

RUNNING THE DUMMY HANGER AND THE SECOND POSITION CASING HANGER, CASING, AND SEAL ASSEMBLY

SUGGESTED PROCEDURE

BIG BORE 2

Tools Needed for This Operation

- Second Position Casing Hanger w/pup joint installed and Dummy Hanger for Big Bore 2 Wellhead System
- 18-3/4" Seal Assembly
- 18-3/4" Casing Hanger and Seal Assembly Running Tool
- Crossover, drill pipe to Running Tool (as necessary)

Pre-Operational Procedures

All components of the SS-15 Subsea Wellhead System are carefully inspected at DRIL-QUIP's manufacturing facilities prior to shipping. Pre-operational procedures are suggested to ensure the equipment is not damaged due to shipping and handling, and to ensure all necessary components are available and in good working order when the equipment is used. If any of the following checks are suspect, contact the nearest DRIL-QUIP office.

Dummy Hanger and Casing Hanger Assembly

1. Refer to **Figure 1** for identification of the Casing Hanger components. Remove the protectors that cover the Casing Hanger. Verify the Casing Hanger has dual grooves in the centralizer sleeve to indicate it is Big Bore 2 equipment. Clean the ID of the Casing Hanger.
2. Check the part number stamped on the Casing Hanger to ensure compatibility of the Casing Hanger with the casing and Running Tool. Record the part number and serial number of the Casing Hanger for the permanent well file.



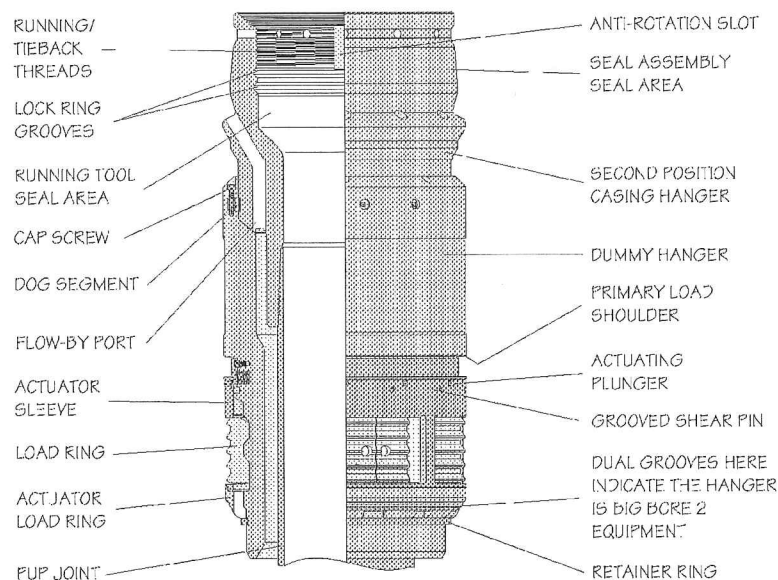


Figure 1. Typical Dummy Hanger and Casing Hanger.
A pup joint is installed at the factory to facilitate handling.

3. Inspect the Dummy Hanger for serviceability.
 - a. Ensure eight socket head cap screws are installed in the top of the Dummy Hanger to assure dog segment engagement and secure it to the Casing Hanger.
 - b. Inspect the load ring to ensure it is in the retracted position. In this position, the load ring OD is smaller than the OD of the actuator sleeve cage. Verify the gap between the two ends of the split load ring measures 1/2" maximum when the load ring is relaxed.
 - c. Tap the 11 actuating plungers with a small hammer to ensure they are free to move. Confirm the 12 grooved shear pins are installed.

Note: The 12 grooved shear pins have a combined shear value of approximately 70,000 lb. If the casing string does not provide the necessary weight to shear the 12 pins, contact the nearest DRIL-QUIP office for specific instructions to re-set the shear value.

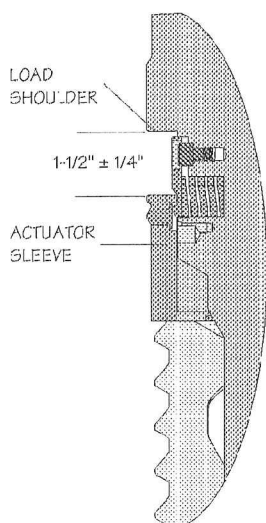


Figure 2. Detail of Load shoulder and actuator sleeve measurement

- d. Verify the gap between the load shoulder and the actuator sleeve is 1-1/2" ($\pm 1/4$ "). Measure this gap in two places, 180° apart. Refer to **Figure 2**.

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- e. Verify the flow-by slots are unobstructed from the Casing Hanger through the Dummy Hanger.
4. Inspect the tapered seal area on the upper OD of the Casing Hanger to ensure there are no dents, scratches, or gouges. The Seal Assembly seals on this area.
 5. Verify the three vertical anti-rotation slots in the top ID of the Casing Hanger are free from dents, scratches, and gouges. Damage to these slots could prevent proper makeup of the Casing Hanger with the Running Tool.
 6. Inspect the right-hand threads in the top ID of the Casing Hanger. These threads can be used to run the Casing Hanger with a threaded Full Bore Running Tool. The threads can also be used for tie-back purposes. Repair the threads as necessary.
 7. Inspect the two Running Tool lock ring grooves in the ID of the Casing Hanger to ensure they are undamaged. Damage to these grooves could prevent proper makeup of the Casing Hanger with the Running Tool.
 8. Inspect the Running Tool seal area to verify it is free of dents, nicks, scratches, and gouges. This seal area is below the two Running Tool lock ring grooves. The seals on the OD of the Running Tool seal on this area.
 9. Remove the thread protector and inspect the bottom pin connection of the casing pup joint made up in the Casing Hanger to ensure it is not damaged or out-of-round. Ensure the pup joint threads are compatible with the threads of the casing string. Clean and re-lubricate the threads, if necessary. Re-install the thread protector.
 10. Re-install the protectors on the Casing Hanger and store it as appropriate for operations.

Seal Assembly

1. Remove the Seal Assembly from its container. Check the part number stamped on the Seal Assembly to ensure it is compatible with the Running Tool and the Casing Hanger. Refer to **Figure 3** for identification of Seal Assembly components.

