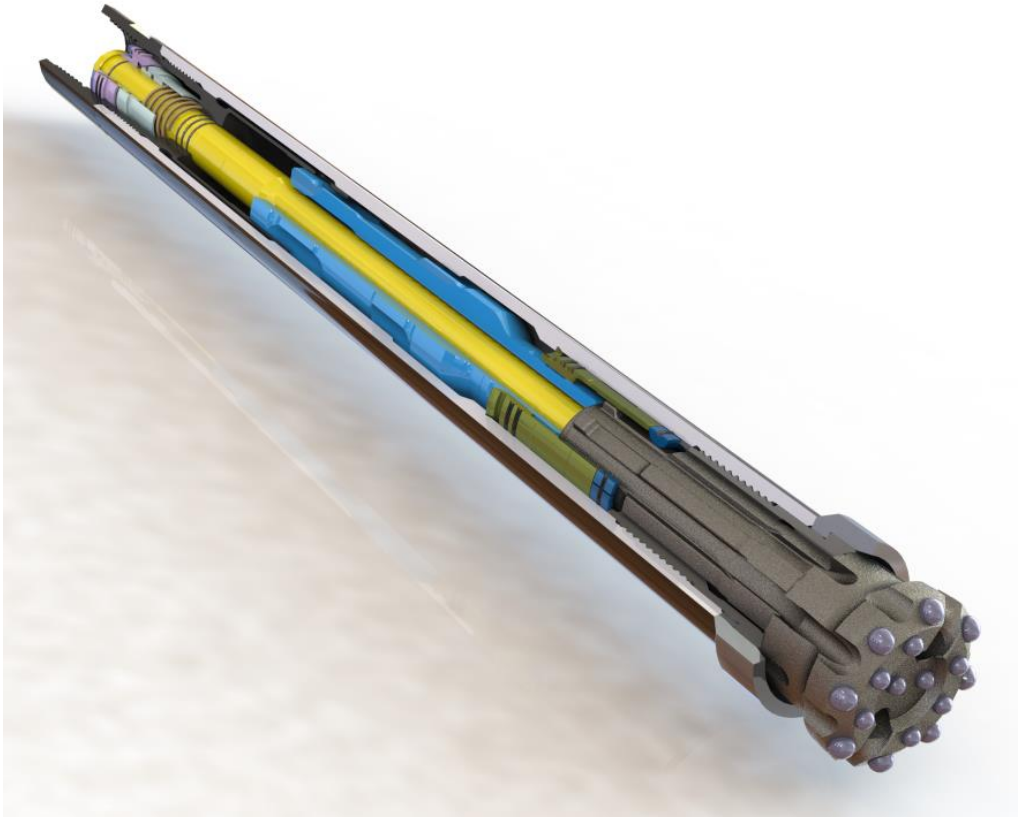
Rock Hog® Drilling Products

RH40RC
DTH RECIRCULATION HAMMER

OPERATION & MAINTENANCE MANUAL

MANUAL No HW-49051



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Section 1. General Information

1.1 Description

The RH40RC hammer is a valveless, pneumatic percussion, reverse circulation hammer for drilling in all rock formations. It is designed for exploration applications that utilize double-wall pipe to collect the ejected sample, known as RC drilling. The hammer incorporates one moving part, the piston, making the hammer very reliable. The sample tube is a one-piece tube that can be pulled out without having to break the hammer. All external parts are hardened to resist wear while all critical internal parts are also hardened for maximum service life. The simple design also makes the hammer easy to maintain and service.

1.2 SPECIFICATIONS

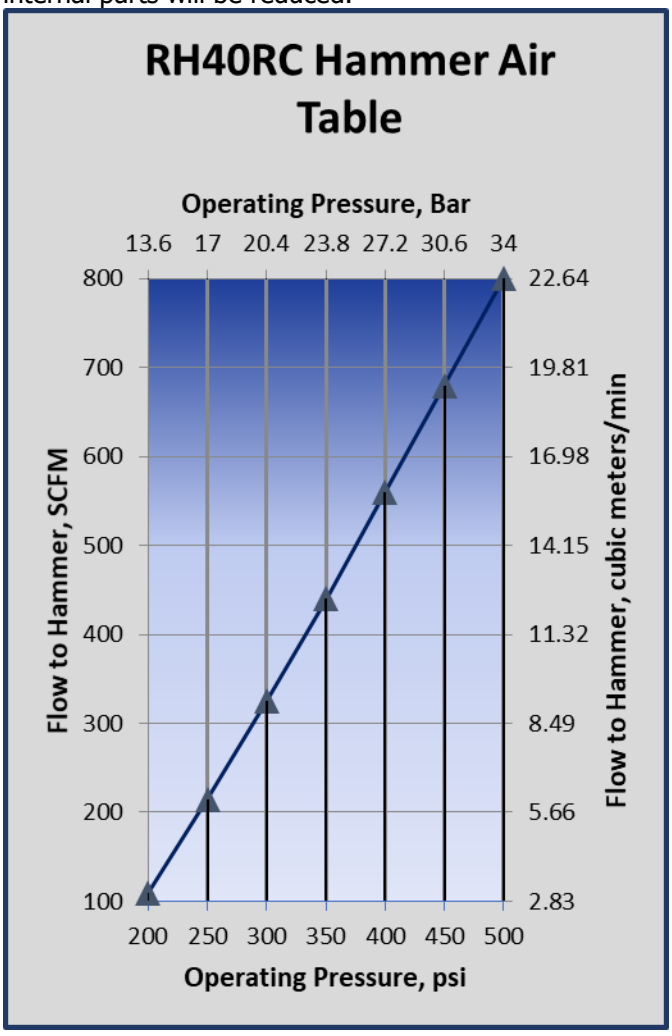
	English	Metric
Outside Dia	3.75 in	92.3 mm
Overall Length Without Bit	40.3 in	1024 mm
Total Weight	80 lbs	36.4 kg
Bore Size	2.95 in	74.9 mm
Piston Weight	14.8 lbs	6.7 kg
Drillpipe Connect	3-1/4 Matrix Box	
Wrench Flats	3.50 in	88.9 mm
Hole Size Range	4 in to 4-1/2 in 101 mm to 114 mm	
Bit Shank Required	AD620	
Minimum Air Volume Required	250 cfm	7 cmm
Recommended Maximum Operating Pressure	350 psi	23.8 bar

1.3 Air Supply

A minimum of 250 cfm should be supplied to the hammer. The hammer will function on lower supplies but the penetration rate will be very slow. Keep in mind that even though the hammer will run on these low air volumes, the RC process may not. Make sure the air supply is sufficient for collecting the cuttings.

For the fastest possible penetration, the hammer should be operated at the highest obtainable pressure for the given air supply. A maximum pressure of 350 psi is recommended. Operating at pressures over 350 psi will increase penetration rates but shorten the service life of internal hammer parts and the bits.

