Welcome to the 2nd installment of our 3 part technical series on DTH Hammers & Bits. Last week's installment focused on the construction and function of Rock Hog's DTH Hammers.

In this series we'll be focusing on:

- Hammer monitoring, maintenance, service schedules, inspection, assembly & disassembly

Monitoring

As the hammer accumulates drill time, these areas need to me monitored to determine when to service the hammer.

External Surfaces:

- Rock Hog hammer parts are made from the best materials and hardened for long life but eventually these surfaces will wear away. The rate of wear depends on the formation being drilled, drilling speed and airflow. Make periodic checks to know what condition the parts are in.

- Normally the chuck wears out first. Check the wall thickness on the bit shoulder end. When it measures 5/16" (8mm) or less at any point, replace the chuck. The service life of the chuck also heavily depends on the condition of the drill bit.

- The wear sleeve will normally wear more on the chuck end. When the outside diameter reaches 5.25" (133.4mm), flip the sleeve. Once either end has worn down to a 5.03" (127.8mm) diameter, replace the sleeve. The service life of the sleeve also heavily depends on the condition of the chuck.

Chuck Splines:

Check the condition of the chuck splines each time the bit is removed.
Do not put a chuck with badly worn splines on a new bit.

Shoulder Gap:

A hand-tight backhead will not be seated on the sleeve. Once the backhead is torqued down, this gap will close and the backhead will seat on the sleeve. This clamps the internal parts to prevent part movement. Periodically check the gap between the sleeve and hand-tight backhead. If the gap falls below .08" (2.0mm), refer to Section 3.4-step 10.

Operating pressure:

This is the best way to know what condition the internal parts are in. As internal parts wear, the operating pressure, and therefore the penetration rate, will drop. Only the operator can say when hammer performance has dropped below an acceptable level at which time the hammer must be serviced. If the pressure goes up after the hammer has been in service for some time, this would indicate the piston is sticking or the air passages inside the hammer are becoming restricted.

Maintenance

Schedule

If the need for service defined in Monitoring, is not reached first, follow these guidelines for servicing the hammer:

- When the hammer is operated to the parameters defined in section 2 in formations up to what is considered “hard”, perform service every 25000 feet (7600 meters) of drilling.
- When water injection & drilling foams are used extensively, perform service every 18000 feet (5500 meters).
- When drilling in “very hard” formations or when drilling under heavy mud, perform service every 10000 feet (3000 meters).
- When injecting agents that are corrosive to metal, like potash to coat the hole wall, clean the hammer at completion of the job.

Use this as a starting point. Keep a log of service done-vs.-footage drilled. This will help refine the service schedule to fit your operation.

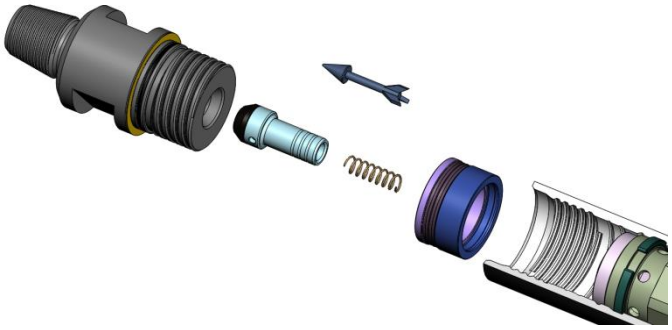
Disassembly

All parts are a sliding or clearance fit inside the hammer but may be held by a retainer ring or may be tight inside the hammer depending on the condition of the parts and the time period since the hammer was last serviced.

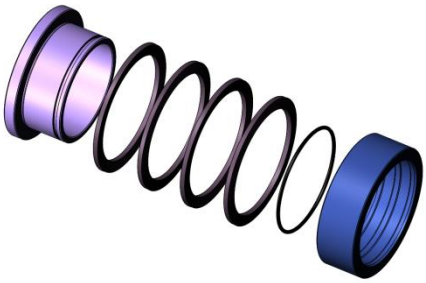
1. Break both the backhead and chuck threads loose. See section 2.13.