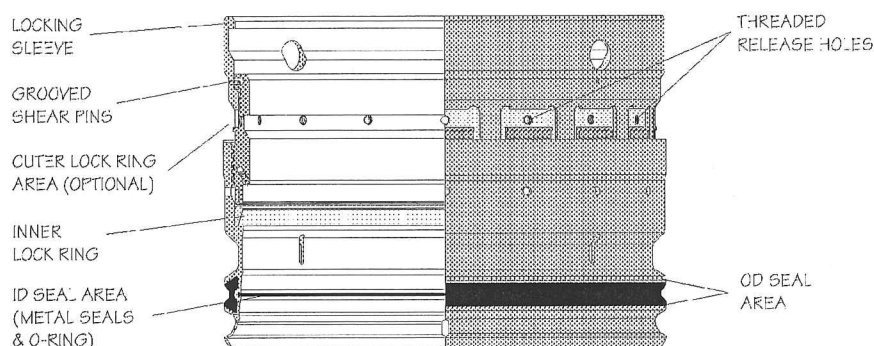


Figure 3. 18-3/4" Seal Assembly and its components

- a. Record the part number and serial number of the Seal Assembly for the permanent well file.

Note: Handle the Seal Assembly carefully. Do not expose this equipment to impact loads that could cause shearing of the grooved shear pins or damage to the seal area.

- b. Record the number of threaded release holes in the OD of the Seal Assembly. There could be either 8 or 16 holes, and will require either 8 or 12 shear pins respectively in the Running Tool.

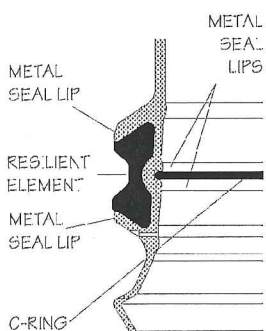


Figure 4. Detail of the seal areas

2. Refer to **Figure 4**. Inspect the sealing area on the OD of the Seal Assembly. Inspect the metal sealing lips above and below the resilient secondary seal for deformation or scratches. These are the primary OD seals and they require protection. Inspect the resilient secondary seal for damage.

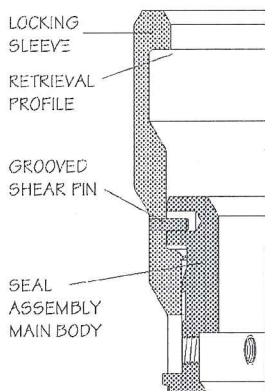


Figure 5. Grooved pin detail

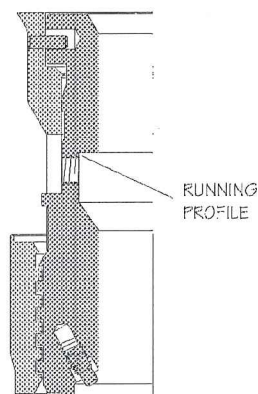


Figure 6. Running profile detail

3. Inspect the sealing area on the ID of the Seal Assembly. Inspect the metal sealing lips above and below the resilient secondary seal (O-ring) for deformation or scratches. These are the primary ID seals and they require protection. Inspect the resilient secondary seal (O-ring) for damage.
4. Refer to **Figure 5**. Inspect the retrieval profile on the top ID of the locking sleeve. The latch ring on the Multi-Purpose Tool engages this profile. Ensure the lip is continuous and free of damage. Repair any gouges that may interfere with the latch ring operation.
5. Inspect the grooved shear pins in the upper lock ring sleeve OD. Eight of these pins must be installed to prevent premature activation of the locking sleeve.
6. Refer to **Figure 6**. Inspect the profile in the main body of the Seal Assembly. This profile is used to run the Seal Assembly on the shear pins of the Running Tool. The shear pins on the Wear Bushing also engage this profile to lock the Wear Bushing inside the Wellhead. Repair any damage that may prevent proper engagement of the shear pins.
7. Inspect the two lead impression pins located in the ID of the Seal Assembly. Refer to **Figure 7**.
 - a. Ensure the lead impression pins are tight and free of deformation.
 - b. Verify the lead impression pins extend 1/8" beyond the shoulder in which they are installed.

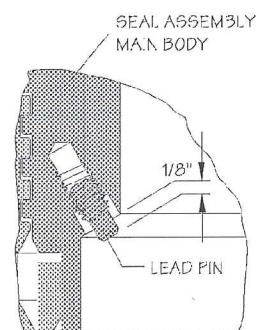


Figure 7. Lead pin detail

Note: In the event the Seal Assembly does not lock down, the lead pins provide a positive indication of the seal location relative to the Casing Hanger.

8. Inspect the inner lock ring that locks the Seal Assembly to the Casing Hanger.
 - a. Ensure the inner lock ring is free of damage and debris.
 - b. Refer to **Figure 8**. Verify proper installation of the inner lock ring. Run a finger over the top ID of the inner lock ring to confirm the sharp bevel faces up. Touch the ring and adjacent surfaces to ensure the ring does not protrude into the ID of the Seal Assembly.
 - c. Find the split of the inner lock ring and push laterally to spin the inner lock ring. Repair the inner lock ring if it does not move freely.
9. Return the Seal Assembly to its container until it is installed onto the Running Tool.

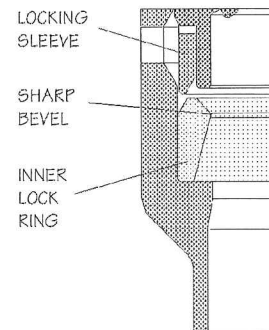


Figure 8. Inner lock ring detail

Optional Outer Lock Ring

When installed, the outer lock ring locks the Seal Assembly to a lockdown profile in the Wellhead Housing ID.

WARNING: The slick OD outer lock ring cannot be used with a serrated Wellhead Housing lockdown profile.

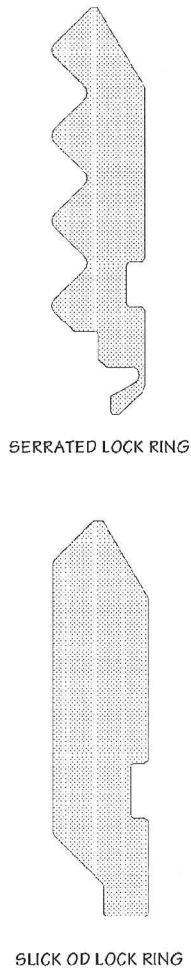


Figure 9. Side view of the two different style Seal Assembly outer lock rings

1. Refer to **Figure 9** and **Figure 10** for identification of the components of the Seal Assembly outer lock ring (outer lock ring). Record the part number and serial number of the outer lock ring for the permanent well file.