The following chart shows the hammers operating pressure for a given air volume supply based on operation at sea level. Again, the hammer will operate at pressures over 350psi but the service life of the internal parts will be reduced.



1.4 Unpacking a New Hammer

First make note of the hammer Part Number & Serial Number found on the ID label outside on the hammer shipping tube and also on the ID label on the wearsleeve of the hammer. Your Rock Hog representative will need these numbers if you have questions on the hammer. The 12-digit hammer serial number is the backhead & piston numbers put together.

Section 2. Hammer Operation

2.1 Lubrication of Internal Parts

The hammer must have a constant and adequate supply of oil to prevent part wear, corrosion, and failure. Rock Hog recommends Exxon AROX EP series, Chevron VISTAC series or an equivalent grade. Contact your local lubricant representative for the proper grade to use for your drilling environment and temperatures.

Make sure the oil injector is filled and working properly. Always verify that there is oil coming through the drill string, **DO NOT RUN THE HAMMER WITHOUT CONSTANT OIL INJECTION!**

Set the system to inject 1 pint per hour for every 300 cfm of air supply. Example, if the supply is 950 cfm, inject 950/300 or 3.2 pints per hour.

Oil Properties			
Exxon APOX Grade	**EP 46**	**EP 150**	**EP 320**
Chevron VISTAC Grade	**ISO46**	**ISO 150**	**ISO 320**
When to use	winter	summer	summer, production drilling
ISO viscosity grade	46	150	320
SAE viscosity grade	20W-20	30	50
Viscosity			
cSt @ 40°C, ASTM D 445	44	144	310
cSt @ 100°C	6	14	22
SUS @ 100°F, ASTM D 2161	228	755	1660
SUS @ 210°F	48	75	112
Flash Point			
°C	210	220	220
°F	410	450	450

2.2 Lubrication of Threaded Connections

All threaded connections must be coated with a no-gall grease. Both the backhead and chuck thread in the wear sleeve must be coated. The hammer is shipped with grease on both these connections. All drill pipe connections must also be coated. **When applying grease, be careful not to put grease where it will enter the air stream. The grease will not blow through the hammer but stick to the internal parts. Excessive grease in the hammer will close the airways and stop the hammer.**

Use a high performance copper based grease. Rock Hog recommends its own Rock Hog Thread Grease. Ask your Rock Hog representative for part number 350010.

2.3 Hole Cleaning

The up-center-tube velocity will always be more than sufficient even with a small air supply. Just be aware that if the shroud wears and develops too much leakage past it, the sample size will become smaller due to air being lost around the shroud and the tube may begin to clog.

2.4 Setting the Choke

This hammer does not have a choke incorporated into the hammer. If excess air needs bled off use a venturi sub in the drill string. Your local pipe supplier should be able to assist with this.

2.5 Effect of Elevation

Elevation above sea level affects the compressor output. As elevation increases, the compressor's volume output decreases. Use the table below to determine volume loss.

Elevation Correction Factor	
Actual Compressor Output = Rated Output x ECF	
Elevation in Feet	**ECF**
4000	0.86
5000	0.82
6000	0.79
7000	0.76
8000	0.73
9000	0.70
10000	0.68
11000	0.65
12000	0.63
13000	0.61
14000	0.59
15000	0.57

2.6 Water Injection

Injecting water into the air supply is a common practice to keep down dust and to improve hole cleaning in soft formations. **ALWAYS USE A CLEAN SUPPLY OF WATER.**

Water injection will increase the hammer operating pressure and reduce the service life of the internal parts. Therefore, use just enough water for the drilling conditions present.

When drilling is complete, always shut off the water and blow air and oil through the drill string to remove the water and coat internal surfaces with oil. This will help prevent surface corrosion of the steel.

2.7 Drilling Under Water

The hammer is equipped with a check valve that closes when the air supply is shut off. This maintains air pressure inside the hammer and prevents water, cuttings, and mud from coming up into the hammer.

Drilling under water increases the backpressure. The higher the head of water the greater the backpressure, the slower the hammer will penetrate. A point can be reached where the up-hole velocity is insufficient to overcome the water head and the piston will stop.

2.8 Drill Pipe

Drill pipe must be kept clean and straight. Dirt and rust blown out of the drill pipe and into the hammer will damage the hammer's internal parts. Always cover the hole in the drill pipe when doing a pipe change. Always blow out the pipe before connecting it to the drill string. Discard any bent or damaged pipe .

2.9 Connect the Hammer

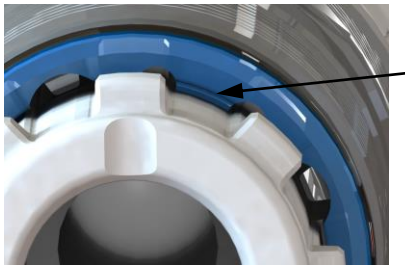
Section 4b shows the types of connections available. First make sure any o-rings needed to seal the sample tube to the drill pipe tube are present and in good condition. Next, make sure the coupler tube will fit properly to the drill pipe tube. Some coupler tubes must go in the correct direction. If a certain end must go toward the hammer there will be the words "HAMMER" and "PIPE" stamped on the coupler tube.

Hoist the hammer into the rig table. If the hammer is new, slowly pour about a ½ pint of rock drill oil down around the center tube in the backhead. Connect to the drill string. If the hammer is new, see section 2.10 on how to install the bit. Once the bit is in the hammer, check to make sure the backhead and chuck are tight. If needed tighten both the chuck and backhead before starting the hammer. When tight, there should be no gap between the shroud & sleeve shoulders and between the backhead & sleeve shoulders. ALWAYS USE A WRAP-AROUND WRENCH TO GRIP THE WEAR SLEEVE.

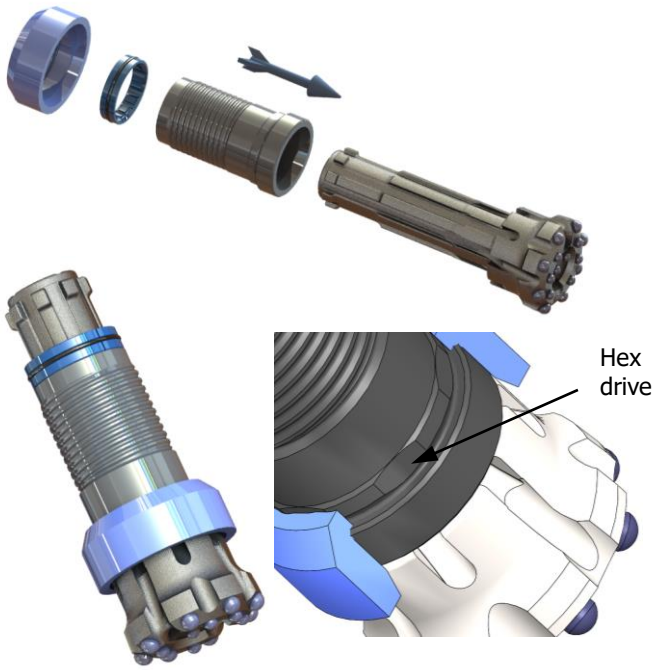
Once the hammer is connected, check the travel of the bit. In the drilling position, the bit should shoulder on the chuck and when the hammer is pulled up, the bit should drop out 1-1/4" (32mm).