2. Lay hammer on a bench, mark the sleeve ends “backhead” and “chuck”.

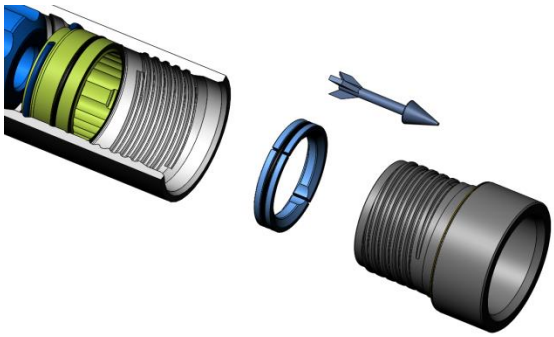
3. Turn out the backhead, lift out the check valve, check valve spring and disc spring pack.



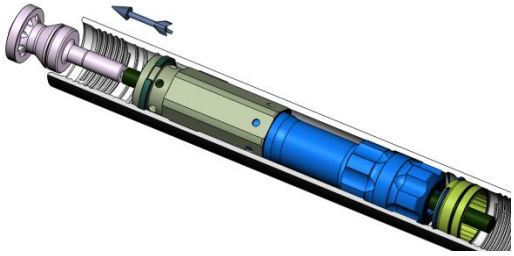
4. If the disc springs look dry and/or rusty, pull the disc spring pack apart. The guide ring is held inside the spacer tube by an o-ring. Hold the spacer tube and tap the guide ring out, remove the o-ring, slide the disc springs off the ring.



5. Turn out the chuck, lift out the bit retainer ring.

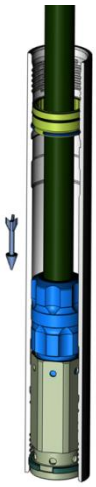


6. Drive out the air distributor from the chuck end with a steel rod or pipe (1-1/4” max dia x 30” min long). Run the rod through the piston to push out the air distributor.



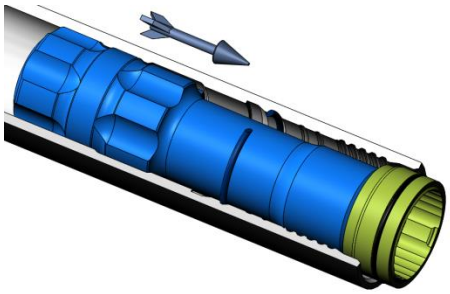
7. Remove the cylinder and piston. Stand the sleeve on the backhead end. The piston will drop against the cylinder. Using a rod, pipe, or timber

(3-1/2 dia x 40” long) and a sledge hammer, or just a heavy bar (*Rock Hog uses a 2-1/2” dia x 5’ long steel bar*), drive down on the piston. This will collapse the ring out of its groove and allow the cylinder and piston to move to the bottom of the sleeve. Lay the sleeve over and push the cylinder/piston out of the sleeve.



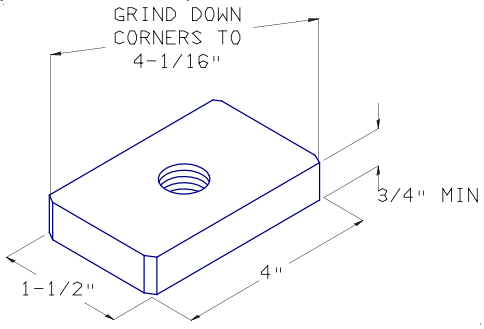
8. Removing the bearing. An o-ring around the bearing is all that holds the bearing in. It may pull out by hand but most likely it will not and either method (a) or (b) can be used to remove the bearing. Use method (a) if the piston is being removed. Use method (b) if the backhead is not broke loose.

   a. Push method: Stand the sleeve on the chuck end. Drop the piston, small end first, into the backhead end of sleeve. This will push the bearing to the floor. Lay the sleeve over and push the bearing out, then push piston back out the backhead end.