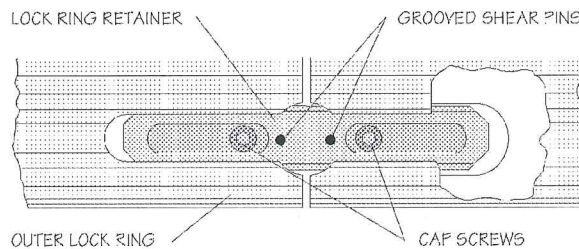


Figure 10. Outer lock ring detail

Note: There are two styles of outer lock rings with matching styles of Wellhead lockdown profiles; slick and serrated. Verify the outer lock ring style conforms to the lockdown profile in the Wellhead.

2. Verify the outer lock ring is serviceable and the installation hardware is available.
3. Install the lock ring retainer at the split of the lock ring and make up one of two cap screws at the end of the lock ring.
4. Expand the lock ring enough to install it over the Seal Assembly locking sleeve. Ensure the lip of the lock ring points toward the bottom of the Seal Assembly. Refer to **Figure 11**.
5. Pull the ends of the ring together until the threaded hole on the outer lock ring is fully exposed, and install the second cap screw.

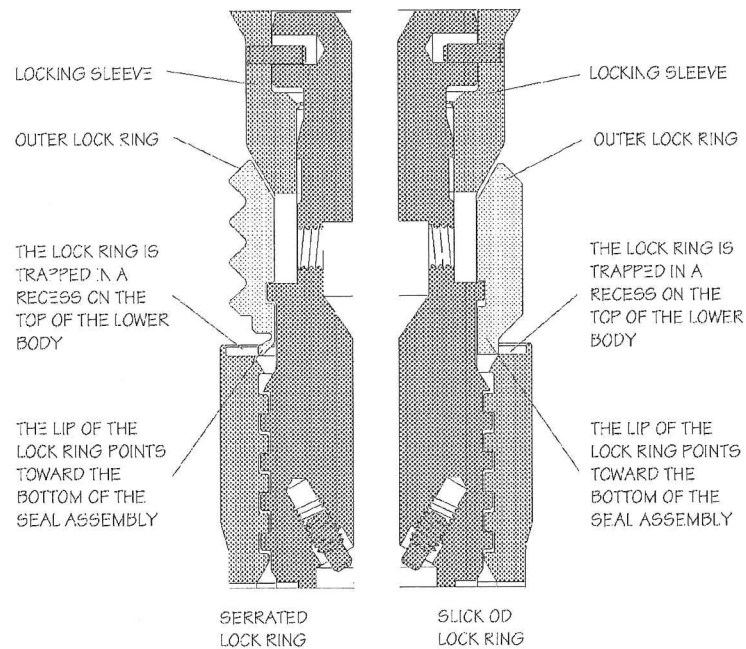


Figure 11. Outer lock rings are installed onto the Seal Assemblies

6. Move the lock ring retainer until the grooved shear pin holes in the retainer line up with the matching holes in the lock ring.
7. Install the grooved shear pins by tapping them in lightly with a small hammer.
8. Tighten the cap screws.
9. Return the Seal Assembly to its storage container.

Casing Hanger and Seal Assembly Running Tool

1. Refer to **Figure 12** for identification of the Casing Hanger and Seal Assembly Running Tool (Running Tool) components. Remove the Running Tool from its soluble oil-bath storage can. Record the part number and serial number of the Running Tool for the permanent well file.

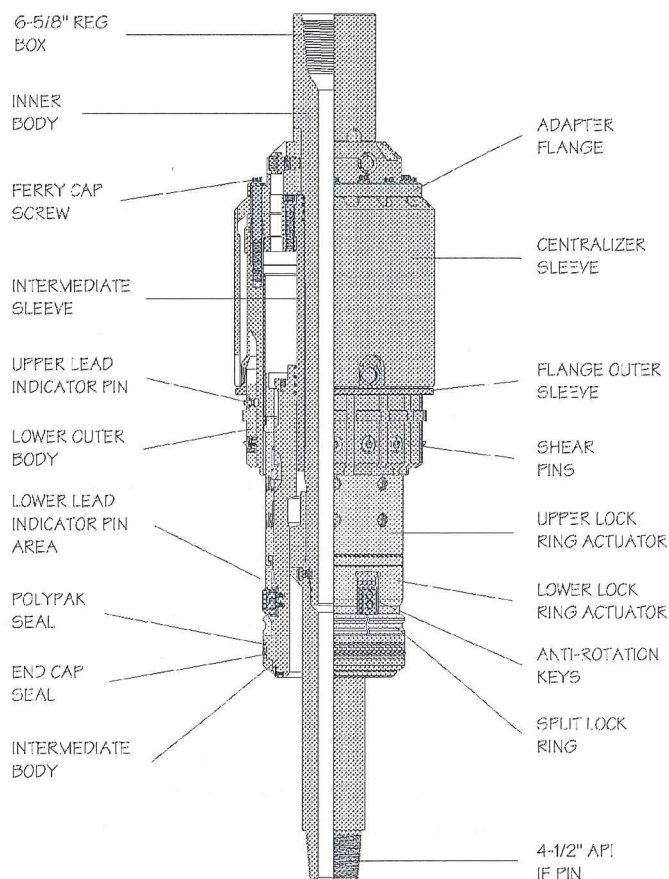


Figure 12. Casing Hanger and Seal Assembly Running Tool

2. Inspect the Running Tool for damage. The Running Tool should be free of debris and cement. Refer to the **Post-Operational Procedures** if cleaning of the Running Tool is required.
3. Inspect the end cap seal and the polypak seal on the lower OD of the Running Tool intermediate body.

- a. Run a finger over the seals. Check for cuts, cracks, or dents. The seals should be smooth and pliable.
- b. Replace the seals if necessary. Refer to the **Post-Operational Procedures** for instruction on removal and replacement of the end cap seal.
4. Verify the split lock ring is retracted (the OD is not greater than the OD of the intermediate body seal area).
 - a. Inspect the split lock ring to ensure it is free of nicks, scratches, and gouges.
 - b. Repair the split lock ring if necessary.
5. Confirm a lead indicator pin is not installed in the lower outer body just below the flanged outer sleeve or installed in the lower lock ring actuator.

Note: If the lead indicator pins are installed, they will be sheared during the process of making up the Casing Hanger and Seal Assembly to the Casing Hanger and Seal Assembly Running Tool.