2.10 Installing the Bit

The best place to install the bit is when the hammer is mounted on the rig. Turn the chuck out. The bit retainer ring will be setting in the top of the chuck. Set the ring to the side. Apply a coating of no-gall grease to the bit splines. Set the chuck down over the bit shank. Pull the two halves open, put the ring down over the bit and set on top of the chuck. Either side of the ring can go toward the bit. Rotate the ring so that the (2) inside tangs on the ring set into a spline gap on the bit.



Set the shroud down over the bit/chuck. Turn the shroud until its hex drive drops onto and locks with the chuck's hex drive. Coat the threads with no-gall grease. Thread the chuck back into the wear sleeve. The shroud will seat against the sleeve. There should be no gap.



Note that the shroud diameter controls the sample size. The smaller the shroud, the more material will be blown back up the hole instead of into the center tube.

However, if the shroud is too big it will bind in the hole. Match the shroud outside diameter to the bit diameter to have the correct shroud-to-hole clearance for the formation being drilled.

2.11 Drilling

With the hammer/bit up off the bottom of the hole, supply air to the hammer. The air will blow through the hammer but the piston will not cycle. This allows for continuous blowing to clean out the hole when needed.

Start rotation of the drill string and lower the hammer/bit onto the bottom of the hole. As the bit pushes into the hammer, the piston will begin to cycle and the pressure will build to its normal operating level.

Once a consistent formation is being drilled, set the rotation speed and hold down pressure. As a starting point, use a rotation speed in revolutions per minute (RPM) of:

RPM = 154 / bit size (in inches)

Set the hold down weight on the bit. As a starting point, the weight should be 1500 lb. to 2500 lb. Keep in mind that as the hole goes deeper, the weight on the bit increases. Eventually hold back is needed to keep excessive pipe weight off the bit.

Only driller experience will determine what RPM and bit weight combination work best in a given formation. In general, too slow a RPM results in slow penetration and shortened bit life but too fast a RPM will also shorten bit life. Excessive weight on the bit will cause bit button failure. Insufficient weight causes the piston blow energy to be dissipated into the bit and piston, which will lead to steel failure of these parts.

Make sure to clear the entire center pipe of cuttings before doing a pipe change.

2.12 The Drill Bit & Shroud

The bits are available in sizes of 4", 4-1/8", 4-1/4", 4-3/8", 4-1/2". The shrouds are available in sizes of 1/16" under the bits.

The bit is what carries the hammer piston energy to the rock therefore the condition the bit cutting face should be checked after the completion of each hole drilled.

As the bit accumulates drill time, the bit's buttons and steel and the shroud will start to wear away. The wear pattern and rate of wear will vary greatly depending on the formation being drilled and drill settings.

In soft formations such as limestone where the bit wears slowly, watch the buttons for "snakeskin" on the surface. These surface cracks must be ground off to prevent button failure.

In hard formations where the bit wears quickly, watch the size of the flats on the buttons. The buttons should be sharpened when the width of the flat is no wider than ½ the diameter to help prevent bit failure.

Some formations wash the steel away quickly. In this case the buttons start to protrude excessively. The buttons need to be ground down to prevent them from breaking off.

Dull buttons are the single biggest contributor to slowed penetration and excessive stress to the bit and hammer.

If a bit must be changed before a hole is complete, make sure the gage diameter of the bit and shroud used to complete the hole is no larger than the bit and shroud just removed. Using a larger bit and shroud will result in probable lost of the gage buttons or binding before the bit reaches the bottom of the hole. For this reason, always keep 1 or 2 worn bits and shrouds that are in good condition on the drill rig.

When installing a new bit make sure the shroud used has the correct outer diameter, normally about .06" (1.5mm) smaller than the bit. Rock Hog recommends always putting a new shroud on a new bit.

2.13 Breaking Threads Loose

When breaking the chuck thread loose to change bits, or the backhead loose to do hammer maintenance, follow these guidelines:

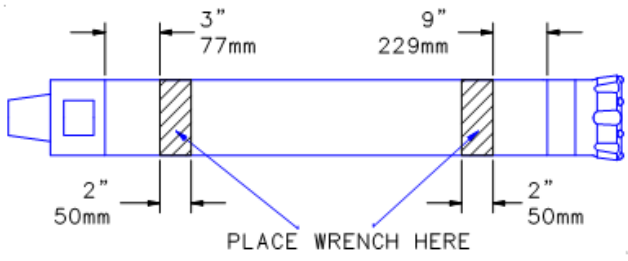
ALWAYS USE A WRAP-AROUND WRENCH this is to prevent pinching the sleeve out-of-round

KEEP SHARP JAWS IN THE WRENCH the wear sleeve is very hard to give a long service life so only quality hardened or diamond-tipped jaws in good condition will grip the sleeve

DO NOT HAMMER ON THE SLEEVE applying hammer blows to the sleeve will crack the surface and voids any warranty on the sleeve.

DO NOT WELD ON THE SLEEVE welding on the hardened sleeve will crack the sleeve and voids any warranty on the sleeve.

PLACE THE WRENCH AS SHOWN BELOW



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Caution: If the drill pipe is connected direct to the hammer, no top sub used, watch the hammer's center tube when breaking and removing the drill pipe from the hammer. The coupler tube and center tube may stick to the drill pipe tube and come out of the hammer when the pipe is pulled off.

2.14 Monitoring

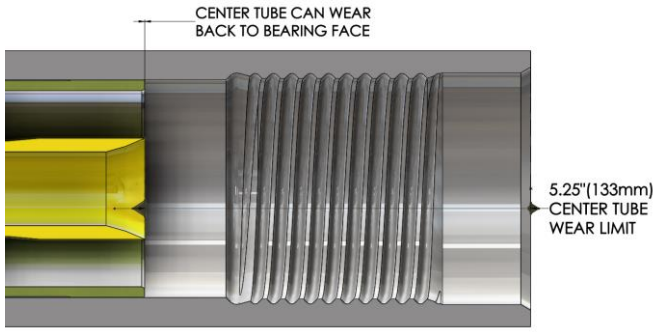
As the hammer accumulates drill time, these areas need to be monitored to determine when to service the hammer:

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.