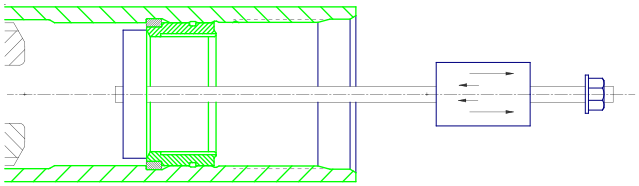
   b. Pull method: (*this will allow the piston to be removed from the chuck end if the backhead is still tight*) prepare a bump-out hammer from these parts:

+Block- 1/2 x 1-1/2 x 3-3/16 x 3-1/4 across corners, with a threaded center hole,



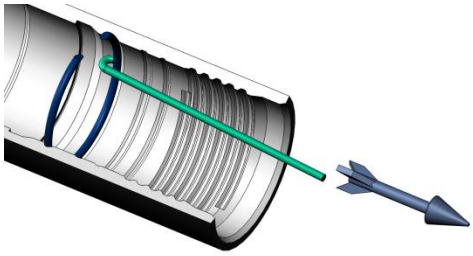
+threaded rod 24” long, nut, washer, and a slide hammer that will fit over the rod.

Pull out the bearing. To use the bump-out hammer, place the block behind the bearing on top of the piston, thread the rod into the block. Put the slide hammer, washer, and nut on the rod and pull the block up against the bearing. Keeping the block centered on the bearing, bump the bearing out of the wear sleeve.

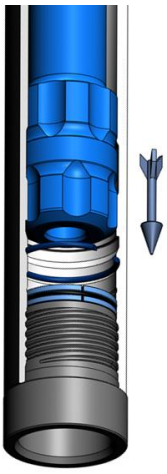


9. Remove the retaining ring. This ring does not need removed unless the wear sleeve needs flipped over, the ring is damaged, or the sleeve is being replaced.

If a hook tool is available, place the hook under the ring and pull it out of the groove.



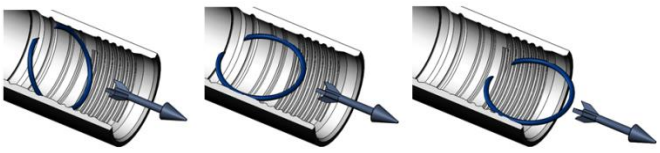
Or,



If a hook is not available, put the bit retainer ring and chuck back in, stand the sleeve on the chuck, and drop the piston, big end first, into the sleeve. The piston will push the ring down to the bit retainer ring (*installing the chuck and bit ret ring prevents the ring from getting pushed into the sleeve threads*). Then lay the sleeve back down, remove the chuck and bit ret ring, and push the piston back out.

The piston has to drop freely through the sleeve for this to work. If the piston does not drop freely, push the piston down to the ring and then drive on the piston to push the ring out of its groove.

Now roll the ring up and pull it out of the sleeve.



Disassembly is complete.

Inspection

Before cleaning any parts, observe them for oil. If the hammer is being properly lubricated, the parts should have a substantial film of oil all over but not dripping.

None of the following should be found inside:

- **dirt and grit**
- **metal shavings**
- **grease (other than at the chuck & backhead)**
- **rust and corrosion**

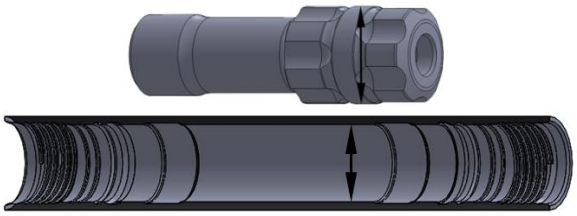
Clean all parts. Carefully look over all parts for cracks, corrosion, and pitting. Any corrosion indicates the hammer is not being oiled properly. Corrosion greatly increases the chance of cracks starting. Remove any and all corrosion using fine emery paper.

Galling- is surface damage caused by metal-to-metal contact under high loads. Many of the parts listed will be checked for galling. Any sign of galling indicates lack of lubrication, use of the wrong type of lubricant, or parts have been damaged to the extent there is interference between parts.

