



Quantum Leap[®]

Technical Manual

QL60 TD90 OG QLX100 QL120 QL200 QL300



Read this instruction manual before operating this equipment.

Contents

Read this instruction manual before operating this equipment.

Safety	4
Installation and Operation	6
Follow Instructions.....	6
Description	6
DTH Setup	6
Setting up the DTH	6
Valve, choke selection and.....	6
Hydrocyclone® setup.....	6
Bailing velocity requirements	6
Valve selection	6
Choke sizing	6
Hydrocyclone® setup.....	6
Bit installation.....	6
New bit and chuck	6
Makeup torque and backhead closure.....	6
Drill lubrication	8
Lubricators	8
Lubrication check	8
Water Injection.....	8
Drill operation	9
Rotation speed	9
Collaring.....	9
Feed force.....	9
Hole cleaning, flushing, and dust suppression.....	9
Dry drilling	9
Wet drilling.....	9
Wet drilling with Hydrocyclone®	9
Bit changing	11
Removing the drill bit	11
Removing the bit with percussion only	11
Maintenance and repair	12
DTH Service	12
Disassembly	12
Hydrocyclone®	17
Disassembly and service	17
DTH inspection	17
Inspection	17
DTH assembly	21
Assembly.....	21
Exhaust tube	24
Replacement and installation.....	24
Bits	24
Selection.....	24
Service	24
Bit Sharpening.....	24
Troubleshooting	26
Specifications	29
Ordering Instructions	31

WARNING: This manual contains data SPECIFIC to QL Series Downhole Drills.

Introduction

The Quantum Leap® Series



READ THIS MANUAL CAREFULLY to learn how to operate and service your DTH correctly. Failure to do so could result in personal injury or equipment damage. Consult your TerraRoc supplier if you do not understand the instructions in this manual or need additional information.


THIS MANUAL should be considered a permanent part of the DTH, and should remain with the DTH and available for reference at all times.

WARRANTY is provided as part of TerraRoc support program for customers who operate and maintain their equipment as described in this manual.

MEASUREMENTS in this manual are given in both English and metric units, and are used to provide additional worldwide understanding. Metric units are shown between parentheses "()". Use only correct replacement parts and fasteners.

The instructions, illustrations, and specifications in this manual are based on the latest information available at time of publication. Your DTH may have improvements and options not yet contained in this manual.

ABBREVIATIONS used throughout this manual.

acfm	Actual Cubic Feet per Minute
API	American Petroleum Institute
C	Centigrade
dia.	Diameter
deg.	Degree
F	Fahrenheit
ft.	Feet
ft.-lb	Foot Pounds
gpm	Gallons per Minute
in.	Inches
kg	kilogram
l	Liter
lbs.	Pounds
lpm	Liters per Minute
m	Meter
mm	Millimeter
mm Hg	Millimeters of Mercury
m ³ /min	Cubic Meters per Minute
psi	Pounds per Square Inch
psig	Pounds per Square Inch Gauge Pressure
rpm	Revolutions per Minute
scfm	Standard Cubic Feet per Minute
	Safety Alert Symbol

Safety regulations

Be aware of safety information understand signal words

A signal word - DANGER, WARNING, or CAUTION - is used with the safety-alert symbol.

DANGER identifies the most serious hazards.



DANGER

Indicates immediate hazards which will result in serious or fatal injury if the warning is not observed.



WARNING

Warning is used to indicate the presence of a hazard which can cause severe injury or death if the warning is ignored.



CAUTION

Caution is used to indicate the presence of a hazard which will or can cause personal injury, or property damage if the warning is ignored.

Safety

Follow instructions

Carefully read all safety messages in this manual and on your machine's safety labels. Keep safety labels in good condition. Replace all missing or damaged safety labels.

Replacement safety labels can be obtained at no cost from your local TerraRoc dealer or representative or by contacting the factory.

Learn how to operate the DTH and how to use the controls on the machine properly. Do not let anyone operate this DTH without proper instruction.

If you do not understand any part of this manual and need assistance, contact your local TerraRoc dealer.

Keep DTH in good working condition

Keep your DTH in proper working condition.

Unauthorized modifications to the DTH may impair the function and/or safety and effect DTH life.

Make sure all safety devices, including shields are installed and functioning properly.

Visually inspect the DTH daily before using. Do not operate the DTH with loose, worn, or broken parts.

Wear protective clothing

Wear APPROVED safety equipment (safety shoes, safety glasses, hearing protection, hard hat, gloves, respirator, etc.) when operating or maintaining the DTH. Wear close fitting clothing and confine long hair.

Operating equipment requires the full attention of the operator. Do not wear radio or music headphones while operating the DTH .

Check for underground utility lines

Before starting work, remember that contact with buried utilities may cause serious injury or death. Electric line contact may cause electric shock or electrocution. Gas line contact may rupture pipe causing explosion or fire. Fiber optic cables can blind you if you look into the laser light in them. Water line rupture may cause a flood and possible ground collapse. Before drilling, check with qualified sources to properly locate all buried utilities in and around drill path. Select a drill path that will not intersect buried utilities. Never launch a drill bit on a path toward electric, gas, or water lines until their location is known. If there is any doubt as to the location of the underground placement, have the utility company shut it off before starting any underground work and excavate to confirm its exact location.

Avoid electrocution. Stay away.

Electrocution possible. Serious injury or death may result if the machine strikes an energized powerline. Take the following precautions to prevent electrocution. Also refer to the operating instructions.

- Always contact your local utility company when working in the vicinity of utilities.
- Locate underground utilities by qualified persons.
- Do not raise, lower, or move drill guide or boom near power lines.
- Always wear proper electrically insulated lineman's gloves and boots.
- Never touch metal parts on machine while standing on bare ground if machine comes in contact with a powerline.
- Always stay in cab during all drilling operations.
- Never step onto or off of a machine if an electric strike occurs.

Loose parts

Make sure the drill rod to rotary head spindle joint is securely tightened before running the rotary head in reverse rotation.

A loose connection could result in the drill rod unscrewing completely; a falling drill rod could strike personnel.



Live air

Never get under a downhole drill to examine the exhaust air; live air is dangerous. Also, part failure could cause the bit to fall out of the downhole drill which could result in bodily injury. A piece of cardboard can be inserted under the bit to check for the lubrication being carried through the downhole drill.

Air pressure

Make certain that the air line lubricator (or lubrication system) is capable of handling the higher air pressures associated with the downhole drill (up to 350 psi (24.13 bar) air pressure). When pressurized, an unsuitable lubricator could burst and possibly cause injury to personnel in the area.

Do not work in trench

Do not work in trench with unstable sides which could cave in. Specific requirements for shoring or sloping trench walls are available from several sources including Federal and State O.S.H.A. offices, and appropriate governing agency. Be sure to contact suitable authorities for these requirements before working in a trench. Federal O.S.H.A. regulations can be obtained by contacting the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402. State O.S.H.A. regulations are available at your local state O.S.H.A. office, and appropriate governing agency.

Check laws and regulations

Know and obey all Federal, State, and Local, and appropriate governing agency laws and regulations that apply to your work situation.

Place warning barriers around work site

Set up orange cones around the work area with warning signs facing outward.

Place pedestrian and traffic barriers around the job site in accordance with Federal, State, and Local, and appropriate governing agency laws and regulations.

Observe environmental Protection regulations

Be mindful of the environment and ecology. Before draining any fluids, find the correct way of disposing them.

Observe the relevant environmental protection regulations when disposing of oil, fuel, coolant, brake fluid, filters and batteries.

When using any solvent to clean parts, make sure that it is nonflammable, that it will not harm the skin, that it meets current O.S.H.A. standards, and appropriate governing agency, and that it is used in an area that is adequately ventilated.



Warning

- Failure to follow any of the above safety instructions or those that follow within this manual, could result in serious injury or death. This DTH is to be used only for those purposes for which it was intended as explained in this instruction manual.

Installation and Operation

General information

Follow instructions

Before operating this down-the-hole drill (DTH) for the first time, become familiar with the operation of the machine and the DTH.

Learn how to operate the machine and how to use the controls properly. Do not let anyone operate this machine without proper instruction.

If you do not understand any part of this manual and need assistance, contact your local TerraRoc dealer.

Description

The Quantum Leap® line of (DTH's) are designed for use on drilling machines in conjunction with a top head or Kelly drive mounting. The mounting must be capable of supplying sufficient hold down, hold back, rpm, torque, hammer lubrication, air pressure, and air volume.

DTH's achieve high productivity in hard rock applications by adding percussion to the drilling process. Rotary drilling methods use the combination of raw weight and rotation to chip and carve rock from a hole. The rotary method works fine in soft formations where adequate weight and stress can be applied to the rock to initiate fracture and chipping. However, in harder rock the rotary method cannot supply sufficient load on the bit inserts to crack the rock and produce a chip. Percussion drills overcome the rotary bit load limitation by producing a very high load during impact of the hammer. This load is sufficient to drive the cutting inserts into the rock to produce chips.

Quantum Leap® DTH's are recommended for practically any hard rock application. Depending on the size downhole drill being used, they are suitable for drilling water wells, primary blast holes in quarries, open pit mining, coal stripping operations, oil and gas exploration, and construction jobs where large volume rock excavation is required.

Common DTH's operate by using the position of a piston to direct supply and exhaust air to and from drive and return volumes. The drive volume "drives" the piston toward impact and the return volume "returns" the piston in preparation for another impact stroke. In order to maximize impact energy it is desirable to deliver supply pressure to the drive volume while the piston is at the top of its stroke, and, turn off the supply pressure when the piston is nearly at its impacting position. However, conventional DTH's which use position dependent fixed porting are not able to alter the position at which supply pressure is delivered and shut off from the drive chamber. As a result, maximum efficiency and power are limited.

The TerraRoc Quantum Leap® DTH cycle overcomes this inherent limitation by using a poppet valve to maximize efficiency. The poppet valve opens and directs supply air to the drive chamber at the top of the piston stroke and cuts off supply air just before impact. Variable drive volume supply timing is the key difference between the Quantum Leap® cycle and common DTH cycles.

