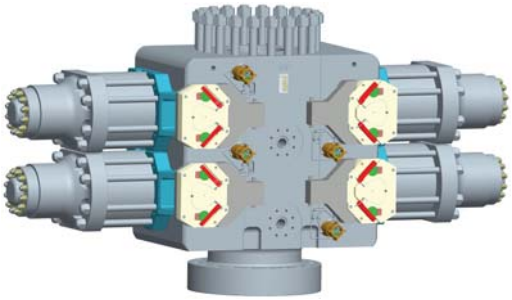

User's Manual

18-15M NXT Ram BOP

GENERIC MANUAL

Customer Name
Rig Name
Sales Order Number

Reference	Reference Description NXT Ram BOP, 18¾-15M with UltraLock II™ (B) and 22" PosLock® Operators
	National Oilwell Varco 12950 West Little York Houston, TX 77041 Phone: 713-937-5000 Fax: 713-856-4138
Document Number **29101207**	Rev. **D**

NATIONAL OILWELL VARCO

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Revision History

D	08.08.10	See Change Description below.			
C	01.06.2010	See Change Description below.			
B	30.03.2010				
A	20.02.2008	Issued for implementation			
Rev	**Date (dd.mm.yyyy)**	**Reason for issue**	**Prepared**	**Checked**	**Approved**

Change Description

Revision	Change Description
A	First issue
B	
C	As per engineering approval, updated shear closing pressures, multi-ram drill pipe suspension weight table on p. 4-1, and 18¾", 15K multi-ram table on p. 6-16. Added door anti-rotation safety device information and related graphics.
D	Modified color scheme for several graphics in Chapters 4, 5, and 6.

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Chapter 6: Specifications and Parts Lists

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General Information

Conventions

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. National Oilwell Varco, Inc. will not be held liable for errors in this material, or for consequences arising from misuse of this material.

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 typical and graphical representation of equipment, its components, or screen snapshots for use in identifying parts, establishing nomenclature, or calling out notes and procedures. Illustrations may or may not show all current aspects of the equipment nor be drawn to scale. Illustrations will not reflect any changes made after publication.

For component information specific to the product purchased, see the technical drawings included with your National Oilwell Varco documentation.

Safety Requirements

Your 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 your manuals are the recommended methods of performing operations and maintenance.

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.

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

Contact the National Oilwell Varco 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. The equipment supplier 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 the supplier.

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.

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 original equipment manufacturer's (OEM's) 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 product-specific service manual for maintenance recommendations.

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

Proper Use of Equipment

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

Transporting Equipment

Transporting precharged accumulator bottles within the United States is covered by HAZMAT rules and DOT regulations. Consult the proper authorities' regulations outside the United States.

Safety Precautions

Operation of the control systems may present certain hazards that require the attention and caution of operators and technicians. Normally, many hazards are avoided by observing and exercising standard safety precautions.

Electrical Precautions

Certain safety precautions must be exercised regarding the electric circuits of the control system. The following precautions will prevent damage to equipment and injury to personnel that might result from electric power:

- Personnel engaged in electrical work should receive proper instruction in accident prevention and first aid procedures.
- An electric source power must be supplied at correct voltage, current, and phase to enable safe and correct operation of equipment.
- Exercise caution when working around exposed electrical conductors, terminals, and remotely activated equipment.
- Ensure flashproof integrity of explosion-proof electrical junction boxes, connections, and circuit breakers. This will prevent fires or explosion that might result from a spark during electrical switching.
- Do not override or tamper with electrical or mechanical interlocks and safety devices.
- Before attempting any corrective action on the electrical circuit, verify that all electric power sources have been removed from the circuit. Ensure that all electrical switches are set to “Off” and the appropriate breakers are set to “Open.”
- Do not service or adjust the electrical circuits alone. Always verify that a qualified person is present who can render aid in case of accident and who is familiar with emergency shutdown procedures.
- Appropriate warning tags labelled “Requiring Open Circuit Condition” shall be placed on all necessary switches and circuit breakers to prevent accidental application of power to units of the system during maintenance procedures.
- Wear suitable protective clothing while working within 4 feet of exposed electrical equipment. Do not wear rings, wrist watches, or clothing with exposed metal buttons, zippers, or fasteners.
- Metal handles of hand-held tools should be insulated by an approved taping, coating, or sleeve method.
- Whenever it is necessary to work on electrical circuits or equipment in wet or damp locations, dry, wooden (or similar nonconducting material) platforms should be provided to prevent the possibility of contact between the wet floor and the workman’s shoes.

Hydraulic Precautions

Hydraulic source power produced by the accumulator control/pump unit is at sufficiently high pressures and volumes to present a hazard if required safety practices are not followed. Exercise the following precautions to aid in preventing damage to equipment and injury to personnel that might result from hydraulic-power related accidents:

- Mop up spilled hydraulic fluid immediately. Immediately investigate and correct the cause of any leakage of hydraulic fluid.
- If clothing becomes drenched with hydraulic fluid, change immediately to dry clothing. The fluid is very irritating to eyes and skin. Prolonged contact with hydraulic fluid may cause dermatitis, which may progress to allergic sensitization.
- Ensure that only correct hydraulic fluid is supplied and used for safe and correct operation of the control systems unit.
- Hydraulic fluid must be filtered to prevent any dirt or debris from entering the hydraulic circuit.
- Ensure that the pressure relief valves are in working condition and that the valves are set to relieve at their designated pressure levels.
- Should there be a rupture or break in the hydraulic circuit (when pressurized), do not place hands, face, or any part of the body over the escaping jet stream of fluid. Severe bodily injury will result.
- Never torque leaking connections or fittings while lines are pressurized. Application of torque to fittings or connections while lines are pressurized may cause lines to rupture and result in injury to personnel.
- Before attempting any corrective action on the hydraulic circuit, verify that the electric power source is turned off, the pneumatic power source is turned off, and all hydraulic pressure is completely vented. Verify that all hydraulic gauges read 0 psi (0 bar).
- When precharging accumulators, use only dry nitrogen gas. The use of another gas may cause unit failure or explosion.

Pneumatic Precautions

Pneumatic source power supplied to the control unit is of sufficiently high pressure and volume to present a hazard if required safety practices are not followed. Exercise the following precautions to aid in preventing damage to equipment and injury to personnel that might result from pneumatic power:

- Ensure that the pneumatic source power is supplied at adequate pressure and volume to enable safe and proper operation of equipment. Maximum system air pressure is 125 psi (9 bar).
- Ensure that the air is filtered to prevent any dirt or debris from entering the pneumatic circuit.
- Ensure that air is dried and lubricated before it pilots or operates any motor (hydraulic pump); moisture can damage components and result in unit failure.
- Should there be a rupture or break in the pneumatic circuit (when pressurized), do not place hands, face, or any part of the body over the escaping air. Severe bodily injury may result.
- Before attempting any corrective action on the pneumatic circuit, verify that the pneumatic power source is cut off and that all pneumatic pressure is completely vented. Verify that all pneumatic pressure gauges read 0 psi (0 bar).

Cable and Hose Precautions

Observing the precautions listed below will prevent damage to equipment and injury to personnel that might result from damage to cables and/or hoses.

- Protect electrical cables, pneumatic hoses, and hydraulic hoses from cutting, scraping, pinching, abrasion or other physical damage.
- Route cables and hoses outside of the crews traffic patterns and away from mechanical equipment.
- Observe the prescribed minimum bend radius for cables and hoses. Twisting or bending cables or hoses beyond the minimum bend radius can rupture the insulation and damage the conductors.

BOP Control Unit Safety

Personnel responsible for the operation of blowout preventers (BOPs) should observe the following precautions:

- Never leave the shutoff valves to the accumulators in the closed position.
- Never use diesel fuel oil or kerosene in the system as a control fluid. Always use good clean lightweight hydraulic oil or soluble oil concentrate properly mixed with potable water or water and glycol.
- Never allow oxygen to be stored in the vicinity of an accumulator unit. Always precharge your accumulator bottles with nitrogen gas, which is inert. Accept no substitutes.
- Never put any locking mechanism on the handles of the four-way hydraulic control valves. A cover made of expanded metal, clear plastic, or other will serve the same purpose without hampering the operation of the valve. Be sure that the cover is large enough to allow the valve handle to operate freely for remote control operation.
- Keep a charging and gauging assembly near the unit at all times.
- Maintain and test the system periodically and operate it at its designed working pressure.
- Leave the four-way control valves in normal operating condition. Never leave in neutral or blocked position during the drilling operations.
- Do not leave electric cable connector plugs unprotected. Install protective covers when not in use.

Work Area Precautions

Work should be performed in an area free of any dangerous obstructions, chemicals or hazards of any kind in order to prevent or reduce the severity of an injury. The precautions listed below should be observed in order to maintain a safe working environment.

- Remove any dangerous obstruction located overhead, to the side, or on the surrounding floor of the work area as safely and quickly as possible utilizing the appropriate personnel.
- Remove any flammable materials located or spilled within or near the work area. Flammable materials include, but are not limited to, the following:
  - oily rags, paper products, or any combustible solid
  - kerosene, gasoline, or any combustible liquid
  - oxygen tanks, acetylene tanks, or any combustible gas
- Correct or remove any condition, situation, or circumstance that may pose serious hazard(s) to the work area.

Use Correct Replacement Parts

Many of National Oilwell Varco's system component parts are specially manufactured to system design specifications, although apparently similar to commercially available hardware. To avoid possible hazardous failures, use only National Oilwell Varco replacement parts, components, or assemblies.

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Introduction

General

A ram Blowout Preventer (BOP) is a safety tool used during the drilling operation to control wellbore fluid pressure. The BOP achieves this pressure control by closing its rams to seal around drilling tubulars, an open hole or to shear drilling tubulars under various drilling conditions. Under normal drilling the BOP has little or no internal pressure. However, if the drill bit penetrates a high-pressure oil or gas pocket in the well, the BOP rams can be closed so that the high-pressure returning well fluid (whose pressure has overcome the weight of the drilling mud) will not blow out of the well.

The BOP is normally composed of a pressure containing body with a vertical through bore with doors (including door operators) on either side, which hold the BOP rams and their hydraulic operating mechanisms. Flanged or studded API pressure connections are configured on either end of the body at the vertical bore to facilitate connecting the BOP to BOP stack or other well control components.

The body is configured with two outlets (one on each side) under each ram located 90° to the doors, which are routed laterally through the body to the vertical bore forming a wellbore fluid outlet path. The side outlets are used in conjunction with the choke and kill valves, choke manifold and other well control equipment to bring the high wellbore pressure under control using a variety of well control techniques available to the well operator.

See Figure 2-1 on page 2-2 for BOP general features. The NXT ram BOPs are functioned hydraulically by rig personnel using the BOP control system. Remote control of the BOPs is located on the Driller's and Toolpusher's control panels.

Inverter Cavity Test Rams (Optional)

Blowout preventers, by design, contain upward wellbore pressure only; they do not contain downward applied pressure. Test rams are designed to contain applied downwards pressure. Test rams are installed in the bottom cavity of the BOP stack to prevent applied downward pressure from entering the wellbore. Test rams are used to test the pipe rams, annulars, and choke/kill valves above the test rams on the BOP stack. Test rams are generally used on deepwater drilling operations, and they eliminate the time taken to run and retrieve the conventional wellbore test plug required to test the BOP stack. If test rams are installed on the BOP stack, refer to the addendum titled "Inverted Cavity – Test Ram."

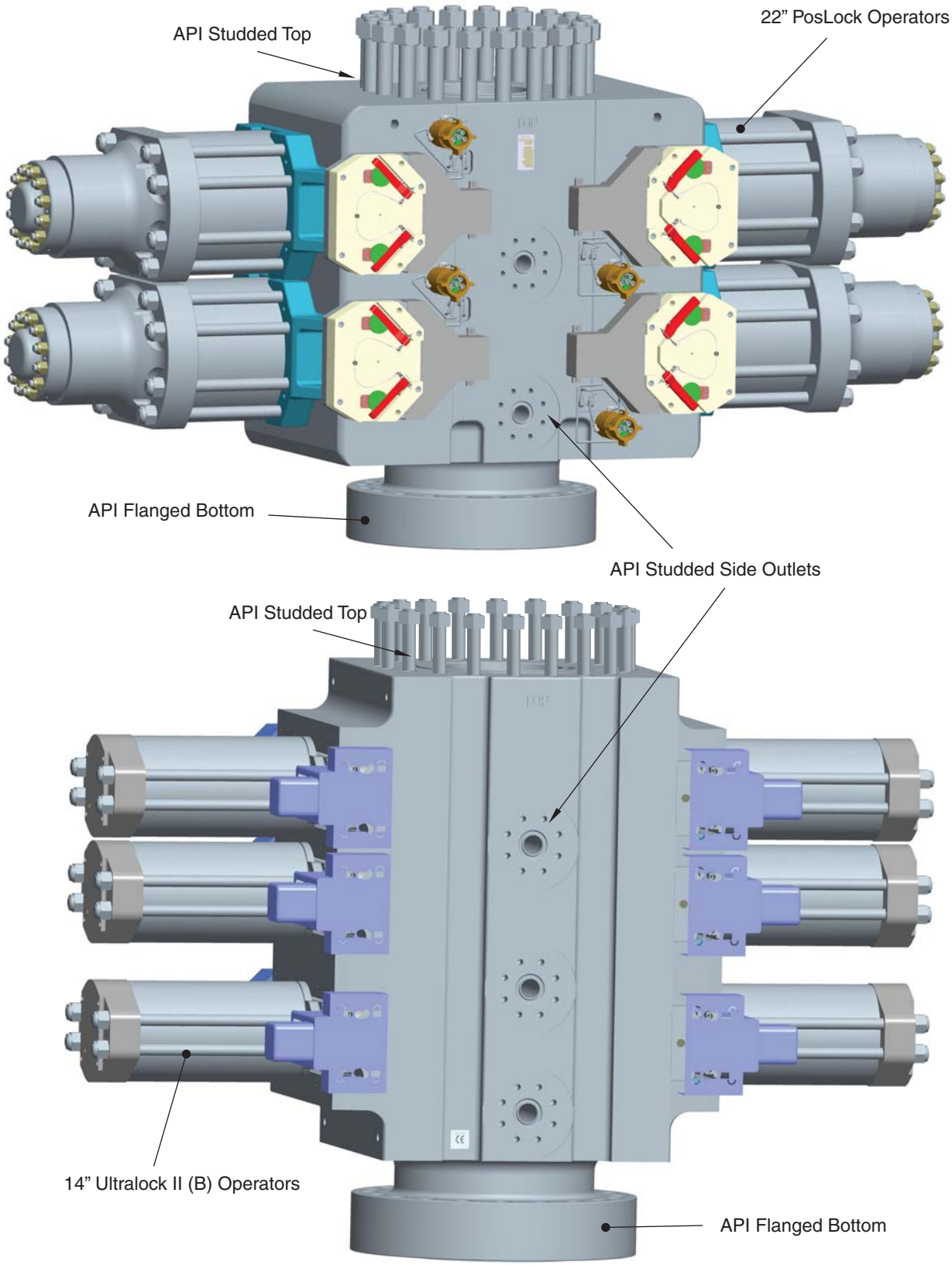


Figure 2-1. 18¾-15M NXT Double with 22” PosLock Operators and 18¾-15M NXT Triple with 14” UltraLock II (B) Operators

BOP Configuration

The 18¾-15M NXT triple ram BOP is configured with an 18¾"-15,000 psi API studded top and flanged bottom, with six $3^{1}/_{16}$"-15,000 psi side outlets, and is equipped with doors utilizing pipe rams (various sizes), hydraulic ram operators with automatic locking, and XT™ door locking system (see Figure 2-1 on page 2-2).

Single, double and triple ram BOPs use ram blocks with rubber face seals to close around or shear and seal the drill string. When the rams are closed, the ram blocks slide on skid plates in the BOP cavity. Wellbore pressure pushes the ram block assemblies upward, and a seal is effected between the ram block rubber top seal and the seal seat insert. Ram block lateral side movement is guided by the cavity side pads (see Figure 2-2).

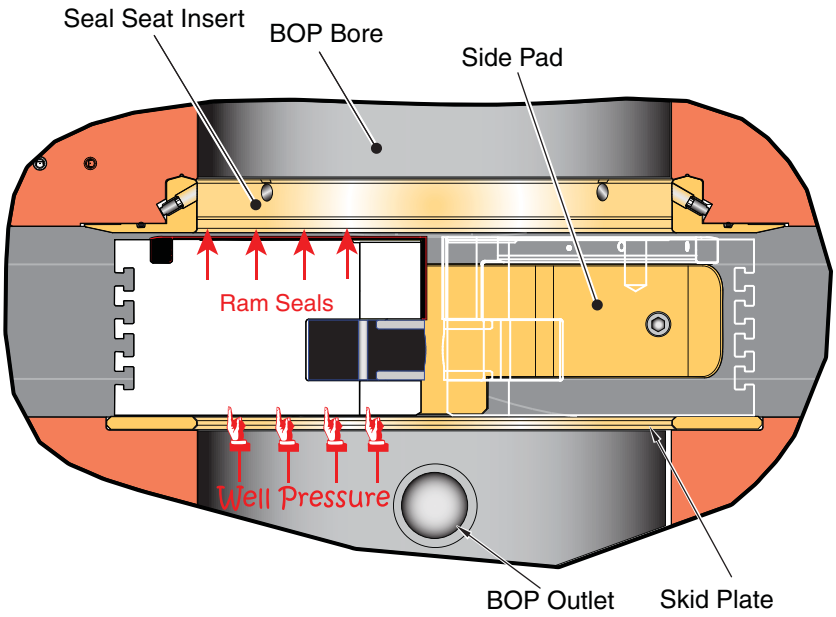


Figure 2-2. Cross Section of Ram Cavity

Introduction

This manual outlines the procedures for the installation, operation and maintenance of the National Oilwell Varco (NOV) 18¾"-15M Ram BOP with UltraLock II (B) operators and/or 22" PosLock operators.

The information contained in this manual applies to single, double and triple ram BOPs with either 14" UltraLock II (B) operators and/or 22" PosLock operators.

The UltraLock II (B) operators are used to close the ram assemblies on drill pipe and close off the wellbore pressure. The 14" UltraLock II (B) operators require a hydraulic pressure of 1,500 psi (103 bar) to accomplish sealing the wellbore pressure to the rated working pressure of the preventers. The 14" UltraLock II (B) operators are located on either side of the NXT body (see Figure 2-1 on page 2-2). When the rams are hydraulically closed, the

UltraLock II (B) operators automatically lock the rams in the closed position, and require opening hydraulic pressure to open them. The UltraLock II (B) operator is a multi-locking device, making it ideal for closing on variable ram assemblies.

Although 1,500 psi (103 bar) hydraulic closing pressure is all that is required to seal off the wellbore to the rated working pressure of the preventers, the UltraLock II (B) hydraulic closing pressure, at the owner's discretion, may be increased to a maximum of 3,000 psi (304 bar), if necessary.

UltraLock II (B) Locking System

The UltraLock II (B) locking system incorporates a unique mechanical locking mechanism within the operating cylinder's piston assembly that is not dependent on closing pressure to maintain a positive lock. This locking system utilizes flat taper wedge locking dogs, carried by the operating piston, that engage stationary flat taper wedge locking rods located within the operating cylinder to effect the required locking force (see Figure 2-3).

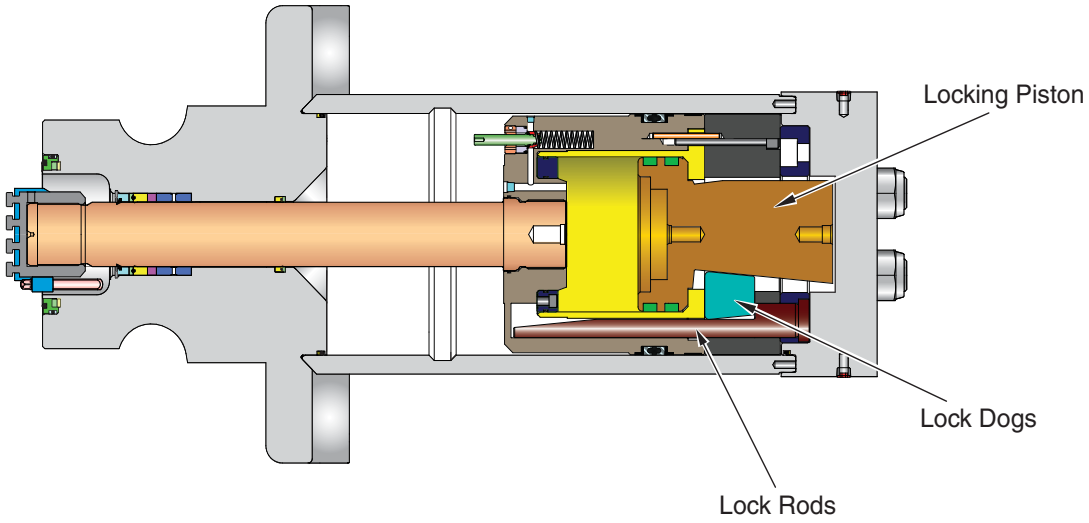


Figure 2-3. UltraLock II (B) NXT Door Assembly

This locking system has been designed to increase the capabilities of Shaffer blowout preventers by providing a low maintenance and adjustment-free locking system while maintaining compatibility with all pipe ram assemblies that the BOP can accommodate. The UltraLock II (B) locking system will lock on any pipe size within the range of the pipe ram assembly being used.

Blowout preventers that are equipped with the UltraLock II (B) locking system are locked automatically in the closed position each time the piston assembly is closed. The preventer will also remain locked in the closed position, even if closing hydraulic pressure is lost or removed. Note that hydraulic opening pressure is required to unlock and reopen the preventer.

Locking System Features

- All operational components are within the hydraulic operating cylinders.
- Different size or type pipe ram assemblies may be freely interchanged. No adjustments are required.
- The UltraLock II (B) locking system accepts any size pipe rams or Multi-Rams without adjustments.
- Pressure ranges of 1,500 to 3,000 psi (103 to 207 bar) will energize the UltraLock II (B) locking system.
- The same hydraulic functions that are required to operate the cylinder's open/close function also unlock/lock the UltraLock II (B) locking system.
- Loss of hydraulic pressure has no effect on the locking mechanism. Once the operating piston is closed on the pipe, the locks are engaged until opening pressure is applied. The cylinder will remain locked, preventing the ram assemblies from drifting and allowing a pressure leak to occur from below the sealed cavity.
- Hang-off capabilities up to 600,000 lb (272,155 kg) at full working pressure are achieved, depending on the type of ram assembly installed (see the section titled "Drill Pipe Suspension" on page 4-1).

UltraLock II (B) Mechanical Design

The UltraLock II (B) is designed to lock on each closure of the blowout preventer. The engagement of a wedge device, called a lock wedge, between a lockrod and locking piston, makes this lock simple and reliable. The design utilizes four individual locking assemblies within the piston actuator, located 90° apart. These assemblies are designed to carry 100% of the load normally carried by the hydraulic fluid pressure applied to the piston area within the operating cylinder.

PosLock Locking System

The PosLock system locks automatically in one position each time it is closed, remaining locked even if closing pressure is removed. Opening hydraulic pressure is required to reopen the pistons. The PosLock system uses a single set of locking segments to achieve the positive mechanical lock. This provides for one locking position, which is the maximum requirement for standard shear rams. The PosLock system must be manually adjusted for changes in ram types or to compensate for ram wear over time.

22” PosLock Operators

The 22” PosLock operators will contain the NXT rated wellbore pressure with 1,500 psi (103 bar) hydraulic closing pressure. However, the maximum 5,000 psi (345 bar) closing hydraulic pressure on the 22” operators should ONLY be used to shear pipe and casing. Contact NOV Engineering with the pipe/casing size and specification to be sheared for the minimum required closing pressure.

The 22” PosLock operators may be used to shear pipe and close the well in, or to close off an open wellbore. The 22” PosLock operators do not require the assistance of booster cylinders to achieve shearing of the drill pipe. The 22” PosLock operators require the maximum available hydraulic closing pressure to accomplish shearing the pipe or casing and contain the wellbore pressure to the rated working pressure of the preventer.

When the rams are hydraulically closed, the PosLock operators automatically lock the shear rams in the closed position and require 1,500 psi (103 bar) hydraulic pressure to open them. The 22” PosLock operators will remain in the closed position and contain the wellbore pressure, even if hydraulic closing pressure is lost or removed (see Figure 2-4).

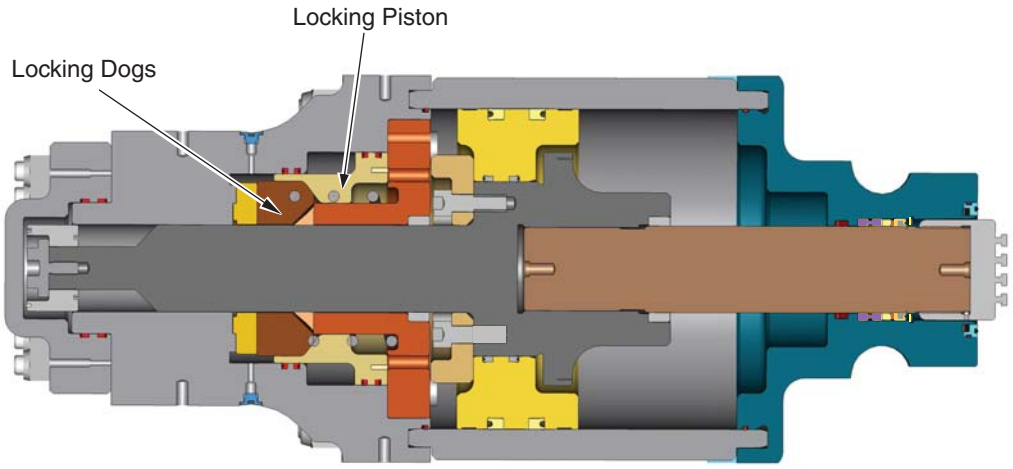


Figure 2-4. NXT Door with 22” PosLock Cylinder

Two 22” PosLock operators are located on either side of the NXT triple body (see Figure 2-1 on page 2-2).

XT™ Boltless Door Locking System

Introduction

The NXT® BOP door locking system enables automatic opening and closing of NXT BOP doors, representing a major step toward automation of BOP servicing. Several operational benefits are available from this system, both in surface and subsea applications.

The NXT BOP door locking system departs from the conventional bolting method. The entire door attachment method can be fully automated using hydraulics to lock, unlock, open and close the doors. This manual outlines several operational benefits that can be derived from an automated door access, such as the one described herein.

The NXT BOP door locking system replaces axially-loaded threaded members (bolts) with transaxially-loaded bearing members. The bearing members act as locking pins, taking the separation load (generated by wellbore pressure) in bearing and shear only, not in tension. The bearing members are contained on the BOP body and are moved to engage the door, providing a pressure containing lock between the body and door. The number of locking members is reduced to two, running across the top and bottom of the door. This replaces the threaded member system of four to ten bolts per door. Actuation or engagement of the two locking members is accomplished simultaneously, dramatically reducing the opening and closing time compared to the threaded member system, which requires that each bolt be made up separately.

Description

The NXT BOP door locking system utilizes a set of lateral grooves located in both the door and pressure-containing body running perpendicular to the ram cavity. These grooves, when aligned, allow load bearing bars to rotate and lock the door and body together. The groove in the door is configured to allow a semicircular cross sectional shaped locking bar to rotate over a wide range of motion. The bar can nest into the body groove or rotate to engage the door groove. Groove pairs and locking bars are located both above and below the ram cavity spanning the interface between the door and body (see Figure 2-5).

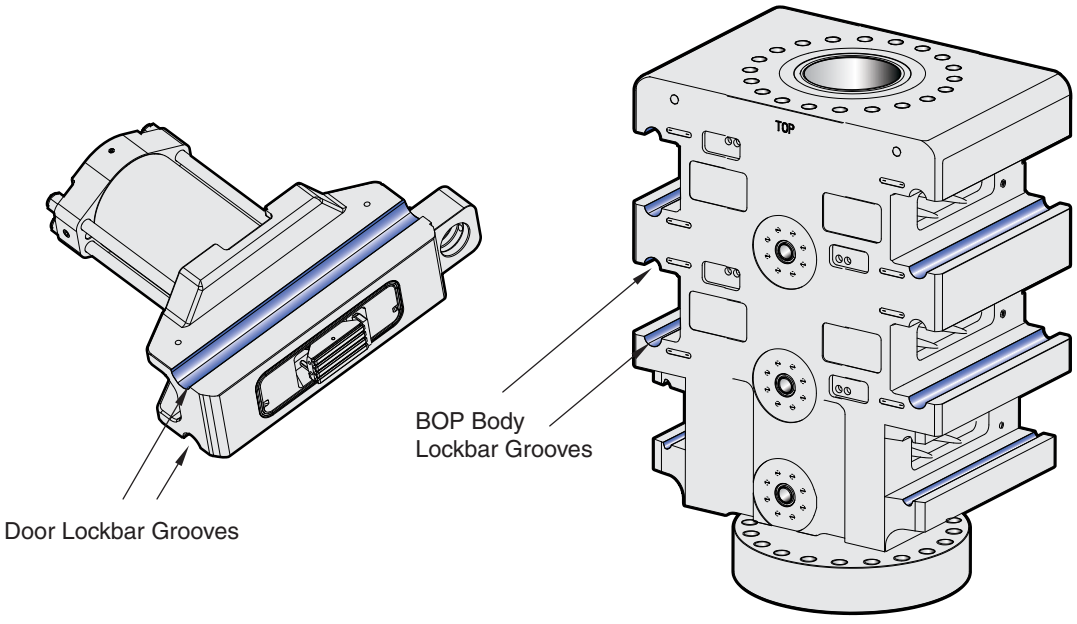


Figure 2-5. Lockbar Grooves

The locking system is actuated using small hydraulic cylinders mounted on the door in the lockrod drive assembly. In addition, a hydraulic rotary actuator is mounted on the hinge and tied into the door to swing the door open and closed, allowing access to the ram assemblies. See Figure 2-10 on page 2-10 and Figure 2-12 on page 2-12 for components of each style door.

The entire door attachment method can be fully automated using hydraulics to lock/unlock the doors and open/close the doors. The 14” door assembly has the addition of the hydraulically operated anti-rotation bar for lockbar security. Manual methods of operation can also be utilized either as the primary means of operation or as a secondary or back-up method to the hydraulics system for the 14” door assembly.

A typical 14” NXT door closing sequence is illustrated in Figure 2-6 through Figure 2-9 on page 2-10. When the door is open, the locking bars are rotated to the horizontal position (see Figure 2-6). In this position, the lobes of the anti-rotation bars are nested into slots in the locking bars, and the door is free to swing into or out of engagement with the BOP body.

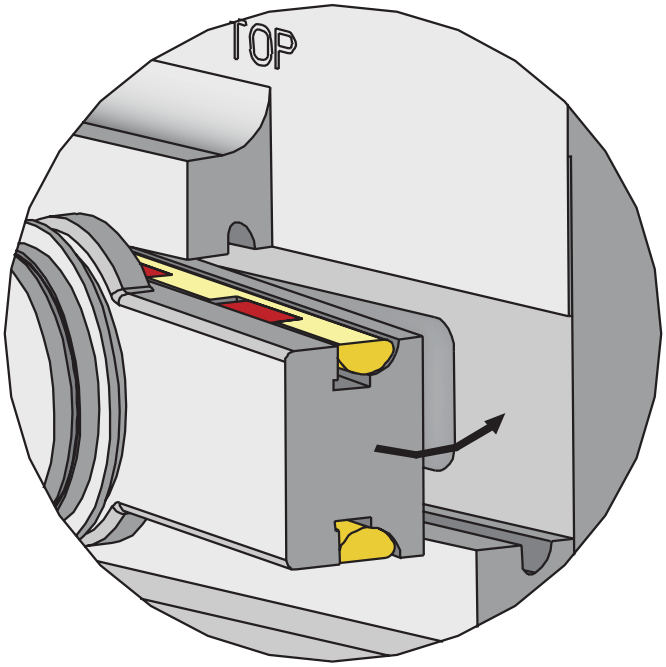


Figure 2-6. Horizontal Bars

When the door has been rotated fully against the BOP body, the locking bars are rotated 65°, which engages the bars with the BOP body grooves (see Figure 2-7). This motion produces a cam-like action that preloads the door seals against the BOP cavity face.

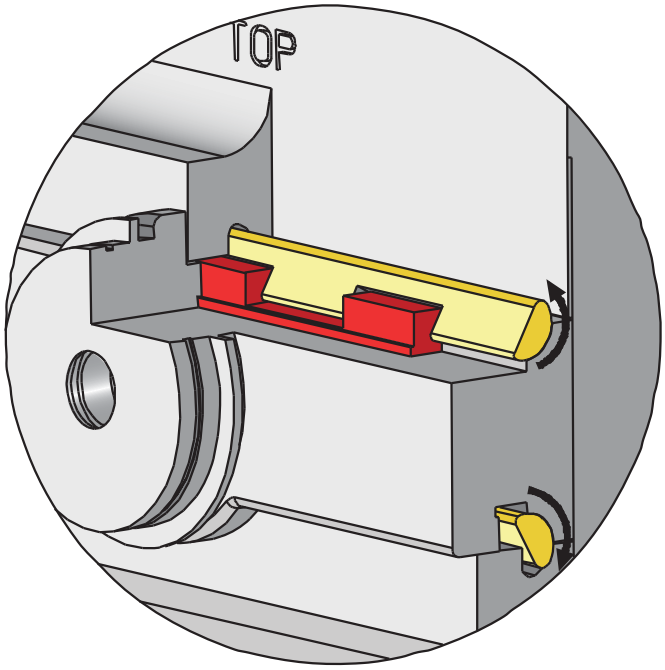


Figure 2-7. Bars Engaging Body Groove

Next, the anti-rotation bars are actuated to move laterally (see Figure 2-8).

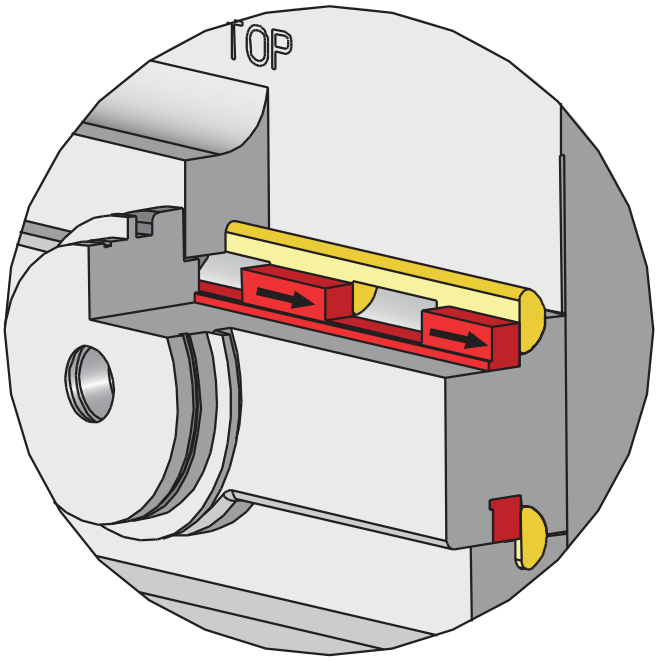


Figure 2-8. Anti-Rotation Bars Engage

This moves the lobes of the anti-rotation bars behind the corresponding flats on the locking bars. This prevents the locking bars from rotating out of engagement when the door is loaded by wellbore pressure introduced into the cavity of the BOP (see Figure 2-9).

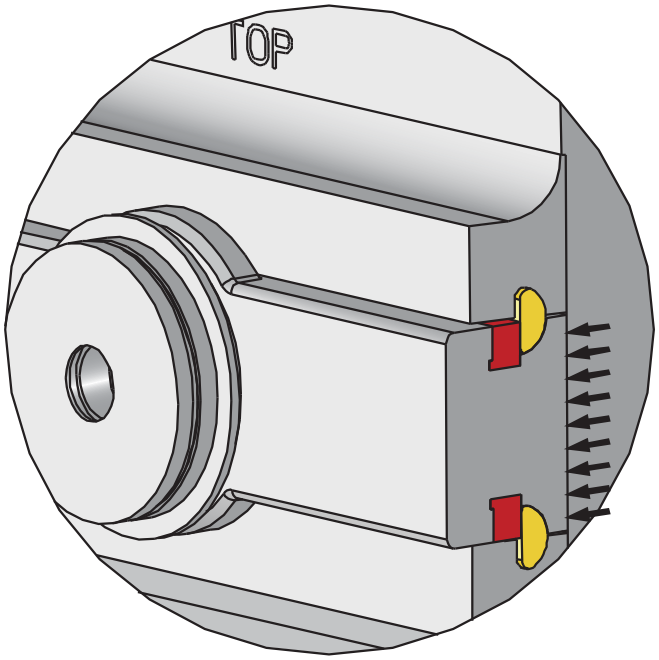
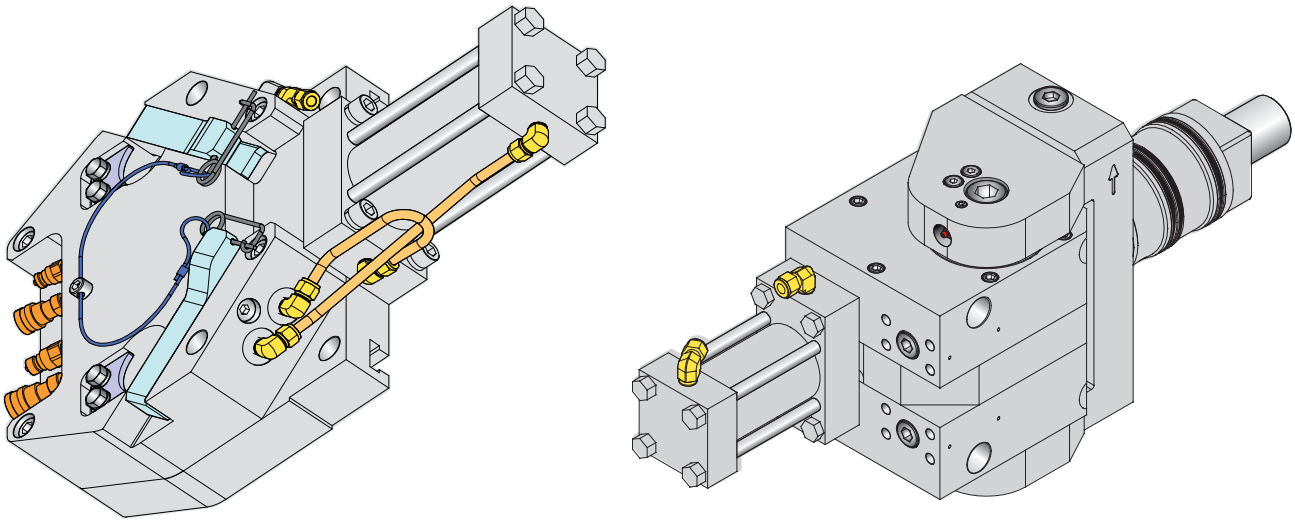


Figure 2-9. Loaded by Wellbore Pressure



Lockrod Drive Assembly

Door Rotation Assembly

Figure 2-10. 22” PosLock Door Operation Components

14” Door Anti-Rotation Safety

Warning

Before pressurizing the BOP, the correct installation of the anti-rotation hitch pins should be checked on all locked 14” operator doors. Failure to heed this warning could cause property damage as well as serious injury or death to personnel.

The hinge-side cover on 14” operators should always be installed. After the lockbars are engaged in the locked position and the anti-rotation bars are also engaged in the locked position, the hitch pin should go through both the cover and stop tab bar (see Figure 2-11). The hitch pin through both locations gives visual confirmation that the locking system is engaged and locked.

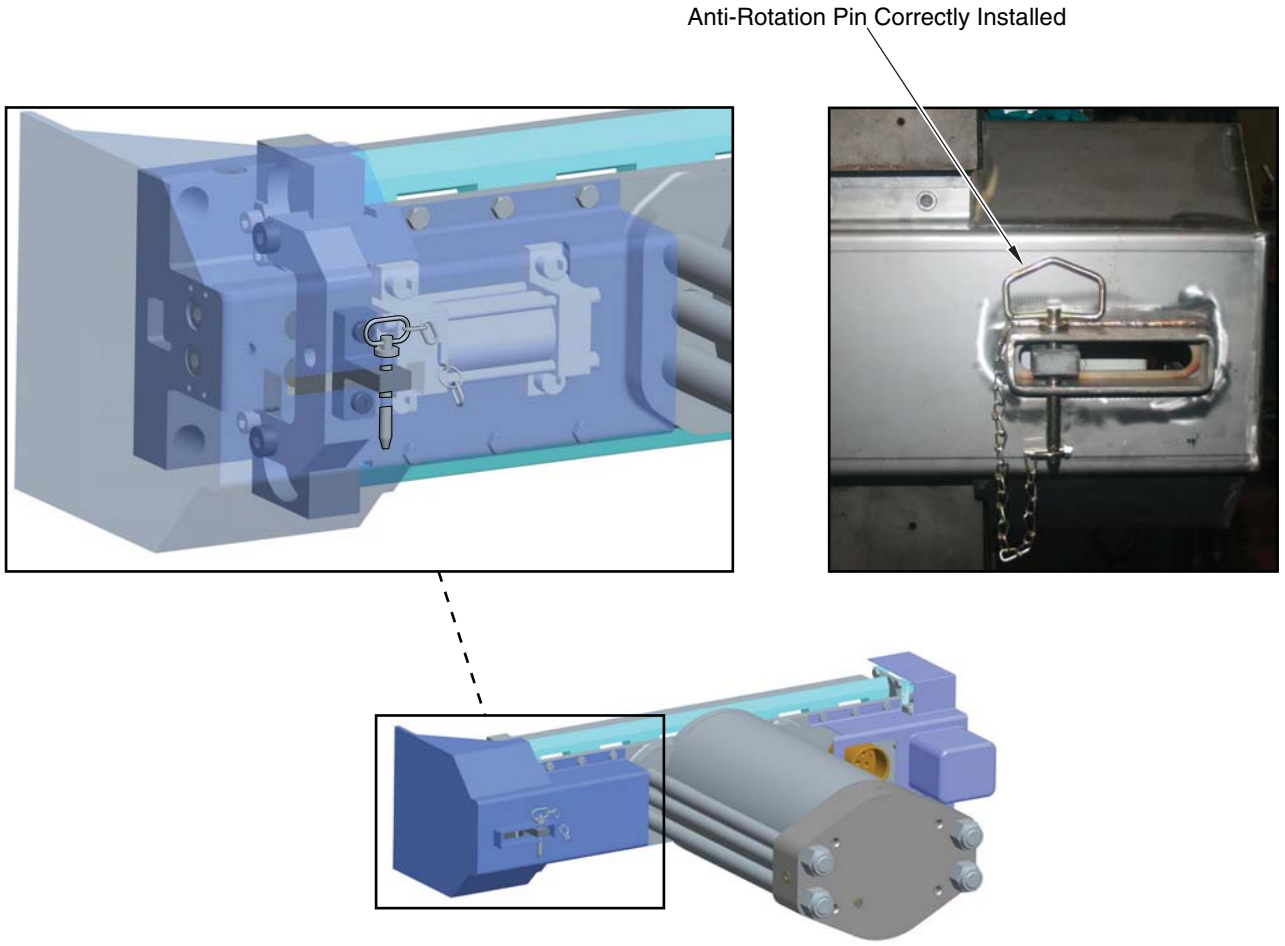


Figure 2-11. 14” Door Anti-Rotation Pin Correctly Installed

In addition, a best practice should be followed by removing the manifold umbilical from the door assembly as soon as the door system is locked and pinned in place. This will prevent inadvertent activation of the lockbars and/or anti-rotation bars into the unlocked position.

Door Locking System Control Panel

A control panel is available to remotely operate the unlocking/locking and opening/closing of the NXT preventer doors (see Figure 2-13 on page 2-13).

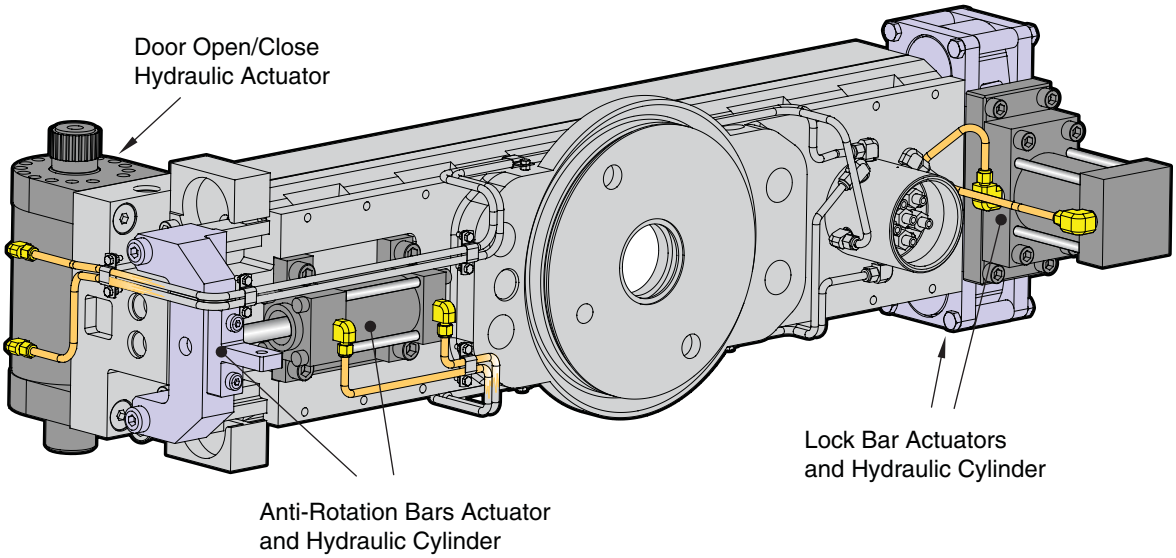
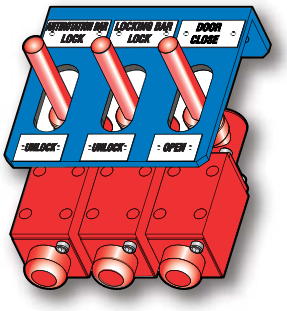


Figure 2-12. 14" UltraLock II (B) Door Operation Components

The control panel consists of three control functions as follows:

- Anti-Rotation Bar — Lock — Unlock
- Locking Bar — Lock — Unlock
- Door — Open — Close



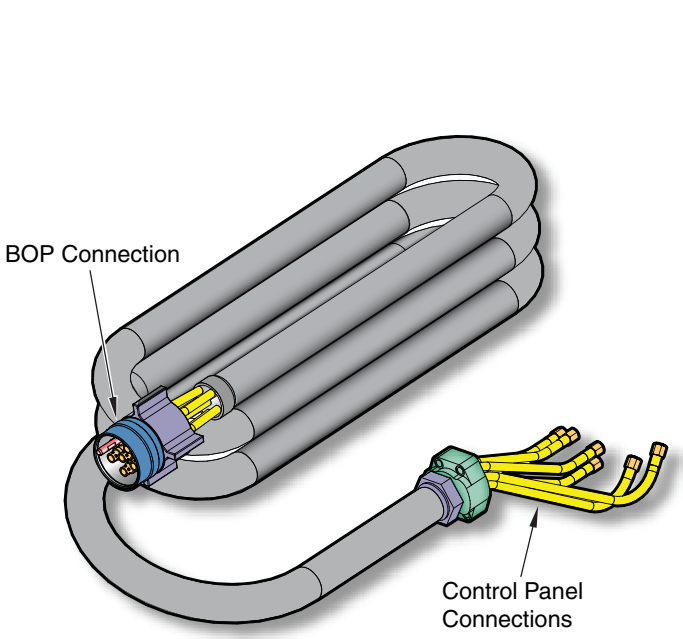
This allows rig personnel to (1) remotely move the anti-rotation bar to the unlock position, (2) rotate the locking bar, releasing the door from the body, and (3) open the door of the preventer.

The control panel is equipped with a stand and hose bundle with multi-plug quick-disconnects. The hose bundle quick-disconnect plug is connected into the BOP door receptacle, where a guide pin aligns the male to female quick-disconnect fittings.

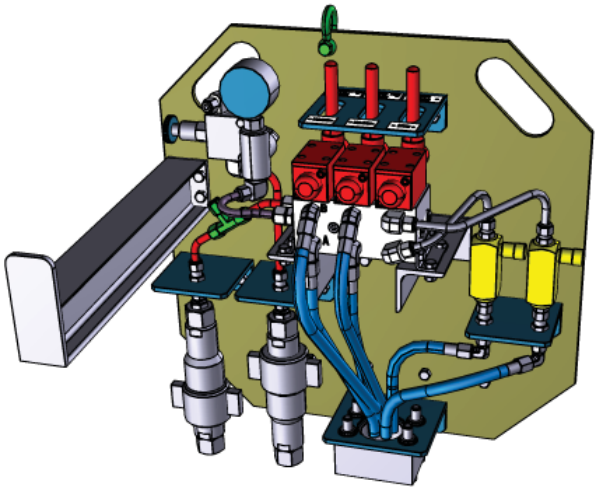
Control Panel Functions

The control functions on the 14” UltraLock II (B) operator doors are different from the 22” PosLock operator doors, because the lockbar anti-rotation device (shown in Figure 2-12 on page 2-12) on the 14” UltraLock II (B) door are not used on the 22” PosLock operator doors. Instead the 22” PosLock operator doors utilize lockbar safety latches located in the lockrod drive assembly (see Figure 2-10 on page 2-10 and Figure 4-7 on page 4-22).

The upper and middle cavities on a BOP stack are not fitted with anti-rotation bars, because these cavities are used or may be used to shear pipe or casing. Since these cavities may be required to shear pipe and casing, they require a much stronger lockbar than is required to close and seal off regular pipe rams. Because of this requirement, the anti-rotation device was replaced with safety latches.



Hose Bundle



Hydraulic Control Panel (HCP)

Figure 2-13. Hose Bundle and Hydraulic Control Panel

On the 22” PosLock operators, the safety latches on the upper and middle cavities must be manually moved clear of the lock bar before the functions on the control panel can be operated to open the door.

The 14” UltraLock II (B) operators on the lower cavity use all three functions on the control panel. However, the 22” PosLock operators on the upper cavities use two functions: locking bar Lock — Unlock and door Open — Close.

Inspection/Installation

This chapter describes the necessary tasks to be performed from the time the equipment arrives at the drilling site to the time it is made operational.

Uncrating

If equipment is crated, perform the following to remove equipment from packing crate:

1. Verify that “Top” and “This Side Up” markings on crate are in the correct position.
2. Loosen and remove fasteners attaching top of crate.
3. Remove sidewalls of crate in the same manner as the top, removing one side of crate at a time.

Inspecting

The inspection process includes the activities listed below:

1. Inspect the BOP upon receipt to make sure the unit as a whole and its components have not been damaged or lost during transit. Any damaged or lost items should be replaced before proceeding with installation or operation.
2. Verify bolt torque on any installed ring joint connections.
3. Thoroughly clean the NXT BOP before installation.
4. 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 an NOV service representative.

Do not use a wire brush to clean the BX ring grooves. This will scratch the surface of the grooves. Install new BX ring gaskets dry after each time the connection is broken.

5. Clean and inspect studs and nuts. Replace any that are damaged.
6. All external fluid connection ports should be clean and plugged until the BOP control lines are installed.
7. If quick disconnections (QDs) are utilized, inspect for damage to O-ring and sealing areas as applicable. QDs should be protected when not in use.
8. Ensure the correct-size rams are in each cavity. The part number is stamped into the block of each ram.
9. Thoroughly clean and lubricate the inside of the NXT BOP.

Condition of BOP is Unknown

If the condition of the BOP is unknown — e.g., stored for some length of time or has not been maintained on a scheduled maintenance program — perform a three-month maintenance check as described in Chapter 5, titled “Maintenance”. A three-month maintenance check includes:

- Visually inspect and thoroughly grease the inside of the BOP.
- Perform a field wellbore pressure test as described in Chapter 5.
- Perform a hydraulic pressure test as described in Chapter 5.

BOP Maintained on a Scheduled Maintenance Program

If the BOP has been properly maintained (scheduled maintenance program), a monthly preventive maintenance check (see Chapter 5, titled “Maintenance”) is all that is required. A monthly preventive maintenance check includes:

- Performing a field wellbore pressure test.
- Checking for external hydraulic leaks while pressure testing.

Cleaning, inspecting and testing of the NXT BOP immediately after completion of the drilling operations reduces installation time on the next well.

