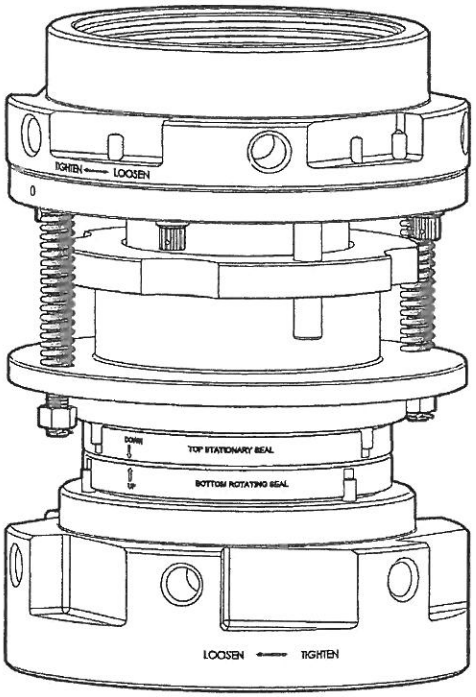
Service Manual

NOV Mechanical Washpipe



Reference

Reference Description

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Revision History

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Change Description

Revision	Change Description
01	First Issue
02	Revised format to remove format notes.
03	Revision 03 changed this document from a small installation procedure to a full service manual. Added General Information, Description, Maintenance, and Troubleshooting chapters.
04	1. Page 3-2. Added Main Shaft end float measurements for separate top drive models. 2. Pages 3-5, 3-11, 3-22, and 4-9. Changed torque setting to 200 ft-lbs (minimum).
05	1. Page 3-2 Added pre-installation subsection about checking for tapered liners. 2. Page 3-7 Added text to note about checking for tapered liners. 3. Page 3-20 Added note about checking for tapered liners. 4. Page 5-1 Added troubleshooting bullet about tapered vs. straight liners.
06	Added additional post-jarring inspection information to page 4-1.
07	• All pages Applied new FrameMaker template. • Page 1-3 Added new, approved General Information "Safe Lifting" content. • Chapter 6 Updated Service Center contact information.
08	• Page 2-4 Added Operating Precautions section with jarring and dry running information. • Page 4-2 Added information about using plain water and standard pressure for basic cleaning. • Page 4-3 Added detailed cleaning instructions to the mechanical seal replacement section. • Removed Chapter 6, Service Centers, added section in Chapter 1, General Information.
09	Added information about the direct coupled washpipe (i.e., TDX-1000 Top Drive washpipe model).

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General Information 1

Conventions

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

Advisories

Graphic symbols and bracketed text indicate advisories for a specific topic. This information provides additional details and may advise the reader to take a specific action to protect personnel from potential injury or lethal conditions. Advisories may also describe actions necessary to prevent equipment damage.

Note

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

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 follow safe work procedures could result in serious or fatal injury to personnel, significant equipment damage, or extended rig down time.

Conventions

Advisories

Hot Surfaces

The hot surface symbol indicates the presence of a hot surface or component. Touching this surface could result in bodily injury. To reduce the risk of injury from a hot component, allow the surface to cool before touching.

Electrostatic Discharge

The Electrostatic Discharge (ESD) symbol indicates the potential for static electrical discharge is present. ESD can damage or destroy sensitive electronic components. ESD can also set off explosions or fires in flammable environments. Always discharge static electricity prior to working on sensitive components or in flammable environments.

Illustrations

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

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

Safety Requirements

The NOV 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 the equipment 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.

Proper Use of Equipment

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

Safe Lifting

When lifting and handling NOV equipment, use approved lifting procedures and safe methods.

Always follow all federal, state and local rules, codes, and rig-specific safety guidelines when lifting and handling NOV equipment. Operators and maintenance personnel should be properly trained in safe lifting procedures and the inspection of material handling equipment and lifting components. Safe lifting recommendations provided in this manual do not take precedence over local safety rules and regulations, OSHA regulations, or instructions issued by the manufacturers of rig hoisting equipment and other tools on the rig.

Lifting equipment improperly creates a hazardous working environment. To avoid lifting hazards, only lift equipment with material handling equipment rated for the expected load and only from the designated lift points. Failure to follow safe lifting guidelines may result in serious or fatal injury to personnel, significant equipment damage, and extended rig down time.

Safety Requirements

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 in rig safety, tool operation, and maintenance to ensure their safety.

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

Contact the NOV 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 manufacturer recommends that only those tools specified be used when stated. Ensure that personnel and equipment safety are not jeopardized when following service procedures and that personnel are not using tools that were not specifically recommended by the manufacturer.

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.

Safety Requirements

Replacing Components

- Verify that all components (such as cables, hoses, etc.) are tagged and labeled during assembly and disassembly of equipment to ensure correct installation.
- Replace failed or damaged components with original equipment manufacturer 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 manuals for maintenance recommendations.

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

Service Centers

For a directory of NOV Service Centers, see NOV document number D811001337-DAS-001, titled "Service Center Directory." This document is located in the User Manual.

The link below provides after-hours contact information for emergencies or other equipment issues requiring an immediate response by NOV service personnel.

www.nov.com/contact_us/24hr_EmergencyList.asp

Description 2

NOV Mechanical Washpipe Description

The NOV mechanical washpipe uses a mechanical seal design, replacing the traditional metal-backed "V" packing system. This washpipe design provides extremely long service life compared with conventional washpipes.

The washpipe is available in standard 3" or 4" I.D. (inside diameter) bore sizes. (Other bore size and thread size options are also available.) The washpipe is rated for 7,500 psi and uses a pressure-balancing design that allows the seals to last much longer than those in conventional washpipe assemblies.

The part numbers for NOV equipment components and kits can be found on the engineering drawings in the Technical Drawing Package (TDP). The TDP is included with the top drive User Manual delivered with the order.

There are two basic mechanical washpipe models.

Standard Mechanical Washpipe

The standard NOV mechanical washpipe consists of upper and lower Acme-threaded nuts, a floating assembly, a stationary top seal, and a rotating bottom seal (see Figure 2-1). This is the NOV mechanical washpipe model used on most top drives. Replacing the top and bottom seals typically takes less than ten minutes and requires only one wrench to tighten and loosen the two nuts.

An exploded view of this washpipe is shown in Figure 2-2 on page 2-3.

Description

Standard Mechanical Washpipe

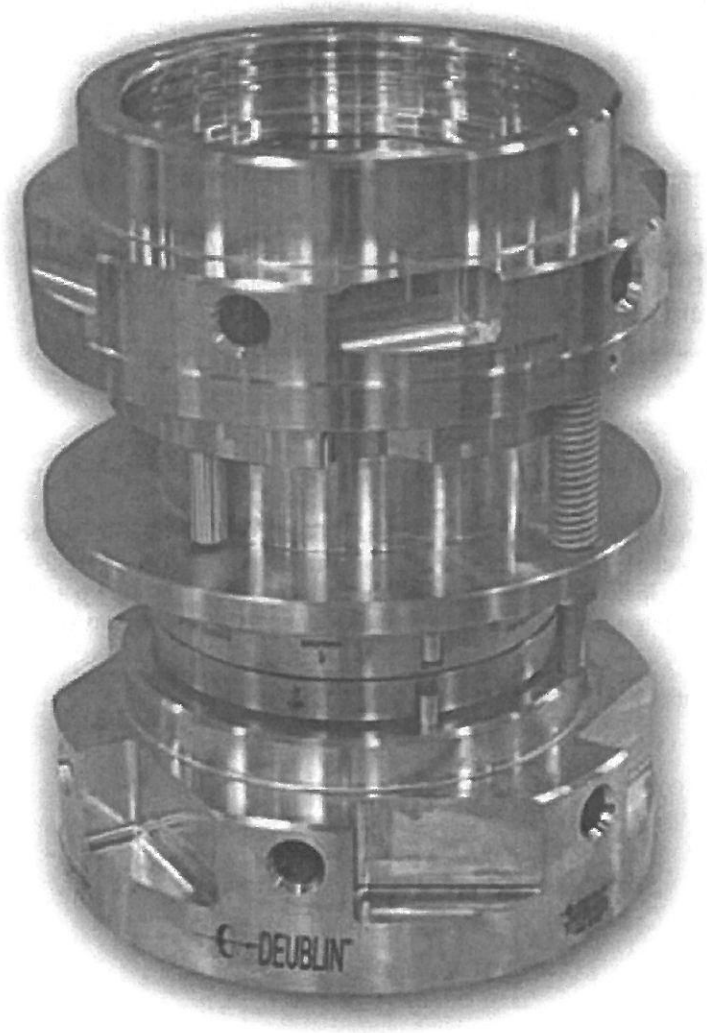


Figure 2-1. Standard Mechanical Washpipe Assembly

Description

Standard Mechanical Washpipe

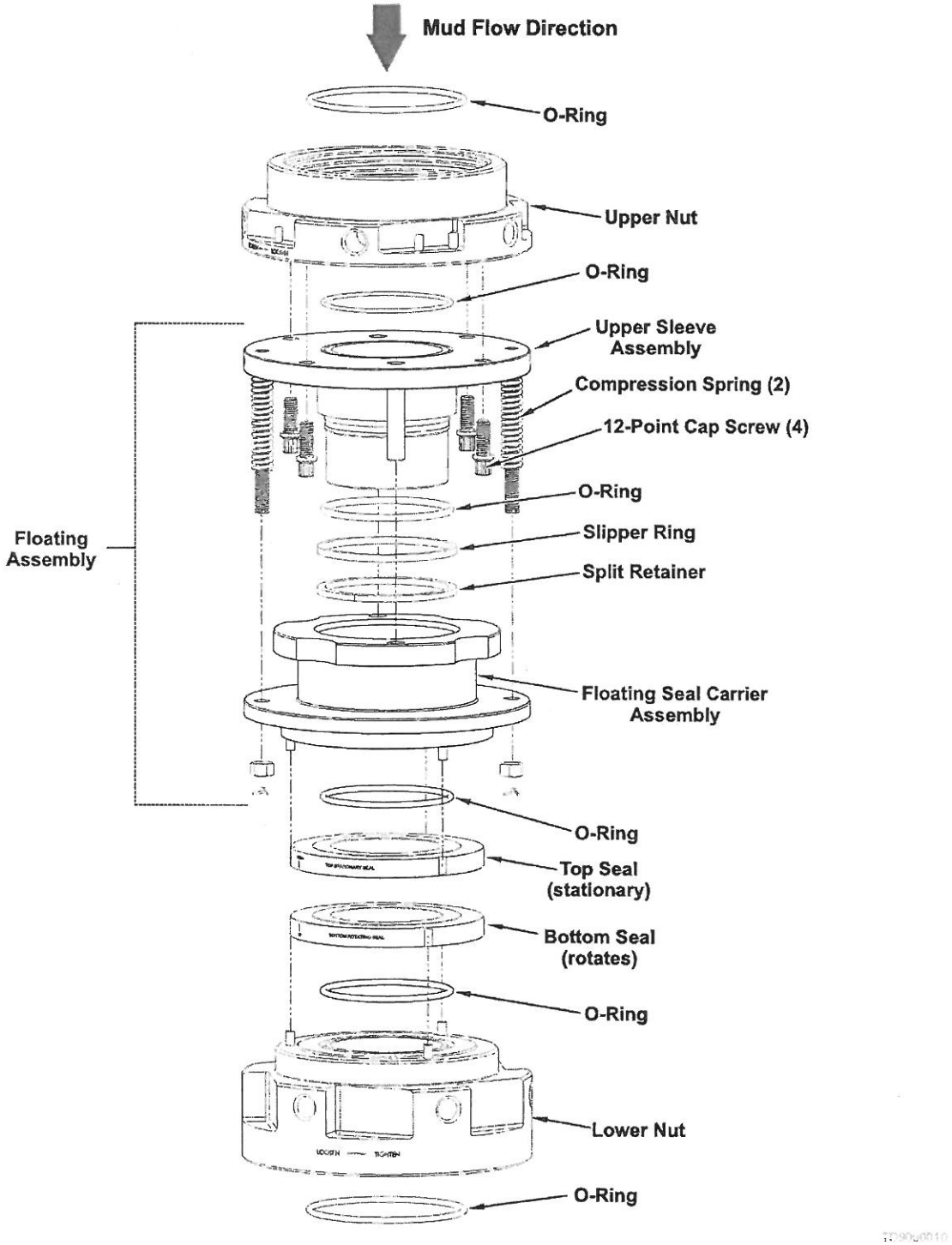


Figure 2-2. Standard Mechanical Washpipe Assembly (Exploded View)

Description

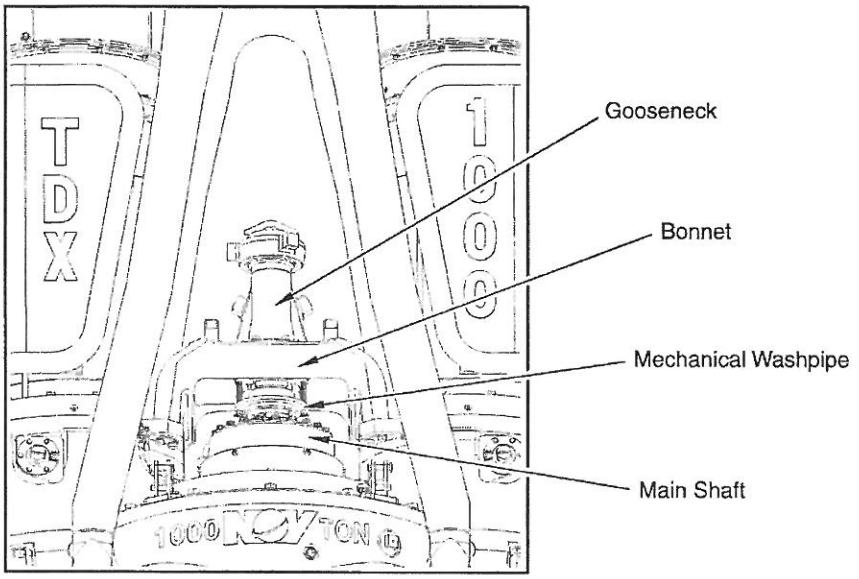
Direct Coupled Mechanical Washpipe

The direct coupled NOV mechanical washpipe attaches directly to the gooseneck and main shaft without using the upper and lower nuts. This washpipe is an integrated component used only with certain NOV top drives. Maintenance and troubleshooting procedures for the direct coupled model are practically identical to the standard model.