Check the bit and shroud after every hole. Watch that the bit gage does not wear below the shroud diameter. If this occurs the shroud will bind in the hole. Shrouds should not be used once the outside has worn down to 3.8" (96mm). Watch that the shroud does not wear to far below the size of the bit. This will begin to reduce the quality of the sample and possibly cause clogging in the center pipe.

Check the outside of the wear sleeve. If any location is worn down to 3.45" (87.6mm) or smaller, replace the sleeve.

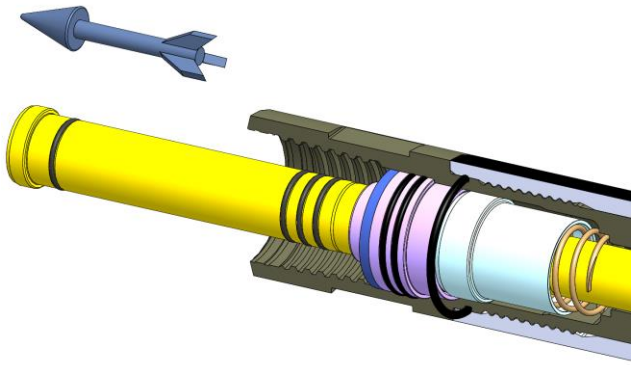
Center exhaust tube: check the center exhaust tube end wear every time the bit is changed and more frequently if needed. The bit end of the tube will wear back. The tube can wear back 0.8" (20mm) before replacement is needed. With the chuck removed from the hammer, measure from the wear sleeve face to the end of the tube. Replace the tube if the end of the tube measures more than 5.25" (133mm) back from the wear sleeve. A second way to check the tube wear is by comparing the end of the tube to the end face of the bearing. If the tube end face is past the bearing end face, replace the tube.



Note: if the tube wear is being checked this way when the hammer is not attached to the drill pipe, make sure the tube is seated down against the tube bushing in the backhead before checking.

If the tube needs replaced, remove as follows: Break the drill pipe or top sub loose from the backhead per section 2.13 and remove from hammer. Remove the center tube by first using a rod and pushing on the tube from the bit end. **Do not** beat or hammer on the bottom of the tube to remove it, push only. The worn end is sharp and thin. Beating on the end will distort the end and when the tube is pulled out it could cut o-ring seals and/or also get stuck in other parts.

Once the tube is protruding from the top of the hammer, pull from the top.



If the backhead is being removed from the hammer, an optional way to remove the center tube is to leave the tube in and thread out the backhead. The tube will come out with the backhead. Then the tube can easily be pushed out of the backhead.

Note: When breaking and removing the drill pipe from the hammer, the coupler tube that connects to the drill pipe may stick to the pipe and come out of the hammer when the pipe is pulled off.

Note: One or more other parts, the screen, tube bushing, check valve, and check valve spring, may also come out with the center tube.

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.**

Shroud: check the wear on the shroud outside diameter regularly. If worn to 3.8" (96mm) or smaller, replace the shroud.

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.

2.15 Storage

Overnight

When drilling is complete for the day, shut off water and any other injections except the oil and allow air and oil only to blow through the hammer for a minute or two. This will blow out most of the water and other injections and coat all the internal parts with oil. **If the hammer is in a wet hole, bring the hammer above the water level before blowing it out.**

Short term

If the hammer will be off the rig for no more than 3 weeks, blow air and oil only through the hammer for a minute or two before taking it off the rig. This will blow out most of the water and other injections and coat all the internal parts with oil. Store the hammer in a dry area with the ends covered. The storage area should have a steady temperature to prevent surface condensation during temperature swings.

Long term

A used hammer going into storage for a month or more should be torn down with all parts cleaned, dried, oiled and stored assembled or disassembled in a dry, steady temperature area. This is to prevent surface corrosion. ***Surface corrosion is a main cause of part failure in hammers.***

Section 3. Maintenance

3.1 Schedule

If the need for service defined in Monitoring, section 2.14, 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, tear down and 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.

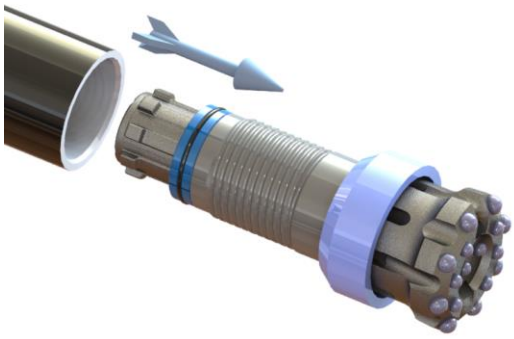
3.2 Disassembly

All parts are a sliding or clearance fit inside the hammer but may be tight inside the hammer depending on the condition of the parts and the time period since the hammer was last serviced. There are a few steps that require a bar be used to push/drive on parts. If available always use a non-hardened steel bar. Wood can be used but wood can splinter and chip leaving contaminants in the hammer.

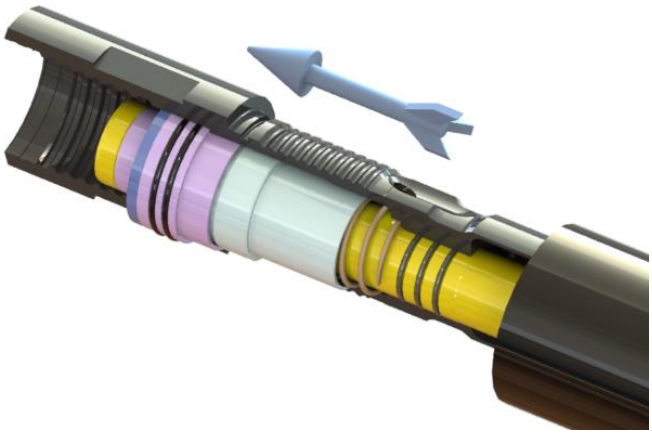
1. Break both the backhead and chuck threads loose. See section 2.13

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

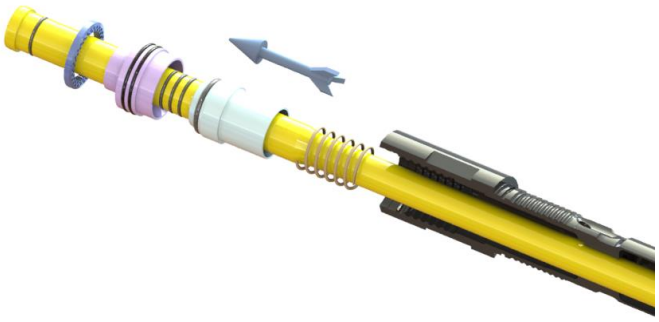
3. Turn out the bit, shroud, and chuck.