Installing

1. Ensure that the BOP is installed right-side up:
   - Some models have “Top” or “This Side Up” cast into the BOP body.

For other models without stampings or lifting lugs, the following will assist in verifying the BOP is installed properly.

   - Externally, the side outlets for the choke and kill lines are below the ram center line.
   - Internally, the skids in the ram compartments are below the rams, and ram sealing seats are located in the top of the ram cavity (see Figure 3-1 on page 3-3).

Warning

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

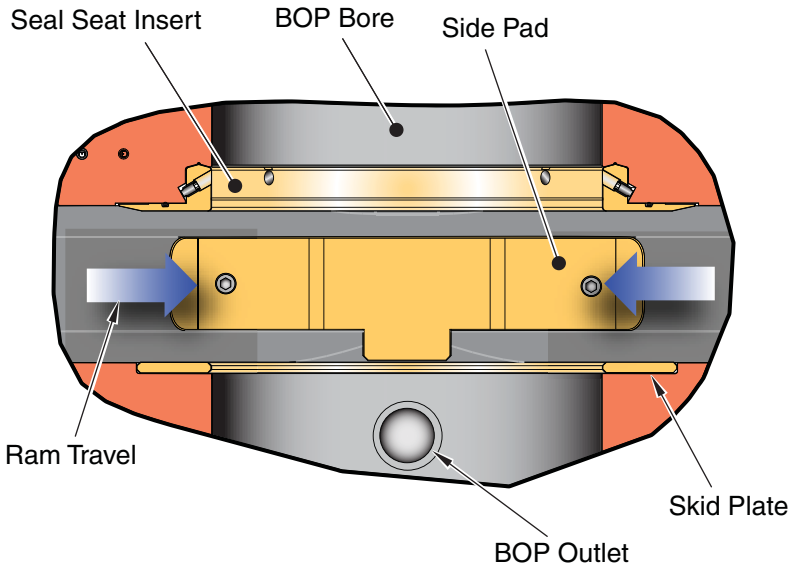


Figure 3-1. BOP Ram Cavity

2. Lift the NXT BOP with approved lifting apparatus capable of safely supporting the NXT BOP weight (see assembly drawing for proper weight).
   - ❏ On NXT models, the BOP is lifted by a shackle and chain or cable of sufficient strength.
   - ❏ The NXT preventer can be lifted by using four lifting shackles mounted on the top side of the BOP body (see Figure 3-2 on page 3-4).

A spreader beam or lift bar should be used to provide vertical lift at the shackles.

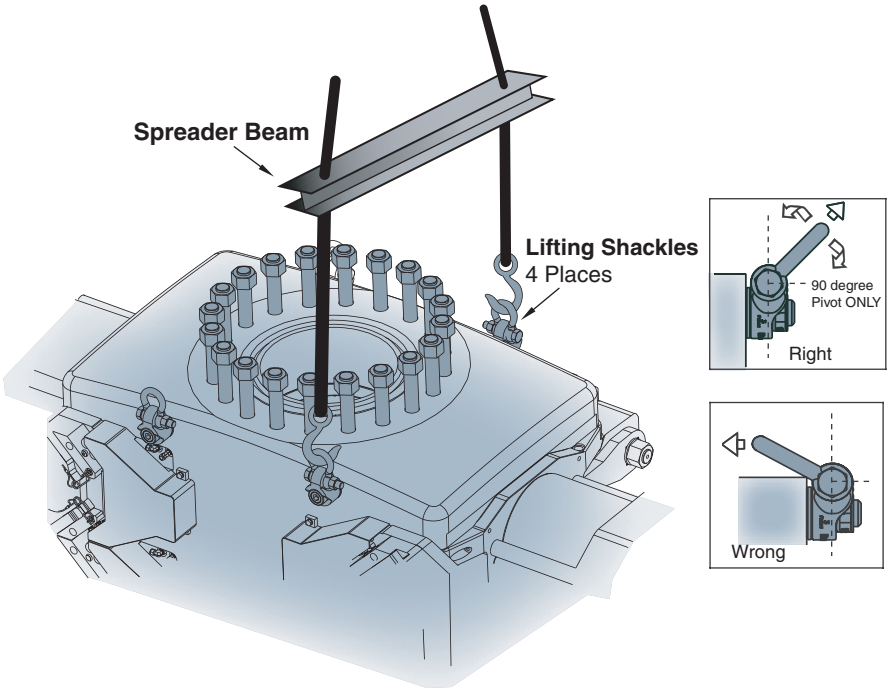


Figure 3-2. Lifting the NXT BOP

Also, the NXT can be lifted by straps placed under the top door operators. Straps should be placed as close to the BOP body as possible.

Warning

Be sure the doors are closed and securely locked before lifting the BOP.

Use a chain, cable, or web strap capable of safely lifting the weight of the BOP, but do not place straps under the door operators as this may damage the door operator locking mechanism.

Ram BOPs should be lifted and handled using the lifting lugs only. Do not lift ram BOPs by their door cylinders, as this will result in damage to the cylinders.

Do not lift the BOP by the side outlets. This will damage the side outlets, preventing the BOP from working properly.

End Connections

Perform the following to make all flanged and studded connections (see Figure 3-3).

1. Install the ring gasket. See the table titled “API BX Ring Gaskets” on page 3-5 for the correct API ring gaskets and proper part number.

Do not use oil/grease on the API ring gaskets; they are installed dry.

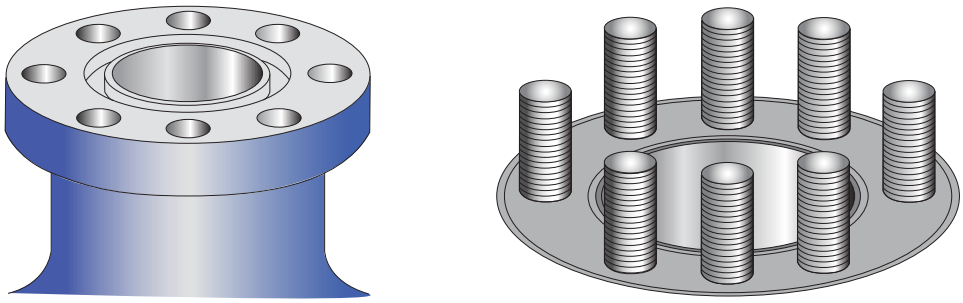


Figure 3-3. Flanged and Studded Connections

API BX Ring Gaskets

Working Pressure	Nominal Size	BX Number	Soft Iron Cad. Plated	Type 304 Stainless Steel
10,000 psi, 15,000 psi	$3^{1}/_{16}$”	154	050355	050647
10,000 psi, 15,000 psi	18¾”	164	050665	050666

2. Install the NXT ram BOP on the mating flange.

Bolt Data

Working Pressure (psi)	15,000	15,000
Flange Size (in.)	$3^{1}/_{16}$”	18¾”
API Stud, Nut Size (in.)	$1^{1}/_{8}$”	3”
Wrench Size (in.)	1¾”	$4^{5}/_{8}$”
Recommended Torque (ft-lb)	*386	*7,479
Number of Studs	8	20
Ring Gasket	BX-154	BX-164

* *The torque values are based on using Sweeney 503 Moly Paste (P/N 7403582) anti-seize. The factor for Sweeney 503 Moly Paste is 0.067.*

3. Lubricate the stud threads and nut faces for the API flange connections with lubricant referenced in the table titled “Bolting Data” on page 3-7.

Use only specified lubricants. Do not use Loctite™ or similar compounds. Do not grease or pack the tapped (threaded) holes with thread lubricant. This causes improper makeup on the studs.

4. Install the studs and/or nuts.

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, striping, or burrs. Do not over torque studs when installing in studded flange.

5. Tighten all nuts uniformly in a diametrically staggered pattern (see Figure 3-4).
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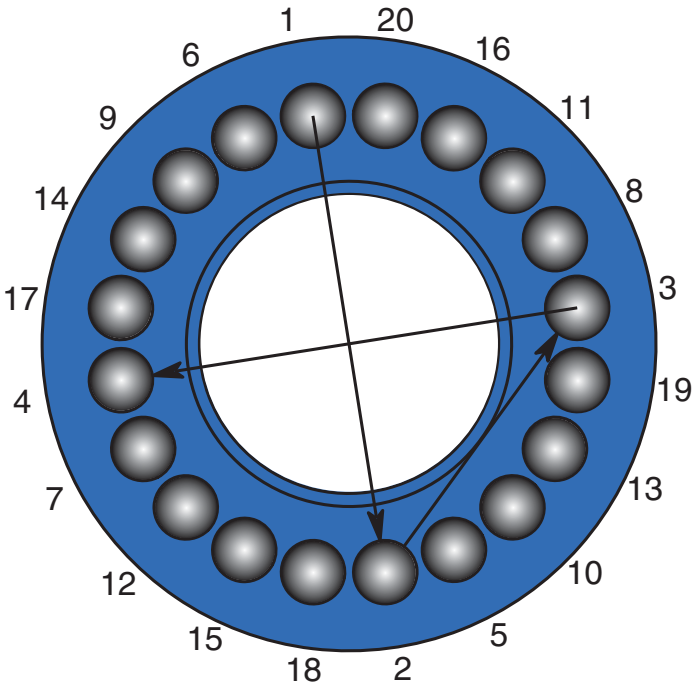


Figure 3-4. Flanged Bolting Sequence

Bolting Data

Working Press. (psi)	Flange Size	API Stud, Nut Size	Wrench Size	Torque (ft-lb)*	Number of Studs	Ring Gasket
15,000	18¾"	3"	$4^{5}/_{8}$"	7,479	20	BX-164
	$13^{5}/_{8}$"	2¼"	3½"	3,149	20	BX-159
	11"	2"	$3^{1}/_{8}$"	2,209	20	BX-158
	$3^{1}/_{16}$"	$1^{1}/_{8}$"	$1^{13}/_{16}$"	386	8	BX-154
10,000	21¼"	2½"	$3^{7}/_{8}$"	4,324	24	BX-166
	18¾"	2¼"	3½"	3,149	24	BX-164
	16¾"	$1^{7}/_{8}$"	$2^{15}/_{16}$"	1,818	24	BX-162
	$13^{5}/_{8}$"	$1^{7}/_{8}$"	$2^{15}/_{16}$"	1,818	20	BX-159
	11"	1¾"	2¾"	1,476	16	BX-158
5,000	21¼"	2"	$3^{1}/_{8}$"	2,209	24	BX-165
	18¾"	2"	$3^{1}/_{8}$"	2,209	20	BX-163
	16¾"	$1^{7}/_{8}$"	$2^{15}/_{16}$"	1,818	16	BX-162
	$13^{5}/_{8}$"	$1^{5}/_{8}$"	2¾"	1,180	16	BX-160

**All torque values are based upon the use of Sweeney 503 Moly Paste thread lubricant (friction factor = 0.067) (P/N 7403582).*

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

The torque values in the table titled “Bolting Data” on page 3-7 are formulated assuming the thread lubricant is Sweeney Moly Paste 503 (P/N 7403582).

Other suitable lubricants are as follows:

- Select-A-Torque 503 Moly Paste Lubricant
- Felpro Moly Paste (formerly, Felpro C-670)

It is critical when considering a substitute lubricant to take into account the compressive resistance of the lubricant as well as its friction factor. NOV recommends the use of Sweeney Moly Paste 503 lubricant because of its excellent compressive resistance. Failure to heed this caution and use lubricants with poor compressive resistance may cause galling of threads and high breakout torque.

Additional Torque Values

ft-lb (@ 52,500 psi stress) yield strength = 105,000 psi (7,281 bar)

Bolt Size (in)	Bolt Thread	Bolt Tension (lbf)	Select-A-Torq 503 Moly-Graph Felpro C-670 μ=0.067	Tool Joint Compound μ=0.08	Graphite w/Petrolatum μ=0.1	Dry, Machined Surfaces, 4140 Steel μ=0.133	Light Machine Oil as Shipped μ=0.15	API Recommendation 6A, Appendix D [1] μ=0.13
1/4	20UNC	1671	4	5	6	8	8	7
5/16	18UNC	2753	8	10	12	15	16	15
1/2	13UNC	7450	34	39	47	60	67	59
3/4	10 UNC	17,559	114	132	159	204	228	196
7/8	9 UNC	24,241	181	210	253	325	362	313
1	8 UN	31,802	269	312	376	484	539	474
1-1/8	8 UN	41,499	386	448	543	700	781	686
1-1/4	8 UN	52,484	533	619	753	973	1,086	953
1-3/8	8 UN	64,759	712	829	1,010	1,308	1,462	1,281
1-1/2	8 UN	78,322	926	1,081	1,319	1,713	1,915	1,676
1-5/8	8 UN	93,173	1,180	1,379	1,686	2,193	2,454	2,146
1-3/4	8 UN	109,313	1,476	1,728	2,115	2,754	3,084	2,695
1-7/8	8 UN	126,741	1,818	2,130	2,611	3,405	3,814	3,331
2	8 UN	145,458	2,209	2,591	3,179	4,150	4,650	4,060
2-1/4	8 UN	186,758	3,149	3,700	4,549	5,950	6,672	5,821
2-1/2	8 UN	233,212	4,324	5,088	6,265	8,207	9,207	8,028
2-3/4	8 UN	284,820	5,758	6,785	8,364	10,971	12,315	10,731
3	8 UN	341,582	7,479	8,821	10,887	14,296	16,053	13,982
3-1/4	8 UN	403,498	9,512	11,229	13,871	18,231	20,478	17,830
3-1/2	8 UN	470,569	11,883	14,038	17,355	22,829	25,650	22,332
3-3/4	8 UN	542,793	14,618	17,281	21,378	28,141	31,627	27,519
4	8 UN	620,172	17,742	20,987	25,979	34,219	38,465	33,461

NXT Ram BOP Installation

Ensure that the BOP is installed right-side up. The lifting lug holes are located along the top edge of the BOP. Externally, the side outlets for the choke and kill lines are below the centerline of the rams. Internally, the skids are located in the bottom of the ram cavity, and ram-sealing seats are located in the top of the ram cavity (see Figure 3-5 on page 3-10).

Warning

If the BOP is installed upside down, it will not contain wellbore pressure. Failure to heed this warning can have catastrophic results.

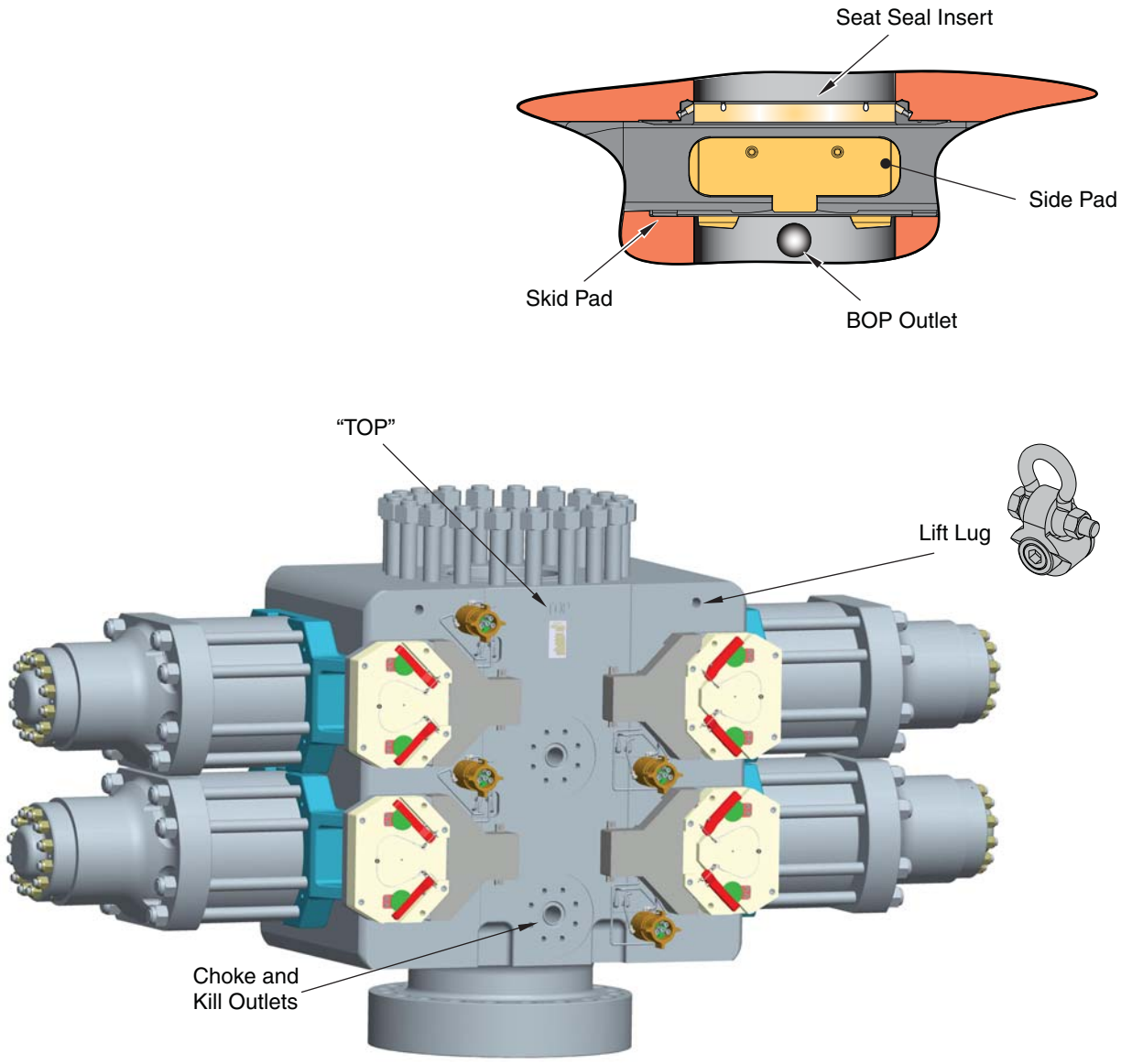


Figure 3-5. NXT Ram BOP Installation

Operation

This chapter explains the operating principles for UltraLock II (B) and 22" PosLock systems of the NXT ram BOP and includes hydraulic system requirements and test procedures to verify system readiness.

Drill Pipe Suspension

Model NXT-D pipe rams will support a 600,000 lb (272,155 kg) drill string load when a tool joint is lowered onto the closed rams. The model "D" designates the rams can support pipe suspension loads. These rams have a hard inlay around the pipe bore to support drill pipe on the 18° tool joint taper.

Not all rams have hang-off capability; the bright hard inlay is easily recognized around the bore in the block. If there is no hard inlay visible, the rams cannot be used to hang-off drill pipe. A special square-shouldered hang-off tool allows the rams to support drill pipe by eliminating the 18° tool joint taper, which extends the life of the rams if repeated hang-offs are planned.

The model NXT multi-ram is limited in the amount of drill string suspension load it can support. The following table lists the multi-ram sizes and the drill pipe suspension weight it can support.

Model NXT Multi-Ram Assemblies

Bore Size and Working Pressure	*Complete Ram Assy. Part No.	Pipe Size Range	Pipe Suspension (000 lb)								
			3½	4	4½	5	5½	5 7/8	6 5/8	7	7 5/8
18¾" 15,000 psi NXT	20012089	3½–5½	200	200	400	600	600	–	–	–	–
18¾" 15,000 psi NXT	20015911	3½–5 7/8	200	200	400	600	600	600	–	–	–
18¾" 15,000 psi NXT	20012091	5–7	–	–	–	300	300	600	600	600	–
18¾" 15,000 psi NXT	20024125	3½–6 5/8	100	100	100	100	100	100	600	–	–
18¾" 15,000 psi NXT	20077021	3½–7 5/8	–	–	–	–	–	–	–	–	600

**Includes block and ram rubber assembly.*

Internal Tech Writer Comment: Pipe suspension weights from table above also apply to both 18-10M NXT and 18-5M NXT multi-rams.

The multi-ram part numbers in the table titled "Model NXT Multi-Ram Assemblies" on page 4-1 can hang off the indicated drill pipe weight; however, not all multi-rams have hang-off capabilities. Consult your nearest National Oilwell Varco representative before attempting to hang off drill pipe on multi-rams.

Stripping Procedure, UltraLock II (B) Rams

Stripping operations utilizing the UltraLock II (B) rams and multi-rams are not recommended. Unlike the spherical annular element, which has a large mass of rubber, the rams (and, especially, the multi-rams) have a limited mass of rubber.

However, NOV recognizes that stripping may become necessary during the drilling operation. When stripping is unavoidable, it is desirable to have a reduced closing pressure until the ram contacts the pipe. At this point, the pipe is stripped until the tool joint contacts either the block or the segments. Then the closing pressure is increased to fully effect the seal.

NOV Shaffer® multi-rams have been tested for their stripping performance; due to the application, however, the usable footage is fairly low. If stripping is unavoidable, follow this procedure:

1. Space the tool joint approximately 2 to 5 ft (61 to 152 cm) above the ram.
2. Close UltraLock II (B) rams with 500 psi (34.5 bar) closing pressure.
3. SLOWLY strip the pipe through the ram while monitoring the weight indicator.
4. When the weight indicator shows the load is being transferred to the ram, STOP.
5. Mark the pipe and raise it 1 to 2 inches (2.5 to 5 cm) above the ram.
6. Open the UltraLock II (B) rams with 500 psi (34.5 bar) opening pressure.
7. Adjust the closing pressure to 1,500 psi (103 bar).
8. Closed UltraLock II (B) rams with 1,500 psi (103 bar) closing pressure.
9. Strip remaining 1 to 2 inches (2.5 to 5 cm) until the pipe is landed out.
10. Perform a wellbore pressure test.

When pipe rams or multi rams are closed on drill pipe, DO NOT ROTATE THE PIPE. If it is necessary to rotate the pipe, the closing pressure must be reduced to 500 psi (34.5 bar), and rotation must be at a very low speed. Failure to heed this caution will result in damage to the ram assemblies.

The condition of the ram rubbers greatly affects the sealing integrity of the rams.

UltraLock II (B) Operation

The hydraulics required to operate the UltraLock II (B) locking system are provided through the existing opening and closing ports of the BOP. No additional hydraulic lines or functions are required for operation of the locking system. The UltraLock II (B) locking system contains several key components in addition to lock rods and wedges, which form the mechanical lock.

UltraLock Poppet Valve Assembly

The purpose of the poppet valve in the UltraLock II (B) operator assembly is to prevent the locking piston from moving into the lock position while the rams are being closed.

This is achieved by the spring-biased closed poppet valve trapping hydraulic pressure between the poppet and the locking piston, thus preventing closing hydraulic pressure from activating the locking system (see Figure 4-1).

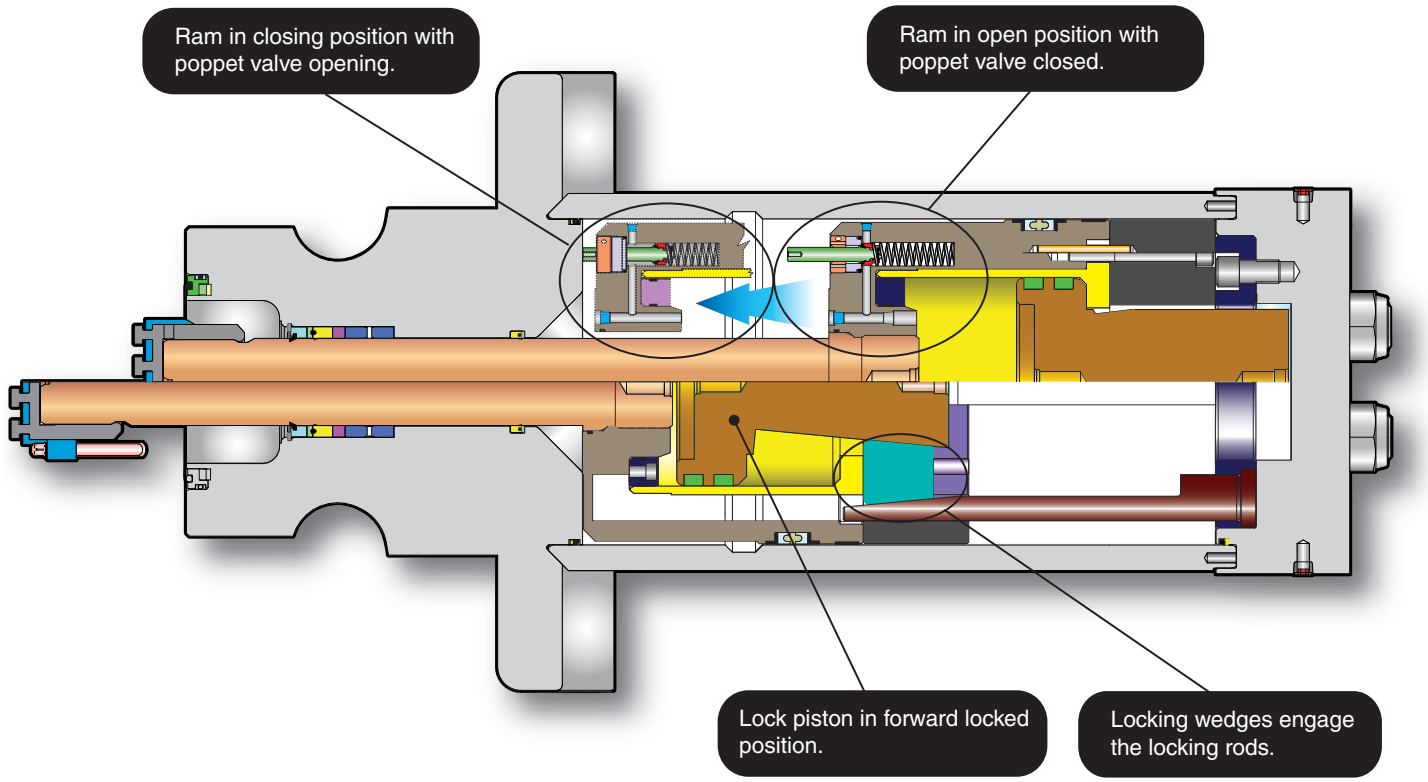


Figure 4-1. Poppet Closed

The spring-biased poppet assembly is a timing device that prevents the locking piston from moving into the lock position until the ram rubbers are being squeezed around the pipe. At that point the poppet contacts the door face, which unseats the poppet and allows the trapped hydraulic pressure to escape.

Removing the trapped hydraulic pressure allows the closing hydraulic pressure to move the locking piston inward, activating the locking system.

Failure of the poppet to hold hydraulic pressure during the closing cycle may cause the rams to lock before the ram rubbers contact the pipe.

Closing Function, UltraLock II (B)

Warning

Use of a BOP control system with hydraulic closing pressure below 1,500 psi (103 bar) may cause failure of the UltraLock II (B) pipe rams to seal wellbore pressure. Failure to heed this warning may cause damage or loss of equipment, and injury or death to drilling personnel.

If a popping sound is heard while closing the UltraLock II (B) operator, inspect the lock segments (wedges) and lock rods. If necessary, replace the lock segments and lock rods in sets of four.

When closing hydraulic pressure is applied, the entire piston assembly moves inward and pushes the rams toward the wellbore (see the table titled “BOP Hydraulic Operator Specifications” for minimum closing pressures; see the table titled “18¾-15M NXT Volumes” for correct gallons or liters to close).

As the ram assembly closes around the pipe in the bore of the preventer and trapped hydraulic pressure is released through the poppet valve, the lock piston moves inward, and the four-sided taper on the lock piston radially moves the four lock wedges outward to engage the four lock rods, locking the rams in the closed position (see Figure 4-1 on page 4-4).

BOP Hydraulic Operator Specifications

Operator Type	Ram Shaft Diameter	Cylinder Diameter	Closing Ratio	Wellbore Pressure	Minimum Closing Pressure
UltraLock II (B)	3¾” (95¼ mm)	14” (355 mm)	13.94	15,000 psi (1,034 bar)	1,500 psi (103 bar)
22” PosLock	6” (152 mm)	22” (558 mm)	13.45	15,000 psi (1,034 bar)	*1,500 psi *(103 bar)

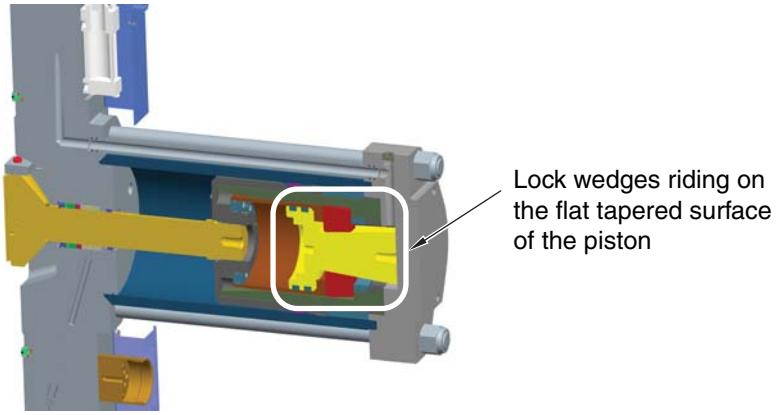
** Use the maximum available closing pressure to shear pipe. Up to 5,000 psi (345 bar) closing hydraulic pressure can safely be applied on 22” PosLock operators to shear pipe. Use 1,500 psi (103) on the 22” PosLock operator for testing and normal operator functioning.*

18¾-15M NXT Volumes

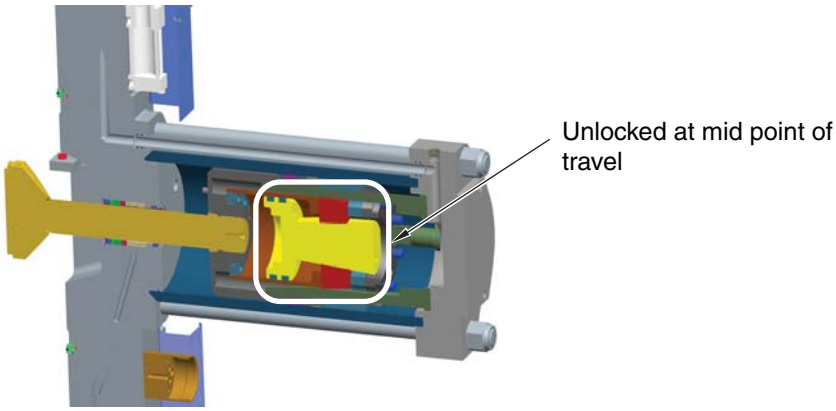
Rams	14” UltraLock II (B) Volume		22” PosLock Volume	
*Open	15.00 gallon	56.8 liter	29.92 gallon	151.1 liter
*Close	15.96 gallon	60.4 liter	31.22 gallon	118.2 liter

** Calculated volumes may vary during field operations.*

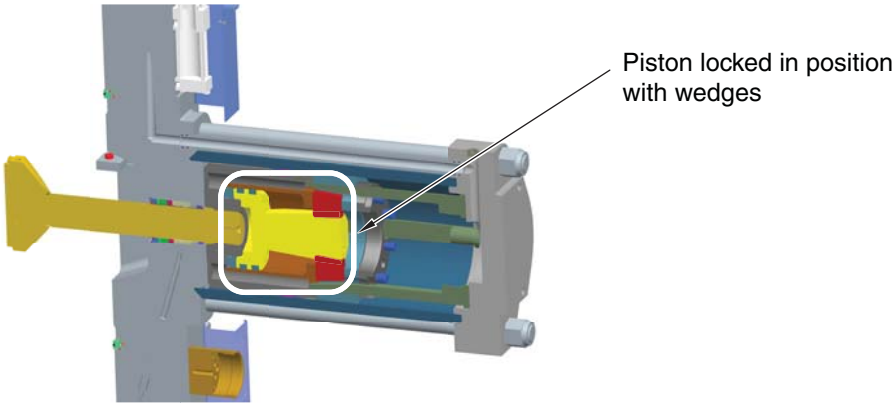
The lock is achieved by engaging the flat planar faces of the lock wedges onto the taper of the lockrod. The taper design prevents opposing force (wellbore pressure) from moving the rams in the opposite direction toward the open position. The system allows for the locks to move progressively inward as hydraulic pressure continues to be applied until the ram is sealed on the pipe. The rams will continue to be held in a locked position in the event that closing hydraulic pressure is lost or removed.



OPEN - Locking Wedges and Piston



Wedges and Piston at Half Travel



CLOSED - Locking Wedges and Piston

Figure 4-2. Cylinder Locking Sequence

Opening Function, UltraLock II (B)

When opening hydraulic pressure is initially applied, the entire piston assembly cannot be moved because the lock piston, lock wedges and lockrods are engaged in the lock position (see Figure 4-1 on page 4-4). This allows the opening hydraulic pressure to enter through the unseated poppet valve (see Figure 4-2 on page 4-6). Increasing pressure is now applied to the lock piston, moving the lock piston outward and allowing the four lock wedges to move radially inward, disengaging the lock wedges from the four lockrods. With the lock wedges disengaged, the main piston is free to move the ram assemblies to the open position (see Figure 4-2 on page 4-6). As the main piston moves outward, the spring closes the poppet valve (see Figure 4-1 on page 4-4), trapping hydraulic pressure between the poppet and lock piston.

NXT Shear Ram BOP with 22” PosLock Operators

Shear rams are designed to shear drill pipe. Do not functionally test shear rams with pipe in hole unless a shear test on actual pipe is required. The shear rams will not shear pipe tool joints. Make sure that there are no tool joints in the vicinity of the shear rams during the pipe shearing operation.

Before attempting to shear drill pipe and casing, NOV recommends that customers contact their NOV representative to discuss the specification and size of drill pipe/casing to be sheared. Failure to heed this caution may damage the shear ram assemblies.

The 18¾”, 15,000 psi (1,034 bar) NXT Triple Ram BOP contains the PosLock shear ram assemblies in the upper cavities. See Figure 2-1 on page 2-2 for ram BOP components. The shear ram assemblies are opened and closed by two 22” (558 mm) hydraulic operating cylinders per ram cavity (see Figure 4-3 on page 4-8). The BOP control system provides the adjustable open/close hydraulic power for operating the cylinders. The open/close hydraulic connections are similar to those described in the the section titled “UltraLock II (B) Operation” on page 4-4. See the table titled “BOP Hydraulic Operator Specifications” on page 4-5 for recommended closing/opening hydraulic pressure.

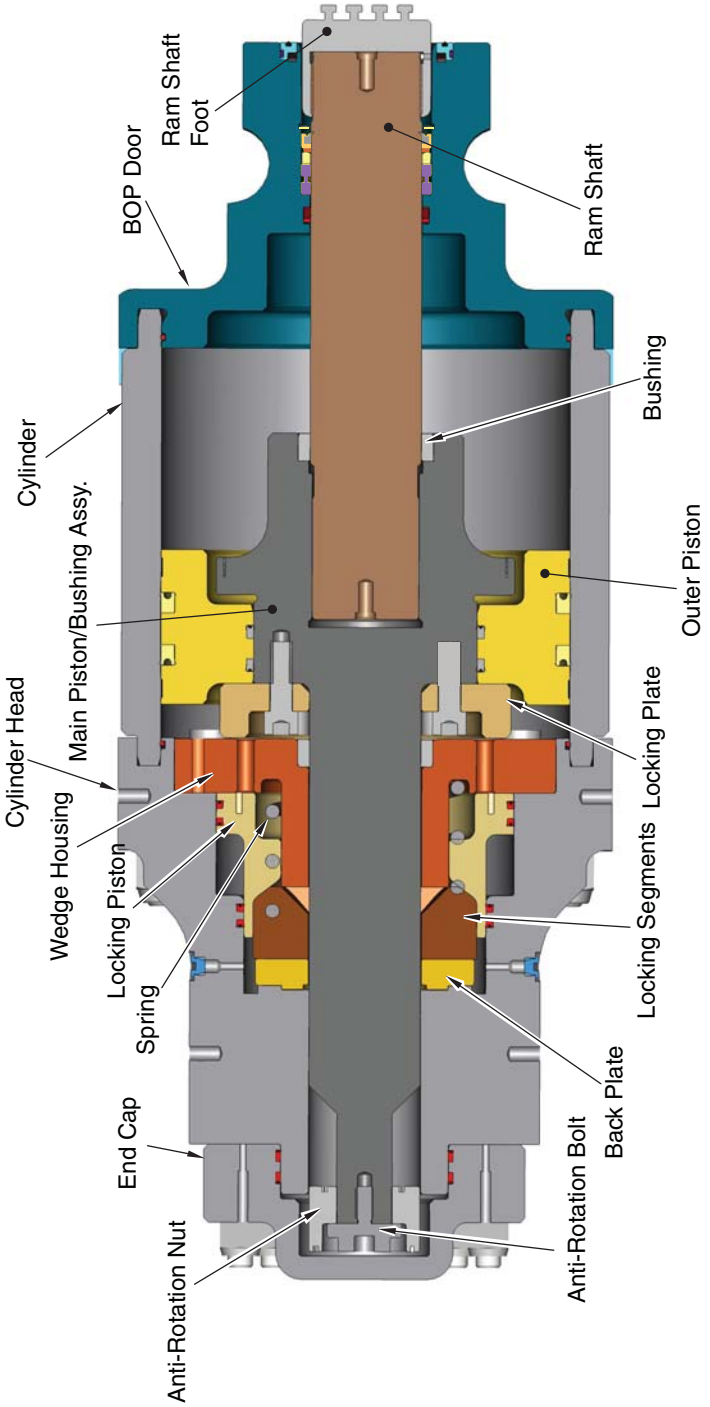


Figure 4-3. 22” PosLock Cylinder

PosLock Operation

Use of insufficient closing pressure in a BOP control system may cause the 22" PosLock operators not to shear pipe properly, which will prevent proper sealing of the wellbore. Failure to heed this warning may cause damage or loss of equipment and injury or death to drilling personnel.

For component descriptions, see Figure 4-3 on page 4-8 and the engineering drawings located in Chapter 6, titled "Specifications and Parts Lists".

Generally, a very low hydraulic closing pressure (force) will move the ram assemblies to a closed position. However, this closing pressure (force) must be increased for the ram assembly rubber to flow and seal-off the wellbore and shear the pipe. The 22" PosLock operators will achieve a wellbore seal to the rated working pressure of the preventer with 1,500 psi (103 bar) closing hydraulic pressure and shear drill pipe with a maximum of 5,000 psi (345 bar) closing hydraulic pressure.

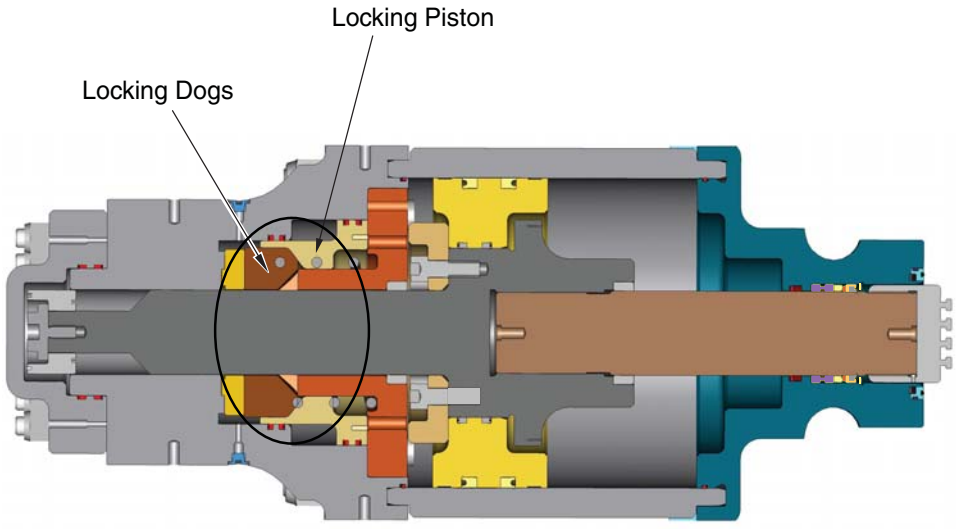
Do not exceed 1,500 psi (103 bar) ***opening*** *hydraulic pressure on the 22" PosLock operators. Failure to heed this caution may cause damage to the ram shaft foot or to the bolts capturing the outer piston to the main piston.*

ONLY use maximum ***closing*** *hydraulic pressure when actually shearing pipe.*

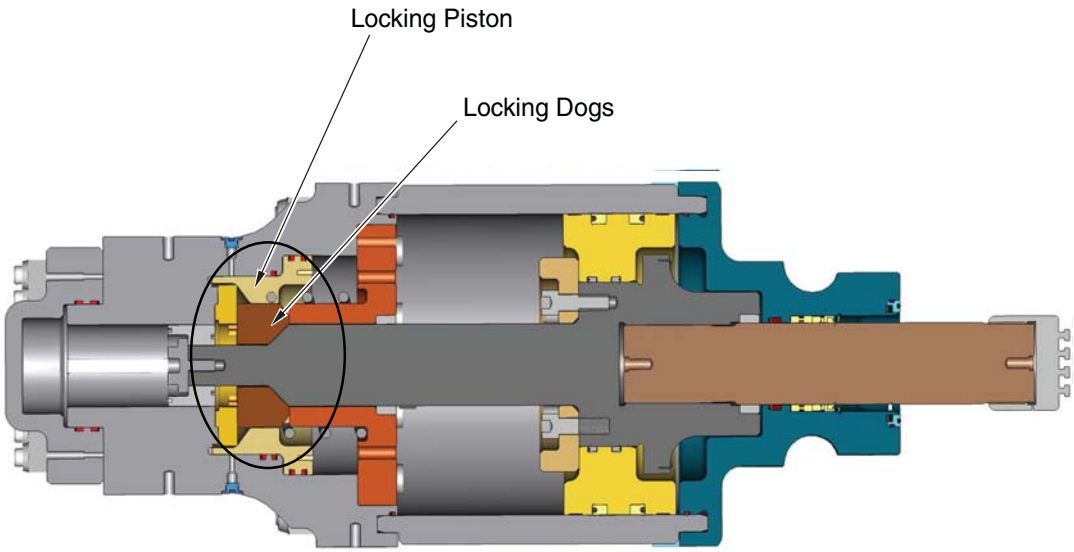
To achieve a low closing force and a high closing force, the PosLock operators are designed with two closing areas. The large outer piston area shears the pipe, and the lower main piston area seals the wellbore. Shear force is not compromised by the split piston design, as the shear blades will already have begun to overlap by the time the outer piston force is reduced. The force reduction is designed to relieve the ram assemblies from seeing the full force generated by the operator during closure, thus extending the service life of the ram packers.

In addition, when closed, the PosLock operators automatically remain in the closed position even when the closing hydraulic pressure (force) is removed. The PosLock

operator uses a single set of locking segments to achieve a positive mechanical lock and requires opening hydraulic pressure (force) to unlock the locking segments. Figure 4-4 shows the PosLock operator in the Open and the Closed positions.



OPEN and UNLOCKED



CLOSED and LOCKED

Figure 4-4. PosLock Operator in Open Position (top) and Closed Position (bottom)

Hydraulic Operating Fluids

Operating fluid used with the UltraLock II (B) and PosLock systems should have the following characteristics:

- Non-freezing in cold climates
- Lubricity to reduce wear
- Chemical compatibility with elastomer seals
- Corrosion resistance

Use a clean, lightweight high-quality hydraulic control fluid, or fluid concentrate (with corrosion inhibitors), which is capable of being mixed with potable water. Do not use motor oil, kerosene, diesel fuel, chain oil, or petroleum products containing aromatics that can damage rubber components and seals.

For temperatures above 35°F (2°C), see specific mixing instruction from fluid supplier. To prevent freezing at lower temperatures, use a mixture of ethylene glycol and water.

Emergency Fluid Recommendations

In an emergency when hydraulic fluid is lost and the BOP containing UltraLock II (B) and PosLock systems must continue to operate, it is permissible to use any available water source. After the emergency, replace the fluid in the system with the proper mixture of K-100 or equivalent and potable water.

Do not use diesel fuel or kerosene. These fluids cause the rubber parts to swell and deteriorate. Do not use drilling mud. The grit in this fluid will cause the pistons and cylinders to wear and gall rapidly.

Operating Pressures

In most applications, the locking system opens and closes with a 1,500 psi (103 bar) operating hydraulic pressure. The addition of the UltraLock II (B) locking system causes no changes to standard operating pressures.

Warning

UltraLock II (B) closing hydraulic pressure below 1,500 psi (103 bar) or with flow rates of less than 50 gpm may cause failure of the rams to seal before locking occurs.

22” PosLock maximum operator closing pressure to shear pipe is 5,000 psi (325 bar), and opening pressure is 1,500 psi (103 bar).

Recommended closing pressure for testing shear rams is 1,500 psi (103 bar).

NXT Ram BOP Testing

Field Wellbore Pressure Test

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

- Wellhead-mounted stack
- Test stump
- Blind flange

It is normally more convenient to start with the bottom rams and proceed up the stack.

The final details of the test sequence will be established by the rig operator and contractor; therefore, modifications to the following procedure may be required. Refer to API Spec 6A, 16A, and API RP53 for additional information.

Test Set-up

Before beginning a wellbore pressure test, the correct installation of the anti-rotation hitch pins should be checked on all locked 14" operator doors. Failure to do so could cause equipment damage as well as serious injury or death. Refer to the section titled "14" Door Anti-Rotation Safety" on page 2-11 for additional information.

1. Connect the following equipment as shown in Figure 4-5:
   a. Two pressure gauges
   b. Three valves
   c. Test pump

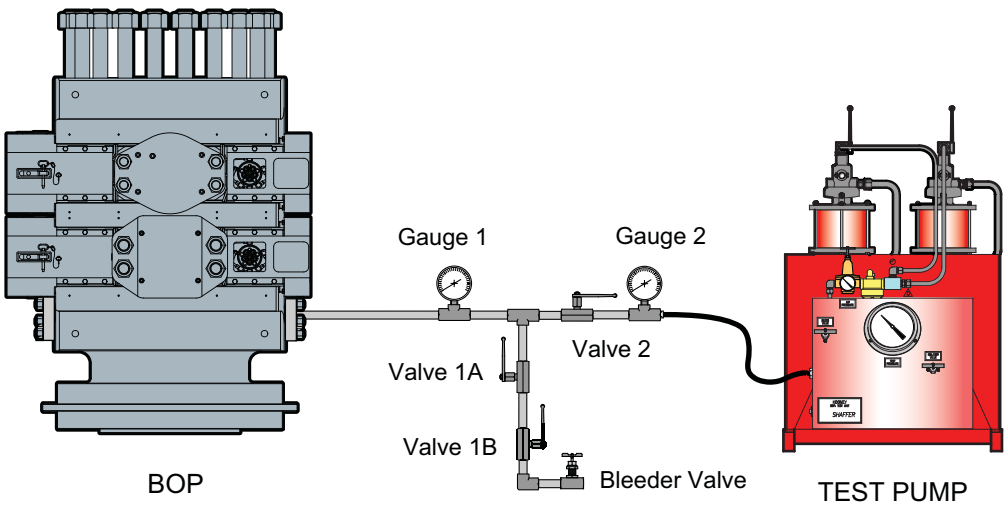


Figure 4-5. Recommended Field Wellbore Pressure Test Set-up

2. Fill the BOP with water or drilling fluid.

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

3. Close the pipe rams on an appropriate test tool using 1,500 psi (103 bar) hydraulic pressure [3,000 psi (207 bar) is optional].

The test tool must be properly secured to prevent test pressure from forcing the test tool out of the preventer.

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 pressurized during test or if a leak in the test tool could cause it to be pressurized)*
- ❑ *All connections, valves, fittings, piping, and hose*

To prevent damage to the ram rubber assemblies, do not close pipe rams unless pipe of the proper size is in the preventer.

Pipe rams should always be closed on pipe to avoid excessive ram rubber wear. Closure on a tool joint will damage the block and rubbers. Blind rams should only be closed on an open hole. Closing on pipe will damage the rubber and the block.

4. Bleed the closing hydraulic pressure.

Pressure Test

1. Close valves 1A and 1B. Open valve 2 (see Figure 4-5 on page 4-13).
2. Apply 200 to 300 psi (14 to 20 bar) simulated wellbore pressure below the rams. Close valve 2. Hold the test pressure for a minimum of three minutes. Check for low-pressure leaks. Monitor gauge 1.

During the above ram test, there is no closing hydraulic pressure holding the rams closed; therefore, the integrity of the locking system is also being verified.

3. Open valve 2. Increase the wellbore pressure to the required test pressure.
4. Close valve 2. Hold the test pressure for a minimum of three minutes.
5. 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.

Do not look into the ram bore while pressure is under the rams. If possible, use a mirror to observe the rams.

6. Bleed all wellbore test pressure to 0 psi/bar, as follows:
   - ❑ Open valve 1A.
   - ❑ Open valve 1B.
   - ❑ Fully open valve 2.
7. Repeat step 1 through step 7 for the second test pressure-holding period.

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.
- ❑ Door Seal — replace door seal.
- ❑ Ram Shaft Weep Hole — if leaking, see the section titled “Emergency Ram Shaft Packing Repair” on page 5-62 to replace the ram shaft packing.
- ❑ Ram — replace the ram rubbers.
- ❑ Ram — adjust the PosLock mechanism (see the section titled “22” PosLock Adjustment” on page 5-94).
- ❑ Ram — repair the UltraLock II (B) mechanism.

Hydraulic Pressure Test

Hydraulic pressure tests include the following:

- Opening pressure
- Closing pressure
- Ram leakage

Do not exceed normal 3,000 psi (207 bar) maximum operating pressure while testing the UltraLock II (B) preventer and 5,000 psi (345 bar) operating pressure while testing the 22" PosLock preventer.

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

The final details of the test sequence will be established by the rig operator and contractor; therefore, modifications to this procedure may be required. Refer to API Spec. 16A and API RP53, paragraph 7.A.2 for additional information.

Opening Hydraulic Pressure Test

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

1. Vent hydraulic closing pressure to atmosphere.
2. Apply 1,500 psi (103 bar) or 3,000 psi (207 bar) opening hydraulic pressure.
3. Close the valve in the opening hydraulic line.
4. Observe the gauge between the valve and the BOP cylinder.
   a. If there is no pressure drop, end the test here.
   b. If there is a pressure drop, proceed to the following step to continue the test.
5. Check for external leaks at the following locations:
   - Hinge pins
   - Weep holes for ram shaft seal
   - Cylinder seal

- Door seal

For replacements and repairs, see Chapter 5, titled “Maintenance”.

6. Check for internal leaks past the piston seals in the following manner:
   - Remove the closing hydraulic line. If the piston seals are leaking, fluid will flow from the closing line.
   - Open all valves and bleed the test pressure to 0 psi (0 bar).

Closing Hydraulic Pressure Test

1. Vent all hydraulic opening pressure.
2. Apply 1,500 psi (103 bar) or 3,000 psi (207 bar) closing pressure.
3. Close the valve on the closing hydraulic line.
4. Observe the gauge between the valve and the BOP.
   a. If there is no pressure drop, end the test here.
   b. If there is a pressure drop, proceed to the following step to continue test.
5. Check for external leaks at the following locations:
   - Hinge pins
   - Cylinder head seal
   - Manifold pipe seal

I

For replacements and repairs, see Chapter 5, titled “Maintenance”.

6. Check for internal leaks past the pistons in the following manner:
   - Remove the opening hydraulic line. If the piston seals are leaking, fluid will flow from the opening line.
   - Open all valves and bleed the test pressure to 0 psi (0 bar).

Test to Determine Cause of Ram Leakage

1. Close the rams with 1,500 psi (103 bar) hydraulic closing pressure. This locks the rams closed.
2. Bleed the hydraulic closing pressure to 0 psi (0 bar).
3. Apply simulated wellbore pressure.
4. Use a mirror to obtain a reflected image of the rams.

Do not look into the ram bore while pressure is under the rams. If possible, use a mirror to observe the rams.

5. If the rams leak, check the ram rubbers and replace if worn. After repair, repeat test.
6. If the rams continue to leak after installing new rubbers, the ram blocks and/or the preventer's cavity are out of dimension. See the section titled "When to Replace the Cavity Seal Seat, Skid Plates, and Side Pads" on page 5-3.