DTH Setup

Before the DTH is used to drill it should be set up for proper air consumption and the joints should be tightened. The selection of choke size and/or valve lift will be dependent on the hole cleaning requirements and the capacity (pressure and flow) of the compressor being used. Hammer air consumption should be set up for the best balance of power and hole cleaning. Other factors which need to be considered are depth of hole, water to be encountered and water to be injected. In some cases, where such factors are unpredictable, the proper choke size can only be selected after experience is developed.

Valve, Choke selection and Hydrocyclone® Setup

The best performance of any DTH will be achieved when a maximum volume of air can be passed through the drill with a solid choke. Under ideal conditions the pressure required to drive this volume through the drill will be within the capabilities of the compressor. All Quantum Leap® DTH's have a choke plug which can be changed for additional hole cleaning capacity if additional hole cleaning air is needed and compressor capacity is sufficient.

Bailing velocity requirements

The need for adequate hole cleaning cannot be emphasized enough. A hole that is not cleaned properly can result in poor performance, rapid wear of bits and accessories and in some cases loss of the drill and pipe down the hole. Hole cleaning is usually directly related to what is called bailing velocity or the speed of the air which is lifting cuttings from the hole.

Bailing velocity is defined as the velocity of the air in the hole annulus at atmospheric pressure. In other words, the effect of bottom hole pressure is not taken into account when computing bailing velocity. For conventional hole cleaning (no soaps or foams) bailing velocity should exceed 3000 ft./min. (914.4 m/min.). However, if possible, bailing velocity should not exceed 7000 ft./min. (2133 m/min.). Bailing velocity can be computed by dividing the air consumption of the DTH in scfm by the annulus area in square feet. The equation following may be used:

$$\text{Velocity [ft./min.] (m/min.)} = \frac{\text{Air consumption [scfm] (m}^3\text{/min.)}}{\text{Annulus area [sq. ft.] (sq. m)}}$$

where:

- Air consumption is the rated delivery of the compressor or the air consumption of the drill at maximum pressure, whichever is less.
- Annulus area is the area between the hole bore and the drill rod. It can be computed as follows:
$$\text{[sq. ft.]} = .0055 \times (\text{hole dia. [inches]}^2 - \text{rod dia. [inches]}^2)$$
$$\text{(sq. m)} = .785 \times (\text{hole dia. [m]}^2 - \text{rod dia. [m]}^2)$$
- Annulus area

The sections following explain how to adjust the choke or valve to increase air consumption.

Valve selection QL 120

The QL60 and QL65 can use two valves. The lift of these valves differs by .030 in. (7.62 mm). The higher lift valve allows more air and power to be delivered to the drive chamber. QL60's and QL65QM's come factory equipped with the low lift valve installed.

The QL120 use stainless steel shims to adjust air flow by limiting valve lift. QL120's ship with the shim installed. Refer to the air consumption curve to determine if the shim should be removed. **It is highly recommended that the proper valve setup be used for adjusting air consumption before choke adjustments are made.**

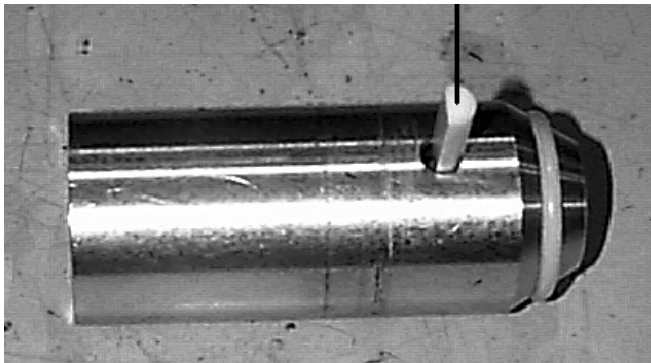
Shim addition or removal on the QL120 may be useful for certain applications. For example,

- Removing the shim on the QL120 is generally suggested for deep-hole applications where air consumption must be increased for hole cleaning.

Choke sizing

All Quantum Leap® DTH 's have a choke plug which is press-fit into the check valve. Different plugs can be inserted in place of the factory installed "solid" choke to increase air consumption of the drill. The choke may need to be opened to bypass more air to reduce pressure and/or increase bailing velocity. It should be noted that opening the choke plug does create a back-pressure on the DTH which reduces performance. Additionally, excess air which is not needed for hole cleaning increases the erosive wear of the DTH .

Therefore, for cases where additional air is not required for hole cleaning, consideration should be given to reducing compressor output by lowering engine RPM or restricting the compressor inlet.



Choke Plug

The QL120 and QL200 are all shipped with spare choke plugs which are matched to common hole sizes.

Figure on page 31 shows a graph of the relationship between flat size and equivalent orifice diameter. The curve is useful for determining what flat size is needed to obtain a required increase in flow.

In addition to using a conventional choke for increasing air consumption, DTH 's equipped with Hydrocyclones® bypass air through the water metering orifices in the separator body. While the primary purpose of these metering holes is to bypass fluids, they can also be adjusted to bypass air. In most cases it will be more efficient to bypass air through the Hydrocyclone® than through the choke because less back-pressure will be created against the DTH.

Hydrocyclone® Setup

The Hydrocyclones® are shipped with metering orifices which regulate the amount of water which can be removed from the air stream. The highest efficiency occurs when all the water and very little air passes through the metering orifice. The following lists the standard and optional metering orifice sizes which can be used on the Hydrocyclones®.

Separator metering orifice size (inch)	Maximum fluid removal capacity (gallons per minute = gpm)			
	0.25 (1/4")		0.312 (5/16")	
Quantity of metering ports	1	2	1	2
Operating pressure (psig)	QL120			
100	13.1	26.1	20.3	40.7
125	14.6	29.2	22.7	45.5
150	17.3	34.5	26.9	53.8
175	17.3	34.5	26.9	53.8
200	18.5	36.9	28.8	57.5
225	19.6	39.2	30.5	61.0
250	21.7	43.3	33.7	67.5
275	21.7	43.3	33.7	67.5
300	22.6	45.2	35.2	70.4
325	23.5	47.1	36.7	73.3
350	24.4	48.9	38.0	76.1
375	25.3	50.6	39.4	78.8
400	26.1	52.2	40.7	81.3

Note: Bypass orifice in Hydrocyclone must be able to pass quantity of water injected at operating pressure. Failure to adjust orifice to correct size will result in loss of power and poor DTH performance.

Bit installation

Bits splines should be well lubricated with rock drill oil or thread grease before the chuck is installed over the splines. Additionally, the threads on the chuck should also be well coated with thread grease before threading the chuck into the DTH . Remember to install the bit retaining ring halves before threading the chuck into the DTH .

New bit and chuck

All QL drills (except the QL200) use tapered retaining rings which are locked in place axially and radially when the chuck is tightened. This patented feature insures lower end drill parts are held securely in place to prevent vibration and movement. Be careful not to get flat retainers from earlier model DTH is mixed with the tapered rings. The QL120 and QL200 use plastic drive pins which insure a non-metallic chuck to bit interface. These pins must be installed properly with the pin end labeled "TOP" (QL200 only) being visible after installation. The QL120 and QL200 pin drive systems have been designed so that if the pins are omitted, or fail, the chuck bit and spline drive surfaces can operate reliably for a short period of time.

Used bit and chuck

Caution must be used when installing a new bit on a used chuck or visa-versa. Some applications, usually soft rock where there is excessive bit travel within the splines, can develop uneven wear on the bit and chuck splines. When a new bit is installed within a used chuck there is likely to be poor mating surfaces. Check the condition of the chuck or bit splines when using a new bit or chuck if your application is prone to this form of spline wear.

It is also suggested that the chuck be rotated relative to the bit splines from time to time to even out the gouging and grooving which takes place due to erosive wear. This practice will extend your chuck and casing life.

Makeup torque and backhead closure

The Quantum Leap® drills have two forms of locking means for internal components; the QL120 and QL200 use relatively low-load belleville springs, all others use "solid clamping" arrangement whereby parts are held in place under very high load.

The QL200 uses a special wrench to close the backhead. However, because of the high load used to clamp the parts in place in the QL120; a high level of torque is needed to close the backhead gap. Rotary head torque is not sufficient to close the backhead gap. A supplementary wrench is needed to properly tighten the joint. It is extremely important that the backhead gap be closed in these drills.

The presence of a gap between the casing and the backhead while drilling will increase the chances for loosening the backhead in the hole and possibly losing the drill.

In addition to at least closing the backhead gap, it is also recommended that the backhead and chuck be torqued to approximately 750 - 1000 ft.-lb per inch (40.5 - 54 N-m per mm) of hammer diameter. This makeup torque insures against loosening joints in the hole and also preloads the threads sufficiently.

Drill lubrication

Lubrication guidelines and specifications

All DTH's require oil lubrication to resist wear, galling and corrosion. Additionally, the film of oil coating all internal parts seals internal clearance paths to reduce power-robbing leakage across sealing clearances. As a general rule of thumb the oil required is proportional to the volume of air being used. Oil also needs to be of sufficiently high quality. It is recommended that TerraRoc rock drill oil be used. If another type of oil is used it must comply with the oil specifications shown in table on page 32.

For dry drilling (less than 2 gpm (7.6 lpm) of water injection) it is generally recommended that oil be injected into the drill air stream at the rate of 1/3 pint (.16 l) of oil per hour for every 100 scfm (2.8 m³/min.) of air. For example a 900 scfm (25.5 m³/min.) compressor delivering full flow to a DTH would require $900 \div 100 \times 1/3 = 3$ pints per hour ($25.5 \div 2.8 \times .16 = 1.6$ l per hour).

For wet drilling (more than 2 gpm (7.6 lpm)), and in particular when using a Hydrocyclone® water separator, it is suggested that the lubrication rate be doubled to 2/3 pint (.32 l) of oil per hour for every 100 scfm (2.8 m³/min.) of air. The additional oil compensates for the wash-out caused by water and the oil losses caused by the Hydrocyclone®.