The direct coupled washpipe is shown in Figure 2-3.

Description

Direct Coupled Mechanical Washpipe



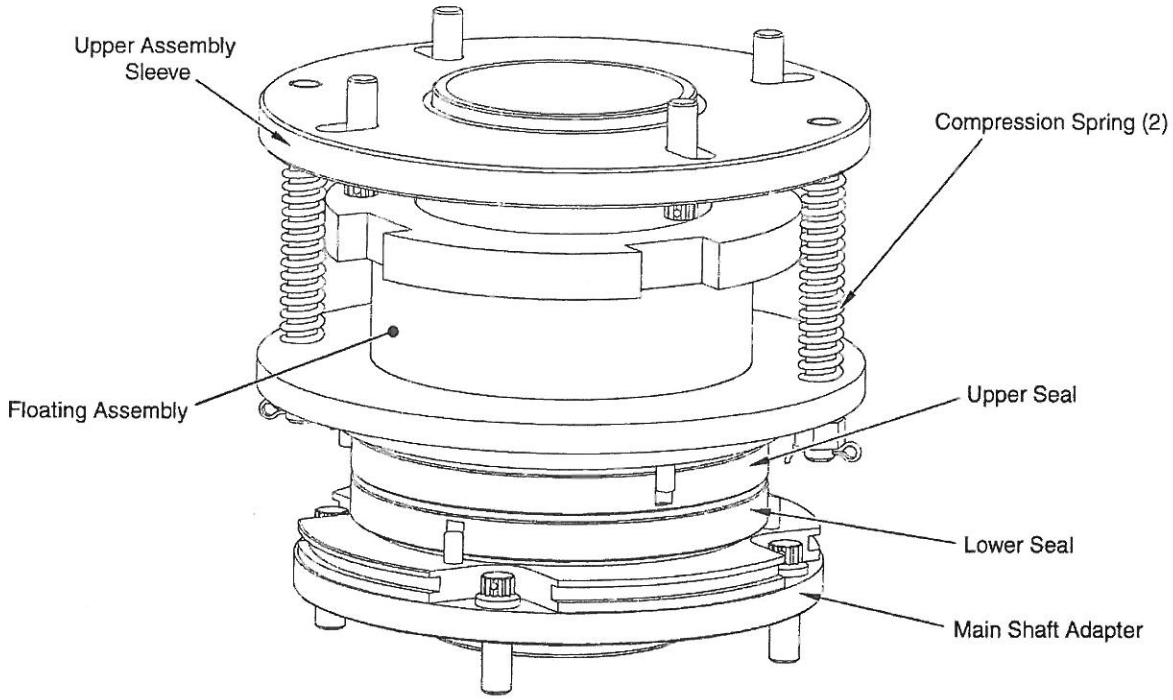


Figure 2-3. Direct Coupled Mechanical Washpipe Assembly

Seal Handling Precautions

Jarring Operations

Jarring can damage the NOV mechanical washpipe. Make sure to thoroughly inspect the mechanical seals after jarring operations.

If the seals have been damaged, they will need to be replaced prior to resuming drilling operations. Refer to the section titled "Mechanical Seal Cleaning or Replacement" on page 4-3 for details about replacing the mechanical seals.

NOV recommends removing the top drive prior to jarring.

Dry Running the Top Drive

Operating the top drive with no mud circulating can damage the NOV mechanical washpipe.

When the main shaft rotates during drilling operations, the top mechanical seal in the washpipe remains stationary and the bottom mechanical seal rotates. Circulating mud provides the lubrication and cooling for the contact surfaces between the two mechanical seals. Extreme wear on the mechanical seals occurs any time the main shaft rotates without mud circulation.

Remove the two mechanical seals in the washpipe prior to dry running the top drive for ***five minutes or longer.***

If the seals have been damaged, they will need to be replaced prior to normal drilling operations. Refer to the section titled "Mechanical Seal Cleaning or Replacement" on page 4-3 for details about replacing the mechanical seals.

Moving the Top Drive

Adhere to the following precaution when moving or transporting the top drive.

Remove the two mechanical seals if you are shipping or transporting the top drive. Shock loads that occur during transport can damage the mechanical seals.

Installation 3

This chapter contains procedures for installing the standard NOV mechanical washpipe (Figure 2-2 on page 2-3). The direct coupled NOV mechanical washpipe is an integrated component used in certain NOV top drive models. Refer to section titled "Direct Coupled Washpipe Components" on page 4-13 if this washpipe model has to be removed or replaced.

The location where the washpipe is installed, in the top drive bonnet, is typically far above the rig floor. Make sure to secure all tools and use a safety harness. Always follow all local safety practices and procedures while working above the rig floor.

Required Tools and Materials

At least one rig hand will be needed to assist the installer when lifting and holding washpipe components as they are maneuvered into position and installed.

The following required tools are provided with the mechanical washpipe equipment order.

- 1/2-inch ratchet wrench (reversible)
- 3/4-inch ratchet wrench (reversible)
- Tightening (torque) bar
- Temporary installation plate

Required Tools and Materials

The following items are required to complete the installation procedures. Make sure they are available prior to beginning.

- Dial indicator (with a magnetic base)
- General purpose grease
- Clean, light oil (SAE 30 motor oil or hydraulic oil)
- Safety Wire
- Safety Wire Pliers

Before working with any NOV equipment, refer to the engineering drawings in the Technical Drawing Package (TDP) in the equipment User Manual.

Pre-Installation Preparation

Review the information in this section prior to starting washpipe installation procedures.

Check Upper and Lower Stem Liners

For some top drives, a small bore (3") washpipe is used with a large bore (4") top drive. This type of configuration uses **tapered liners** (4" to 3") to adapt the washpipe connections at the gooseneck and main shaft (Figure 3-1).

Before installing the mechanical washpipe, tapered liners must be replaced with **straight liners.**

If the top drive requires replacement stem liners, contact your NOV service representative.

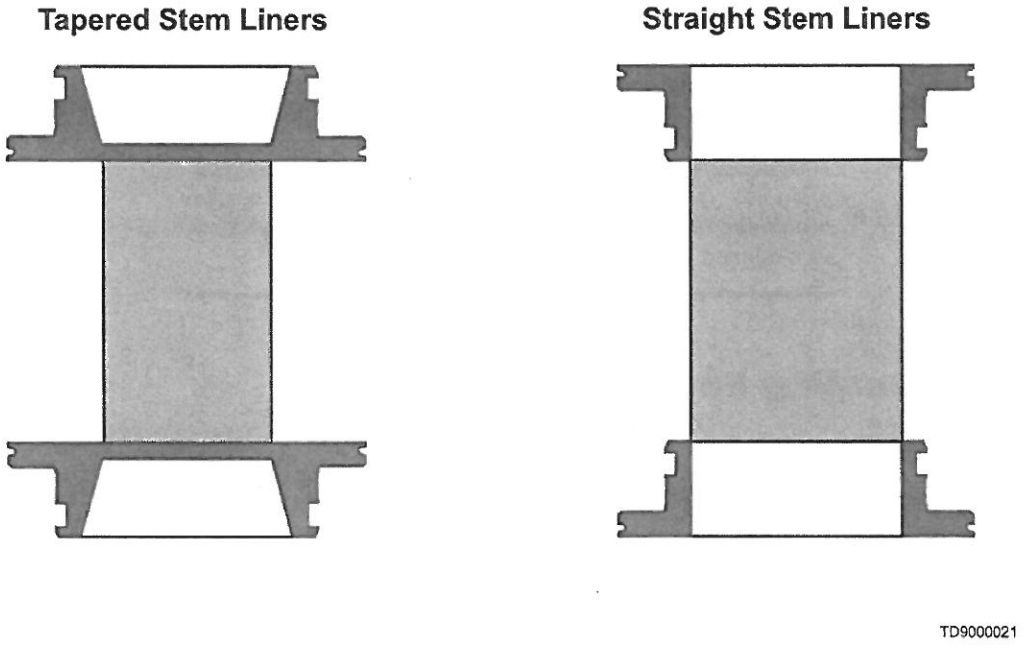


Figure 3-1. Stem Liners

Pre-Installation Preparation

Verify Maximum Run-Out and End Float

Prior to installing the NOV mechanical washpipe, inspect the equipment to verify that the following **run-out** and **end float** measurements are within acceptable limits. If equipment run-out and end float are too high, adjust the equipment until the following measurements fall below the maximum acceptable.

- **Main Shaft** end float:
  - TDS and TDX series — .003" maximum
  - PS and HPS series — .030" maximum
- **Main Shaft Face** run-out — .002" maximum
- **Stationary Face** run-out — .006" maximum
- **Radial** run-out — .020" maximum

The pressure-balancing feature designed for this washpipe promotes longer seal life. If the equipment is not in alignment, the mechanical sealing system will not perform as designed and the seals will be damaged.

Verify Sealing Face Alignment

Using a dial indicator, verify the proper alignment of sealing faces as shown in the following pictures. Refer to the previous section titled "Verify Maximum Run-Out and End Float" for the allowed variance for each measurement.

Main Shaft Face and Radial run-out should be checked again after the lower nut is installed.

Pre-Installation Preparation

Verify Sealing Face Alignment

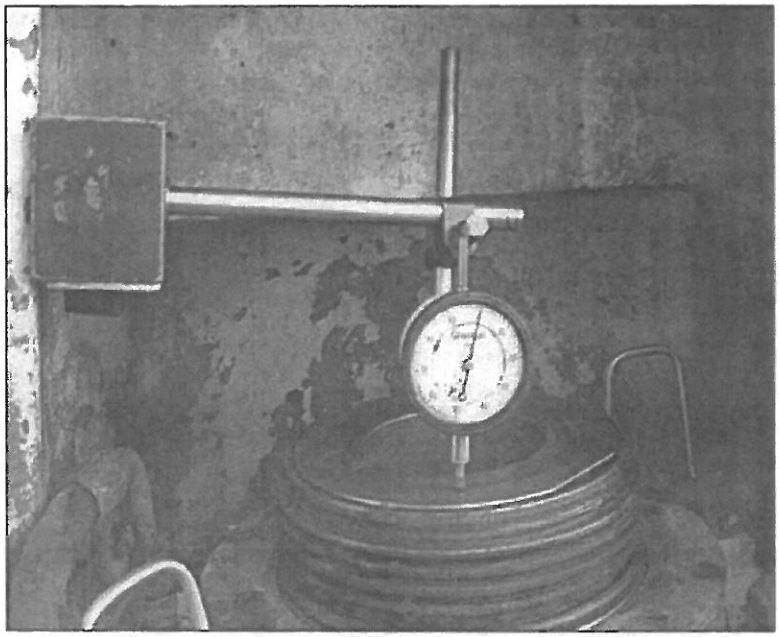


Figure 3-2. Checking Main Shaft End Float and Face Run-Out

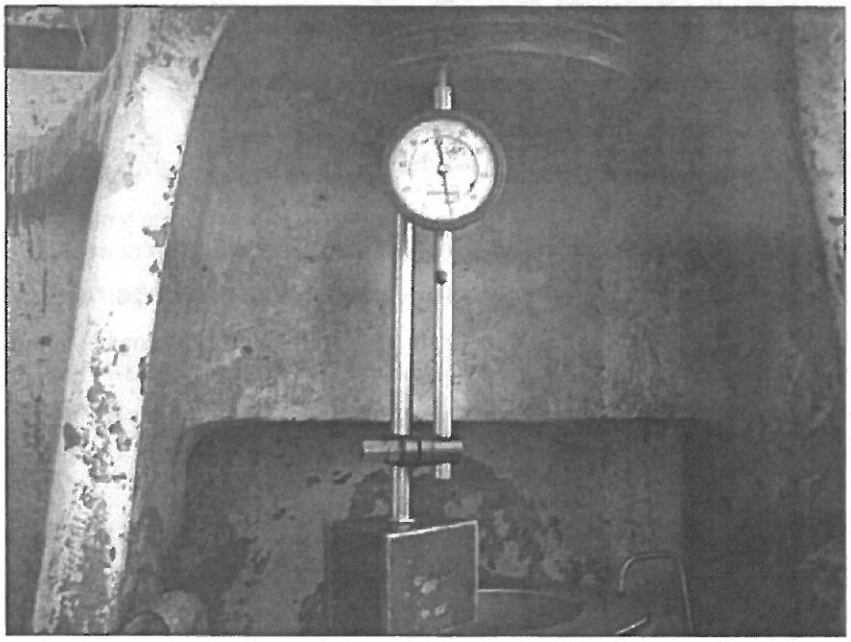


Figure 3-3. Checking Stationary Face Run-Out

Pre-Installation Preparation

Check Threads and Surfaces

Clean the threads and sealing surfaces for both the main shaft and the gooseneck face (the upper and lower sealing surfaces). Make sure they are not damaged.