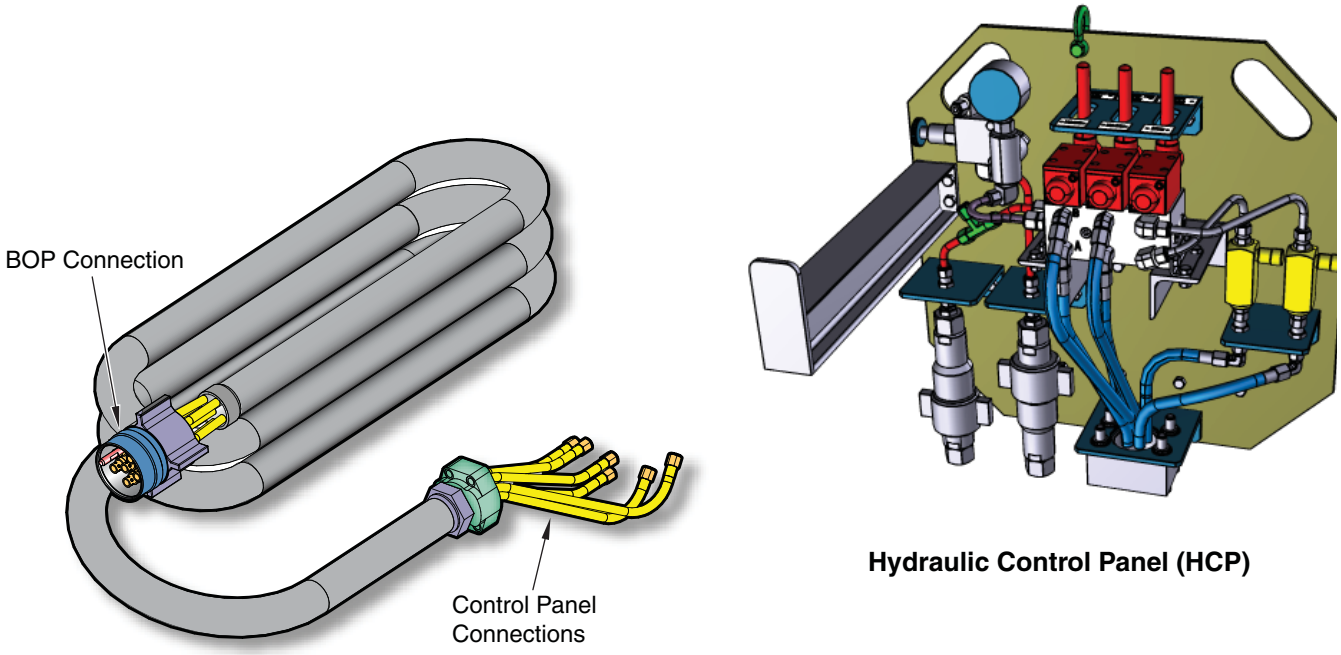
Test to Determine Whether 22" PosLock is Properly Adjusted

Before attempting any PosLock adjustments, verify that the ram rubbers are in good condition and that the preventer cavity dimensions are within specification. Then proceed as follows:

1. Close the 22" PosLock shear rams on an open hole using 1,500 psi (103 bar) hydraulic closing pressure.
2. Vent the hydraulic closing pressure to 0 psi (0 bar).
3. Pump 200 to 300 psi (14 to 21 bar) simulated wellbore pressure into the preventer.
4. Isolate simulated wellbore pressure to the preventer and observe the wellbore pressure gauge.
5. If the test pressure drops or cannot be reached, the PosLock mechanism will require adjustment (see the section titled "22" PosLock Adjustment" on page 5-94).
6. If there is no pressure drop, continue to pump, stopping at 500 psi (34.5 bar) increments to observe pressure gauge, until the rated working pressure of the preventer is reached.
7. If the rated working test pressure of the preventer is reached, the PosLock mechanism is properly adjusted and in working order.
8. If the ram rubbers are in good condition, the preventer cavity dimensions are within specification, and the wellbore pressure drops during the test, the PosLock mechanism will require adjustment (see the section titled "22" PosLock Adjustment" on page 5-94).

NXT Door Locking System and Door Hydraulic Control Panel

Except for a Lockrod Safety Latch (see Figure 4-7 on page 4-22) that must be manually released on each 22” door assembly before it can be opened, the door locking system (opening and closing of the BOP doors) is controlled with the BOP stack-mounted Hydraulic Control Panel (HCP) (see Figure 4-8 on page 4-23). The HCP is hydraulically powered by a rig-supplied hydraulic source. A hose bundle connects the HCP to each door being unlocked and opened (see Figure 4-6). Quick-connect fittings on the end of the hoses, for the lockrod drive hydraulic connections, and the quick-connect manifold assembly on the door facilitate this process. The quick-connect fittings are two different sizes and genders to prevent improper connections. The HCP can be positioned in one of several positions on the BOP Stack depending on which BOP ram door is being serviced (see Figure 4-9 on page 4-24).



Hose Bundle

Hydraulic Control Panel (HCP)

Figure 4-6. Manifold with 6-Hose Bundle

Door Operation Instructions

Opening and closing the 14” UltraLock doors and 22” PosLock doors requires the use of the HCP (see Figure 4-6). However, the upper and middle 22” doors with 22” PosLock operators do not have hydraulically operated anti-rotation bars, and do not use the “Anti-Rotation Bar” function on the HCP (see Figure 4-8 on page 4-23). The 22” doors use safety latches as an anti-rotation device, which must be manually operated (see Figure 4-7 on page 4-22).

The lower 14” doors with 14” UltraLock II (B) operators use all three functions on the HCP. The 22” doors with 22” PosLock operators only use the “LockBar” and “Door” functions on the HCP.

To open and close the preventer doors, proceed as follows:

1. Before attempting to unlock and open the BOP doors for servicing, verify the following:
   - There is 0 psi (0 bar) wellbore pressure.
   - The ram operators are in the Open position.
   - BOP control system pressure is 0 psi (0 bar) to the operating functions of the ram operators.
2. Position the HCP such that the hose bundle will reach the BOP doors to be serviced (see Figure 4-9 on page 4-24).

Be sure to turn off the hydraulic power source to the HCP and bleed hydraulic pressure to 0 psi (0 bar) before moving the hose bundle to the next door to be serviced.

3. On the 22” door assembly being serviced, connect the quick-disconnect fittings on the hose bundle adapter to the mating quick-disconnect fittings on the lockrod drive (see Figure 4-10 on page 4-24). The fittings are configured with two different sizes and genders to facilitate correct connection.
4. On the Lockrod Drive of the 22” door being serviced, remove the safety pin, and then rotate the safety latch from the Lock position to the Unlock position (freeing the lockrod) as shown in Figure 4-7 on page 4-22.
5. Verify rig hydraulic power source is capable of supplying SAE 20 (or equivalent) hydraulic fluid at approximately 3,000 psi (207 bar) and 5 gpm (18.9 lpm) to NAS Class 8 cleanliness.
6. Connect rig hydraulic power supply and return hoses to 1” quick-disconnect fittings on the HCP (see Figure 4-8 on page 4-23).
7. Turn on hydraulic power source.
8. Using the HCP hydraulic regulator, adjust hydraulic pressure to 3,000 psi (207 bar). Monitor pressure on gauge (see Figure 4-8 on page 4-23).

9. Check for hydraulic leaks. If any are found, stop, turn off hydraulic power source, and then repair the leak before resuming operation.

The 22” PosLock door assemblies may require adjustment of the HCP hydraulic regulator. DO NOT EXCEED 3,000 psi (207 bar).

10. Using the “Locking Bar” Lock/Unlock valve handle on the HCP, unlock the Locking Bar. This rotates the door lockrod to the Unlock position, freeing the door to open.
11. Once the lockrod is Unlocked, use the “Door” Close/Open valve handle on the HCP to open the door. Adjust HCP pressure reducing valve to 1,000 psi (69 bar).

The door should open with a slow, smooth action. The speed that the door opens and closes can be regulated by the “Adjustable Flow Control Valves” located on the HCP (see Figure 4-8 on page 4-23).

A properly adjusted door should rotate smoothly between 800 and 1,000 psi (55 and 69 bar).

Make sure the door seal is not damaged and is properly positioned before closing the door.

12. To close the 22” door assembly, reverse the preceding instructions. To prevent the door lockrods from rotating, manually move the safety latches into the Lock position, and install the safety pins (see Figure 4-7 on page 4-22).

Be sure to turn off the hydraulic power source to the HCP and bleed hydraulic pressure to 0 psi (0 bar) before moving the hose bundle to the next door to be serviced.

13. On the UltraLock 14” door assembly, remove the hose bundle adapter, and then connect the slip ring of the hose bundle to the door manifold assembly (see Figure 4-11 on page 4-25).

14. To open and close the UltraLock 14” door assembly, the procedure is as described for the PosLock and UltraLock operators on 22” doors, except in step 4 and step 12. In step 4 and step 12, the HCP “Anti-Rotation Bar” Lock/Unlock hydraulic function is used to lock (engage) and unlock (disengage) the door locking rods.
15. Before opening the UltraLock 14” door assembly, the “anti-rotation bar” valve handle must first be moved into the “Unlock” position (disengage lockbar) before the “Locking Bar” valve handle is placed in the “Unlock” position (rotate lockbar).
16. After closing the UltraLock 14” door assembly, the “Locking Bar” valve handle must first be moved into the “Lock” position (rotate lockbar) before the “anti-rotation bar” valve handle is placed in the “Lock” position (engage lockbar).

Warning

After closing and locking the 14” operator doors, the correct installation of the anti-rotation hinge pins should be checked. Failure to do so could cause equipment damage as well as serious injury or death. Refer to the section titled “14” Door Anti-Rotation Safety” on page 2-11 for additional information.

These operational instructions are repeated for each door that is opened and closed for servicing.

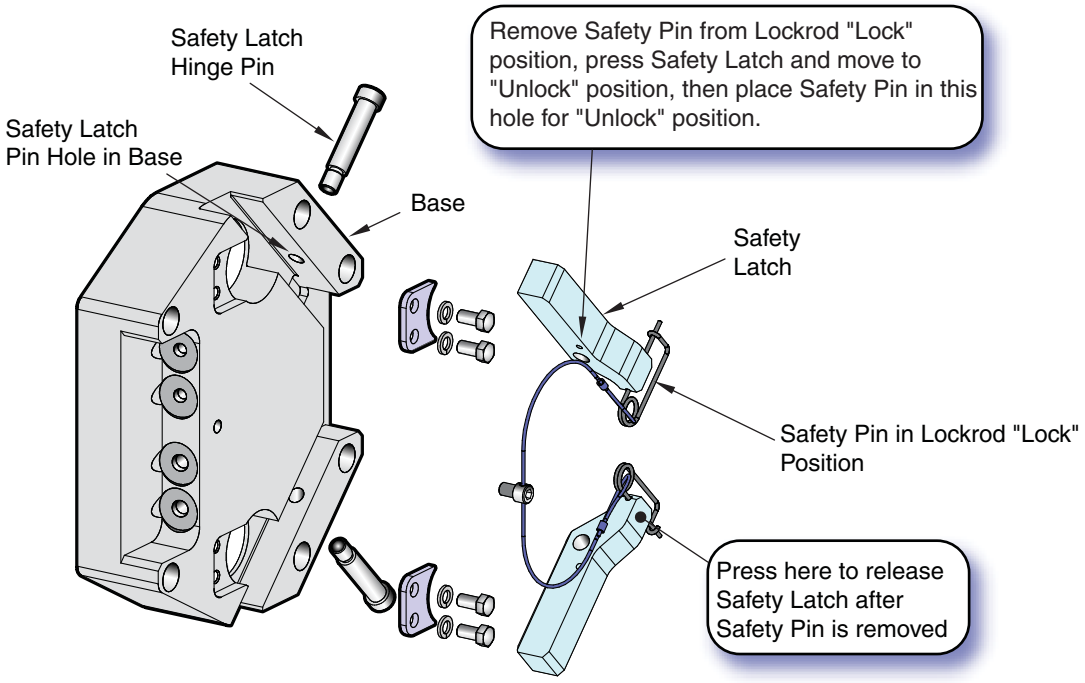


Figure 4-7. 22” Door Lockrod Safety Latches

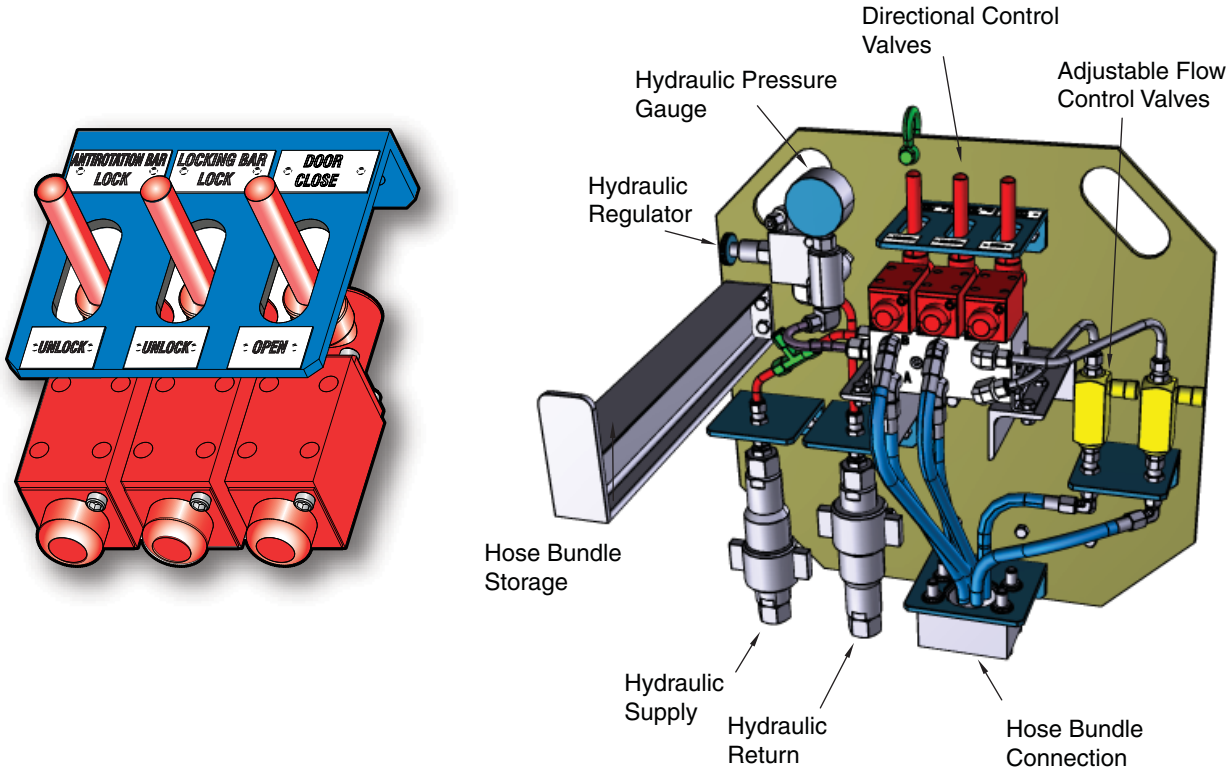


Figure 4-8. Hydraulic Control Panel (HCP)

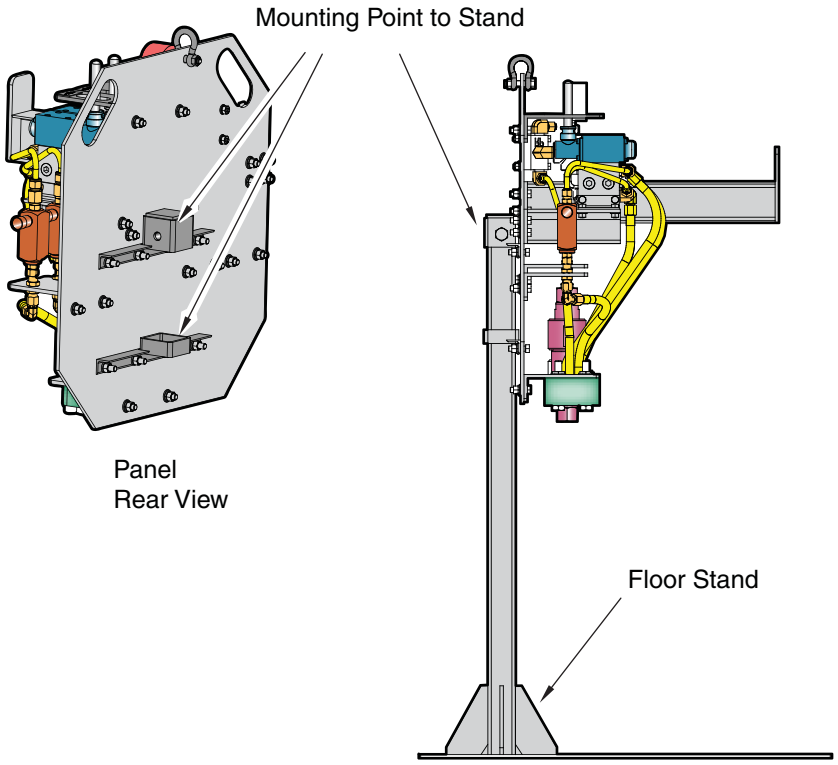


Figure 4-9. Door Control Panel Mounting Detail

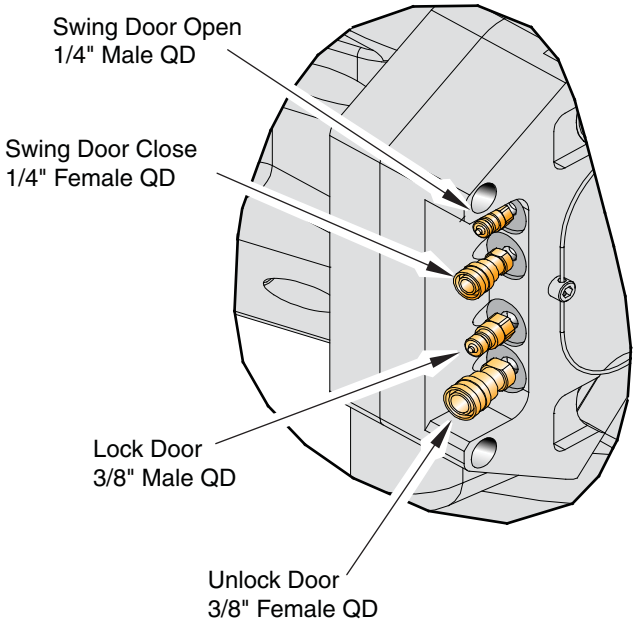


Figure 4-10. 22” Door Hose Bundle Connections

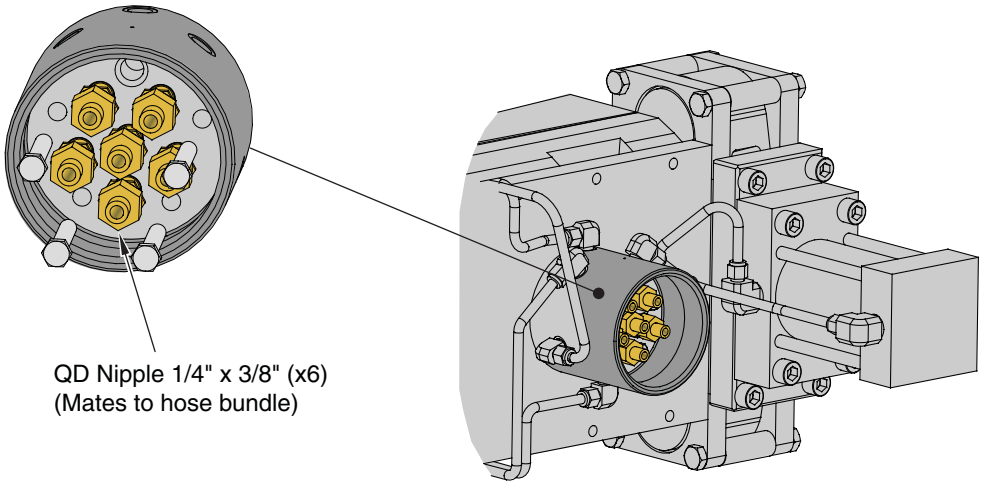


Figure 4-11. 14” Door Hose Bundle Connections

NXT Door Control Manifold Plug Assemblies (P/N 20072479 and 20072478)

Prior to deploying the BOP stack subsea, it is very important that the manifold plug assemblies (P/N 20072479 and 20072478) be installed in all NXT preventer door manifolds on the lower BOP stack (see Figure 4-12 and Figure 4-13 on page 4-26). Failure to heed this caution will allow seawater to contaminate the door operator hydraulic circuit and also may trap high pressure, making it extremely difficult to install the door opener control panel umbilical into the 18-15M NXT preventer door manifold.

The information in this section pertains to subsea environments only; the NXT door control manifold plug assemblies (P/N 20072479 and 20072478) are not required for land drilling operations.

Door manifold plug assemblies (P/N 20072479 and 20072478) are used to prevent hydrostatic head sea pressure from entering the NXT preventer door operating hydraulic

circuit. The manifold plug assemblies must remain permanently in the NXT preventer doors and are only removed when necessary to unlock and open the NXT doors. They are attached to the NXT preventer by a quick-release pin and lanyard, which prevents losing them overboard when not in use.

Door manifold plug assembly (P/N 20072479) is a six-function unit and is used to plug the NXT door manifold with UltraLock II (B) operators (see Figure 4-12). The location of the connector manifold is on the front of the UltraLock II (B) door.

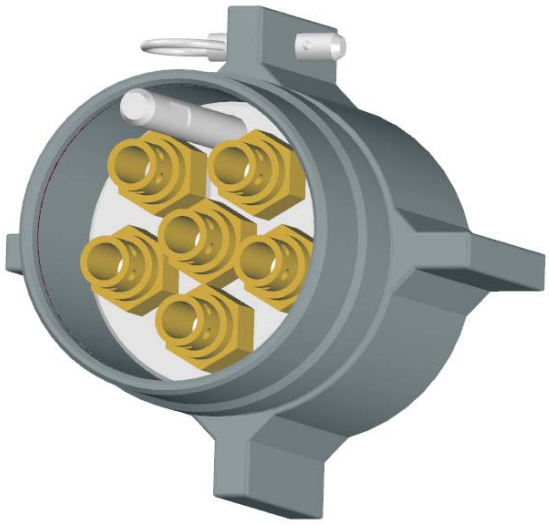


Figure 4-12. Six-Function Manifold Plug Assembly

Door manifold plug assembly (P/N 20072478) is a four-function unit and is used to plug the NXT door manifold with PosLock 22” operators (see Figure 4-13). The location of the connector manifold is on the body of the preventer.

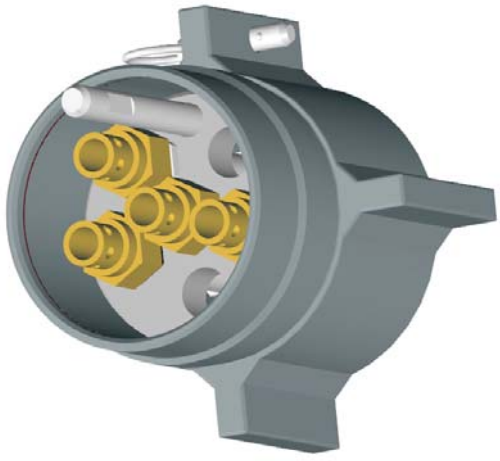


Figure 4-13. Four-Function Manifold Plug Assembly

Maintenance

Preventive Maintenance

Following a sound preventive maintenance program will ensure the NXT Ram BOP maintains its operational characteristics and reliability for many years.

See the table titled “Preventive Maintenance Schedule” for a list of recommended preventive maintenance procedures, which should be used as a quick reference to accompany the detailed procedures in this chapter.

Recommended frequencies are included in the table below; however, this schedule may be revised based upon how frequently the equipment is operated.

Preventive Maintenance Schedule

Interval *	Performed At	Performed By	Procedure
Between wells	Rig	Rig Personnel	• Clean and inspect BOP components. • Remove and inspect ram assemblies. • Grease door hinges. • Replace ram rubbers. • Perform wellbore test. • Perform hydraulic test. • See the section titled “Cleaning and Inspecting BOP Components” on page 5-2.
Daily	Rig	Rig Personnel	• Operate all rams. • Look for external hydraulic leaks. • See the section titled “Daily Preventive Maintenance” on page 5-10.
30 days	Rig	Rig Personnel	• Do not open the doors. Perform a field wellbore pressure test (surface only). • Look for external hydraulic leaks. • See the section titled “Monthly Preventive Maintenance” on page 5-10.
90 days	Rig	Rig Personnel	• Open doors and inspect visually. • Perform a field wellbore pressure test, an internal hydraulic pressure test, and a locking hydraulic pressure test. • See the section titled “Three-Month Preventive Maintenance” on page 5-11.

Preventive Maintenance Schedule (Continued)

Interval *	Performed At	Performed By	Procedure
12 months†	Rig	National Oilwell Varco	• Open doors. • Measure rams and ram cavity. Do field repairs, as needed. • Perform a field wellbore pressure test, an internal hydraulic pressure test, and a locking hydraulic pressure test. • See the section titled “Yearly Preventive Maintenance” on page 5-13. • Pressure-test UltraLock II (B) poppets. • Inspect locking system.
24 months	Rig	National Oilwell Varco	• Replace UltraLock II (B) lock segments (wedges) and lock rods as a set (4 each segments and 4 each rods).
36 months‡	National Oilwell Varco	National Oilwell Varco	• Completely disassemble. • Repair or replace all parts required to bring equipment to original specifications. • Replace all seals, including secondary flow valve. • Perform a field wellbore pressure test, an internal hydraulic pressure test, and a locking hydraulic pressure test. • See the section titled “Three-Year Maintenance” on page 5-13.

** These intervals are typical and serve as convenient designations to separate the simpler inspections from the more complex recommendations. (Local governmental agencies may mandate a more stringent maintenance schedule.)*

† Some rig operators use the yearly maintenance inspection as a rig acceptance test.

‡ The three-year maintenance will be performed only if the yearly inspection indicates the need for it.

Cleaning and Inspecting BOP Components

A general inspection of the NXT Ram BOP is essential to prevent possible failure due to damage or wear and will provide the rig operator with a current operational status of the equipment. Cleaning and inspecting the NXT Ram BOP between wells, as a regularly scheduled program, will ensure the equipment will be in operational condition when it is placed back into service on the next well.

When cleaning the bore, outlets, and all ram cavities, remove all foreign matter, especially cement and dried drilling mud. Care should be taken while cleaning all seal surfaces. High-pressure steam or water will adequately clean the surfaces in most cases.

1. Apply open hydraulic pressure to move ram assemblies into fully open position.

2. Prior to opening door assemblies, bleed hydraulic pressure to 0 psi (0 bar).
3. Unlock the door and swing it open. Ensure that door cartridge seal remains in position.
4. Remove the ram assemblies for inspection (see the section titled “Ram Assembly Removal and Inspection” on page 5-101).
5. Inspect the doors, body, rams, and other BOP major assemblies for physical damage and excessive wear.

Checking for Bore Wear

Look through the bore to inspect for excessive wear. The bore should not be worn more than $^{1}/_{8}$” (3.175 mm) oversize on any side (API requirement).

When to Replace the Cavity Seal Seat, Skid Plates, and Side Pads

Customers who have preventers with extensive service should contact their nearest National Oilwell Varco (NOV) representative for assistance in verifying that preventer cavities are within tolerance.

Cavity Dimension Data

BOP Model	BOP Size	Vertical Cavity Height*	Side Pad Width*
SL and SLX	13-10M; 18-10M	7.421” ± 0.003” (188.493 mm ± 0.076 mm); 8.921” ± 0.003” (226.593 mm ± 0.076 mm)	22.020” ± 0.008” (559.308 mm ± 0.023 mm); 28.770” ± 0.008” (730.758 mm ± 0.203 mm)
NXT SLX	18-5M/10M/15M; 18-5M/15M	8.177” ± 0.003” (207.696 mm ± 0.076 mm)	26.136” ± 0.010” (663.854 mm ± 0.254 mm)

**Dimensions given are without seal seats, skid plates, and side pads installed.*

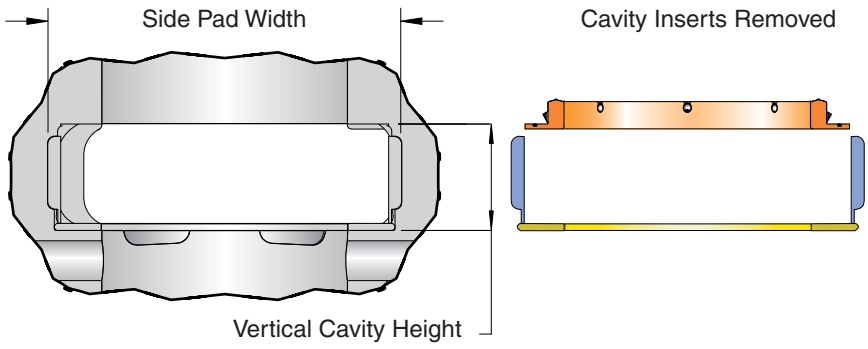


Figure 5-1. Vertical and Horizontal Cavity Dimensions

When a new or reconditioned preventer is received by the customer, it is recommended to record the vertical skid plate-to-seal seat cavity height dimension and the horizontal side pad-to-side pad dimension. This will establish a data base to compare the allowable wear limits shown in the table titled “BOP Cavity Nominal Limits — High Tolerance Values”.

Before measuring, verify that all bolts and set screws are torqued properly (see table titled “Torque Requirement — 18¾”–15M NXT Triple Ram BOP” on page 5-16).

BOP Cavity Nominal Limits — High Tolerance Values

BOP Size	Cavity Vertical Height	Cavity Horizontal Width
18¾–15M	7.268” (184.607 mm)	25.034” (635.864 mm)

BOP Cavity Wear Limits — Vertical (Skid Plate to Seal Seat)

Pipe Without Hang-off	Pipe With Hang-off	Multi-Ram Without Hang-off	Multi-Ram With Hang-off	All Shear Types	Comments
0.093” (2.4 mm)	0.063” (1.6 mm)	0.080” (2.0 mm)	0.035” (0.9 mm)	0.024” (0.6 mm)	Cavity wear high tolerance with new ram assemblies
0.115” (2.9 mm)	0.085” (2.2 mm)	0.092” (2.3 mm)	00.57” (1.4 mm)	0.069” (1.7 mm)	Total acceptable vertical clearance between any ram & cavity

BOP Cavity Nominal Limits — Horizontal (Side Pad to Side Pad)

Pipe & Multi-Ram	Shear	Comments
0.050” (1.3 mm)	0.025” (0.6 mm)	Cavity wear limit above high tolerance with new ram assemblies
0.089” (2.3 mm)	0.064” (1.6 mm)	Total acceptable horizontal clearance between any ram & cavity

Cavity Dimension Check Procedure

The following procedure is not recommended for use on preventers that have been in service for between a six-month to one year period or longer. It is recommended on these preventers that the skid plate, seal seat, and side pads be removed and the cavity area cleaned. Measure and record the vertical and horizontal cavity body dimensions (with side pads, seal seat, and skid removed), which should be sent to your nearest NOV representative for confirmation they are within tolerance.

The following procedure is recommended to establish data on a new or reconditioned preventer vertical skid plate to seal seat cavity height dimension and horizontal side pad to side pad dimensions.

1. Open the ram doors and remove the ram assemblies from the cavity.
2. Preferably high-pressure steam clean or use a high-pressure potable water hose to clean the inside of the BOP cavity.
3. Install four hydraulic jacks in the four corners of the cavity (see Figure 5-2). Use pieces of hard wood or other suitable material under the head of the jacks to prevent mechanical damage to the seat sealing surfaces.

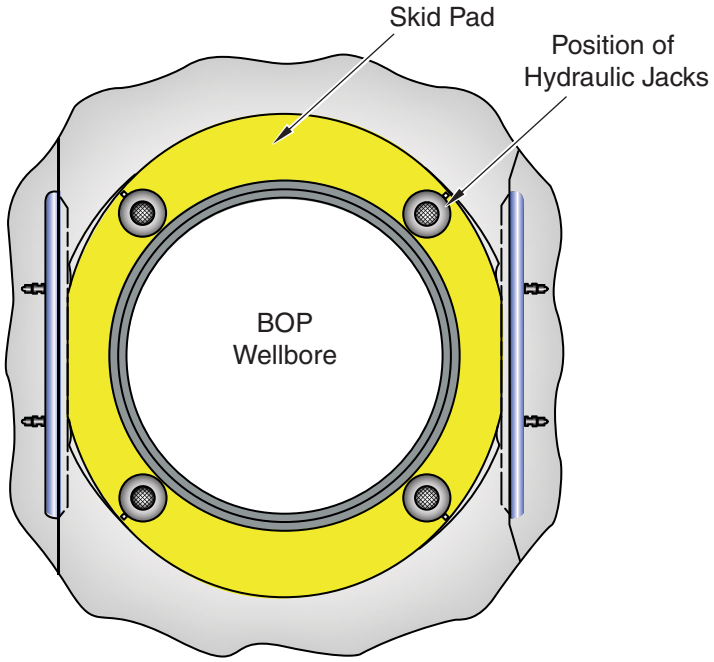


Figure 5-2. Location of Hydraulic Jacks on Skid Plate

4. Evenly apply 500 psi (34 bar) per jack on the top seal to compress the O-ring seal.

5. Measure and record the vertical skid plate-to-seal seat dimension in four places 90º apart.
6. Measure and record the horizontal side pad-to-side pad dimension in three places: at the ends and center of the side pads.
7. Remove the four hydraulic jacks
8. Repeat the above step for all cavities in the BOP stack.

After a 6-month to a year service, repeat the above procedures. If the cavity recorded dimensions are not within the BOP cavity nominal limits, follow the procedure below, see the section titled “Removing/Installing Replaceable Seal Seat Insert” on page 5-117, and see the section titled “Removing/Installing Side Pads and Skid Plate” on page 5-119.

1. If the cavity recorded dimensions are greater than the BOP cavity nominal limits and less than the BOP cavity wear limits, remove the side pads, skid plate, and seal seat.
2. Ensure surfaces are clean, and then measure the cavity height and width and compare to the cavity dimension data.
3. Record these values.
4. Reinstall side pads, skid plate, and seal seat.
5. Remeasure cavity height and width. Although jacking is not necessary, ensure bolts and set screws are properly torqued (see table titled “Torque Requirement — 18¾”–15M NXT Triple Ram BOP” on page 5-16).
6. Measure and record values. Compare to previous measurements and BOP cavity wear limits.
7. If these values are within BOP cavity wear limits, then the BOP is fit for service.
8. If the cavity recorded dimensions taken in step 1 are greater than the BOP cavity wear limits, or if the values from step 7 are greater than the BOP cavity wear limits, remove the skid plates, seal seat, and side pads.
9. Consult NOV representatives to determine whether new side pads, skid plate, and seal seat installation would result in a usable cavity.

When the preventer has seen extensive service, NOV Engineering recommends that the side pads, seat seal, and skid plates be removed, and the inside of the cavity be cleaned. Measure and record the vertical and horizontal cavity body dimensions (with side pads, seal seat, and skid removed), which should be sent to your nearest NOV representative for confirmation they are within tolerance.

Ram Seal Surfaces

1. Visually inspect the (ram) seal surfaces, located on the upper surface of the body cavity bore (ceiling of the ram cavity), for excessive wear or damage such as cracking or gouging.
2. Inspect the side skids for excessive wear or gouges.

Ram Shaft

1. Apply 200 psi (14 bar) closing hydraulic pressure to slowly extend the ram shaft for inspection.
2. Inspect the extended ram shaft for damage such as pits or scratches. If damage is observed, replace the ram shaft.

During this operation and under normal conditions, there should be no noticeable ratchet sound. If a ratchet sound or any metal-to-metal sound is heard, it is recommended that the cylinder operator assembly be opened and the unlock piston subassembly be removed for a full inspection.

3. UltraLock II (B) cylinders require no adjustment. However, perform PosLock adjustment test to verify PosLock function (see the section titled “Test to Determine Whether 22” PosLock is Properly Adjusted” on page 4-18).

Door Cartridge Seal

Inspect the door cartridge seal and mating seal surface on the BOP body for wear or pitting.

Major repair of these seal surfaces can only be made in a qualified service center, due to the nature of the surface finish and flatness. Refer this work to an authorized National Oilwell Varco service center.

See the section titled “Correspondence” on page 6-1 for contact information.

Checking UltraLock II (B) Settings

Position the rams in the Open position, and then bleed all hydraulic pressure to 0 psi (0 bar) before removing the pipe plug from the cylinder head.

1. After bleeding all hydraulic pressure to 0 psi (0 bar), remove the ¾" pipe plug on the end of the cylinder head (see Figure 5-3).

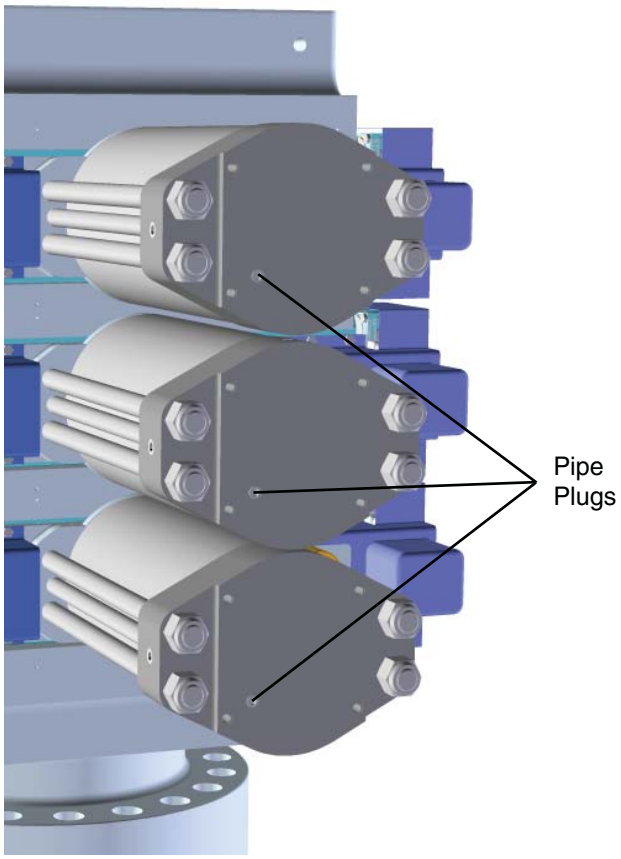


Figure 5-3. Pipe Plug on Cylinder Head

2. With the pipe plug removed, there will either be a plate covering the hole at a depth of 2" to 3" (5 to 7.6 mm), or the hole will be open:
   - If the hole is covered, the UltraLock II (B) is set correctly.
   - If the hole is open, the UltraLock II (B) must be disassembled and reset (see the section titled "UltraLock II (B) Operator Locking System Repair" on page 5-63).

NXT Ram BOP Cleaning and Lubricating Instructions

Part	How to Clean	Lubricants
1. NXT exterior	Steam, high-pressure water **WARNING** **Diesel fuel is a flammable liquid. It will cause rubber goods to swell and deteriorate.**	N/A
2. NXT interior	Flush with steam, high-pressure water	Commercially available EP/2 grease.
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 (see **WARNING** above)	Commercially available EP/2 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	Commercially available EP/2 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.
13. Door lockbar groove	Emery cloth	Sweeney 503 moly paste (P/N 7403582)

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

*** Use grease only for storage.*

Daily Preventive Maintenance

The following should be performed daily for surface BOP applications and prior to any subsea deployment:

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.

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

2. Check the 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.

Monthly Preventive Maintenance

The following should be performed before starting a new well for both subsea and surface applications and at least monthly while drilling on surface applications:

1. Run a field wellbore pressure test and look for external hydraulic leaks. See the section titled “Field Wellbore Pressure Test” on page 4-12.
2. Make sure the bolts on the locking assembly are tight.

Three-Month Preventive Maintenance

The following should be performed every 90 days:

The ram BOP uses two hydraulic systems; a water-based hydraulic fluid system to open/close the rams and a petroleum-based hydraulic fluid system to lock/unlock the lockrod and open/close the ram BOP doors. The rams should be fully opened (retracted) before trying to open the BOP doors; otherwise, damage to the ram shaft, ram holder blocks and body-to-door sealing surface will result. Water-based and petroleum-based fluid systems should not be interchanged or substituted with one another.

1. Before opening the doors, run the following tests:
   - Field wellbore pressure test (see the section titled “Field Wellbore Pressure Test” on page 4-12)
   - Hydraulic pressure test (see the section titled “Hydraulic Pressure Test” on page 4-16)
   - PosLock adjustment test (see the section titled “Test to Determine Whether 22” PosLock is Properly Adjusted” on page 4-18)

Test results will be very helpful during this inspection. Also, National Oilwell Varco service representatives can be called at this time if hydraulic system repairs are required.

2. Open the rams with 1,500 psi (103 bar).
3. Bleed all hydraulic pressure to 0 psi (0 bar).
4. Open the doors and remove the rams for cleaning and inspection (see the section titled “Ram Assembly Removal and Inspection” on page 5-101).

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

5. Clean and inspect the rams.
6. Wash out the inside of the BOP so that it can be inspected (see the table titled “NXT Ram BOP Cleaning and Lubricating Instructions” on page 5-9).

7. Check lockrods and lock bars for damage. For minor scratches, buff to remove raised areas. Lubricate locking grooves and bars using grease.
8. Remove minor pits and scratches from the BOP cavity seat-sealing surface with an emery cloth.
9. 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.
10. Check bore for accidental damage. Smooth as required. Occasionally, the drill pipe will rotate against the bore and cause excessive wear. Measure maximum diameter and estimate maximum wear on any side. If any radius is more than $^{1}/_{8}$" (3.17 mm) oversize, contact National Oilwell Varco.
11. Check the door sealing area on the BOP body for pits and scratches. Remove pits and scratches with an emery cloth (see the table titled "NXT Ram BOP Cleaning and Lubricating Instructions" on page 5-9).
12. Inspect the ram shafts (see the section titled "Ram Shaft" on page 5-7).
    - Slowly apply 200 psi (14 bar) closing hydraulic pressure to fully extend both ram shafts for inspection.

The doors must be open. If they are not fully open, the ram shaft and holder can be damaged. However, do not open more than one door at a time if the BOP is not flanged to a wellhead or securely fastened. The weight of two open doors can tip over the BOP.

    - Visually check the OD of each ram shaft for pits and scratches. The ram shafts should be replaced by a National Oilwell Varco service representative if pits or scratches are visible.
    - Visually check ram foot of each ram shaft for cracks. The ram foot should be replaced if any are visible.
13. Remove the door seal cartridges and inspect the door seal grooves (see the section titled "Replacing Door Cartridge Seal Assembly" on page 5-18). Reinstall the cartridges.
14. Reinstall the rams (see the section titled "Ram Assembly Removal and Inspection" on page 5-101).
15. Clean and oil the door and the sealing surfaces on the body using SAE-10W oil.

Do not use grease on the door face or sealing surface.

16. Close and lock the doors, making sure the safety latches are in place.

17. Run a final field wellbore pressure test before the BOP is returned to service (see the section titled “Field Wellbore Pressure Test” on page 4-12).

Yearly Preventive Maintenance

Yearly maintenance is performed by a National Oilwell Varco service representative. The purpose of this procedure is to evaluate wear in the BOP so that major overhaul (three-year maintenance) can be scheduled, at a convenient time, before a failure occurs.

Yearly maintenance includes:

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

Three-Year Maintenance

Three-year maintenance is performed at a National Oilwell Varco repair facility after a yearly maintenance check determines it is necessary. The three-year maintenance procedure includes the following:

- BOP is completely disassembled, cleaned, and inspected.
- All elastomer seals are replaced.
- All parts are repaired or replaced, as required.
- Field wellbore and hydraulic pressure tests are run.
- PosLock system is adjusted.
- BOP is returned to service.

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

Troubleshooting

Observe all safety precautions outlined in the section titled “General System Safety Practices” on page 1-3 prior to attempting any maintenance procedures. Pay particular attention to the safety precautions. Compliance with warnings, cautions, and notes will protect equipment from damage and personnel from injury.

Many BOP failures are the result of malfunctions in the hydraulic lines. Each of the many functions built into the BOP assembly is controlled by two or more hydraulic lines, which, due to system use, may leak system pressure. Vibration is the primary cause of leakage. However, the majority of the hydraulic lines on the BOP assembly are flexible hoses, which are less susceptible to normal vibration.

Begin troubleshooting the BOP by eliminating any hydraulic malfunctions that may be present in the surface control equipment. If a BOP function does not operate, it may be the control equipment and not the BOP function that needs repair. Refer to the *Hydraulic Power Unit/Mixing System User’s Manual*.

If the system power and surface control equipment are functioning correctly, check the BOP and hydraulic lines. When the trouble has been isolated to a particular hydraulic circuit on the BOP, refer to the appropriate hydraulic schematic to isolate the malfunction either to equipment or a hydraulic line problem (see the table titled “Troubleshooting – NXT PosLock BOP” on page 5-15).

Troubleshooting – NXT PosLock 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 skids. Inside the BOP, the side outlets are below the rams (see the section titled “Installing” on page 3-2).
	Bad ram rubbers	Check ram rubbers and replace if necessary (see the section titled “Ram Assembly Removal and Inspection” on page 5-101).
	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 5-11).
	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 5-62, and Figure 5-52 on page 5-63). **Not recommended if BOP is used subsea*
	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 5-10 and the section titled “Replacing Door Cartridge Seal Assembly” on page 5-18).
	Pump leaking in the test unit	Install an 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 an NOV 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 an NOV 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”.

Corrective Maintenance

Perform the following procedures to repair NXT Ram BOP components. For required bolt torque, see the table titled “Torque Requirement — 18¾”–15M NXT Triple Ram BOP”.

The following table provides the proper torque values and wrench sizes for the maintenance of the 18¾-15M NXT Ram BOP. To find the proper torque and wrench size, see the engineering drawings located in Chapter 6, titled “Specifications and Parts Lists”. Locate the required drawing and bill of material for the equipment being maintained. Look in the drawing for the item number and locate the part number from the bill of materials. In the following table titled “Torque Requirement — 18¾”–15M NXT Triple Ram BOP”, locate the bolt size and verify the part number. When they match, the wrench size and torque value are indicated on the right.

Torque Requirement — 18¾”–15M NXT Triple Ram BOP

**All torque values are based upon the use of Sweeney 503 Moly Paste thread lubricant (friction factor = 0.067) (P/N 7403582).*

Fastener P/N	Description	Wrench Size	*Torque	*Torque
8002824	¼”-20UNC Socket Head Cap Screw	3/16” Hex	5 ft-lb	7 Nm
207182	3/8”-16UNC Hex Head Cap Screw	9/16”	18 ft-lb	24 Nm
20008072	3/8”-16UNC Soc. Hd. Dog Point Screw	5/16” Hex	18 ft-lb	24 Nm
20029188	3/8”-16UNC Socket Head Cap Screw	5/16” Hex	18 ft-lb	24 Nm
8002881	7/16”-14UNC Socket Head Cap Screw	3/8” Hex	28 ft-lb	38 Nm
010608	½”-13UNC Socket Head Cap Screw	3/8” Hex	34 ft-lb	81Nm
011402	½”-13UNC Socket Head Cap Screw	3/8” Hex	22 ft-lb	30 Nm
012708	½”-13UNC Set Screw	3/8” Hex	34 ft-lb	46 Nm
012747	½”-13UNC Socket Head Cap Screw	3/8” Hex	34 ft-lb	46 Nm
011409	½”-13UNC Hex Head Cap Screw	¾”	34 ft-lb	46 Nm
011410	½”-13UNC Hex Head Cap Screw	¾”	34 ft-lb	46 Nm
011129	½”-13UNC Hex Head Cap Screw	¾”	34 ft-lb	46 Nm
207148	½”-13UNC Hex Head Cap Screw	¾”	30 ft-lb	46 Nm
7401069	½”-13UNC Socket Head Cap Screw	½” Hex	44 ft-lb	60 Nm
8049095	5/8”-13UNF Socket Head Cap Screw	½” Hex	88 ft-lb	119 Nm
20005290	5/8”-13UNF Socket Head Cap Screw	½” Hex	88 ft-lb	119 Nm
8003325	5/8”-11UNC Socket Head Cap Screw	½” Hex	75 ft-lb	102 Nm
8002918	5/8”-11UNC Socket Head Cap Screw	½” Hex	77 ft-lb	104 Nm
010614	5/8”-11UNC Socket Head Cap Screw	½” Hex	88 ft-lb	119 Nm
8020285	5/8”-11UNC Jam Nut	15/16”	88 ft-lb	119 Nm

Torque Requirement — 18¾"–15M NXT Triple Ram BOP (Continued)

**All torque values are based upon the use of Sweeney 503 Moly Paste thread lubricant (friction factor = 0.067) (P/N 7403582).*

Fastener P/N	Description	Wrench Size	*Torque	*Torque
20006460	5/8"-11UNC Socket Head Cap Screw	½" Hex	88 ft-lb	119 Nm
20006462	5/8"-11UNC Socket Head Cap Screw	½" Hex	88 ft-lb	119 Nm
20006459	5/8"-11UNC Socket Head Cap Screw	½" Hex	88 ft-lb	119 Nm
20006463	5/8"-11UNC Socket Head Cap Screw	½" Hex	88 ft-lb	119 Nm
20006465	5/8"-11UNC Hex Head Cap Screw	15/16"	88 ft-lb	119 Nm
20017096	5/8"-Shoulder Screw	½" Hex	88 ft-lb	119 Nm
010733	¾"-10UNC Socket Head Cap Screw	5/8" Hex	110 ft-lb	149 Nm
012655	¾"-10UNC Socket Head Cap Screw	5/8" Hex	110 ft-lb	149 Nm
012656	¾"-10UNC Socket Head Cap Screw	5/8"Hex	110 ft-lb	149 Nm
20006461	¾"-10UNC Socket Head Cap Screw	5/8" Hex	110 ft-lb	149 Nm
20006464	¾"-10UNC Shoulder Screw	5/8" Hex	110 ft-lb	149 Nm
8003349	¾"-10UNC Socket Head Cap Screw	5/8" Hex	110 ft-lb	149 Nm
020003	1"-8UNC Hex Nut	1½"	270 ft-lb	366 Nm
011401	1"-8UNC Socket Head Cap Screw	¾" Hex	280 ft-lb	380 Nm
010004	1"-8UNC Socket Head Set Screw	¾" Hex	270 ft-lb	366 Nm
010762	1"-8UNC Socket Head Cap Screw	¾" Hex	355 ft-lb	481 Nm
8003387	1"-8UNC Socket Head Cap Screw	¾" Hex	355 ft-lb	481 Nm
8003389	1"-8UNC Socket Head Cap Screw	¾" Hex	355 ft-lb	481 Nm
168114	1 1/8"-12UNF Adjustment Screw	7/8"	380 ft-lb	515 Nm
168115	1 1/8"-12UNF Jam Nut	1 11/16"	3801 ft-lb	515 Nm
20018415	1¼"-12UNF Socket Head Cap Screw	7/8" Hex	500 ft-lb	678 Nm
020105	1 3/8"-8UNC Hex Lock Nut	2¾"	700 ft-lb	949 Nm
011346	1½"-6UNC Socket Head Cap Screw	1" Hex	850 ft-lb	1,152 Nm
020109	1 7/8"-10UNC Hex Nut	2 13/16"	†2,200 ft-lb	†2,983 Nm
020111	2¼"-8UNC Hex Nut	3 3/8"	†4,500 ft-lb	†6,101 Nm
20016735	Anti-Rotation Bolt	2¾"	269 ft-lb	365 Nm
020035	3"-8UNC Hex Nut	4½"	7,479 ft-lb	10,140 Nm
20019069	3"-8UNC Hex Jam Nut	4½"	1,500 ft-lb	2,033 Nm

† Torque values are for use on special high-yield bolting requirement.

It is critical when considering a substitute lubricant to take into account the compressive resistance of the lubricant as well as its friction factor. NOV recommends the use of Sweeney Moly Paste 503 lubricant because of its excellent compressive resistance. Failure to heed this caution and use lubricants with poor compressive resistance may cause galling of threads and high breakout torque.

The torque values in the table titled “Torque Requirement — 18¾”–15M NXT Triple Ram BOP” on page 5-16 are formulated assuming the thread lubricant is Sweeney Moly Paste 503 (P/N 7403582). Other available lubricants are as follows:

- Select-A-Torque 503 Moly Paste
- Felpro Moly Paste (formerly, Felpro C-670)

Replacing Door Cartridge Seal Assembly

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

Removal — Door Cartridge Seal Assembly

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 (see the section titled “Three-Month Preventive Maintenance” on page 5-11).
2. Remove the door cartridge seal from its seat (see Figure 5-4 on page 5-19). With a large screwdriver, use the two slots in the cartridge to pry the assembly from the door.