Lubricators

There are two primary types of lubricators; a plunger oiler and a venturi oiler: A plunger oiler normally operates from a timed plunger system which delivers a fixed "slug" of oil into the line in timed intervals. These systems are beneficial in that the oil reservoir does not need to contain a high pressure. Plunger lubricators are also insensitive to oil viscosity and temperature. However, because of their complexity, the reliability of plunger lubricators is not as good as the venturi type. Also, because oil is delivered as "slugs" it is not atomized and delivered to the drill internals as evenly as a venturi.

Venturi type lubricators (sometimes referred to as pig oilers) operate in a similar fashion to a gasoline carburetor. A necked down area in the venturi creates a pressure drop which draws oil into the air stream. The oil is atomized and mixed very efficiently with the air providing maximum coverage and cohesion to internal drill components. A needle valve is usually used to adjust the oil volume delivered. Disadvantages of the venturi oiler are that it requires a pressurized volume, which is generally small in volume. Also, the lubrication rate is dependent on oil viscosity which varies with temperature.

Lubrication check

When oil is injected into an air stream with dry piping or hoses it takes a considerable amount of time to coat the walls of the piping so that the oil is actually delivered to the DTH. Until these surfaces are coated with an oil film very little is actually delivered to the DTH. It's important to insure that an oil film is established before starting the DTH. It's recommended that the drill be allowed to blow until a visible film of oil is developed on the bit blow holes.



Placing a piece of cardboard or wood beneath the blow holes gives a good indication when oil is passing through the drill. The cardboard or wood will become wet with oil when an adequate film of oil has been developed. If a drill string has not been used for some time and the oil has dried out it is suggested that a cup of oil be poured into each rod to assist in developing an oil film. After drilling with high levels of water injection it is important to note that any oil film has probably been washed off. For operators that switch from wet to drydrilling (i.e. waterwell and quarry) its important to redevelop the oil film.

Water injection

Water injection can cause a DTH to either consume more air (hold a lower pressure) or less air (hold a higher pressure) depending on the volume of fluids injected. For example, if a DTH is lubricated with oil and water is then injected at a low rate (less than 1 gpm (3.8 lpm)), the oil film which is sealing the internal leak paths is washed out and air consumption will increase (pressure will fall).

Conversely, if water is injected at a high rate (more than 3 gpm (11.4 lpm)) the fluid level will be sufficient to seal the leak paths and restrict the flow of air through the DTH. In this case the air consumption will decrease (pressure will increase).

The pressure rise associated with water injection can sometimes exceed the maximum pressure rating of a compressor. In these cases the choke or Hydrocyclone bypass hole must be increased to reduce pressure. The use of water, while required in most cases, does reduce component life. The following lists some of the problems that water injection can cause:

- Poor quality water can either be corrosive or can carry contamination into the drill. Premature wear or corrosion related failures can result. All water injected into a DTH should be neutral in pH and free from particulate contamination.
- Water injection reduces drill performance considerably. Water restricts the flow and resultant pressure in working chambers of the drill and reduces face cleaning which causes regrinding of cuttings.
- Water present at the impact face causes cavitation of the bit and piston and jetting or cutting of the exhaust tube. In both cases component life is reduced.

A DTH that has been operated with water injection and will be idle for more than a few days should be dried out and lubricated with oil. This can be accomplished by blowing lubricated air through the tool when drilling is finished.

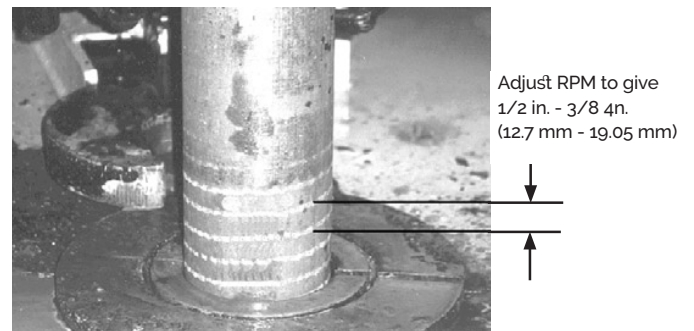
Drill operation

Rotation speed

Rotation speed directly affects the amount of angular index the bit inserts go through from one impact to the next. The optimum amount of index is dependent on variables such as blow energy (pressure), rock hardness, bit diameter, etc. The ideal rotation speed produces the best overall balance of penetration rate, bit life and smoothness of operation. It generally occurs when cuttings are their largest.

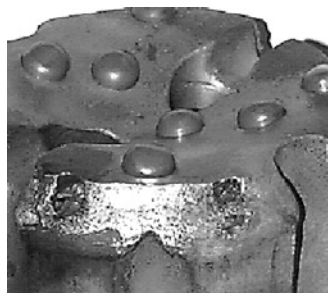
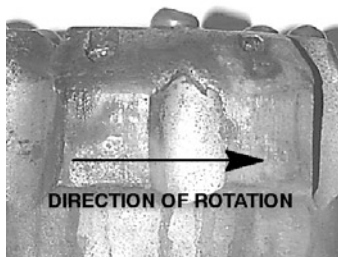
Determining the optimum rotation speed needs to be carried out in the actual application. A good rule-of-thumb is to divide 300 by the bit diameter in inches to determine RPM. This will get the rotation speed in the "ballpark". However, a fine-tuned rotation speed also needs to be correlated with penetration rate. It has been found that a proper rotation speed usually results in a 3/8 in. - 5/8 in. (9.525 mm - 15.875 mm) advance of the bit per revolution of the DTH. This measurement can normally be taken by using chalk or soapstone to scribe a spiral on the drill pipe while the drill is operating. The distance between the spirals (thread pitch) can be measured to determine if rotation speed should be increased or decreased. Obviously, if the pitch is less than 3/8 in. (9.525 mm) the drill RPM should be decreased, if it is more than 5/8 in. (15.875 mm) the drill RPM should be increased.

The picture following shows an example of the marks left on a drill pipe when using chalk to mark the advance of the drill.



Another method for setting rotation speed involves witnessing the wear flat developed on the carbide. The wear flat on the should be directly on the top of the inserts. A flat which is on the leading edge of carbide (side facing the direction of rotation) indicates rotation speed is too slow. Conversely, rotating too fast will cause rapid wear of the bit and the wear flat will be on the trailing edge of the carbide.

Note that due to the higher penetration rate of Quantum Leap® drills over conventional valveless drills, rotation speed will normally need to be increased in proportion to the increase in drilling speed.



Rotation Torque

As a general rule of thumb, you should apply roughly 500 foot/pounds (27 newton/meter) of torque for each inch of bit diameter.

Example: 6 inch diameter bit X 500 ft/ pounds = 3000 ft/pounds of rotation torque

Collaring

Collaring a drilled hole is a critical stage of the drilling process. In blast holes it can determine the quality of the top of the hole and the ability to load a charge. In foundation and well drilling it can determine the overall straightness of the completed hole. It is suggested that a drill be collared with low pressure and feed until the hole has stabilized. Just as a twist drill needs to be controlled carefully when drilling with an electric hand drill, a DTH needs to be started with care.

Feed force (hold down and hold back)

The force required to feed a percussive tool properly is directly proportional to the level of output power.

As a rule of thumb, DTH's need to be fed with a force of roughly 500 lb per inch (9 kg per mm) of hammer diameter when operating at maximum power.

In many cases operators will simply adjust the feed pressure until rotation pressure starts to pulse and then back off slightly until rotation pressure becomes smooth. When a hole is first started, if the weight of the starter rod or collars is not sufficient to feed the drill then pull down will be needed. As the hole is advanced and more weight is added to the drill string, the level of pull down will need to be decreased. Eventually, the weight of the string may exceed the proper feed force and the feed system will need to be shifted to a pull-back mode.

When drilling through varying conditions such as hard and soft or voided material, every effort should be made to keep the drill fed properly. A loose running DTH can cause damage to the tool and bit in a short period of time. The feed system of a drilling rig should have a sufficiently fast response so the DTH can "catch up" with the bit when a void or soft seam is encountered.

As with rotation speed, Quantum Leap® drills will typically need to be fed harder due to their higher output power level over valveless drills.

It's equally important to avoid feeding too hard through voided and fractured material. The piston in a DTH operates within the casing with a clearance of about .003 in. (.076 mm) on each side. While the casing appears very strong and stiff, it does not take much sideways pressure to distort the casing enough to cause interference with the piston as it reciprocates. If the casing is overfed through voided ground it is likely that deflection of the casing will occur. Frictional cracks will develop on the surface of the piston if the piston rubs hard enough against the wall of the casing while being distorted. These small frictional cracks can eventually grow and break the piston.

Feed force should be reduced when drilling through voided, unconsolidated or fractured ground to avoid twisting or distorting the hammer casing..

Hole cleaning, flushing and dust suppression

As stated previously, the importance of good hole cleaning cannot be over emphasized. A hole which is not cleaned effectively will cause reduced production (penetration rate), decreased bit and accessory life and could ultimately increase the risk of losing the drill & string in the hole.

Dry drilling

The most effective means for hole cleaning is drilling dry. Cuttings are normally lifted and cleaned from the hole very efficiently. Imagine blowing, or sweeping, dust or dirt from a floor when the floor is dry and wet....which is more effective? The same principle holds true for cleaning cuttings from a hole.

Wet drilling

Water injection is required in many applications for dust suppression or hole cleaning. Water injection rates for dust suppression only are usually less than 1 gpm (3.785 lpm) and just sufficient to moisten fine dust. It is usually common to use minimal water injection for dust suppression in shallow blasthole applications where water intrusion into the hole is not a problem.

Heavier volumes of water injection are usually required in water well and deep-hole applications where a number of factors come into play;

- Water intrusion into the hole can develop mud rings where dry cuttings meet a seam of water entering the hole. Mud rings develop where dry cuttings stick to the wall of the hole when they hit the moist area. Water injection is needed to keep the hole wet enough to prevent these mud rings from developing. Fluid injection rates can vary from 2 - 15 gpm (7.57 - 56.775 lpm) depending of the hole size, rate of penetration and the type of material being drilled.
- Some materials such as those which drill fast or contain clay can sometimes require very heavy levels of water injection. These applications are unique in that they can either be drilled totally dry or totally wet....not in between. Marginal fluid injection results in making a tacky mud which sticks to the drill rods and hole wall and hinders hole cleaning. The correct level of fluid injection thins the paste so it will be cleared from the hole.