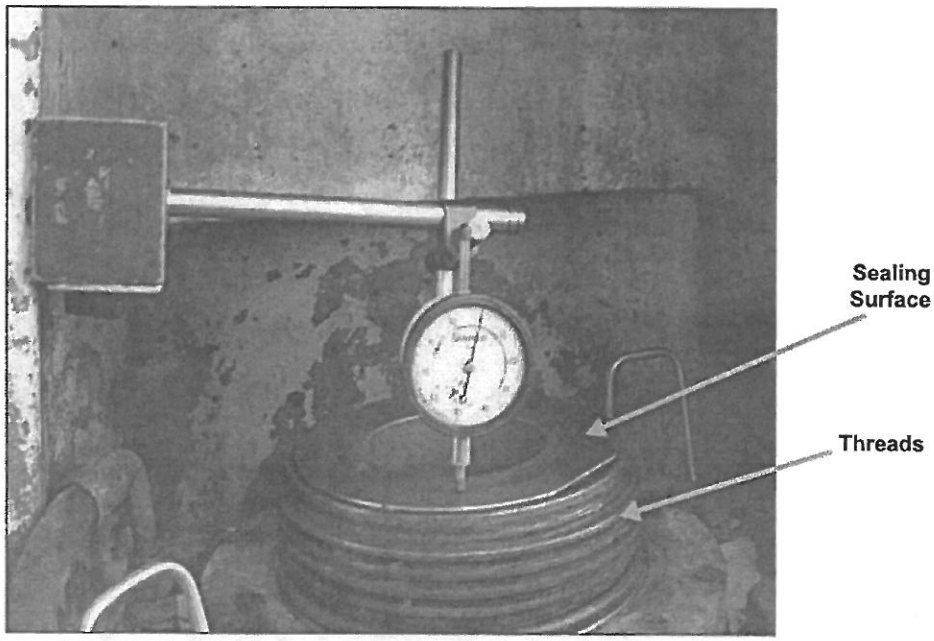


Figure 3-4. Main Shaft Sealing Surface and Threads

Check Bonnet Opening Width

The width of the bonnet opening for some top drive models may require that a modified installation procedure be used. Measure the bonnet opening before starting to install the washpipe.

The bonnet opening width should be equal to or greater than **10.5 inches (26.7 cm)**.

- If the width of the bonnet opening *is equal to or greater than* 10.5 inches, use the procedure in section titled "Standard Installation Procedure" on page 3-7.
- If the width of the bonnet opening *is less than* 10.5 inches, use the procedure in section titled "Modified Installation Procedure" on page 3-20.

Check Bail Position

Make sure to check the position of the top drive bails and the bonnet opening prior to beginning the installation. For some top drive models, a bail may be directly in front of the bonnet opening. In this case, the installer may require additional help to carefully maneuver the washpipe components into position for installation.

Washpipe Installation

This section provides instructions for installing the mechanical washpipe.

Standard Installation Procedure

Before starting this procedure, **make sure to check the bonnet opening width** (see section titled "Check Bonnet Opening Width" on page 3-6). You may need to use a modified procedure to install the washpipe.

Before starting this procedure, **make sure to check the upper and lower stem liners** (see section titled "Check Upper and Lower Stem Liners" on page 3-3). Tapered stem liners must be replaced.

First Step: Install the Lower Nut

1. Clean the swivel stem (the main shaft sealing surface and threads).
2. Apply a small amount of general purpose grease to the swivel stem.
3. Clean the top and bottom of the lower nut. While cleaning the lower nut, make sure there is an O-ring in both the top and bottom O-ring grooves.
4. Apply a small amount of general purpose grease to the inside threads of the lower nut.
5. Install the lower nut. Use the tightening bar (provided) to tighten the lower nut to 200 ft-lbs of torque (minimum).

Do not use a hammer on the washpipe. *Using a hammer will damage washpipe components. Use the tightening bar provided with the mechanical washpipe. This tightening bar is designed specifically for tightening and loosening washpipe components.*

If the nuts are completely stuck, a hammer may be used for ***loosening only.*** *Make sure to hit the nut on one of the angled notches provided specifically for this purpose.*

Both the upper nut and lower nut have left-handed threads. Counterclockwise rotation tightens these nuts.

Washpipe Installation

Standard Installation Procedure

First Step: Install the Lower Nut

6. Clean the top surface of the lower nut and make sure the top surface O-ring is in place (Figure 3-5).

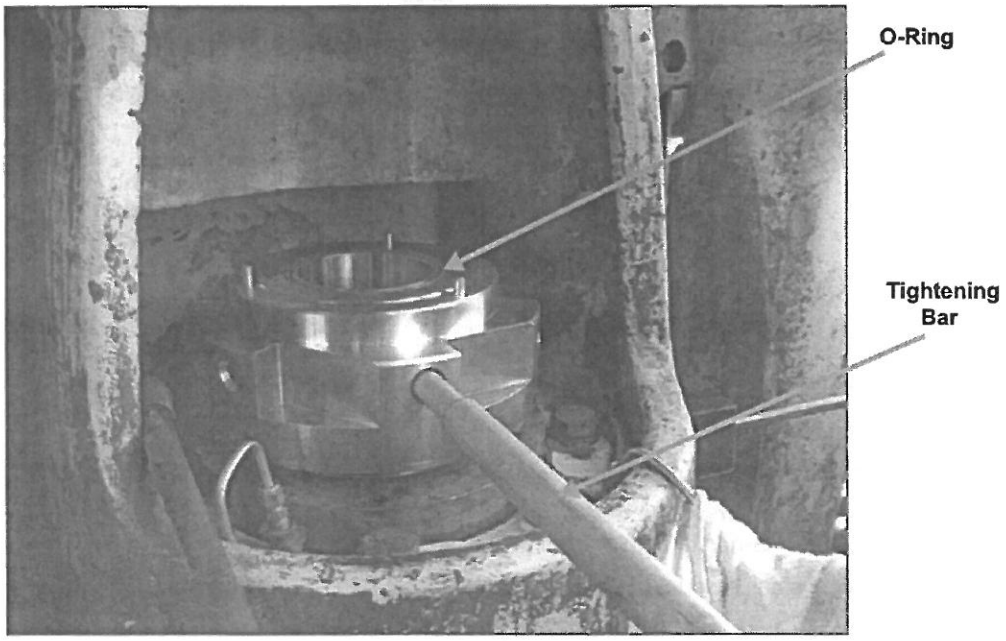


Figure 3-5. Installing the Lower Nut

Do not use a hammer on the washpipe. *Using a hammer will damage washpipe components. Use the tightening bar provided with the mechanical washpipe. This tightening bar is designed specifically for tightening and loosening washpipe components.*

If the nuts are completely stuck, a hammer may be used for ***loosening only****. Make sure to hit the nut on one of the angled notches provided specifically for this purpose.*

Washpipe Installation

Standard Installation Procedure

First Step: Install the Lower Nut

7. Check Face run-out and Radial run-out. Refer to the section titled "Pre-Installation Preparation" for the allowed variance for each measurement.

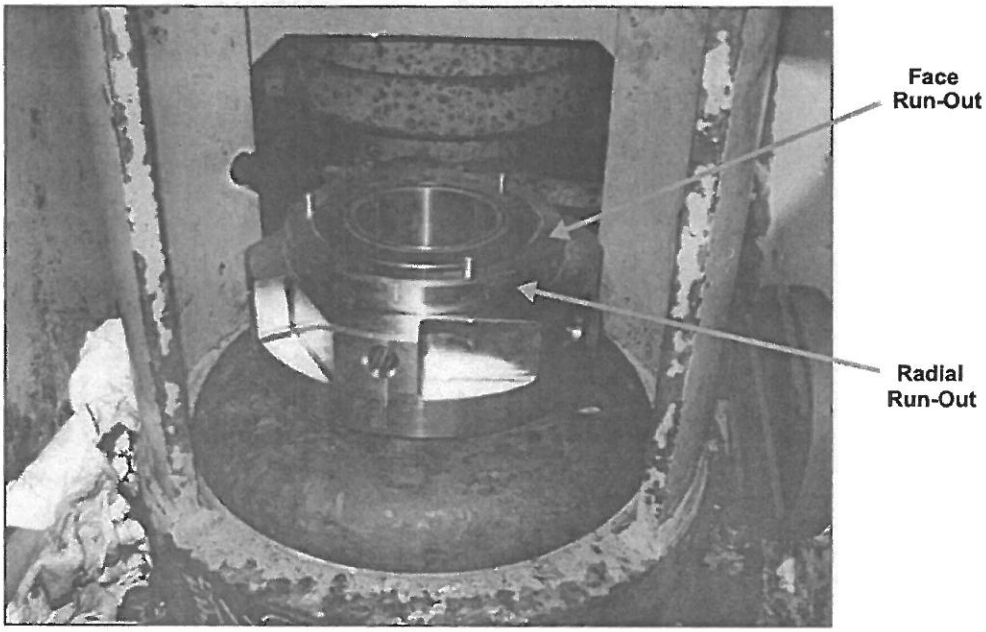


Figure 3-6. Face and Radial Run-Out Check Locations

The pressure-balancing feature designed for this washpipe promotes longer seal life. If the equipment is not in alignment, the mechanical sealing system will not perform as designed.

Washpipe Installation

Standard Installation Procedure

Second Step: Install the Upper Nut

1. Install the temporary installation plate (Figure 3-7). This plate protects the surface of the lower nut.

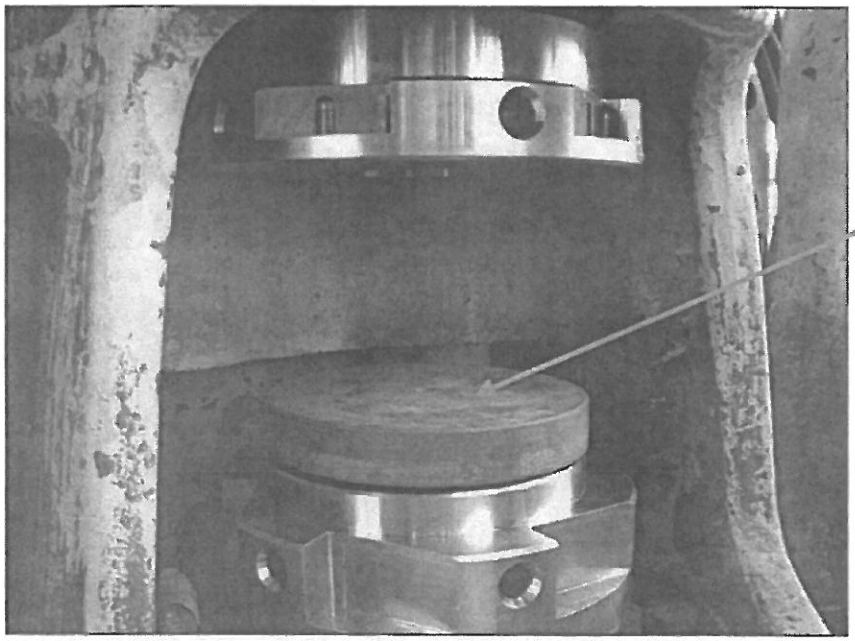


Figure 3-7. Positioning Temporary Installation Plate

2. Clean the gooseneck sealing surface and threads.
3. Apply a small amount of general purpose grease to the gooseneck face and threads.
4. Make sure there is an O-ring properly installed in the top of the upper nut.
5. Apply a small amount of general purpose grease to the inside threads of the nut.
6. Install the upper nut. **Hand tighten only** at this step.

Do not fully tighten the upper nut. You will need to rotate (unscrew) the upper nut later in the installation procedure to access the other side.

Both the upper nut and lower nut have left-handed threads. Counterclockwise rotation tightens these nuts.

Washpipe Installation

Standard Installation Procedure

Third Step: Install the Floating Assembly

1. Clean the bottom surface of the upper nut with a clean cloth.
2. Apply a small amount of general purpose grease to the Floating Assembly surface.
3. Position the Floating Assembly on the temporary installation plate.
4. Align the holes in the Floating Assembly with any four threaded holes in the upper nut flange. There are multiple tapped holes in the upper nut. Choose holes that are evenly spaced apart and that work best for the installation.

When aligning the four holes, make sure the compression springs are positioned as close as possible to 3 and 9 o'clock when facing the front of the washpipe.