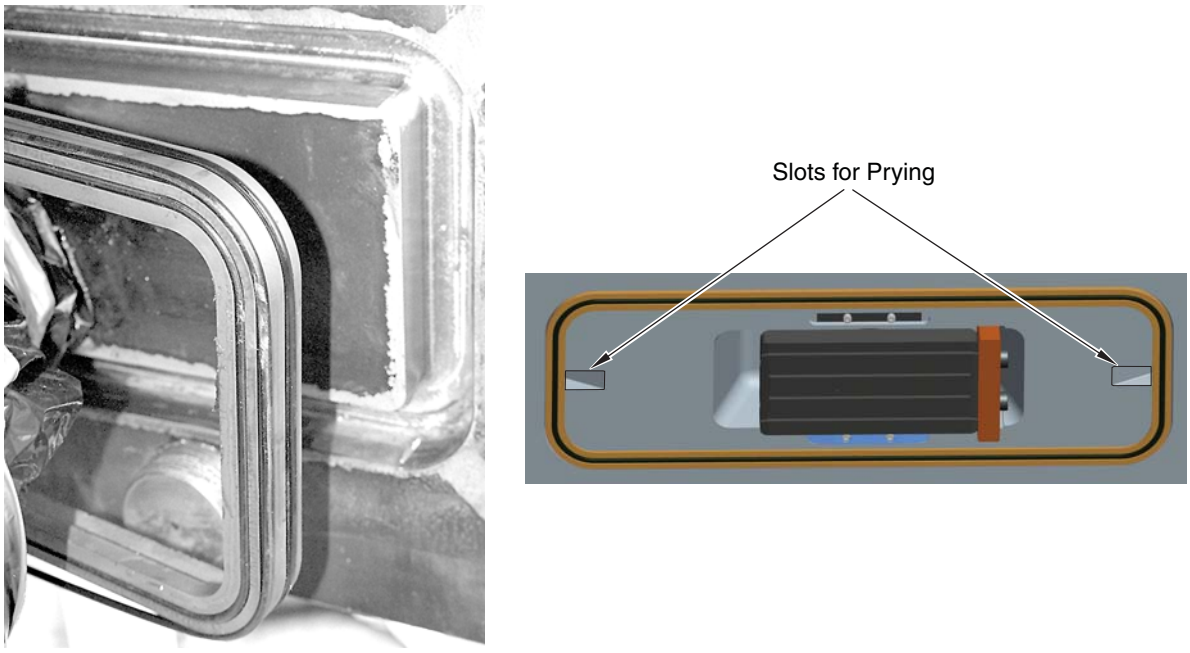


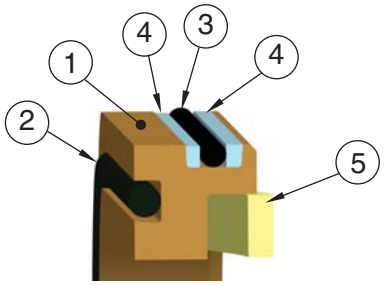
Figure 5-4. Remove Door Cartridge Seal

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 National Oilwell Varco service representative.
4. Clean and lightly oil the door-sealing surface on the body.

Installing — Door Cartridge Seal Assembly

Numbers in parentheses correspond to the callouts in Figure 5-5 on page 5-20 and the item numbers in the table titled “Parts List — Door Cartridge Seal Assembly” on page 5-20.

1. Lightly oil all O-ring grooves and sealing surfaces.
2. Install the radial O-ring (3) into the radial seal groove.



SECTION A-A
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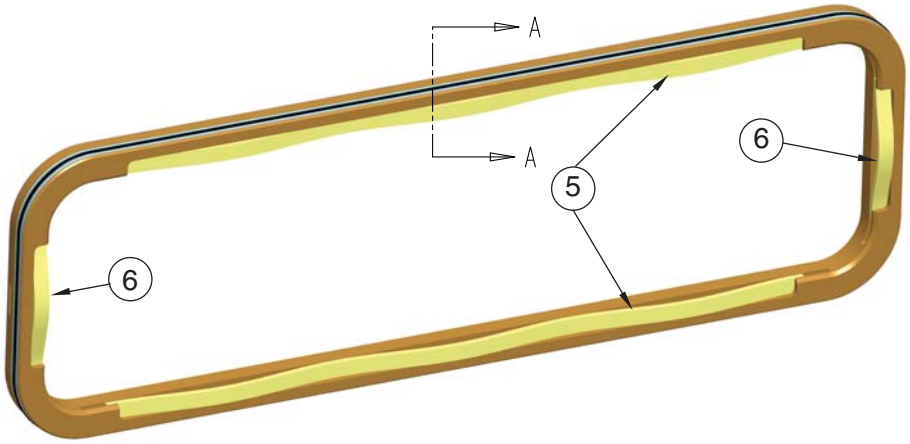


Figure 5-5. Install Radial O-Ring into Groove Cartridge Seal Assembly

Parts List — Door Cartridge Seal Assembly

Item No.	Qty	Part No.	Description
1	1	168052	Door Cartridge
2	1	030998	O-Ring
3	1	030997	O-Ring (Radial)
4	2	030946	Back-up Ring
5	2	168192	Wave Spring
6	2	168195	Wave Spring

3. Install back-up rings (4) on either side of the radial O-ring (3).

4. Install the O-ring (2) into its groove.

A small amount of grease may be applied to each corner to hold the O-ring in place.

5. Install the wave springs (5, 6) into the recess area of the cartridge assembly.

Installing Cartridge into Door

1. Insert the four springs into the cartridge assembly.
2. Insert the cartridge into the door groove. If the lower seal run is assembled in the vertical position, make sure it does not become trapped or twisted.
3. Using a rubber mallet, tap the seal assembly into the door groove until it is firmly seated.

Do not damage the backup ring while installing the seal assembly into the door groove.

4. Install the face seal O-ring into face seal groove.
5. The door seal cartridge is installed in the door.

Door Removal

Damage may occur during door removal from preventers equipped with hinge and hinge tee assemblies. Failure to heed this caution could result in damage to hinge tee threads and leveler boss due to the impact of the hinge boss of the door.

The following procedure is recommended when it is necessary to remove the UltraLock II (B) doors and 22” PosLock doors from the body of the preventer.

The preferred method of door removal is to leave the hinge assembly attached to the preventer body and remove the door, hinge tee, and leveler as one attached unit, as shown in Figure 5-6 on page 5-22. Once the door is moved to a safe area, the hinge tee may then be removed.

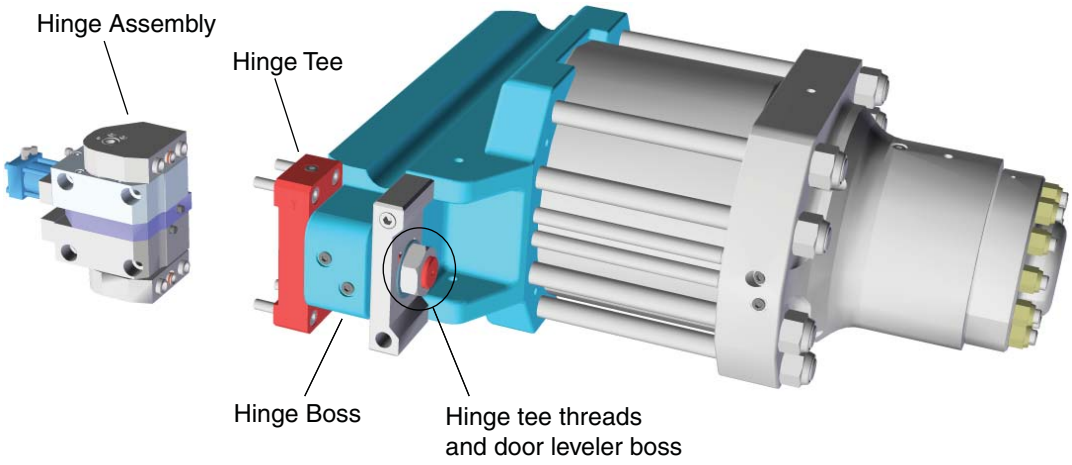


Figure 5-6. Door and Hinge Assembly

Prior to removing the hinge tee from the door, wrap the hinge tee threads and door leveler boss with multiple layers of duct tape. Protect the threads and tee sealing surfaces by wrapping duct tape around square corners and threads.

Corrective Maintenance of NXT Door Locking System

Before attempting any corrective maintenance, see the section titled “XT™ Boltless Door Locking System” on page 2-7 to understand how the system works.

See the various assembly drawings and documents in Chapter 6, titled “Specifications and Parts Lists” during corrective maintenance of the BOP systems.

The corrective maintenance section consists of assembly and disassembly instructions for the lockrod drives, door assemblies, and rotation assemblies, plus general troubleshooting and service instructions for the NXT door control panel.

Consult with the supplier’s service department regarding variations to the order, necessity, or interpretation of these corrective maintenance or service instructions.

Corrective Maintenance of Powered Door Hinge Assembly

To replace the NXT door hinge assembly, refer to Figure 5-7 or engineering drawing D-168023. See the table titled “Torque Requirement — 18¾”–15M NXT Triple Ram BOP” on page 5-16 for bolt torque values.

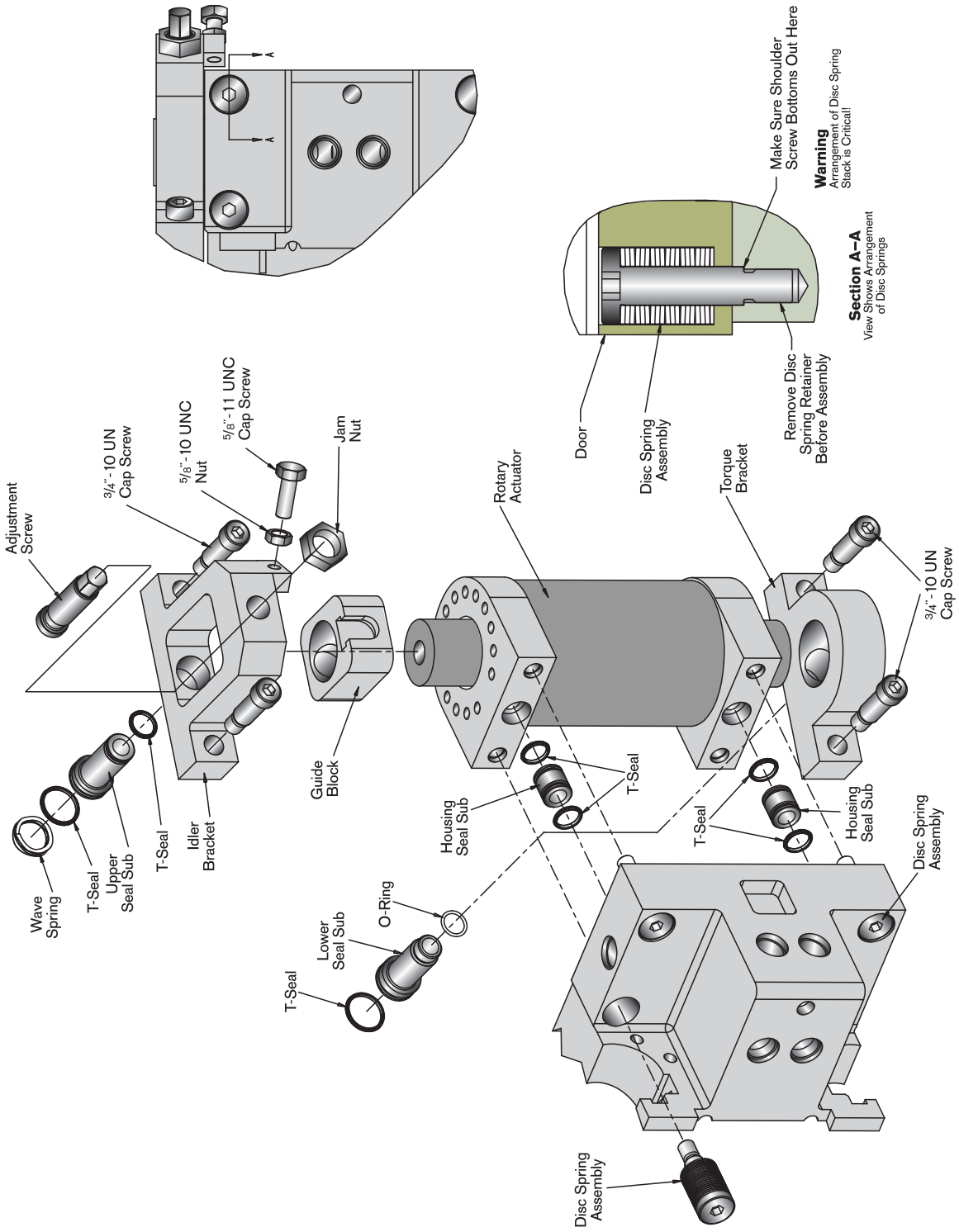


Figure 5-7. NXT Door Hinge Assembly

Disassembly — NXT Door Hinge Assembly

1. Remove all tubing from the rotary actuator.
2. Remove the two $^{5}/_{8}$"-11NC cap screws from the locking rod holder. Remove the locking rod holder.
3. Remove the anti-rotation bar.

Secure the rotary actuator with lifting/moving straps prior to removing the actuator (see Figure 5-8).

Figure 5-8. Lifting the Rotating Actuator

4. Remove the four ¾"-10UN shoulder screws holding the rotary actuator bracket to the body.
5. Remove the four disc spring assemblies holding the rotary actuator to the door.

Keep the disc springs in the correct order (see engineering drawing B-168085 for correct order).

6. Remove the housing seal subs from the doors. Replace the T-seals if damaged.

7. Before removing torque bracket, mark the shaft and bracket for reassembly alignment (see Figure 5-9).

Figure 5-9. Torque Bracket and Shaft Alignment

8. Remove jam nut (see Figure 5-10).

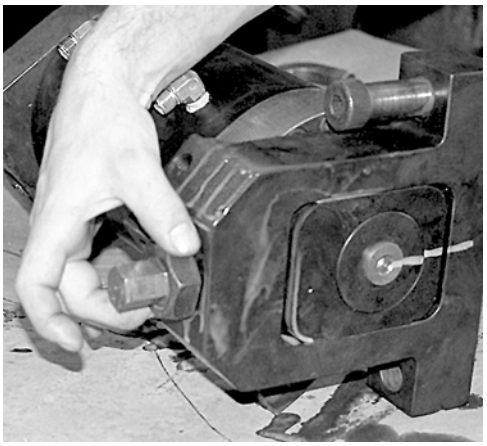


Figure 5-10. Removal of Jam Nut

9. Unscrew the lower seal sub from the torque bracket. Replace the O-ring and T-seal if damaged (see Figure 5-11).

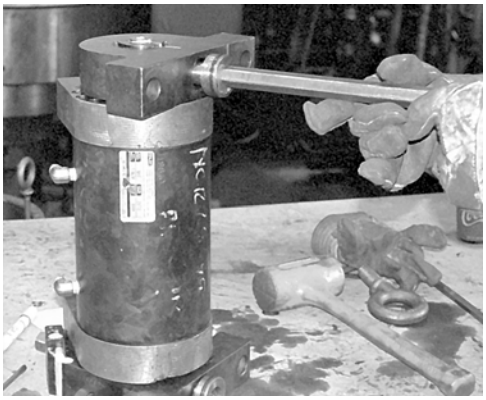


Figure 5-11. Removal of Lower Seal Sub

10. Remove the rotary actuator torque bracket (see Figure 5-12).

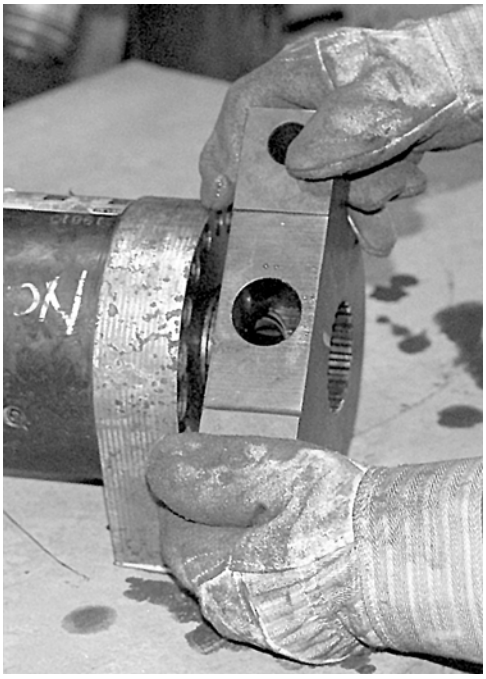


Figure 5-12. Removal of Rotary Actuator Torque Bracket

11. Pry the upper seal sub out of the idler bracket using a couple of screwdrivers (see Figure 5-13). Do not damage the T-seal. Replace the T-seals and wave spring if damaged.

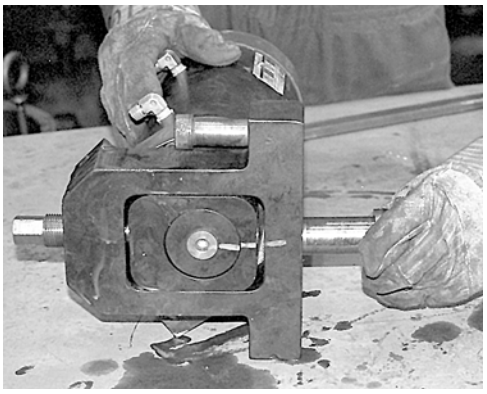


Figure 5-13. Removal of Upper Seal Sub

12. Remove the rotary actuator idler bracket (see Figure 5-14).

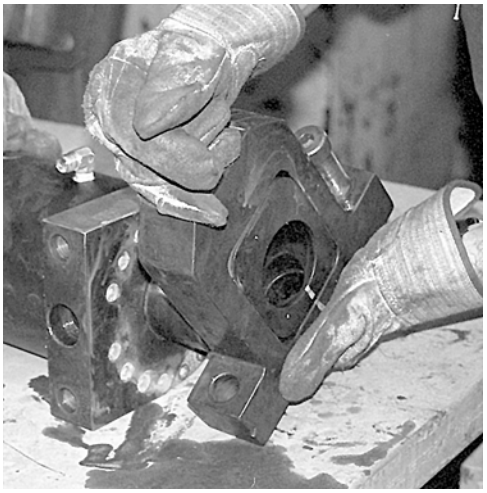


Figure 5-14. Removal of Rotary Actuator Idler Bracket

13. Remove the guide block from the idler bracket and remove adjustment screw (see Figure 5-15).

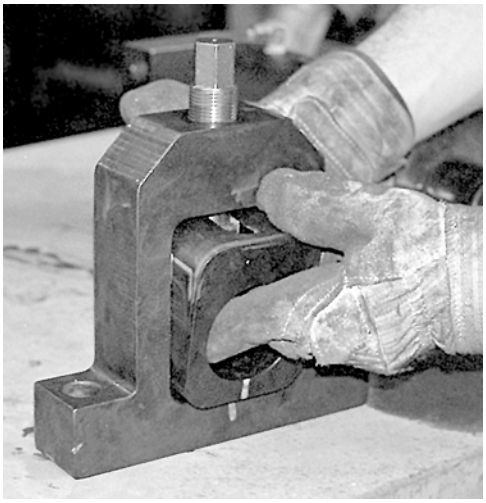


Figure 5-15. Removal of Guide Block from Idler Bracket

Reassembly — NXT Door Hinge Assembly

1. Replace the adjustment screw in the idler bracket.
2. Insert the guide block into the idler bracket (see Figure 5-15).
3. Install the upper bracket onto the rotary actuator (see Figure 5-16).

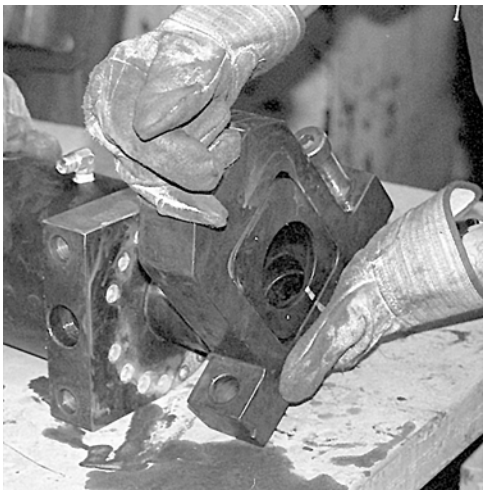


Figure 5-16. Installation of Idler Bracket onto Rotary Actuator

4. Align the actuator, guide block, and bracket (see Figure 5-17).

Figure 5-17. Alignment of Rotary Actuator, Guide Block, and Bracket

5. Insert the upper seal sub into the idler bracket. Use a rubber mallet to install the seal sub (see Figure 5-18).

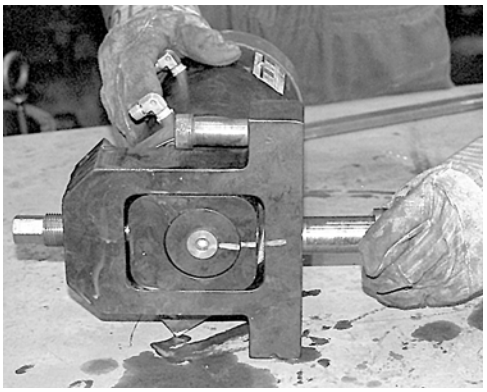


Figure 5-18. Insertion of Upper Seal Sub into Idler Bracket

6. Install the torque bracket onto the rotary actuator (see Figure 5-19).

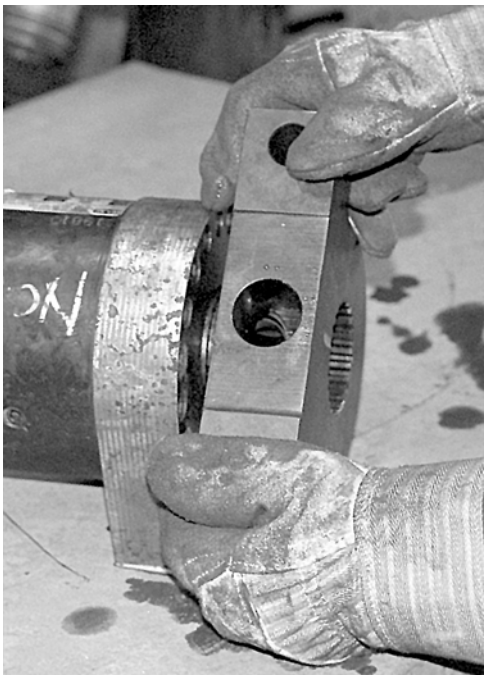


Figure 5-19. Installation of Torque Bracket onto Rotary Actuator

7. Screw the lower seal sub into the torque bracket (see Figure 5-20).

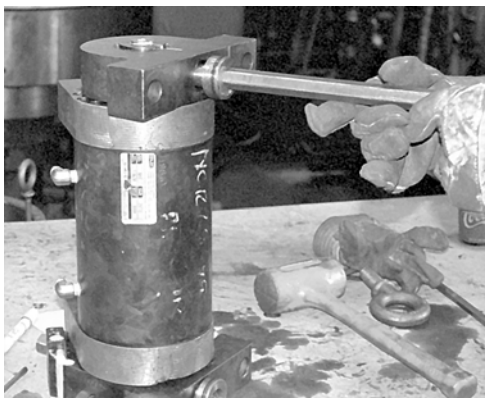


Figure 5-20. Installation of Lower Seal Sub onto Torque Bracket

8. Install the jam nut onto the adjustment screw (see Figure 5-21).

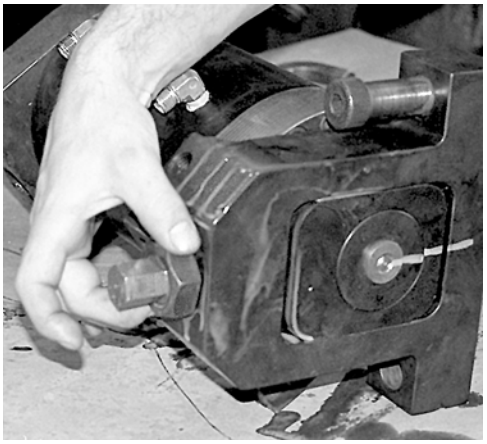


Figure 5-21. Installation of Jam Nut

9. Install the housing seal sub into the door (see Figure 5-22).

Do not cut or nick the T-seal when installing the seal subs.

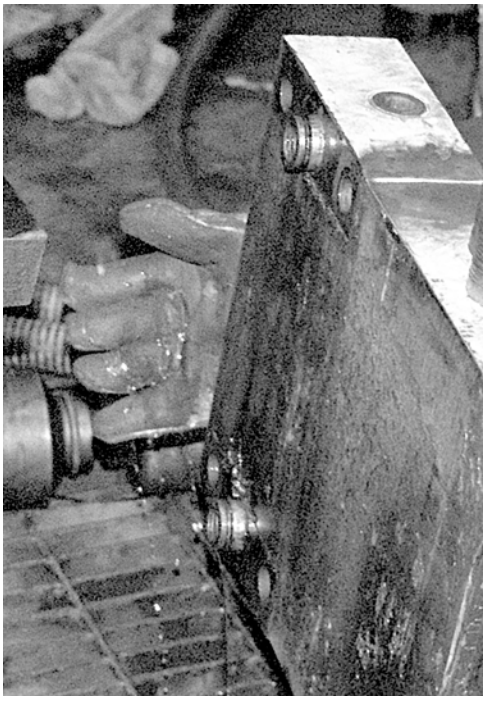


Figure 5-22. Install of Housing Seal Sub into Door

10. Install the rotary actuator assembly onto the door with four disc spring assemblies. Tighten until they bottom out.

Grease the shaft of the disc spring assembly with molybdenum disulfide grease.

11. Mount the rotary actuator assembly to the body with the four ¾”-10UN shoulder screws.
12. Install the anti-rotation bar.
13. Install the locking rod holder with two $^{5}/_{8}$”-11NC cap screws.
14. Install tubing to the rotary actuator assembly.
15. To adjust the doors, loosen the jam nut on the adjustment screw located at the top of the rotary actuator assembly. Turn the screw until the door is aligned to close properly (see Figure 5-23).

The clearance at the top of the door on the non-hinge side should be equal to the clearance at the bottom of the door on the hinge side (see Figure 5-24 on page 5-33).

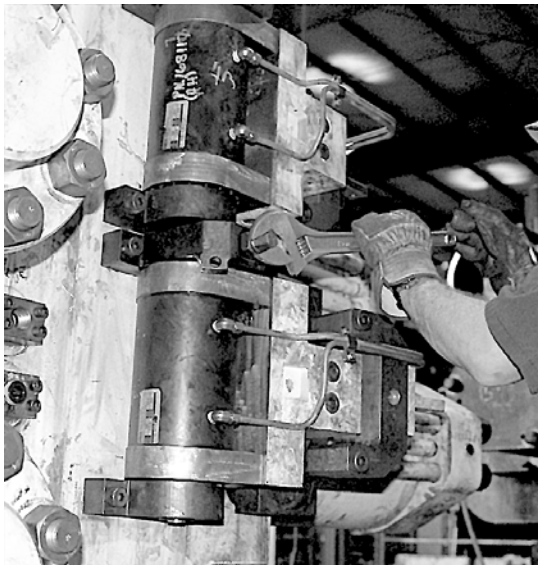
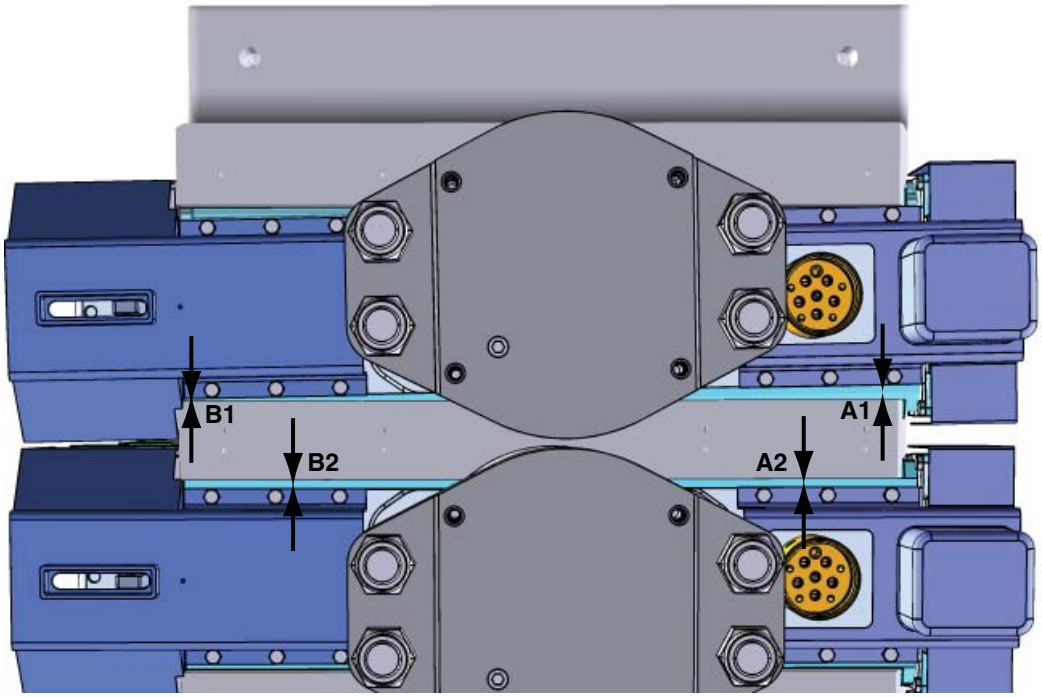


Figure 5-23. Adjustment of Door to Close Properly



Top Door is misaligned: A1 ≠ B1

Bottom Door is correctly aligned: A2 = B2

Figure 5-24. Door Adjustment

Disassembly Instructions — Lockrod Drive Assembly

Numbers in parentheses correspond to the callouts in Figure 5-27 on page 5-36 and the item numbers in the table titled “Parts List — Lockrod Drive Assembly” on page 5-37.

1. Verify there is no wellbore pressure on the BOP stack.
2. Open rams on the BOP ram cavity(ies) being serviced.
3. Remove both $^{5}/_{8}$” shoulder screws (10), which are the hinge pins for the safety latches (9), and then remove the safety latches and safety clip (14).
4. Open desired NXT ram BOP door(s) using the NXT door locking system and door control panel as detailed in Chapter 4, titled “Operation”.
5. Check all hydraulic fittings and cylinder for leakage, and make note accordingly for fault verification later.

For each lockrod drive being disassembled, the BOP door on that side should be fully open. The door can remain closed if no disassembly to the rotation assembly is anticipated; however, the lockrod groove in the BOP ram body will not be fully accessible for inspection.

6. Thoroughly wash the open ram cavity with high-pressure water spray to remove mud, cement or any foreign debris. Do not use abrasive material to clean this area.
7. Remove the two lockrod drive covers by first removing two ½" hex head cap screws from each cover (see Figure 5-25).

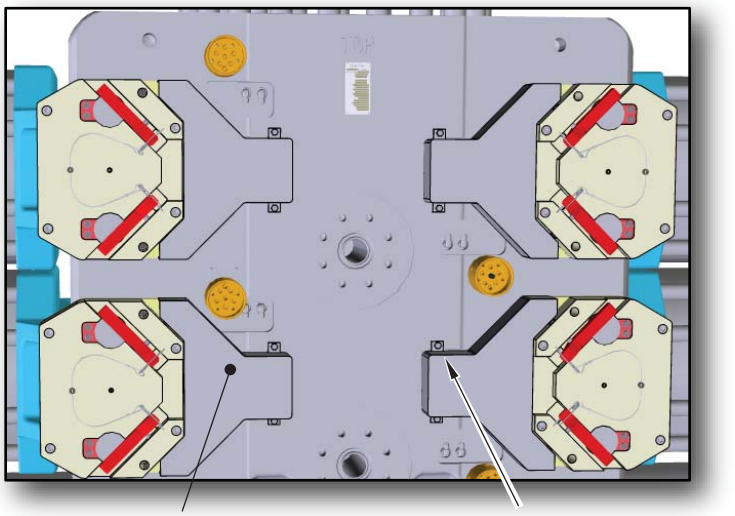


Figure 5-25. NXT Door Locking System – Lockrod Drive Assembly Installed

8. Confirm the lockrod drive hydraulic cylinder is fully extended to the Unlock position.

In the Unlock position, the two lockrod flat faces (looking down axis of lockrod) should be parallel to each other and 90º to the wellbore vertical centerline.

9. Remove all lockrod drive hydraulic control hoses, and relieve all hydraulic pressure by partially opening the hydraulic fittings that may be holding pressure on the lockrod drive assembly.
10. Remove all hydraulic tubing between the lockrod drive assembly and the BOP body.
11. Use a padded block to vertically support the upper lockrod in place inside the open ram cavity.

12. On the door hinge side of the BOP, remove the two lockrod holders by first removing the three $^{5}/_{8}$" shoulder screws from each holder (see Figure 5-26).

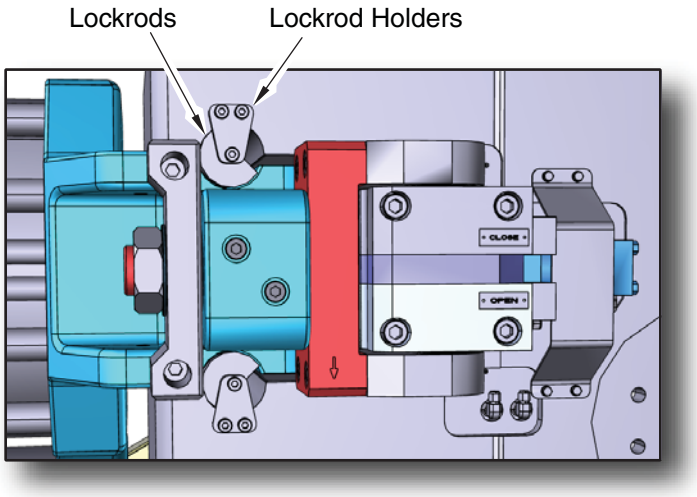


Figure 5-26. Lockrod and Holder — Door Rotation Assembly Side

13. From each ram cavity lockrod drive assembly, remove the two lockrod keeper plates (15) by first removing the two ½" hex head cap screws (17) and washers (16), retaining each keeper plate (see Figure 5-27 on page 5-36).

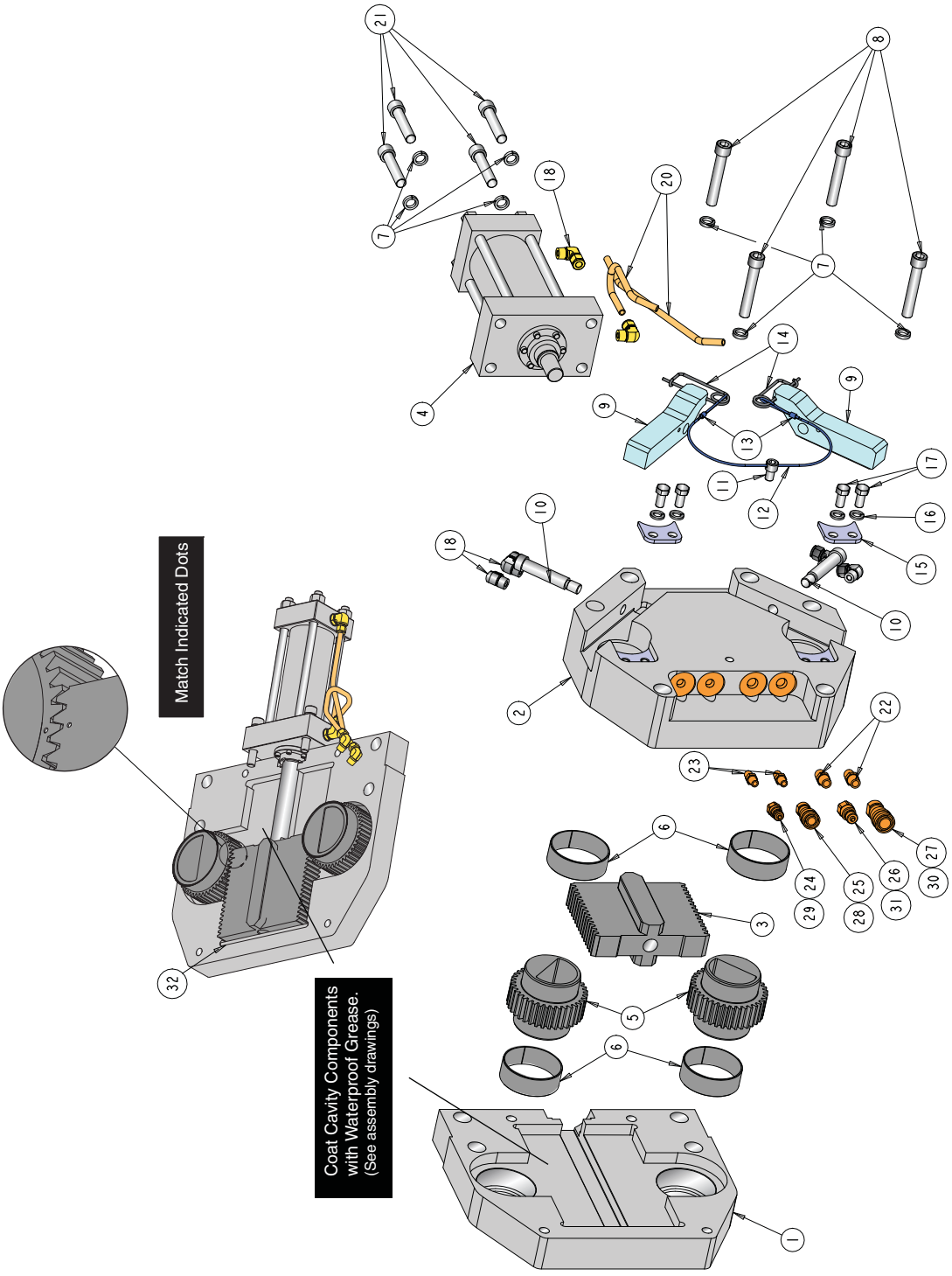


Figure 5-27. NXT Door Locking System — Lockrod Drive Assembly Exploded View

Parts List — Lockrod Drive Assembly

Item No.	Qty	Description
1	1	Base
2	1	Cover
3	1	Rack Gear
4	1	Hydraulic Cylinder (3¼" Bore x 5½" Stroke)
5	2	Spur Gear
6	4	Bearing
7	8	5/8" Lock Washer
8	8	5/8" Soc Hd Cap Screw
9	2	Safety Latch
10	2	5/8" Shoulder Screw
11	1	½" Soc Hd Cap Screw
12	2	1/8" Wire Rope
13	2	Sleeve
14	2	Safety Clip
15	2	Keeper Plate
16	4	½" Lock Washer
17	4	½" Hx Hd Cap Screw
18	6	Hydraulic Connector Elbow
19		NOT USED
20	24	10 mm Tubing
21	4	5/8" Soc Hd Cap Screw
22	2	3/8" Hx Nipple
23	2	¼" Hx Nipple
24	1	¼" Hyd Male Quick Disconnect
25	1	¼" Hyd Female Quick Disconnect
26	1	3/8" Hyd Male Quick Disconnect
27	1	3/8" Hyd Female Quick Disconnect
28	1	¼" Coupler Dust Cap
29	1	¼" Nipple Dust Cap

Parts List — Lockrod Drive Assembly (Continued)

Item No.	Qty	Description
30	1	3/8" Coupler Dust Cap
31	1	3/8" Nipple Dust Cap
32	1	Spacer

14. From the lockrod drive side, gently drive the lockrod inward until it is free of the drive, remove the padded block installed earlier, lower the lockrod, remove it from the ram cavity, and then set aside taking care not to nick or otherwise damage its machined surface.

Great care should be taken when removing or installing the lockrod to avoid nicks or gouges that could affect the smooth movement of the lockrod.

15. Install a ½" eyebolt in the uppermost lockrod keeper plate retainer screw hole and rig up to support the weight of the lockrod drive assembly with an overhead lifting device.
16. With the overhead lifting device rigged up previously, remove the four socket head cap screws and high collar lock washers which mount the lockrod drive to the BOP body. Move the lockrod drive assembly to an appropriate work area for further disassembly (see Figure 5-28).

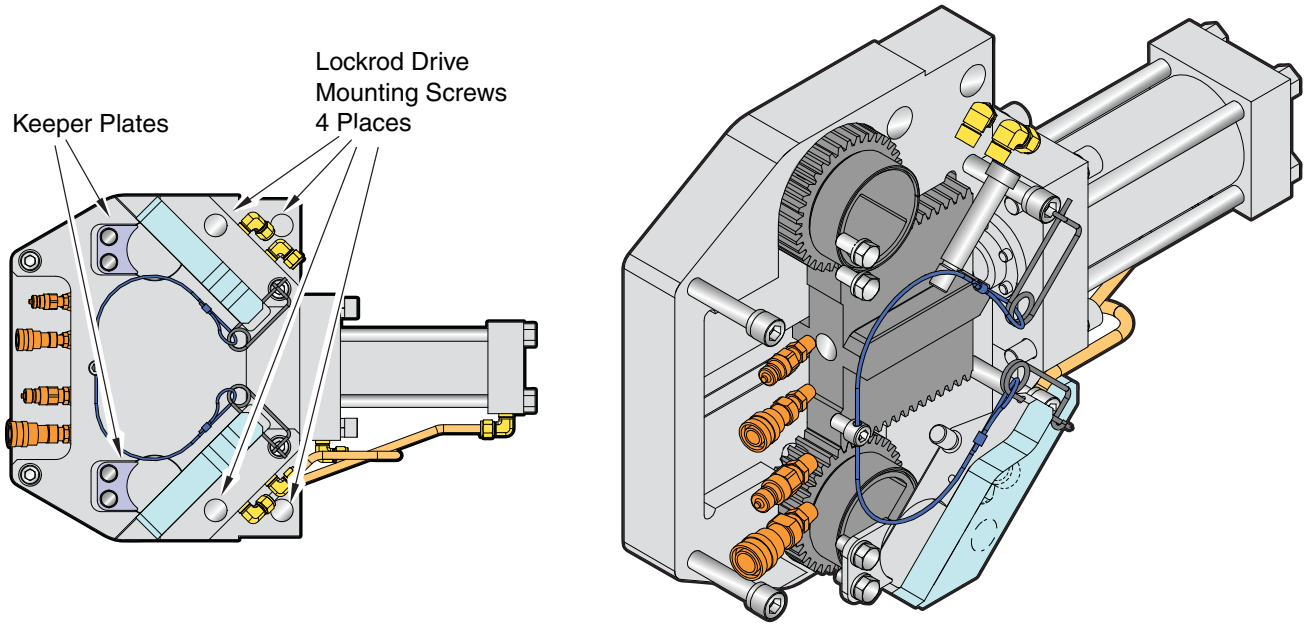


Figure 5-28. NXT Door Locking System – Lockrod Drive Assembly 3D View

17. Remove all hydraulic tubing between the lockrod drive assembly hydraulic cylinder (4) and drive cover (2).
18. Remove the four socket head cap screws and lockwashers (8, 7) which hold the drive cover to the drive base (see Figure 5-27 on page 5-36 and the table titled “Parts List — Lockrod Drive Assembly” on page 5-37).
19. Remove the four socket head cap screws and lockwashers (21, 7) which hold the hydraulic cylinder to the drive cover and drive base (see Figure 5-27 on page 5-36 and the table titled “Parts List — Lockrod Drive Assembly” on page 5-37).
20. Carefully pry apart the drive cover from the drive base.
21. Remove the hydraulic cylinder (with rack gear attached).
22. Unscrew the rack gear from the cylinder rod. Use wrench flats on the cylinder as a back-up.
23. Remove the two spur gears (5).
24. If the spur gear was loose in the bearing, remove the bearing (6) from the drive cover and base.
25. Clean machine parts in solvent and inspect for damage, replacing worn parts if required.

It is recommended that the spur gear bearings (6) be replaced if the spur gear is not firmly held in place by the bearings.

26. Inspect the gear teeth of the spur and rack gears; replace if gear teeth are chipped or overly worn.

Proper inspection of gears and determination of their suitability for service require specially trained and equipped personnel. Call the supplier’s service department for assistance with gear inspection if required.

27. Taking the appropriate safety precaution, blow out all hydraulic passages of the lock drive cover with compressed air.
28. Clean and inspect lockbar and lockbar groove in the BOP body. If any gouges or excessive wear are noted in the lockbar groove, contact the supplier’s factory representative for evaluation and repair/refurbishment recommendations.

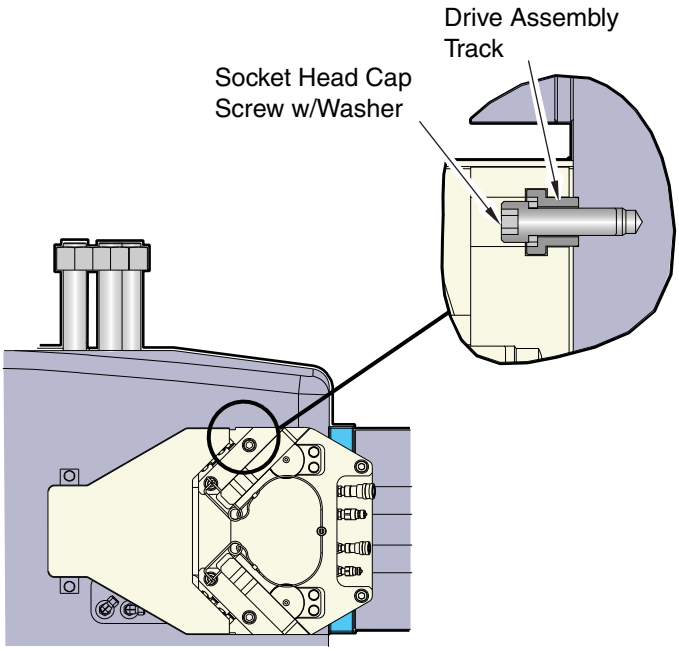


Figure 5-29. Lockrod Drive Mounting to Ram BOP Body

Assembly Instructions – Lockrod Drive Assembly

Numbers in parentheses correspond to the callouts in Figure 5-27 on page 5-36 and the item numbers in the table titled “Parts List — Lockrod Drive Assembly” on page 5-37.

1. Replace all components requiring replacement as determined by qualified personnel during the inspection process.
2. With close-tolerance mating components, use the petroleum-based hydraulic oil (which is used as the operating hydraulic medium) as a light lubricant coating on the components prior to assembly. During assembly heavier grease will be used on the spur gears and rack gear components.
3. Install new or original (if not worn) bearings (6) in base (1) and cover (2).
4. Screw the ack gear (3) onto the rod thread of the hydraulic cylinder (4), and then orient as shown in Figure 5-27 on page 5-36.

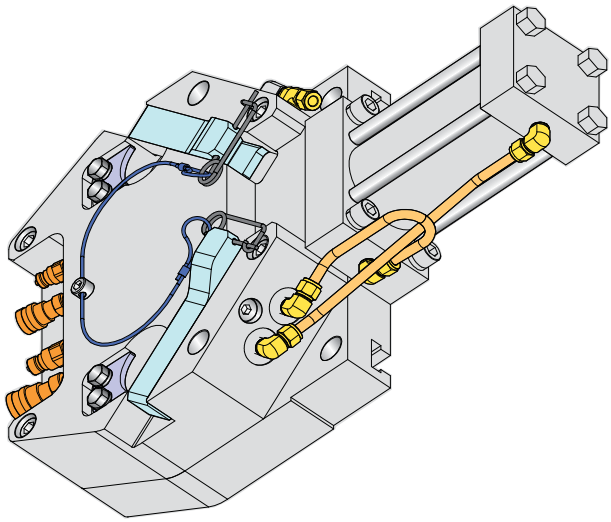


Figure 5-30. NXT Door Locking System – Lockrod Drive-Assembled View

5. With compressed air [approx. 10 to 15 psi (0.7 to 1 bar)], retract cylinder rod fully to the lockbar Lock position.
6. Install the hydraulic cylinder/rack gear into the cover (2) and attach with $2^{5}/_{8}$" socket head cap screws. At this point, the cylinder is only being held in place by two fasteners.
7. Install safety clip and safety latch (2 each of [9, 14]).

Safety latches, when in place, hold the lockrods in the Lock position and prevent them from becoming loose during operation. The sides of the safety latches that contact the lockrod are used in the next step to orient the spur gears for installation in the Lock position.

8. Install the spur gears (5) in the cover (2). Spur gear teeth must align with rack gear teeth. Flat side of "D" shaped in profile on spur gear must be parallel and flush with the side of the safety latch that contacts the lockrod (see Figure 5-27 on page 5-36 and Figure 5-30).
9. Liberally coat internal components of cover (rack and spur gears) with waterproof grease such as Shell Alvania EP2 or equivalent.
10. Carefully install the base (1) onto the cover (2) and its assembled components, taking care to align the spur gears with the bearings in the base.
11. Install four socket head cap screws and lock washers (8, 7) into the base (1), through cover (2) to hold the cover and base together (see Figure 5-28 on page 5-38).
12. Install the remaining two $^{5}/_{8}$" socket head cap screws and lock washers (21, 7) to complete the mounting of the hydraulic cylinder to the base (1).

13. Install hydraulic tubing and fittings between the cover and the hydraulic cylinder (see Figure 5-30 and Figure 5-28 on page 5-38.)
14. Install a ½" eyebolt in the uppermost keeper plate retaining screw hole.
15. Install the track drive assembly into the T-slot on the back of the base (1).
16. Using an appropriate configured lifting device, lift the lockrod drive assembly into place on the ram BOP body.
17. Fasten the assembly in place to the body with two socket head cap screws and lock washers (37, 45) connected through mounting screw holes in cover and base and into the BOP body (see Figure 5-28 on page 5-38 and Figure 5-29 on page 5-40).
18. Remove the ½" eyebolt used for lifting.
19. Open the safety latches (9) and secure open with safety clips (14).
20. Lightly coat the lockrod with oil.
21. Install the lockrod either through open ram cavity or through lockbar groove accessible from rotation assembly side of BOP. The ockrod should pass through spur gear internal profile and extend into cover in the safety latch area.
22. Install the lockrod keeper plate with fasteners (15, 16, 17) on the lockrod drive assembly and then the lockrod holder and its fasteners on the BOP body (see Figure 5-31 on page 5-43).
23. Repeat the previous three steps for the other lockrod.
24. Install the hydraulic tubing between the cover and the BOP body.
25. Connect hydraulic fluid hoses on lockrod drive side and control fluid hoses on rotation assembly side. Then perform function and pressure test of lockrod drive assembly, rotation assembly, and BOP rams to confirm integrity of all fluid pressure connections.

Make sure the BOP ram door is properly aligned to the ram cavity opening in the body before test-opening the ram BOP door. See details for this operation in the section titled "Assembly Instructions — Rotation Assembly (P/N 20032414)" on page 5-51.

Disassembly Instructions — Rotation Assembly

1. Verify there is no wellbore pressure on the BOP stack.
2. Open the rams on the cavity(ies) being serviced.
3. Open the desired door(s) using the door locking system and door control panel as described in Chapter 4, titled "Operation". Check all hydraulic fittings and cylinder, for leakage and make note accordingly for fault verification later.

For each rotation assembly being disassembled, the BOP door on that side should be fully open.

4. Bleed all system pressure from the door operator and remove BOP control hoses.
5. Remove the two rotary actuator covers by first removing four $^{3}/_{8}$" hex head screws from each cover (see Figure 5-31).

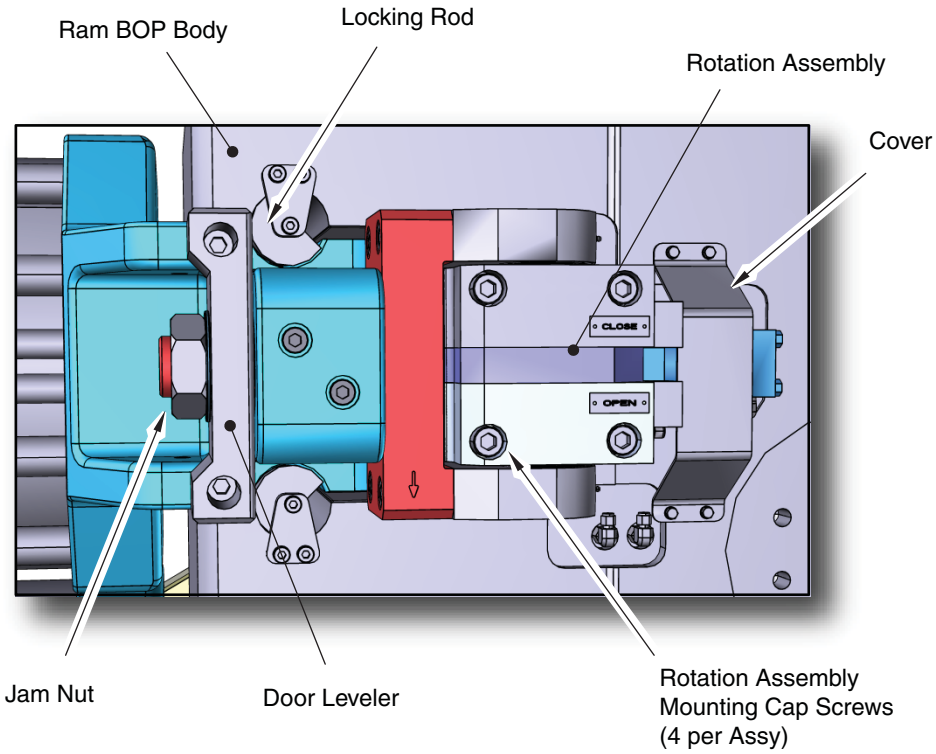


Figure 5-31. NXT Door Locking System Rotation Assembly Installed

6. Bleed all hydraulic pressure from the rotation assembly, and then remove hoses and all tubing between the rotation assembly hydraulic cylinder and ram BOP body.
7. Prepare the lifting device to support the weight of the ram BOP door.
8. With weight of ram BOP door supported by the lifting device, remove the door retainer nut and door, leveling arm from the rotation assembly hinge tee manifold, and remove the door and set aside for inspection/service (see Figure 5-31 and Figure 5-32 on page 5-44).

