber. If damaged, replace it according to the steps listed below. (See Figure 4-26).
  - ❑ Remove the seven socket head screws.
  - ❑ Lift the lower shear rubber from the ram block.
  - ❑ Clean blade area of the lower block
  - ❑ Install the new lower shear rubber in the ram block.
  - ❑ Insert the cap screws and tighten to approx. 30 ft-lbs. torque.

### Reassembly of the Shear Ram

1. Clean any mud and debris off the bottom of the block and out of the rubber grooves.
2. Thoroughly oil the block groove area.

3. Install the new rubbers on the block as shown in Figure 4-26 using a rubber mallet to seat the rubbers in the grooves.



**CAUTION:** Take care not to tear or cut the rubber during installation.

4. Install the retracting screws and torque (see Figure 4-26).

## Offset Rams for Dual Completions

Single offset rams have only one bore, which is offset to API center line standards. This allows complete control of a dual completion when the second tubing string is to be run later.

Dual offset rams are furnished to API centerline standards for complete control of a dual completion when both tubing strings are run together.

Contact your local Shaffer sales representative for part numbers and delivery dates. Be sure to specify the following when ordering:

- ❑ BOP size and working pressure.
- ❑ If single or dual offset rams are required.
- ❑ Tubing OD and type of coupling so the coupling OD can be determined.
- ❑ Casing size and weight so that the casing ID can be determined.
- ❑ Tubing hanger centerline dimensions.

## Aluminum Drill Pipe Rams

Since aluminum drill pipe has an oversize OD, these rams must have oversize bores in both the ram blocks and in the ram rubber extrusion plates. Contact your local Shaffer sales representative for part numbers and the following:

- ❑ BOP size and working pressure.
- ❑ Aluminum drill pipe OD.

## Cleaning and Storage of the SLX BOP

A BOP should be cleaned immediately after it is taken out of service. Proper cleaning of a BOP before it is stored will increase its life significantly. If a BOP is in an active drilling program, this cleaning should be done approximately every three months or when the rig is between wells. Refer to the table titled "SLX Ram BOP Cleaning and Lubricating Instructions" on page 4-42.

Open the doors and remove the rams (see the section titled "Removal of Rams" on page 4-30).



**CAUTION:** *If the BOP is not flanged to a wellhead or securely fastened, open only one door at a time. The weight of two open doors can tip the BOP over.*

- ❑ Store rubber parts in their natural shape. Do not hang o-rings on nails or hooks.
  - ❑ Storage areas should be kept as dry as possible. Oil, grease or other fluids should be stored elsewhere to avoid spillage.
  - ❑ If storage is for a long duration, it is recommended that rubber parts be placed in sealed containers or be given a protective surface covering impervious to temperature or light. This will extend the shelf life.
  - ❑ Rubber parts should be used on a first in, first out basis.
5. Inspect rubber parts according to the instructions listed below.
- ❑ Each rubber part must be inspected before it is put into service.
  - ❑ Bend, stretch, or compress each part and look for cracks.
  - ❑ Observe if the rubber part has a hard skin or small cracks which may become chalky or bark like in appearance.



**NOTE:** Some cracks are not obvious, but when the rubber part is bent, stretched or compressed, very minute cracks will become apparent.

## Troubleshooting

The the table titled "Troubleshooting – SLX Manual Lock BOP" on page 4-40 provides possible causes and corrective action for some of the more common problems likely to be encountered.

## Storage and Inspection of Rubber Parts

Shaffer rubber parts are especially compounded to give maximum storage life under normal oilfield conditions. Proper storage minimizes deterioration and increases the service life of these items.

Aging of rubber parts is based on several factors, including atmosphere, light, temperature, and size. Ozone in the atmosphere reacts with rubber parts and hastens deterioration. Rubber parts should never be stored around electrical equipment because of the occurrence of ozone.



Direct light, especially sunlight which contains ultraviolet rays, is very harmful and must be avoided.

All rubber parts undergo several kinds of changes when they are exposed to low temperature. In temperatures of minus 40° F (–40° C) the rubber becomes brittle and will shatter when dropped or handled roughly. Some changes occur immediately, others after prolonged exposure. All are reversible; the rubber regains its original properties when it is returned to 65° F (18° C) or room temperature.

Heat causes a gradual hardening of the rubber, especially when ozone or oxygen is present. In warm, humid climates, particularly the tropics, fungi and bacteria attack the organic content in reinforced rubber parts.

The size, composition, and function of rubber parts prevents giving a precise shelf life. Large rubber parts might suffer the same amount of deterioration as small parts and still be usable, whereas small parts become useless and should be thrown away.

Both natural and synthetic rubber parts are susceptible to deterioration from various solvents, e.g. oil field liquid hydrocarbon, which causes swelling or shrinkage.

In the final analysis, personal judgement determines whether a rubber part should be used. If there is doubt, replace the part.

- ❑ Rubber parts should be stored as described below:
  - ❑ Store rubber parts in a dark place, indoors, and away from sunlight, windows, and direct artificial lighting.
  - ❑ Store in a cool location [approximately 65° F (18° C)].
  - ❑ Store rubber parts in their natural shape. Do not hang O-rings on nails or hooks.
  - ❑ Storage areas should be kept as dry as possible. Oil, grease, or other fluids should be stored elsewhere to avoid spillage.
  - ❑ If storage is for a long duration, it is recommended that rubber parts be placed in sealed containers or be given a protective surface covering impervious to temperature or light. This will extend the shelf life.
  - ❑ Rubber parts should be used on a first in, first out basis.
- ❑ Inspect rubber parts as described below:
  - ❑ Each rubber part must be inspected before it is put into service.
  - ❑ Bend, stretch, or compress each part and look for cracks.



**NOTE:** Some cracks are not obvious, but when the rubber part is bent, stretched, or compressed, very minute crack will become apparent.

## SLX BOP Data Location

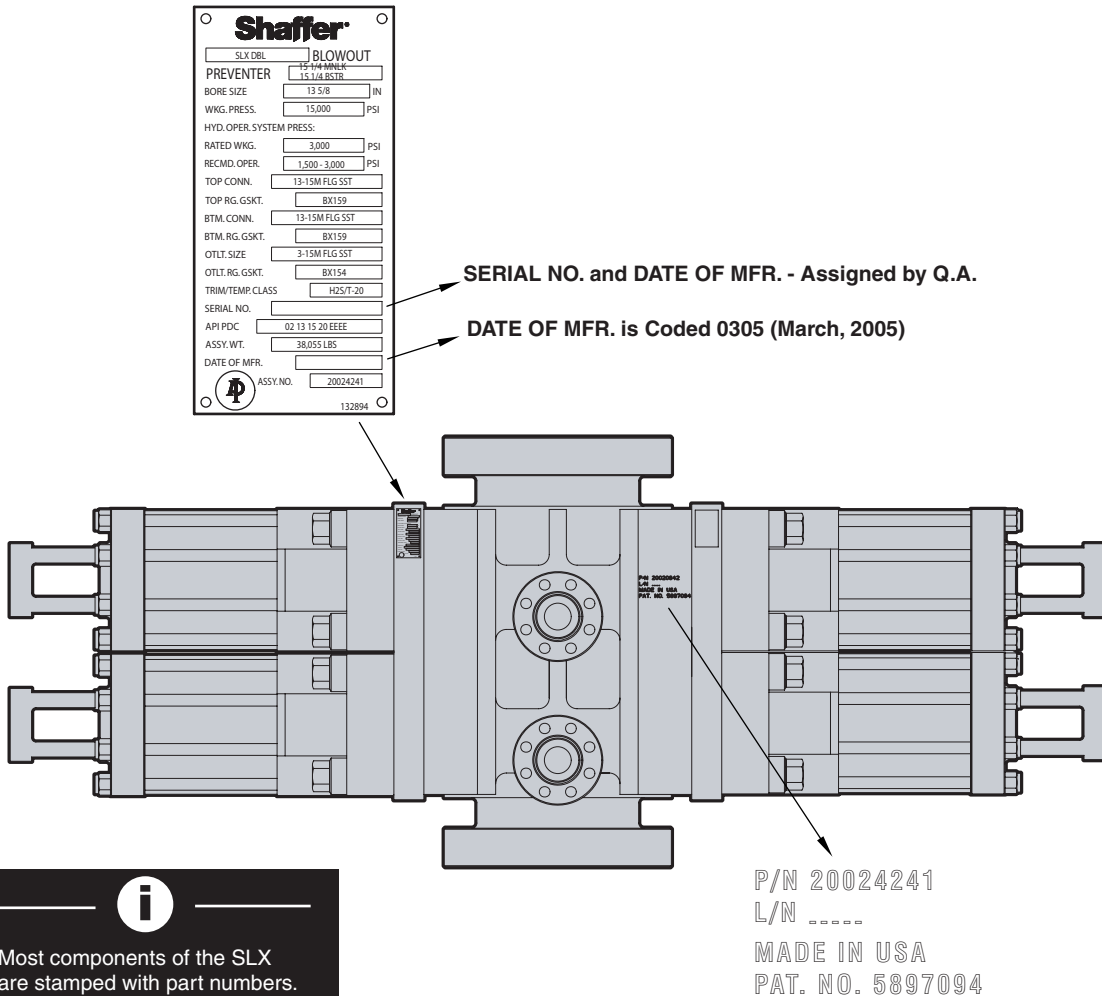
See Figure 4-27 for the location of BOP data. A data plate is fastened in the location shown. Also shown in the figure are other areas of information

- ❑ The serial number on the door is located on the hinge boss and consists of the letters SND followed by numbers.
- ❑ The body serial number or part number is located in various places on the body.

- Most components of the SLX BOP are stamped with their part numbers and other manufacturing data.



**NOTE:** Always give the serial numbers or part numbers and size of the SLX BOP when ordering parts.



**i**  
Most components of the SLX are stamped with part numbers.

Figure 4-27. Data Information Location

**Troubleshooting – SLX Manual Lock BOP**

Problem	Possible Cause	Correction
Will not hold well pressure	BOP is upside-down.	When BOP is right side up, the side outlets are below the skirts. Inside the BOP, the side outlets are below the rams (see the section titled "Installation Instructions" on page 3-2).

**Troubleshooting – SLX Manual Lock BOP (Continued)**

Problem	Possible Cause	Correction
	Bad ram rubbers	Check ram rubbers and replace if necessary (see the section titled "Ram Assembly Removal and Inspection Procedures" on page 4-30 and the section titled "Troubleshooting" on page 4-38).
	Damaged seat	Check seat sealing area for cuts and sealing surface scratches. Smooth minor damage with emery cloth (see the section titled "Three-Month Preventive Maintenance" on page 4-4).
	Leaking ram shaft seal	Check the weep holes in the doors for leakage. Replace the ram shaft seal if necessary. A temporary repair can be made by energizing the plastic packing, but the seal should be replaced as soon as possible (see the section titled "Emergency Ram Shaft Packing Repair" on page 4-16, Figure 4-1 on page 4-3).
	Leaking door seal	Check for leaks between the doors and the body. Tighten door bolts or replace the door seals as required (see the section titled "Monthly Preventive Maintenance" on page 4-3 and the section titled "Door Cartridge Seal Corrective Maintenance" on page 4-9).
	Pump leaking in the test unit	Install isolation valve in the pump line close to the BOP. Install a pressure gauge between the isolation valve and the BOP. No indication of pressure drop indicates a leak in the test unit.
Rams will not close	Hydraulic fluid not reaching the BOP	Remove the closing line from BOP and pump a small amount of hydraulic fluid through it. If no fluid appears, the line is plugged. Clear the closing line.
	Opening hydraulic line plugged or piston seal damaged	Remove opening line from the BOP and apply closing hydraulic pressure. 1. If hydraulic fluid spurts out of BOP briefly and stops and rams close, the opening hydraulic line is plugged. Call a Shaffer service representative. 2. If hydraulic fluid spurts out of BOP continuously, the piston seal is damaged. The rams would also move, but there would be no pressure buildup. Call a Shaffer service representative.
	Foreign substance in the wellbore area	Open the door(s) and inspect for cement, metal fragments, etc. Clean the ram cavity.
	Both hydraulic lines are connected to an 'Open' or a 'Close' port on the BOP	This can happen because there are two opening and two closing ports on the BOP. The closing unit will unload itself very quickly. Be sure that one line is connected to a port marked 'Close' and the other line is connected to a port marked 'Open'.
One (or both) rams will open partly, but will not move out of the wellbore	Manual lock(s) rams partly locked	Unlock rams. Check for damage to the locking shafts, threads, or bent shaft (see the section titled "Three-Month Preventive Maintenance" on page 4-4).
	Retracting screw(s) not made up and head(s) striking BOP door	Remove ram and tighten retracting screws (see the section titled "Ram Assembly Removal and Inspection Procedures" on page 4-30 and the section titled "Changing Pipe and Blind Ram Rubbers" on page 4-32).