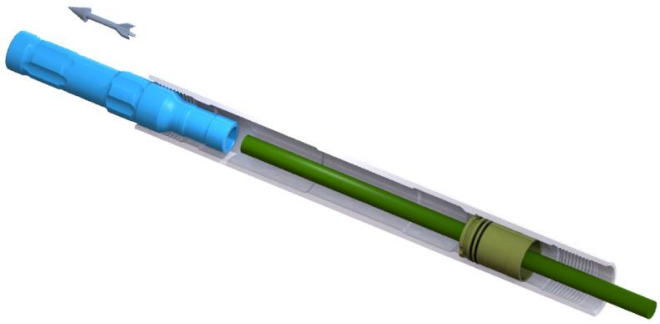
4. Turn out the backhead. The center tube and other parts will stay inside the backhead.



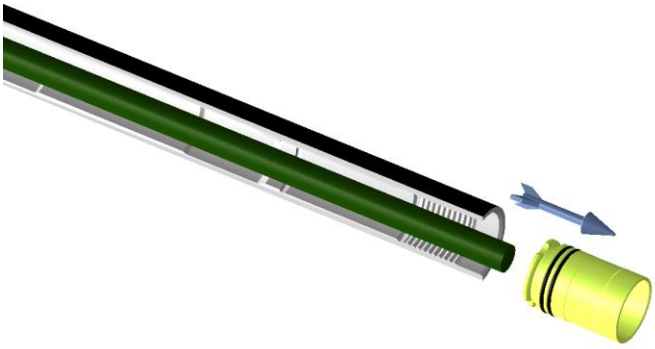
6. Push the center tube out. The screen, tube bushing, check valve, and check valve spring may come out on the tube. If not, stand the backhead on a solid surface and bump it on the surface to force the parts to drop down out of the backhead.



7. Remove the piston. Turn the sleeve up on the backhead end. The piston should slide out. If the piston is stuck, use a steel bar and bump on the piston. Moderate force and hammering may be needed to push the piston out depending on the condition of the inside of the hammer. Extreme loads may be needed if the parts are rusted or if the hammer is full of debris.



8. Remove the bearing. Insert a rod from the backhead end of the sleeve and bump on the bearing. Push the bearing out of the sleeve.



9. Remove the shroud, bit retainer ring, and chuck from the bit. With the bit standing on the head, pull the retainer ring open, lift the ring off of the bit. Lift the chuck/shroud off the bit. Lift the shroud off the chuck. If the shroud is stuck on the chuck, set the chuck/shroud on a solid surface and lightly hammer on top of the chuck to make the chuck drop down out of the shroud.

Disassembly is complete.

3.3 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, grit, mud
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. Removed 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.

The clearance checks given below are what Rock Hog considers as the limit of wear for those parts. Past this point, the hammer performance will no longer be satisfactory. The clearance may be checked using feeler gages or measuring both parts with micrometers. **These clearances may or may not be acceptable for your given application. With so many variables (air supply, rig settings, rock formation, etc) affecting hammer performance, only the operator can say when hammer performance has dropped below an acceptable level**. Again, keeping a log of when & what service was performed will help fine-tune the service schedule to fit your operation.

Backhead/Cylinder: the top half is the backhead, the bottom half is the cylinder

Backhead checks:

Be sure to remove all the old grease from both the drill pipe and hammer 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 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.

Cylinder checks:

Check the bottom inside diameter where the piston runs for galling, rust, or heavy wear marks. Polish out any minor damage found on the surfaces. Check for cracks and out-of-round conditions.

Check the (6) angled holes. Remove for any foreign matter.

Check the clearance of the bore with the top guide diameter of the piston. If it exceeds .010" (.25mm), replace the cylinder. Check the new cylinder to the used piston. If the clearance exceeds .008" (.20mm), replace the piston also.

Screen: check all the holes in the screen. Remove any foreign matter.

Bushing, Center Tube: check all the holes. Remove any foreign matter. Check the condition of the o-rings. If cracked, cut, or brittle, replace them.

Check Valve: check the condition of the inside seal and outside o-ring seal. If the seals are cracked, cut, or brittle, replace them. Make sure the inside diameter shows no galling or damage. **With the inside seal removed**, test the sliding fit of the check valve over the center tube. It must slide freely.

Check Valve Spring: inspect the spring for wear and cracks. Make sure it still has memory and returns to its original length after being compressed.

Piston: check the (3) 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.

Check the clearance of the piston's big diameter with the sleeve bore. If it exceeds .010" (.25mm), replace the wear sleeve. Check the old piston to the new sleeve bore. If the clearance exceeds .008" (.20mm), 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 of the wear sleeve for wear and cracks. If any location on the outside is worn down to 3.45" (87.6mm) or less, replace the wear sleeve. Check the bore where the piston runs and the threads for galling. Polish out any surface damage.

Look for any indication the sleeve may have been crushed out-of-round during service or during the breaking of the thread joints.

Bearing: Check the inside diameter where the piston runs for galling, rust, or heavy wear marks. Polish out any minor damage found on the surfaces. Check for cracks and out-of-round conditions.

Check the condition of the o-rings. If cracked, cut, or brittle, replace them.

Check the clearance of the bore with the bottom guide diameter of the piston. If it exceeds .010" (.25mm), replace the bearing. Check the new bearing to the used piston. If the clearance exceeds .008" (.20mm), replace the piston also.

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 surfaces of the driving hex that the shroud locks to. If badly worn, replace the chuck.

Shroud: look for cracks all over. Replace if any cracks are visible.

Any shroud can be used until the outside is worn down to 3.8" (96.5mm). As long as the driving hex is in good condition, the shroud can be used provided it matches to the bit size being run.

Be aware that if the outside is rebuilt with weld, the hex drive will become distorted. This may cause the shroud to not fit the chuck.

Center Tube: The bit end of the tube will wear away. If the overall length of the tube measures less than 31-1/8" (790mm), replace the tube.

Check the wear on the tube's center hole. The wear limit on the inside of the tube is 1.21" (30.7mm). Using a 1.2" (30mm) diameter rod, bar, pipe, ball, or other suitable gage, drop the gage into the tube. If the gage passes thru the tube, replace the tube.

Check the condition of the (4) o-rings. If cracked, cut, or brittle, replace them. If still in good condition, they can be used on a new tube.

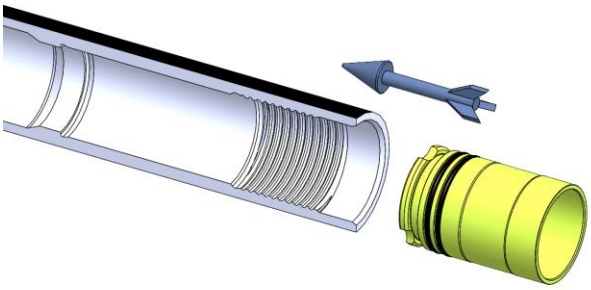
If a used tube will be reinstalled, make sure there are no sharp corners or burrs sticking outward on the bottom edge.