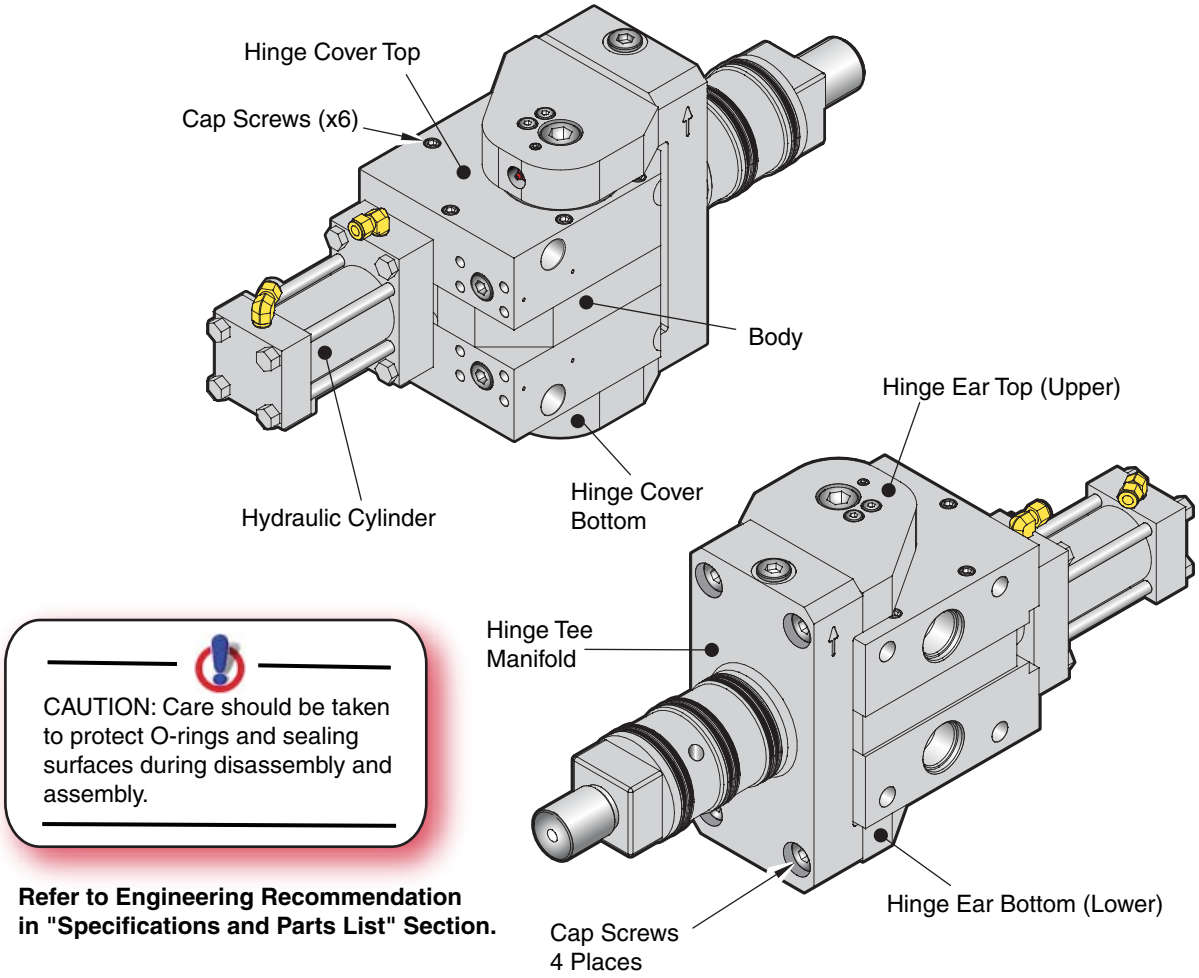


Figure 5-32. NXT Door Locking System – Rotation Assembly Major Components

9. Prepare lifting device to support the rotation assembly.

The ram BOP door and rotation assembly may be removed together as an option. In this case, omit step 5 - 9.

10. With weight of the rotation assembly alone or with the BOP door supported by the lifting device, remove the four cap screws that mount the rotation assembly to the BOP body.
11. Remove the door leveler (see Figure 5-31 on page 5-43).
12. Taking care not to damage hydraulic seal subs between rotation assembly and the BOP body, carefully remove the rotation assembly and set aside.
13. If the door was not removed from the rotation assembly, remove the jam nut (see Figure 5-31 on page 5-43) and then remove the door.

14. Remove the hinge tee manifold by removing the four mounting cap screws (see Figure 5-32 on page 5-44).
15. Taking care not to damage the hydraulic seal subs between the hinge tee manifold and upper and lower hinge ears, carefully remove the hinge tee manifold assembly and set aside (see Figure 5-33).

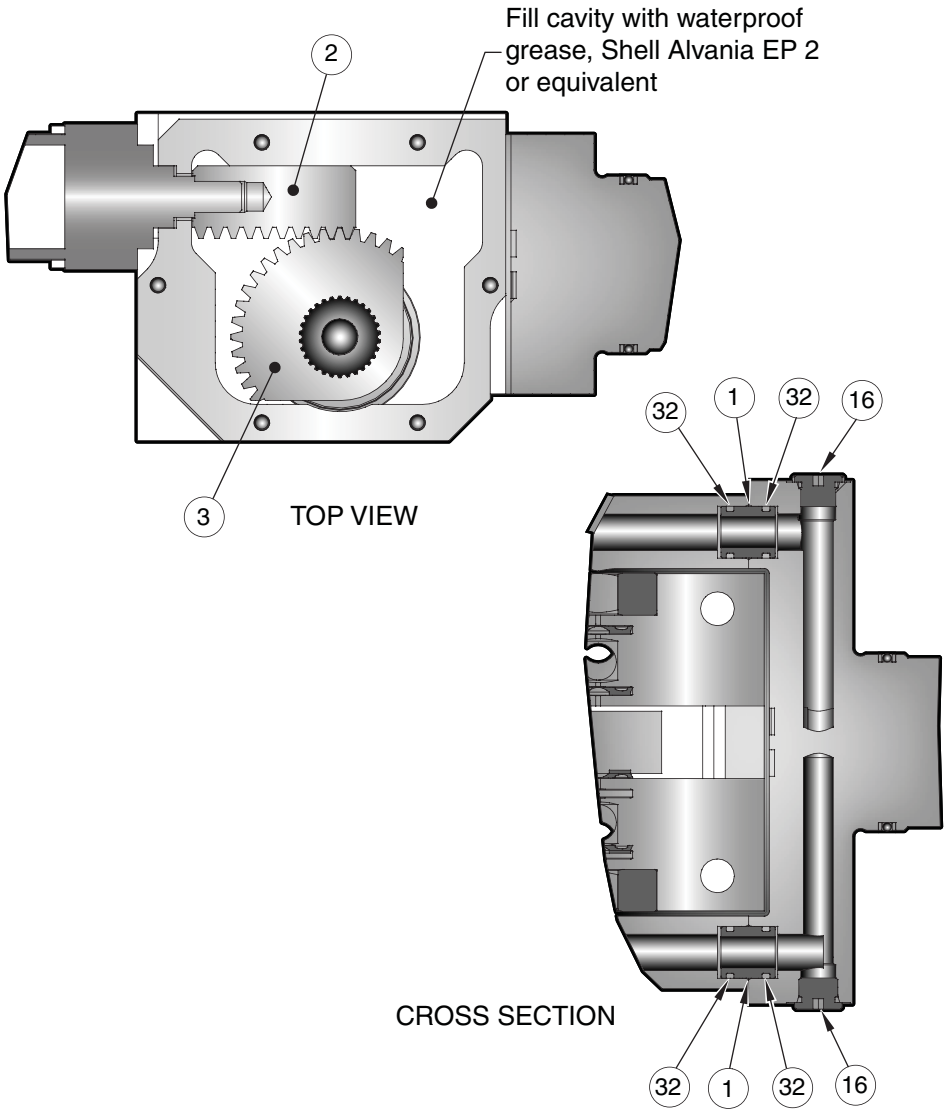


Figure 5-33. NXT Door System — Rotation Assembly — Section View

Parts List — Rotation Assembly (P/N 20032414)

Item No.	Qty.	Part No. for 22" PosLock Operator	Description
1	2	20011703	Seal Sub Housing
2	1	20032361	Hinge Rotation Rack
3	1	20032355	Hinge Sector Gear
4	2	20017028	Hinge Bushing
5	1	20017014	Top Hinge Cover
6	1	20017013	Bottom Hinge Cover
7	1	20017030	Top Hinge Ear
8	1	20017029	Bottom Hinge Ear
9	1	20017033	Hinge Tee Manifold
10	1	20032373	Hinge Drive Shaft
11	1	20017032	Hinge Body
12	1	20016491	Hydraulic Cylinder (22½" Bore x 3" Stroke)
13	2	2115247	3/8" x 3/8" Tube Elbow
14	2	2407139	SAE 4-Bolt Flg
15	12	2041873	½" SAE Hex Plug
16	2	2041874	¾" SAE Hex Plug
17	2	2152081	1" SAE Hex Plug
18	4	065009	3/8" NPT Hollow Hex Plug
19	2	065007	1/8" NPT Hollow Hex Plug
20	4	20017010	1½" OD Bushing, Press Fit
21	4	207148	½" Socket Hd Cap Screw
22	12	7401069	½" Socket Hd Cap Screw
23	2	8003389	1" Socket Hd Cap Screw
24	4	8003387	1" Socket Hd Cap Screw
25	12	8020984	½" Lock Washer
26	2	8020993	1" Lock Washer
27	8	8002881	7/16" Socket Hd Cap Screw
28	8	1802147	7/16" Lock Washer
29	4	062287	Polypak Seal

Parts List — Rotation Assembly (P/N 20032414)

Item No.	Qty.	Part No. for 22” PosLock Operator	Description
30	3	5003303	O-Ring
31	6	20017256	Back-up Ring
32	4	5030014	T-Seal, Piston
33	2	204219	$^{1}/_{16}$” Grease Fitting
34	2	20017035	Thrust Bearing
35	2	5003145	O-Ring
36	1	20032705	Washer
37	2	20032476-01	Key, Hinge Assy, 22” Operator, 1.970 LG
38	2	20032476-02	Key, Hinge Assy, 22” Operator, 2.155 LG
39	4	20032476-03	Key, Hinge Assy, 22” Operator, 2.470 LG

16. Remove the 1” socket head cap screw from the upper and lower hinge ears, and then remove hinge ears (see Figure 5-34).
17. Remove the two hex head cap screws attaching the hydraulic cylinder to the top hinge cover (see Figure 5-32 on page 5-44 and Figure 5-35 on page 5-49).

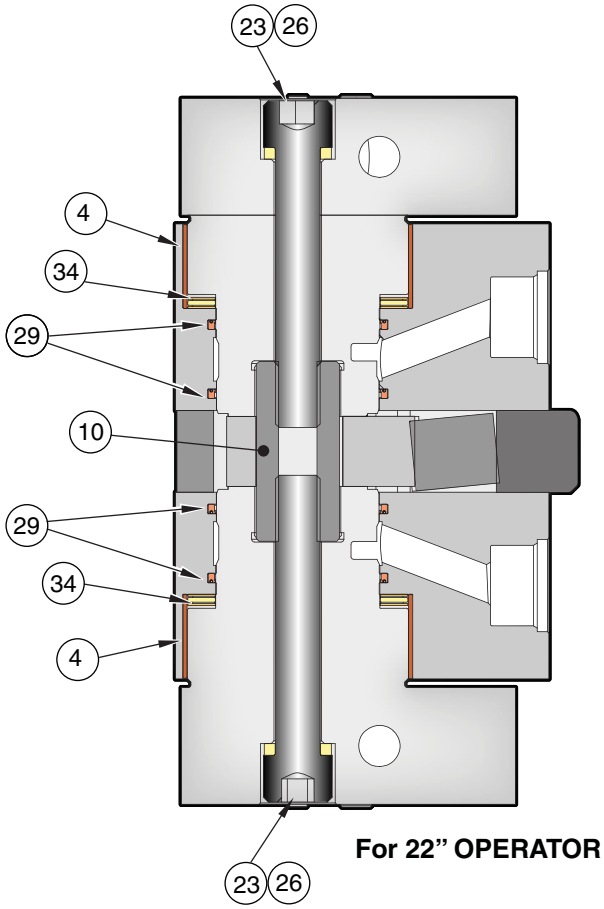


Figure 5-34. NXT Door Locking System — Rotation Assembly — Section View

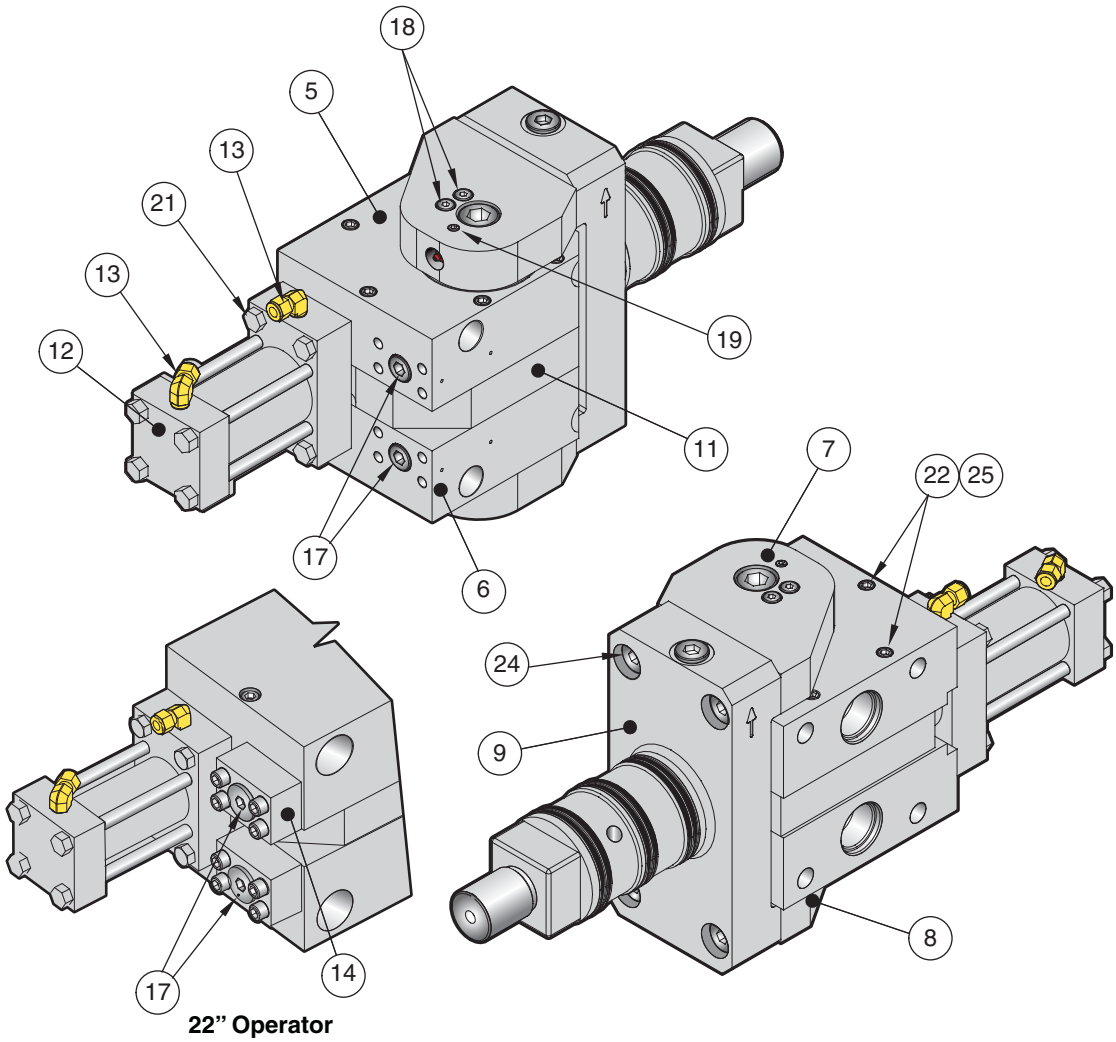


Figure 5-35. NXT Door Locking System — Rotation Assembly

Numbers in parentheses correspond to the item numbers in the table titled “Parts List — Rotation Assembly (P/N 20032414)” on page 5-46.

18. Remove the six $^{3}/_{8}$” socket head cap screws (22) from the top hinge cover (see Figure 5-35).
19. Remove the top hinge cover, hinge sector gear, and hinge drive shaft (see Figure 5-34 on page 5-48 and Figure 5-35).
20. Remove the hinge bushing (4) from the top hinge cover (5) (see Figure 5-34 on page 5-48).

Removal of the hinge bushings is only required if the hinge ear(s) appear to be loosely fitting into the top or bottom hinge cover.

21. Using compressed air (about 10 to 15 psi) rigged to the hydraulic cylinder port nearest hinge body, extend the cylinder fully to expose $^{7}/_{8}$" wrench flats on the cylinder rod (see Figure 5-32 on page 5-44 and Figure 5-35 on page 5-49).

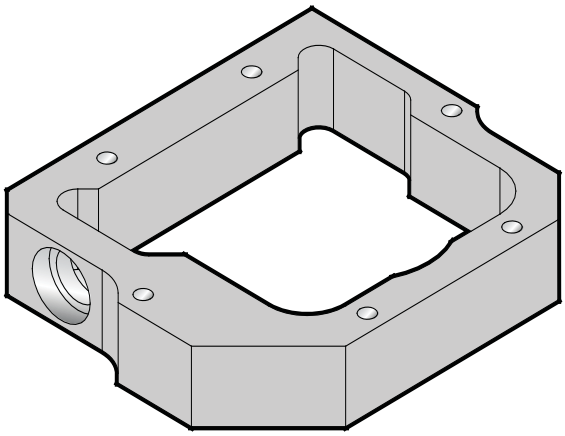


Figure 5-36. Hinge Body

22. While supporting hinge rotation rack, unscrew the cylinder rod from the hinge rotation rack (see Figure 5-33 on page 5-45).
23. Remove the two hex head cap screws attaching the hydraulic cylinder to the top hinge cover, and then remove the cylinder (see Figure 5-32 on page 5-44 and Figure 5-35 on page 5-49).
24. Remove the six $^{3}/_{8}$" socket head cap screws from the bottom hinge cover, and then separate the hinge body from the bottom hinge cover (see Figure 5-35 on page 5-49).
25. Remove rubber goods and seals from all rotation assembly components.
26. Remove the hinge bushing (4) from bottom hinge cover (6) (see Figure 5-34 on page 5-48).

As a recommendation, all rubber goods should be replaced when the rotation assembly is disassembled.

27. Thoroughly wash all components with solvent and inspect for wear or other damage. Replace worn components and all hydraulic sealing components (rubber goods).

It is recommended that the hinge bushings (4) be replaced if the hinge ears are not firmly held in place by the bushings. This fit must be tight as the bushings support the cantilevered weight of the BOP door when it is open.

28. Remove the SAE plugs from the hinge tee manifold.

29. Inspect the SAE plug O-rings; replace if cracked or worn.
30. With compressed air [about 10 to 15 psi (0.7 to 1 bar)], blow out the internal hydraulic fluid flow paths for all components where applicable.
31. Inspect all geared components for signs of wear or damage; replace as required.

Proper inspection of gears and determination of their suitability for service requires specially trained and equipped personnel. Call supplier's service department for assistance with gear inspection if required.

Assembly Instructions — Rotation Assembly (P/N 20032414)

1. Install new rubber goods in all components.
2. Replace all components requiring replacement as determined by qualified personnel during the inspection process.
3. With close tolerance mating components, use the petroleum-based hydraulic oil (which is used as the operating hydraulic medium) as a light lubricant coating on the components prior to assembly.

Do not use water-based hydraulic fluid as a lubricant during reassembly except for seal sub O-rings.

4. If the hinge bushings were determined during inspection to require replacement, install new hinge bushings into the top and bottom hinge covers.
5. Install hinge body onto bottom hinge cover, and then install the six $^{3}/_{8}$" socket head cap screws and lock washers to retain the bottom hinge cover to hinge body.
6. Install the bottom hinge ear into the bottom hinge cover, and then orient the bottom hinge ear as shown in Figure 5-37 on page 5-52 and Figure 5-33 on page 5-45.

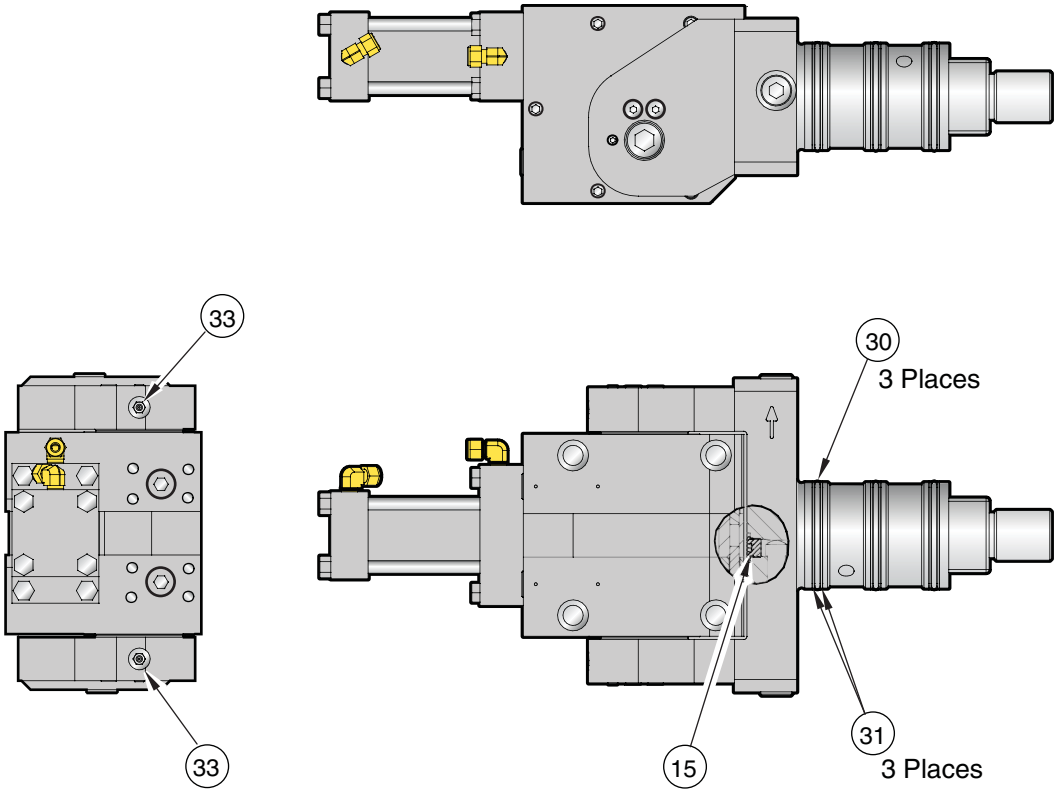


Figure 5-37. NXT Door Locking System – Rotation Assembly – Section View

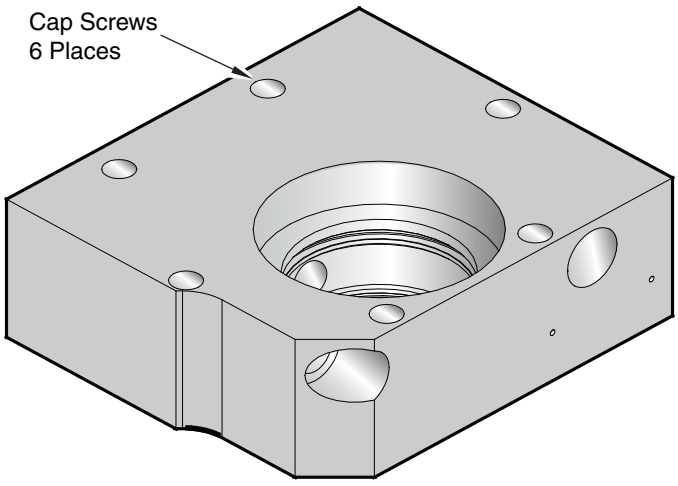


Figure 5-38. Top or Bottom Hinge Cover

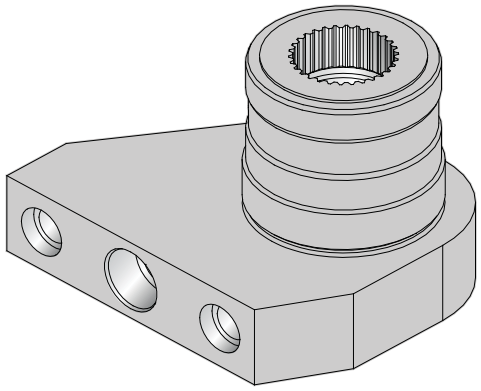


Figure 5-39. Top or Bottom Hinge Ear

7. Install hinge drive shaft into internal spline of bottom hinge ear.
8. Install socket head cap screw retaining bottom hinge ear to hinge drive shaft.
9. Install the hydraulic cylinder into the hinge body and install the two hex head cap screws that attach the cylinder to the bottom hinge cover.
10. With compressed air [about 10 to 15 psi (0.7 to 1 bar)] attached to the cylinder blind end port, extend cylinder enough to expose the cylinder rod wrench flats where they are accessible through the center of the hinge body.
11. Place the hinge rotation rack, with gear face toward hinge drive shaft, in line with the cylinder rod inside hinge body, and thread the cylinder rod on to the hinge rotation rack using $^{7}/_{8}$" wrench flats on cylinder rod.
12. Switch compressed air to the cylinder port nearest the hinge body and retract the cylinder rod fully.
13. Install the hinge sector gear over the hinge drive shaft taking care to mate it with hinge rotation rack gear teeth while also maintaining bottom hinge ear orientation as shown in Figure 5-37 on page 5-52 and Figure 5-33 on page 5-45.
14. Fill hinge body cavity with waterproof grease (Shell Alvania EP 2 or equivalent).
15. Install top hinge cover onto the hinge body, and then install the six $^{3}/_{8}$" socket head cap screws and lock washers to retain the top hinge cover to the hinge body.
16. Install the top hinge ear into the top hinge cover and mate the internal spline (see Figure 5-39) with the hinge drive shaft while maintaining top hinge ear orientation as shown in Figure 5-37 on page 5-52 and Figure 5-33 on page 5-45.
17. Install socket head cap screw retaining top hinge ear to the hinge drive shaft.
18. Install the SAE plugs with new O-rings into the hinge tee manifold.
19. Ascertain correct **Arrow** orientation on the hinge tee manifold (see Figure 5-35 on page 5-49).

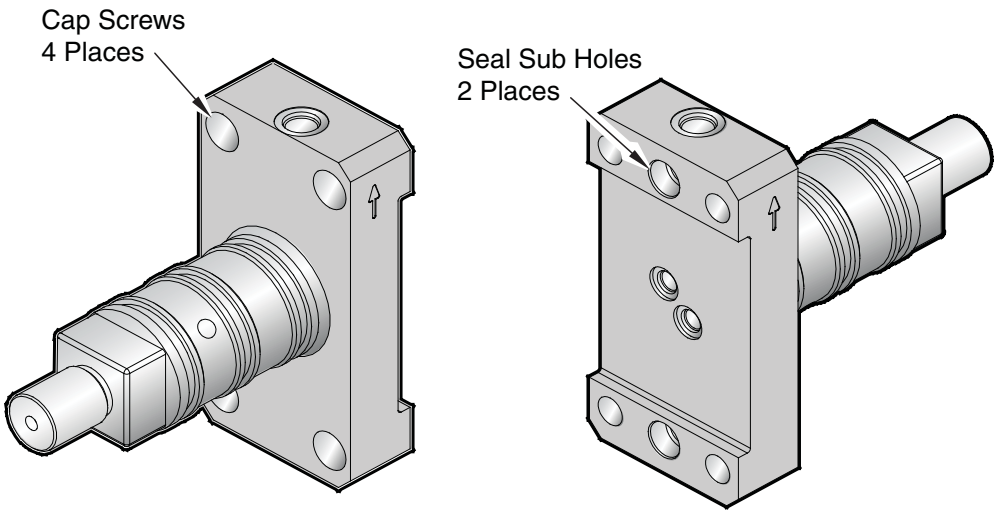


Figure 5-40. Hinge Tee Manifold

20. Maintaining correct **Arrow** orientation from previous step, install seal sub (with new O-ring) into mating holes in the hinge tee manifold that will align with mating seal sub holes in top and bottom hinge covers (see Figure 5-33 on page 5-45 and Figure 5-40).
21. Taking care not to damage seal sub O-rings, install hinge tee manifold into top and bottom hinge ears and install the four socket head cap screws retaining the manifold to the ears.
22. Install the seal subs (with new O-rings) in BOP body in the mating fluid ports for the rotation assembly
23. Using a lifting device, carefully install the rotation assembly over the BOP body seal subs and retain rotation assembly with four socket head cap screws and lock washers (see Figure 5-31 on page 5-43).
24. Using compressed air [approx. 10 to 15 psi (0.7 to 1 bar)] attached to blind end port of cylinder, extend the cylinder which will rotate hinge tee manifold to the **Door Open** position.
25. Install BOP door and leveling arm onto hinge tee manifold and retain with hex nut (see Figure 5-31 on page 5-43).
26. With rotation assembly cylinder ports open and lockrods in **Open** position, close the BOP door manually taking care that door does not contact lockrods or BOP body.
27. If required, parallel align door to BOP body ram cavity opening by adjusting the set screws on top and bottom of door which contact the leveling arm to allow the door to fit into the body without contacting the open lockrods or other components.
28. Connect hydraulic tubing and fittings, bleed air from lines, connect hydraulic fluid hoses on lockrod drive side and control fluid hoses on rotation assembly side. Perform function and pressure test of the rotation assembly and rams open/close to confirm integrity of all fluid pressure connections.

Door Locking Assembly

Disassembly — Door Locking Assembly

For disassembly of the door locking assembly, refer to Figure 5-50 on page 5-59 and the section titled “Engineering Drawings and Parts Lists” on page 6-20.

Numbers in parentheses correspond to the callouts in Figure 5-50 on page 5-59 and the item numbers in the table titled “Parts List — UltraLock II (B) Door Locking Assembly (P/N 168023)” on page 5-60.

1. Open the NXT door.
2. Remove the six ½”-13UNC cap screws from both hinge covers (see Figure Figure 5-41). Remove covers.

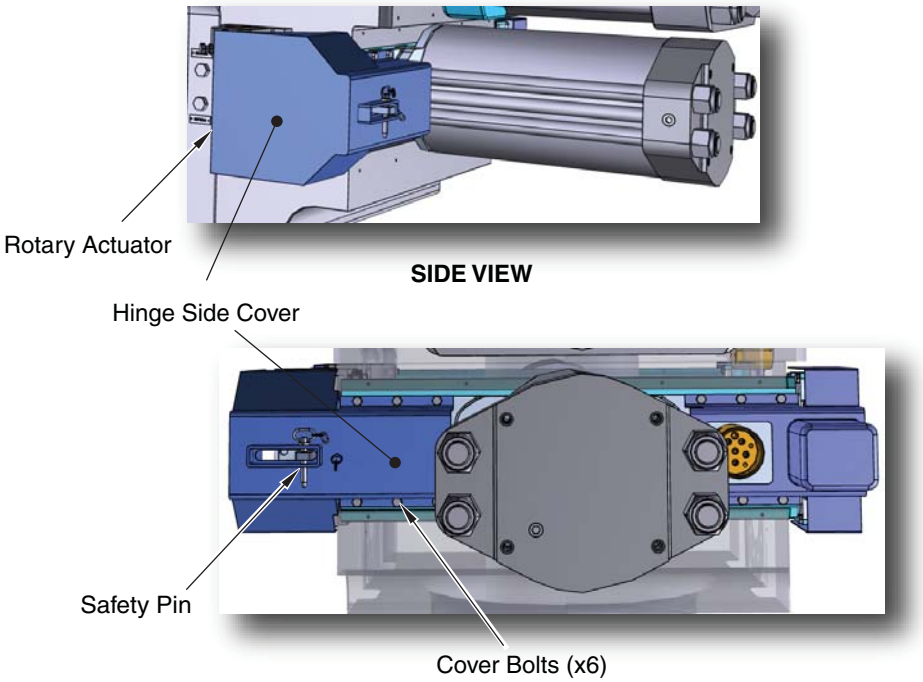


Figure 5-41. Door Hinge Covers

3. Place the lock bar in the Lock position.
4. Bleed off all hydraulic pressure from the door.
5. Remove all tubing.
6. Remove the two $^{5}/_{8}$”-11NC cap screws (15) from the lock rod holder (3). Remove the lock rod holder.

7. Remove the two ¾”-10UNC shoulder screws (16) from the anti-rotation bracket (5) (see Figure 5-42).

Figure 5-42. Installation/Removal of Anti-Rotation Bracket

8. Remove the four ¾”-10NC cap screws (17) from the anti-rotation actuator (6) (see Figure 5-43).

Figure 5-43. Adjustment to Lower Locking Pressure

9. Remove the anti-rotation actuator and bracket (see Figure 5-44).

Figure 5-44. Remove Anti-Rotation Actuator and Bracket

10. Remove the lock bar adapter (4) from the lock bar (1).
11. Remove the anti-rotation bars (2) from the grooves.
12. Remove the lock bars (1) from the door by using a block of wood against one of the lock bar ledges and tapping it out until the pins on its end are disengaged from the lever arm.
13. Remove the four $^{5}/_{8}$"-11UNC cap screws (22) from the lock bar actuator mounting plate (13) (see Figure 5-45).

Figure 5-45. Installation/Removal or Anti-Rotation Actuator Bolts

14. Remove the four ½”-13NC cap screws (8) from the lever arm cover (11). Remove the cover (see Figure 5-46). The four spacers (7) do not need to be removed unless they are damaged.

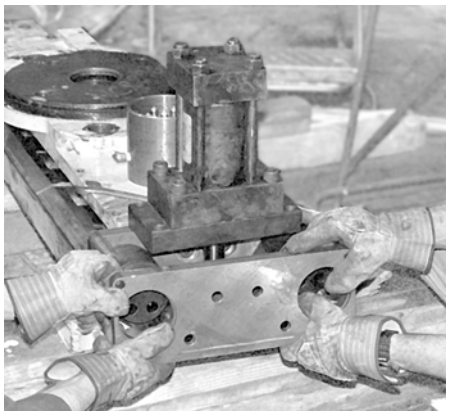


Figure 5-46. Installation/Removal of Lever Arm Cover Plate

15. Lift the lock bar actuator and mounting bracket. Unscrew the actuator shaft from the locking lever plate (12) (see Figure 5-47).

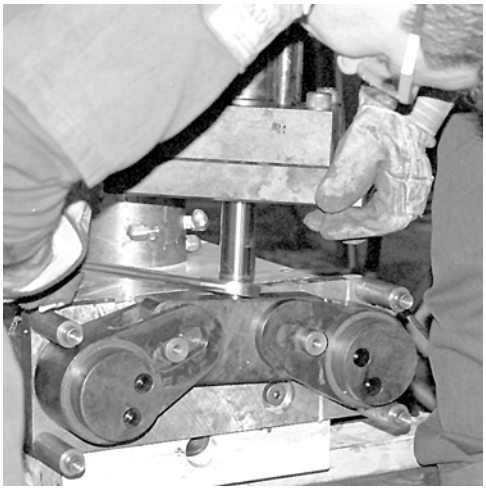


Figure 5-47. Installation/Removal of Lock Bar Actuator to/from Locking Lever Plate

16. Remove the two $^{5}/_{8}$"-11NC cap screws (22) from the locking lever arm (10). Remove the locking lever arm (see Figure 5-48).

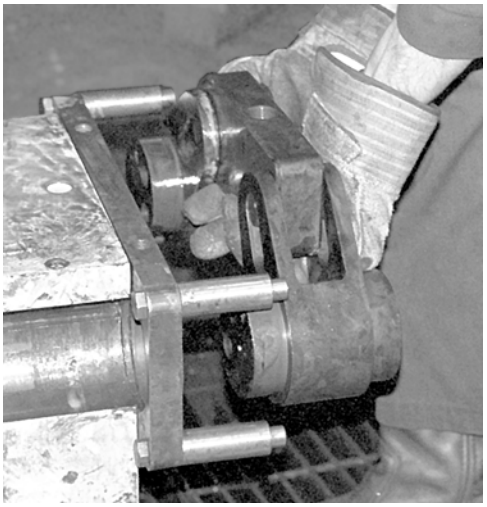


Figure 5-48. Installation/Removal of Lock Bar Lever Arm

17. Remove the four ½"-13NC cap screws (19) from the lever arm cover (11). Remove the cover plate from the door (see Figure 5-49).

Figure 5-49. Installation/Removal of Lever Arm Lock Bar Cover

See foldout.

Figure 5-50. Door Locking Assembly

Parts List — UltraLock II (B) Door Locking Assembly (P/N 168023)

Item	Qty	Description	P/N
–	–	Assembly	168023
1	2	Door Locking Bar	168015
2	2	Anti-Rotation Bar	168016
3	2	Locking Rod Holder	168025
4	2	Lock Bar Rotate Adapter	168043
5	1	Anti-Rotation Bar Bracket	168017
6	1	Anti-Rotation Hydraulic Actuator	168077
7	4	Lever Arm, Plate, Spacer	168082
8	8	Screw, HHC	010233
9	4	Bushing, Lever Arm	168045
10	2	Lever Arm	168018
11	2	Lock Bar, Lever Arms Cover	168042
12	1	Lever Plate	168021
13	1	Hydraulic Cylinder, Mounting Bracket	168030
14	1	Act, Hydraulic Lock Bar	168078
15	4	Screw, SHC	010713
16	2	Screw, SHC	012655
17	4	Screw, SHC	010554
18	8	Dowel Pin, Pull-out	012657
19	4	Screw, SHC	012702
20	2	Dowel Pin, Pull-out	012658
21	2	Screw	012656
22	6	Screw, SHC	010614
23	2	Screw, SHC	010612
24	1	Manifold Assembly	168134
25	1	Stop Tab, Bar, Anti-Rotation	168081

Reassembly — Door Locking Assembly

Prior to reassembly of the door locking assembly, clean out locking grooves and chase threads if needed. See the table titled “Torque Requirement — 18¾”–15M NXT Triple Ram BOP” on page 5-16 for bolt torque values.

Use thread lubricant on all threads.

1. Install and bolt the lever arm cover (11) to the anti-rotation bars with four ½”-13 shoulder screws (19) (see Figure 5-49 on page 5-59).
2. Install and bolt the locking lever arm (10) to the lever arm lock bar cover (11) with two $^{5}/_{8}$”-11NC cap screws (22) (see Figure 5-48 on page 5-59).
3. Screw the lock bar actuator shaft (14) to the locking lever plate (12) (see Figure 5-47 on page 5-58).
4. Install and bolt the lever arm cover (11) to the lever arm cover (11) located on the door. Use four ½”-13NC cap screws (8) to bolt this cover (see Figure 5-46 on page 5-58).
5. Install and bolt the actuator mounting plate (13) to the two lever arm covers (11) with four $^{5}/_{8}$”-11NC cap screws (22) (see Figure 5-45 on page 5-57).
6. Grease the lock bar and anti-rotation grooves in the door with a heavy grease compound.
7. Install the lock bars (1) by aligning the lock bar dowel pins (18) with the holes in the locking lever arm (10) (see Figure 5-51). Using a block of wood and a hammer, tap the lock bar into position.

Install the lower lock bar first.

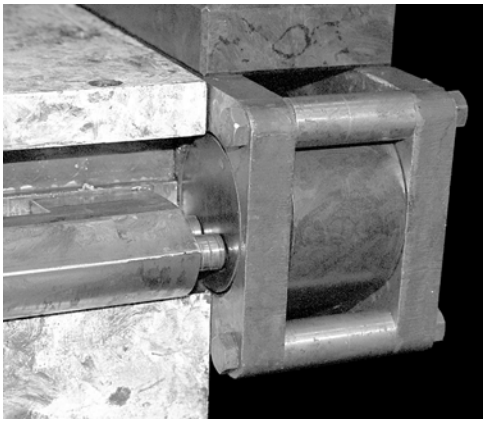


Figure 5-51. Align Pin to Lever Arm

8. Install the lock bar adapter (4) to the lock bar (1) by aligning the holes in the adapter to the dowel pins (18) on the lock bar.
9. Install lock rod holder (3) to the lock bar adapter (4). Bolt the lock rod holder to the door with two $^{5}/_{8}$"-11NC cap screws (15).
10. Install the anti-rotation bars (2) into the grooves.
11. Install the anti-rotation actuator (6) and the anti-rotation bar bracket (5).
12. Bolt the anti-rotation actuator (6) to the door with four ¾"-10NC cap screws (17) (see Figure 5-45 on page 5-57).
13. Bolt the anti-rotation bar bracket (5) to the door with two ¾"-10NC cap screws (16) (see Figure 5-42 on page 5-56).
14. Replace all the tubing and covers.
15. Function door open and close three times to ensure the system is working.

Emergency Ram Shaft Packing Repair

The following procedures are intended for surface-operated BOP equipment only and are not recommended for subsea blowout preventers.

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 an NOV service representative.

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

Some BOPs have a straight-in pipe plug, while others have the pipe plug set 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 5-52).

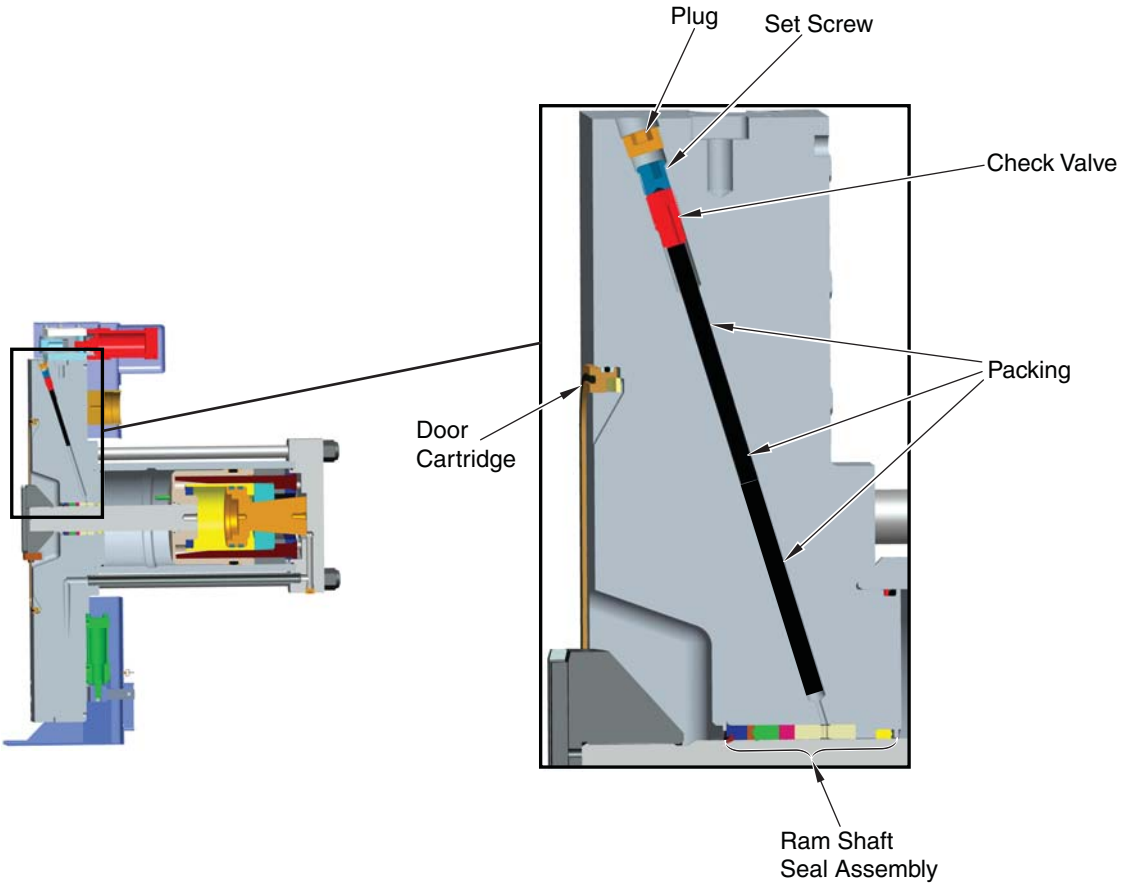


Figure 5-52. Secondary Packing

Additional packing may be injected until leak stops. Remove set screw and insert additional packing sticks, then retighten set screw.

3. Once leak has stopped, replace socket head pipe plug removed in step 1.
4. At the proper time, tear down and replace the RSSA or call an NOV service representative to repack the ram shaft.

UltraLock II (B) Operator Locking System Repair

Perform the following procedures to repair UltraLock II (B) operator locking system. For bolt torque requirements, see the table titled “Torque Requirement — 18¾”–15M NXT Triple Ram BOP” on page 5-16.

Disassembly — UltraLock II (B) Cylinder

For disassembly of the UltraLock II (B) cylinders, see Figure 5-66 on page 5-78 and engineering drawing C-20001255D. For a list of tools required to repair the UltraLock II (B) cylinders, see the table titled “UltraLock II (B) Toolkit (P/N 165551)” below. For parts list, see the table titled “Parts List — UltraLock Piston Assembly” on page 5-76.

Observe all safety precautions outlined in the section titled “General System Safety Practices” on page 1-3 and in the following steps prior to attempting any removal or repair procedures. Compliance with warnings, cautions, and notes will protect equipment from damage and personnel from injury.

UltraLock II (B) Toolkit (P/N 165551)

Description	P/N	Qty.
Cylinder Head Jack Screws	815934	3
Piston Assembly Jack Screw	815924	2
Puller Tool	815661	1
All thread Jack Screw	815664	1
Puller Nut Assembly	815667	1
All thread, ½” x 12” Long	815921	2
All thread, $^5/_8$” x 10” Long	815676	2
All thread, ½” x 10” Long	815677	2
Lifting Eye Bolt, $^5/_8$”	050243	2
Poppet Installation Tool	127110	1
Eye Bolt, ½” x 1½” long	218535	2
Driver Nut	815922	2
Driver Nut	815935	2

1. Open door and remove the ram:
   a. Position the rams in the open position and bleed all hydraulic pressure to 0 psi (0 bar). Open the door.
   b. Attach a 1”-8UNC lifting eye in the ram assembly. Attach lifting equipment to the lifting eye to support the ram assembly.

c. Remove the ram assembly (see the section titled “Ram Assembly Removal and Inspection” on page 5-101).

d. Remove two set screws and the ram foot.

The piston must be fully stroked out prior to removing the ram foot.

2. Remove Cylinder Head:

a. Install a $^{5}/_{8}$”-UNC lifting eye on the cylinder head (see Figure 5-53). Attach lifting equipment to the lifting eye to support the cylinder head.

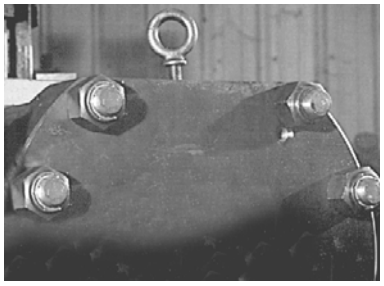


Figure 5-53. Typical Lift Eye Installation

b. Remove the four lock nuts from the cylinder head using a $2^{7}/_{8}$” wrench.

When removing the lock nuts, should the stud be removed from the door assembly, reinstall the stud as follows:
Clean the threads in the door and stud, and then apply Loctite 243 to the first three female threads in the door. Rotate the stud into the door by hand until all the threads of the stud are in the body. Allow approximately one hour for the Loctite 243 to cure.

Do not use excessive torque on the stud into the door. Failure to heed this caution will force the unthreaded section of the stud into the door, causing damage to the stud and door thread.

c. Using a $^{3}/_{8}$" hex wrench, remove the four pipe plugs, install four $^{5}/_{8}$"-11UNC jackscrews, and then remove the cylinder head with lock rods from the cylinder by alternately screwing the jack screws into the cylinder head (see Figure 5-54).

The cylinder manifold may come off with the cylinder head and lockrods. Remove the manifold and secure (see Item 8 on engineering drawing D-20002534D, located in the section titled "Engineering Drawings and Parts Lists" on page 6-20).

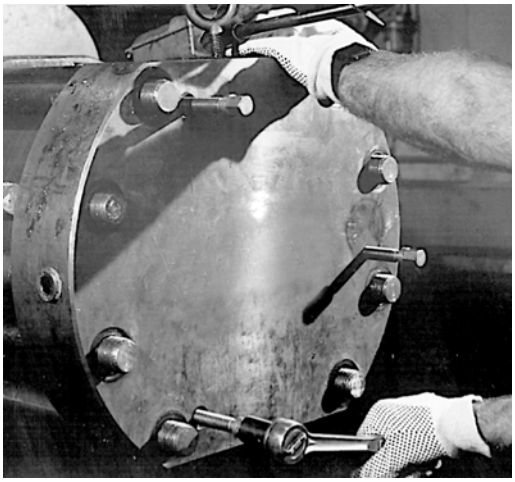


Figure 5-54. Typical Jack Screws Used in Cylinder Head Removal

d. After removing the cylinder head, break loose, but do not remove, the retainer plate cap screws using a $^{5}/_{8}$" hex wrench.

e. Place a web-lifting strap around the cylinder and piston assembly and support the weight of the assembly. Use "come alongs" or other manually adjustable lifting devices to support the web-lifting strap (see Figure 5-55).

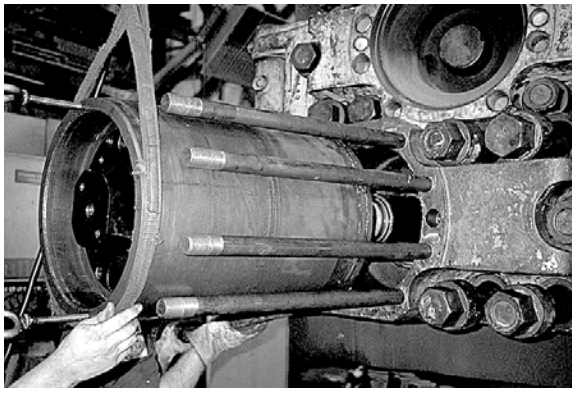


Figure 5-55. Typical Cylinder and Lifting Method

3. Remove Cylinder, Piston, and Ram Shaft Assembly:

   a. Install $1^{7}/_{8}$" nuts over two diagonally opposite cylinder studs. Install two ½"-NC by 12" long all thread rods into the cylinder. Install the puller tool over the cylinder studs and the two 12" long all threads. Position the $1^{7}/_{8}$" nuts to allow sufficient clearance between the puller and cylinder face for the cylinder to clear the door. Install the two ½"-NC nuts and washers on the all thread rods. Tightening these nuts will pull the cylinder, piston, and ram shaft assembly out of the door (see Figure 5-56).