**SLX Ram BOP Cleaning and Lubricating Instructions**

Part	How to Clean	Lubricants
	Steam, high pressure water, diesel fuel	
1. SLX exterior	<b>WARNING</b> <b>Diesel fuel is a Flammable liquid. It will cause rubber goods to swell and deteriorate.</b>	N/A
2. SLX interior	Steam, high pressure water	SAE-10W hydraulic oil or equivalent.
3. Studs/nuts	Water, wire brush	Grease specified in API 5A2.
4. Ring groove*	Emery Cloth	(Grease if not immediately in service).
5. Ram assembly	Steam, high pressure water, diesel fuel (See Warning)	Grease
6. Lifting eye threads	Water, wire brush	Pack heavy grease to prevent corrosion.
7. Seat sealing surfaces	Emery cloth	SAE-10W hydraulic oil or equivalent.
8. Bore	Steam, high pressure water	SAE-10W hydraulic oil or equivalent.
9. Skids and side pads	Steam, high pressure water, emery cloth	Grease
10. Sealing areas (door face, door sealing surface)	Emery Cloth	SAE-10W hydraulic oil or equivalent.
11. Seals	Wipe with damp cloth	SAE-10W hydraulic oil or equivalent.
12. Door seal grooves	Emery cloth	SAE-10W hydraulic oil or equivalent.

\* Do not use a wire brush to clean the ring groove. Install new ring gaskets dry.

# Specifications and Parts Lists

## Customer Service

Direct all correspondence to one of the addresses provided below.

### Mailing Address

National Oilwell Varco (NOV)  
P.O. Box 1473  
Houston, Texas 77251, U.S.A.

### Shipping Address

12950 West Little York  
Houston, Texas 77041  
Phone: (713) 937-5000  
Fax: (713) 937-5779

### Repair Center

5900 Brittmoore  
Houston, Texas 77041-5620  
Phone: 281-847-9990

## Parts Identification

All parts required for maintenance or repair are available from NOV at the above locations. Assembly drawings correspond to the parts list, which identifies each part by number. Using this part number and part name will ensure procurement of the proper part when ordering parts.

## Ordering Replacement Parts

When ordering replacement parts, please specify the following information:

- Part name – list part name as called out on the applicable drawing
- Part number – list part number as called out on the applicable drawing
- Drawing number – list engineering drawing number and the item number for the drawing
- Quantity – list the quantity needed
- Serial number – list the serial number (if applicable) as shown on the nameplate

# Specifications

## BOP Characteristics

BOP CHARACTERISTICS	13 <sup>5</sup> / <sub>8</sub> " 10,000 PSI
Working Pressure	10,000 psi
Test Pressure	10,000 psi
Cylinder Size	15 <sup>1</sup> / <sub>4</sub> "
Max. Ram Size	11 <sup>3</sup> / <sub>4</sub> "

## OPERATOR CHARACTERISTICS

Working Pressure (Max.)	3,000 psi
Volume to Open, Gallons	
15 <sup>1</sup> / <sub>4</sub> " cylinder	6.10 per
15 <sup>1</sup> / <sub>4</sub> " X 15 <sup>1</sup> / <sub>4</sub> " cylinder	12.09 per
Volume to Close, Gallons	
15 <sup>1</sup> / <sub>4</sub> " cylinder	6.22 per
15 <sup>1</sup> / <sub>4</sub> " X 15 <sup>1</sup> / <sub>4</sub> " cylinder	12.21 per
Piston Stroke	8.449 inches
Ram Shaft	4 <sup>1</sup> / <sub>2</sub> " diameter

## WEIGHTS

Double, F x F, with 15 <sup>1</sup> / <sub>4</sub> " Cylinders and 15 <sup>1</sup> / <sub>4</sub> " X 15 <sup>1</sup> / <sub>4</sub> " Boosters	38,055 lbs.
Double, F x F, with 15 <sup>1</sup> / <sub>4</sub> " Cylinders	25,200 lbs.
Single, F x F, with 15 <sup>1</sup> / <sub>4</sub> " Cylinders	23,753 lbs.
Ram Assembly (per set)	486 lbs. (approx.)

## Recommended Spare Parts

The table below provides recommended spare parts coverage for the SLX manual lock preventer.

### SLX Manual Lock BOP Spare Parts List

P/N	Description	Qty. <sup>1</sup>
<b>Spare Parts Kits</b>		
20023582	Spare Part Kit, 13-10M, SLX, 15.25" Manual Lock Cylinders	2
20023581	Spare Part Kit, 13-10M, SLX, 15.25" Manual Lock Cylinders with 15.25" Booster Cylinders (if supplied)	2
<b>Hinge Bracket Spares</b>		
20019696	Seal	20
030065	O-ring	4
030012	O-ring	20
060810	Thrust Bearing	4
060827	Bearing Race	8
050267	Grease Fitting	4

1. Quantities are for one cavity. Multiply by the number of cavities needed.

## Ram Parts Lists

The following tables contain listings for various ram assemblies for the SLX ram BOP.

U/T = Ultra Temp

### 13<sup>5</sup>/<sub>8</sub>" 10,000 psi SLX Ram Assemblies

Pipe O.D. <sup>1</sup> (in.)	Ram Type	Ram Block Assy <sup>2</sup>	Ram Rubber Assy <sup>3</sup>	Ram Block	Face Seal
C.S.O.	SLX-U/T	20024728	20020847	20019613	20020200
2 <sup>3</sup> / <sub>8</sub>	SLX-U/T	20024729	20020848	20019639	20020201
2 <sup>7</sup> / <sub>8</sub>	SLX-U/T	20024730	20020849	20019641	20020202
3 <sup>1</sup> / <sub>2</sub>	SLX-U/T	20024731	20020850	20020159	20020203
4	SLX-U/T	20024733	20020851	20020161	20020204
4 <sup>1</sup> / <sub>2</sub>	SLX-U/T	20024735	20020852	20020169	20020205
5	SLX-U/T	20024737	20020853	20020173	20020206
5 <sup>1</sup> / <sub>2</sub>	SLX-U/T	20024739	20020854	20020175	20020207
5- <sup>7</sup> / <sub>8</sub>	SLX-U/T	20024742	20020855	20020177	20020823
6 <sup>5</sup> / <sub>8</sub>	SLX-U/T	20024744	20020856	20020181	20020208
7	SLX-U/T	20024746	20020857	20020183	20020209
7 <sup>5</sup> / <sub>8</sub>	SLX-U/T	20024747	20020858	20020184	20020210
8 <sup>5</sup> / <sub>8</sub>	SLX-U/T	20024749	20020860	20020186	20020211
9 <sup>5</sup> / <sub>8</sub>	SLX-U/T	20024750	20020861	20020187	20020212
9 <sup>7</sup> / <sub>8</sub>	SLX-U/T	20024751	20020862	20020188	20020213
10 <sup>3</sup> / <sub>4</sub>	SLX-U/T	20024752	20020863	20020190	20020214

Common Part Numbers    20019895 Top Seal  
All Pipe Sizes

<sup>1</sup> Other Pipe OD sizes require Engineering review.

<sup>2</sup> Includes ram block and ram rubber assembly.

<sup>3</sup> Includes face seal, top seal and two retaining screws. Rubber is nitrile (Shaffer spec. SS-204)



The following tables contain listings for various ram assemblies for the SLX ram BOP.

D = Hang-off capacity

U/T = Ultra Temp

**13<sup>5</sup>/<sub>8</sub>" 10,000 psi SLX Ram Assemblies**

Pipe O.D. <sup>1</sup> (in.)	Ram Type	Ram Block Assy <sup>2</sup>	Ram Rubber Assy <sup>3</sup>	Ram Block	Face Seal
3 <sup>1</sup> / <sub>2</sub>	SLX-U/T	20024732	20020850	20020160	20020203
4	SLX-U/T	20024734	20020851	20020167	20020204
4 <sup>1</sup> / <sub>2</sub>	SLX-U/T	20024736	20020852	20020170	20020205
5	SLX-U/T	20024738	20020853	20020174	20020206
5 <sup>1</sup> / <sub>2</sub>	SLX-U/T	20024741	20020854	20020176	20020207
6 <sup>5</sup> / <sub>8</sub>	SLX-U/T	20024745	20020856	20020182	20020208

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Common Part Numbers    20019895 Top Seal  
All Pipe Sizes

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*1 Other Pipe OD sizes require Engineering review.*

*2 Includes ram block and ram rubber assembly.*

*3 Includes face seal, top seal and two retaining screws. Rubber is nitrile (Shaffer spec. SS-204)*