6. Insert a socket wrench over the head of the modified shoulder screws in the anti-rotation keys and verify the modified shoulder screws are properly tightened. Depress the anti-rotation keys to verify they retract and extend freely.
7. Remove the protectors from the tool joints. Check the threads for damage. Repair and lubricate the threads if necessary. Re-install the protectors.
8. Verify the number of shear pins installed in the Running Tool complement the number of Seal Assembly threaded release holes.
 - Eight threaded release holes require eight shear pin assemblies (one empty pocket between shear pin assemblies).
 - Sixteen threaded release holes require 12 shear pin assemblies (in groups of three with an empty pocket between groups).

9. Ensure the shear pins on the lower outer body are installed with the tapered side of the pins facing the bottom and the flat surface facing the top. Refer to **Figure 13**.

- a. Depress the shear pins to verify they retract and extend freely.
- b. Ensure the retainer nut and retainer do not protrude beyond the Tool OD. Place a straight edge vertically over the retainer nut, as close to the shear pin as possible, and verify the straight edge contacts the Tool body above and below the shear pin assembly.

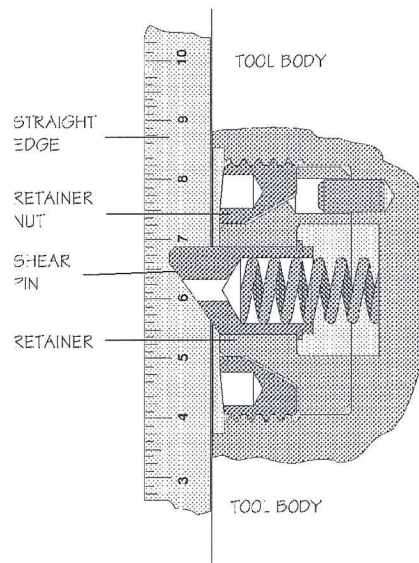


Figure 13. Verification of proper installation of shear pins

- c. If the shear pin assembly is not properly installed, refer to the **Post-Operational Procedures** for instruction on removal, cleaning, and installation.
10. Ensure the ferry cap screws on top of the Running Tool are tight. Perform this check using a 1/2" drive ratchet wrench, without handle extensions or cheater bars.
11. Store the Running Tool as appropriate for operations.

Running Procedure

CAUTION: Do not torque through the Casing Hanger and Seal Assembly Running Tool while making up the box or pin connections. The anti-rotation cap screws can shear and the extension sub (stop sleeve) on the bottom of the Tool can back out while downhole.

Preparation

1. Before running casing, set the Running Tool in the mousehole or rotary table.
 - a. Make up any necessary crossover on top of the Running Tool.
 - b. Make up a 30-ft long joint of drill pipe on top of the crossover.

Note: Usually a smooth joint of drill pipe is made up immediately above the Running Tool, instead of heavy-wall drill pipe. This is due to the possible interference of the center wear pad of the heavy-wall drill pipe with a BOP ram when the Seal Assembly and/or BOP stack tests are performed. However, if the location of the center wear pad is of no concern, a joint of heavy-wall drill pipe immediately above the Running Tool is acceptable.

- c. Make up the remainder of the string at the discretion of the operator.

Note: To improve Seal Assembly setting performance in severe gumbo, trash, and cuttings environments the weight-set Seal Assembly must have a minimum string weight of 20,000 lb for seal activation.

2. Pick up the Running Tool/drill pipe assembly in the elevators.

- a. Make up the equalizer sub to the lower tool connection, but do not make up the cement wiper plugs yet.
 - b. Set the assembly aside in the derrick.
3. Use two straps to pick up the Casing Hanger and pup joint assembly and support the assembly in the rotary table with casing slips. Use care to prevent damage to the tapered seal area of the Casing Hanger during this operation. Remove the Casing Hanger metal protector.
4. Use the blocks and a set of drill pipe elevators to pick up the Running Tool. Carefully lower the Running Tool into the Casing Hanger while aligning the anti-rotation keys with their slots in the Casing Hanger.
 - a. Allow the Running Tool to stroke closed and put the full weight of the drill pipe on the Running Tool.
 - b. Carefully pick up on the blocks and stroke the Running Tool open. Continue to pick up until the anti-rotation keys of the Running Tool start to rise.
 - c. Refer to **Figure 14**. Insert the 5-ft torque bars into the torque bar holes of the Running Tool. Rotate the Running Tool clockwise to ensure it is fully unlocked. The Running Tool could turn up to 1-1/2 turns depending on how it was left after its last usage. Excessive force is not required.
 - d. Verify the Running Tool is fully stroked open by measuring from the top of the anti-rotation key to the bottom of the lower outer body of the Running Tool. The measurement should be 11-3/8". Refer to **Figure 15**.
5. Paint a vertical mark on the upper tool connection and at the bottom of the Casing Hanger.
6. Rotate the Running Tool three turns counterclockwise to lock the Tool stroked open.

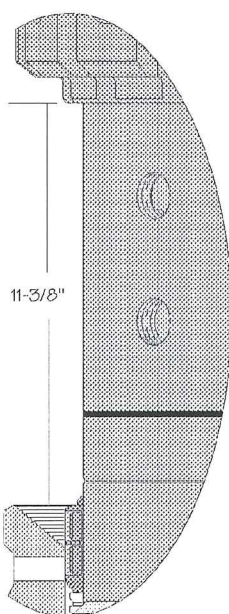


Figure 15. Detail of the Running Tool stroked fully open

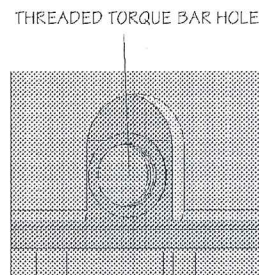


Figure 14. Torque bar hole detail

7. Set the Running Tool fully down in the Casing Hanger and measure the distance from the top of the Hanger to the bottom of the lower outer body of the Tool. The measurement should be 8-7/8". Refer to **Figure 16**.

- If the measurement is greater than 8-7/8", the Running Tool is not fully seated in the Hanger.
- Take corrective action until the proper measurement is obtained.

8. Rotate the Running Tool four turns counterclockwise. These turns lock the Running Tool to the Casing Hanger. As the Running Tool starts to make up to the Casing Hanger, a torque increase is encountered.

9. Verify the Running Tool is fully made up by observing the knurled indicator band. The band is $\pm 1/4$ " from the top of the Casing Hanger when the Running Tool is fully made up to the Casing Hanger. Refer to **Figure 17**.