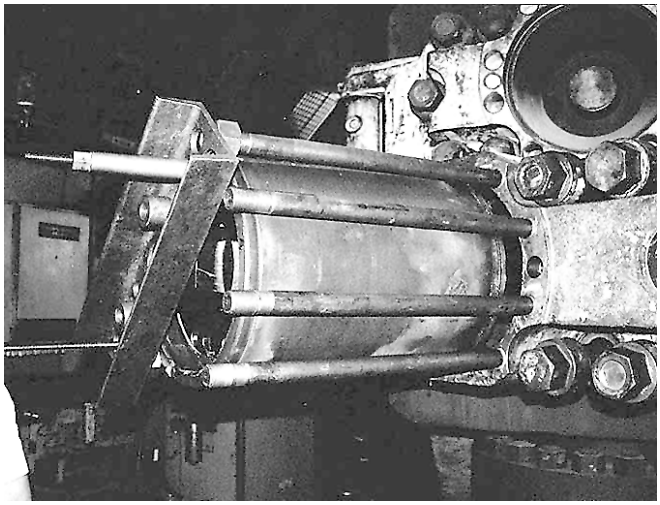


Figure 5-56. Typical Cylinder Removal From Door

   b. While the cylinder and piston assembly is supported by the web-lifting strap, pull the assembly clear of the cylinder studs.

   c. The ram shaft can now be removed from the piston with a strap wrench.

Care should be taken not to damage the OD (seal surface) of the ram shaft.

4. Attach lifting chains to the two lifting eye bolts (see Figure 5-57 on page 5-68). Lift the cylinder vertically approximately six inches above the workbench. With a block of wood, hammer the UltraLock II (B) piston out of the cylinder. The piston can also be removed by pushing it through the cylinder with the use of the puller nut assembly and puller tool (see Figure 5-58 on page 5-68).

Figure 5-57. Removal of Piston from Cylinder

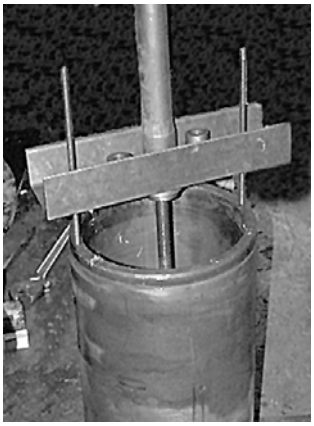


Figure 5-58. Pushing Piston Through Cylinder

5. Disassembly of Piston Assembly:

   a. Remove the cap screws holding the retainer plate to the piston, using a $^{5}/_{8}$" hex wrench; remove retainer plate from piston (see Figure 5-59 and Figure 5-60).

Figure 5-59. Removal of Retainer Plate/Piston Sleeve

Figure 5-60. Removal of Retainer Plate

b. Install a 1”-8UNC lifting eye into the locking piston and lift the locking piston/sleeve out of the piston assembly (see Figure 5-61).

Figure 5-61. Install Lifting Eye Bolt in Locking Piston

c. Remove the 12 cap screws from the seal plate using a $^{3}/_{8}$” hex wrench. Install ½” lift eyes, 2 each, and remove the seal plate.

d. Install two $^{5}/_{8}$”-11UNC lifting eye bolts into the locking piston sleeve. Pick up approximately six inches, and then knock out the locking piston using a wood block to protect the piston.

e. Remove the poppet assembly using removal/installation tool (P/N 127110); rotate tool counterclockwise, and then remove the poppet assembly and compression spring from the piston (see Figure 5-62).

For inspection and repair of the poppet assembly, see the section titled “Poppet Assembly Repair” on page 5-71.

Figure 5-62. Removal/Installation Poppet Valve Assembly

6. Disassembly of Rod Plate Assembly:
   a. Remove the eight cap screws using a ¾" hex wrench, and then lift the rod plate assembly from the cylinder head.
   b. Remove the lock rods.

Poppet Assembly Repair

This section outlines the repair procedures for the poppet assembly (P/N 20022638) used in the UltraLock II (B) piston assembly (P/N 20001257) (see engineering drawing C-2001255D). These procedures are provided for field repair operations and involve the total replacement of O-rings, seal, cotter pin, and Nylok pellet. For a list of tools used during repair, see the table titled "Recommended Tools — Poppet Assembly Repair" on page 5-71.

Number in parentheses correspond to the callouts in Figure 5-63 on page 5-72 and the item numbers in the table titled "Parts List — Poppet Assembly" on page 5-72. Refer to this table for assembly and kit part numbers.

Recommended Tools — Poppet Assembly Repair

Description	Purpose
Torque wrench with 50 ft-lb range	Tightening valve components
8-inch pliers	Removing Nylok pellet from retainer
$^{3}/_{8}$" hex wrench	Hex head screws
Removal/installation tool (P/N 127110)	Installing poppet assembly

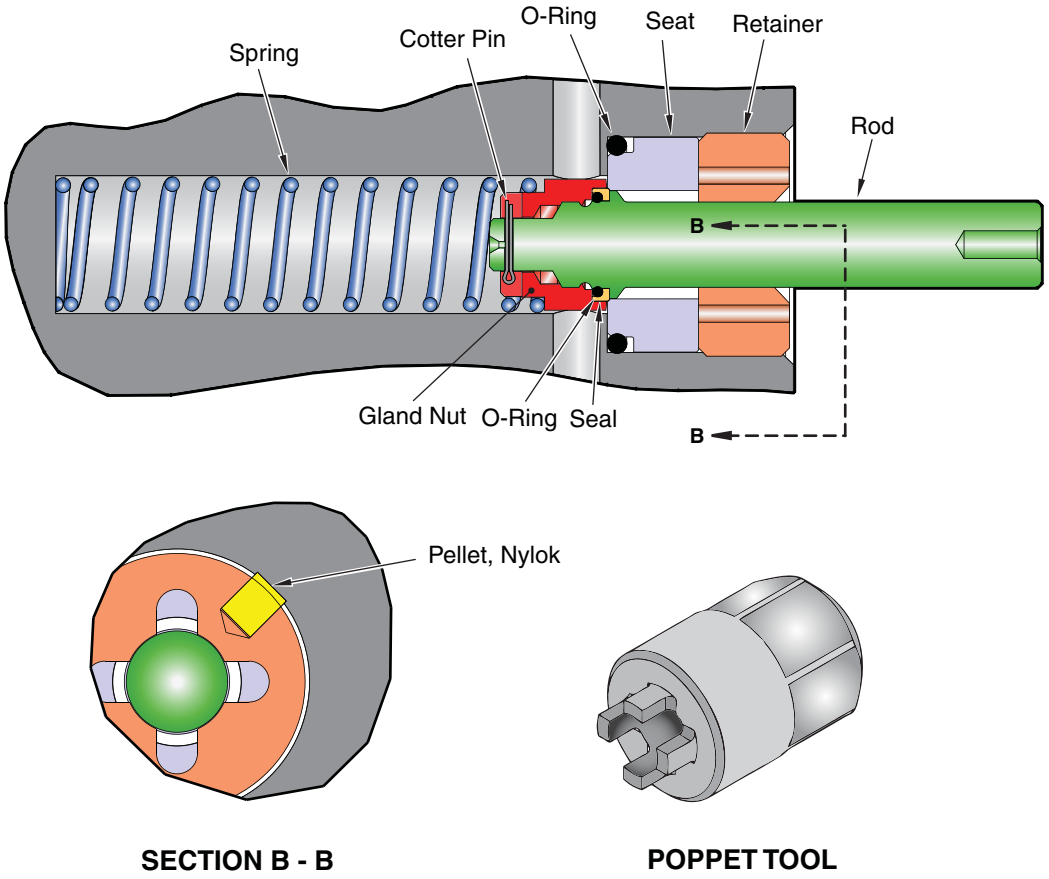


Figure 5-63. Poppet Assembly (P/N 20022638)

Parts List — Poppet Assembly

Item #	In Repair Kit	P/N	Description	Qty.
–		20022638	Poppet Assembly	–
–		20022674	Repair Kit	–
1			Seat	1
2	✓		O-Ring	1
3			Retainer	1
4			Rod	1
5	✓		Seal	1
6	✓		O-Ring	1
7			Gland Nut	1
8	✓		Cotter Pin	1
9			Spring	1
10	✓	20008501	Pellet, Nylok *	1

NOTE: Replace Nylok pellet every time the poppet assembly is removed from UltraLock II (B) piston. It is recommended that spare Nylok Pellets be kept on hand.

Disassembly — Poppet Assembly

Before commencing disassembly of the poppet assembly, verify the repair kit (P/N 20022674) is available.

1. Remove the poppet assembly using removal/installation tool (P/N 127110), rotate the tool counterclockwise, and then remove the poppet assembly and compression spring from the piston.
2. Remove the spring (9) and slide retainer (3) and seat (1) off the rod (4). Remove the O-ring (2) from the seat; using pliers, remove the Nylok pellet (10) from the retainer.
3. With suitable hard wood or copper to protect the vise jaws from marking the rod, clamp the rod [with gland nut (7) facing up] vertically in a vise.
4. Remove the cotter key (8) from the rod (4), and then unscrew the gland nut (7) counterclockwise from the rod.
5. Remove the O-ring (6) and seal (5) from the rod.
6. Discard the old O-rings, seal, cotter pin and Nylok pellet.

Reassembly — Poppet Assembly

1. Clean all parts and inspect for damage; replace any damaged item(s).
2. With suitable hard wood or copper to protect the vise jaws from marking the rod, clamp the rod (with rod thread and cotter key hole up) vertically in a vise.
3. Install a new seal (5) over the rod until it contacts the shoulder of the rod (see Figure 5-63 on page 5-72).
4. Install the O-ring (6) over the rod until it contacts the seal (see Figure 5-63 on page 5-72).
5. Screw the gland nut (7) clockwise onto the rod until it contacts the O-ring (6) and seal (5). Do not use force or squeeze the O-ring and seal. If the hole in the gland nut does not align with the hole in the rod, rotate the gland nut counterclockwise until the holes are aligned.
6. Install a new cotter key (8) into the gland nut (7) and through the rod (5). Spread the ends of the cotter key to prevent it from coming loose.
7. Install a new O-ring (2) into the seat groove (see Figure 5-63 on page 5-72).
8. Slide the seat, retainer, and removal/installation tool over the rod.
9. Holding the seat/retainer/removal/installation tool assembly in one hand, and the spring onto the gland nut with the other hand, enter the spring into the UltraLock II (B) piston, taking care not to move the O-ring (2) off the seat (1).
10. Enter the retainer into the thread on the piston and rotate clockwise into the piston using the installation tool. Torque retainer to 100 ft-lb.

Leakage Test — UltraLock II (B) Poppet Assembly

The operator assembly and ram shaft must be removed from the NXT door to gain access to the front of the piston as shown in Figure 5-64 (see the section titled “UltraLock II (B) Operator Locking System Repair” on page 5-63).

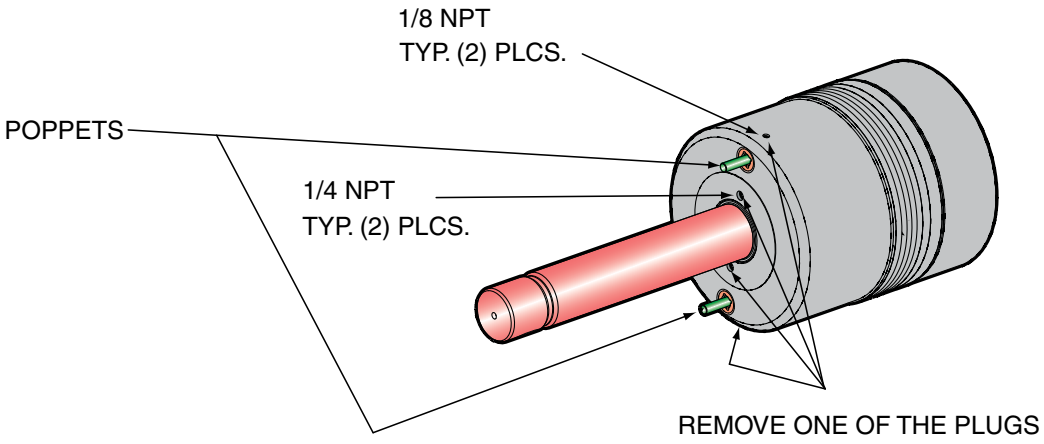


Figure 5-64. UltraLock Operator and Ram Shaft Assembly

The test apparatus shown in Figure 5-65 is required to properly test the poppet assembly.

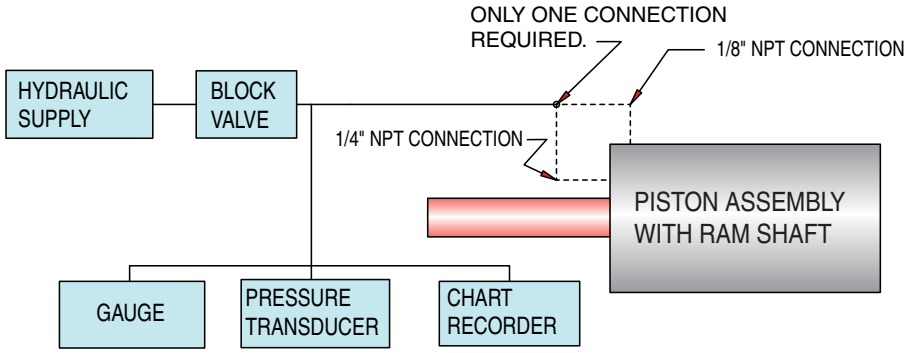


Figure 5-65. Test Apparatus

To perform the poppet assembly leakage test, proceed as follows:

Warning

A small volume of hydraulic pressure may be trapped in the piston assembly. Depress a poppet to release this pressure.

1. Using a ¼” hex wrench, remove one of the plugs indicated in Figure 5-64 on page 5-74.

2. Connect the test apparatus into the ¼" NPT port in the side of the operator.
3. Using a $^{3}/_{16}$" hex wrench remove the $^{1}/_{8}$" NPT plug from the port of the operator.
4. With the open $^{1}/_{8}$" NPT port facing upward, slowly open the block valve and purge all trapped air from the operator. When all air is removed, install the $^{1}/_{8}$" NPT plug into the operator.
5. Slowly apply pressure until 1,500 psi is indicated on the test gauge. Hold the 1,500 psi (103 bar) test pressure for 3 minutes.
6. If there is zero leakage from the two poppets, the test is completed. If leakage exceeds 5 ml/min, replace the poppet assemblies.

To replace the poppet assemblies, see the section titled "Poppet Assembly Repair" on page 5-71.

Reassembly — UltraLock II (B) Locking Operator

For reassembly of the UltraLock II (B) operator, see Figure 5-66 on page 5-78 and engineering drawing C-20001255D. For a list of tools, see the table titled “UltraLock II (B) Toolkit (P/N 165551)” on page 5-64.

For parts list, see the table titled “Parts List — UltraLock Piston Assembly”. Item numbers in this table correspond to the callouts in Figure 5-66 on page 5-78, and numbers in parentheses in the following procedures.

Use only water-soluble lubricants to assemble the UltraLock system. Apply all thread lubricants sparingly, to prevent contamination of the UltraLock friction surfaces.

Parts List — UltraLock Piston Assembly

Item #	Qty	Description	P/N
–	1	Piston Assembly	20001257
1	1	Piston	20001256
2	1	Seal	031181
3	2	Wear Ring, 14”	115524
4	1	Wear Ring	119263
5	1	O-Ring	030124
6	1	Back-up Ring	030954
7	2	Dowel Pin	050098
–	–	Poppet Assembly	20022638
8	2	Spring	*
9	2	Rod	*
10	2	Seat	*
11	2	O-Ring	*
12	2	Retainer	*
13	2	Nylok Pellet	20008501
14	2	Pipe Plug, 1/8”	065007
15	2	Pipe Plug, ¼”	065008
16	1	Seal Plate	165502
17	1	O-Ring	030147

Parts List — UltraLock Piston Assembly (Continued)

Item #	Qty	Description	P/N
18	2	Back-up Ring	030962
19	1	O-Ring	030139
20	2	Back-up Ring	030953
21	12	O-Ring	030252
22	12	Screw, SHC	010608
23	1	Piston, Locking	165557
24	2	Seal, Polypak	031351
25	1	Sleeve	165556
26	4	Wedge, Locking	20002093
27	1	Retainer Plate	165555
28	8	Screw, SHC	010733
29	1	Lock Rod Plate	165537
30	4	Locking Rod	20001252

** Items #8 through #12 are replaced as an assembly (P/N 20022638).*

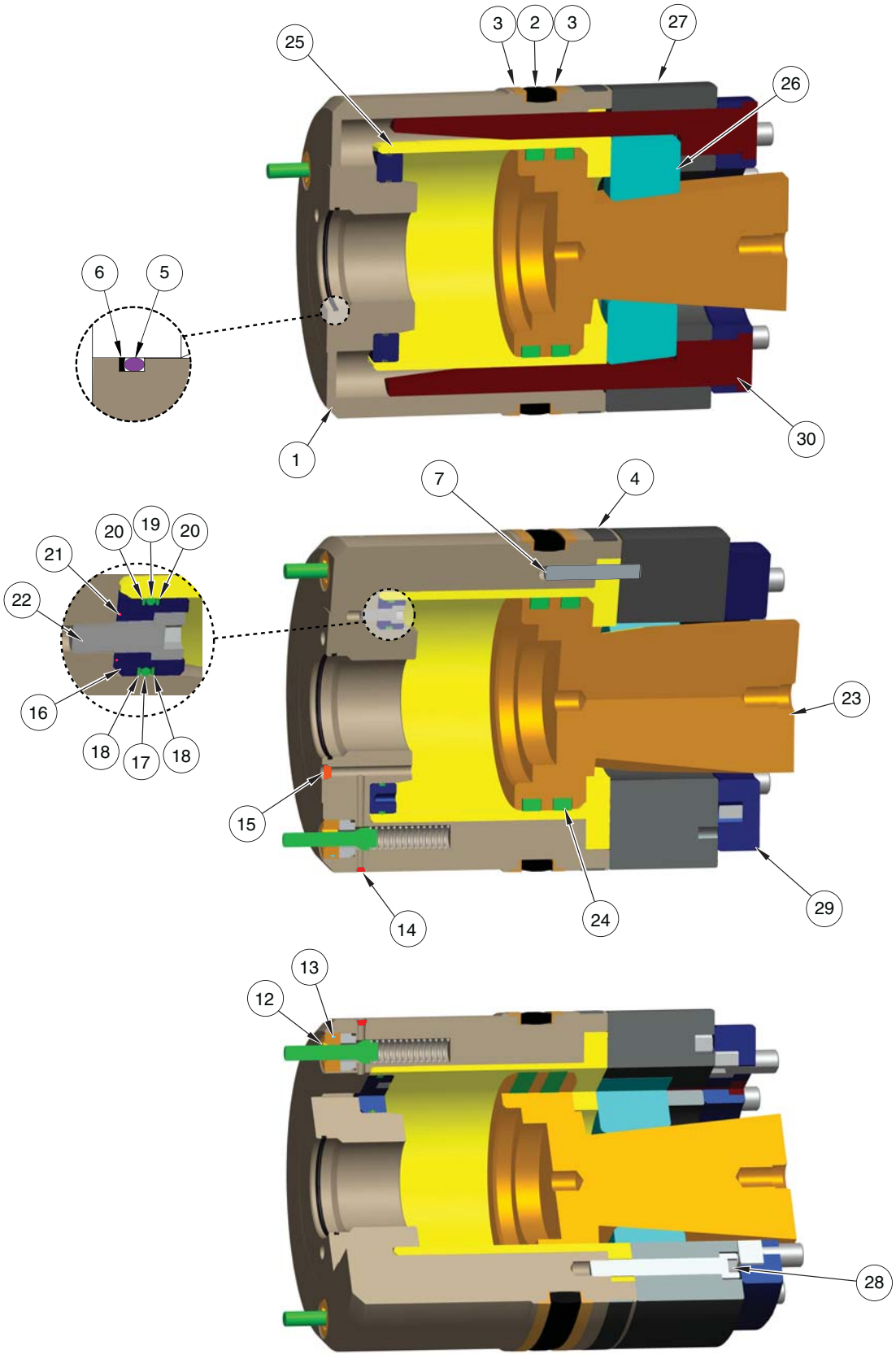


Figure 5-66. Piston Assembly, 14” UltraLock II (B)

1. Assemble UltraLock II (B) Piston:
   a. Using the poppet installation tool, install the poppet assembly. See Figure 5-62 on page 5-70. Tighten until assembly bottoms in piston.
   b. Install the OD O-rings (17) and backup rings (18) and the ID O-ring (19) and the backup rings (20) into the seal plate (16). Install the twelve O-rings (21) into the seal plate (see Figure 5-66 on page 5-78). Lightly grease the O-rings to help keep them in place.
   c. Install 2 each ½"-NC all thread into the screw holes in the UltraLock II (B) piston. Carefully position the seal plate (16) over the all thread guides and slide down until contact is made with the piston. Using the puller nuts, pull the seal plate into place being careful not to dislodge the O-rings on the face of the seal plate. Remove guide pins and install the 12 cap screws (22) using $^{3}/_{8}$" hex wrench; torque to 100 ft-lb (149 kg/m) (see Figure 5-67).

Figure 5-67. Install Seal Plate

   d. Install seals, lips out and heals in, on the locking piston. Lightly lubricate the seals and install the locking piston (23) into the locking piston sleeve (25), making sure that the slots on the locking sleeve align with the flats on the locking piston (see Figure 5-66 on page 5-78 and Figure 5-68 below).

Figure 5-68. Locking Piston

e. Install the dowel pins (7), in two places, 180° apart, in the retainer plate (27) (see Figure 5-69).

f. Position the locking wedges (26) on the locking piston (23), and then align the retainer plate (27) over the locking wedges using the dowel pins (7) (see Figure 5-70).

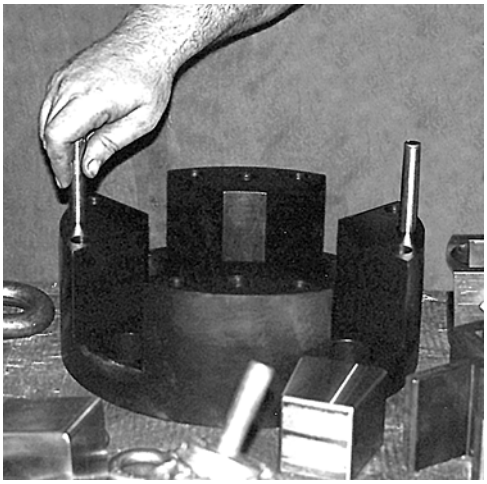


Figure 5-69. Install Dowel Pins in Retainer Plate

Figure 5-70. Installing Retainer Plate and Lock Assembly

g. Install a 1”-8UNC lifting eyebolt in the locking piston (23), and install the retainer plate/locking piston assembly into the piston (1) using the dowel pins as guides. Lubricate inside of the piston (1) and locking piston sleeve prior to installation (see Figure 5-68 on page 5-79).

h. Install the eight socket head cap screws (28) using a $^{5}/_{8}$” hex wrench; torque to 200 ft-lb (271 Nm).

i. Install OD poly bi-pack (2) and backup rings (3) on UltraLock II (B) piston. Install a new wear band (4) on piston. Use light grease, sparingly, to hold wear bands in place. Install O-ring (5) and back-up ring (6) into (ram shaft) bore of piston (1).

The back-up ring (6) faces the door side of the O-ring (5) (see Figure 5-66 on page 5-78).

j. Lubricate UltraLock II (B) piston OD and cylinder ID with lightweight oil (SAE 10W), and then slide the piston assembly into the cylinder. Place a block of wood on top of the locking piston, and then drive the UltraLock II (B) piston assembly into the cylinder, making sure not to damage the piston seals (2, 3) as they enter the cylinder.

k. Install the 1”-8UNC lifting eye into the locking piston (23) and then pull it up until bottomed out in the sleeve (25).

l. Lay the assembly on its side.

m. Rotate the ram shaft clockwise into the main piston.

2. Install Cylinder, Piston, and Ram Shaft Assembly:

a. With the door in the open position inspect the ram shaft seal assembly in the door. Replace seals as required (see Figure 6-5 on page 6-11 and the table titled “Parts List — Ram Shaft Seal Assembly (P/N 168075)” on page 6-11).

b. Lubricate seal assembly (4) and ram shaft (2) with lightweight oil. Attach a web-lifting strap around the piston assembly and lift. Position the ram shaft in front of the cylinder side of the door and in alignment with the seal assembly. Insert the ram shaft carefully into the seal assembly, using “come alongs” or other manual lifting devices to precisely control the assembly (see Figure 5-71).

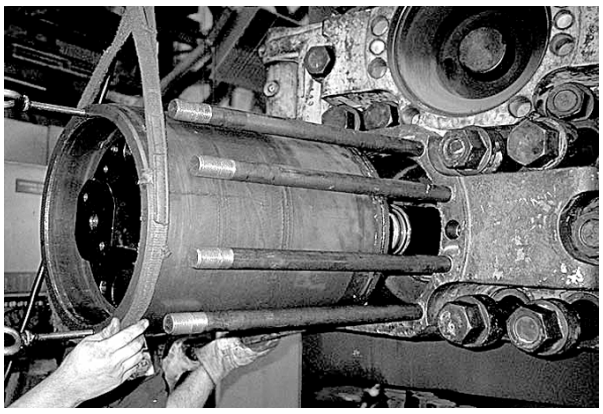


Figure 5-71. Typical Lifting of Piston Assembly into Door

The word “PIPE” is stamped on the outward area of the piston body, outside two of the four large 2” diameter holes near the outside diameter (two locations, 180° apart). With the door installed on the BOP body, the marking “PIPE” should be located at the top of the assembly (see Figure 5-73 on page 5-83).

c. Carefully slide the UltraLock II (B) piston assembly into the door and install the puller tool over two opposing cylinder studs.

d. Install two $1^{7}/_{8}$” nuts and pull the cylinder tightly into the door. Care must be taken not to cut the cylinder O-ring (8) and backup ring (9).

e. Assemble the foot onto the ram shaft and turn it to accept the ram block assemblies.

When closed, the pipe ram assemblies will not unlock if the piston assembly and cylinder assembly marks are not properly aligned.

f. Install the door seal cartridge (3) on the door and the ram assembly on the ram shaft.

g. Close the door.

3. Install Lock Rod/Lock Rod Plate:

Check that the lock rod center bores are clean and free of debris, Loctite, etc. Install the lock rods (30) to the lock rod plate (29) (see Figure 5-72 and Figure 5-66 on page 5-78).

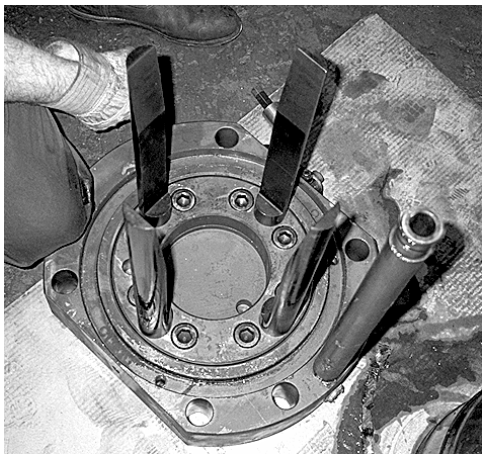


Figure 5-72. Rod Plate

4. Assemble Locking Rod Plate to Cylinder Head (see Figure 5-73):

   a. The cylinder head has been stamped with the word “TOP” in two places 180° apart. The lockrod plate assembly is marked on the lockrod plate at each lockrod. The marking is “TOP-PIPE” (see Figure 5-73). The lockrod plate assembly, when installed into the cylinder head, must be assembled with these markings matched. Torque the screws to 200 ft-lb (271 Nm).

When closed, the pipe ram assemblies will not unlock if the piston assembly and cylinder assembly marks are not properly aligned.

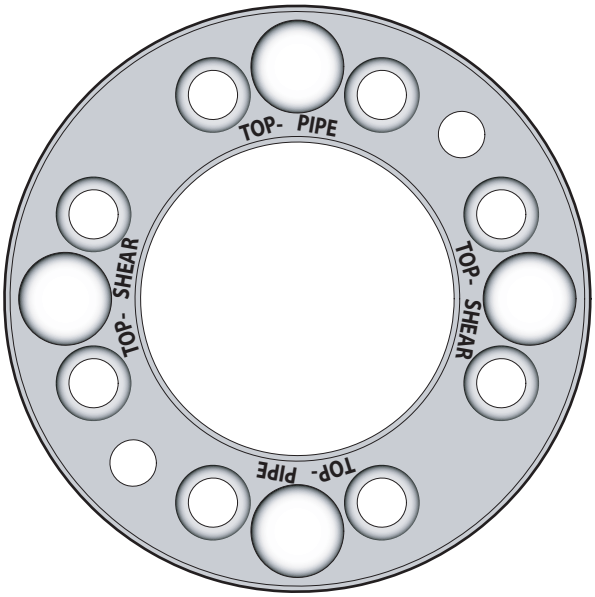


Figure 5-73. Lockrod Plate

   b. Install the lockrod plate assembly into the cylinder head using the eight socket head cap screws (28) and $^{5}/_{8}$” hex wrench; torque to 200 ft-lb.

   c. Check for free movement of the lockrods in the lockrod plate (see Figure 5-72 on page 5-82).

5. Install cylinder head and locking rods:

Flush the open and close hydraulic ports prior to installing the cylinder head. Flushing should be performed from the door hinge hydraulic ports and through the manifolds to dislodge any debris or foreign matter that may be trapped there.

a. Install the manifold O-rings (6) on the manifold pipe (5). Lubricate the O-rings with light oil and install the manifold pipe into the door (see Figure 6-2 on page 6-4).

b. Install the cylinder head O-ring (10) and backup ring (11). Lubricate with light oil and install cylinder head over cylinder studs and manifold pipe (see Figure 6-2 on page 6-4).

c. Install the four cylinder head lock nuts (14) using a $2^{7}/_{8}$" wrench; torque to 2,200 ft-lb (2,983 Nm) using Sweeney 503 Moly Paste (P/N 403582). Use a crisscross pattern to pull cylinder head down evenly; *do not overtorque*.

If Sweeney 503 Moly Paste is not available, torque to 6,000 ft-lb (8,135 Nm) using SAE-10W oil on threads.

The "TOP" markings on the cylinder head and lockrod plate assembly must match the marking on the piston during this assembly.

6. Perform hydraulic pressure test (see the section titled "Hydraulic Pressure Test" on page 4-16).

Do not exceed normal 1,500 psi (103 bar) operating pressure while testing.

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. 16A and API RP53, paragraph 7.A.2 for additional information.

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

Replacing the Ram Shaft Seal Assemblies – UltraLock II (B)

To replace the ram shaft seal assembly (RSSA) requires the ram shaft to be removed from the door (see the section titled “UltraLock II (B) Operator Locking System Repair” on page 5-63”).

To replace the RSSA proceed as follows:

(All items in parenthesis refer to Figure 5-74 and the associated parts lists.)

The RSSA also includes one hydraulic opening pressure polypak seal (see Figure 5-74).

1. Clean the RSSA door cavity and clean the operator side groove for the hydraulic opening pressure polypak seal with fine emery cloth.
2. Lubricate the RSSA and the door cavity with SAE 30W oil, and install the new RSSA complete with a new spiral retainer ring as shown on Figure 5-74.

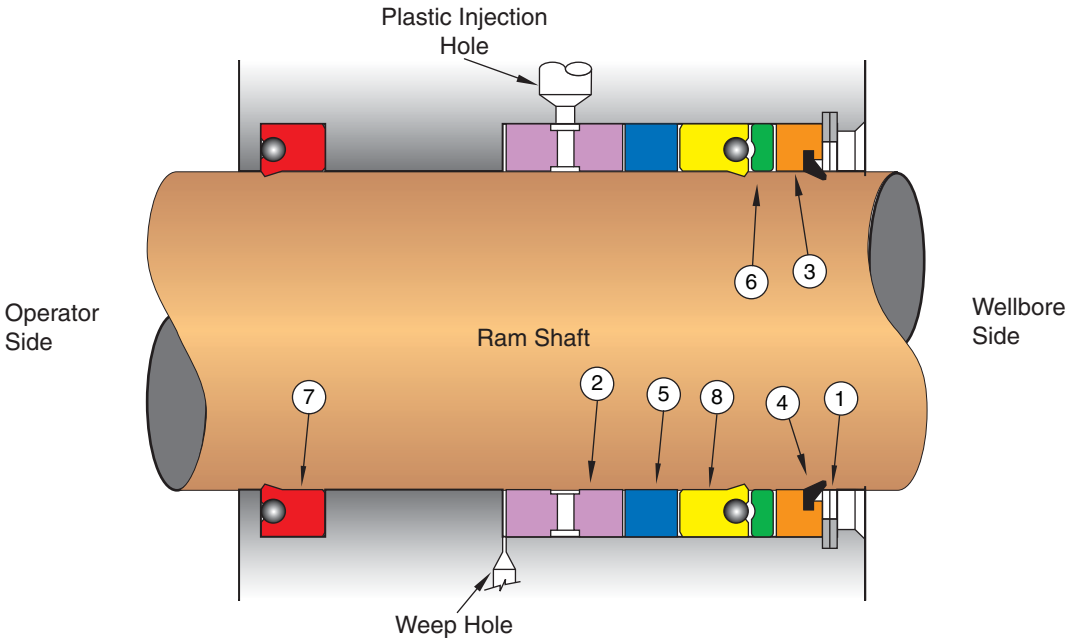


Figure 5-74. Ram Shaft Seal Assembly – UltraLock

Ram Shaft Seal Assembly Parts List (P/N 168075)

Item No.	Part Number	Description	Qty.
1	20141470	Retainer Ring	1
2	168058	Packing Adapter	1
3	168059	Holder	1
4	031176	Wiper Ring	1

Ram Shaft Seal Assembly Parts List (P/N 168075) (Continued)

Item No.	Part Number	Description	Qty.
5	062735	Modular Bearing	1
6	031381	PIP Ring	1
7	031382	Polypak Seal, Deep	1
8	031379	Polypak Seal	1

Removing 22” PosLock Ram Shaft Seal Assembly

If the wellbore is under pressure and fluid is visible from the NXT door weep hole, this indicates the RSSA is leaking.

To remove the RSSA proceed as follows:

(Numbers in parentheses correspond to Figure 5-76 on page 5-90 and the associated parts list.)

1. Vent all wellbore pressure and open the door assemblies that have the defective seal assemblies.
2. Remove the ram shaft foot by applying a small amount of closing pressure to extend the ram assembly and expose the foot. Remove the ram assembly from the foot (see the section titled “Ram Assembly Removal and Inspection” on page 5-101).
3. Remove the ram foot (34), by first removing the two socket head screws and the stop/guide plates (36).

If removing the RSSA from the lower operator on a double NXT Ram BOP, it is recommended to open the upper ram and remove the ram assembly. This will allow easier access of the necessary lifting equipment.

4. Apply opening pressure to retract the ram shaft and then vent operating hydraulic pressure to 0 psi (0 bar).
5. Use the cylinder drain plugs to remove any remaining hydraulic fluid from the operating chamber.

6. Remove the 12 hex nuts (12) from the end cap (4), exposing the anti-rotation nut (15) and bolt (16). Install four all thread ($^5/_8$"-11UNC) jacking screws with two nuts each into the UNC threaded holes in the face of the end cap. Lubricate the screws with an anti-seize lubricant. Use lifting eye in top ½" hole for handling.

When removing the lock nuts, should the stud be removed, see Note 5 in the door assembly engineering drawing located in the section titled "Engineering Drawings and Parts Lists" on page 6-20.

7. Tighten the jack bolts to remove the end cap.
8. Remove both the anti-rotation nut and bolt from the end of the main piston shaft (14).
9. Remove the eight hex nuts (6) from the cylinder head assembly, and install two lifting eye bolts in the top of the assembly (see Figure 5-76 on page 5-90). Attach lifting equipment to the eye bolts to support the weight of the cylinder head assembly. Maintain a level position while removing the assembly. Using the same jacking bolts from the end cap, locate and install in the threaded holes in the cylinder assembly. Tighten the screws to remove the assembly (see Figure 5-76 on page 5-90).

When removing the lock nuts, should the stud be removed, see Note 1 in the door assembly engineering drawing located in the section titled "Engineering Drawings and Parts Lists" on page 6-20.

10. Carefully slide the cylinder head assembly off the main piston shaft. While moving the assembly, exercise care with the removal of the two door manifolds (10).
11. With the cylinder head assembly off, remove two opposing bolts from the wedge and bushing housing assembly (see Figure 5-75 on page 5-89). Insert and thread the two spring compression tools (P/N 20020234) to compress the locking segments and spring within the cylinder head assembly. Remove the remaining six bolts from the wedge and bushing housing assembly (see Figure 5-75 on page 5-89). Begin backing off of the compression tools evenly until spring is decompressed.

Thread the compression tool in until it bottoms out. Alternate between the tools in the threading process. Do not over tighten.

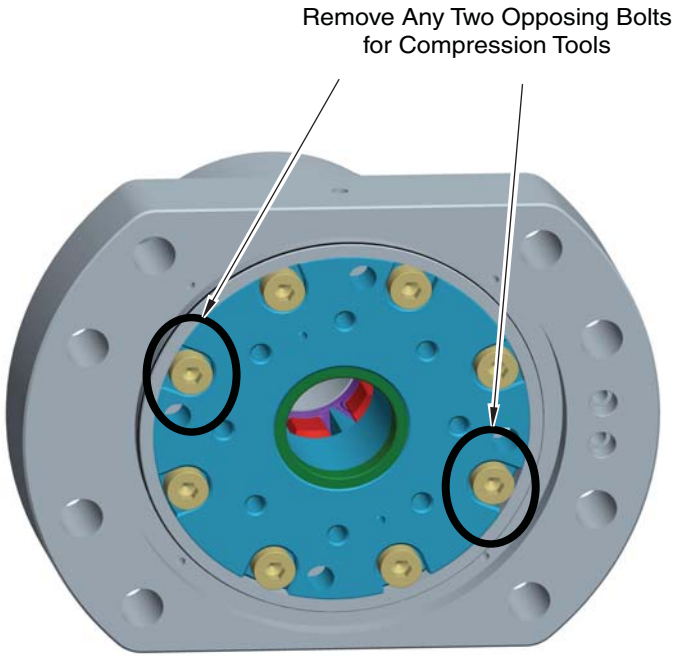


Figure 5-75. Cylinder Head

12. The main piston and ram shaft can now be removed as an assembly. A lifting eye can be installed in the end of the main piston shaft as a pulling aid for removal. A suitable hardwood block can be used to drive the ram shaft from the door. Use web lifting straps to support the weight of the assembly during removal.

Care should be taken not to damage the outside diameter (seal surface) off the ram shaft and piston shaft.

Make temporary alignment marks on the cylinder and main piston assembly for ease of reassembly.

Additional straps should be used to support the cylinder while the shafts are removed. Straps should be placed under the cylinder studs.

13. The ram shaft seal assembly is now available for removal. Remove the spiral retainer ring (6) and then the seal assembly can follow. See Figure 5-77 on page 5-92 and the related parts list.

With the cylinder head assembly removed for RSSA replacement, the opportunity can be taken to replace the seals and O-rings within the assembly. For details, see Figure 5-76 and the door assembly drawing in Chapter 6, titled “Specifications and Parts Lists”.

The locking segments and springs must be compressed for installation of the cylinder head assembly onto the Main piston shaft.

Be sure to line up the fluid ports in the wedge housing during the assembly.

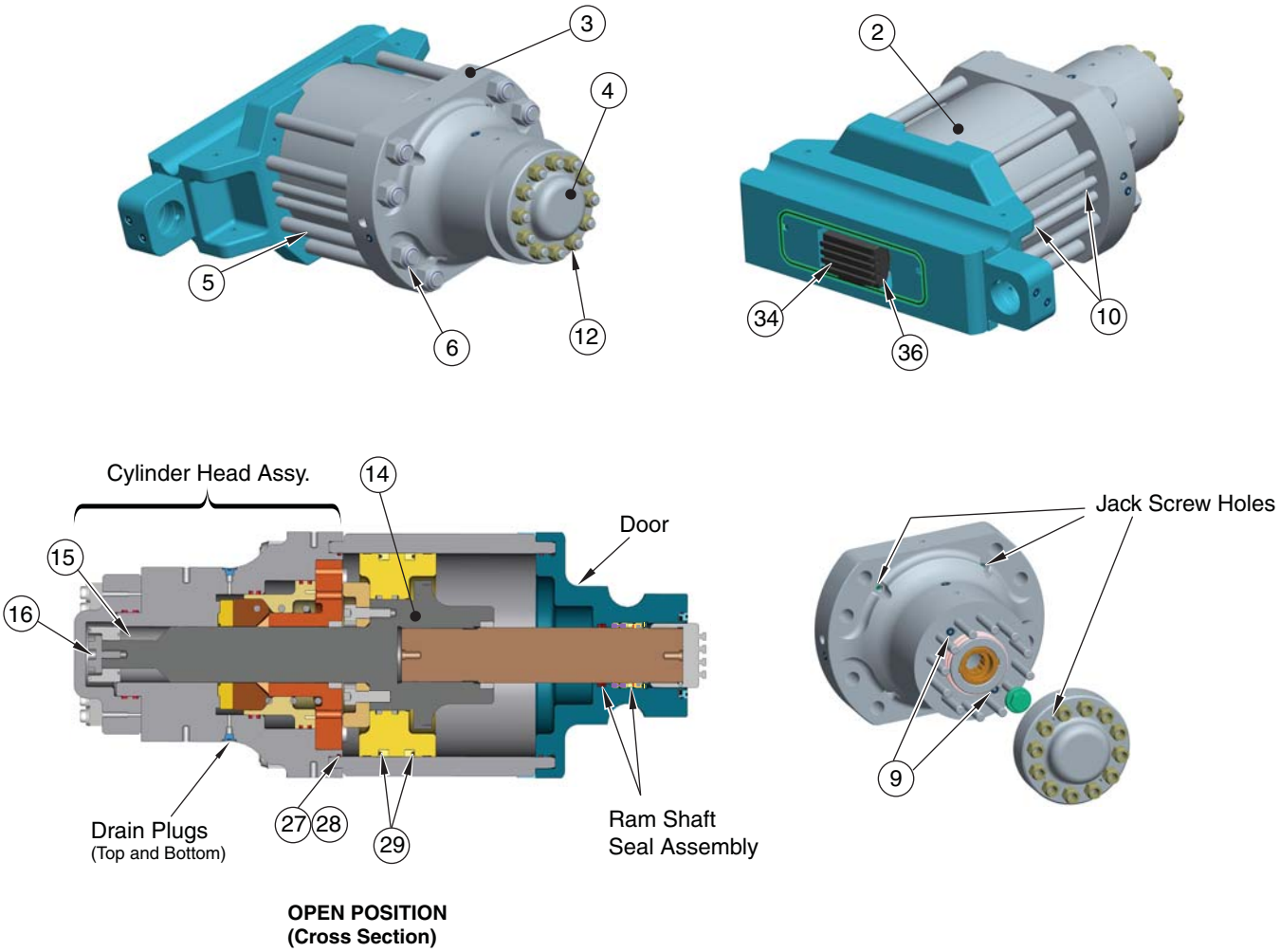


Figure 5-76. 22” PosLock Door Assembly Components

Components of 22” PosLock Door Assembly (P/N 20018931)

Item No.	Description
2	Cylinder
3	Cylinder Head Assembly
4	End Cap
5	Cylinder Stud
6	Nut, Cylinder Stud
9	Plug
10	Manifold, Cylinder
12	Nut, End Cap
14	Main Piston Assembly
15	Anti-Rotation Nut
16	Anti-Rotation Bolt
27	O-Ring, Cylinder Head
28	Back-up Ring, Cylinder Head
29	Seal, Polypak, Main Piston
34	Foot, Ram Shaft
36	Plate, Stop/Guide

Ensure the proper orientation of the anti-rotation nut and bolt (15, 16); otherwise, damage will occur. Refer to the door assembly drawing in Chapter 6, titled “Specifications and Parts Lists”.

Replacing 22” PosLock Ram Shaft Seal Assembly

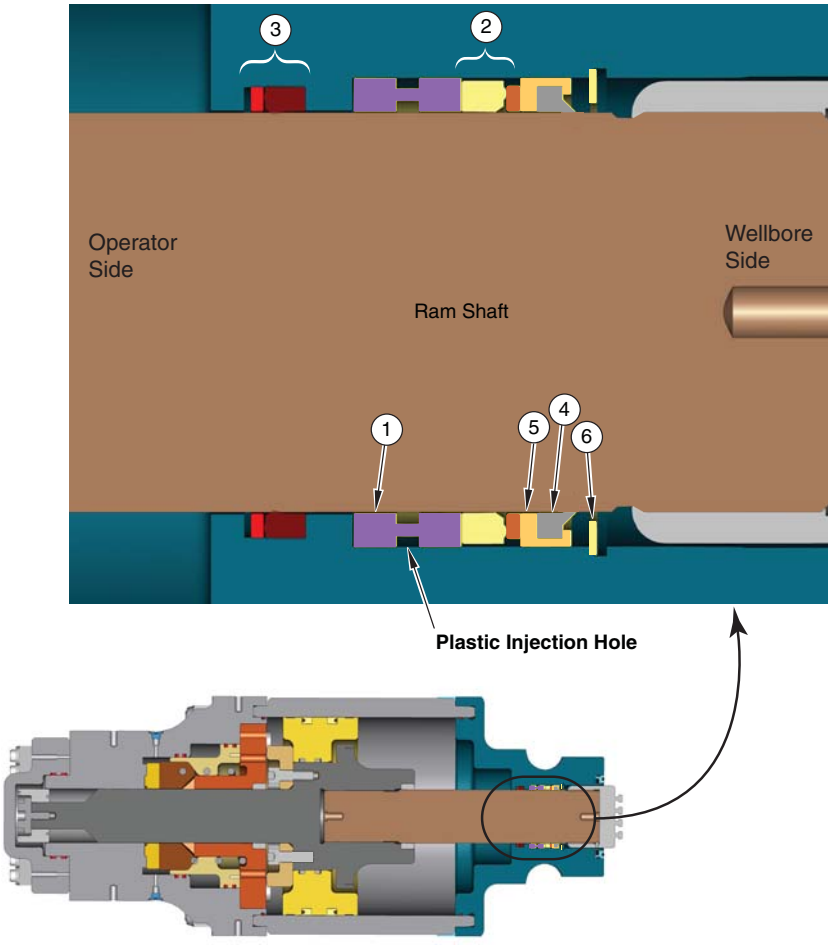
Replacing the ram shaft seal assembly (RSSA) requires the operator to be disassembled (see the section titled “Removing 22” PosLock Ram Shaft Seal Assembly” on page 5-87).

To replace the RSSA, proceed as follows:

(Numbers in parentheses correspond to Figure 5-77 and the associated parts list.)

The RSSA also includes one hydraulic opening pressure polypak seal (see Figure 5-77).

1. Clean the RSSA door cavity and clean the groove for the hydraulic opening pressure polypak seal with fine emery cloth.
2. Lubricate the RSSA and the door cavity with SAE-30W oil, and install the new RSSA complete with a new spiral retainer ring as shown on Figure 5-77.



OPEN POSITION
(Cross Section)

Figure 5-77. 22” PosLock RSSA

Ram Shaft Seal Assembly Parts List (P/N 20018651)

Item No.	Part Number	Description
1	20016822	Packing Adapter
2	20018603	Pip Seal Assembly
3	20018604	Pip Seal Assembly
4	030965	Wiper Ring
5	20016823	Holder, Wiper Ring
6	20018595	Spiral Ring, Retainer

Reassembly — 22” PosLock Operators

Numbers in parentheses correspond Figure 5-76 on page 5-90 and the table titled “Components of 22” PosLock Door Assembly (P/N 20018931)” on page 5-91.

1. Install a new Polypak seal (29) onto the piston assembly (14). Arrange a lifting strap on the piston operator, lift the piston assembly and align with the opening of the cylinder. Lubricate the inside of the cylinder and RSSA with SAE 30W oil. Carefully enter the shaft of the piston assembly into the RSSA; with a suitable hardwood block or rubber mallet tap the operator shafts into the RSSA, taking care to aligning the piston into the cylinder. Continue to tap the piston operator until the piston is fully entered into the cylinder.
2. Install four new O-rings on the manifolds (10). Lubricate with SAE 30W oil and install into the door.
3. Install a new backup ring (28) and O-ring (27) into the cylinder head. O-rings are placed on the cylinder so the orientation is inward or facing each other.

If the cylinder was removed, install a new O-ring and back-up ring in the door.

4. Install lifting eyes into the cylinder head and lift the cylinder head until aligned with the cylinder and manifold. Lubricate the manifold and the cylinder head O-rings with SAE-30W oil, and slide the cylinder head over the studs (5), aligning the cylinder head until it enters the cylinder and manifold. Install the hex lock nuts and torque in a criss-cross fashion until a maximum torque of 4,500 ft-lb (6,101 Nm) on the 22” PosLock is reached.
5. Install the ram shaft foot and stop plate guide (see the section titled “Three-Month Preventive Maintenance” on page 5-11).

The ram shaft foot must be fully engaged and torqued to the ram shaft.

6. For the 22” PosLock cylinder, an adjustment in the PosLock setting may be necessary if changes have been made that affect the settings (see the section titled “PosLock Adjustment Procedure” on page 5-99).

Ensure proper orientation of the anti-rotation nut and bolt (15, 16) or damage will occur. Part is stamped “HEAD SIDE” and “DOOR SIDE” for proper alignment. See the door assembly drawing in Chapter 6, titled “Specifications and Parts Lists”.

7. Once any adjustments are made, the end cap can be replaced after the installation of the anti-rotation nut and bolt. Apply proper torque to all hex nuts (see the 22″ PosLock assembly drawing in Chapter 6, titled “Specifications and Parts Lists”).
8. Install the ram assembly (see the section titled “Ram Assembly Removal and Inspection” on page 5-101).
9. Close the door (see the section titled “NXT Door Locking System and Door Hydraulic Control Panel” on page 4-19).

22” PosLock Adjustment

Overview

The PosLock system locks automatically in one position each time it is closed, remaining locked even if closing pressure is removed. Opening hydraulic pressure is required to reopen the pistons [do not exceed 1,500 psi (103 bar)]. The PosLock system uses a single set of locking segments to achieve the positive mechanical lock. This provides for one locking position, which is the maximum requirement for standard pipe rams or shear rams (not applicable to multirams). The PosLock system must be manually adjusted for changes in ram types, and to compensate for ram wear over time. See Figure 5-78 on page 5-95 for component detail.

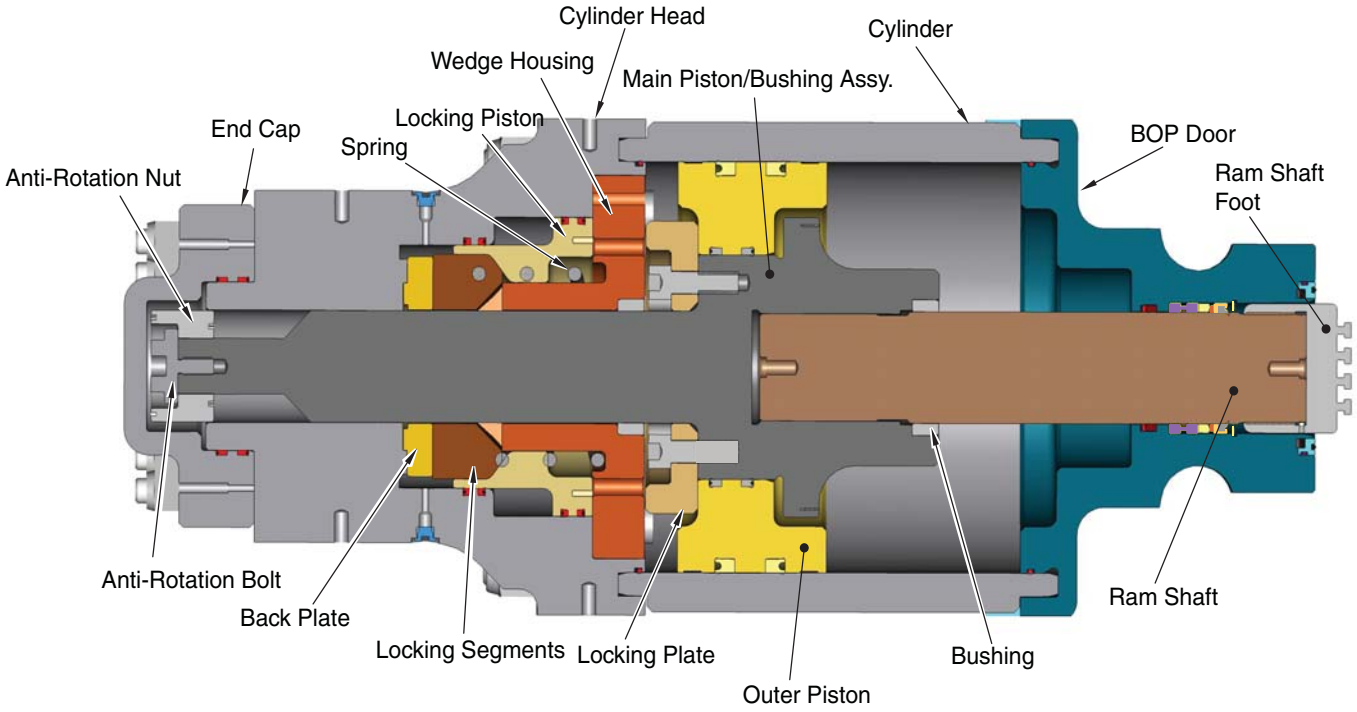


Figure 5-78. 22" PosLock Operator Components

Generally, a very low closing pressure will close the rams until the ram rubbers meet. At this point, the locking segments are near the locking shoulder on the main piston assembly. As additional pressure is applied, the ram rubber is compressed and the locking segments move past the locking shoulder. This allows the locking segment to move radially from the locking piston, which they promptly do because they are forced radially inward by the taper on the locking piston. The locking piston is a small piston inside the main piston and is forced outward (away from well center) by the same closing hydraulic pressure, which moves the main piston inward (toward well center).