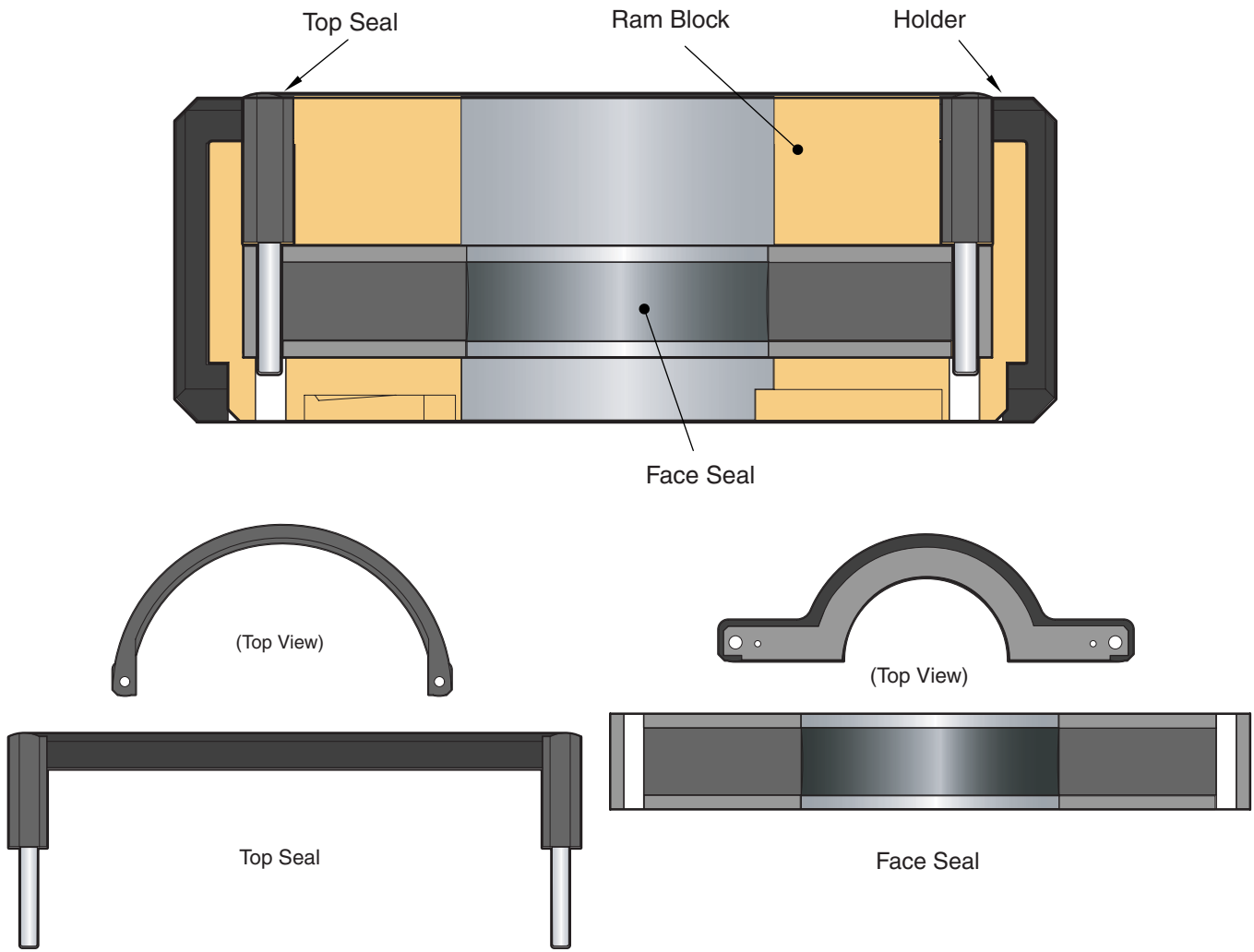


Figure 5-1. SLX Ram Assembly

**13<sup>5</sup>/<sub>8</sub>" 10,000 psi SLX V-Shear Ram Assembly**

Description	Qty.	Part Number	Description	Qty.	Part Number
Complete Assembly	1	20024179	Upper Shear, Rubber Lower Section	1	20010205
Upper Shear Ram Assembly	1	20024175	Upper Shear, Rubber Upper Section	1	20010206
Lower Shear Ram Assembly	1	20024174	Lower Shear, Rubber	1	20010207
Ram Block, Upper Blade	1	20024172	Shoulder Screws	7	20010474
Ram Block, Lower Blade	1	20024171	Retaining Screws	4	010699
Upper Shear Rubber Assy	1	20010471			

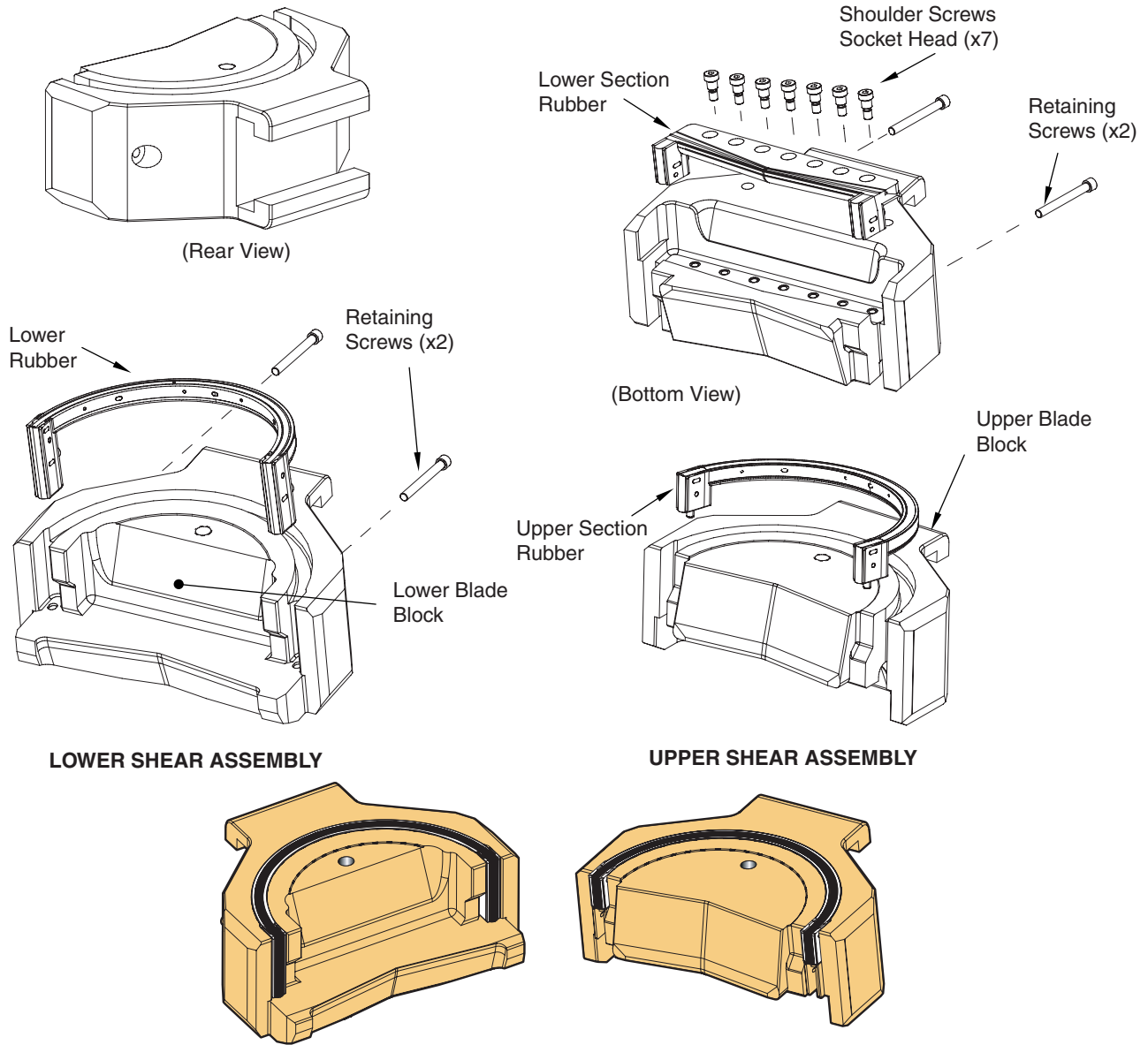


Figure 5-2. V-Shear Ram Assembly

**13<sup>5</sup>/<sub>8</sub>" 10,000 psi SLX Multi-Ram Assemblies**

Pipe Size Range	Complete Assy.	Block Sub Assy.	Rubber Assy.	Holder	Block	Face Seal	Top Seal	Retract Screw
2 <sup>3</sup> / <sub>8</sub> - 3 <sup>1</sup> / <sub>2</sub>	125393*	—	125394	—	124485	124484	124486	—
3 <sup>1</sup> / <sub>2</sub> - 5	125120**	125121	125117	138180	125123	125119	121010	142061
5 - 6 <sup>5</sup> / <sub>8</sub>	124723***	—	—	—	124491	124797	124800	—

*Note:*

- \* Pipe suspension (Hang-off) on 3-<sup>1</sup>/<sub>2</sub>" 400,000 lbs. (2<sup>3</sup>/<sub>8</sub> - 2<sup>7</sup>/<sub>8</sub> 0lbs)
- \*\* Pipe suspension (Hang-off) on 3-<sup>1</sup>/<sub>2</sub>" 200,000 lbs.
- \*\* Pipe suspension (Hang-off) on 4" 200,000 lbs.
- \*\* Pipe suspension (Hang-off) on 4-<sup>1</sup>/<sub>2</sub>" 400,000 lbs.
- \*\* Pipe suspension (Hang-off) on 5" 600,000 lbs.
- \*\*\* Pipe suspension (Hang-off) on 5-<sup>1</sup>/<sub>2</sub>" 400,000 lbs.
- \*\*\* Pipe suspension (Hang-off) on 6-<sup>5</sup>/<sub>8</sub>" 400,000 lbs.

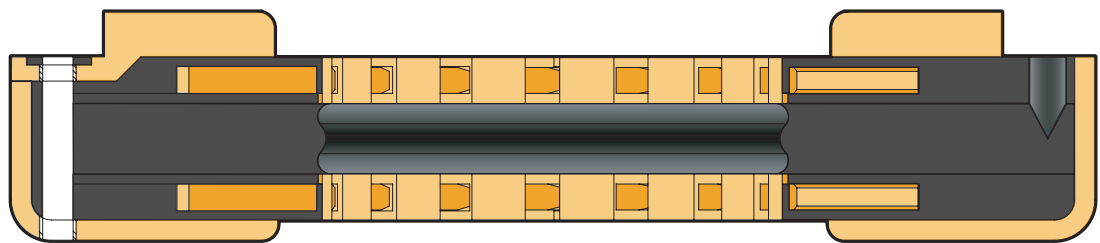


Figure 5-3. Multi Ram Face Rubber

## API Hardware

The following tables list general API hardware for the SLX BOP and any associated equipment.

### API Nuts

#### Normal Temperatures

Heavy Hex Nuts	Black A194, Gr 2H	Cad. Plated A194, Gr 2H	Low Temperatures A194 Gr 4 or 7
1/4" - 20 UNC	020018	020300	020301
5/16" - 18 UNC	020019	020304	020305
3/8" - 16 UNC	020020	020308	020309
1/4" - 14 UNC	020021	020312	020313
1/2" - 13 UNC	020006	020316	020317
9/16" - 12 UNC	020007	202320	020321
5/8" - 11 UNC	020008	020324	020325
3/4" - 10 UNC	020004	020328	020329
7/8" - 9 UNC	020009	020333	020334
1" - 8 UNC	020001	020338	020339
1 1/8" - 8 UN	020003	020343	020344
1 1/4" - 8 UN	020010	020347	020348
1 3/8" - 8 UN	020011	020351	020352
1 1/2" - 8 UN	020000	020356	020357
1 5/8" - 8 UN	020012	020361	020362
1 3/4" - 8 UN	020013	020366	020367
1 7/8" - 8 UN	020014	020371	020372
2" - 8 UN	020015	020376	020377
2 1/4" - 8 UN	020016	020381	020382
2 1/2" - 8 UN	020017	020386	020387
2 3/4" - 8 UN	020034	020391	020392
3" - 8 UN	020035	020396	020397

**Tap End Studs for API Flanges**

Tap End Studs	Normal Temperature		Low Temperature
	Black A193, B7	Cad. Plated A193, B7	A320, L7
1/2" x 2 3/4"	011000	012050	012051
5/8" x 3 1/2"	011001	012055	012056
3/4" x 3 3/4"	011002	012060	012061
3/4" x 4"	011003	012065	012066
7/8" x 4"	011004	012070	012071
7/8" x 4 1/4"	011005	012075	012076
7/8" x 4 1/2"	011006	012080	012081
1" x 4"	011037	—	—
1" x 4 3/4"	011007	012085	012086
1" x 5"	011008	012090	012091
1 1/8" x 5 1/4"	011009	012095	012096
1 1/8" x 5 1/2"	011010	012100	012101
1 1/8" x 5 3/4"	011011	012105	012106
1 1/8" x 7"	011036	012110	012111
1 1/4" x 6"	011012	012115	012116
1 1/4" x 6 1/4"	011013	012120	012121
1 3/8" x 6 1/2"	011014	012125	012126
1 3/8" x 6 3/4"	011015	012130	012131
1 3/8" x 7 1/4"	011016	012135	012136
1 3/8" x 7 1/2"	011017	012140	012141
1 1/2" x 7 1/4"	011019	012145	012146
1 1/2" x 7 3/4"	011020	012150	012151
1 1/2" x 8 1/4"	011021	012155	012156
1 1/2" x 8 1/2"	011022	012160	012161
1 5/8" x 8 1/4"	011023	012165	012166
1 5/8" x 8 1/2"	011024	012170	012171
1 5/8" x 13 1/8"	152150	012175	012176
1 3/4" x 8 1/4"	011034	012180	012181
1 3/4" x 9 1/2"	011025	012185	012186
1 7/8" x 9 1/2"	011026	012190	012191
1 7/8" x 10 1/4"	011018	012195	012196
1 7/8" x 10 3/4"	011033	012200	012201
1 7/8" x 11 1/4"	011027	012205	012206