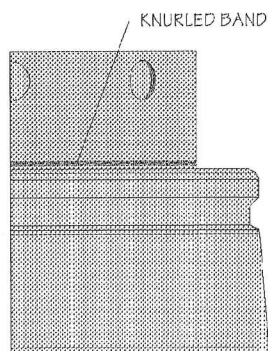


Figure 17. A knurled band is visible when the Running Tool is properly made up to the Casing Hanger.

10. Pick back up on the Running Tool assembly. The Running Tool strokes out approximately 2" before the Casing Hanger rises.

- a. Set the Casing Hanger back down and slack off all drill pipe weight. After the Casing Hanger has set down, the Running Tool should close (stroke in) approximately 2" and stop.

- b. Rotate the Running Tool clockwise three turns (it may be necessary to hold a backup on the pup joint).

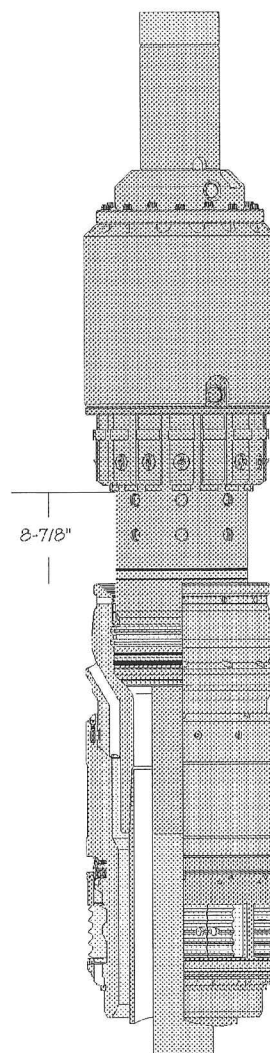


Figure 16. Stroke measurement with Running Tool properly set in the Casing Hanger

RUNNING TOOL
THRUST
SHOULDER

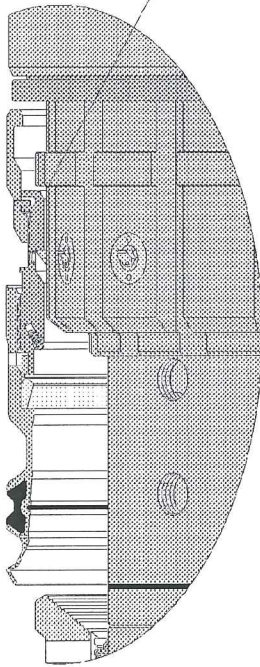


Figure 18. Seal Assembly properly snapped on the Running Tool shear pins

- c. Remove the 5-ft torque bars from the Running Tool.
11. Lift the Running Tool out of the Casing Hanger and pull it to the side.
 - a. Install two new lead indicator pins. Install one pin in the lower outer body, just below the centralizer sleeve. Install the other pin in the lower lock ring actuator. These lead pins indicate the flanged outer sleeve has moved down to lock the Seal Assembly to the Casing Hanger when the Seal Assembly is tested.
 - b. Remove the Seal Assembly from its shipping box.

Note: Verify the number of shear pins installed in the Running Tool complements the number of Seal Assembly release holes. This verification is crucial if the Seal Assembly must be removed from the Running Tool.

- c. Lift the Seal Assembly onto the lower outer body of the Running Tool. Raise the Seal Assembly until its main body contacts the thrust shoulder on the lower outer body. Refer to **Figure 18**.
- d. Verify the Seal Assembly is properly snapped over all of the shear pins on the Running Tool by rotating the Seal Assembly left and right. The Seal Assembly should rotate in a level plane without binding.

Note: Record in the permanent well file whether or not the outer lock ring is installed. This information is crucial if the Casing Hanger is to be retrieved in the future, or if the well is to be permanently abandoned.

12. Install the cement wiper plug(s) to the bottom of the Running Tool.
13. Lower the Running Tool assembly into the Casing Hanger, aligning the anti-rotation keys with the matching slots in the Casing Hanger. Set the entire weight of the Running Tool and drill pipe on the Casing Hanger.
14. Re-install the 5-ft torque bars.

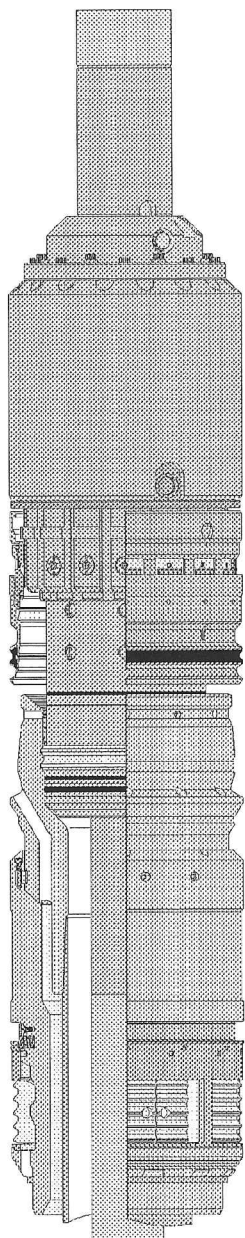


Figure 20. Running Tool, Seal Assembly, and Casing Hanger made up as a unit

- a. Rotate the Running Tool three turns counterclockwise to re-lock the Running Tool to the Casing Hanger.
 - b. Turn the Running Tool back clockwise 1/8 turn (do not exceed 1/4 turn) to ensure high torque will not be encountered when the Running Tool is released from the Casing Hanger at the conclusion of the cementing operation.
15. Verify the Running Tool is fully made up by observing the knurled indicator band. The band is $\pm 1/4$ " from the top of the Casing Hanger when the Running Tool is fully made up to the Casing Hanger. Refer to **Figure 19**.
 16. Paint a vertical alignment mark down the side of the Running Tool and Casing Hanger, but do not paint on the seal surfaces of the Seal Assembly and Casing Hanger. The Running Tool, Casing Hanger, Seal Assembly, and wiper plugs are now properly made up as a unit and ready to be run into the 18-3/4" Wellhead Housing. Refer to **Figure 20**.