After the locking segments have extended inwardly radially, the locking piston moves outward blocking the segments from retracting and thus locking the rams in the closed position. The spring behind the locking cone prevents the locking cone from vibrating out of position.

In opening the rams the operation is reversed. Opening pressure forces the lock piston back against the spring, which in turn allows the locking segments to move radially to the piston, unlocking the ram and allowing the piston to open the ram.

The PosLocks have to be properly adjusted to ensure that the locking segments are engaged when there will be sufficient sealing compression at the face and the top ram seals. The ram shaft is threaded into the piston with right hand adjustment threads. By rotating the piston on the ram shaft the length of the ram shaft can be adjusted.

PosLocks should be checked each time routine maintenance is done on the stack to ensure they are properly adjusted, particularly after changing rams.

If hydraulic closing fluid is slowly throttled into the preventer, pressure drops will be observed as the locking cones move into the locked position. The pressure at which these fluctuations occur indicates the amount of ram rubber compression. The following procedure details the measurement of the PosLock locking pressure for both shear and pipe rams and gives detailed notes on PosLock adjustments in order to obtain the proper amount of rubber compression.

The setting of the PosLocks includes several factors:

- BOP Size and Model — dependent on the BOP operator, PosLocks require different settings.
- Type of Ram — settings are different for the various types of available rams.
- Condition of components — new components may require different settings than used components. As in the case of ram rubbers, new ram rubbers react differently than used rubbers.

The following procedure supplies pressure ranges that the PosLocks are to be adjusted to. It is important to note that the locking pressure will typically fall after a number of cycles, due to the working of the rubber seals. Therefore, setting the PosLocks to the upper pressure limit may extend the time required between adjustment periods.

When shearing pipe, it should be noted that the shear pressure would be higher than the PosLock Locking pressure. This is due to the shears having to shear the drill string prior to actually locking the PosLocks (PosLocks only lock in the sealing position). Regardless of the actual shear pressure the setting of the PosLock locking pressure should be maintained per this procedure to prevent unneeded wear to the shear ram rubbers.

Procedures

The setting of a set of PosLocks requires the following steps:

- Presetting the PosLocks during the assembly process of the operator using the PosLock Adjustment Presetting Guidelines (see “PosLock Adjustment Presetting Guidelines” below).
- Perform PosLock Adjustment Test, which will verify the current locking pressure and determine if an adjustment is necessary (see the section titled “PosLock Adjustment Test” on page 5-97).
- Re-adjust the PosLock as required (see the section titled “PosLock Adjustment Procedure” on page 5-99), and re-perform PosLock Adjustment Test. Repeat until locking pressure is within the acceptable pressure range.

PosLock Adjustment Presetting Guidelines

In order to minimize the adjustment times required to set the PosLock, see the table titled “PosLock Adjustment Guideline” on page 5-97. The table specifies what initial setting is to be used on a particular BOP size, model, operator cylinder size, and type of ram being used.

1. Refer to the table to find the initial settings.
2. Verify the ram shaft is bottomed out on the mandrel. This is accomplished by rotating the piston clockwise until the ram shaft bottoms out on the mandrel.
3. Rotate the piston counterclockwise to the initial setting.

PosLock Adjustment Test

To determine if the PosLock mechanism is adjusted properly, use the following procedure:

1. With the preventer in the open position, vent the opening port.
2. Set up the closing pressure per Figure 5-79 on page 5-98, placing the gauge as near to the closing port as possible. It is not necessary to supply accumulator pressure in excess of the required PosLock locking pressure required for the BOP.

Pipe rams should be closed on pipe of the proper size, and blind or shear rams should be closed on an empty hole.

3. Apply hydraulic pressure to the closing port while watching the gauge. Throttle the valve so fluid enters the preventer slowly enough to get an accurate reading.
4. As the preventer locks, two fluctuations will occur, one for each PosLock locking. One PosLock always locks before the other. The first pressure drop will be the locking of the first PosLock at low pressure, usually around 150 to 450 psi. (The low locking pressure on the first PosLock is because the ram rubber seals will not have the other ram to compress the ram rubber seals against.) The second pressure drop will be the locking of the other PosLock, and this pressure will be the PosLock locking pressure. The second pressure drop will be very noticeable, especially if the fluid is throttled in very slowly. The gauge will usually drop about 300 psi or so. The pressure at which the second drop begins to take place is called the PosLock locking pressure. See the table titled “PosLock Adjustment Guideline” for the specific locking pressures. If not, see the section titled “Procedures” on page 5-96 to determine which corrective action should be taken.
5. See the table titled “Adjustments Required Based on the Locking Pressure” on page 5-98 for corrective procedures if the PosLock locking pressure is not correct.

PosLock Adjustment Guideline

BOP Size	Model	Cylinder Size and WP	Mandrel Adjustment		Type Ram	Locking Pressure
			Right	Left		
13 5/8”-10M	NXT	22”-5K	4½	4 2/3	CVX	700 – 900
18¾”-5M	NXT	22”-3K	4½	4 2/3	CVX	700 – 900
18¾”-10M	NXT	22”-5K	4½	4 2/3	CVX	700 – 900
18¾”-15M	NXT	22”-5K	4½	4 2/3	CVX	700 – 900

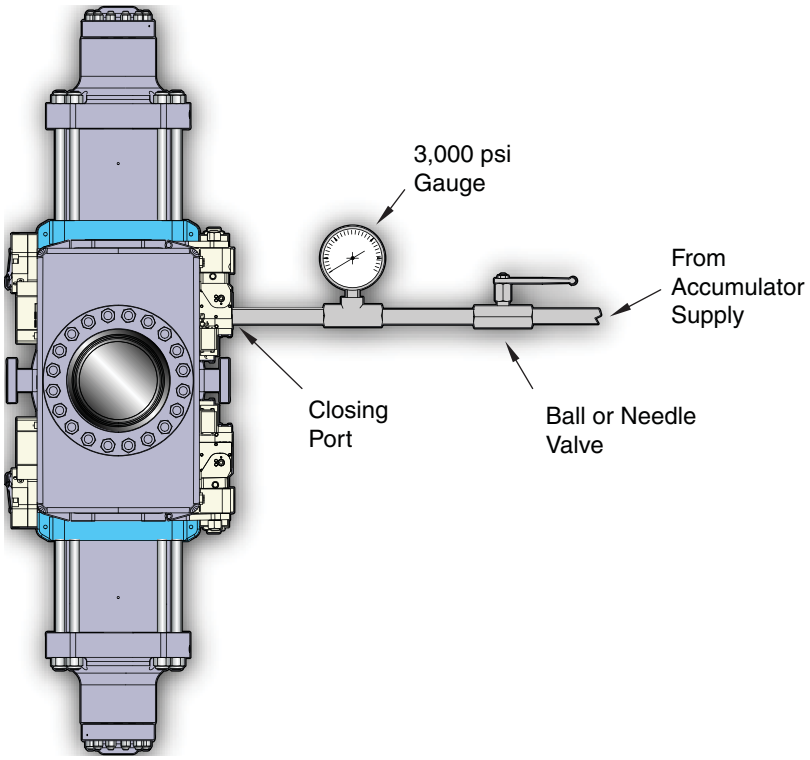


Figure 5-79. PosLock Adjustment Test Setup

Adjustments Required Based on the Locking Pressure

Observed PosLock Locking Pressure	Adjustment
Low (200 or 300 psi)	Raise the locking pressure.
High (above the pressure range recommended in the section titled “PosLock Adjustment Guideline” on page 5-97.)	Lower the locking pressure.
No locking pressure (0 psi)	Bleed hydraulic pressure on closing side to 0 psi and apply wellbore pressure. If the preventer gives a good test, PosLock adjustment is probably too tight and should be loosened. If the preventer does not test and the ram rubbers are good, the adjustment is too loose and should be tightened.

PosLock Adjustment Procedure

To adjust the PosLock locking pressure, use the following procedure:

1. Fully open the rams.
2. Bleed off the hydraulic pressure to the BOP.
3. Loosen and remove the 12 nuts on the end cap.
4. Attach an eyebolt (½”-13UNC) into the top of the end cap.
5. Insert four jack bolts ($^{5}/_{8}$”-11UNC) into the holes on the end cap and slowly tighten the four jack bolts alternately to force the end cap off the cylinder head.
6. Remove the end cap from the cylinder.
7. Remove the anti-rotational bolt using a 2¾” hex or 12-point socket and breaker bar.
8. Remove the anti-rotational nut.

The anti-rotation nut has a 12-point hex, allowing a resolution of 30° for each adjustment or $^{1}/_{12}$ of a turn.

9. Remove one of the 12 studs that are used in mounting the end cap (which was removed in step 6). The stud chosen for removal should not be in the vicinity of the two plugs on the end of the cylinder head.
10. Insert and lightly torque the reaction bolt (included in the 22” PosLock operator adjustment kit [P/N 20029399]) into the hole vacated by the stud in step 9.
11. Place the 2¾”twelve point socket (included in adjustment kit) on the end of the main piston assembly.
12. Adjust the PosLock settings, using the hydraulic torque wrench (included in adjustment kit) for rotation of the main piston.

Refer to the manufacturer’s instruction regarding operation of hydraulic torque wrench.

13. Adjust PosLock settings:
    - Rotating the main piston assembly counterclockwise raises the locking pressure.
    - Rotating the main piston assembly clockwise lowers the locking pressure.

Over-adjustment of the locks will cause either the rams not to meet or will not allow them to lock.

Adjustment of the PosLock should never exceed 10 turns. Contact an NOV representative if this occurs.

Ensure proper orientation of the anti-rotation nut and bolt (15, 16) or damage will occur. Part is stamped "HEAD SIDE" and "DOOR SIDE" for proper alignment. See the door assembly drawing located in Chapter 6, titled "Specifications and Parts Lists".

Always try to keep both pistons on the BOP within ½ to ¾ revolution of each other so that the rams will always meet near the center of the bore.

As you get close to the correct setting, the adjustments should be made in $^1/_8$-turn increments. Each $^1/_8$ revolution will typically affect locking pressure by approximately 75 to 100 psi, or as much as 200 to 400 psi on one-piece blocks.

14. Replace the anti-rotational nut by aligning the nut with the slots in the cylinder head and the 12-point head of the main piston assembly.
15. Install and tighten the anti-rotational bolt.
16. Check the end cap polypak seals and backup rings and replace if necessary.
17. Clean and oil all seals.
18. Align and replace the end cap, being careful not to damage the seals. Apply Moly Paste 503 to the stud and install and tighten the 12 nuts on each end cap in a cross pattern to a torque of 525 ft-lb.
19. Function the preventer three to four times to remove air from the hydraulic system.

Do not exceed 1,500 psi (103 bar) opening pressure.

Pipe rams should be closed on pipe of the proper size. Blind or shear rams should be closed on an empty hole.

20. Check the locking pressure.
21. Perform a wellbore pressure test to verify the BOP's sealing capabilities.

When the PosLock setting is completely wrong (e.g. after removing a ram shaft), the piston should be turned all the way in (clockwise) until the main piston assembly bottoms out on the ram shaft. It should then be turned back out counterclockwise to the initial settings given in the table titled "PosLock Adjustment Guideline" on page 5-97. This gives a reasonable starting point for making finer adjustments.

Ram Assembly Removal and Inspection

Procedures for removal and installation of pipe, blind, multi-rams and shear rams in the NXT Ram BOP are the same for both UltraLock II (B) and PosLock operator.

Removing Rams

1. Open the rams with hydraulic pressure.
2. Bleed off the hydraulic pressure to 0 psi (0 bar) so that the doors will swing open easily and to prevent possible damage to the rotary actuator seals.
3. Open the door (see the the section titled "NXT Door Locking System and Door Hydraulic Control Panel" on page 4-19).

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

4. Install 1"-8UNC eyebolt in the top of the ram block.

5. Remove the ram from the ram shaft by sliding it off horizontally (see Figure 5-80).

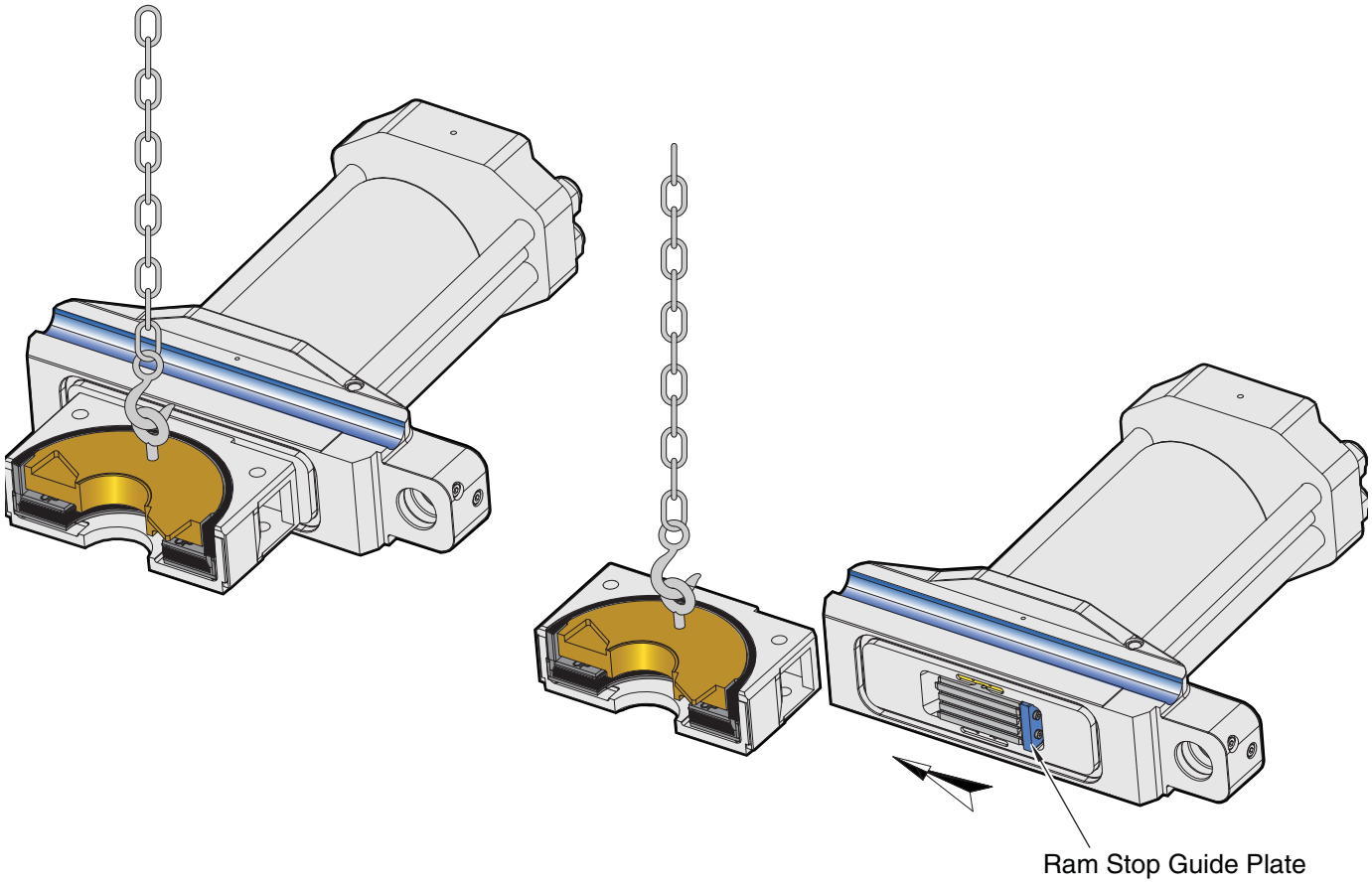


Figure 5-80. Sliding Direction of Ram Assembly

Cleaning and Inspecting Rams

1. Clean the rams. See the table titled “NXT Ram BOP Cleaning and Lubricating Instructions” on page 5-9.
2. Inspect the ram rubbers for damage such as cracking, gouging, chunking or splitting. Replace the rubbers if damaged.

Installing Rams

1. Thoroughly grease all ram exterior surfaces and the ram shaft mounting slots.
2. Grease the inside of the BOP body at the following locations:
   - ram shaft foot
   - side pads in the body cavity
   - skids in the bottom of the body cavity
   - ram sealing seat in the top of the body cavity
3. Apply a thorough coat of grease to the lock bars and anti-rotation bars and the accessible areas of their grooves.

4. Clean and lightly oil the door face, and replace the door cartridge seal if damaged.

Do not use grease on door seals or door sealing surfaces. Grease can cause the door seals to leak.

5. Clean and lightly oil the door sealing surface on the body.
6. Mount the ram assembly on the ram foot. Slide the ram horizontally toward the stop guide plate until it stops (see Figure 5-80 on page 5-102).
7. Prior to closing the door, see “Shimming NXT Ram Assemblies” below. Shimming may be required to level new ram assemblies.

Shimming NXT Ram Assemblies

The ram assemblies, by design, require movement between the ram holder and the ram shaft foot. This enables the rams to float upward in the preventer cavity to seal the wellbore pressure.

When the NXT BOP doors are open, this movement may allow the ram assemblies to hang downward. In this position the ram assemblies may not be in alignment with the cavity in the preventer body (see Figure 5-81 on page 5-104).

New NXT BOPs are pre-adjusted and tested prior to shipment.

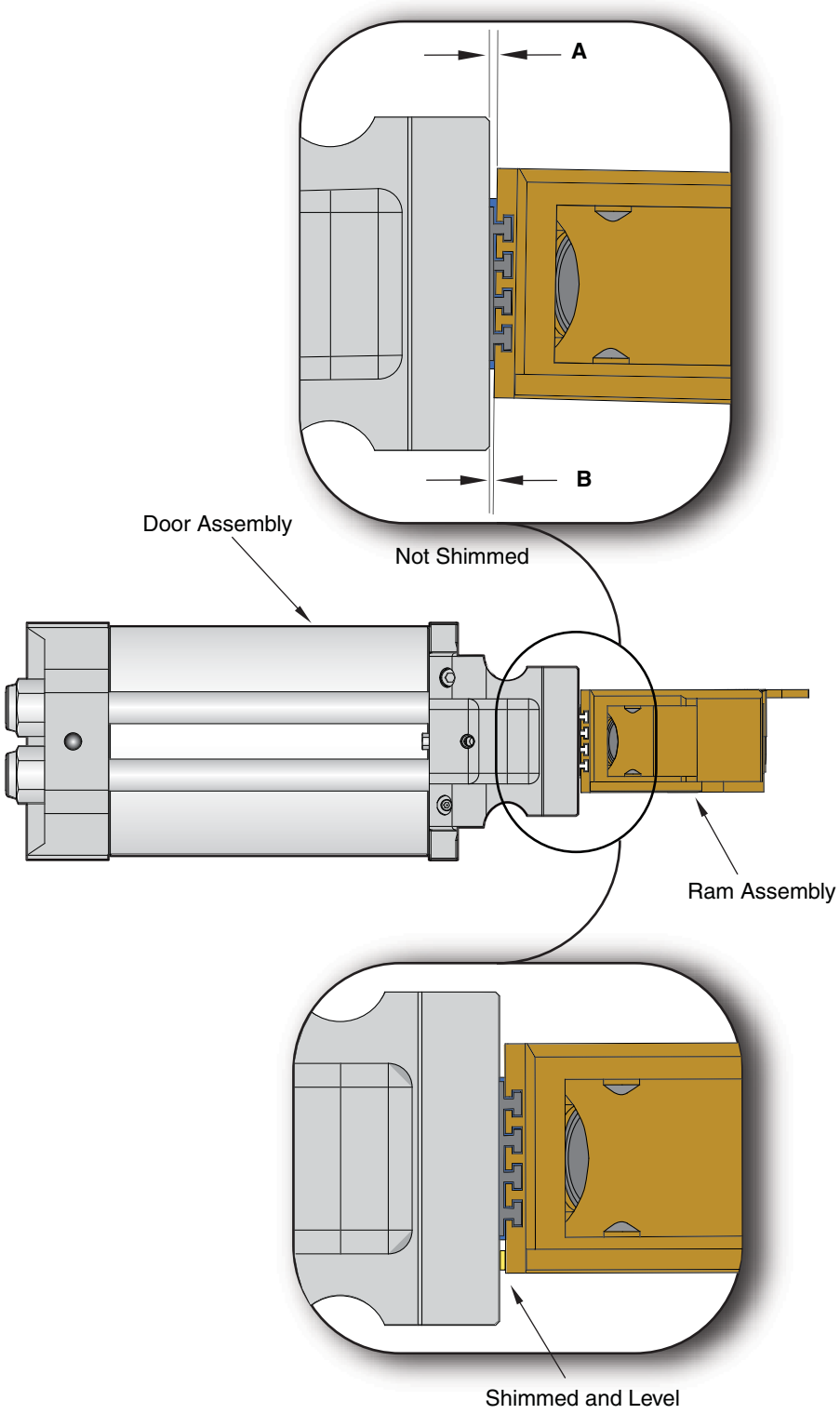


Figure 5-81. NXT Door Shimming

Closing the NXT BOP doors, when the ram assemblies are not properly aligned with the cavity, will cause severe damage to the door sealing area of the preventer body.

To align the ram assemblies, a block leveler and shims are installed between the BOP door and the lower portion of the ram holder. The block leveler and shims are installed in a recess machined into the door face (see Figure 5-82).

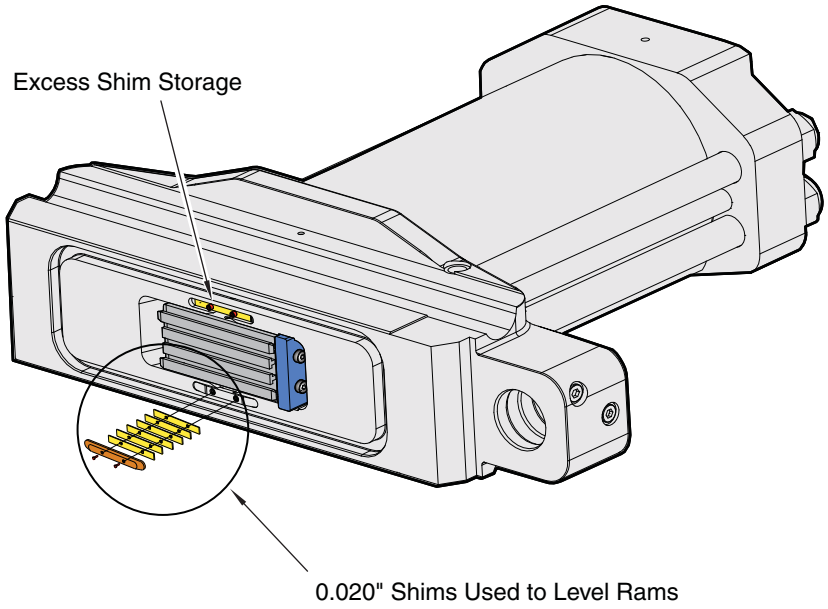


Figure 5-82. Block Leveler and Door Shims

The purpose of the block leveler is to support the weight of the ram assemblies in a horizontal position. The shims are used to adjust the proper alignment of the ram assemblies with the cavity in the BOP body (see Figure 5-81 on page 5-104).

Moving ram assemblies from cavity to cavity, or replacing the ram holder and ram shaft foot, will require verification that the ram assemblies are properly aligned with the cavity in the preventer body.

NXT Ram Assembly Alignment Procedures

To properly align the ram assemblies with the cavity in the NXT BOP body, the following procedure should be used:

1. Begin with the NXT preventer door in the fully open position.
2. Reduce the (ram open/close) hydraulic pressure to 300 psi (20 bar).
3. With inside calipers, measure the distance between the door face and the lower and upper portion of the ram holder (see Figure 5-81 on page 5-104).
4. To determine the number of 0.020 inch shims required to support the ram assembly in alignment with the BOP cavity, subtract the lower dimension “B” from the upper dimension “A.” Divide the resultant dimension by 2.

Due to ram assembly and ram shaft foot stacking tolerances, the ram assembly may require no shims or may require ten or more shims to achieve proper alignment with the cavity of the preventer body.

5. Slowly close (or extend) the ram, until there is enough room to access the block leveler in the door.

Do not fully extend the rams. Take care to ensure the ram assembly does not contact the sealing area of the preventer body.

6. Add or subtract shims as required, based on the dimension data found in step 4 above. Install the block leveler into the door.
7. Slowly retract the rams until the ram holder contacts the block leveler.
8. Very slowly and carefully close the NXT preventer door. Stop closing the door just before the ram assembly enters the cavity of the preventer body.
9. The lower edge of the ram assembly must clear the lower edge of the cavity in the preventer body; verify by using a straightedge.
10. Based on the above results, add or subtract shims. Repeat step 7 - 9 above to verify that the ram assembly is properly aligned with the cavity in the preventer body.

Repeat above procedures as required for all BOP cavities with shimming application.

22” Door Ram Block Adjustment

On the 22” PosLock operator and UltraLock with 22” doors, each door is provided with two adjustment nuts in the ram shaft foot to level the ram block assembly. The ram block needs to be able to enter the ram cavity without hitting and damaging the BOP or the ram assembly and it’s related components. The leveling of the rams is the simple process of turning the adjustment nuts against the rams until the ram clears the BOP body entering the cavity (see Figure 5-83).

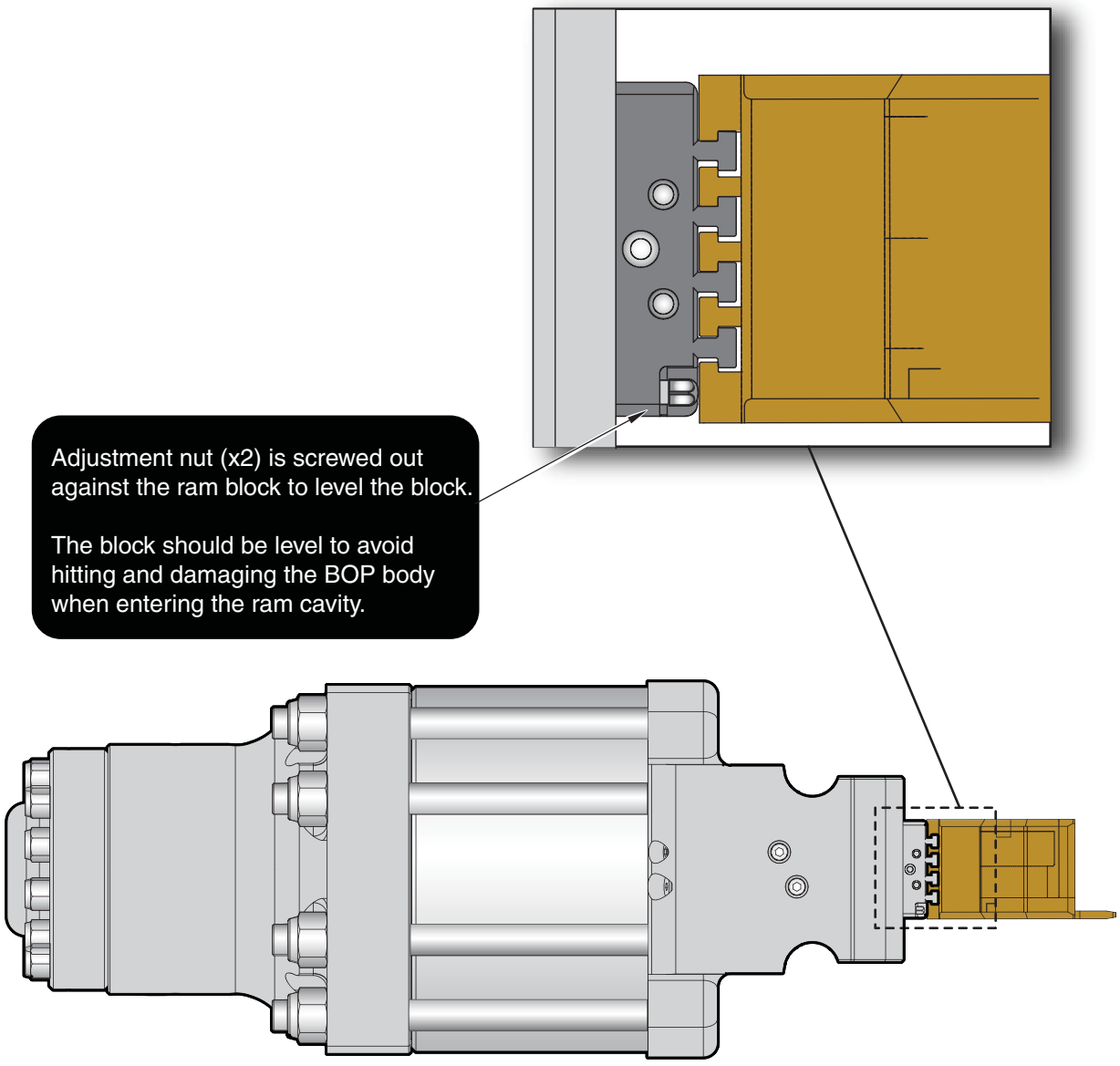


Figure 5-83. Adjusting Rams on 22” Operators

Changing Ram Rubbers

1. Clean the rams.
2. Using a long screwdriver, pry the top seal from the ram block (see Figure 5-84).
3. Using a long screwdriver, pry the face seal from the ram block.
4. For reinstalling the ram rubbers, reverse the above procedures. Use a rubber mallet, if necessary, to seat the rubber.

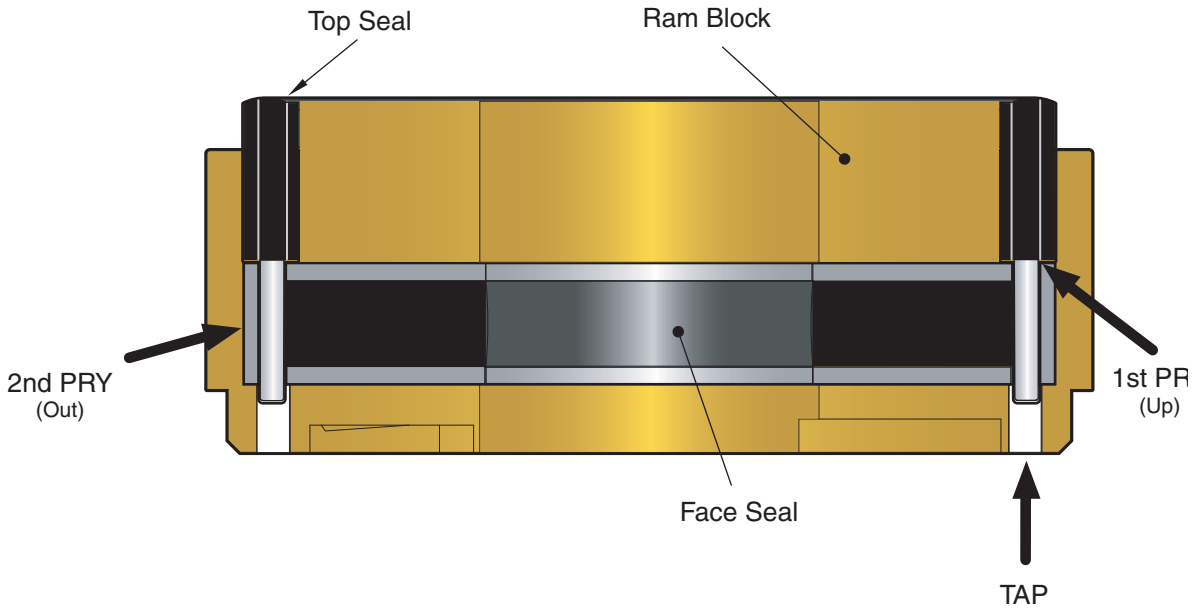


Figure 5-84. Removing Ram Seals

Changing Multi-Ram Rubbers

The multi-ram assemblies must be removed from the ram shafts in order to replace the ram rubbers.

1. Clean the rams.
2. Arrange the ram block in a horizontal position and remove the top seal by prying up until pins are clear of the face seal.
3. Remove retaining screws from the face seal.
4. Remove face seal by prying out away from the block.
5. For reinstalling the new ram rubbers, reverse the procedures.

CVX Ram Rubbers

CVX Ram Rubber Removal

Warning

The CVX shear rams consist of a lower shear ram assembly and an upper shear ram assembly. Before removing the shear ram assemblies from the NXT cavities, note the position of the lower and upper shear rams. They must be replaced in the same position. This allows the lower shear blade to close under the upper shear blade. If the CVX-Shear rams are installed upside down, they will not seal the wellbore pressure.

Warning

To replace the ram rubbers, the CVX ram assemblies should be removed (using a 1"-8UNC lifting eye) from the ram shaft. Changing the ram rubbers while the ram assemblies are attached to the ram shaft is dangerous, because the rams can rotate and fall off the ram shaft. Failure to heed this warning can cause severe injury to rig personnel.

The CVX ram assemblies consist of one lower assembly and one upper assembly, each with one ram rubber. To remove the rubber assembly, proceed as follows:

1. Clean the ram assemblies.
2. Remove the two retainer screws from the lower shear ram assembly using a $^{3}/_{8}$" hex wrench.

3. Using a long (¾" blade) pry bar, pry the rubber from each end of the shear block. Pry at the bottom of the thicker ends (see Figure 5-85). Pry until the rubber is lifted approximately 1" out from the block, and the non-bonded lower packer rubber is lifted approximately ½" above the block.

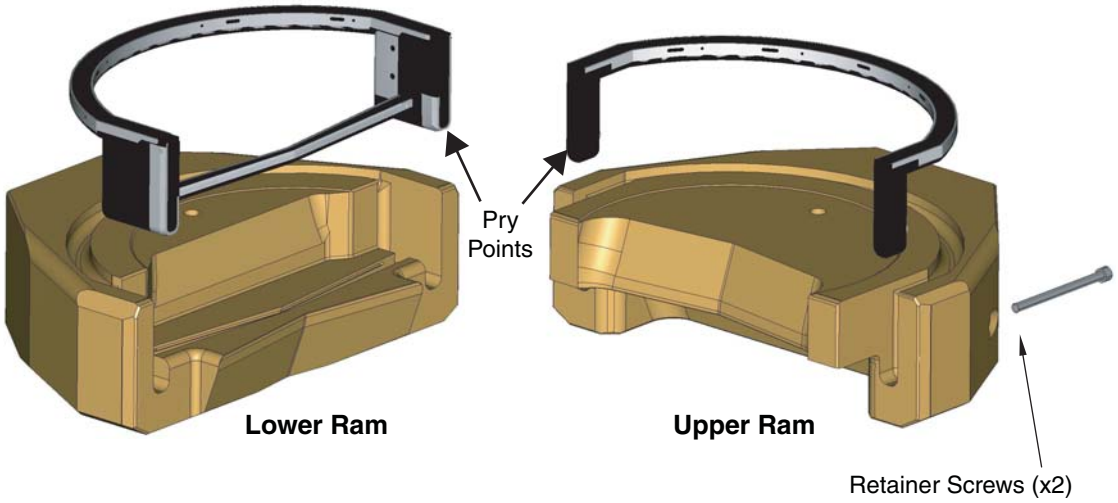


Figure 5-85. Prying CVX Ram Rubbers

4. Use a 1" wide (thin blade) paint scrapper as a "shoe horn" at one end to disengage the extrusion plate ridges from the block groove.
5. Pry the extrusion plate $^{3}/_{8}$" above the lower blade.

In the following step 6, do not over-tighten the vise grip pliers, as this will permanently damage the extrusion plate. Use only enough force to allow the ram rubber ridge to exit from the seat groove of the blade.

6. Using vise grip pliers, compress the extrusion plates together at one end (see Figure 5-86).

Figure 5-86. Compressing Extrusion Plate

7. Use the pry bar along the lower packer until the ram rubber is removed from the ram block.

Removal of the ram rubber from the upper shear ram assembly is similar to the above procedure.

CVX Ram Rubber Installation

The lower blade face seal is intentionally not bonded to the extrusion plates (see Figure 5-87). This is not a molding process defect. Only the center portion of the rubber is bonded to the extrusion plates. Care should be taken not to damage the center rubber to extrusion plate bonding when installing or removing the ram rubbers.

Figure 5-87. Lower Packer Bonding

Prior to installing the ram rubber into the ram block, it is important to ensure the groove along the lower blade is clean. Use smooth emery cloth to remove all foreign material from the bottom and sides of the groove. Pay particular attention to the seat groove on the vertical wall that locks the ridge on the ram rubber into the lower blade. Failure to heed this caution and not properly clean the groove in the lower blade will cause failure to seal wellbore pressure.

The CVX ram assemblies consist of one lower assembly and one upper assembly, each with one ram rubber. To install the rubber assembly, proceed as follows:

Installing new rubbers in the upper and lower ram blocks is similar. However, installing the rubbers in the lower ram block is a more difficult procedure, as one must insert the face seal properly into the groove of the lower blade.

The following procedure covers installing the ram rubber in the lower ram block:

When replacing the upper and lower ram rubber seals, use a light coating of SAE-10W oil in the area where the seals have metal contact. Use a 2-3 lb hammer and wood block to tap the ram rubbers in place.

1. Install the ram rubber into the lower block; gently tap the rubber into the upper circular groove of the block and into the groove of the lower blade.

In the following step 2 do not over-tighten the vise grip pliers, as this will permanently damage the extrusion plate. Use only enough force to allow the ram rubber ridge to enter the seat groove of the blade.

2. Install vise grip pliers above the ridge on the face seal extrusion plates. Use the vise grip pliers to compress the extrusion plates together at both ends (see Figure 5-88).

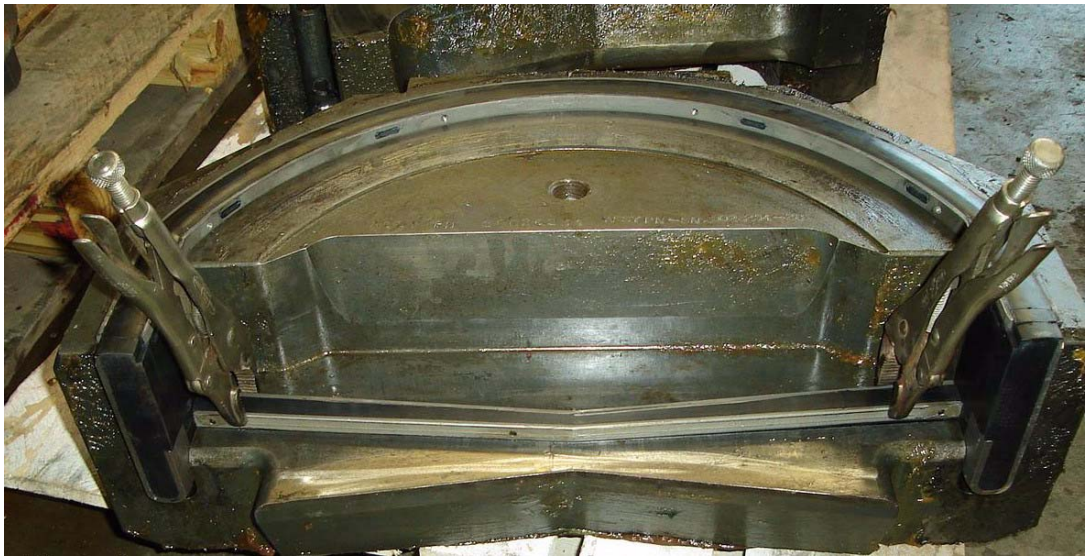


Figure 5-88. Compressing Extrusion Plates

3. Using a hammer and wooden block, begin at one end to tap the seal into the groove of the blade. As the seal enters, continuously tap and move the wood block 2 inches along the seal length to other end. During this procedure the vise grips will be released. Continue tapping every 2 inches along the length of the seal, until the seal is properly seated into the lower blade (see Figure 5-89).

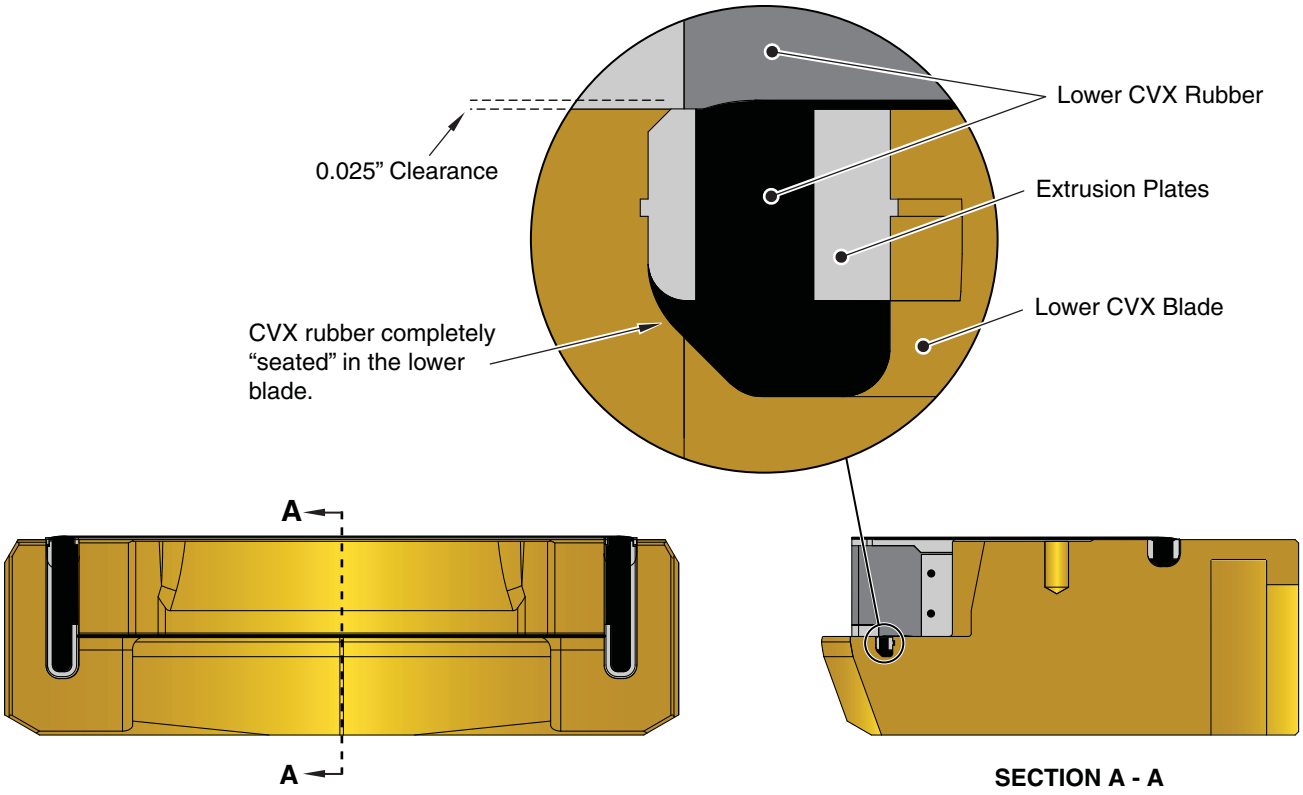


Figure 5-89. Proper Rubber Installation

4. Using a $^{3}/_{8}$” hex wrench, install the two retainer screws and torque to 30 ft-lb (40 Nm).

When installed properly, the extrusion plates of the lower CVX rubber must not protrude more than 0.025” above the lower CVX blade, as shown in Figure 5-89. Depending on the block tolerances, the rubber may extrude considerably more, and may be shaved when the rams are closed. This shaving of the rubber is acceptable, as there is ample rubber left to seal on the blade. Expect a maximum of 0.060” to be shaved from the center of the ram rubber.

Pressure Testing CVX Ram Rubbers

Test CVX ram rubbers to the rated working pressure of the preventer.

When the pressure test is completed, ensure that all wellbore pressure below the rams is vented to atmosphere before the CVX rams are opened. Failure to heed this caution may dislocate the ram rubbers from the ram blocks, which will cause failure to seal wellbore pressure.

Dressing Shear Rams

Following a shear, the shear blades of the V-Shears, CVX Shears and other non-wireline cutting blades must be re-dressed to eliminate burrs and cracks that may have developed during the shear. The following is the recommended procedure:

1. Ensure the rams are fully retracted.
2. Ensure the operator supply pressure and return lines are at 0 psi.
3. Open the doors of the BOP shear cavity.
4. Attach a lifting eye onto the shear block.
5. Remove the shear block and place it on a stable work surface.

Warning

Do not work on block with them hanging on the ram shaft; they could slide, rotate or otherwise fall off. Failure to heed this warning can cause severe injury to rig personnel.

6. Using a crosscut file, remove burrs and high spots.
7. Using a flapper wheel, buff a $^{1}/_{32}$" to $^{1}/_{16}$" radius onto the leading edge of the blades.
8. Using a flapper wheel, buff any gouges on the sealing surfaces of the blades. It is preferable to dish out the gouge rather than only taking off the high spots. Take as little material as possible to remove a gouge.
9. Check the blades and blade corners for cracks with dye penetrant.
10. If any indications are found, do not return the shears to service. Notify an NOV representative for further action.
11. If no indications are found, the blades may be returned to service.
12. The seals should be evaluated for condition. If the seals are severely worn, they should be replaced (see the section titled “CVX Ram Rubber Removal” on page 5-109).
13. Install the blocks into the BOP.
14. Close and lock the doors.

Removing/Installing Replaceable Seal Seat Insert

The inside of the BOP cavity has a replaceable seal seat insert, two side pads and a skid plate (see Figure 5-90). Cavities that have shear ram installed have a different part number seal seat. The seal seat insert used on the shear cavity is of a hardened material that is more compatible with the hard material used on the shear ram assemblies.

Verify cavity and part number of the seal seat used. Do not put standard seal seat in the shear ram cavity. Ensure that a properly sized deal seat is utilized.

To help identify the hardened seal seat, a groove is cut into the bore of the seal below the set screws when installed (see Figure 5-90).

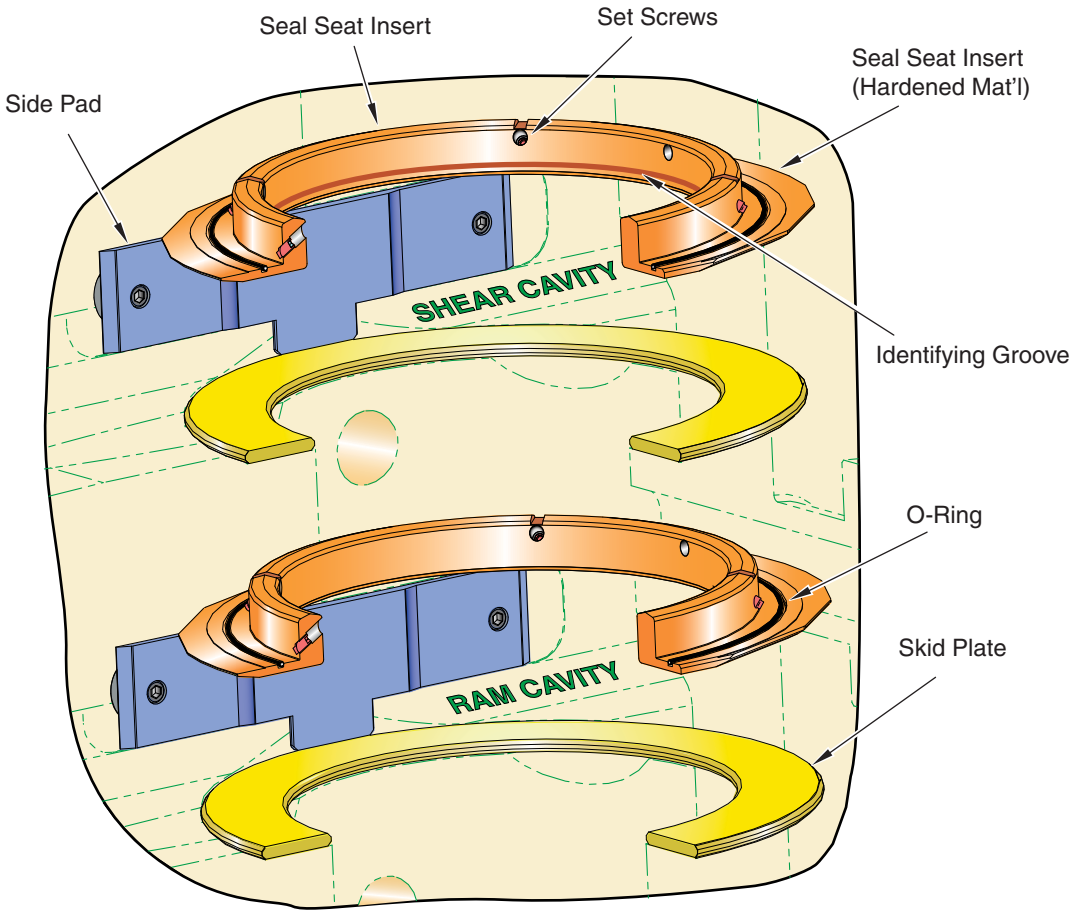


Figure 5-90. Seal Seat and Side Pads

1. Place supports below the seal seat insert to prevent it from falling into the cavity upon removal of the setscrews.
2. Loosen and back out the six setscrews using $^{3}/_{8}$" hex wrench. Pry the seal insert loose if it does not fall onto the supports. Remove the seal seat insert from the cavity and remove and discard the O-ring.
3. Remove the two side pads using ½" hex wrench; take care not to drop pads into the cavity.
4. Thoroughly clean the side pads recess. Use a flapper wheel (180 to 220 grit) to remove scale and loose rust. Do not gouge surface.
5. Thoroughly clean the sealing surface for the top seat. Remove burrs on edges using a flapper wheel (180 to 220 grit) (see Figure 5-91). Remove scale and loose rust. Do not gouge surface.

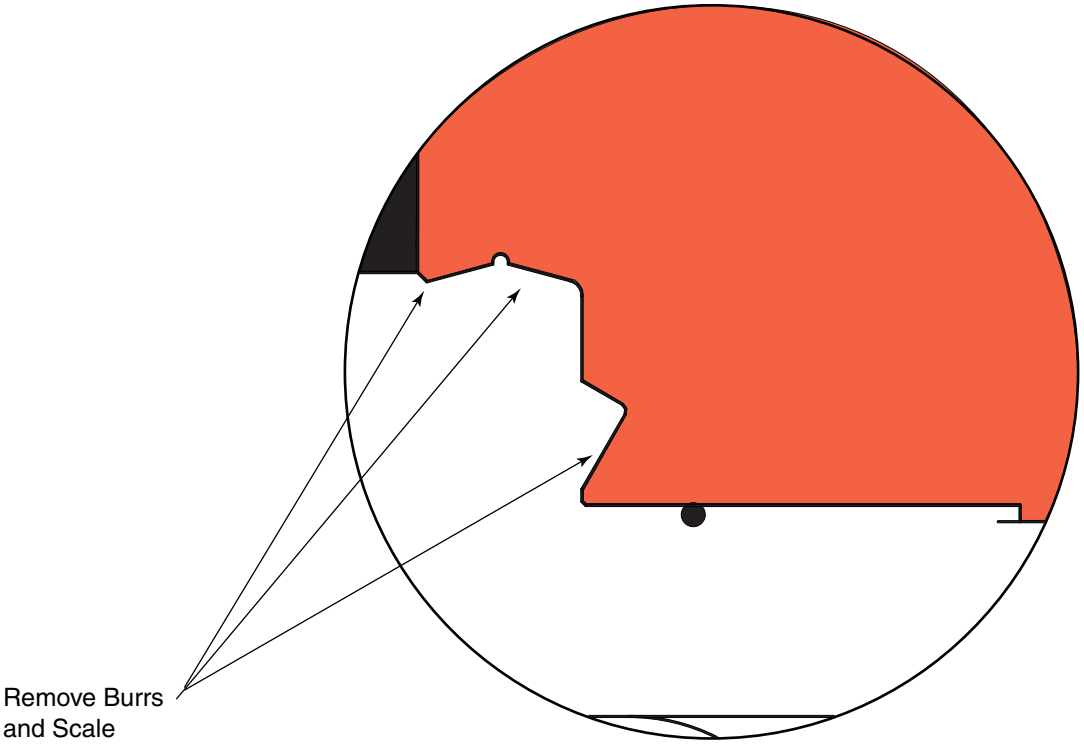


Figure 5-91. Remove Burrs and Scale

6. Prepare the ram cavity by placing a light coating of grease on the seal seat cavity profile. Avoid any grease on the O-ring seal surface.
7. Install a new O-ring on the seal seat insert (see Figure 5-90 on page 5-117).
8. Place supports inside the ram cavity on jacks, and slide the seal seat insert into the cavity under the seal seat profile. To prevent mechanical damage to the seal seat, place pieces of wood or other barrier between the jacks and the seal seat.