**Tap End Studs for API Flanges (Continued)**

Tap End Studs	Normal Temperature		Low Temperature
	Black A193, B7	Cad. Plated A193, B7	A320, L7
2" x 10 1/4"	011028	012210	012211
2" x 11 1/4"	011035	012215	012216
2" x 11 1/2"	011029	012220	012221
2" x 12"	011030	012225	012226
2 1/4" x 12 1/4"	012240	012241	012242
2 1/4" x 13 1/4"	012246	012247	012248
2 1/4" x 14 1/4"	011031	012230	012231
2 1/4" x 15 1/2"	011032	012235	012236

**API Ring Gaskets**

Flange		R or RX Number	R (Oval)			RX	
Working Pressure (psi)	Nominal Size and Bore		Soft Iron Cad. Plated	Type 304 SS	Rubber Coated	Soft Iron Cad. Plated	Type 304 SS
2,000	2 1/16"	23	050192	050567	050420	050376	050603
3,000/5,000	2 1/16"	24	050193	050568	050421	050380	050604
2,000	2 9/16"	26	050194	050569	050422	050381	050606
3,000/5,000	2 9/16"	27	50195	050570	050423	050382	050607
2,000/3,000	3 1/8"	31	050196	050571	050424	050383	050608
5,000	3 1/8"	35	050197	050572	050426	050384	050609
2,000/3,000	4 1/16"	37	050198	050573	050427	050385	050610
5,000	4 1/16"	39	050199	050574	050428	050386	050611
3,000	5 1/8"	41	050200	050575	050429	050387	050612
5,000	5 1/8"	44	—	050576	—	050388	050613
2,000/3,000	7 1/16"	45	050201	050577	050430	050373	050614
5,000	7 1/16"	46	050202	050578	050431	050389	050615
2,000/3,000	9"	49	050203	050580	050433	050390	050617
5,000	9"	50	050204	050581	050432	050391	050618
2,000/3,000	11"	53	050205	050582	050435	050377	050619
5,000	11"	54	050206	050583	050436	050392	050620
2,000/3,000	13 5/8"	57	050207	050584	050437	050393	050621
5,000	14"	63	050208	050585	050442	050394	050622



**API Ring Gaskets (Continued)**

Flange		R or RX Number	R (Oval)			RX	
Working Pressure (psi)	Nominal Size and Bore		Soft Iron Cad. Plated	Type 304 SS	Rubber Coated	Soft Iron Cad. Plated	Type 304 SS
2,000	16 3/4"	65	050209	050586	050443	050395	050623
3,000	16 3/4"	66	050210	050587	050444	050396	050624
2,000	17 3/4"	69	050306	050588	050445	—	050625
3,000	17 3/4"	70	050307	050589	050446	—	050626
2,000	21 1/4"	73	050211	050590	050448	050397	050627
3,000	20 3/4"	74	050156	050591	050449	050398	050628
2,000/3,000	9"	99	—	050601	—	050408	050638

**API BX Ring Gaskets**

Flange				
Working Pressure (psi)	Nominal Size	Soft Iron BX Number	Type 304 Cad. Plated	Stainless Steel
10,000, 15,000, 20,000	1 13/16"	151	050352	050644
	2 1/16"	152	050353	050645
	2 9/16"	153	050354	050646
10,000, 15,000	3 1/16"	154	050355	050647
	4 1/16"	155	050366	050648
	7 1/16"	156	050356	050649
	9"	157	050227	050650
	11"	158	050350	050651
10,000/5,000	13 5/8"	159	050357	050652
	13 5/8"	160	050462	050653
5,000/5,000/10,000	16 3/4"	161*	050536	050654
	16 3/4"	162	050661	050662
5,000/10,000	18 3/4"	163	050663	050664
	18 3/4"	164	050665	050666
5,000/10,000	21 1/4"	165	050667	050668
	21 1/4"	166	050690	050691

\* For obsolete 16 3/4", 5,000 psi WP 7,500 psi test flange.

**All Thread Studs and Nuts for API Flanges**

All Thread Studs With Two Nuts Each	Normal Temperature		Low Temperature
	Black A193, B7	Cad. Plated A193, B7	A320, L7
1/2" x 4 1/2"	011440	011442	011444
5/8" x 4 1/2"	011449	011451	011453
5/8" x 5 3/4"	011458	011460	011462
5/8" x 6"	011467	011469	011471
3/4" x 4"	011476	011478	011480
3/4" x 5 1/4"	011485	011487	011489
3/4" x 6"	011496	011498	011500
3/4" x 7"	011505	011507	011509
7/8" x 4 1/2"	011514	011516	011518
7/8" x 5 1/2"	011523	011525	011527
7/8" x 6"	011532	011534	011536
7/8" x 7 1/2"	011543	011545	011547
7/8" x 8"	011552	011554	011556
1" x 6"	011561	011563	011565
1" x 6 1/2"	011570	011572	011574
1" x 7"	011579	011581	011583
1" x 7 1/4"	011588	011590	011592
1" x 7 3/4"	011606	011608	011610
1" x 9 1/4"	011615	011617	011619
1" x 10"	—	011991	—
1 1/8" x 7"	011624	011626	011628
1 1/8" x 7 1/2"	011633	011635	011637
1 1/8" x 8 1/4"	011644	011646	011648
1 1/8" x 9"	011655	011657	011659
1 1/4" x 8"	011664	011666	011668
1 1/4" x 8 3/4"	011673	011675	011677
1 1/4" x 9 1/4"	011682	011684	011686
1 1/4" x 12"	011691	011693	011695
1 3/8" x 9"	011700	011702	011704
1 3/8" x 9 1/2"	011709	011711	011713
1 3/8" x 10 1/4"	011720	011722	011724
1 3/8" x 10 3/4"	011729	011731	011733
1 3/8" x 12 1/2"	011738	011740	011742
1 3/8" x 13 1/4"	011747	011749	011751
1 1/2" x 10 1/4"	011756	011758	011760
1 1/2" x 11 1/4"	011765	011767	011769
1 1/2" x 13"	011776	011778	011780

**All Thread Studs and Nuts for API Flanges (Continued)**

All Thread Studs With Two Nuts Each	Normal Temperature		Low Temperature
	Black A193, B7	Cad. Plated A193, B7	A320, L7
1 5/8" x 11"	011787	011789	011791
1 5/8" x 11 3/4"	011796	011798	011800
1 5/8" x 12"	011805	011807	011809
1 5/8" x 12 1/2"	011814	011816	011818
1 5/8" x 17"	011825	011827	011829
1 3/4" x 12 1/4"	011836	011838	011840
1 3/4" x 14 1/4"	011845	011847	011849
1 3/4" x 15"	011856	011858	011860
1 7/8" x 13 3/4"	011867	011869	011871
1 7/8" x 14 1/2"	011876	011878	011880
1 7/8" x 15 3/4"	011887	011889	011891
1 7/8" x 17 1/2"	011898	011900	011902
1 7/8" x 18 1/2"	011909	011911	011913
2" x 14 1/2"	011918	011920	011922
2" x 17 1/4"	011927	011929	011931
2" x 17 1/2"	011938	011940	011942
2" x 18 1/2"	011947	011949	011951
2" x 19 1/4"	011958	011960	011962
2 1/4" x 22 1/4"	011969	011971	011973
2 1/2" x 24 1/4"	011980	011982	011984

## Engineering Drawings

The table below lists the engineering drawings and parts lists for the SLX Ram BOP.

### Engineering Drawings and Parts Lists

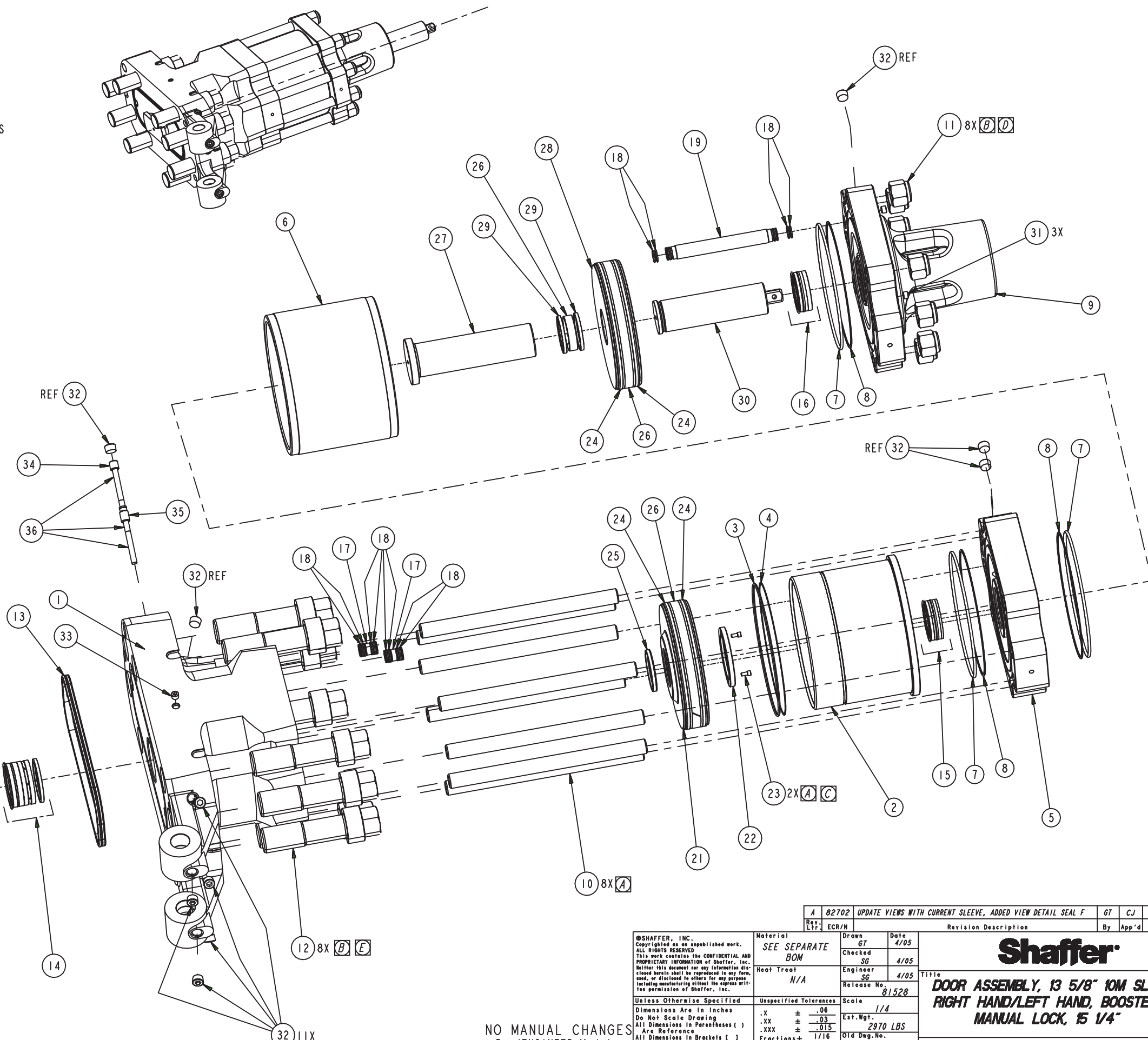
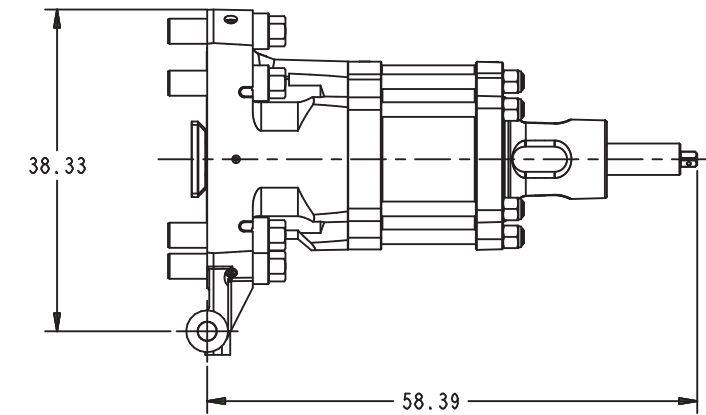
Drawing #	Parts List	Description
D20023559	20023559	Door Assy, 13-10M, SLX, 15.25" Manual Lock (Sht. 1 of 2)
D20023559	20023559	Door Assy, 13-10M, SLX, 15.25" Manual Lock (Sht. 2 of 2)
D-20020123D	20020123	Door Cartridge, Seal Assy
B-126258DD	126258	Hinge Bracket Assy
D-20023573D	20023573	Locking Shaft Seal Assy
A-20023567D	20023567	Ram Shaft Seal Assembly
—	20023581	Spare Part Kit, 13-10M, SLX, 15.25" Manual Lock Cylinders with 15.25" Booster Cylinders (If supplied)
—	20023582	Spare Part Kit, 13-10M, SLX, 15.25" Manual Lock Cylinders