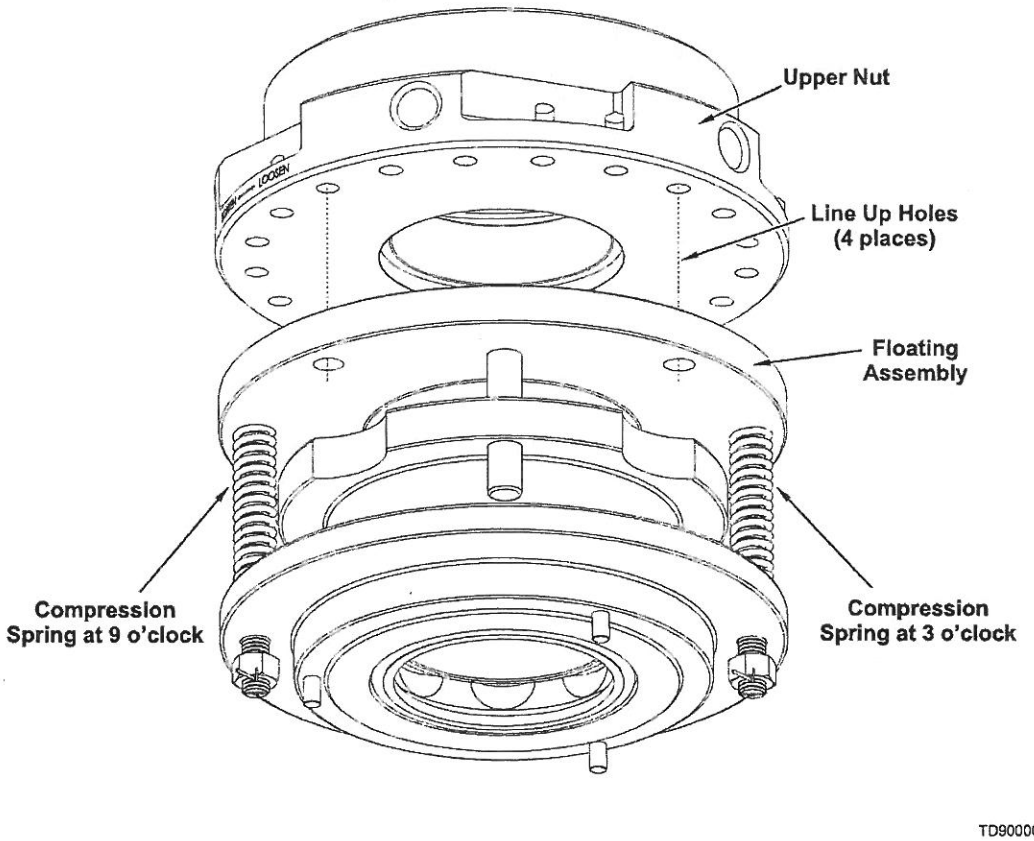


Figure 3-8. Aligning the Floating Assembly and the Upper Nut

Washpipe Installation

Standard Installation Procedure

Third Step: Install the Floating Assembly

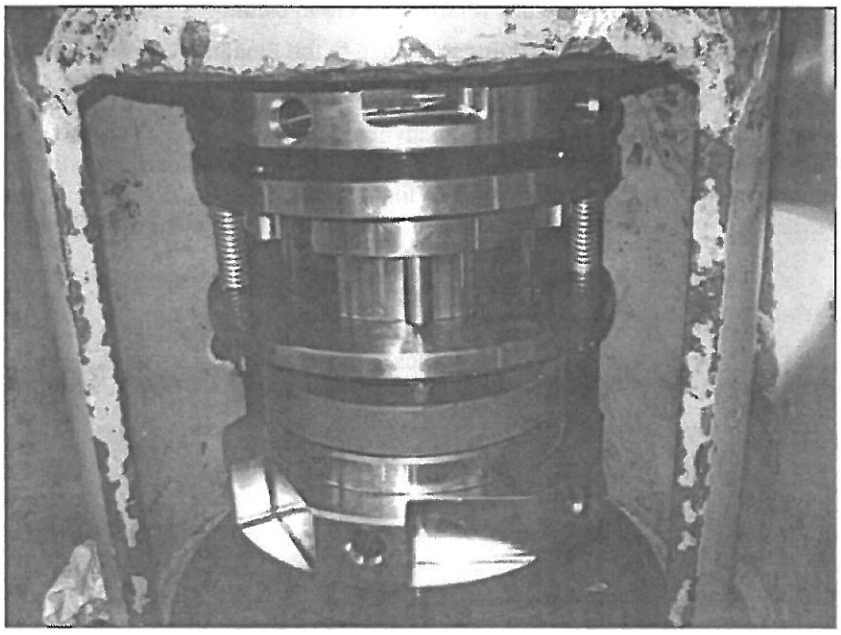


Figure 3-9. Lining up Holes for the Cap Screws

5. Using the 1/2" ratchet wrench provided, install the front two cap screws.
6. Rotate (unscrew) the upper nut until the back two cap screws can be installed. This should be a 180 degree turn.
7. Using the 1/2" ratchet wrench provided, install the back two cap screws.
8. Tighten all four cap screws to 45 to 50 ft-lbs of torque.

Washpipe Installation

Standard Installation Procedure

Third Step: Install the Floating Assembly

Figure 3-10. Tightening the Cap Screws

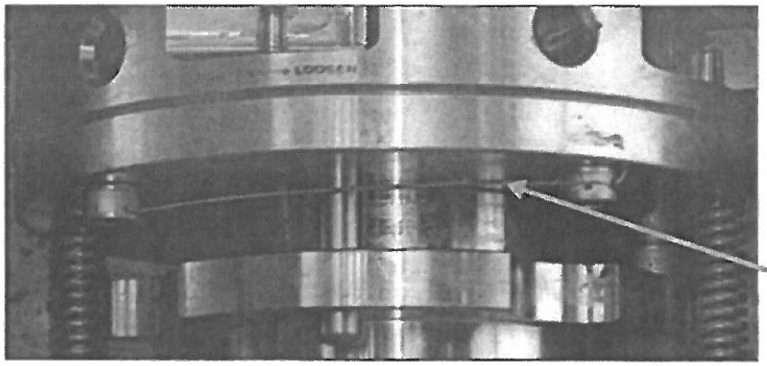


Figure 3-11. Safety Wire Installed

9. Install safety wire on all cap screws. Rotate (unscrew) the upper nut until all safety wire can be installed on all cap screws
10. Using the tightening bar (provided), tighten the upper nut to 200 ft-lbs of torque (minimum).
11. Remove the temporary installation plate and store it for future use.

Washpipe Installation

Standard Installation Procedure

This is the final step for both the Standard and Modified installation procedures.

Final Step: Install the Mechanical Seals

Keep the mechanical seals in their shipping containers until needed for installation. When handling the mechanical seals, ***use extreme care*** *not to scratch the seal surfaces.*

Each mechanical seal has the following identifiers that assist with correct seal orientation.

- **Top Stationary Seal** or **Bottom Rotating Seal** is stamped on the seal.
- A directional arrow points to the side of the seal that should face up or down.
- The notches on the seals that mate with the three dowels are closed on one end. This ensures that the seal can only be placed over the dowels in the correct direction.

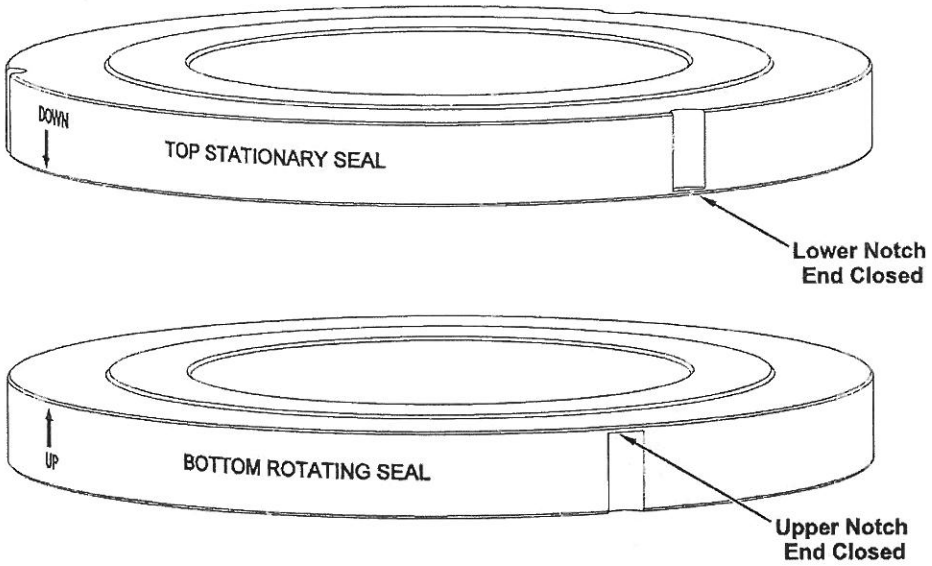


Figure 3-12. Identifying Top and Bottom Seals

Depending on the washpipe equipment option ordered, there may be up to 12 notches in the mechanical seals.

Washpipe Installation

Standard Installation Procedure

Final Step: Install the Mechanical Seals

Complete the following procedure to install the seals.

1. Identify the Bottom Rotating Seal (Figure 3-12).
2. Carefully clean both sides of the Bottom Rotating Seal.
3. Carefully clean the mating surface on top of the lower nut.
4. Apply **clean**, light oil to the top of the lower nut. (SAE 30 motor oil or hydraulic oil can be used in place of general purpose light oil.)
5. Cover both sides of the Bottom Rotating Seal with clean, light oil.
6. Check that the orientation is correct and then carefully place the Bottom Rotating Seal on top of the lower nut. Make sure the dowels align with the notches in the seal.

Use extreme care *when handling the seals. The seal rings are very hard and brittle. They may chip and crack if mishandled.*

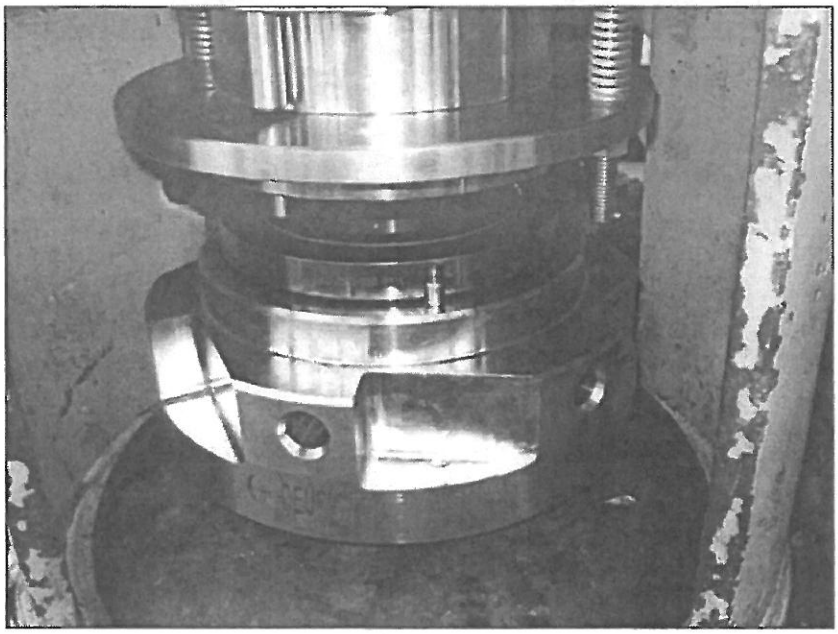


Figure 3-13. Installed Bottom Rotating Seal

Washpipe Installation

Standard Installation Procedure

Final Step: Install the Mechanical Seals

7. Carefully clean both sides of the Top Stationary Seal.
8. Apply clean, light oil to the bottom exposed surface of the Floating Assembly. Make sure the O-ring is in the O-ring groove.
9. Cover both sides of the Top Stationary Seal with **clean**, light oil.
10. Make sure that the seal orientation is correct and then **carefully** place the Top Stationary Seal on top of the installed Bottom Rotating Seal. (Make sure to be extremely careful when handling the mechanical seals.)
11. Align the Top Stationary Seal notches with the dowels on the Floating Assembly.

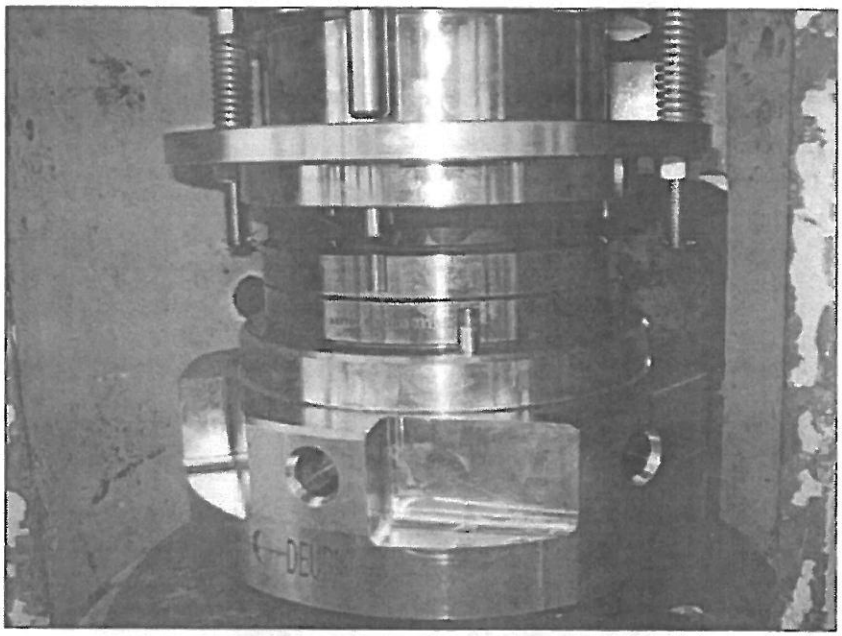


Figure 3-14. Installed Top Stationary Seal

Washpipe Installation

Standard Installation Procedure

Final Step: Install the Mechanical Seals

12. Slowly and alternately, loosen each compression nut. The Floating Assembly will expand and engage the Top Stationary Seal.

*Make sure to **alternately loosen** each nut slowly so the Floating Assembly is lowered straight. If it engages the Top Stationary Seal at an angle, the seals could be damaged.*

13. Continue to alternately loosen the hex nuts all the way to the end of the two threaded rods. (There are cotter pins that ensure the hex nuts do not come off the end of the threaded rods.)

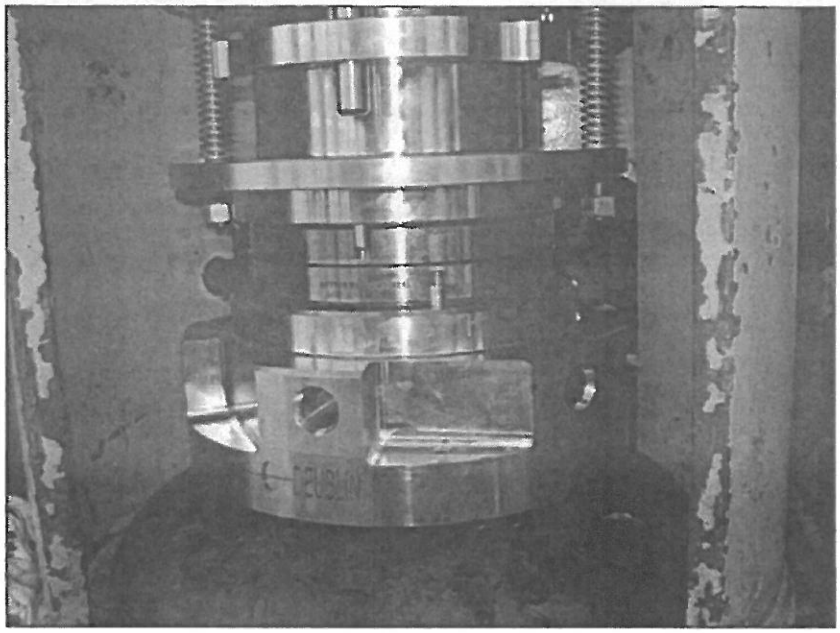


Figure 3-15. Engaging the Top Stationary Seal

Washpipe Installation

Standard Installation Procedure

Final Step: Install the Mechanical Seals

14. Figure 3-16 shows the mechanical seals installed correctly. (Note that safety wire has not been not properly installed on the cap screws.)