9. Raise the jacks evenly to set the seal seat insert into the seal seat cavity profile. The seal seat insert is properly installed when the distance from the bottom of the insert to the top of the bottom skids is the same vertical height in four corners.

The vertical height measurement referred to above depends on the type of ram assemblies installed in the cavity. Questions on vertical height dimensions should be referred to your NOV representative.

To establish a true vertical height dimension, the O-ring under the seal seat insert must be removed and a new seal seat insert and skid plate installed. The seal seat insert is held in place by four evenly-spaced hydraulic jacks. When this is achieved, the proper vertical height dimension can be established.

10. Apply light coating of quality anti-seize compound to set screws. Install the six set screws using $^{3}/_{8}$" hex wrench, and tighten to 20 to 25 ft-lb (27.11 to 33.9 Nm) torque value.
11. Pressure test the cavity to the working pressure of the preventer.

Removing/Installing Side Pads and Skid Plate

1. Remove the two socket head cap screws from the side pad using a ½" hex wrench. Remove the side pads, taking care not to drop the side pad into the cavity (see Figure 5-90 on page 5-117).
2. Remove the other side pad and slide out of the cavity.
3. Reinstall by reversing the order of removal.
4. Tighten the side pad socket head cap screws to 65 to 70 ft-lb (88.13 to 94.9 Nm) torque value using a ½" hex wrench.
5. Measure the cavity height and width to confirm proper installation. The measurements should be uniform between the side pads and skid plate to seal seat.

The measurement referred to above depends on the type of ram assemblies installed in the cavity. Questions on side pad to side pad dimensions and vertical height dimensions should be referred to your NOV representative.

The stated torque values are formulated assuming the thread lubricant is Sweeney 503 Moly Paste (P/N 7403582).

Storage of NXT Ram BOP

General Cleaning and Inspecting

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. See the table titled “NXT Ram BOP Cleaning and Lubricating Instructions” on page 5-9.

1. Open the doors and remove the rams (see the section titled “Ram Assembly Removal and Inspection” on page 5-101).

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.

Rubber Parts

NOV 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 — 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.
- Light — Direct light, especially sunlight which contains ultraviolet rays, is very harmful and must be avoided.
- Temperature — All rubber parts undergo several kinds of changes when they are exposed to low temperature:
  - At a temperature of –40°F (–40°C), the rubber becomes brittle and shatters when dropped or handled roughly. Some changes occur immediately, others after prolonged exposure. All changes are reversible, however, as rubber will regain its original properties when 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.
- Size — 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.
- Solvents — Both natural and synthetic rubber parts are susceptible to deterioration from various solvents (e.g., oilfield liquid hydrocarbon, which causes swelling or shrinkage).

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

Storing Rubber Parts

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.

Inspecting Rubber Parts

- 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.

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

NXT Ram BOP Data Location

See Figure 5-92 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 face of 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 NXT Ram BOP are stamped with their part numbers and other manufacturing data.

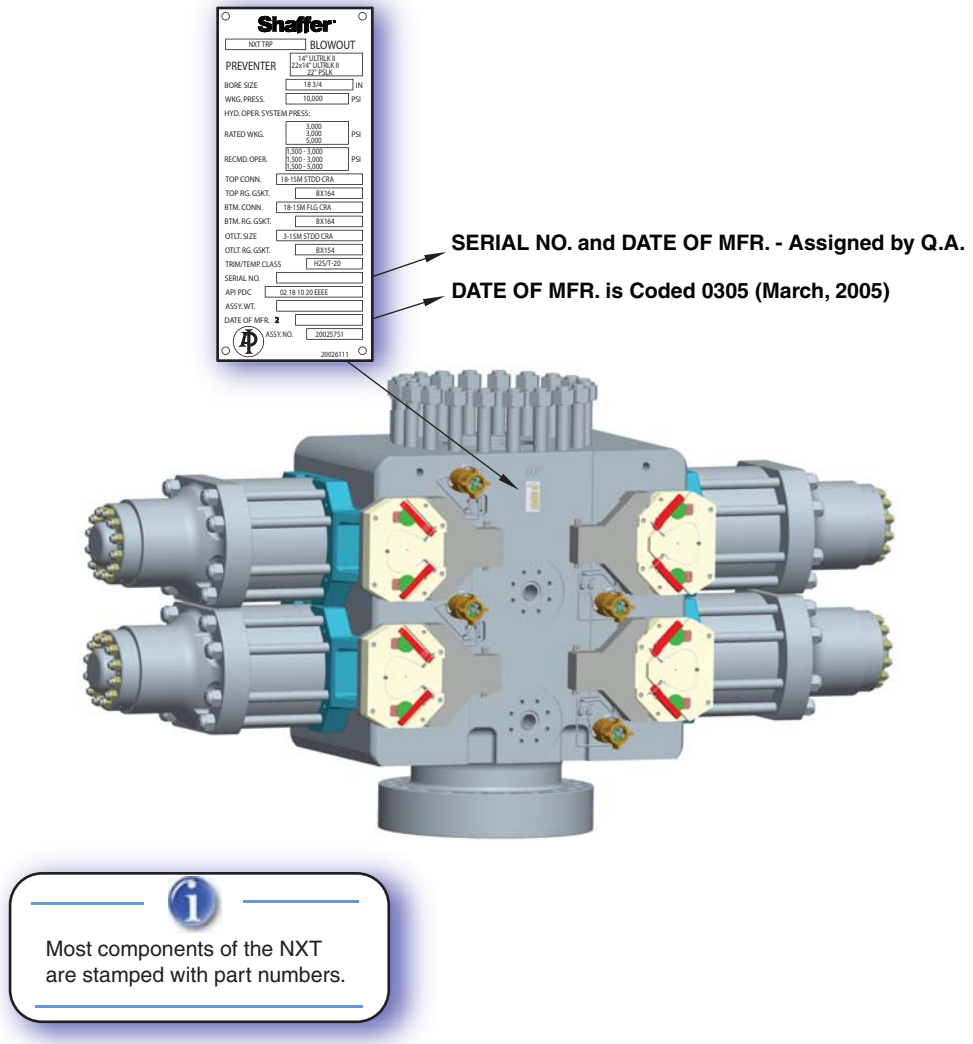


Figure 5-92. Data Information Location

Specifications and Parts Lists

Correspondence

Direct all correspondence to the appropriate address listed below:

Mailing Address

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

Shipping Address

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

NOV Repair Center Address

5100 N. Sam Houston Parkway West
Houston, Texas 77086
Tel. (281) 569-3000

Parts Lists

Parts Identification

All parts required for maintenance or repair are available from National Oilwell Varco. Assembly drawings and exploded views 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 spare parts.

Ordering Replacement Parts

All parts required for maintenance or repair are available from National Oilwell Varco. When ordering replacement parts, please specify the following information:

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

Recommended Spare Parts

The following table lists the recommended spare parts for the 18¾”-15M NXT Triple Ram BOP.

18¾”-15M NXT Ram BOP with 22” PosLock and/or 14” UltraLock II (B) Operators

*Qty.	P/N	Description
2	20019444	Spare Part Kit, 22” PosLock Operator
2	20019273	Spare Part Kit, PosLock Segments
2	20018651	Ram Shaft Seal Assembly, 22” PosLock Operator
2	20001259	Spare Part Kit, Piston Assembly, UltraLock II (B)
2	168178	Spare Part Kit, Door Assembly, UltraLock II (B)
2	168075	Ram Shaft Seal Assembly, 14” UltraLock Operator
2	168122	Spare Parts Kit, Replaceable Cavity Seats
2	20020683	Spare Parts Kit, Replaceable Cavity Seats with Shear
2	168047	Door Cartridge Seal Assembly
2	20016844	Spare Parts Kit, Door Control Manifold
–	20029399	22” PosLock Operator, Adjustment Kit
–	165551	UltraLock II (B) Operator, Tool Kit

**Quantity is the recommendation per ram cavity. Multiply by the number of applicable cavities.*

UltraLock II (B) and 22” PosLock Door Assemblies

Figure 6-1 through Figure 6-11 illustrate the components of the UltraLock II (B) and 22” PosLock door assemblies. Parts lists for the UltraLock and PosLock components are provided in the following tables:

- Parts List – 18¾”-15M NXT Ram BOP Assemblies table on page 6-3
- Parts List – UltraLock Piston Assembly table on page 6-7
- Parts List – 22” PosLock Door Common Wear Items table on page 6-10
- Parts List — Ram Shaft Seal Assembly (P/N 168075) table on page 6-11
- Parts List – Ram Shaft Seal Assembly (P/N 20018651) table on page 6-12
- Parts List – Door Cartridge Seal Assembly (P/N 168047) table on page 6-13
- Parts List – CVX Shear Ram Assy. 18¾”, 15,000 psi (P/N 20026257) table on page 6-14
- Parts List – 18¾”, 15,000 psi Multi-Ram™ table on page 6-16
- Parts List – NXT 18¾”, 5/10/15M Ram Assemblies table on page 6-18

Parts Lists

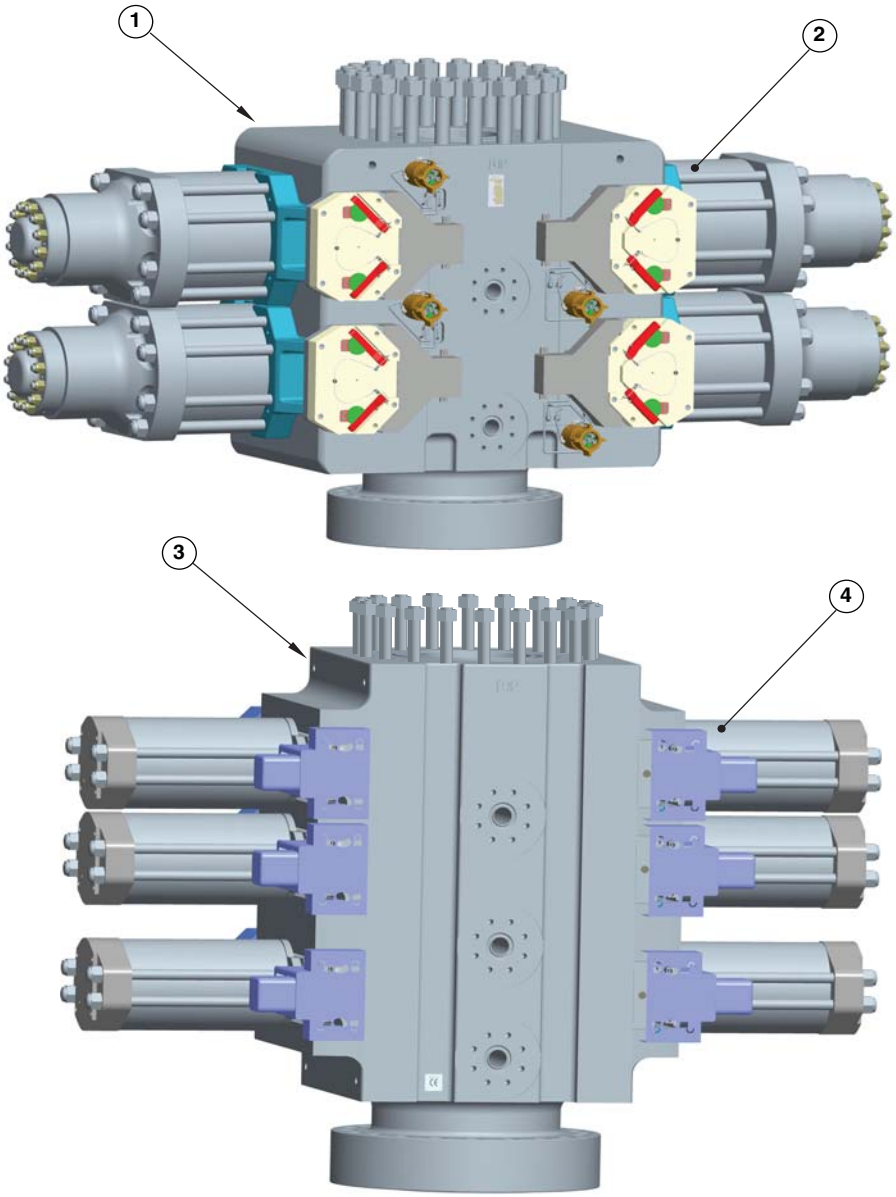


Figure 6-1. 18¾", 15M NXT Ram BOP Assemblies

Parts List – 18¾"-15M NXT Ram BOP Assemblies

Item	Description	P/N	Qty.
1	BOP Assembly	20030015	1
2	22" PosLock Door Assembly	20018931	4
3	BOP Assembly	20027890	1
4	14" UltraLock II (B) Door Assembly	168053	6

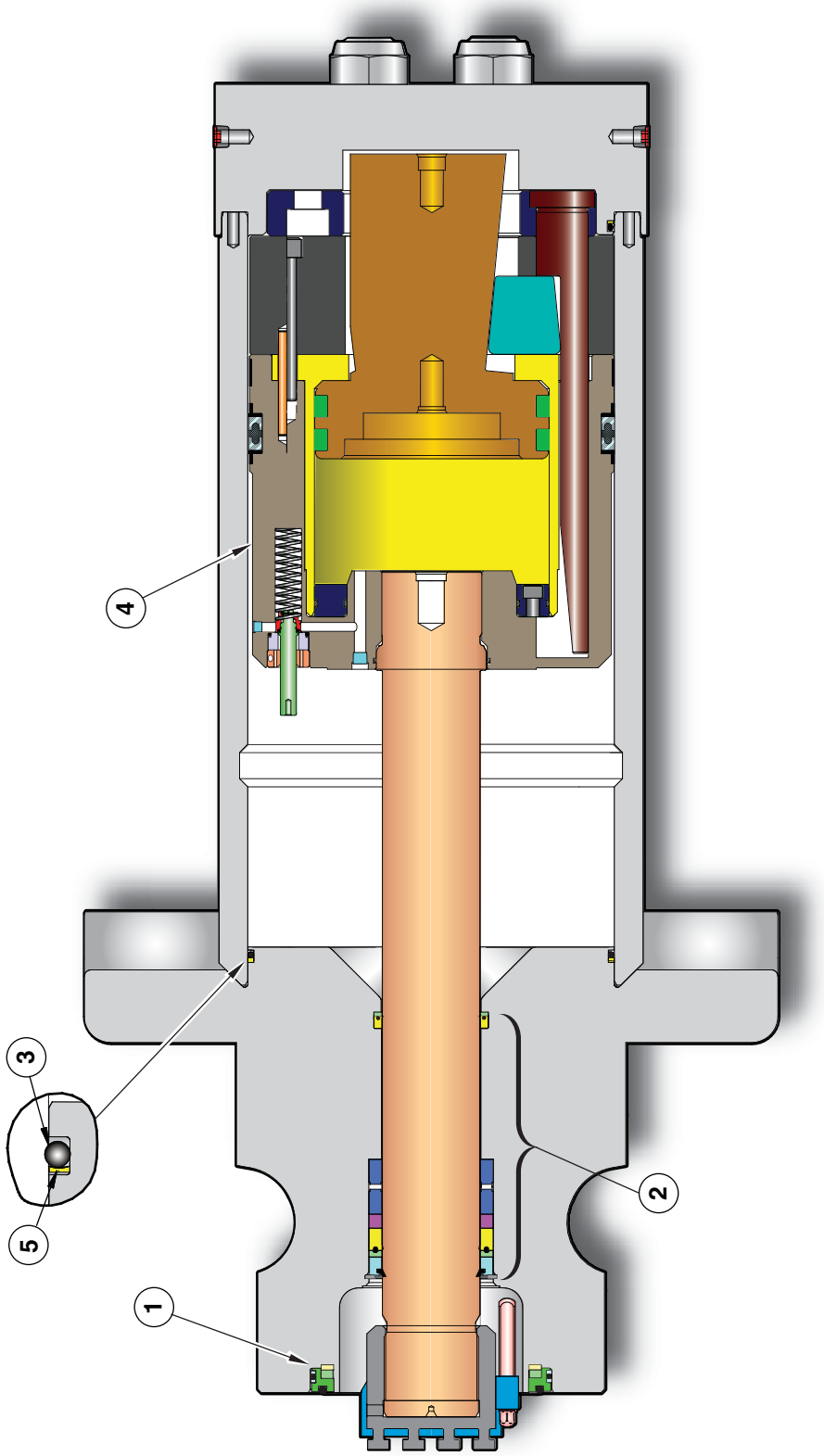


Figure 6-2. UltraLock II (B) NXT Door

Parts List – NXT UltraLock II (B) Common Wear Items

Item No.	Part Number	Description	Qty.
1	168047	Door Cartridge Seal Assembly	1
2	168075	Ram Shaft Seal Assembly	1
3	030105	Cylinder O-Ring	2
4	20001257	14” UltraLock II (B) Piston Assembly See Figure 6-3 on page 6-6 for wear items.	1
5	030791	Cylinder Back-up Ring	2

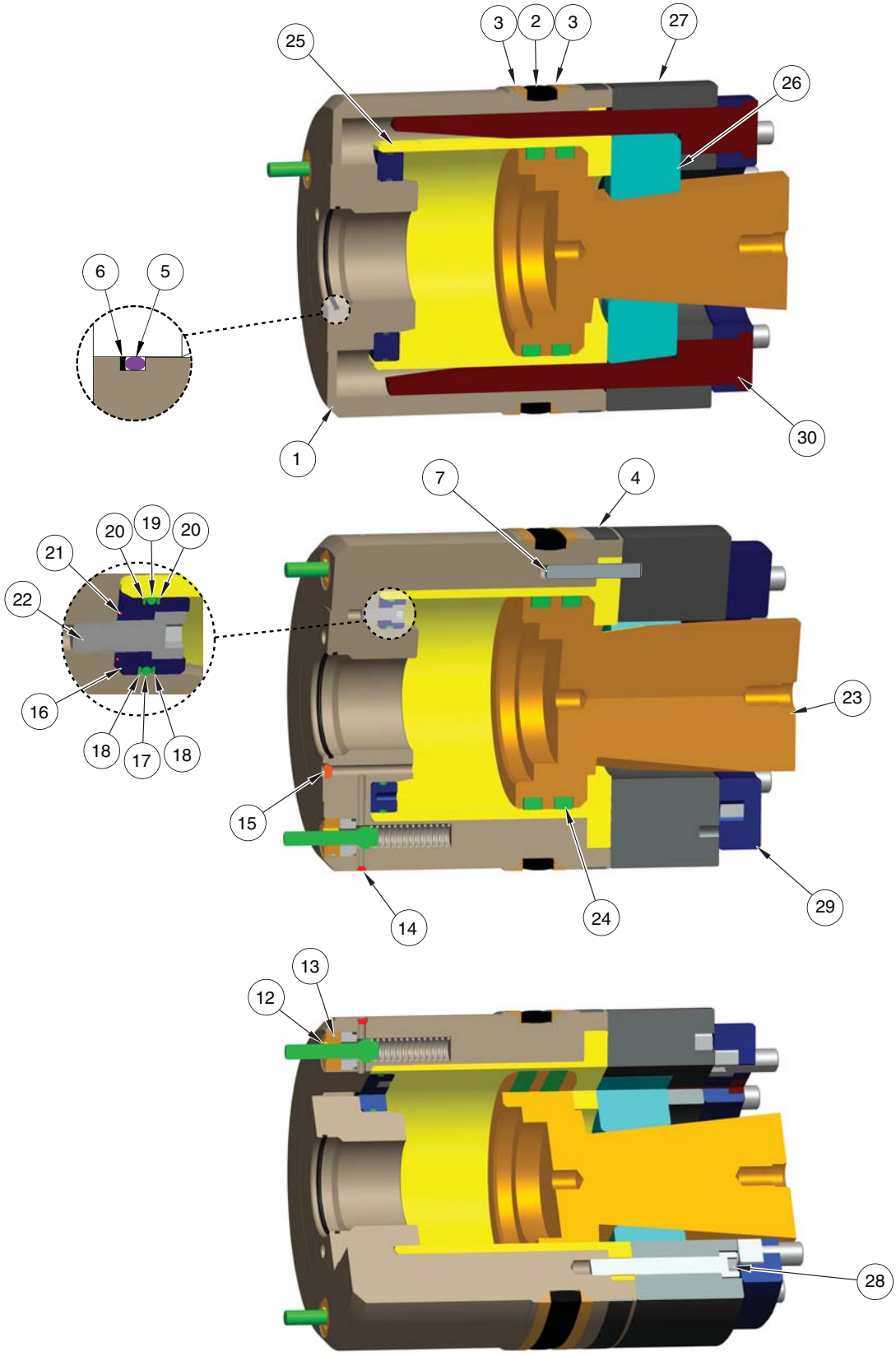


Figure 6-3. UltraLock II (B) Piston Assembly

Parts List – UltraLock Piston Assembly

Item #	Qty	Description	P/N
–	1	Piston Assembly	20001257
1	1	Piston	20001256
2	1	Seal	031181
3	2	Wear Ring, 14”	115524
4	1	Wear Ring	119263
5	1	O-Ring	030124
6	1	Back-up Ring	030954
7	2	Dowel Pin	050098
–	–	Poppet Assembly	20022638
8	2	Spring	*
9	2	Rod	*
10	2	Seat	*
11	2	O-Ring	*
12	2	Retainer	*
13	2	Nylok Pellet	20008501
14	2	Pipe Plug, 1/8”	065007
15	2	Pipe Plug, ¼”	065008
16	1	Seal Plate	165502
17	1	O-Ring	030147
18	2	Back-up Ring	030962
19	1	O-Ring	030139
20	2	Back-up Ring	030953
21	12	O-Ring	030252
22	12	Screw, SHC	010608
23	1	Piston, Locking	165557
24	2	Seal, Polypak	031351
25	1	Sleeve	165556
26	4	Wedge, Locking	20002093
27	1	Retainer Plate	165555

Parts List – UltraLock Piston Assembly (Continued)

Item #	Qty	Description	P/N
28	8	Screw, SHC	010733
29	1	Lock Rod Plate	165537
30	4	Locking Rod	20001252

** Items #8 through #12 are replaced as an assembly (P/N 20022638).*

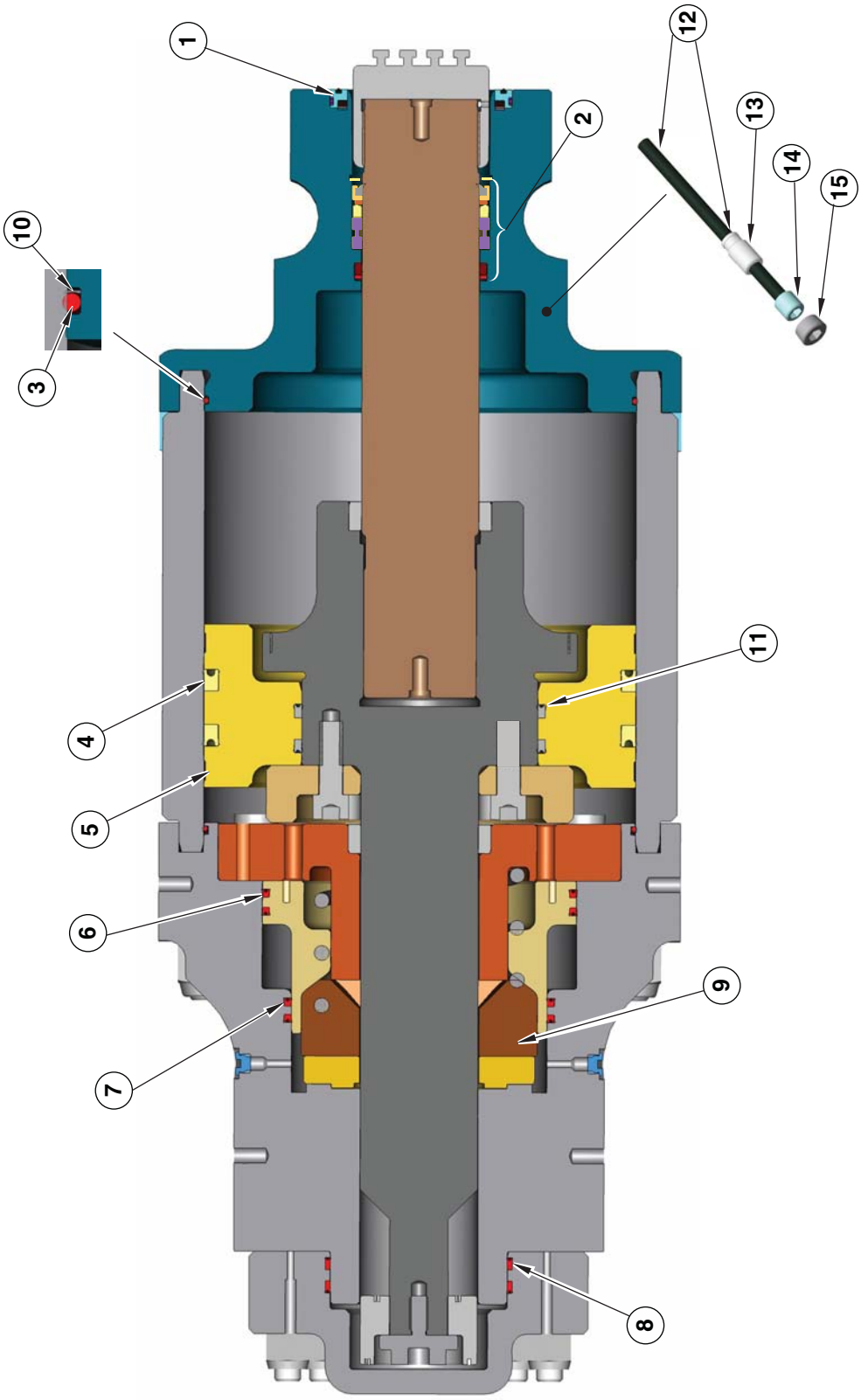


Figure 6-4. 22” PosLock Cylinder Assembly

Parts List – 22” PosLock Door Common Wear Items

Item No.	Part Number	Description	Qty.
1	168047	Door Cartridge Seal Assembly	1
2	20018651	Ram Shaft Seal Assembly	1
3	20017682	Cylinder O-Ring	2
4	20017863	Outer Piston Polypak Seals	2
5	150613	1” Wear Ring	280 in.
6	20018485	Locking Piston Polypak Seals	2
7	20017864	Polypak Seals	2
8	20018437	Polypak Seals	2
9	20017964	Locking Wedges	6
10	20018435	Back-up Ring	2
11	20018436	Outer Piston I.D. Polypak Seals	2
12	050000	Plastic Packing Sticks	4
13	130368	Check Valve	1
14	010004	Set Screw	1
15	065002	Plug	1

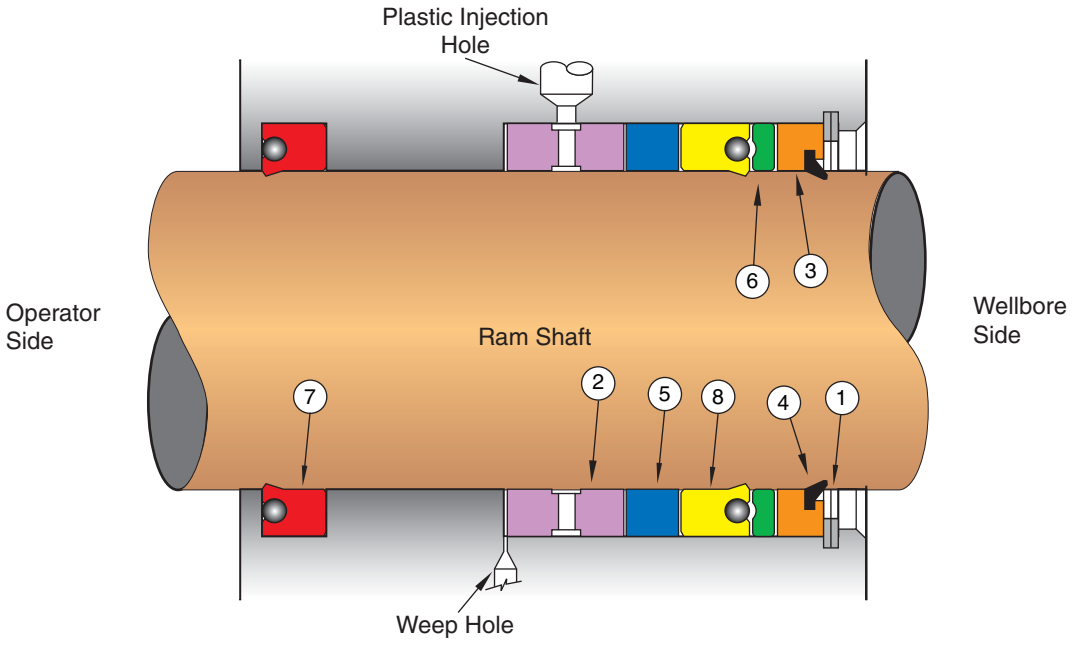


Figure 6-5. UltraLock II (B) RSSA

Parts List — Ram Shaft Seal Assembly (P/N 168075)

Item No.	Part Number	Description	Qty.
1	20141470	Retainer Ring	1
2	168058	Packing Adapter	1
3	168059	Holder	1
4	031176	Wiper Ring	1
5	062735	Modular Bearing	1
6	031381	PIP Ring	1
7	031382	Polypak Seal, Deep	1
8	031379	Polypak Seal	1

Qty is per door assembly

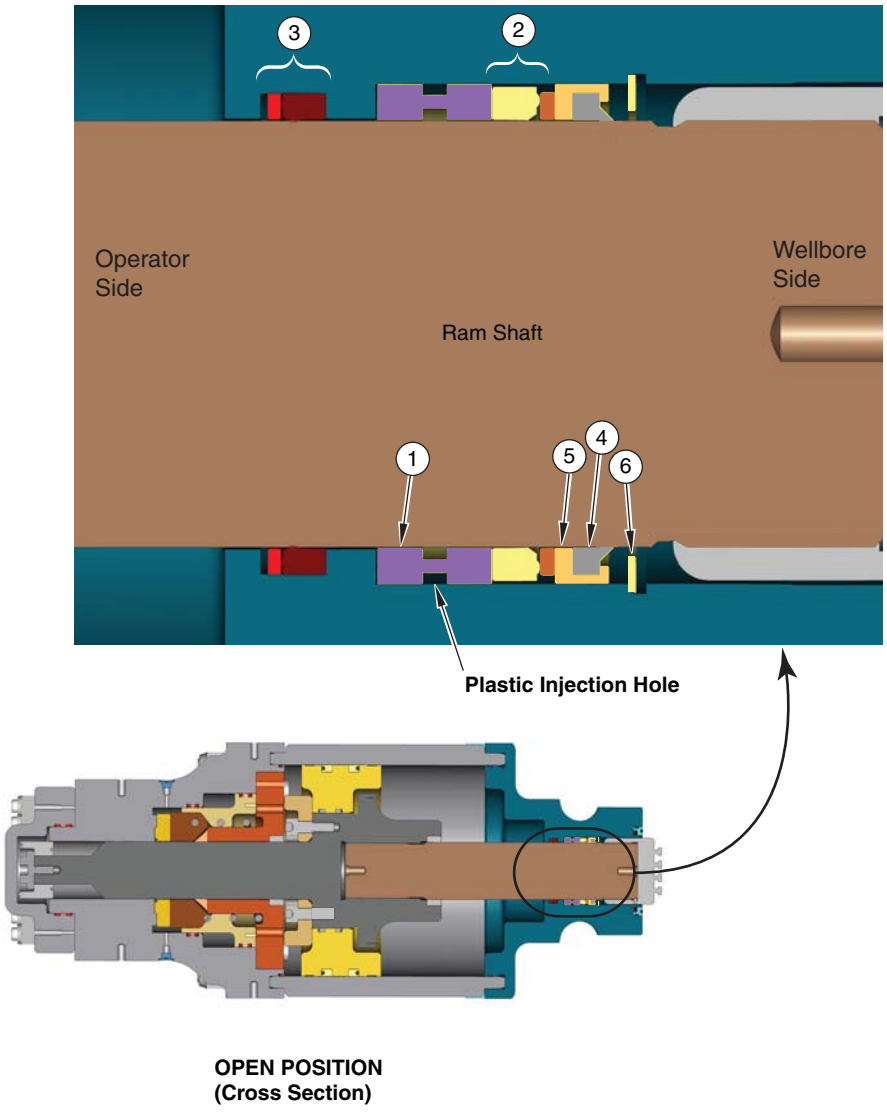
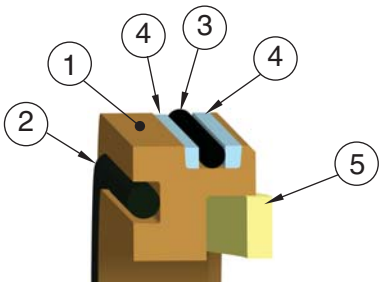


Figure 6-6. Ram Shaft Seal Assembly – 22” PosLock

Parts List – Ram Shaft Seal Assembly (P/N 20018651)

Item No.	Part Number	Description
1	20016822	Packing Adapter
2	20018603	Pip Seal Assembly
3	20018604	Pip Seal Assembly
4	030965	Wiper Ring
5	20016823	Holder, Wiper Ring
6	20018595	Spiral Ring, Retainer



SECTION A-A
P/N 168047

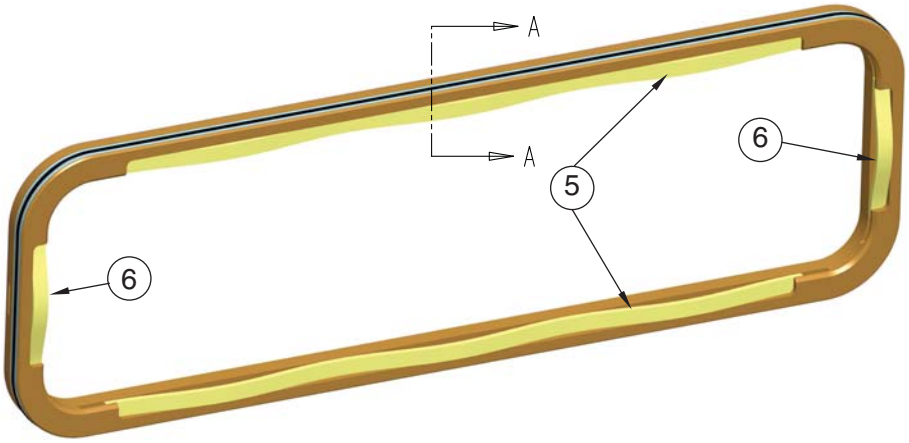


Figure 6-7. Door Cartridge Seal Assembly

Parts List – Door Cartridge Seal Assembly (P/N 168047)

Item #	Qty.	Description	P/N
1	1	Seal Cartridge	168052
2	1	O-Ring	030998
3	1	O-Ring	030997
4	2	Back-up Ring	030946
5	2	Wave Spring (Door)	168192
6	2	Wave Spring (Cartridge)	168195

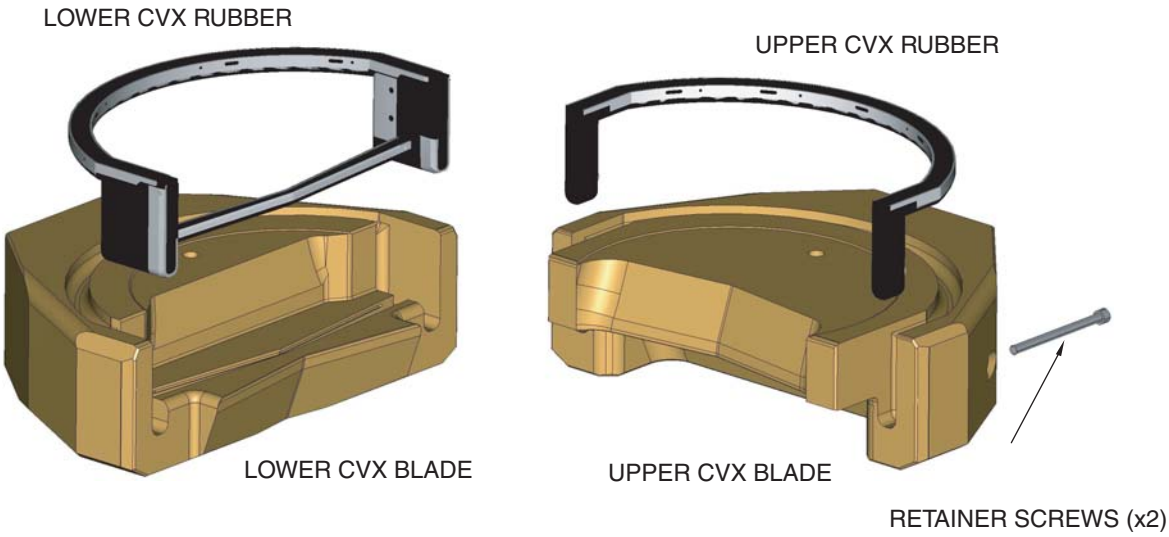


Figure 6-8. CVX™ Shear Ram Assembly

Parts List – CVX Shear Ram Assy. 18¾", 15,000 psi (P/N 20026257)

Item #	Qty.	Description	P/N
–	–	Upper Shear Ram Complete Assembly	20026243
1	1	Upper CVX Blade	20021845
2	1	Upper CVX Rubber	20026217
3	2	6½" Retainer Screw	122864
–	–	Lower Shear Ram Complete Assembly	20026231
4	1	Lower CVX Blade	20026179
5	1	Lower CVX Rubber	20026206

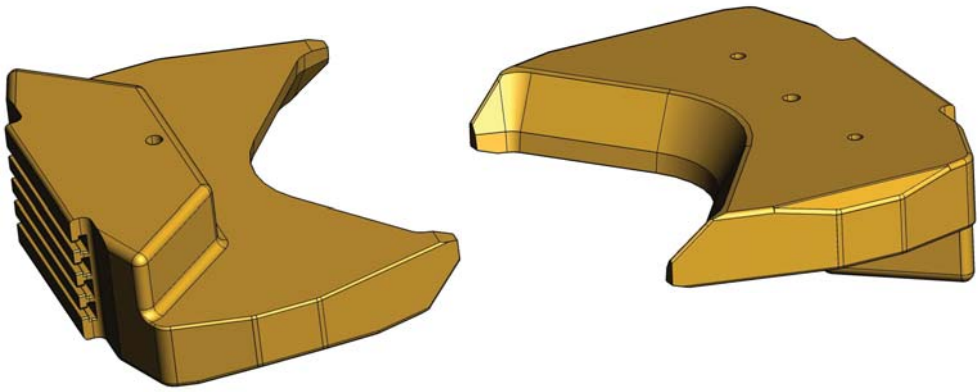


Figure 6-9. Casing Shear Ram Assy. 18¾", 15,000 psi (P/N 20013162)

Parts List – Casing Shear Ram Assy. 18¾", 15,000 psi (P/N 20013162)

Item #	Qty.	Description	P/N
1	1	Upper Casing Shear Blade	20013683
2	1	Lower Casing Shear Blade	20013683

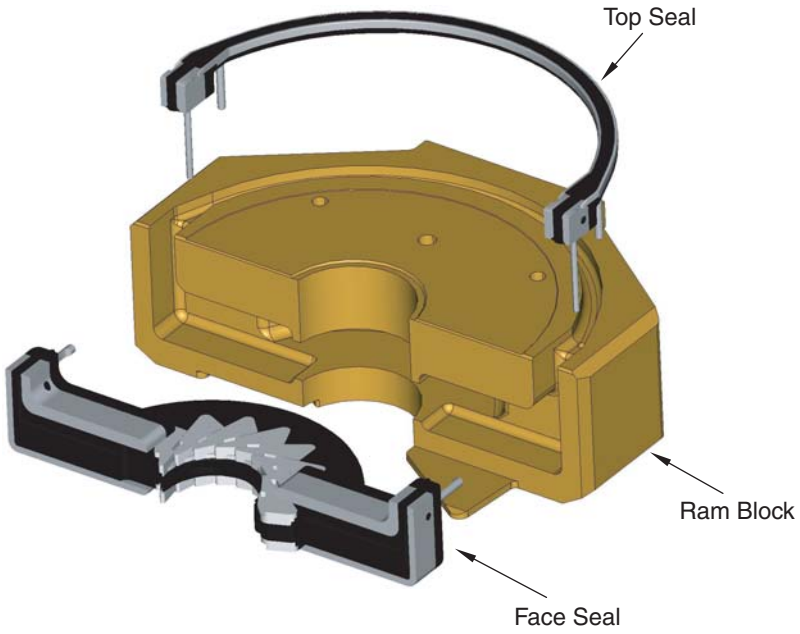


Figure 6-10. Multi-Ram Assembly

Parts List – 18¾", 15,000 psi Multi-Ram™

Pipe O.D.	Ram Type	*Complete Ram Assy	Block	**Ram Rubber Assy.
3½" to 5½"	NXT	20012089	20012092	126665
3½" to 5 7/8"	NXT	20015911	20015868	20028655
3½" to 6 5/8"	NXT	20024125	20024105	20092575
5" to 7"	NXT	20012091	20012093	20017694

FACE 10648443-001
TOP:20023274

** Includes block and ram rubber assembly.*
*** Includes top seal and face seal.*

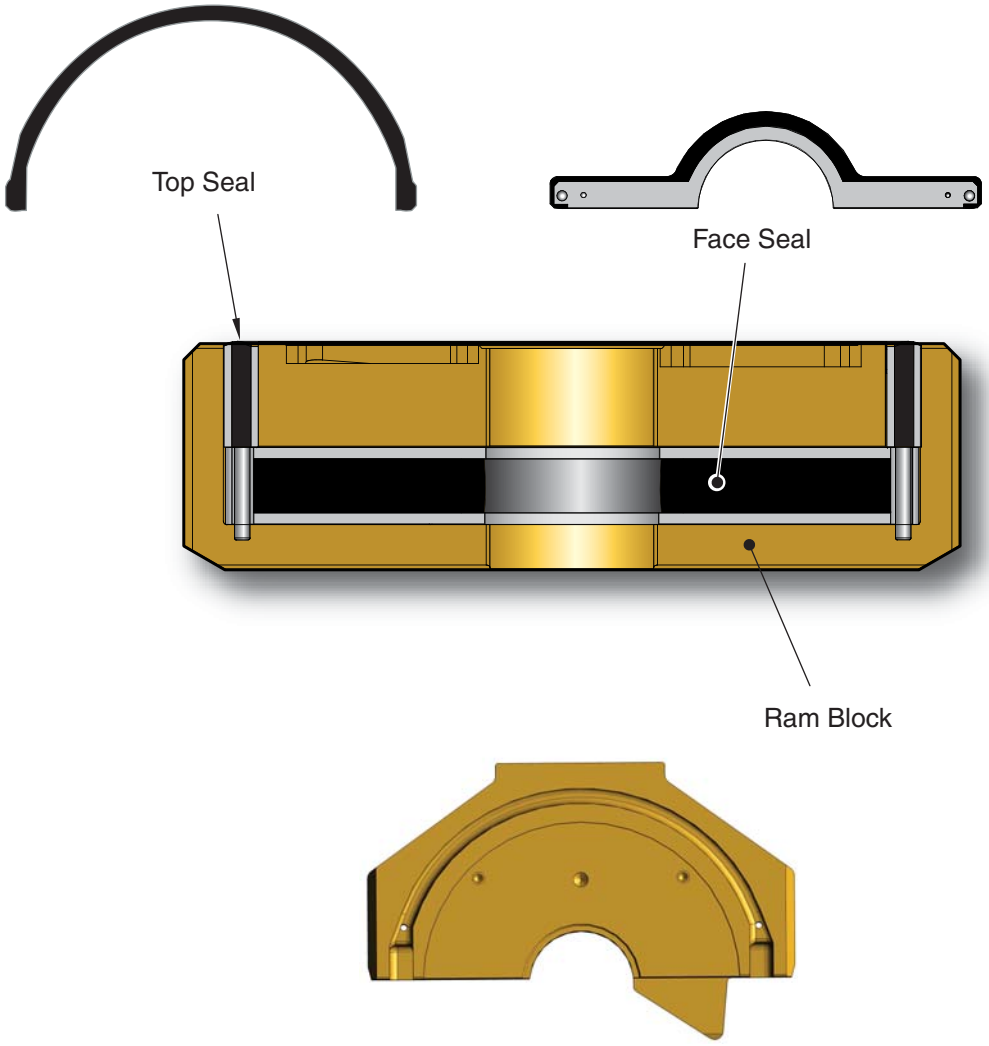


Figure 6-11. NXT Ram Assembly

Parts List – NXT 18¾", 5/10/15M Ram Assemblies

Part Number	Pipe Size	*Ram Type	Ram Block (1 pc Design)	Top Seal	Face Seal	Ram Rubber Assy
20011968	3½"	NXT-D, U/T	20011825	171002	171034	–
20011973	4"	NXT-D, U/T	20011829	171002	171035	–
20011977	4½"	NXT-D, U/T	20011833	171002	171036	–
20011981	5"	NXT-D, U/T	20011840	171002	171037	–
20011985	5½"	NXT-D, U/T	20011844	171002	171038	–
20018599	5 7/8"	NXT-D, U/T	20012363	171002	20017704	20017846
20011989	6 5/8"	NXT-D, U/T	20011848	171002	171039	–
20011965	3½"	NXT-D	20011825	126103	126182	126165
20011971	4"	NXT-D	20011829	126103	126183	126166
20011975	4½"	NXT-D	20011833	126103	126184	126167
20011979	5"	NXT-D	20011840	126103	126185	126168
20011983	5½"	NXT-D	20011844	126103	126186	126169
20012398	5 7/8"	NXT-D	20012363	126103	20012387	20012399
20011987	6 5/8"	NXT-D	20011848	126103	126187	126170
20011960	CSO	NXT. U/T	20011716	171002	20010422	20010896
20011967	3½"	NXT, U/T	20011823	171002	171034	–
20011972	4"	NXT, U/T	20011828	171002	171035	–
20011976	4½"	NXT, U/T	20011832	171002	171036	–
20011980	5"	NXT, U/T	20011838	171002	171037	–
20011984	5½"	NXT, U/T	20011843	171002	171038	–
20018599	5 7/8"	NXT, U/T	20012363	171002	20017704	
20011988	6 5/8"	NXT, U/T	20011847	171002	171039	–
20011991	7"	NXT, U/T	20011851	171002	171040	–
20011995	9 5/8"	NXT, U/T	20011857	171002	170382	170378
20016070	10¾"	NXT, U/T	20011863	171002	20010423	–
20016071	13 3/8"	NXT, U/T	20011865	171002	20010488	20010898

Parts List – NXT 18¾", 5/10/15M Ram Assemblies (Continued)

Part Number	Pipe Size	*Ram Type	Ram Block (1 pc Design)	Top Seal	Face Seal	Ram Rubber Assy
20011959	CSO	NXT	20011716	126103	126179	126162
20011962	2 3/8"	NXT	20011821	126103	126180	126163
20011963	2 7/8"	NXT	20011822	126103	126181	126164
20011964	3½"	NXT	20011823	126103	126182	126165
20011970	4"	NXT	20011828	126103	126183	126166
20011974	4½"	NXT	20011832	126103	126184	126167
20011978	5"	NXT	20011838	126103	126185	126168
20011982	5½"	NXT	20011843	126103	126186	126169
20012397	5 7/8"	NXT	20012362	126103	20012387	20012399
20011986	6 5/8"	NXT	20011847	126103	126187	126170
20011990	7"	NXT	20011851	126103	126188	126171
20011992	7 7/8"	NXT	20011854	126103	126189	126172
20011993	8 5/8"	NXT	20011855	126103	126190	126173
20011994	9 5/8"	NXT	20011857	126103	126191	126174
20013695	9 7/8"	NXT	20013689	126103	20013693	20013694
20011996	10 3/4"	NXT	20011863	126103	126192	126175
20011997	11 3/4"	NXT	20011864	126103	126193	126176
20011998	13 3/8"	NXT	20011865	126103	126194	126177
20012651	5½" x 2 3/8"	Dual Offset				
20012463	5½" x 2 3/8"	Left Hand	20012459	126103	20012464	–
20012591	5½" x 2 3/8"	Right Hand	20012584	126103	20012464	–

NXT-U/T is NXT rams with "Ultra Temp" (high temperature) ram rubbers.

NXT-D are NXT rams with "Hard Inlay" for drill pipe hang off.

Engineering Drawings and Parts Lists

The table titled “Engineering Drawings and Parts Lists” lists engineering drawings for the NXT BOP, UltraLock II (B) and 22” PosLock door assemblies.

Engineering Drawings and Parts Lists

Drawing	Parts List	Description
D-20030015D	20030015	BOP Assembly, NXT Double 18-15M with 22” Operators
D-20027890D	20027890	BOP Assembly, NXT Triple 18-15M with 14” UltraLock 2B Operators
D-20018931D	20018931	Door Assembly, 18-15M NXT with 22” Operator
D-20002534D	168053	Door Assembly, 18-15M NXT with UltraLock II B Operator
D-20001255D	20001257	Piston Assembly, 14” UltraLock II B Operator
–	168075	Ram Shaft Seal Assembly, 14” UltraLock II B Operator
D-168023D	168023	Door Locking Assembly, UltraLock II B
D-168110D	168110	L.H. Rotary Actuator Assembly, UltraLock II B Operator
–	168111	R.H. Rotary Actuator Assembly, UltraLock II B Operator
–	168047	Door Cartridge Seal Assembly
–	20018651	Ram Shaft Seal Assembly, 22” PosLock Operator
D-20026545D	20026545	Lock Bar Drive Assembly, 22” PosLock Operator
D-20032414D	20032414	Hinge Assembly, 22” PosLock Operator
D-20026244D	20026257	CVX-W Sheer Ram Assembly, NXT
–	20013162	Casing Shear Ram Assembly, NXT
–	20015911	3½”–5$^{7}/_{8}$” Multi Ram Assembly, NXT
–	20012091	5”–7” Multi Ram Assembly, NXT, H_2S
–	20011985	5½” Ram, NXT-D, Ultra Temp, H_2S
D-129531D	168125	Hydraulic Door Control Panel
D-168100D	–	NXT Door Manifold and Hydraulic Coupling Schematic
D-168145D	168145	Hose Assembly, Door Control Panel
D-20026903D	20026903	Manifold Assembly, 4 Function Hydraulic Actuator, 22” PosLock Operator
–	–	Inverted Cavity – Test Ram (addendum located at end of this manual)
–	168134	Manifold Assembly, 6 Function Hydraulic Actuator, UltraLock II B Operator

Engineering Drawings and Parts Lists

Drawing	Parts List	Description
–	20016844	Spare Parts Kit, Door Control Manifold
–	168109	Spare Parts Kit, 18¾”–15M UltraLock 2B
–	168178	Spare Parts Kit, 18¾”–15M UltraLock 2B Door
–	168122	Spare Parts Kit, 18¾”–15M UltraLock 2B, Cavity Seat
–	20019444	Spare Parts Kit, 18-15M NXT with 22” Operator,
–	20019273	Spare Parts Kit, PosLock Segments, 18-15M NXT with 22” Operator
–	20001259	Spare Parts Kit, Piston Assembly, UltraLock IIB Operator
–	20020683	Spare Parts Kit, 18-15M NXT with 22” Operator, Cavity Seat for Shear Ram
–	20029399	Adjustment Kit, 18-15M NXT with 22” Operator
–	165551	Tool Kit, UltraLock II B Operator
–	20003776	Seal Kit, Manifold Assembly, 4-Function Hydraulic Actuator

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