**RECOMMENDED THREAD COATING AND TORQUE VALUES:**

- A** APPLY LOCTITE 542 TO CYLINDER STUD PORTION THAT GOES INTO DOOR AND RAM SHAFT RETAINER BOLTS.
- B** COAT DOOR BOLTS AND STUD THREADS WITH 503 MOLY/FELPRO C670.
- C** RAM SHAFT RETAINER BOLT TORQUE: 5 - 9 FT-LBS
- D** CYLINDER STUD NUT TORQUE FOR SHELL TEST & STANDARD USE: 1,750 FT-LBS
- E** DOOR BOLT TORQUE:  
SHELL TEST: - 7,600 FT-LBS  
STANDARD: - 7,600 FT-LBS

**NOTES:**

1. TORQUE VALUES BASED ON API 6A TORQUE TABLE FRICTION FACTOR OF .067.
2. ASSEMBLE PISTON, ITEM 21, TO RAM SHAFT ITEM 20, PRIOR TO INSTALLING CYLINDER, ITEM 2. TO ASSEMBLE PISTON TO RAM SHAFT, THREAD TOGETHER UNTIL INDICATED PISTON SURFACE IS FLUSH WITH NOTCH ON RAM SHAFT AS SHOWN. ATTACH RETAINER PLATE, ITEM 22. IF RETAINER PLATE & PISTON HOLES DON'T ALIGN, UNSCREW PISTON UNTIL ALIGNMENT IS ACHIEVED.
3. RAM SHAFT STROKE = 8.258 IN
4. CLOSING RATIO = 10.5
5. GALLONS TO CLOSE = 12.08 Gal
6. GALLONS TO OPEN = 11.96 Gal
7. C.G. LOCATION WITHOUT FLUID
8. TOTAL ESTIMATED WT: 2,970 LBS (WITH OPERATOR FLUID)



NO MANUAL CHANGES  
Pro/ENGINEER Model

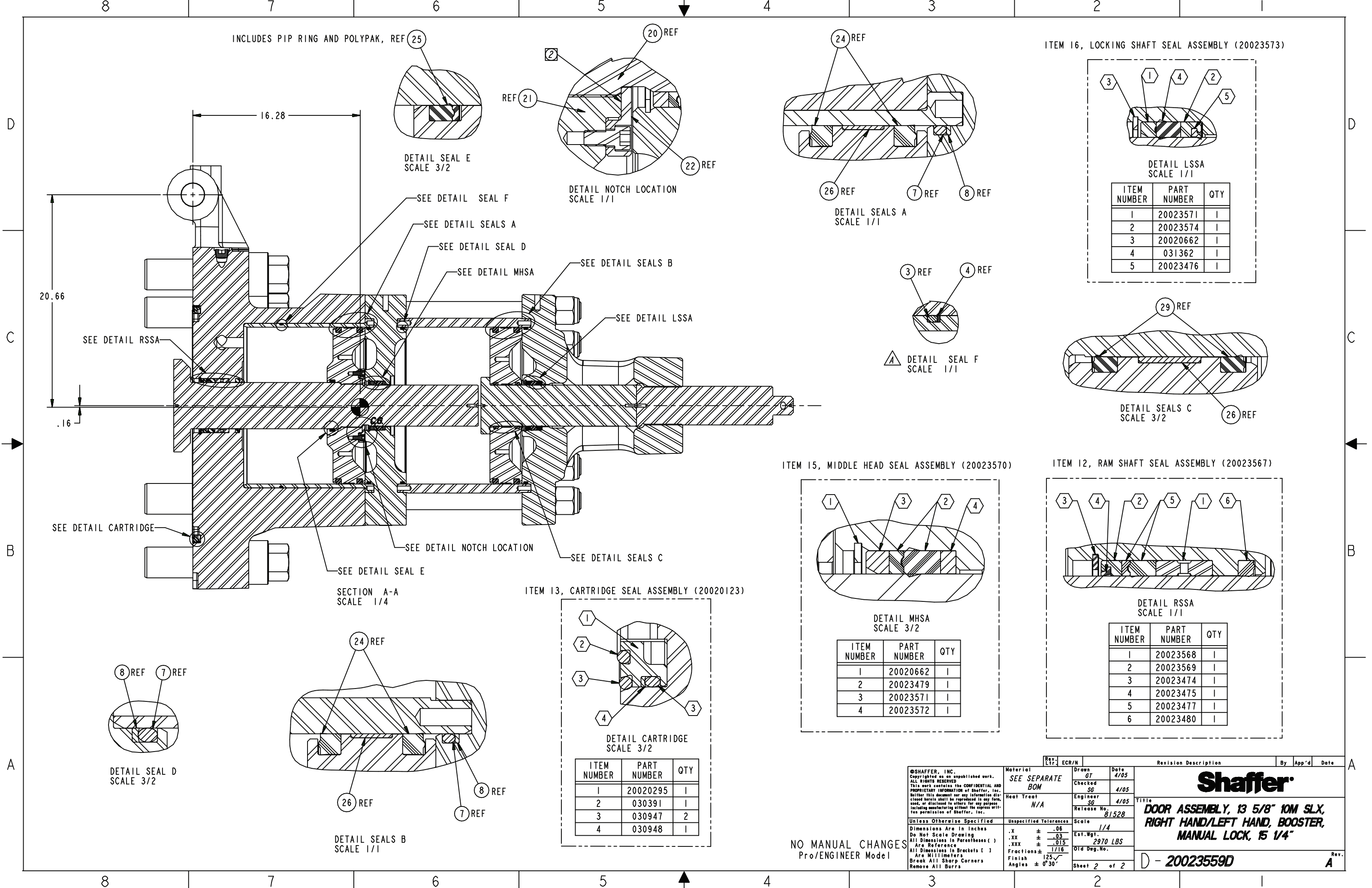
Rev: A	ECR/N	GT	CJ	9/05
Ltr: ECR/N		Revision Description		
By: App'd		Date		
Material: SEE SEPARATE BOM		Drawn: GT	Date: 4/05	
Heat Treat: N/A		Checked: SG	Date: 4/05	
Engineer: SG		Release No.: 81528	Date: 4/05	
Scale: 1/4		Title: DOOR ASSEMBLY, 13 5/8" 10M SLX, RIGHT HAND/LEFT HAND, BOOSTER, MANUAL LOCK, 15 1/4"		
Est. Wgt.: 2970 LBS		Old Dwg. No.:		
Finish: 125		Sheet 1 of 2		
Angles: ± 0°30'		Rev. A		

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Unless Otherwise Specified  
Dimensions Are in Inches  
Do Not Scale Drawing  
All Dimensions in Parentheses ( ) Are Reference  
All Dimensions in Brackets [ ] Are Millimeters  
Break All Sharp Corners  
Remove All Burrs

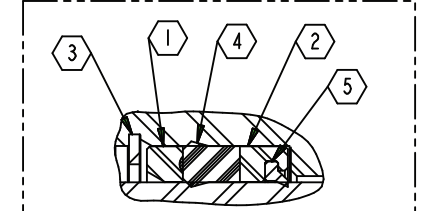
Unspecified Tolerances  
.X ± .06  
.XX ± .03  
.XXX ± .015  
Fractions: 1/16  
Finish: 125  
Angles: ± 0°30'

D - 20023559D



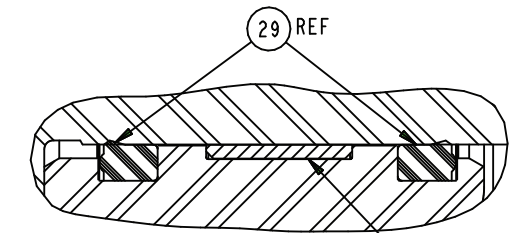
INCLUDES PIP RING AND POLYPAK, REF (25)

ITEM 16, LOCKING SHAFT SEAL ASSEMBLY (20023573)



DETAIL LSSA SCALE 1/1

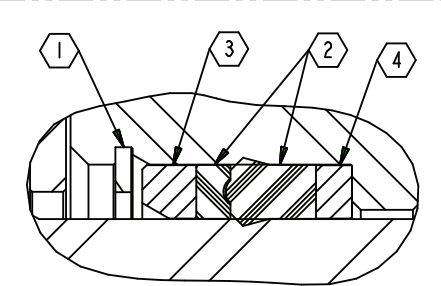
ITEM NUMBER	PART NUMBER	QTY
1	20023571	1
2	20023574	1
3	20020662	1
4	031362	1
5	20023476	1



DETAIL RSSA SCALE 1/1

ITEM NUMBER	PART NUMBER	QTY
1	20023568	1
2	20023569	1
3	20023474	1
4	20023475	1
5	20023477	1
6	20023480	1

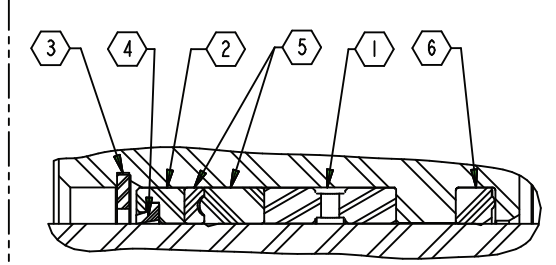
ITEM 15, MIDDLE HEAD SEAL ASSEMBLY (20023570)



DETAIL MHSA SCALE 3/2

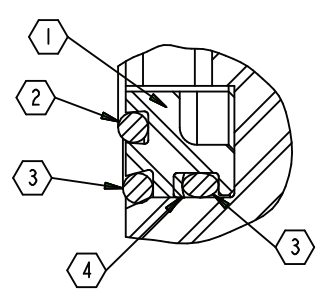
ITEM NUMBER	PART NUMBER	QTY
1	20020662	1
2	20023479	1
3	20023571	1
4	20023572	1

ITEM 12, RAM SHAFT SEAL ASSEMBLY (20023567)