Wet drilling with Hydrocyclone®

Many of the compromises associated with water injection are eliminated when using a Hydrocyclone® water separator. With the Hydrocyclone®, as much water as needed can be injected without a significant loss in performance. The Hydrocyclone® will typically remove approximately 98% of the fluids injected until the bypass orifice becomes saturated and cannot pass any more water.

If the Hydrocyclone® bypass orifice is not large enough to pass all the fluid being injected, the remainder of fluid will pass through the drill as if the Hydrocyclone® was not present. However, a portion of the benefits associated with using the Hydrocyclone® will be lost. If this does occur it is suggested that the bypass orifice within the Hydrocyclone® be enlarged to pass the additional volume of fluid. See previous paragraphs and table on page 8 involving Hydrocyclone® setup.

Because the Hydrocyclone® removes matter that's heavier than air, it removes rust scale, small rocks and other debris in addition to fluids. As a result, the Hydrocyclone® can become clogged with debris. It is suggested that after every hole, the ports in the Hydrocyclone® backhead are checked to be open. This can be determined simply by witnessing the passage of air or fluid through the ports while blowing air. If they are clogged refer to the service and maintenance section for repair instructions.

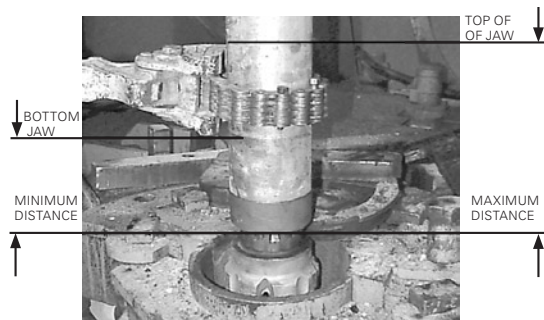
Ensure Hydrocyclone® backhead ports are passing air at the end of each hole.

Bit changing

Removing the drill bit

Bit removal can be one of the most dangerous and frustrating tasks associated with the drilling operation. However, with the proper tools and techniques it should require no more than a few minutes and few expletives to remove a bit. The following lists pointers which will be beneficial in helping you remove a bit quickly, safely and with reduced risk to damaging DTH parts and components:

1. Use sharp tong jaws. Worn or rolled over tong jaws increase the jaw pressure and make the wrench more prone to damaging the hammer case. Many TerraRoc hammer cases are case hardened which means sharp jaws are needed to grip through the hardened case.
2. Grip the casing in the proper location. Gripping over the threads can make thread loosening extremely difficult. Example; as the wrench tightens it exerts an inward force which can pinch the threads if they are under the wrench jaw. This only increases the torque needed to uncouple the thread. Also, do not grip the casing in an area where the bore is not supported by either the piston or bearing. Gripping over an unsupported area can distort the bore. The figure and table below shows the recommended locations for wrenches.



Chain Wrench Positions

DTH Model	Minimum distance from chuck to lower jaw	Maximum distance from chuck to upper jaw
QLX60 OG	6.5 in. (165mm)	17 in. (432mm)
TD90 OG	8 in. (203mm)	17 in. (432mm)
QLX100	9 in. (228mm)	20 in. (508mm)
QL120	12 in. (305mm)	30 in. (762 mm)
QL200	Special Wrench	Special Wrench
QL300	See manual for QL300	See manual for QL300

3. Insure the bit fits properly within the bit basket. An improper fit may result in the bit slipping from the basket.
4. Never weld or hammer on the casing to loosen it. All casings except the QL200 are case hardened for extended service life. The hard casing surface can be cracked by welding or impacting with a sledge hammer.



Warning

- Ensure chain wrenches or tongs are rated for the torque applied. The flying parts of chain wrenches can cause injury or death when they break!

Removing the bit with percussion only

If a chuck is difficult to loosen it is sometimes helpful to use low-pressure percussion assisted with reverse rotation to free the thread. The following lists the process and cautionary notes:

Process instructions

1. Place a piece of relatively hard polyurethane or conveyor belting in the bit break-out basket to absorb shock.
2. Remove all drill pipe so only the DTH and required adapters are attached to the rotary head.
3. Bring the drill in contact with the bit basket with a relatively light feed.
4. Bring the hammer pressure up to roughly 150 psig (10.3 bar).
5. See if the joint has loosened on its own after about 10 seconds of cycling.
6. If the joint has not loosened, "Bump" the rotation in reverse at a slow speed while the drill cycles until the joint has loosened.
7. Stop as soon as the chuck loosens, grease and air will be noticed coming from the loosened joint at the time of loosening.



Caution

- Wear eye protection as the hammer will be cycling above ground. insure that all drill string joints are tight watch other string joints to insure they do not loosen before the chuck. if they do loosen, stop the process.

Maintenance and Repair

General information

Follow instructions

Along with correct operational technique; proper and timely service and repair of a DTH can extend component life and reduce operational expenses considerably. The sections following describe how to disassemble, inspect, repair and reassemble all Quantum Leap® DTH's.

Depending on the degree to which you plan on servicing a DTH, a number of tools are required. The following lists the tools needed for a complete overhaul of all Quantum Leap® DTH 's. Obviously a stand is required for holding the DTH and it is presumed that backhead and chuck threads have been loosened. Complete overhaul includes measuring and inspecting all clearances at seal locations and other wear points.

Tools required for DTH service and repair		
Tool	QL120	QL200
Outside Micrometer	9-10", 8-9" 7-8", 2-3"	12-13", 10-11" 2-3", 3-4"
Feeler Gauges	set	set
Telescopic Bore Gauges	set up to 10"	set up to 13"
Vernier Caliper	0-6"	0-6"
Brass (soft) Bar	2" dia. by 48"	2-1/2" dia. by 48"
"J" Wrench	9 1/4"	none
Threaded Rod	none	1-1/2" dia. by 18"
Bar Stock	included	long bar or tube
Lifting Eye	none	1 ea. 3/4" -8 female, 2 ea. 5/8" -11 male

DTH Service

In most cases a DTH will only require servicing when the casing wears out or when performance deteriorates due to internal parts wear. The level of inspection can obviously be much less if the casing only needs replacement. If the DTH has lost performance a more detailed inspection will be required.

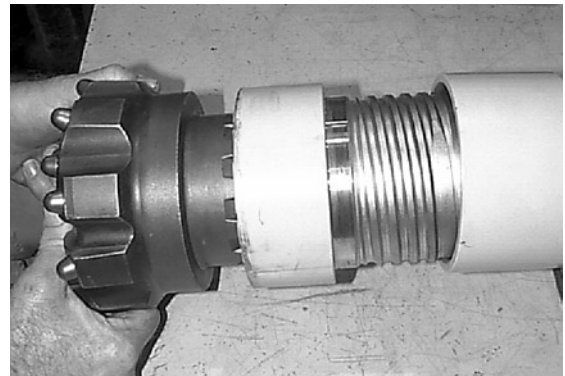
DTH Disassembly

Disassembly

The following disassembly procedure starts with the resumption that the chuck and backhead threads have been loosened. While the disassembly process is similar for all Quantum Leap® hammers there are slight distinctions from one model to another that will be noted. In general the QL50, QL55QM, QL60, QL65QM and QL80 are identical in the way they are serviced.

It's important to note that the Quantum Leap® piston can only be removed from the chuck end of the drill.

1. **Mark the casing** so you can note which end is the backhead side and which is the chuck end. Once the hammer has been disassembled it's hard to tell which end is which.
2. **Loosen the chuck** along with bit and retaining rings and remove from casing.

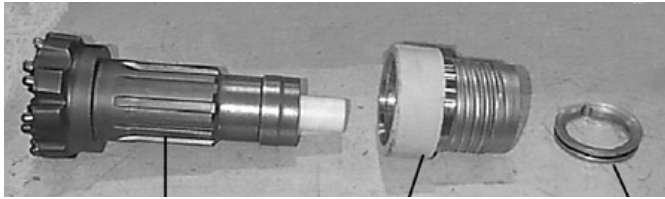


- This can be accomplished with all of the DTH's laying horizontal, except for the QL200. It may be preferable to hang the QL200 vertically from a hoist, use a wrench and break lose the joint, and spin the casing while slowly lifting the DTH .



QL200

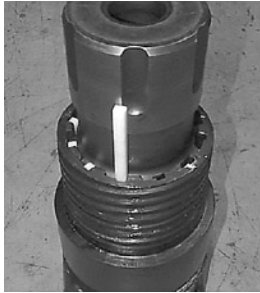
3. Remove retaining rings and o-ring from bit shank.



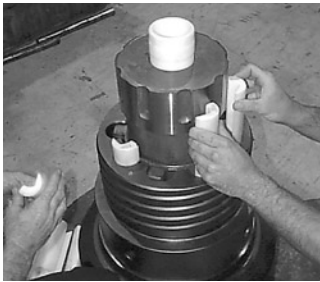
Bit Chuck Retaining Rings and O-Ring

4. Remove the chuck from the bit.

■ Remove the drive pins from the QL120.



■ Remove the drive pins from the QL200.