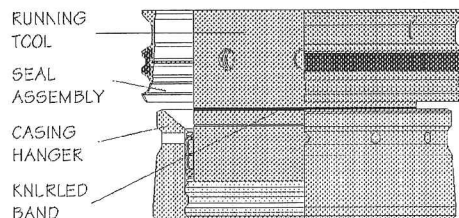


Figure 19. Detail of the Running Tool knurled band visible through the gap between the Seal Assembly and Casing Hanger

- a. Protect the Seal Assembly and Casing Hanger seal area using ropes, rags, or a metal protector.
- b. Rack the Running Tool/Casing Hanger assembly back in the derrick or lay it out on the deck.

Running the Casing Hanger and Seal Assembly

1. Circulate and condition the hole for casing. DRIL-QUIP recommends the following actions for preparing the hole before pulling out to run casing.
 - a. Wiper trip to ensure the hole section is clean.
 - b. Pump and circulate out high-viscous fluid sweeps.
 - c. Verify a decrease in cuttings coming across the shale shakers.
2. If the BOP stack has a flex joint with a restrictive Wear Bushing installed, retrieve the Wear Bushing from the flex joint. Confirm the Nominal Bore Protector has been retrieved from the Wellhead Housing. If it has not been retrieved, refer to the Nominal Bore Protector retrieval section in this manual for specific instructions.
3. Run the casing string as dictated by the casing program and well design.

Note: DRIL-QUIP does not recommend the use of centralizers on casing for subsea application. Previous experience has shown these units can be damaged, or torn off the casing when passing through ball joints and BOP stacks. As a result, they can become lodged in the Wellhead, causing damage and problems in setting the subsea Casing Hanger and Seal Assembly.

Note: DRIL-QUIP recommends washing through the casing shoe as it passes the Wellhead Housing.

4. When the last joint of casing is in the slips, change to drill pipe elevators. Carefully pick up the Casing Hanger and Running Tool assembly previously made up to drill pipe and make up this assembly to the last casing joint.

Note: Ensure the hook on the traveling block is now unlocked and remains unlocked until the Casing Hanger has landed. There are two reasons to support this practice.

- If the tong operator cross-threads the pup joint when making it up to the last casing joint and has to back the pup joint out, the hook must be free to swivel to avoid putting right-hand torque into the Casing Hanger/Running Tool assembly. If this cross-threading and backout occurs, observe the vertical mark on the assembly closely to ensure the Casing Hanger and the Running Tool turn as a unit, and the Running Tool does not begin to release from the Casing Hanger.
- A free-turning hook will absorb any left- or right-hand twists that may occur as the Casing Hanger/Running Tool assembly passes through the riser and BOP stack.

5. Continue to run the running string. Activate the motion compensator as the last joint of the running string is run. Adjust it to support the weight of the running string only.

Note: DRIL-QUIP recommends washing the Casing Hanger using the choke or kill lines as the Casing Hanger passes through the BOP stack.

6. Land the Casing Hanger in the 18-3/4" Wellhead Housing. A weight loss of 70,000 lb can be observed on the weight indicator. This weight loss will be immediately regained when the actuating plungers on the actuator sleeve engage the Wellhead Housing. The assembly will move down approximately 2" and stop.
 - a. Slack off all casing string weight.
 - b. When the Casing Hanger assembly lands, allow the motion compensator to stroke to the cylinder mid-point. If the motion compensator has been adjusted properly, the running string should be slightly in tension.

7. Verify the landing string/Casing Hanger elevation against the measurements obtained when the Nominal Bore Protector was retrieved (dimension "B").

- a. Set 20,000 lb of landing string weight down on the Running Tool.
- b. Measure from the landing shoulder on the Casing Hanger to a distance on the landing string equal to dimension "B." Refer to **Figure 21**.

- c. Mark the drill pipe at the dimension "B" elevation on the string. Pull the steel index line vertical and use a straight edge to compare the mark on the drill pipe to the mark on the steel index line (reference "A").

- d. Verify the marks are at the same elevation to confirm the Casing Hanger is landed at the proper elevation in the Wellhead Housing.

8. Make a horizontal mark on the drill pipe level with the rotary table level as a future reference to detect vertical movement of the drill pipe.

Make a vertical mark across the drill pipe and the rotary table to detect rotation of the drill pipe.

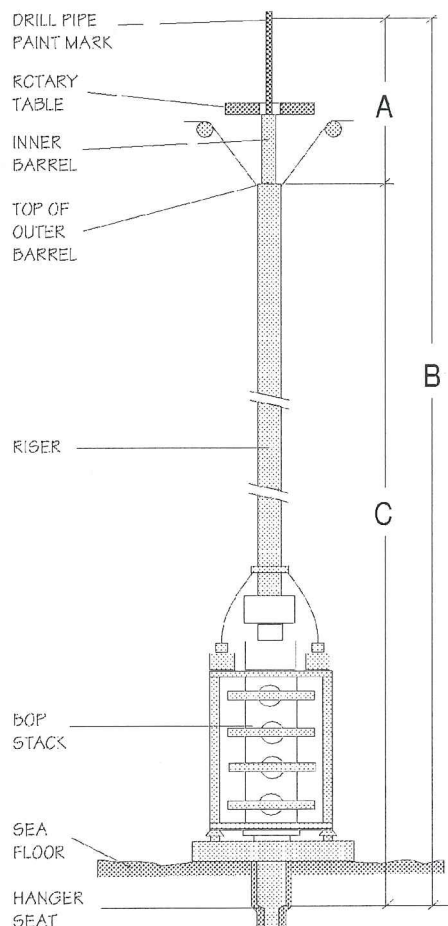


Figure 21. Determining the Exact Location of the Hanger Seat

9. Cement the casing string according to the well program. Do not pick up or attempt to rotate the casing string during circulating, cementing, or displacing.
10. At the conclusion of the cementing operation, remove the cement line from the running string.
 - a. Adjust the motion compensator to put a minimum weight of 20,000 lb down on the Running Tool.
 - b. Ensure the marks made on the running string above the rotary table are still visible. Make new marks if necessary.
 - c. Turn the running string to the right five to six turns, or until the running string drops approximately 10". This 10" drop lands the Seal Assembly on the Casing Hanger and energizes the seals. Do not rotate the drill pipe running string any further.
11. Adjust the motion compensator to put additional string weight on the Running Tool and further energize the Seal Assembly. DRIL-QUIP recommends limiting the additional weight to 70,000 lb to prevent damage to the Running Tool or the drill pipe running string.

Seal Assembly Setting and Testing Procedure

Note: The letters preceding the potential leak paths correspond to the troubleshooting chart presented later in this section.

Pressure System Checks

DRIL-QUIP recommends pressuring up to 10,000 psi when locking down the Seal Assembly to displace debris and maximize Seal Assembly lockdown performance. The pressure system should be tested to a minimum of 10,000 psi.