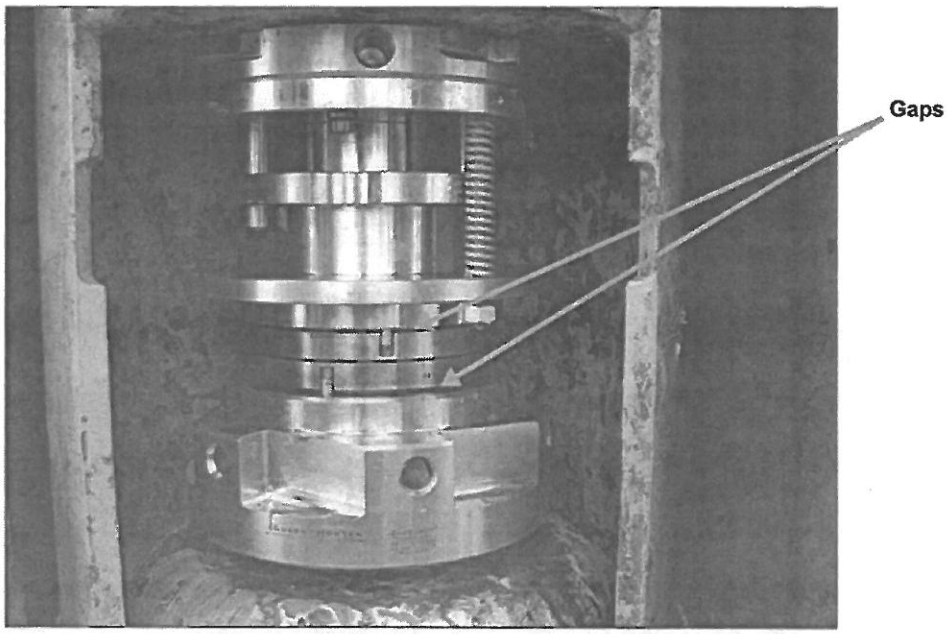


Figure 3-16. Mechanical Seals Installed

Figure 3-16 shows small gaps between the upper seal surface of the Top Stationary Seal and the lower seal surface of the Bottom Rotating Seal. These gaps are normal after installation and are caused by the O-rings. The O-rings will compress and the gaps will go away when mud pressure is applied to the system.

Before using the mechanical washpipe for normal drilling operations, review section titled "Post-Installation Pressure Testing" on page 3-29.

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Washpipe Installation

Modified Installation Procedure

Some top drive models have smaller bonnet openings. If the bonnet opening width is less than **10.5 inches (26.7 cm)**, complete the following steps to install the mechanical washpipe.

***Before starting** this procedure, complete the steps in section titled "Verify Sealing Face Alignment" on page 3-4. The pressure-balancing feature designed for this washpipe promotes longer seal life. If the equipment is not in alignment, the mechanical sealing system will not perform as designed and the components may become damaged.*

Before starting this procedure, **make sure to check the upper and lower stem liners** (see section titled "Check Upper and Lower Stem Liners" on page 3-3). Tapered stem liners must be replaced.

First Step: Install the Upper Nut

1. Clean the gooseneck face (sealing surface) and threads.
2. Apply a small amount of general purpose grease to the gooseneck face and threads.
3. Make sure there is an O-ring properly installed in the top of the upper nut.
4. Apply a small amount of general purpose grease to the inside threads of the upper nut.
5. Install the upper nut. You will need to rotate the upper nut slightly so it goes through the bonnet opening at an angle. **Hand tighten only** at this step.

Do not fully tighten the upper nut.

Both the upper nut and lower nut have left-handed threads. Counterclockwise rotation tightens these nuts.

Washpipe Installation

Modified Installation Procedure

First Step: Install the Upper Nut

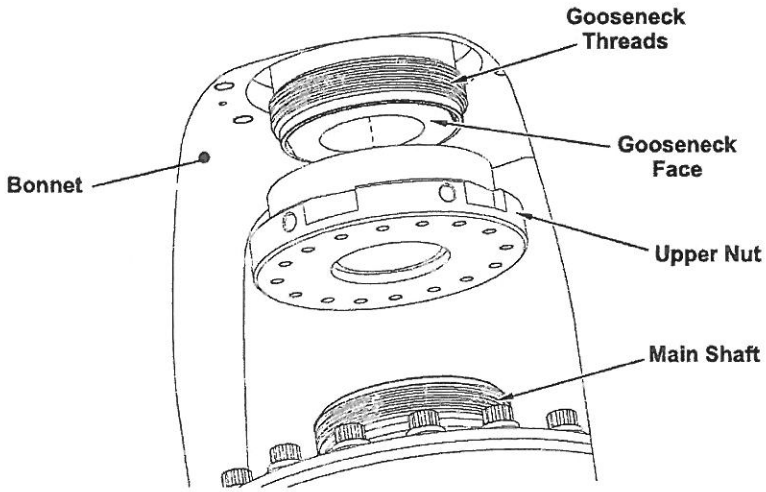


Figure 3-17. Modified Procedure: Installing the Upper Nut

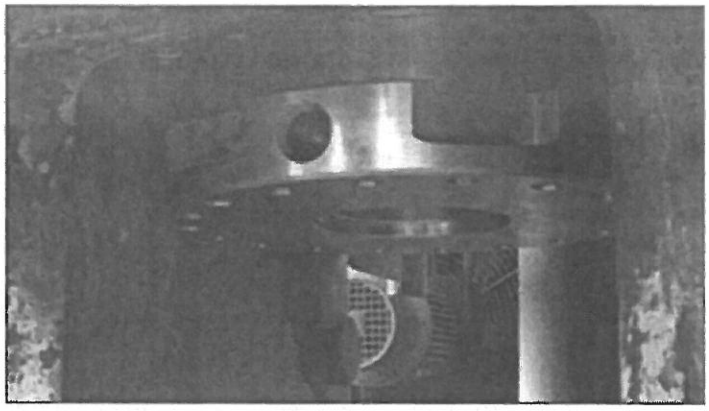


Figure 3-18. Modified Procedure: Installed Upper Nut

Washpipe Installation

Modified Installation Procedure

Second Step: Disassemble the Floating Assembly

The Floating Assembly is a subassembly of the mechanical washpipe (see Figure 2-2).

To disassemble the Floating Assembly:

1. Remove the two cotter pins that stop the hex nuts at the end of the threaded rod.
2. Remove the two hex nuts from the threaded rods.
3. Separate the Floating Seal Carrier from the Upper Sleeve.
4. Set the parts aside for reassembly inside the bonnet.

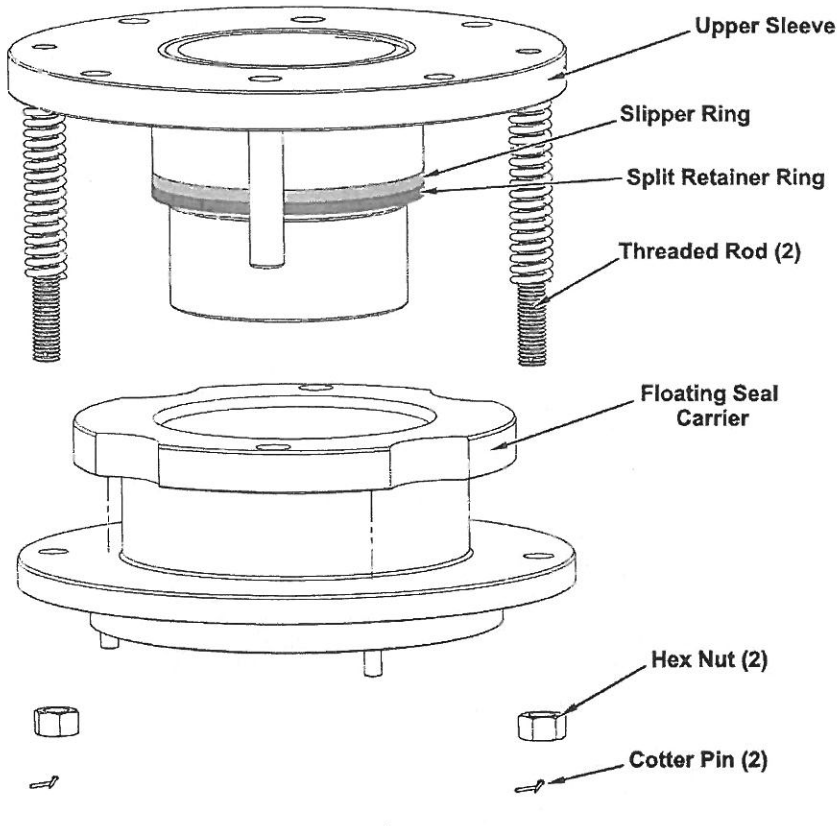


Figure 3-19. Modified Procedure: Disassembled Floating Seal Assembly

Washpipe Installation

Modified Installation Procedure

Third Step: Install the Upper Sleeve

1. Apply a small amount of general purpose grease to the bottom surface of the upper nut.
2. Apply a small amount of general purpose grease to the top surface of the Upper Sleeve.
3. Position the Upper Sleeve in the bonnet. You will need to rotate the Upper Sleeve slightly so it goes through the bonnet opening at an angle.
4. Align the holes in the Upper Sleeve with any four threaded holes in the upper nut flange. There are multiple tapped holes in the upper nut. Choose holes that are evenly spaced apart and that work best for the installation.

When aligning the four holes, make sure the compression springs are positioned as close as possible to 3 and 9 o'clock when facing the front of the washpipe.

5. Using the 1/2" ratchet wrench (provided), install the front two cap screws.
6. Rotate the upper nut and install the back two cap screws.
7. Tighten all four cap screws to 45 to 50 ft-lbs of torque.

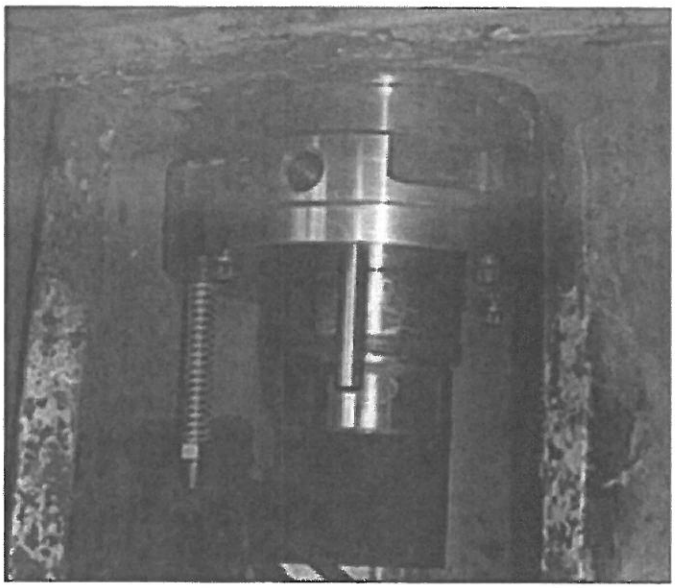


Figure 3-20. Modified Procedure: Installed Upper Sleeve

8. Install safety wire on all cap screws. Rotate (unscrew) the upper nut until all safety wire can be installed on all cap screws.

Washpipe Installation

Modified Installation Procedure

Fourth Step: Install the Floating Seal Carrier

1. Attach the Floating Seal Carrier using the two hex nuts.

Do not forget to install the springs on the threaded rods if they were removed earlier.

2. Tighten the two hex nuts until the compression springs are fully tightened. This will provide sufficient space below the Floating Assembly to install the lower nut and mechanical seals (Figure 3-21).
3. Re-insert the two cotter pins into the threaded rods.
4. Using the tightening bar (provided), tighten the upper nut to 200 ft-lbs of torque (minimum).