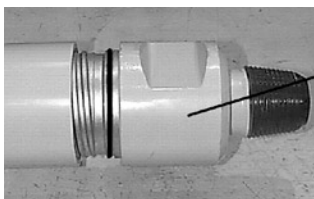


QL200 - Removing drive pins



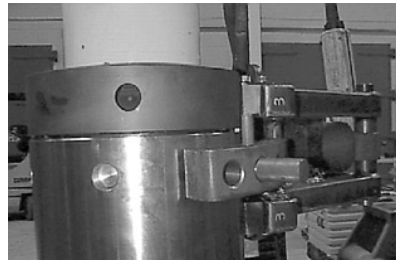
QL200 - Removing chuck from bit

5. Remove the backhead from the other end of the casing.

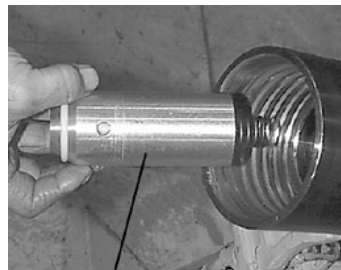


Backhead

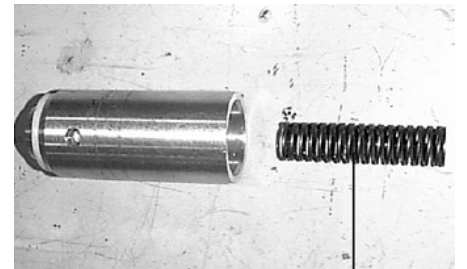
■ As with the chuck, it may be preferable to hold the QL200 vertically from a hoist, use a wrench and break loose the joint and spin the backhead off while slowly lifting.



6. Remove the check valve, and check valve spring.



Check Valve



Check Valve Spring

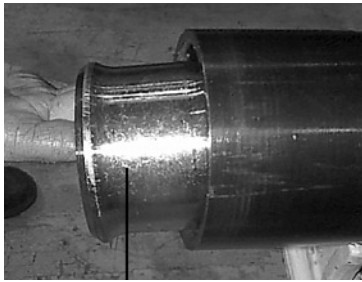
Check Valve

QL200



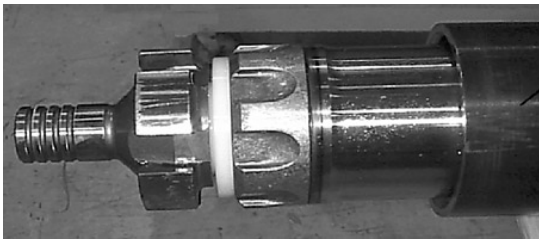
Check Valve Spring

6a. Remove the make up spacer, or on the QL200 bellville springs and make up spacer.



Make up Spacer

- On the QL200, the belleville springs will be removed with the air distributor.
- 7. **Grip the valve cap** (which is attached to the air distributor and cylinder as an assembly), and pull the group of parts from the casing. Clamping the valve cap stem with a pair of vice grips can help. Depending on the level of corrosion or dryness in the tool, it may be difficult to move the parts. If the parts are tight use the brass bar to tap the assembly by inserting it through the piston bore on the other end. Sometimes tapping the casing in the center with a soft bar or hammer can free the parts and allow them to move.

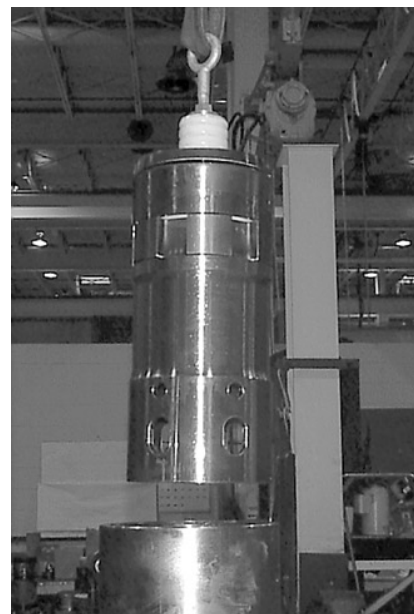


Casing

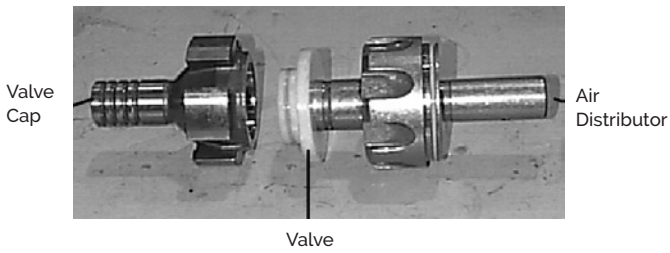
- Alternatively, a 3/4 in. (19.05 mm) threaded rod with an appropriately sized washer and nut can be inserted into the guide and a female lifting eye can be attached to the opposite end. The casing can be hoisted vertically and the internal stack of parts can be lifted from the casing.



- Attach lifting eyes to the valve cap on the QL200 with a lifting strap and hoist the valve cap, distributor and cylinder assembly (along with belleville springs) from the casing.
- Alternatively, with the casing on its side, a brass bar can be used to drive the valve cap, distributor and cylinder assembly (along with belleville springs) from the casing. Do not hit the guide too hard as it is made of plastic and can be damaged.
- The QL120 ships with a lifting plug which threads into the air distributor.



8. **Disassemble the cylinder assembly** by prying the valve cap from this air distributor. An old set of belleville springs are sometimes useful for prying the valve cap from the distributor. Be careful not to damage the valve when prying the cap off.

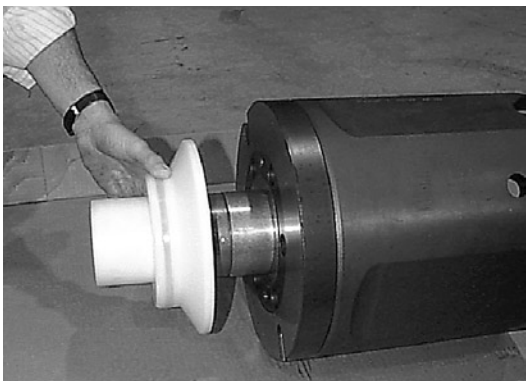


- The QL200 has two slots machined in the air distributor for inserting prying bars.

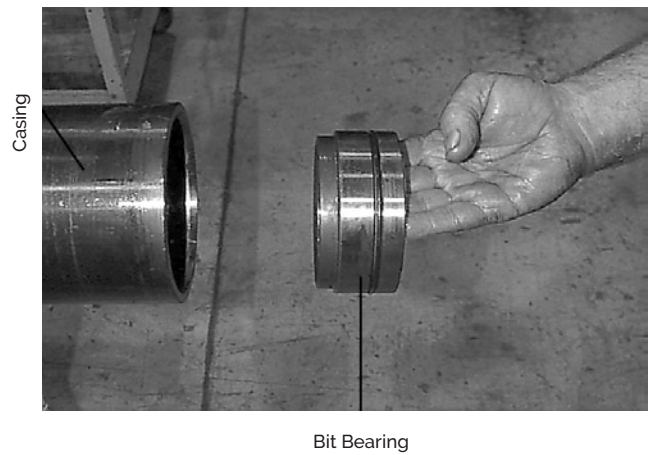
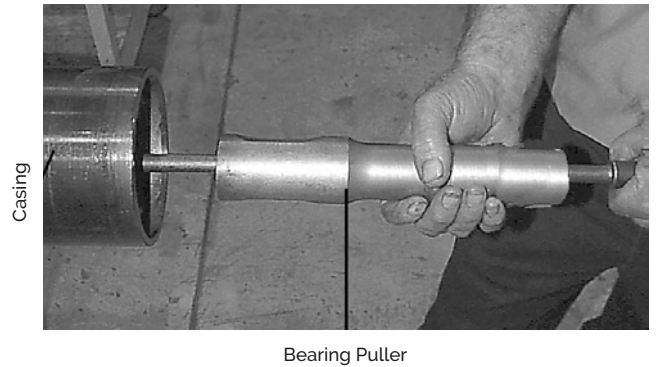


9. Remove the **valve** from the air distributor.

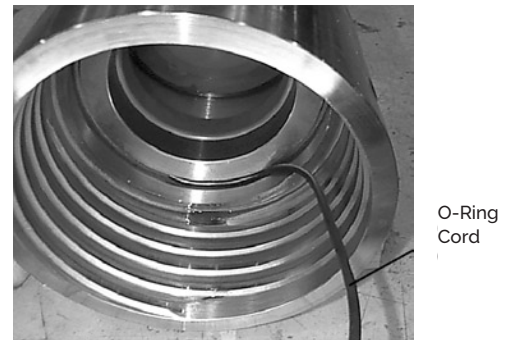
QL200



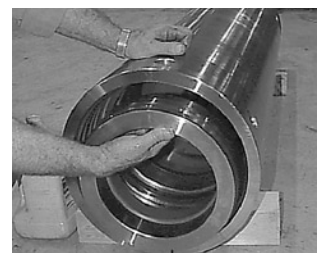
10. Moving back to the chuck end, **pull the bit bearing** from the hammer casing. Depending on the degree of rust or dryness of this area, a bearing puller may be needed to remove the bearing. When using a puller, be careful not to catch the bearing retaining ring. Sometimes lifting and dropping the casing on a block of hardwood can jar the bearing loose.



- Remove the o-ring cord holding the bearing in place on the QL120/QL200 before attempting to remove the bearing. Remove the polyurethane bearing stop ring from the QL120/QL200 casing bore.

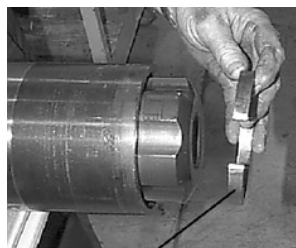
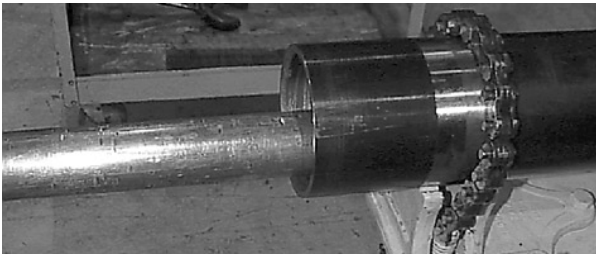


Bearing Stop Ring



Bearing

11. With the casing standing vertically (the backhead end up and the chuck end down), the **piston can be used to drive the bearing retaining ring from the casing**. A brass bar may be useful for impacting and driving the piston. The plastic non-lube bearing retaining ring can be removed by hand. This may make field replacement of seals easier.