3.4 Assembly

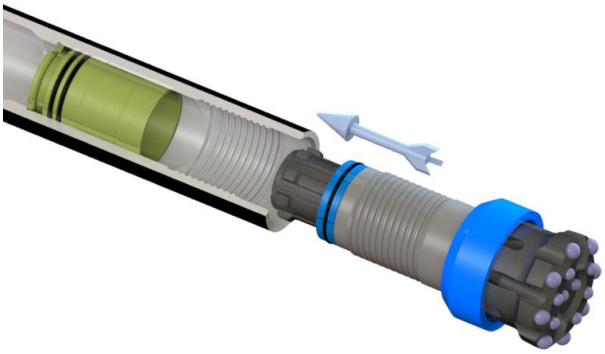
1. **Make sure all parts are clean and rust free. Wash and wipe off and/or blow out any dirt. Apply a light coat of oil to all internal parts.**

2. If a used sleeve is being used, the backhead end and chuck end should have been marked at disassembly. The sleeve is not reversible so parts must be put into the correct end. If the sleeve is new, the chuck end has a shoulder inside at a distance in from the end face of 9-3/4" (248mm).

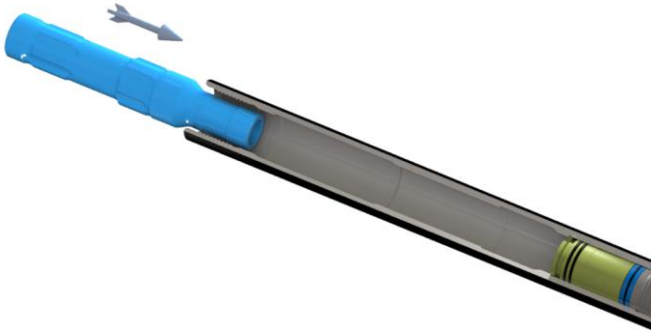
3. Install the bearing in the chuck end of the sleeve. Put an o-ring in the (2) grooves. Put oil or grease on the o-rings to help them slide. The bearing end with the cut-outs and o-rings goes in first. Push it in as far as possible, then use a steel bar to tap in until it seats. When in position the bearing will be 5-1/4" (133mm) from the end of the sleeve.



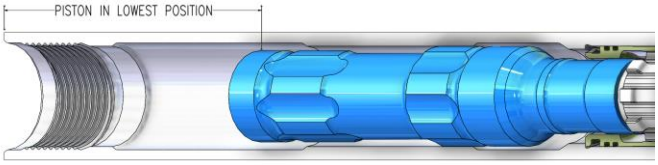
4. Install the chuck and bit. If a bit is being installed at this time see section 2.10. If a bit is not being installed, put the o-ring around the retainer ring halves. Set the bit retainer ring in against the bearing. The chuck can be turned into sleeve with or without a shroud.



5. Install the piston. Stand the hammer on the bit, chuck, or shroud. Make sure the piston is well oiled. Drop the piston, small end first, into the backhead end of the sleeve. Note that the piston may get stuck on grooves in the sleeve bore as it goes in. It this happens shake the hammer from side to side to free the piston.

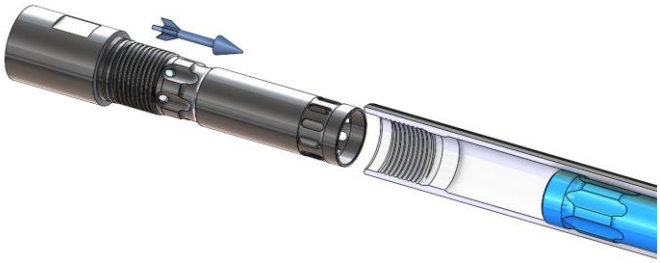


When down all the way, the top of the piston will be 10-5/8"(270mm) from the top of the sleeve if a bit is installed and seated against the chuck. If the hammer is standing the chuck or shroud, the top of the piston will be 12"(305mm) from the top of the sleeve.

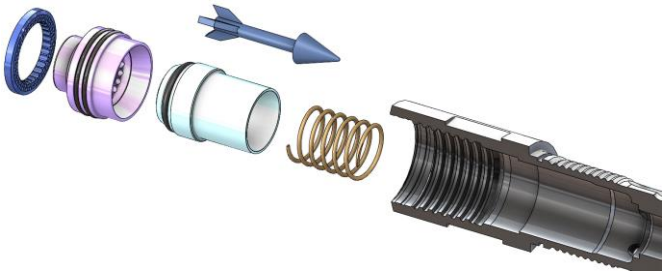


If the piston does not drop in all the way, remove the piston and determine what is preventing the piston to drop in.

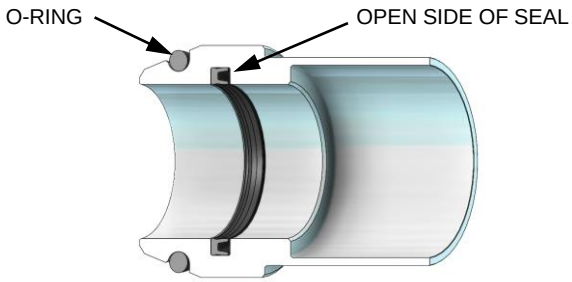
6. Install the backhead/cylinder. Put the o-ring in the groove. Apply no-gall grease to the thread and o-ring. Turn backhead/cylinder in until it seats on the sleeve.



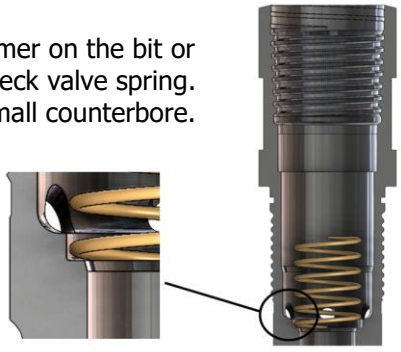
7. Install the top end parts.



First put the seals on the check valve body, an o-ring in the outside groove and the lip seal in the inside groove. Make sure the lip seal is installed in the correct direction with the open side of the seal away from the o-ring.

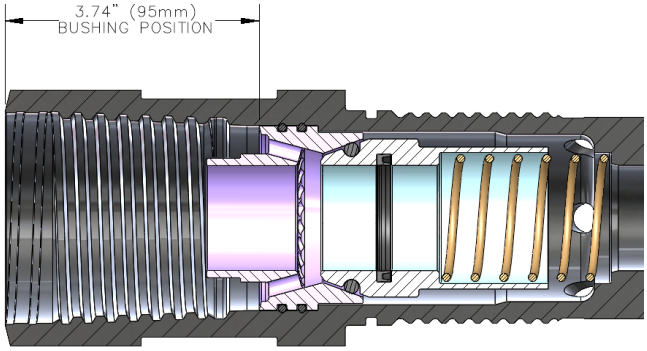


Now stand the hammer on the bit or chuck. Drop in the check valve spring. It sets down in the small counterbore.