Note: If the maximum BOP Stack test pressure was less than 10,000 psi after the Stack was initially run subsea, use that test pressure value as the maximum system test pressure.

1. Before beginning the setting and test procedures, it is recommended the following pre-test checks of the pressure system be performed to identify possible leak paths. The possible leak paths are:
 - a. Test rams
 - b. BOP stack connection(s) between the test rams and the wellhead connector
 - c. Test pump unit
 - d. Choke and kill manifold
 - e. Test line and all the connections from the test pump to the BOP
 - f. BOP stack valve(s) or any other choke/kill inlets
 - g. Ring gasket between the Wellhead and the wellhead connector
 - h. O-ring seals on the Casing Hanger Seal Assembly Running Tool
 - i. Seal Assembly
2. Fill the riser with drilling fluid to detect pipe ram leakage.
3. Open the drill pipe running string to the atmosphere. Confirm the drill pipe is full of fluid. Fill the drill pipe if necessary.
4. Verify the integrity of the pressure system:
 - a. Select a set of pipe rams to be used to set and test the Seal Assembly. Call these rams the test rams.

CAUTION: If the maximum BOP Stack test pressure was less than 10,000 psi after the Stack was initially run subsea, use that test pressure value as the test pressure for **Step 4b**.

- b. Select a choke or kill line that enters the BOP stack below the test rams. Call this line the test line. Close the test line valve closest to the BOP stack. Use a test pump unit to pressure up the test line to a minimum of 10,000 psi or the desired BOP stack pressure, whichever pressure is greater.

Note: DRIL-QUIP recommends the use of cement pumps as the test pump unit. Experience has shown the cement pump unit is more effective than rig pumps in energizing and locking the Seal Assembly down.

- c. Note the fluid level in the test unit suction tank and hold the test for 1 minute. If a pressure drop is noticed, trace the source of the drop, correct the problem, re-test the test line, and hold pressure for 1 minute.
- d. If a choke or kill line other than the test line enters the BOP stack below the test rams, test the lower line's valve at the BOP stack in the manner just described. If there are no other inlets in the BOP stack below the test rams other than the test line, this step can be omitted.

Seal Assembly Setting and Testing

To improve Seal Assembly setting performance in severe gumbo, trash, and cuttings environments the following steps are recommended. Both steps help to displace debris and maximize Seal Assembly lockdown performance.

- Once the minimum setting pressure has been applied, pressure will be increased to 10,000 psi and held for 10 seconds. The operator can hold the pressure longer if desired.
- After the initial test of the Seal Assembly, the Running Tool will be picked up 2 to 3 feet above the Casing Hanger, washed, and re-landed. The Seal Assembly will then be re-tested to 10,000 psi and the pressure held for 10 seconds. The operator can hold the pressure longer if desired.

Setting Procedure

1. Close the test rams and quickly build setting pressure to a minimum of 4,000 psi.
 - a. Note the amount of test fluid used (no more than 1/2 to 1-1/2 barrels should be used depending upon water depth and type of test fluid). The pressure acts on the piston area of the Running Tool and moves the locking sleeve on the Seal Assembly down to actuate the inner lock ring and lock the Seal Assembly to the Casing Hanger. If the outer lock ring was installed before the Seal Assembly was run, the Casing Hanger and the Seal Assembly are locked to the 18-3/4" Wellhead Housing.
 - b. When a minimum of 4,000 psi has been reached, stop pumping, and hold the pressure for a minimum of 30 seconds. The operator can hold the pressure longer if desired.

Note: If during the setting of the Seal Assembly a pressure drop is experienced, refer to **Table 1** for troubleshooting information. This table can be used to quickly isolate the source of the leak.

CAUTION: If the maximum BOP Stack test pressure was less than 10,000 psi after the Stack was initially run subsea, use that test pressure value as the maximum setting pressure to lock down the Seal Assembly.

2. Once the 4,000 psi setting pressure is successfully held, raise the setting pressure to 10,000 psi and hold the pressure for 10 seconds. Once the pressure has been held for 10 seconds the operator can begin a test of the Seal Assembly.

Testing Procedure

CAUTION: Do not exceed a test pressure of 15,000 psi.

1. Test the Seal Assembly at a minimum of 4,000 psi. Do not exceed 15,000 psi. Hold the Seal Assembly test pressure for 5 minutes. The operator can hold the pressure longer if desired.
2. Perform all BOP stack tests.
3. When the pressure tests are complete, open all rams and pick straight up on the Running Tool. An overpull of approximately 90,000 lb for 12 shear pins (or approximately 60,000 lb for 8 shear pins) is necessary to release the Running Tool from the locked-down Seal Assembly. A successful overpull indicates the seal is in the proper position and locked to the Casing Hanger.

Note: In isolated instances, the nominal 90,000 lb (or 60,000 lb as applicable) shear-out may not be clearly observed. High riser angles or an improperly calibrated weight indicator can affect overpull readings. This could also be an indication the Seal Assembly did not lock to the Casing Hanger.

4. Re-test the Seal Assembly regardless of the overpull value.
 - a. Pick up the Running Tool approximately 2 to 3 feet or until the cement plug launcher clears the Casing Hanger. Circulate down the drill string at the maximum practical pump pressure and flow rate for approximately 2 minutes.
 - b. Land the Running Tool on the Casing Hanger, and set down the entire weight of the running string (70,000 lb maximum). Close a set of rams, and re-test the Seal Assembly to 10,000 psi for 10 seconds. The operator can hold the pressure longer if desired.
5. When the pressure tests are complete, open all rams. Pick straight up to recover the Running Tool. Pull out of the hole without rotating the string.