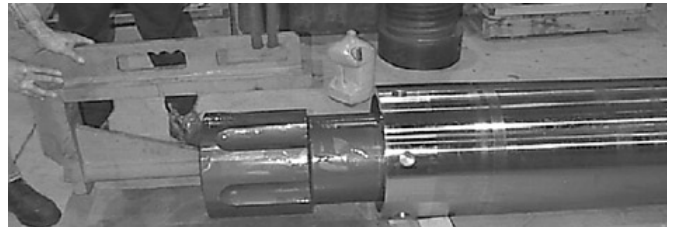
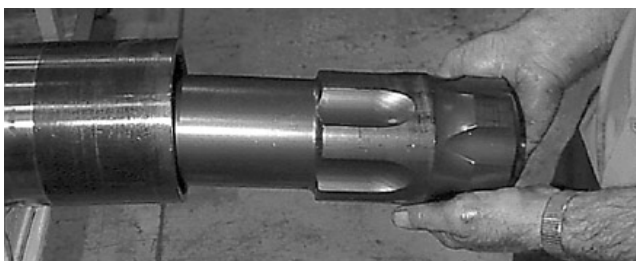
Bearing Retaining Ring

- On the QL120/QL200 remove the flexible polyurethane bearing stop ring. The piston will be able to slide out of the drill.



QL200

12. **Slide the piston** out of the drill being careful to carry its weight when it's no longer supported by the casing. QL120 (360 lb. (164 kg)), and QL200 (610 lb. (276.7 kg)) pistons will require a sling to carry their weight.



13. **Remove the cylinder from the air distributor**. A preferred method is to take the cylinder and distributor assembly and fit it over the small diameter end of the piston. By raising the assembly up and impacting it down onto the piston the cylinder can be freed. **Be careful not to get fingers caught in the cross holes in the cylinder while driving it up and down.** The cylinder stop rings on the QL120 and QL200 can be removed.



Cylinder



Cylinder

Piston

- The QL200 has two-piece cylinder stop rings which can be removed by reaching in the the casing bore, turning the rings sideways and retracting them through the casing end.



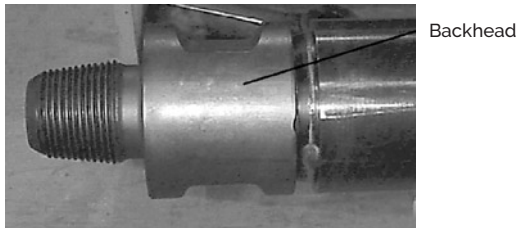
Hydrocyclone® Disassembly and service

Disassembly

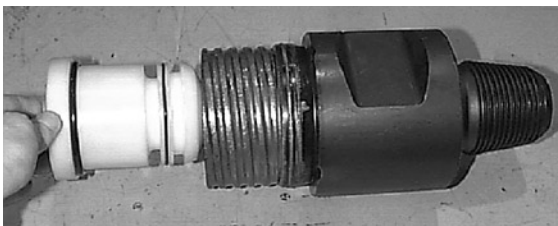
There are no moving parts in the cyclone. Service will only be required if the unit becomes clogged or if the rubber check seal becomes eroded. Note that if the Hydrocyclone® becomes clogged, the drill will continue to operate, but without separation.

Service as follows:

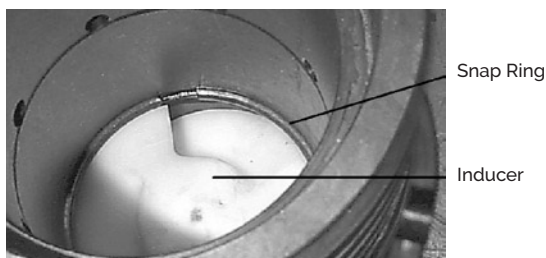
1. Remove backhead.



2. Pull the plastic separator out. A puller or tool which can reach into the separator bore may be needed. The separator can be difficult to remove if it becomes lodged with dirt.



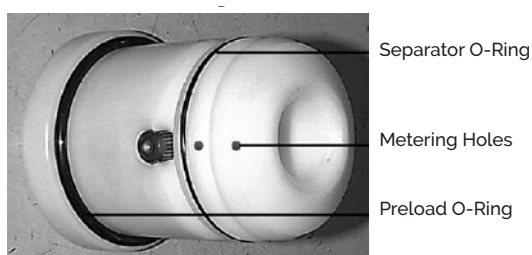
3. There is no need to remove the inducer unless damage is visible. (Only inducers with snap rings can be removed).



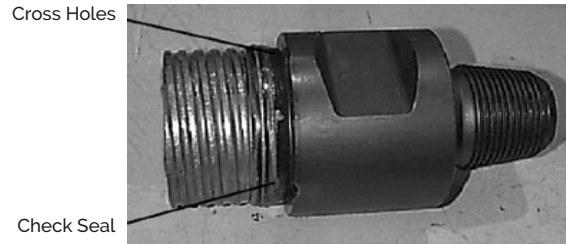
4. If the inducer has to be removed, press out the old one and press in the new one.

NOTE: Inducers can be removed only in hydrocyclones that use a snap ring to hold the inducer in place. Inducers are permanently installed at the factory on all other models they are not to be removed.

5. Insure the the metering hole(s) are clear in the separator.



6. Inspect the separator o-ring for damage. Replace if necessary.
7. Clean out the dirt trap ring and the inside of the backhead.



8. Inspect the check seal for erosion or damage, replace if necessary.
9. Insure the cross holes in the backhead are clear.
10. Reassemble the unit and grease the check seal.
11. Install the Hydrocyclone® in the DTH .

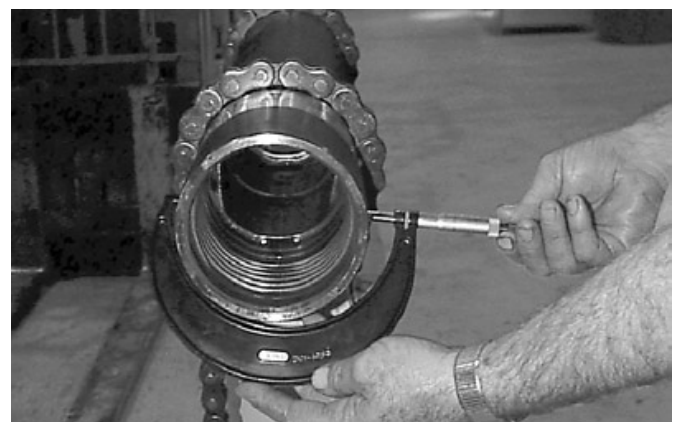
DTH inspection

The following lists critical measurements which are required to determine what parts, if any, require replacement, repair or reversal. Refer to the specifications for finding the appropriate discard point clearances. Bear in mind that discard point clearances represent an increase in clearance of 50% over the maximum as-new clearance. In some applications this clearance increase may represent too much performance loss and in other applications the opposite may be true.

Note that deterioration in drill performance is caused by the increase in clearance between two parts. It is obviously more cost effective to replace the part which decreases clearance the most at the lowest cost.

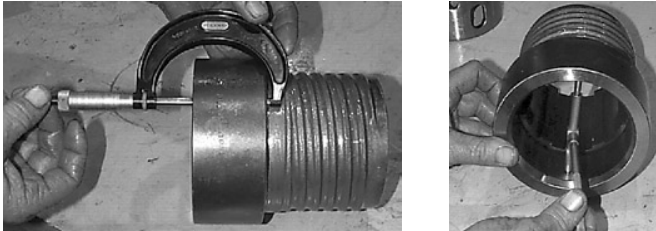
1. Casing outside diameter should be measured roughly 2 - 3 in. (50.8 - 76.2 mm) from the end of the chuck end. Refer to the casing reverse and discard dimensions to determine if the casing should be replaced or reversed.

■ It's suggested that if the casing is replaced the chuck and backhead should also be replaced.



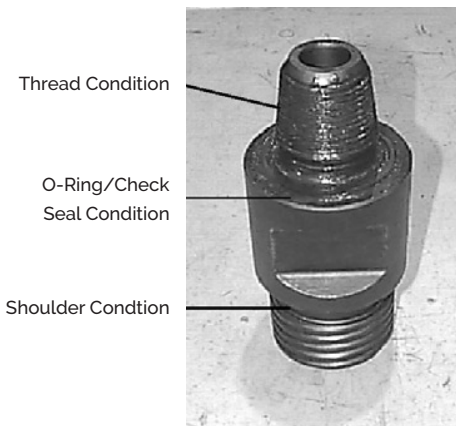
2. The **chuck** should be inspected from a few perspectives:

- The overall length of the chuck should be checked against specification. A short chuck can cause cycling problems, difficulty handling water and a rough drill operation.
- The chuck should be replaced if spline wear is heavy or uneven. The chuck should be replaced if its minimum outside diameter is less than the casing discard point.

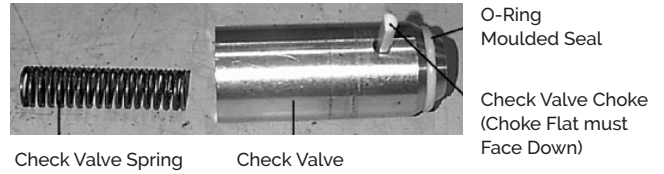


3. The **backhead** should be inspected from a few perspectives:

- The condition of the connection thread should be checked. A backhead should be replaced if the threads are torn, galled or damaged. The condition of the connection shoulder should also be inspected for a depression which means the thread will not make-up properly.



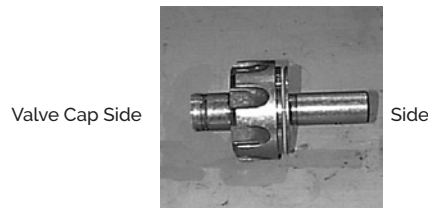
- 4. The **backhead o-ring or check seal** should be replaced if damaged in any way.
- 5. Check the **belleville springs** (QL200) for damage by bouncing them with a drop of a few inches on a hard surface and listening for a ring. A dull sound will indicate a crack may exist. Springs which have been flattened or deformed will need replacement.
- 6. The **check valve spring** should be checked for cracks and obviously replaced if it is broken. In addition to visual inspection, compress the spring by hand and listen for a faint cracking sound to determine if cracks exist.
- 7. Inspect the check valve rubber or o-ring for damage on its sealing surface. Replace a damaged check valve. **Remember to replace the check valve choke if a new check valve is required.**



- 8. Inspect the **valve cap** seal bore for grooving or severe corrosion where the valve assembly contacts. Clean this area as required with emery paper to remove rust, scale or nicks and burrs. A valve cap with a deep groove should be replaced.