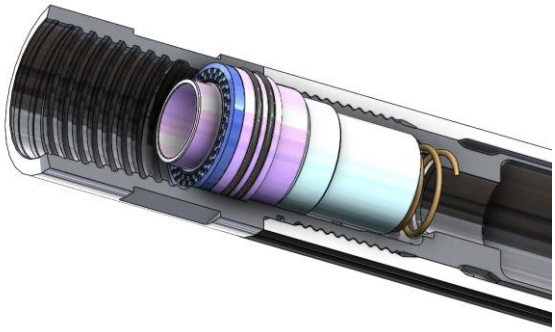


Put a coating of oil or grease on the inside check valve seal. Set the check valve down on the spring.

Put the o-rings on the bushing and coat with oil or grease. Set the bushing into the backhead. Tap down into position. The bushing shoulder should be at 3.74" (95mm) from the top of the backhead.



Set the screen on top of the bushing.



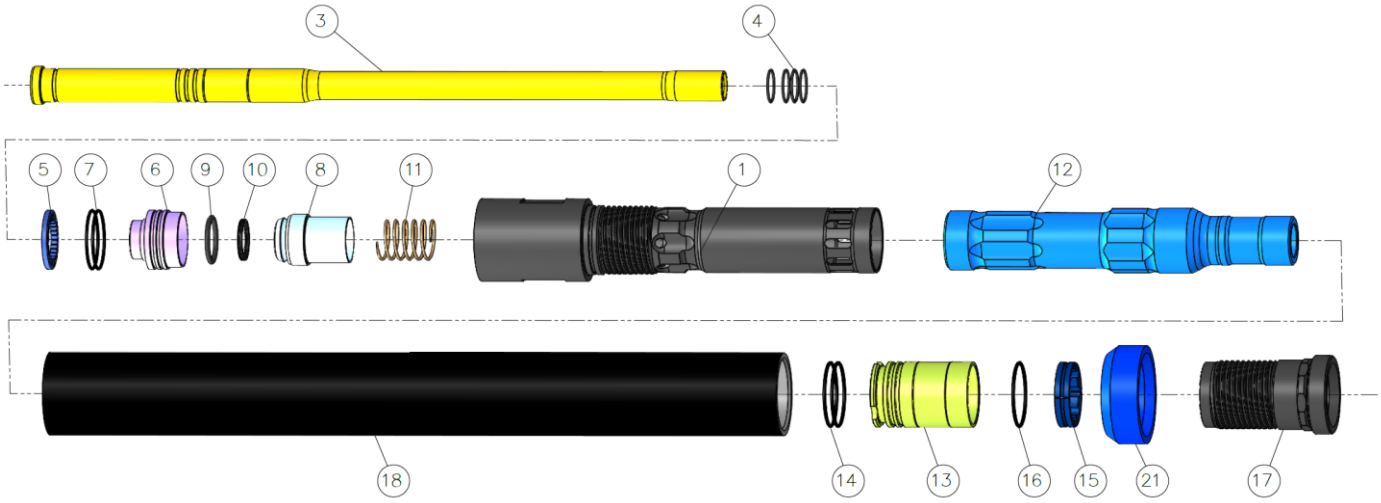
9. Install the center tube. Put an o-ring in each of the (4) grooves. Apply a coating of oil or grease on the o-rings. Slowly push tube into the hammer. There will be resistance as the tube's o-rings pass thru the parts. Push the tube in until it seats on the top of the bushing.

10. The parts in the top of the hammer are retained by the drill pipe or a top sub being connected. If a sub is not being attached to the hammer at this time, secure a cover or plug to the top of the backhead to prevent any parts being lost in transport.

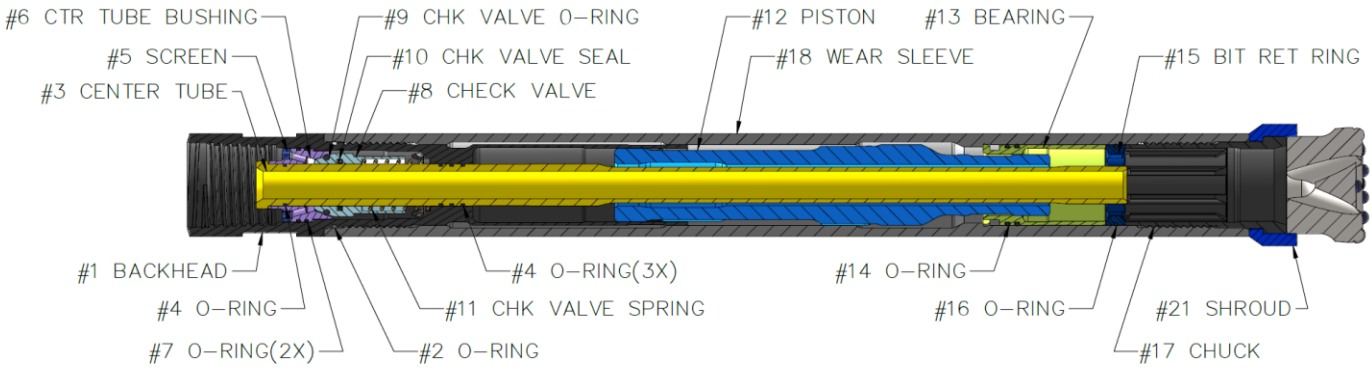
Assembly is complete.

Section 4a. Parts Breakdown

Exploded View of Hammer



Assembled View of Hammer



Parts List

Additions parts required that are sold separate from the hammer are shown on the next page.

Shown at the right side of the chart is the quantity of spare parts that should be kept on hand. Level 1 is for local drilling, Level 3 is for very remote drilling.