Do not use a hammer on the washpipe. *Using a hammer will damage washpipe components. Use the tightening bar provided with the mechanical washpipe. This tightening bar is designed specifically for tightening and loosening washpipe components.*

If the nuts are completely stuck, a hammer may be used for ***loosening only****. Make sure to hit the nut on one of the angled notches provided specifically for this purpose.*

Washpipe Installation

Modified Installation Procedure

Fourth Step: Install the Floating Seal Carrier

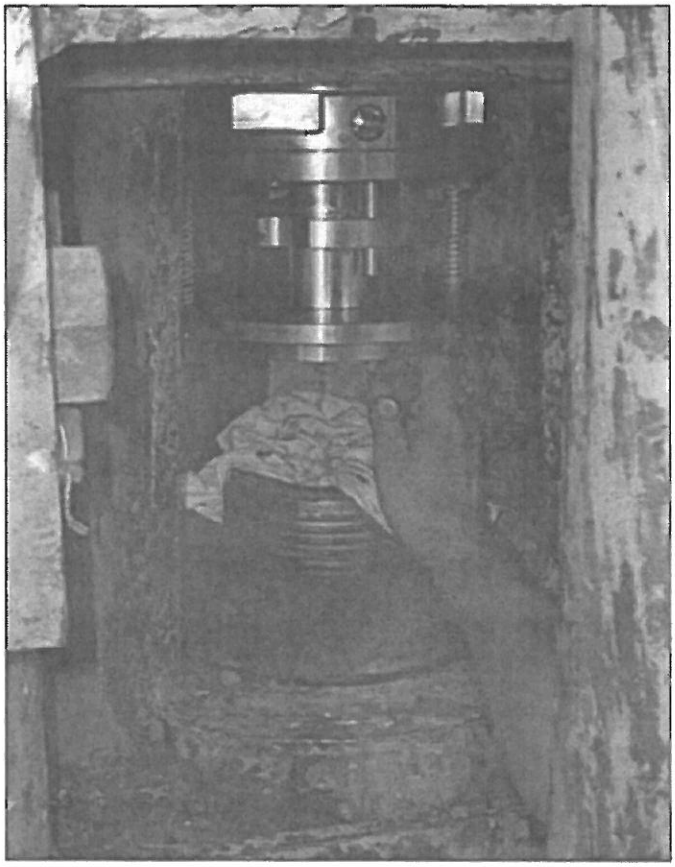


Figure 3-21. Modified Procedure: Tightening the Hex Nuts on the Floating Assembly

Washpipe Installation

Modified Installation Procedure

Fifth Step: Install the Lower Nut

1. Clean the main shaft sealing surface and threads.
2. Apply a small amount of general purpose grease to the main shaft.
3. Clean the top and bottom of the lower nut. While cleaning the lower nut, make sure there is an O-ring in both the top and bottom surfaces.
4. Apply a small amount of general purpose grease to the inside threads of the lower nut.
5. Install the lower nut. Use the tightening bar (provided) to tighten the lower nut to 200 ft-lbs of torque (minimum).

Do not use a hammer on the washpipe. *Using a hammer will damage washpipe components. Use the tightening bar provided with the mechanical washpipe. This tightening bar is designed specifically for tightening and loosening washpipe components.*

If the nuts are completely stuck, a hammer may be used for ***loosening only****. Make sure to hit the nut on one of the angled notches provided specifically for this purpose.*

Washpipe Installation

Modified Installation Procedure

Fifth Step: Install the Lower Nut

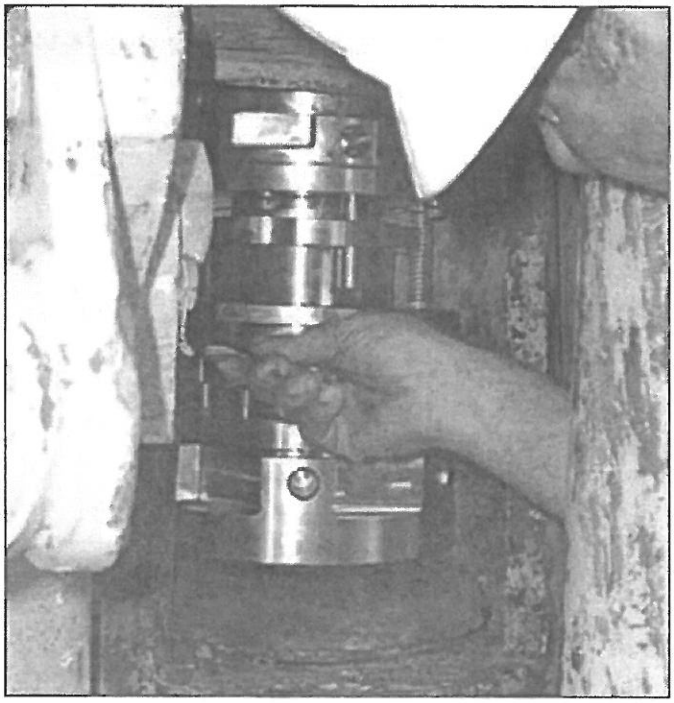


Figure 3-22. Modified Procedure: Installing the Lower Nut

Washpipe Installation

Modified Installation Procedure

Final Step: Install the Mechanical Seals

The procedure for installing the mechanical seals is the same for both the Modified Installation Procedure and the Standard Installation Procedure.

Refer to section titled "Final Step: Install the Mechanical Seals" on page 3-14 to complete the Modified Installation Procedure.

Post-Installation Pressure Testing

After installation and before normal operation, complete the following steps to test the washpipe under static pressure.

During each of the following pressure tests, **check for leaks**. Leaks indicate that the mechanical seals are misaligned.

1. Slowly increase pressure to **250 psi**.
   - Hold at 250 psi (static pressure) for five minutes.
2. Slowly increase pressure to **750 psi**.
   - Hold at 750 psi (static pressure) for five minutes.
3. Slowly increase pressure to **3000 psi**.
   - Hold at 3000 psi (static pressure) for five minutes.
4. Slowly increase pressure to **5000 psi**.
   - Hold at 5000 psi (static pressure) for five minutes.

The following step is recommended if the rig has the capacity to operate at 7500 psi. However, testing beyond 5000 psi is not required to validate that the washpipe is correctly installed.

5. Slowly increase pressure to **7500 psi**.
   - Hold at 7500 psi (static pressure) for five minutes.

This mechanical sealing system is designed to leak a small amount of drilling fluid under pressure *while rotating*. This leakage should typically be less than 125 ml per day. Depending on the type and weight of drilling fluid used, the amount may vary. Figure 3-23 shows normal residue.

Post-Installation Pressure Testing

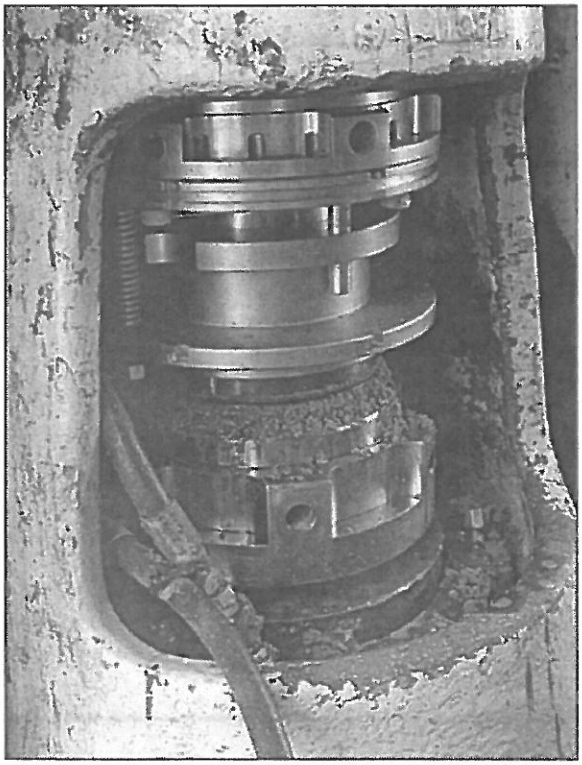


Figure 3-23. Normal Residue

Maintenance 4

Contact your NOV representative or NOV Service Center to order kits and replacement parts for the mechanical washpipe.

The example illustrations in this chapter show the standard mechanical washpipe. The maintenance procedures for this washpipe model are practically identical to the maintenance procedures required for the direct coupled washpipe model.

Inspection Schedule

Pre-Installation

- Inspect the mating surfaces on the main shaft and gooseneck before installing the washpipe.

  If the mating surfaces or threads are damaged, the damaged components will need to be repaired or replaced.

Weekly

- Inspect for excessive drilling fluid residue.

  Excessive residue may indicate that the mechanical seals are misaligned or that the mechanical seals need to be replaced. (The washpipe leaks a certain amount of drilling fluid under pressure while rotating.)

Every Six Months

- Check main shaft end play and component alignment.

  The top drive service manual provides instructions for checking main shaft end play. The service manual is located in the User Manual provided with the equipment. Additional instructions for checking component alignment are provided in Chapter 3 of this manual, in section titled "Verify Sealing Face Alignment" on page 3-4.

Inspection Schedule

After Jarring

Jarring can damage the mechanical washpipe. Make sure to thoroughly inspect the mechanical seals after jarring operations. If the seals have been damaged, they will need to be replaced prior to resuming drilling operations.

- Raise the Floating Seal Carrier, remove the mechanical seals, and inspect both seals for damage. Replace damaged seals. Refer to the section titled "Mechanical Seal Cleaning or Replacement" on page 4-3 for replacement instructions.
- Check main shaft end play and component alignment.

  The top drive service manual provides instructions for checking main shaft end play. The service manual is located in the User Manual provided with the equipment. Additional instructions for checking component alignment are provided in the section titled "Verify Sealing Face Alignment" on page 3-4.

Basic Washpipe Cleaning

Once a week, clear away drilling fluid residue from inside the top drive bonnet.

- Use plain water to clean the mechanical washpipe; a special cleaning solution is not necessary.
- Use regular water hose pressure (40 to 60 psi) only.

Do not use a high-pressure washer unit for weekly basic cleaning. A pressure washer can force drilling fluid residue into the mechanical sealing surfaces. This will cause the mechanical sealing system to fail.

If a more thorough cleaning is required, refer to the section titled "Mechanical Seal Cleaning or Replacement" on page 4-3.

Mechanical Seal Cleaning or Replacement

Use the following procedure when a thorough washpipe cleaning is required or if you are replacing the mechanical seals.

1. Clear away drilling fluid residue from inside the top drive bonnet.

Since the mechanical seals will be removed for this procedure, a high-pressure washer unit can be used. Use plain water to clean the washpipe; a special cleaning solution is not necessary.

2. Using the 3/4-inch ratchet wrench (provided), fully tighten the compression spring hex nuts on the Floating Assembly. This lifts the Floating Assembly up and away from the mechanical sealing system (Figure 4-1).

To avoid damaging the Slipper Ring inside the Floating Assembly, make sure to alternately tighten the hex nuts so the Floating Assembly is raised straight.

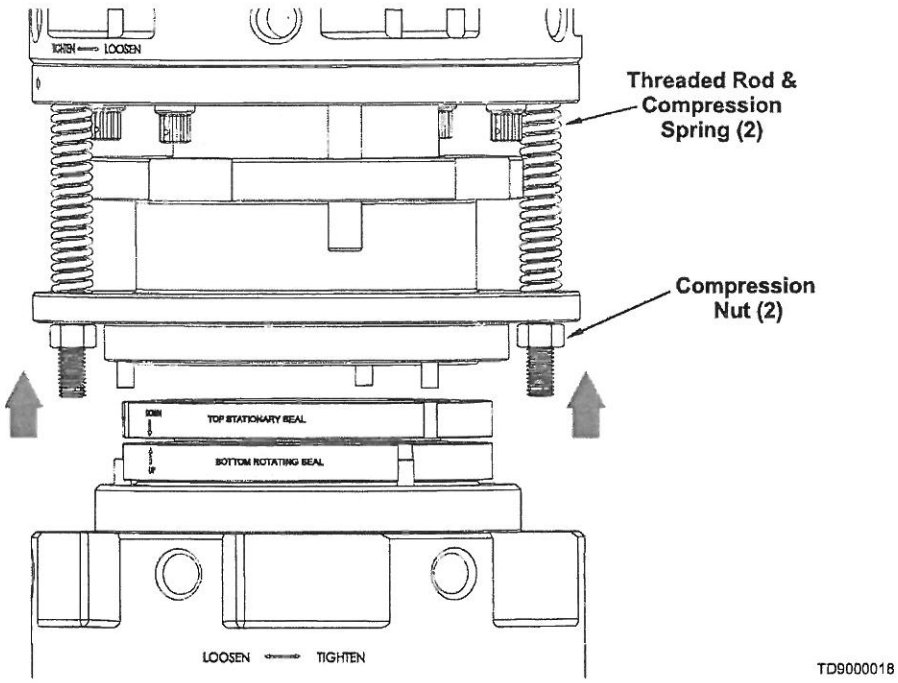


Figure 4-1. Lifting the Floating Assembly

Mechanical Seal Cleaning or Replacement

3. Clean the newly exposed surfaces.
4. Remove the Top Stationary Seal and the Bottom Rotating Seal.
5. If cleaning the mechanical seals only, inspect and clean the mechanical seals. Replace the mechanical seals if needed.
6. Remove the O-rings from the bottom of the Floating Assembly and the top of the Lower Nut. The O-rings for both the Floating Assembly and Lower Nut are exactly the same.
7. If cleaning the mechanical seals only, inspect and clean the O-rings. Replace the O-rings if needed.
8. Insert the O-rings in the Floating Assembly and the Lower Nut O-ring grooves.
9. Clean the mating surface on the top of the Lower Nut.
10. Carefully clean both sides of the Bottom Rotating Seal.
11. Apply **clean**, light oil to the top of the Lower Nut. (SAE 30 motor oil or hydraulic oil can be used in place of general purpose light oil.)
12. Cover both sides of the Bottom Rotating Seal with clean, light oil.
13. Check that the orientation is correct and then carefully place the Bottom Rotating Seal on top of the Lower Nut. Make sure the dowels align with the notches in the seal.