Table 1. Troubleshooting the Seal Assembly Test

Symptoms	Possible Problem	Suggested Solution
Fluid loss at test pump unit	c. Test Pump Unit	Repair the leak in the Test Pump unit, and test again
Fluid returns in the well bore	a. Test Rams	Open and close the Test Rams, and test again Select new Test Rams, and test again
Fluid returns at the Choke/Kill manifold	d. Valves in the Choke/Kill manifold f. Choke/Kill valves at the BOP	Open and close the Valves, and test again Open and close the Valves, and test again Close the backup C/K valves at the BOP, and test again
Continuous fluid returns through the drill pipe running string	h. Test seals on the Casing Hanger Running Tool	Retrieve the Running Tool and Seal Assembly, and run the Seal Assembly on the Seal Assembly Running Tool
Fluid noticed through the camera, between the Wellhead and Wellhead connector	g. Wellhead ring gasket	Replace the Wellhead ring gasket, and test again
Fluid noticed through the camera, from the main BOP	b. Ram body/ Wellhead connections	Retrieve the BOP, replace the ring gasket(s), re-run the BOP, and test again
Fluid noticed through the camera, from the test line connections	e. Packing in the Choke/ Kill test line	Retrieve the Riser, replace the packing, re-run the Riser, and test again
No visible fluid loss	i. Seal Assembly	Ensure a minimum weight of 20,000 lb is set down on the Running Tool Pull the Running Tool and Seal Assembly, run the Mill & Flush Tool, run a new Seal Assembly with the Seal Assembly Running Tool, and test again

Releasing the Seal Assembly from the Running Tool

To release the Seal Assembly from the Running Tool before running it into the hole, proceed as follows.

1. Set the Running Tool/Casing Hanger assembly in the rotary table and support the assembly using casing slips.
2. Remove the Running Tool from the Casing Hanger.
 - a. Re-install the 5-ft torque bars.
 - b. Rotate the Running Tool clockwise three turns (it may be necessary to hold a backup on the pup joint).
 - c. Remove the 5-ft torque bars from the Running Tool.
3. Lift the Running Tool out of the Casing Hanger and pull it to the side.
4. Align the Seal Assembly release holes with the shear pins on the Running Tool. Refer to **Figure 22**.
5. Install screws into all of the release holes on the OD of the Seal Assembly. Thread the screws in all the way to release the Seal Assembly.

Note: When all of the shear pins are depressed, the Seal Assembly will fall off the Running Tool. Precautions must be taken to prevent damage to the Seal Assembly.

6. Optionally, depress all pins simultaneously with a welding rod or any other suitable object.

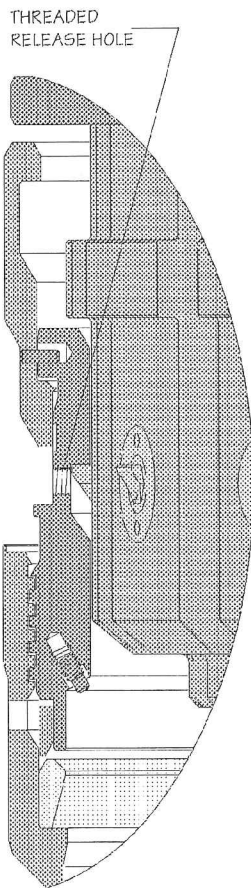


Figure 22. Detail of a Seal Assembly threaded release hole

Post-Operational Procedures

Casing Hanger Seal Assembly Running Tool

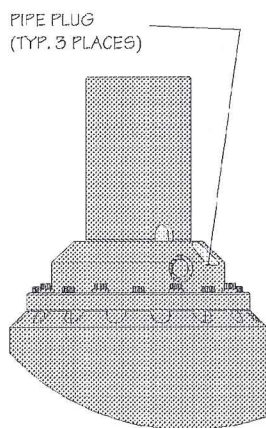


Figure 23. Detail of the pipe plug location

1. Remove the three pipe plugs in the top of the Running Tool. Refer to **Figure 23**.
2. Wash the Running Tool thoroughly with fresh water, forcing water through the sleeves and holes in the Tool. Re-install the pipe plugs.
3. Replace the shear pin assemblies on the Running Tool.
 - a. Use a spanner wrench to unscrew the retainer nut and remove the used shear pin assembly.
 - b. Lightly grease and install the new shear pin assembly. Install the shear pin with the tapered side facing down and the flat side facing up. Refer to **Figure 24**.
 - c. Tighten the retainer nut with the spanner wrench.
 - d. Ensure the retainer and the retainer nut do not protrude beyond the Tool OD. If either one, or both protrude, remove, clean, and re-install the shear pin assembly as necessary to achieve the proper installation.
 - e. After installation, check the spring behind the shear pin by depressing the shear pin. When released, the shear pin should return to the extended position.

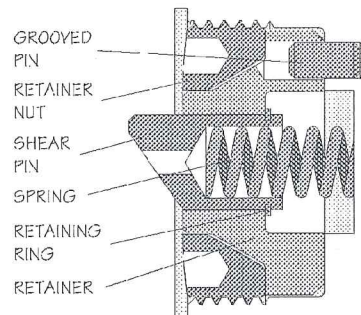


Figure 24. Detail of a shear pin assembly layout

Note: Excessive grease and/or debris can prevent the retainer nut and retainer from fully seating when the shear pin is installed.

4. Refer to **Figure 25**. Inspect the polypak seal and end cap seal on the lower OD of the Running Tool intermediate body. Check for cracks, cuts, or dents. The seals should be smooth and pliable. Replace the seals if necessary. Replace the end cap seal as follows.
 - a. Remove the four socket head cap screws from the retainer ring. Unscrew and remove the retainer ring.
 - b. Slide the load ring off the intermediate body, then slide off the end cap seal. Replace the seal.
 - c. Slide the load ring back into position on the intermediate body.
 - d. Thread on the retainer ring until it is hand-tight. Back the retainer ring off until the holes for the socket head cap screws align with the tapped holes in the intermediate body.
 - e. Install and tighten the socket head cap screws.
5. Remove the two sheared lead indicator pins, one from the lower outer body, and the other pin from the lower lock ring actuator, from the Running Tool.
6. Remove the top and bottom crossover subs.
7. Inspect the tool joints and make all necessary repairs.
8. Prepare the Running Tool for storage.
 - a. Moderately coat the Running Tool with quality grease.

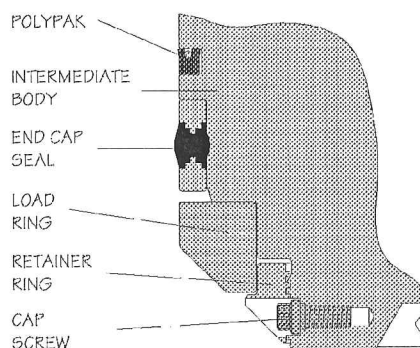


Figure 25. End Cap Seal Replacement detail

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- b. Inspect the fluid in the storage container for debris or contamination. Replace the fluid if necessary.
 - c. Store the Running Tool in its oil-bath storage container. Ensure the storage can contains enough soluble oil/fresh water solution to cover the main body of the Tool. Fill the storage container if necessary.