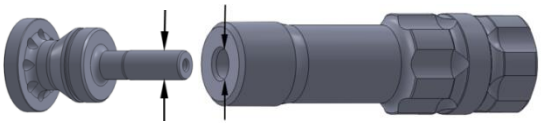
Max Clearances:

Wear on the following part locations directly affect the hammer's operating pressure, and therefore the penetration rate. When clearances have reached the values given below, Rock Hog considerers the part or parts worn out and recommends replacement. However, the hammer will continue to operate at clearances greater than those listed but at a greatly reduced efficiency. So only the operator can say when hammer performance has dropped below an acceptable level. Some operators may choose to replace parts before these limits have been reached to keep the hammer running at top performance.

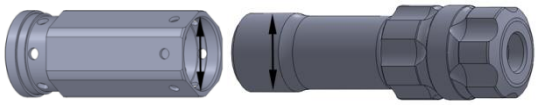
Clearance 1: Piston OD to Sleeve ID .008



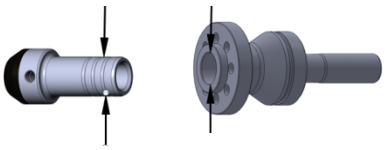
Clearance 3: Air Dist OD to Piston ID .009



Clearance 2: Piston OD to Cylinder ID .009



Clearance 4: Check Valve OD to Air Dist ID .009



Clearance may be checked using feeler gages or by measuring both parts with micrometers. Additional details are given under individual parts below. Again, keeping a log of when & what service was performed will help fine-tune the service schedule to fit your operation.

Backhead:

Be sure to remove all the old grease from the drill pipe connection threads. Moisture can get trapped under the grease and corrode the surface. This also allows for a visual check of wear on the threads. Compare the worn threads to a new thread. If 50% of the thread form is worn away, replace the backhead. Check the condition of the o-ring. If it is cracked, cut, or brittle, replace it. Check the large threads for galling. Polish out any damaged areas.

The outside of the backhead will wear away. This wear is not detrimental to the function of the hammer but will eventually allow the drill pipe to wear away. Replace the backhead if it is no longer protecting the drill pipe.

Check Valve:

Check the condition of the rubber top. If the surface is degraded, replace the check valve. If the clearance with the air distributor bore is greater than .009” (.23mm), replace the check valve.

Check Valve Spring:

The outside of the spring will be worn on one side about mid-length. If the wire diameter has been reduced by more than 30%, replace the spring.

Disk Spring Pack:

Replace any parts that are cracked or damaged. In this case, the o-ring is not a seal but a retainer. Replace the o-ring if it no longer holds the pack together. If there is any rust on the disc springs, remove all the rust and put a coat of oil on the springs. Look for wear on the faces of the ring, spacer, and springs. As the faces wear, there is less compression force created by the springs. This compression is set by the compression gap described in section 3.4-step 10.

Air Distributor:

Make sure all the air holes are clear. Check the clearance of the stem end with the back bore in the piston. If it exceeds .009” (.23mm) replace the air distributor. Check the condition of the o-ring. If it is cracked, cut, or brittle, replace it.

Cylinder:

Check the inside bore for galling with the piston. Polish out any surface damage. Check the clearance of the bore with the top diameter of the piston. If it exceeds .009" (.23mm), replace the cylinder. Check the new cylinder to the used piston. If the clearance exceeds .006" (.15mm), replace the piston also. Check the faces on the retaining ring in the outside groove. If the faces have a heavy step worn in them, cut off the ring and put on a new ring.