DETAIL RSSA SCALE 1/1

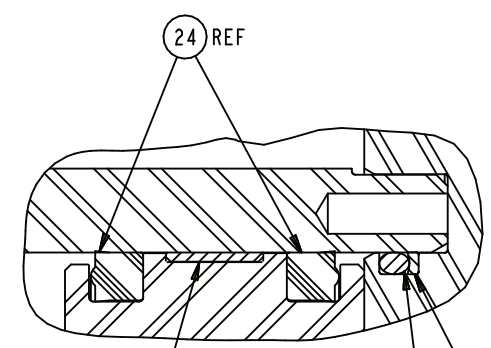
ITEM 13, CARTRIDGE SEAL ASSEMBLY (20020123)



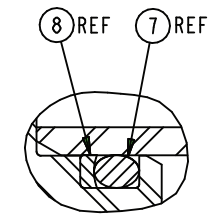
DETAIL CARTRIDGE SCALE 3/2

ITEM NUMBER	PART NUMBER	QTY
1	20020295	1
2	030391	1
3	030947	2
4	030948	1

SECTION A-A SCALE 1/4



DETAIL CARTRIDGE SCALE 3/2



DETAIL SEAL D SCALE 3/2

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Unless Otherwise Specified Dimensions Are in Inches Do Not Scale Drawing All Dimensions in Parentheses ( ) Are Reference All Dimensions in Brackets [ ] Are Millimeters Break All Sharp Corners Remove All Burrs	Unspecified Tolerances .X ± .06 .XX ± .03 .XXX ± .015 Fractions: 1/16 Finish 125 Angles ± 0°30'	Heat Treat N/A	Scale 1/4 Est. Wgt. 2970 LBS Old Dwg. No.	Release No. 81528
NO MANUAL CHANGES Pro/ENGINEER Model			<b>Shaffer</b> <b>DOOR ASSEMBLY, 13 5/8" 10M SLX, RIGHT HAND/LEFT HAND, BOOSTER, MANUAL LOCK, 15 1/4"</b> <b>D - 20023559D</b>	
			Sheet 2 of 2 Rev. A	



Technical Publication for Single Level Bill of Material

Bill of Material for: 20023559

Description: DOOR ASSY, 13-10M SLX, RH/LH, BSTR, 15.25", MNLK,

Weight (LB): 2970.00

CCN: 200 - VARCO SHAFFER

Balloon No.	Component Item	Rev	Description	U M	Qty Per	Effective Beg	Effective End
	20023559D	A	DWG: DOOR ASSY, 13-10M SLX,RH/LH, BSTR, 15.25",MNLK	EA	0.0000	09/06/05	
	20023581		SPARE PART KIT, DOOR, 13-10M SLX, 15.25",BSTR,MNLK	EA	0.0000	03/31/05	
	AX060172	AE	TS: ENGRG TESTING R/RAM BOPS	EA	0.0000	06/29/06	
1	20023561		DOOR, FM, 13-10M SLX, RH/LH, 15.25", MNLK/BSTR,	EA	1.0000	03/31/05	
2	20020145		SLEEVE, CYL, 15.25", 13-10M	EA	1.0000	03/31/05	
3	20020129		O-RING, 75-85 DURO	EA	1.0000	03/31/05	
4	20020127		RG, BU	EA	1.0000	03/31/05	
5	20023562		MDL HD, BSTR, MNLK, 15.25", 13-10M, SLX	EA	1.0000	03/31/05	
6	20019898		CYL, BSTR, 15.25", 13-10M	EA	1.0000	03/31/05	
7	030645		O-RING, 70-75 DURO	EA	3.0000	03/31/05	
8	20020128		RG, BU	EA	3.0000	03/31/05	
9	20023563		CYL HD, BSTR, MNLK, 15.25", 13-10M, SLX	EA	1.0000	03/31/05	
10	20023565		STUD, TE, BSTR, 1.750" X 23.87"LG	EA	8.0000	03/31/05	
11	020108		NUT, LK, HX, 1-3/4"-8UN-2B	EA	8.0000	03/31/05	
12	116134		SCREW, CAP, DOOR, 3.000-8UN-2A X10.032"LG	EA	8.0000	03/31/05	
13	20020123		SEAL ASSY, CARTRIDGE, 13-10M SLX	EA	1.0000	03/31/05	
14	20023567		RSSA, 4.5" SHAFT	EA	1.0000	03/31/05	
15	20023570		SEAL ASSY, MDL HD, 4"SHAFT	EA	1.0000	03/31/05	
16	20023573		LSSA, 4"SHAFT	EA	1.0000	03/31/05	
17	20020125		SEAL SUB, 1.5" X 2.125"LG, 1"-8UNC BORE	EA	2.0000	03/31/05	
18	030061		O-RING, 75-80 DURO	EA	12.0000	03/31/05	
19	20023575		MNFD, CYL, 13.37"LG	EA	1.0000	03/31/05	
20	20023576		SHAFT, RAM, 4.5", MNLK, 13-10M, F/BSTR, SLX	EA	1.0000	03/31/05	
21	20023252		PSTN, MNLK, 15-1/4" F/4.5"SHAFT	EA	1.0000	03/31/05	
22	20023578		PLT, RETNR, SHAFT, RAM, PSTN	EA	1.0000	03/31/05	
23	8002856		SCREW, SHC, 3/8"UNCX3/4"LG, SS	EA	2.0000	03/31/05	
24	20020124		SEAL, POLYPAK, 15.25"ODX14.25"IDX1/2CS	EA	4.0000	03/31/05	
25	20023478		PIP SEAL ASSY, 4.5"ID, 1/4" CS	EA	1.0000	03/31/05	
26	150613		WEARBAND, 1"WIDE	IN	122.0000	03/31/05	
27	20023579		SHAFT, LKG, BSTR, 4.0" X 15.125"LG	EA	1.0000	03/31/05	
28	20023253		PSTN, BSTR, MNLK, 15-1/4" F/4.0"SHAFT	EA	1.0000	03/31/05	
29	20023481		SEAL, POLYPAK, 4"ID, 1/4"CS	EA	2.0000	03/31/05	
30	20023580		SCREW, LKG, 3-3/4-4 STUB ACME, 15.375"LG	EA	1.0000	03/31/05	
31	065001		PLUG, SKT HD, HX, 1/2"NPT, ALLOY STL, OIL Q&T TO H	EA	3.0000	03/31/05	
32	065002		PLUG, SKT HD, HX, 1"NPT	EA	11.0000	03/31/05	
33	136635		PLUG, BLEED, SEC SEAL	EA	1.0000	03/31/05	
34	010004		SCREW, SET, SKT, 1"-8UNC-2AX1" LG	EA	1.0000	03/31/05	
35	130368		CHECK VLV ASSY, SEC SEAL	EA	1.0000	03/31/05	
36	050000		PKG, STICK, INJECTION, PLASTIC	EA	3.0000	03/31/05	

End of publication

8

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D

C

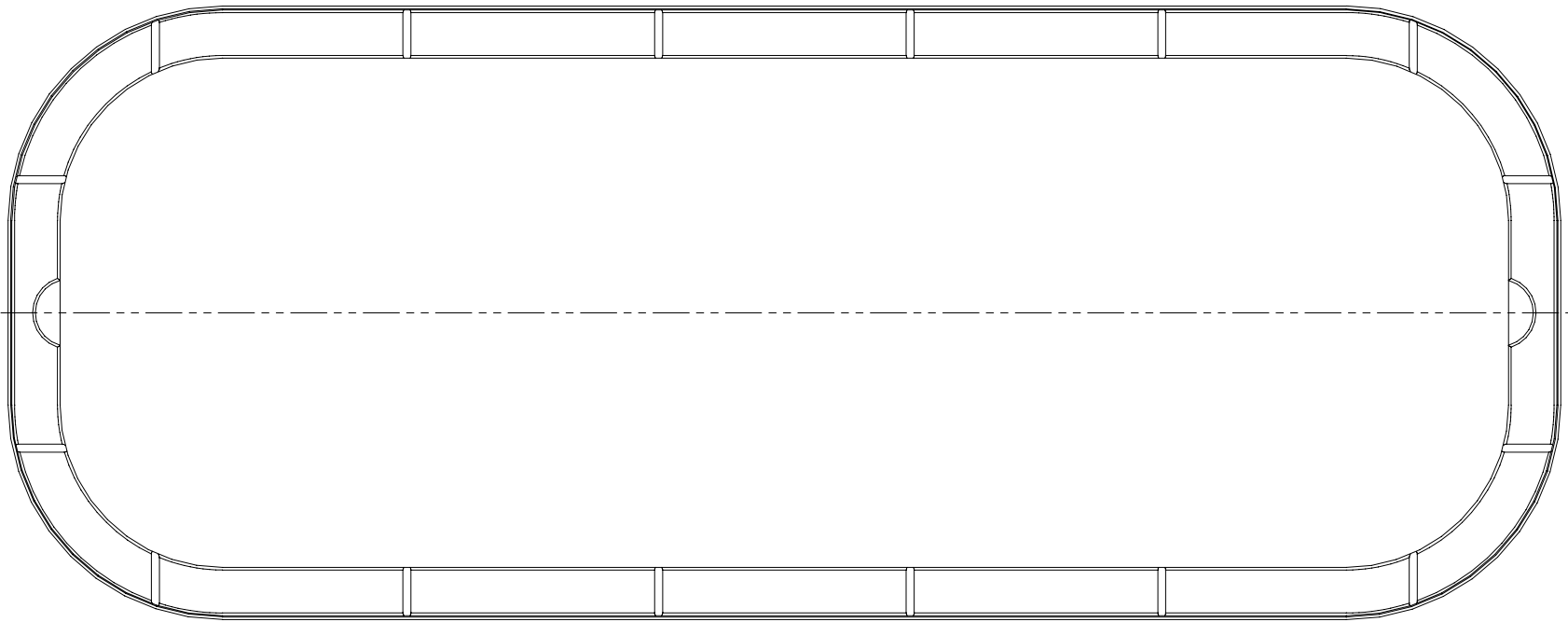
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B