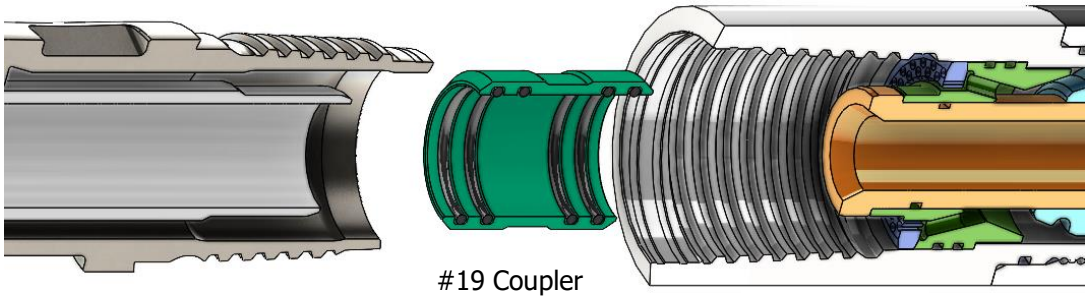
ITEM No	PART No	QTY REQD	PART NAME	WEIGHT LBS	WEIGHT KGS	SPARE PARTS ON HAND LEVEL 1	LEVEL 2	LEVEL 3
1	06240RC14	1	BACKHEAD/CYLINDER with 3.5 WRENCH FLATS and 3-1/4 MATRIX BOX CONNECTION	12.48	5.66	-	-	-
2	560232	1	O-RING, BACKHEAD	0.01	0.00	-	-	-
3	89140RC14	1	CENTER TUBE	6.74	3.06	-	-	-
4	560125	4	O-RING, CENTER TUBE	0.01	0.00	-	-	-
5	743002	1	SCREEN	0.23	0.10	-	-	-
6	095013	1	CENTER TUBE BUSHING	1.03	0.47	-	-	-
7	560143	2	O-RING, CTR TUBE BUSHING	0.01	0.00	-	-	-
8	92240RC	1	CHECK VALVE	1.02	0.46	-	-	-
9	560327	1	O-RING, CHECK VALVE	0.01	0.00	-	-	-
10	US19151901	1	SEAL, CHECK VALVE	0.01	0.00	-	-	-
11	798018	1	SPRING, CHECK VALVE	0.1	0.05	-	-	-
12	60540RC	1	PISTON	14.76	6.69	-	-	-
13	06540RC	1	BEARING	1.91	0.87	-	-	-
14	560231	2	O-RING, BEARING	0.01	0.00	-	-	-
15	698079	1	BIT RETAINING RING	0.35	0.16	-	-	-
16	560143	1	O-RING, BIT RETAINING RING	0.01	0.00	-	-	-
17	11240RC	1	CHUCK	3.7	1.678	-	-	-
18	780RH5RC	1	WEAR SLEEVE	36.21	16.42	-	-	-

Additions parts required, sold separate from the hammer, are shown on the next page.

Section 4b. Additional Parts Sold Separate from Hammer

For direct hookup;

To connect 3-1/4 Matrix Pin-Down RC Type-i Pipe direct to the Hammer use the following coupler. The coupler is reversible. Either end can go into the hammer:



RC Pipe

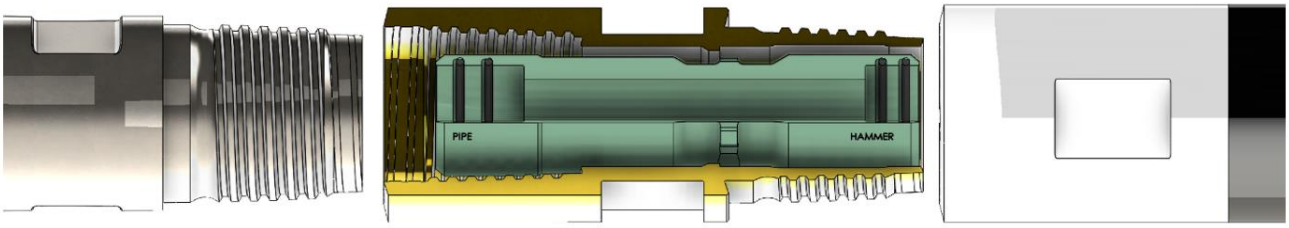
#19 Coupler
#20 Seals

Hammer

For use of a top sub or top stabilizer sub;

These top subs have 2-3/4" wrench flats, the same as on 3-1/4 RC pipe.
The subs are available as a complete 3-part unit or as individual pieces; outer shell, inner tube, seals.
When installing, put the inner tube into the hammer first making sure the end marked "HAMMER" is toward the hammer, then put the outer shell on. Once the outer shell is threaded into the hammer the inner tube cannot pull out of the hammer.

To connect between 3-1/4 Matrix Pin-Down RC Type-i Pipe to the hammer use the following:



RC Pipe

Top Sub #23 Complete Unit
#20 Seals #24 Outer Shell #25 Inner Tube

Hammer

Bits and Shrouds;

A shroud must be used. The hammer <u>cannot be run without a shroud</u>.
Choose the shroud with the outside diameter that works with the bit and the formation being drilled.

#21 Shroud

Bit Ret Ring

Chuck

#22 Bit

List of Parts Sold Separately

Shown at the right side of the chart is the quantity of spare parts that should be kept on hand. Level 1 is for local

ITEM No	PART No	QTY REQD	PART NAME	WEIGHT LBS	WEIGHT KGS	SPARE PARTS ON HAND LEVEL 1	LEVEL 2	LEVEL 3
19	779011	1	COUPLER	0.6	0.27	-	-	-
20	560224	4	O-RING, COUPLER	0.01	0.00	-	-	-
21		1	SHROUD					
	77240140		3.94 OUTSIDE DIAMETER					
	77240141		4.06 OUTSIDE DIAMETER					
	77240142		4.19 OUTSIDE DIAMETER					
	77240143		4.31 OUTSIDE DIAMETER					
	77240145		4.44 OUTSIDE DIAMETER					
22		1	BIT					
	40R564A62		4"					
	41R564A62		4-1/8"					
	42R564A62		4-1/4"					
	43R564A62		4-3/8"					
	45R564A62		4-1/2"					
23		1	COMPLETE TOP SUB w/ 2.75 FLATS includes items #20, 25, 25	9.85	4.47	-	-	-
	835D37506302		3.75 OUTSIDE DIAMETER (SAME AS HAM'R)					
24		1	SUB SHELL w/ 2.75 FLATS	9.85	4.47	-	-	-
	835D37506301		3.75 OUTSIDE DIAMETER (SAME AS HAM'R)					
25	889059		TUBE, SUB INNER	4.31	1.95	-	-	-
-	350010		ROCK HOG THREAD GREASE	10	4.54			

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Section 5. Trouble Shooting

These are typical problems that can develop after the hammer has been in service:

	Possible Causes
Piston will not cycle	1. Center tube is worn back to far 2. Piston stuck in sleeve due to a. Sleeve was pinched shut with wrench when threads were being loosened/tightened b. Foreign material entered through drill string and jammed piston c. Mud backed up into hammer (drilling under water), inspect the check valve 3. An internal part failed
Slow penetration, pressure ok	1. Dull or broken buttons on bit 2. Shroud is binding in hole 2. Incorrect drill rotation or down pressure for the formation being drilled 3. Harder rock formation than the normal
Low pressure	1. Leak in the air line 2. Leak in the hammer (cracked or broken part) 3. Hole worn thru center tube 4. Compressor output problem
High pressure	1. Air line is partially closed off 2. Foreign material clogging air passages in hammer 3. Bit blow holes are clogged 4. Center return is clogged
Poor cuttings sample	1. Shroud is worn too far under the bit 2. A hole is worn thru the sample tube