Piston:

Check the (2) outside guide diameters and top bore for galling and burning. Polish out any minor damage found on the surfaces. Any black areas on the surface indicate the piston was rubbing and over heating. Surface heating is very detrimental to the piston. In most cases, if the surface is black, that surface will also be covered with cracks. Replace the piston if it has excessive surface cracks. If the wear sleeve has not been previously flipped, check the clearance of the piston's big diameter with the sleeve bore where the cylinder sits. If it exceeds .006" (.15mm), replace the piston. Check the new piston to the sleeve bore on the chuck end. If the clearance exceeds .006" (.15mm), flip the wear sleeve at assembly (note: normally sleeve external wear determines when the sleeve gets flipped). If the sleeve has been previously flipped, check the clearance of the big diameter with the sleeve bore where the piston runs. If it exceeds .008" (.20mm), replace the sleeve. Check the piston to the new sleeve bore. If the clearance exceeds .006" (.15mm), replace the piston. Check the strike face for chipping and pitting. Replace a piston with a badly damaged strike face.

Note: the face can be reconditioned by removing up to .04" (1mm) of material. Only a qualified machinist should do this. Reconditioned pistons are not covered under warranty. Remove any nicks, dents, burrs with fine emery paper or a fine honing stone.

Again look over the piston for any rust, corrosion, pitting. All these will lead to cracks and failure of the piston.

Wear Sleeve:

Check the outside diameter. The wear sleeve will normally wear more on the chuck end. When any location on the outside diameter has reached 5.25" (133.4mm), flip the sleeve. **Once any location has worn down to a 5.03" (127.8mm) diameter, replace the sleeve.** Check the bore where the piston runs and the threads for galling. Polish out any surface damage.

Bearing:

Check the inside bore for galling. Polish out any damage. Check the clearance of the bore with the guide diameter of the bit. If it exceeds .010" (.25mm), replace the bearing.

Chuck:

Check the large threads for galling. Polish out any damaged areas. Check the splines. The driving side will wear away. If the form of the driving side still matches the bit, the chuck is usable. If the form no longer matches the bit or more than ½ the spline thickness is worn away, replace the chuck. Check the outside diameter for wear. If the wall thickness on the bit shoulder end measures 5/16" (8mm) or less at any point, replaced the chuck.

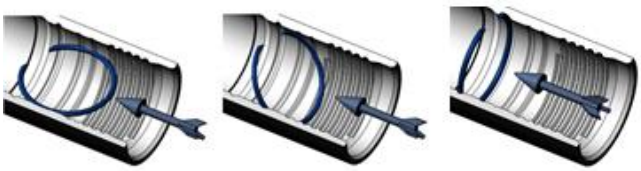
Breakout Washers:

These copper washers are on the hammer when shipped, one between the backhead and sleeve, and one between the chuck and sleeve. The washers are optional but they do reduce the torque required to break the threads loose. These rings do disintegrate over time. During inspection there may be just a portion of the ring remaining or no ring at all.

Assembly

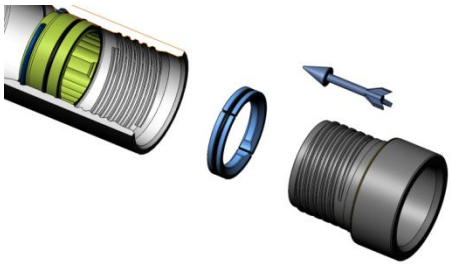
1) **Make sure all parts are clean. Wash and wipe off and/or blow out any dirt. DIRT IN THE HAMMER WILL CAUSE THE PISTON TO STICK. Apply a light coat of oil to all internal parts.**

2) As determined from the inspection process, start with the chuck end. With the sleeve standing on the backhead end, install the retaining ring if needed. With the ring opening down, push the ring into the first bore in the sleeve. While keeping the ring vertical, use a hammer or rod to tap the ring down to its location. The groove is located 6-1/2" (165mm) in.
   Tap the ring down until its center is just above the proper groove, then roll it over to horizontal and snap the ring into the groove.



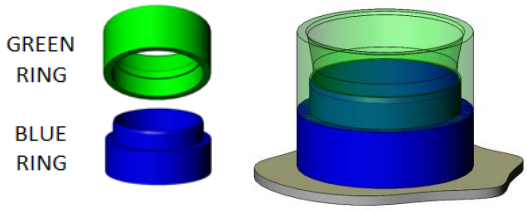
3) Install bearing. First apply some oil or grease to the o-ring to help it slide in. The bearing goes in with the smallest inside diameter toward the sleeve. Push the bearing in by hand as far as possible. Set the piston on top of the bearing. The bearing is a slip fit. The only resistance to it going in is the drag of the o-ring. Using the piston as a bump hammer, tap the bearing in until it comes to a hard stop on the retainer ring. Pull out the piston.