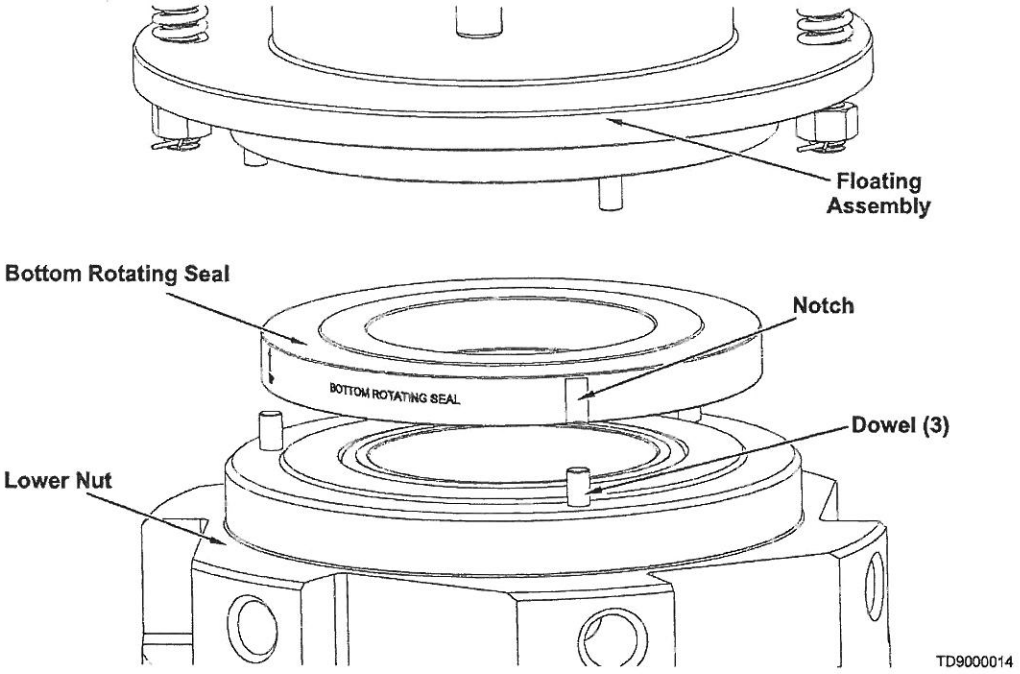


Figure 4-2. Installing the Bottom Rotating Seal on the Lower Nut

Mechanical Seal Cleaning or Replacement

14. Carefully clean both sides of the Top Stationary Seal.
15. Apply clean, light oil to the bottom exposed surface of the Floating Assembly.
16. Cover both sides of the Top Stationary Seal with **clean**, light oil.
17. Make sure that the seal orientation is correct and then **carefully** place the Top Stationary Seal on top of the installed Bottom Rotating Seal.

Use extreme care *when handling the seals. The seal rings are very hard and brittle. They may chip and crack if mishandled.*

18. Align the Top Stationary Seal notches with the dowels on the Floating Assembly.
19. Slowly and alternately, loosen each compression nut. The Floating Assembly will expand and engage the Top Stationary Seal.

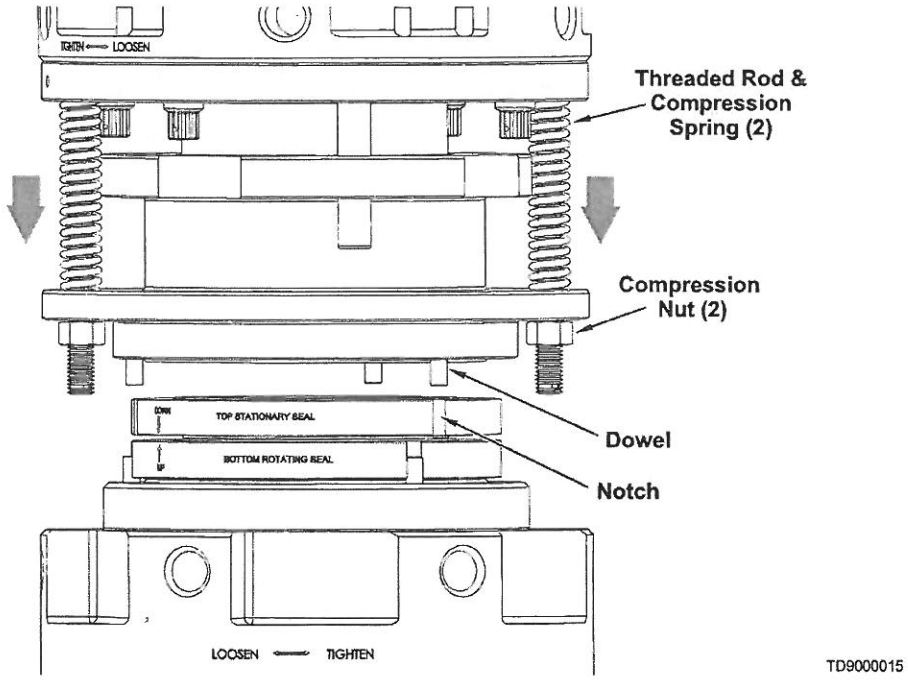


Figure 4-3. Engaging the Top Stational Seal

Make sure to ***alternately loosen each nut slowly*** *so the Floating Assembly is lowered straight. If it engages the Top Stationary Seal at an angle, the seals could be damaged.*

Mechanical Seal Cleaning or Replacement

20. Figure 4-4 shows the mechanical seals installed correctly. (Note that safety wire has not been not properly installed on the cap screws.)

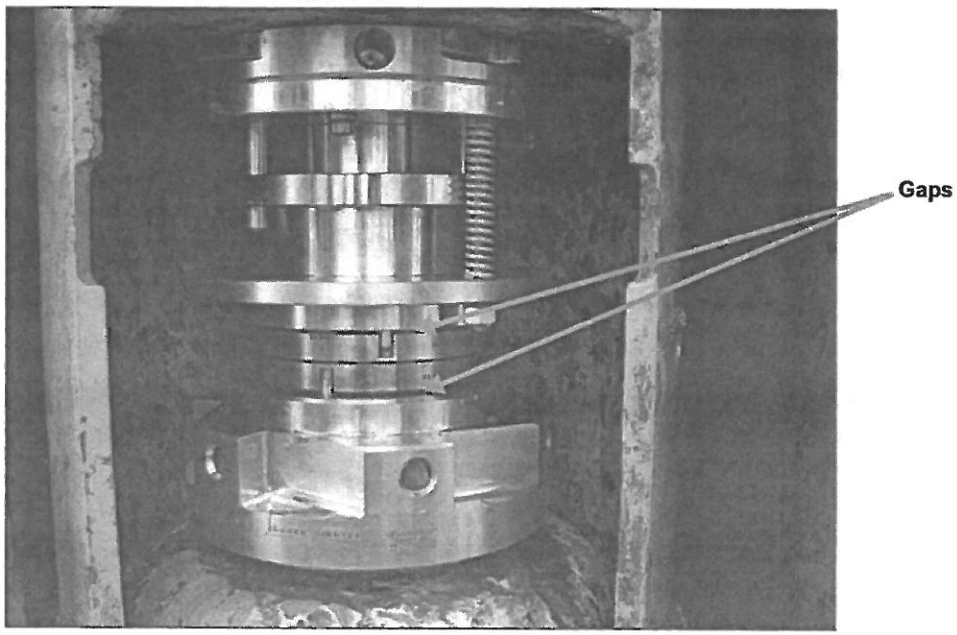


Figure 4-4. Mechanical Seals Installed

Figure 4-4 shows small gaps between the upper seal surface of the Top Stationary Seal and the lower seal surface of the Bottom Stationary Seal. These gaps are normal after installation and are caused by the O-rings. The O-rings will compress and the gaps will go away when mud pressure is applied to the system.

Before using the mechanical washpipe for normal drilling operations, review section titled "Post-Installation Pressure Testing" on page 3-29.

Replacing Floating Assembly Rings

The Floating Assembly is a subassembly of the mechanical washpipe (see Figure 2-2). Under certain conditions, the Split Retainer Ring, the Slipper Ring, and the O-Ring may need to be replaced.

Contact your NOV representative or NOV Service Center to order kits and replacement parts for the mechanical washpipe.

Complete the following steps to replace the Split Retainer Ring, the Slipper Ring, and O-Ring in the Floating Assembly. Figure 2-2 on page 2-3 shows an exploded view of the components described in the procedure.

Before beginning this procedure, make sure the area inside the bonnet and around the washpipe is clean and free of drilling fluid residue.

First Step: Remove the Floating Assembly

1. Tighten the hex nuts on the Floating Assembly and raise it so there is enough room to remove the mechanical seals.
2. Remove the Top Stationary Seal and the Bottom Rotating Seal.

Use extreme care *when handling the seals. The seal rings are very hard and will chip and crack if mishandled.*

3. Loosen the Upper Nut. The Upper Nut will need to be rotated to access the back two cap screws that attach the Floating Seal Assembly to the Upper Nut.
4. Using the 1/2" ratchet wrench (provided), remove the four 12-point cap screws that secure the Floating Assembly to the Upper Nut. Rotate the Upper Nut to access the back two cap screws.
5. Remove the Floating Assembly from the washpipe assembly and bonnet.

Replacing Floating Assembly Rings

Second Step: Disassemble the Floating Assembly

To disassemble the Floating Assembly:

1. Remove the two cotter pins that stop the hex nuts at the end of the threaded rod.
2. Remove the two hex nuts from the threaded rods.
3. Separate the Floating Seal Carrier from the Upper Sleeve.

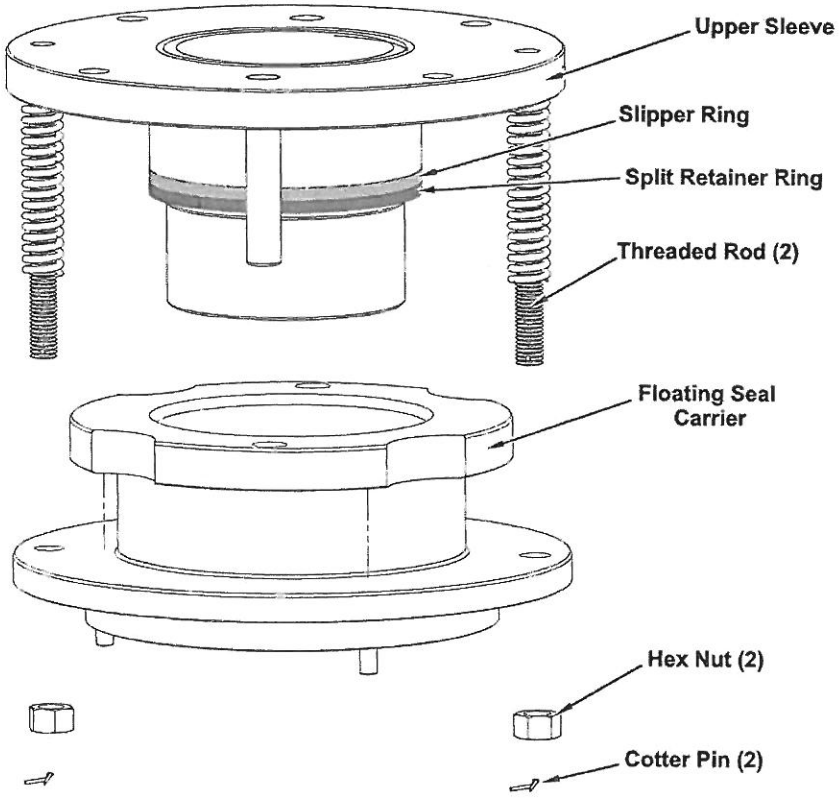


Figure 4-5. Separating the Floating Assembly

Replacing Floating Assembly Rings

Third Step: Remove the Rings

To remove the rings from the Upper Sleeve:

1. Use a screwdriver to pry the Split Retainer Ring open.
2. Remove the Split Retainer Ring from the Upper Sleeve.
3. Remove the Slipper Ring from the Upper Sleeve.
4. Remove the O-ring from the Upper Sleeve.

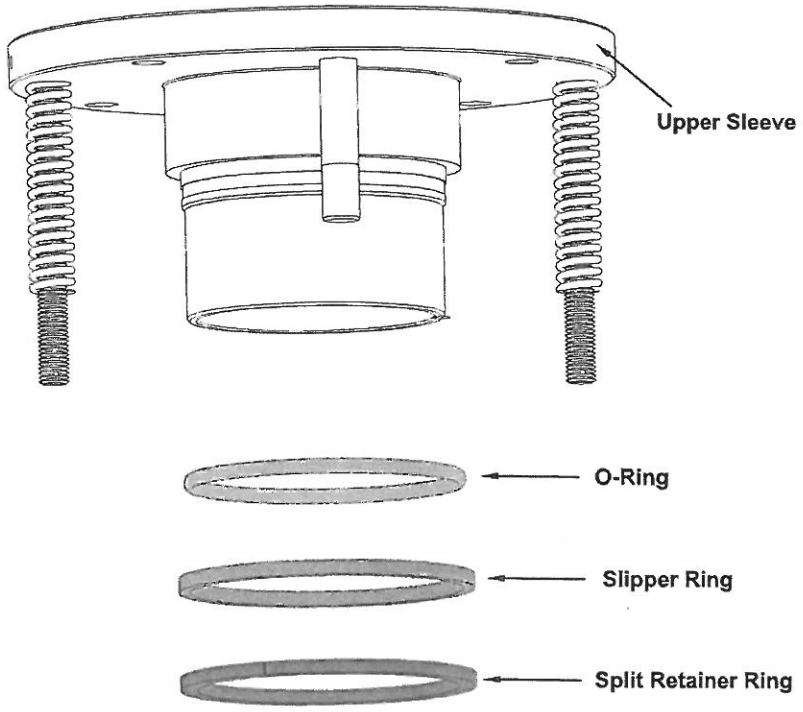


Figure 4-6. Removing the Rings

Replacing Floating Assembly Rings

Fourth Step: Install New Rings and Components

Complete the following steps to complete the ring replacement procedure.

1. Install the new O-ring on the Upper Sleeve.
2. Install the new Slipper Ring on the Upper Sleeve.
3. Install the new Split Retainer Ring on the Upper Sleeve.
4. Reassemble the Floating Assembly:
   a. Push the Floating Seal Carrier back onto the Upper Sleeve.
   b. Screw the two hex nuts back onto the threaded rods.