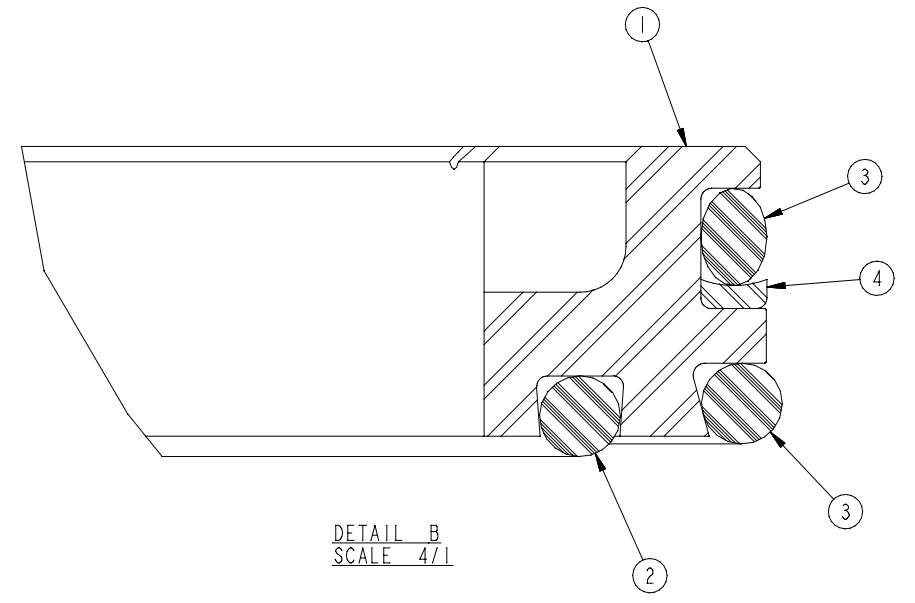
B

A

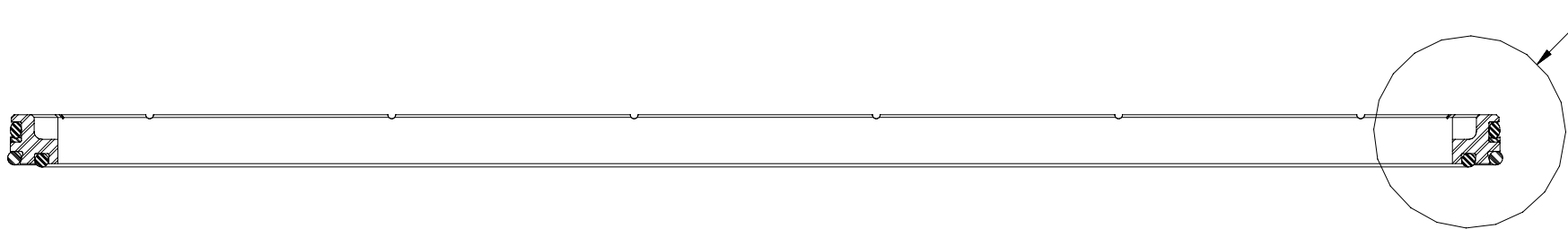
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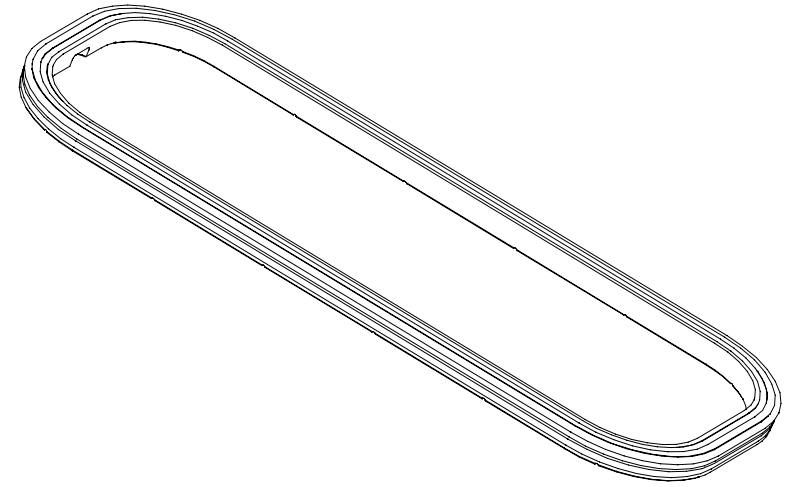
SECTION A-A



DETAIL B  
SCALE 4/1



SEE DETAIL B



SCALE 3/8

NO MANUAL CHANGES  
Pro/ENGINEER Model

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Unless Otherwise Specified		Heat Treat N/A	Checked SG 2/05	Engineer SG 2/05	Title <b>SEAL ASSEMBLY, CARTRIDGE, 13-10M, SLX</b>	D - 20020123D		
Dimensions Are In Inches		Unspecified Tolerances	Scale 3/4	Release No. 80931				
Do Not Scale Drawing		.X ± .06	Est. Wgt. 7.07 LBS	Old Dwg. No.				
All Dimensions in Parentheses ( ) Are Reference		.XX ± .03						
All Dimensions in Brackets [ ] Are Millimeters		.XXX ± .015						
Break All Sharp Corners		Fractions ± 1/16						
Remove All Burrs		Finish 125√						
		Angles ± 0°30'						
			Sheet 1 of 1					

8

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1





## Bill of Material for Item 20020123

Description: SEAL ASSY, CARTRIDGE, 13-10M SLX

Weight (LB): 8.30

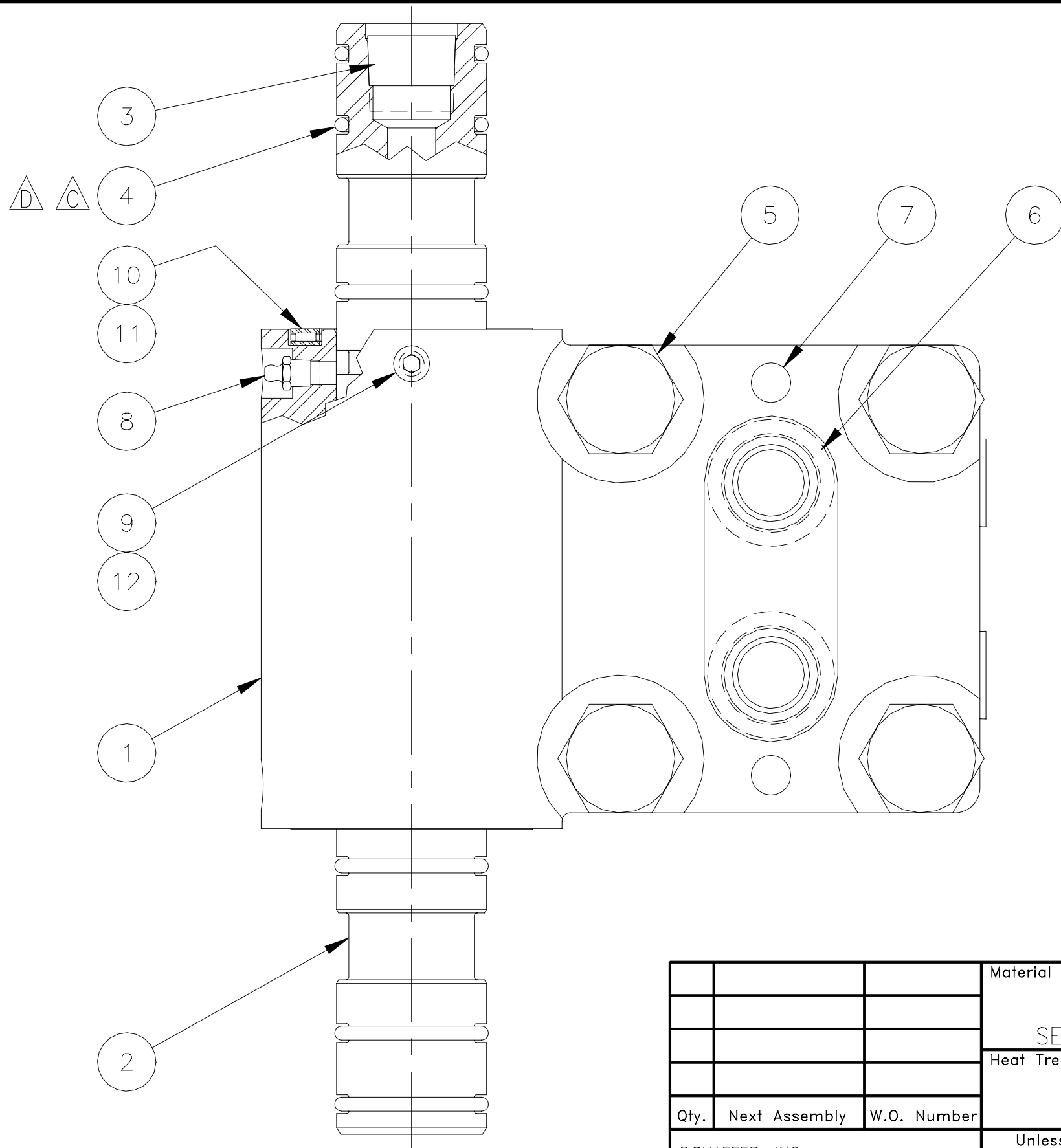
CCN: 200 - VARCO SHAFFER

Date: 5/18/06

Time: 11:28AM

No.	Item	Rev	UM	Qty	Description	Effbeg	Effend
	20020123D	-	EA	0.00	DWG: SEAL ASSY, CARTRIDGE, 13-10M SLX	03/24/05	
1	20020295		EA	1.00	CARTRIDGE, SEAL, DOOR, 13-10M SLX	03/24/05	
2	030391		EA	1.00	O-RING, 16.955"IDX.210 C.S.	03/24/05	
3	030947		EA	2.00	O-RING, 75 DURO	03/24/05	
4	030948		EA	1.00	RG, BU	03/24/05	

*End of Report*



F	83905	DELETE ITEM 7 (DOWEL PIN)	MJB	BB	1/06
E	83836	ADD ITEM 7 (DOWEL PIN)	MJB	BB	12/05
D	78159	CHANGE ITEM 4: 030012 WAS 20019696.	LM	IN	6/04
C	77087	CHANGE ITEM 4: 20019696 WAS 030012	TZN	IN	03/04
B	76056	ADDED "SLX" TO TITLE BLOCK DESCRIPTION.	LMM	LM	12/03
A	37465	ADD DWG;ITEM 9 WAS 066335 QTY2;ITEM 3 WAS QTY 6	SG	MW	8/94

Rev. Ltr.	ECR/N	Revision Description	By	App'd	Date
-----------	-------	----------------------	----	-------	------

Material	SEE SEPARATE B.O.M.	Drawn	SG	Date	8-94
Heat Treat	N/A	Checked	MW		8/94
Qty.	Next Assembly	W.O. Number	Engineer	MW	8/94
			Approved	DO	8/94
			Release No.	37091	
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Dimensions Are In Inches			.X	±	.06
Do Not Scale Drawing			.XX	±	.03
All Dimensions In Parentheses ( )			.XXX	±	.015
Are Millimeters			Fractions	±	1/16
Break All Sharp Corners			Finish	N/A	✓
Remove All Burrs			Angles	±	N/A