- 9. Inspect the **air distributor stem** (valve cap side) for grooving or severe corrosion where the valve seal contacts. Clean this area as required with emery paper to remove rust, scale or nicks and burrs. A distributor with a deep groove should be replaced.
- The QL200 has a distributor sleeve which can be replaced if it becomes worn or damaged.



- 10. Inspect the **valve** for seal interference and damage. The valve seals should have interference with the valve cap bore and distributor guide. The valve sealing surfaces should be free of nicks and burrs.

- Insert the valve into the valve cap and check for interference. Replace the valve if there is no interference.



- Place the valve over the distributor guide and check for interference. Replace the valve if there is no interference.



- Measure the height of the valve with calipers and check against the discard specification. Replace the valve if it is below discard point. A shortened valve may cause a loss in operating pressure.

- Check to see that the outside diameter seal has not worn its groove in the valve by more than .060 in. (1.52 mm) axially. Replace the valve if the seal groove has worn.

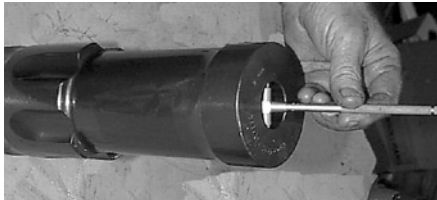


11. Inspect the **bearing bore** just above the internal flutes for wear using a telescopic bore gage and a micrometer. Replace the bearing if the net clearance with a new bit has worn beyond the discard point. Replace the bearing o-ring if it has been damaged or torn.



12. Inspect the **piston** for wear using micrometers in the four locations noted below. The piston usually wears more than its mating parts so it is likely that it will affect clearance the most. Record the dimensions for comparison to mating parts (cylinder, distributor and casing) to determine which part offers the most economical replacement cost. See special notes for non-lube seal and bearing inspection on page 3-23.

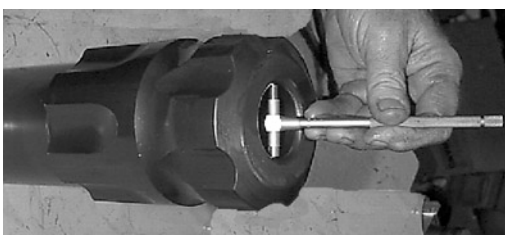
- Measure the tail bore in the location shown.



- Measure the tail outside diameter in the location shown.



- Measure the tail outside diameter in the location shown.



- Measure the piston large diameter in the location shown.

NOTE: This is the most critical wear point on the drill as it influences performance the most.



When should seals and bearings be replaced or serviced?

- If the DTH loses performance, operates erratically or exhibits other behavior that cannot be traced to a faulty part (pay attention to the bearing and valve), then a seal kit should be installed.
- Seals may last longer than 250 hours but it is wise to replace at this time period as preventive maintenance.

Remove tail seal by prying out with a screwdriver.



Install new tail seal by working it into the groove as much as possible.

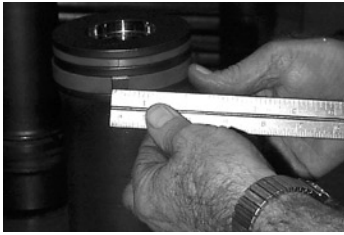


Snap tail seal into bore by lightly tapping into groove



- Check the gap in the bearings to insure they are at least 1/4" wide. Proper seal function will be lost if this gap closes too much. To increase the gap simply cut or grind away what is required to achieve a 3/8" to 1/4" wide gap.

Precision is not required!



It is useful to pre-stress the seals slightly so they don't get caught in casing grooves when installing piston.

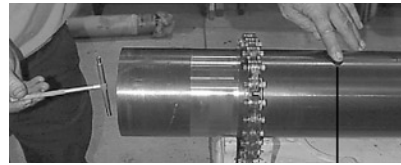


Install bearings and seals by spreading over groove and allowing them to snap back into undercuts.



13. Carefully remove any sharp edges, burrs or nicks which have developed on the piston using a hand grinder. **Do not overheat the piston...it will crack if overheated!** If the piston face is heavily cavitated or pitted either use a ceramic facing tool to dress the face of the piston or use a well cooled grinder. In either case, a maximum of .060 in. (1.52 mm) can be removed from the piston face.

14. If the **casing** did not require replacement due to wear on its outside diameter, measure and record the bore diameter for later reference. Use a telescopic bore gage and micrometers while measuring in the location shown.



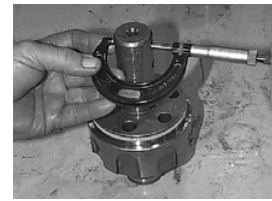
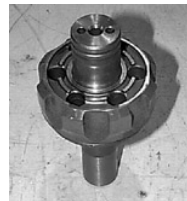
Measure at this location (1/2" past long undercut)

15. Inspect the **cylinder** for cracks or damage. Measure and record the cylinder bore for later reference.



16. Inspect the **air distributor** for excessive wear on the valve seat, replace if wear is deeper than .005 in. (.127 mm). Measure and record the guide diameter for later reference.

■ Note that the QL200 guide and distributor are two different parts and can be replaced individually.



17. Referring to the chart in Section 6, which contains replace clearances and worst case as-new dimensions, determine the following from the measurements recorded:

- If any of the four clearances have exceeded the discard point.
- Bit to bit bearing.
- Piston to casing.
- Piston to cylinder.
- Piston to guide.

18. Determine which parts have suffered the most wear by referring to the as-new dimensions in Section 5. Replace the part(s) needed to bring the clearance back to specification. The chart below may be useful for recording and determining which clearances require service.

DTH Clearance worksheet						
Dimensions	Measured Dimensions		As new diameter from table	Actual wear	Measured clearance	Discard clearance from table
	ID	A	B	C	D	E
Piston to Casing Large piston OD Casing ID	1			1B-1A	2A-1A	
	2			2A-2B		
Piston to cylinder Small piston OD Cylinder ID	3			3B-3A	4A-3A	
	4			4A-4B		
Piston to guide Piston tail ID Guide OD	5			5A-5B	5A-6A	
	6			5B-5A		
Bit to bearing Bit bearing ID New bit tail OD	7			7A-8A	7A-7B	
	8			8B-8A		

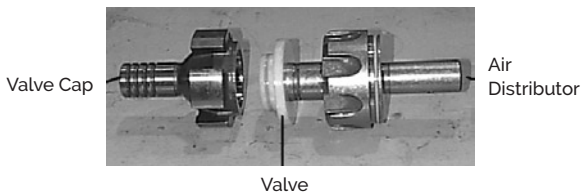
DTH assembly

The DTH assembly process is identical to the disassembly process yet in reverse.

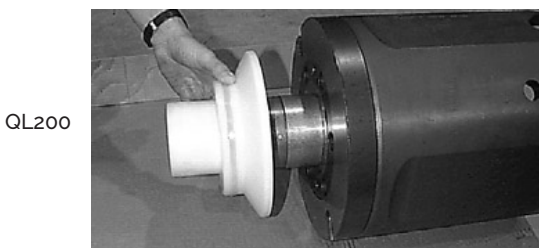
The following guidelines should be used:

- All parts should be clean and free of grit dirt and other foreign material.
- All nicks and burrs on parts should have been removed.
- All parts should be coated with rockdrill oil and preferably the same type to be used on the drilling rig
- All damaged o-rings should have been replaced if. All seals should be oiled or greased to avoid cutting or tearing.
- If corrosion is common it may be useful to spray the threads on the casing with a corrosion protector such as LPS Hardcoat or an equivalent. Make sure the threads are clean and dry and sufficient drying time is allowed.

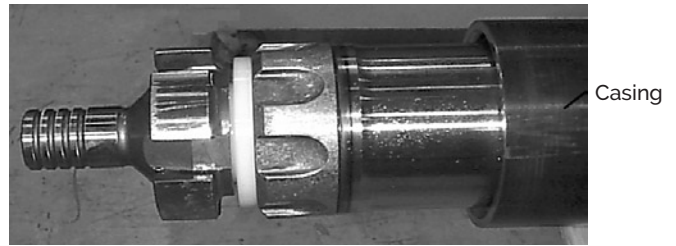
1. Reassemble the air distributor, valve and valve cap assembly. Remember that the air distributor and valve cap o-rings "lock" the parts together for ease of assembly and disassembly:



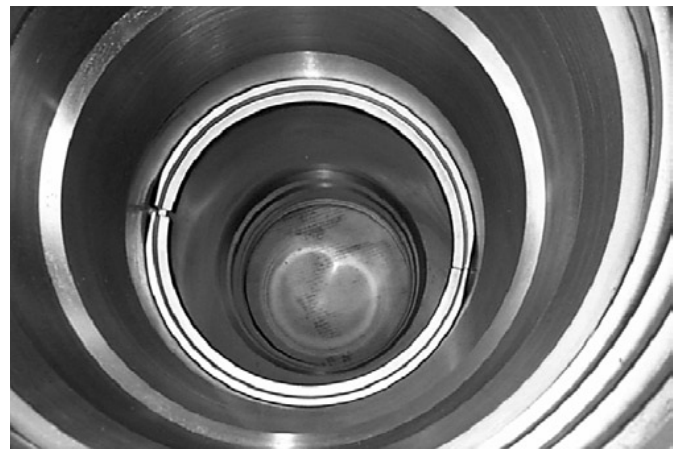
- With the cylinder resting on a piece of wood or hard rubber, place the air distributor (insure o-ring is installed) on the cylinder and drive it into the cylinder bore. Use a mallet or brass bar to overcome the o-ring pressure.
- Insure the valve cap o-ring is installed in the valve cap and that it is in good condition.
- Install the valve into the valve cap being careful not to fold or tear the valve seal.
- Slide the valve and valve cap onto the distributor stem, again being careful not to damage the valve seal. Tap the top of the valve cap with a mallet to seat the o-ring and lock the parts together.