Tighten the hex nuts until the Floating Assembly is compressed enough to allow the mechanical seals to be re-installed.

   c. Re-insert the two cotter pins at the end of the threaded rods.
5. Using the 1/2" ratchet wrench (provided), install the four 12-point cap screws that secure the Floating Assembly to the Upper Nut. Rotate the Upper Nut to access the back two cap screws. Tighten all cap screws to 45 to 50 ft-lbs of torque.
6. Install safety wire on all cap screws. Rotate (unscrew) the upper nut until all safety wire can be installed on all cap screws
7. Using the tightening bar (provided), tighten the Upper Nut to 200 ft-lbs of torque (minimum). (Do not use a hammer on the washpipe.)
8. Re-install the Top Stationary Seal and the Bottom Rotating Seal. Refer to page 3-14 in the Installation chapter for detailed mechanical seal installation steps.

Use extreme care *when handling the seals. The seal rings are very hard and brittle. They will crack if mishandled.*

9. Slowly and alternately, loosen each compression nut. The Floating Assembly will expand and engage the Top Stationary Seal.

Make sure to ***alternately*** *loosen each compression nut. Failure to do so may damage the mechanical seals.*

Standard Washpipe Removal

For certain troubleshooting procedures, the washpipe may need to be completely removed from the top drive. Complete the following steps to remove the washpipe.

Refer to Figure 2-2 on page 2-3 of this manual for the location of washpipe components.

1. Clean the washpipe and the area inside the bonnet.
2. Using the 3/4-inch ratchet wrench (provided), fully tighten the compression spring hex nuts on the Floating Assembly. This lifts the Floating Assembly up and away from the mechanical sealing system (Figure 4-1).

To avoid damaging the Slipper Ring inside the Floating Assembly, make sure to alternately tighten the hex nuts so the Floating Assembly is raised straight.

3. Remove the Top Stationary Seal and the Bottom Rotating Seal.
4. Loosen the Upper Nut.

Both the Upper and Lower Nuts get very tight over time. When removing the washpipe after a prolonged period of use, a hammer may be used to loosen the Upper and Lower Nuts. Use the angled notches that are provided specifically for this purpose.

5. Remove the four cap screws that attach the Floating Assembly to the Upper Nut.
6. Remove the Floating Assembly. If the bonnet is too small to remove the Floating Assembly as a single unit, it will have to be disassembled. For detailed instructions on disassembling the Floating Assembly, refer to page 3-22.
7. Remove the Upper Nut.
8. Loosen and remove the Lower Nut.

Direct Coupled Washpipe Removal

For certain troubleshooting procedures, the direct coupled washpipe may need to be completely removed from the top drive. Complete the following steps to remove the washpipe.

1. Disconnect the S-pipe and swing it away from the bonnet.
2. Clean the washpipe and the area inside the bonnet.
3. Using the 3/4-inch ratchet wrench (provided), fully tighten the compression spring hex nuts on the Floating Assembly. This lifts the Floating Assembly up and away from the mechanical sealing system (Figure 4-1).

To avoid damaging the Slipper Ring inside the Floating Assembly, make sure to alternately tighten the hex nuts so the Floating Assembly is raised straight.

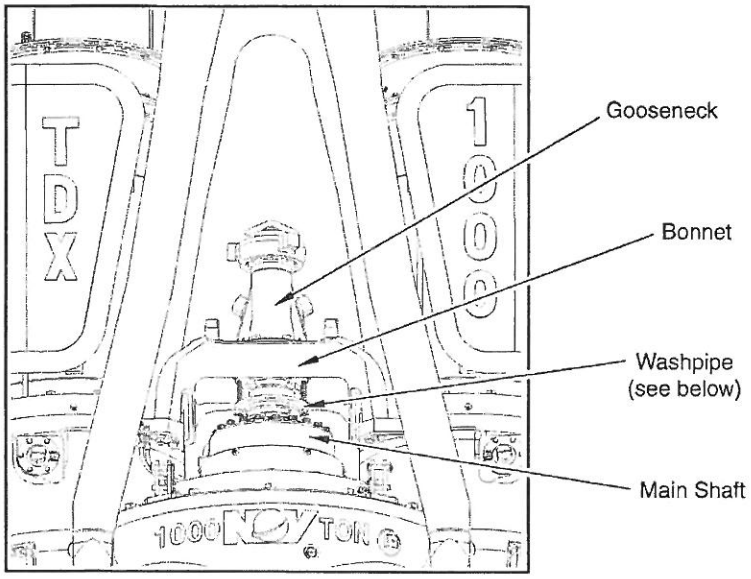
4. Remove the Top Stationary Seal and the Bottom Rotating Seal.
5. Remove the four cap screws that attach the Upper Assembly Sleeve and Seal Carrier to the gooseneck.
6. Remove the Upper Assembly Sleeve and Seal Carrier.
7. Remove the four cap screws that attach the Main Shaft Adapter to the main shaft.
8. Remove the Main Shaft Adapter.

To install the components, reverse the removal procedure.

Make sure the pressure test the components before operating the top drive after replacing the washpipe. Refer to section titled "Post-Installation Pressure Testing" on page 3-29 for details.

Figure 4-7 on page 4-13 shows the washpipe component locations.

Direct Coupled Washpipe Removal



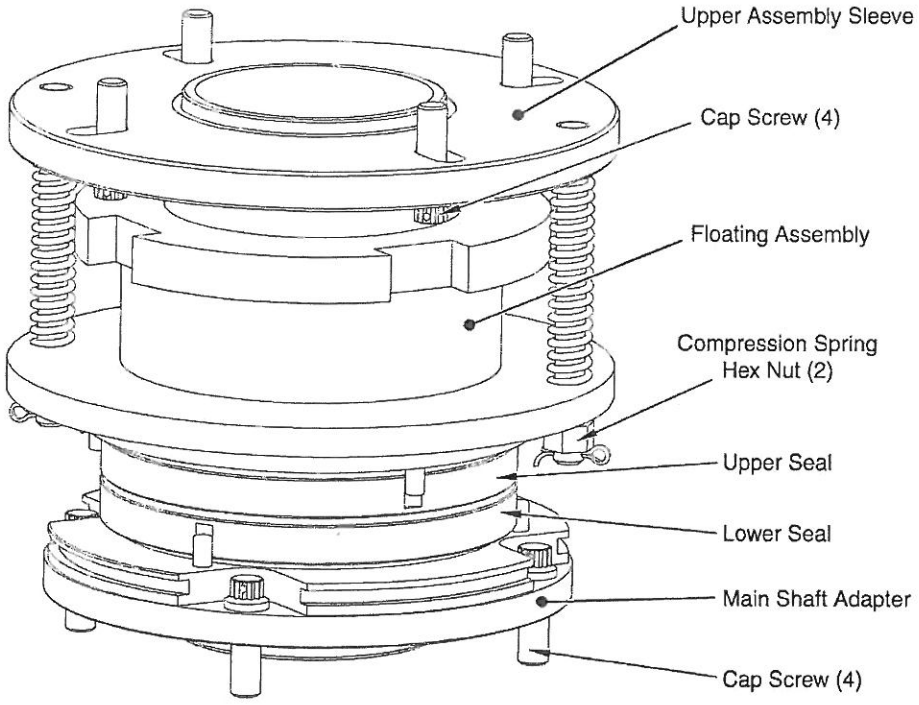


Figure 4-7. Direct Coupled Washpipe Components

Troubleshooting 5

Washpipe Troubleshooting

The troubleshooting information in this chapter provides typical symptoms and possible causes. If the issue cannot be resolved through one of the following troubleshooting methods, contact the NOV Service Center in your region.

Mechanical Washpipe Troubleshooting

Symptom	Possible Causes	Remedy
Leakage at threads between Lower Nut (or Shaft Adapter) and top drive main shaft	• Stem liners are tapered and not straight • Polypak seal failure in main shaft stem liner • Lower O-ring failure • Lower stem liner is not flat and does not allow the O-ring to seal properly	1. Remove washpipe assembly. 2. Inspect upper and lower stem liners. Make sure the liners are straight liners and not tapered. Replace tapered liners with straight liners. 3. Inspect the Polypak seal in the main shaft stem liner. Replace if needed (see Figure 5-1). 4. Inspect the main shaft and stem liner for any burrs that can damage the O-ring and de-burr as required. The surface of the stem liner should be smooth and flat. If it is not, replace the stem liner. 5. Inspect the O-ring in the Lower Nut (or Shaft Adapter). Replace if damaged. 6. Reinstall washpipe assembly.

Washpipe Troubleshooting

Mechanical Washpipe Troubleshooting

Symptom	Possible Causes	Remedy
Leakage at threads between the washpipe Upper Nut (or Upper Assembly Sleeve) and the gooseneck	• Polypak seal failure in upper stem liner • Upper O-ring failure • Upper stem liner is not flat and does not allow the O-ring to seal properly	1. Remove washpipe assembly. 2. Inspect the Polypak seal in the upper stem liner. Replace if needed (see Figure 5-1). 3. Inspect the O-ring in the Upper Nut (or Upper Assembly Sleeve). Replace if damaged. 4. Inspect the gooseneck and the stem liner for any burrs that can damage the O-ring and de-burr as required. The surface of the stem liner should be smooth and flat. If it is not, replace stem liner. 5. Reinstall washpipe assembly.
Excessive leakage above, between, or below mechanical sealing system	• Misaligned components • O-ring failure • Worn or damaged seals	1. Raise Floating Assembly. 2. Remove the Top Stationary Seal and inspect the seal surfaces and the O-ring. 3. Remove the Bottom Rotating Seal and inspect the seal surfaces and the O-ring. 4. Replace O-rings and seals as needed (refer to section titled "Mechanical Seal Cleaning or Replacement" on page 4-3).
Premature failure accompanied by occasional spurts of drilling fluid from mechanical sealing system	Washpipe misalignment caused by improper installation, or misalignment of the gooseneck, or main shaft end play.	If necessary, reinstall washpipe, align the gooseneck, or align the main shaft. • Check main shaft alignment as provided in the top drive service manual procedure for main shaft inspection. • Check component alignment as provided in section titled "Verify Sealing Face Alignment" on page 3-4 of this manual.

Washpipe Troubleshooting

Figure 5-1 shows a typical polypak seal and stem liner configuration.

For Reference Only. This is an example of a typical polypak seal and stem liner configuration for a top drive. Refer to the top drive service manual for specific details about your equipment.

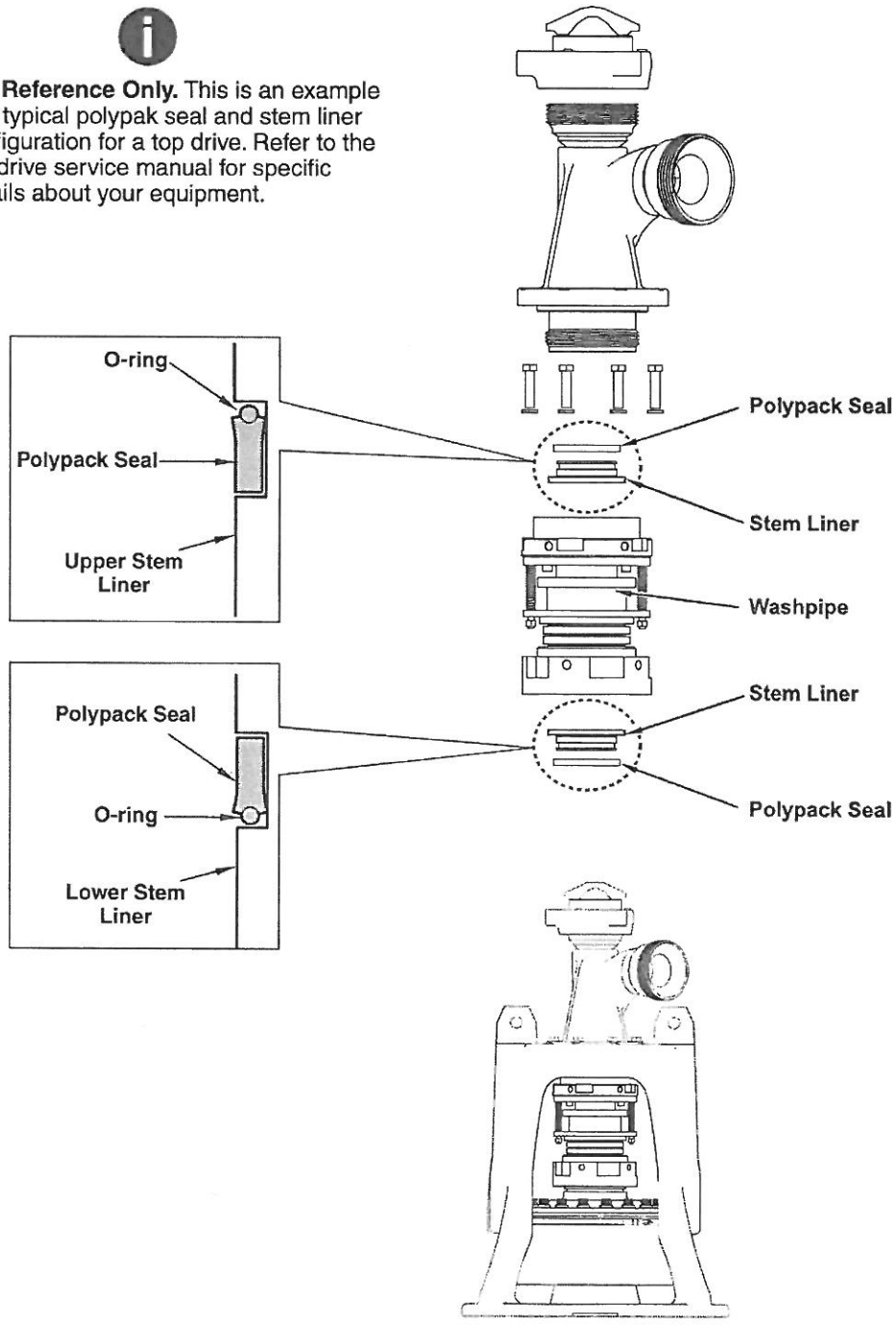


Figure 5-1. Polypak Seals and Stem Liners