**Shaffer**

Title  
HINGE BRACKET ASSEMBLY, SLX,  
BEARING TYPE, RH/LH

Scale 1/2  
Est.Wgt. 75#

**B-126258D**

Rev. F

Old Dwg.No. Sheet 1 of 1

**NO MANUAL CHANGES**  
 FILE: 126258D.DWG 1/6/06  
 PROJECT: BOPS\RAM-DOOR



## Bill of Material for Item 126258

Description: HNG BRKT ASSY, SLX, BRG TYPE, RH/LH

Weight (LB): 75.00

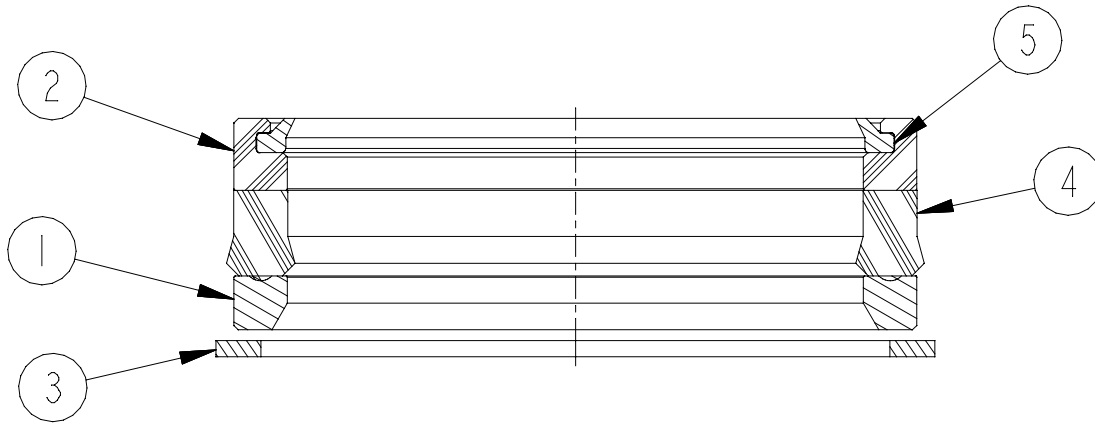
CCN: 200 - VARCO SHAFFER

Date: 5/18/06

Time: 11:30AM

No.	Item	Rev	UM	Qty	Description	Effbeg	Effend
	126258D	B	EA	0.00	DWG: HNG BRKT ASSY, SLX, BRG TYPE, RH/LH	12/16/03	03/08/04
		C	EA	0.00	DWG: HNG BRKT ASSY, SLX, BRG TYPE, RH/LH	03/09/04	06/02/04
		D	EA	0.00	DWG: HNG BRKT ASSY, SLX, BRG TYPE, RH/LH	06/03/04	12/28/05
		E	EA	0.00	DWG: HNG BRKT ASSY, SLX, BRG TYPE, RH/LH	12/29/05	01/05/06
		F	EA	0.00	DWG: HNG BRKT ASSY, SLX, BRG TYPE, RH/LH	01/09/06	
		A	EA	0.00	DWG: HNG BRKT ASSY, BRG TYPE,		12/15/03
1	126261		EA	1.00	BRKT, HNG, SLX		
2	134134		EA	1.00	PIN, HNG, SL BOP		
3	065002		EA	4.00	PLUG, SKT HD, HX, 1"NPT		
4	030012		EA	10.00	O-RING, 75-85 DURO	04/30/04	
			EA	10.00	O-RING, 75-85 DURO		02/29/04
	20019696		EA	10.00	SEAL, PSP, 2-1/4" X 1-7/8" X 3/16" ** SEE TEXT **	03/01/04	04/29/04
5	011203		EA	4.00	SCREW, HHC, 1"-8NCX4"LG, ASTM, A354		
6	030065		EA	2.00	O-RING, 75-80 DURO		
7	050096		EA	3.00	PIN, DOWEL, 5/8"NOMX3"LG, ALLOY STL	12/29/05	01/05/06
			EA	2.00	PIN, DOWEL, 5/8"NOMX3"LG, ALLOY STL	01/06/06	
			EA	2.00	PIN, DOWEL, 5/8"NOMX3"LG, ALLOY STL		12/28/05
8	050267		EA	2.00	FITTING, GREASE		
9	065008		EA	1.00	PLUG, SKT HD, HX, 1/4"NPT		
10	060810		EA	2.00	BEARING, THRUST, NEEDLE		
11	060827		EA	4.00	RACE, BRG, WSHR, THRUST		
12	011340		EA	1.00	SCREW, SET, SKT, 3/8"-16NCX1" LG, FULL DOG PT, CA		

**End of Report**



NO MANUAL CHANGES  
Pro/ENGINEER Model

Rev. Ltr.	ECR/N	Revision Description			By	App'd	Date	
		Material	Drawn	Date	<h1>Shaffer®</h1> <p>Title LSSA, 4" SHAFT</p>			
		SEE BOM	MR	6/05				
		Heat Treat	Checked	SG				6/05
		N/A	Engineer	SG				6/05
			Release No.					
			81965					
		Unless Otherwise Specified	Scale					
		Unspecified Tolerances	3/4					
		Dimensions Are In Inches	Est.Wgt.	1.30 lbs				
		Do Not Scale Drawing	Old Dwg.No.					
		All Dimensions In Parentheses ( )						
		Are Reference						
		All Dimensions In Brackets [ ]						
		Are Millimeters						
		Break All Sharp Corners						
		Remove All Burrs	Sheet	1 of 1				
						Rev.		
						-		

A - 20023573D



## Bill of Material for Item 20023573

Description: LSSA, 4"SHAFT

Weight (LB): 1.30

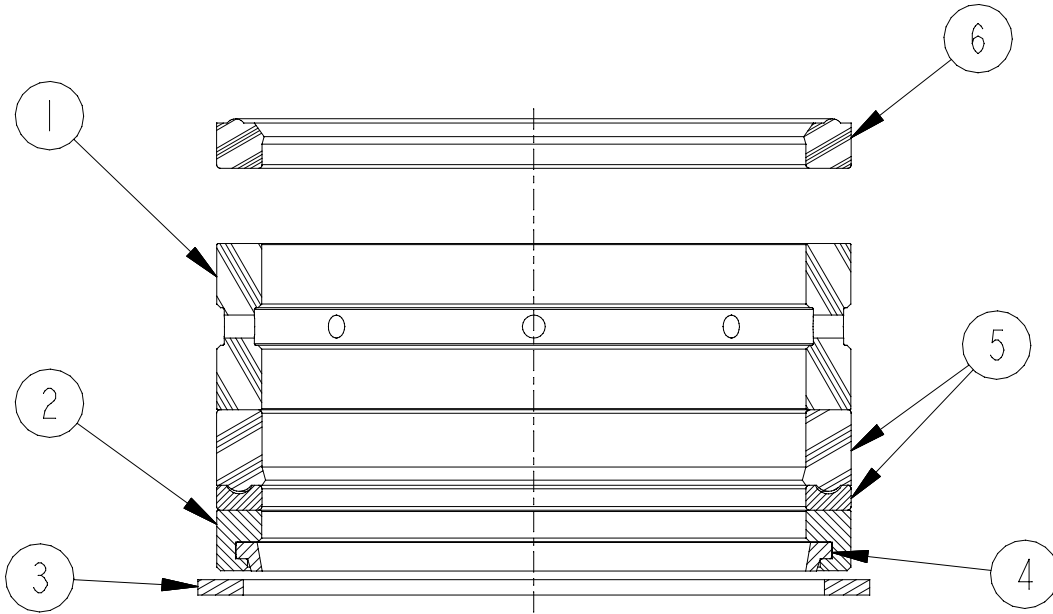
CCN: 200 - VARCO SHAFFER

Date: 5/18/06


Time: 10:50AM

No.	Item	Rev	UM	Qty	Description	Effbeg	Effend
	20023573D	-	EA	0.00	DWG: LSSA, 4"SHAFT	06/16/05	
1	20023571		EA	1.00	RG, SPACER, 4.75"OD X 4"ID	02/24/05	
2	20023574		EA	1.00	HLDR, RG, WIPER, 4"SHAFT, 0.5"THK	02/24/05	
3	20020662		EA	1.00	RG, RETNR	02/24/05	
4	031362		EA	1.00	SEAL, POLYPAK, DEEP	02/24/05	
5	20023476		EA	1.00	RG, WIPER, 4"	02/24/05	

**End of Report**



NO MANUAL CHANGES  
Pro/ENGINEER Model

Rev. Ltr.	ECR/N	Revision Description			By	App'd	Date
		Material	Drawn	Date	 Title RSSA, 4.5" SHAFT		
		SEE BOM	MR	6/05			
		Heat Treat	Checked	6/05			
		N/A	Engineer	6/05			
			SG	81965			
Unless Otherwise Specified		Unspecified Tolerances	Scale	5/8			
Dimensions Are In Inches		.X ± .06	Est.Wgt.	3.56 lbs			
Do Not Scale Drawing		.XX ± .03	Old Dwg.No.				
All Dimensions In Parentheses ( ) Are Reference		.XXX ± .015	Sheet	1 of 1			
All Dimensions In Brackets [ ] Are Millimeters		Fractions ± 1/16					
Break All Sharp Corners		Finish 125 ✓					
Remove All Burrs		Angles ± 1/2°					
				A - 20023567D		Rev. -	



## Bill of Material for Item 20023567

Description: RSSA, 4.5" SHAFT

Weight (LB): 3.56

CCN: 200 - VARCO SHAFFER

Date: 5/18/06

Time: 11:36AM

No.	Item	Rev	UM	Qty	Description	Effbeg	Effend
	20023567D	-	EA	0.00	DWG: RSSA, 4.5" SHAFT	06/16/05	
1	20023568		EA	1.00	ADPTR, PKG, 4.5"SHAFT	03/10/05	
2	20023569		EA	1.00	HLDR, RG, WIPER, 4.5" SHAFT, .5"LG	03/10/05	
3	20023474		EA	1.00	RG, RETNR	03/10/05	
4	20023475		EA	1.00	RG, WIPER, 4.5"	03/10/05	
5	20023477		EA	1.00	PIP SEAL ASSY, 4.5"ID, 3/8" CS	03/10/05	
6	20023480		EA	1.00	SEAL, POLYPAK, 4.5"ID, 3/8"CS	03/10/05	

**End of Report**



## Bill of Material for Item 20023581

Description: SPARE PART KIT, DOOR, 13-10M SLX, 15.25",BSTR,M

Weight (LB): 25.20

CCN: 200 - VARCO SHAFFER

Date: 5/18/06

Time: 11:38AM

No.	Item	Rev	UM	Qty	Description	Effbeg	Effend
	20023559D	-	EA	0.00	DWG: DOOR ASSY, 13-10M SLX,RH/LH, BSTR,15.25",MNLK	06/03/05	09/05/05
		A	EA	0.00	DWG: DOOR ASSY, 13-10M SLX,RH/LH, BSTR,15.25",MNLK	09/06/05	
3	20020129		EA	2.00	O-RING, 75-85 DURO	03/30/05	
4	20020127		EA	2.00	RG, BU	03/30/05	
7	030645		EA	6.00	O-RING, 70-75 DURO	03/30/05	
8	20020128		EA	6.00	RG, BU	03/30/05	
13	20024201		EA	2.00	SEAL KIT, CARTRIDGE, F/20020123	03/30/05	
14	20023567		EA	2.00	RSSA, 4.5" SHAFT	03/30/05	
15	20023570		EA	2.00	SEAL ASSY, MDL HD, 4"SHAFT	03/30/05	
16	20023573		EA	2.00	LSSA, 4"SHAFT	03/30/05	
18	030061		EA	24.00	O-RING, 75-80 DURO	03/30/05	
24	20020124		EA	8.00	SEAL, POLYPAK, 15.25"ODX14.25"IDX1/2CS	03/30/05	
25	20023478		EA	2.00	PIP SEAL ASSY, 4.5"ID, 1/4" CS	03/30/05	
26	150613		IN	244.00	WEARBAND, 1"WIDE	03/30/05	
29	20023481		EA	4.00	SEAL, POLYPAK, 4"ID, 1/4"CS	03/30/05	
36	050000		EA	6.00	PKG, STICK, INJECTION, PLASTIC	03/30/05	
37	178170		EA	2.00	SEAL KIT, BRKT, HNG	03/30/05	

**End of Report**





## Bill of Material for Item 20023582

Description: SPARE PART KIT, DOOR, 13-10M SLX, 15.25", MNLK

Weight (LB): 17.50

CCN: 200 - VARCO SHAFFER

Date: 5/18/06

Time: 11:40AM

No.	Item	Rev	UM	Qty	Description	Effbeg	Effend
	20023560D	-	EA	0.00	DWG: DOOR ASSY, 13-10M SLX, RH/LH, 15.25", MNLK,	06/03/05	09/05/05
		A	EA	0.00	DWG: DOOR ASSY, 13-10M SLX, RH/LH, 15.25", MNLK,	09/06/05	
3	20020129		EA	2.00	O-RING, 75-85 DURO	03/30/05	
4	20020127		EA	2.00	RG, BU	03/30/05	
5	030645		EA	2.00	O-RING, 70-75 DURO	03/30/05	
6	20020128		EA	2.00	RG, BU	03/30/05	
11	20024201		EA	2.00	SEAL KIT, CARTRIDGE, F/20020123	03/30/05	
12	20023567		EA	2.00	RSSA, 4.5" SHAFT	03/30/05	
13	20023573		EA	2.00	LSSA, 4"SHAFT	03/30/05	
15	030061		EA	12.00	O-RING, 75-80 DURO	03/30/05	
21	20020124		EA	4.00	SEAL, POLYPAK, 15.25"ODX14.25"IDX1/2CS	03/30/05	
22	20023478		EA	2.00	PIP SEAL ASSY, 4.5"ID, 1/4" CS	03/30/05	
23	150613		IN	95.00	WEARBAND, 1"WIDE	03/30/05	
30	050000		EA	6.00	PKG, STICK, INJECTION, PLASTIC	03/30/05	
31	178170		EA	2.00	SEAL KIT, BRKT, HNG	03/30/05	

**End of Report**