4) Put the o-ring around bit retainer ring halves. Set bit retainer ring in back to bearing. If used, put the breakout washer on the chuck and thread in the chuck. The chuck should seat up on the sleeve. If there is a gap, parts are out of place. Find the cause of the gap and correct it.

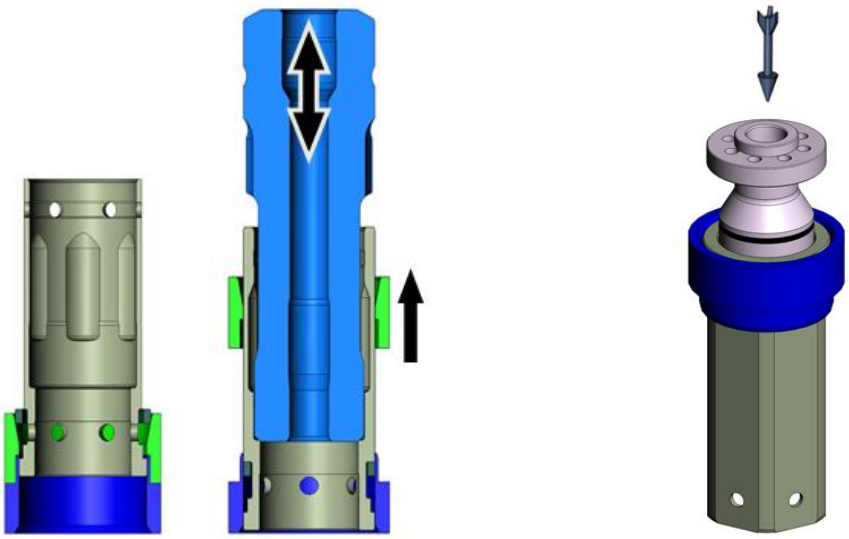


The bottom end is complete.

5) Prepare the cylinder and air distributor next. You will need the set of cylinder install rings. If you don't already have it, contact your Rock Hog rep. There is NO CHARGE for the rings. Stack them on a solid surface as shown here. The rings will be called out as blue and green.

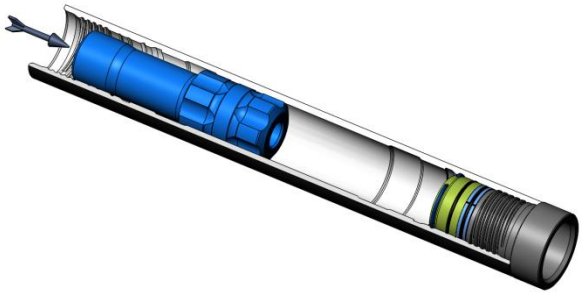


Set the cylinder into the ring stack, then set the piston down into the cylinder. Using the piston as a bump hammer, drive the cylinder into the ring stack until the cylinder hits the surface (*a few high-force blows with the piston work best*). Now pull the piston out of and slide the green ring off of the cylinder. The blue ring will stay on the cylinder keeping the cylinder retainer ring collapsed in the cylinder groove.



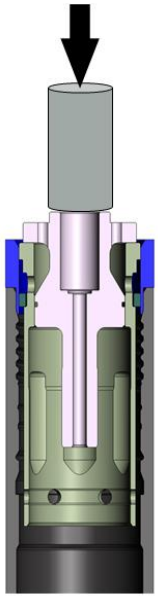
Stand the cylinder with the blue ring at top. Apply oil to the air distributor o-ring. Set the air distributor into the cylinder. Tap the air distributor in until it seats on the cylinder.

6) Apply film of oil to piston. Lay the sleeve horizontal and push piston, large end first, into the backhead end of the sleeve. The piston will hang up some as it passes the grooves but should then slide free to the bearing. If the piston does not slide free between the grooves, remove it and determine what is holding it up.

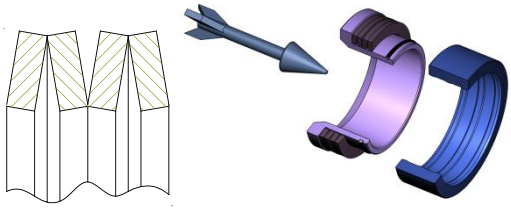


7) Install the cylinder/air distributor next: stand the hammer, chuck down, on a solid surface. Set the cylinder into the sleeve. Push/tap it in until the blue ring seats on the sleeve. Place a piece of soft steel, aluminum, or wood on top of the air distributor (*Rock Hog uses a piece of aluminum 2.5" round X 6" long*). With a sledge hammer, drive the cylinder/air distributor into the sleeve.

The ring will only seat into the correct location so drive the cylinder in until it comes to a hard stop. The top of the air dist will be below the sleeve 5.64" (143mm). Remove the blue ring and driver from the sleeve.

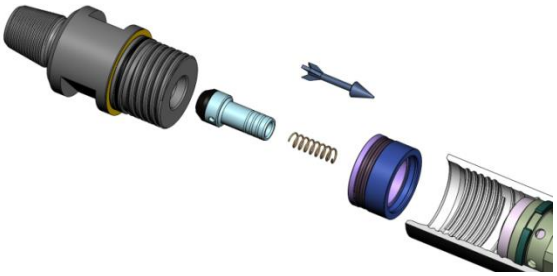


8) Put the spring pack together. The disc springs must be stacked as shown here. Grease the springs. Slide the springs over the guide, put the o-ring in the groove, tap the guide into either side of the spacer.



Set disc spring pack on top of the air distributor. **THE SPACER MUST BE TOWARD THE AIR DIST TO PREVENT BINDING OF THE DISC SPRINGS.**

9) Set the check valve spring then the check valve into the air distributor center hole. Push check valve all the way down, the spring should push it back. **The valve must move freely**.

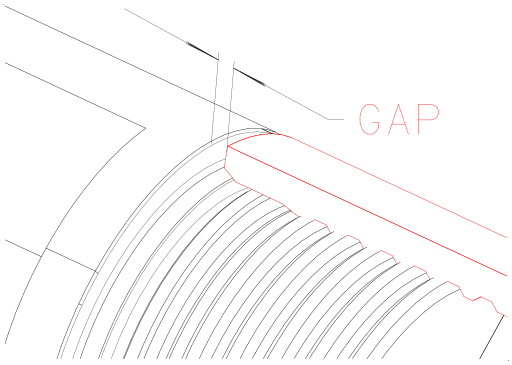


10) Check the backhead compression gap. This gap is critical for keeping the internal parts tight. With the o-ring and breakout washer off of the backhead, thread the backhead into the sleeve until it is **hand-tight**. Measure the gap between the backhead shoulder & the sleeve face. If it is greater than .24" (6.0mm), a part is out of position. If it is less than .08" (2.0 mm), perform one of the following:

    (a) Purchase and install Rock Hog part #943028 between the spring pack and air distributor.
    (b) Obtain and install a steel washer (4.65 OD x 3.80

    ID x .090 THK) between the spring pack and air distributor.

    If the gap is less than .08 and a make-up washer is already in the hammer, replace the disc springs. Then check the condition of the cylinder retaining ring and the shoulders the ring sets on. Replace any worn parts. Assemble the hammer without the make-up washer, and check the gap. If the gap is still less than .08, put (1) new make-up washer back in.



11) Once the gap is correct, remove the backhead, put the breakout washer on if used and put the o-ring on. Apply thick coating of copper coat grease to the backhead wear sleeve threads. Turn the backhead into the sleeve until hand tight. If available, put a thread protector cap on the drill pipe thread.

Assembly is complete.

Next Mailer:

- We'll be focusing on hammer maintenance and service schedules, inspection, assembly and disassembly.