2. If the casing needs to be reversed, slide the cylinder, distributor and valve cap assembly into what was the chuck end. Otherwise slide the assembly into the backhead end. Note that even though the casing may not require reversal due to OD wear, it may be worthwhile to reverse the casing to renew the end of the bore the piston slides in.

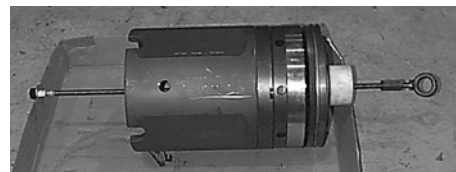


- The QL200 casing is not reversible so the cylinder stop rings halves must be reinstalled in the same direction they were removed.

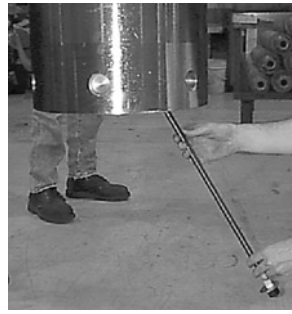


3. On the QL200 special handling is needed to install the cylinder assembly:

- Insert the 3/4 in. (19.05 mm) threaded rod with washer and locknut attached into the guide and attach the female lifting eye to the other end.



- With the casing standing straight up and the cylinder retaining rings spread outwards, lift the cylinder assembly up and into the casing bore.
- Unthread the lifting eye and let the threaded rod drop out through the bottom. When the casing is placed on its side the rod can be retrieved.



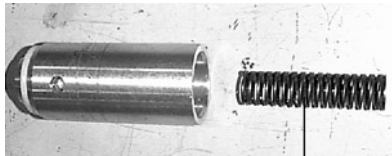
■ The QL120 ships with a lifting plug which threads into the air distributor.



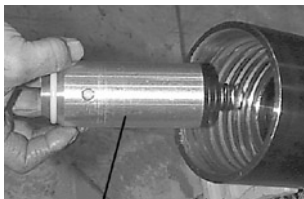
4. Install the solid spacer, check valve spring and check valve.



Makeup Spacer

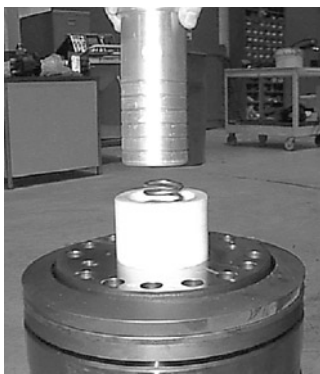


Check Valve Spring



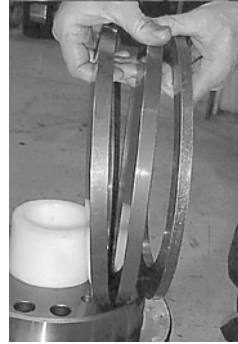
Check Valve

QL200

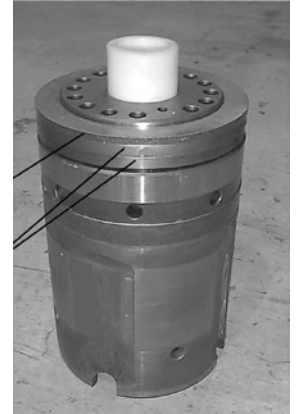


■ On the QL200, install the bellville springs and spacer. **Be careful to install the springs in their proper orientation. This is extremely important.**

QL200



Bellville springs and (bevel down)

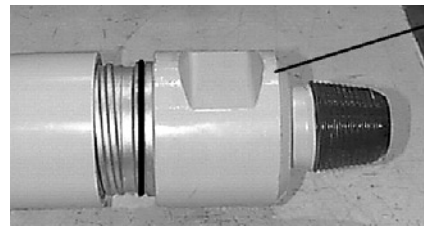


Spacer

Bellville Springs (Bevel Down)

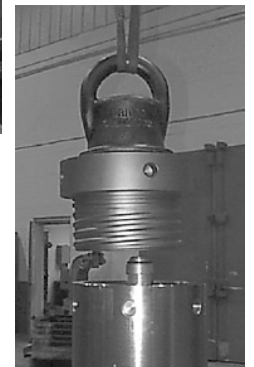
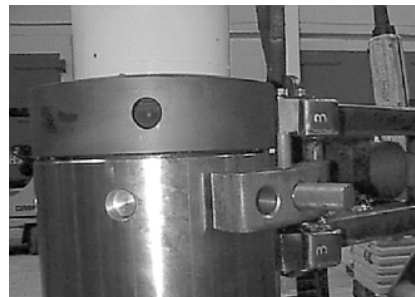
5. Make sure the backhead o-ring is in place on the backhead. Coat the backhead thread with a copper or zinc based thread compound and thread the backhead into the casing. All should close to create a gap between the casing when snug "refer to technical specifications" section. If there is no gap or the gap is too great the assembly must be rechecked.

■ The QL200 backhead should close to within 1/8 in. (3.18mm) when snug. A wear shim must be installed if the gap is less than 1/16 in. (1.59 mm).

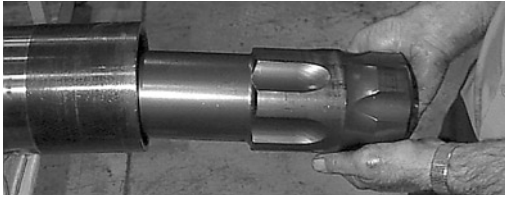


Backhead

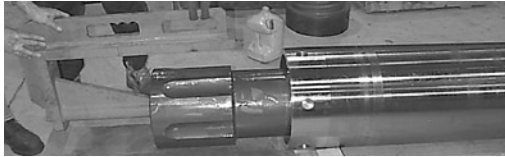
6. Torque all backheads until the backhead to casing gap is closed.



7. Install the piston through the chuck end of the casing.



■ A lifting cradle may be useful for the QL200 piston.



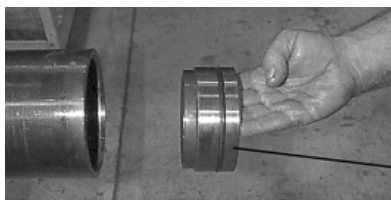
8. Install the bearing stop ring into the casing by starting it sideways and when it is near the undercut turn into the proper orientation until it snaps into the groove. A brass rod may be useful to driving and turning the ring. **Be sure to wear safety glasses as oil and grease in the groove may be expelled when the ring snaps.**



■ On the QL120/QL200 install the polyurethane bearing stop ring in the groove by hand.



9. Insure the o-ring on the bearing is in good shape as it holds the bearing in place when the chuck is removed. Slide the bearing into the casing until it seats against the bearing stop ring. The bearing may need to be tapped from side to side to prevent it from getting stuck in the bore.



Bit Bearing

■ Install the bit bearing o-ring on the QL120 and QL200 by seating it into the gland. Improper installation could allow the piston to fall out.



10. Coat the bit splines liberally with copper or zinc based thread compound and install the chuck on the bit.

■ On the QL200 install the drive pins in the proper direction so as the chuck turns clockwise it drives into the drive pins. Pins are marked "TOP" on one end.

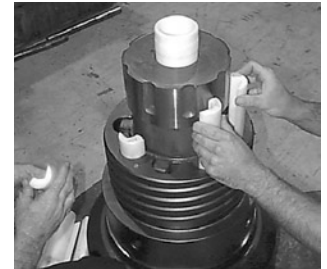
■ On the QL120, the drive pins do not have any particular direction. But they must all be assembled in the same orientation. Torque drives through the thin section.

(Viewed from top end)

QL120



QL200



11. Install the bit retaining rings and bit retaining ring o-ring on to the bit and chuck.

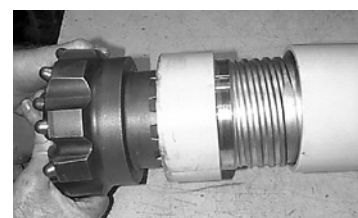


Retaining Ring & O-Ring

Chuck

Bit

12. Coat the chuck threads liberally with copper or zinc based thread compound and thread the bit, chuck and retaining rings into the casing.



■ On the QL200 use a lifting bail on the backhead thread to lift the assembly and thread it onto the chuck.

13. **Be sure to torque the chuck to specification before drilling!**



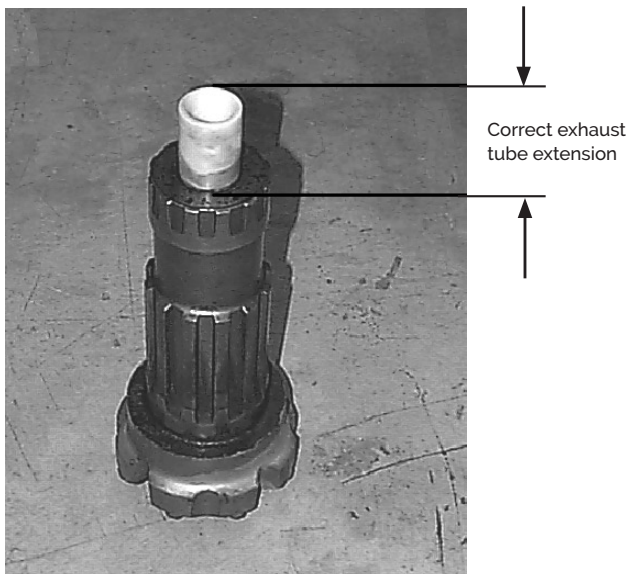
Exhaust tube replacement and installation

Exhaust tubes (footvalves) can become damaged during handling or physically eroded while in service, the net result is that they need to be serviced from time to time.

Tube failures will generally occur due to erosion caused by the jetting of water, oil and grit which is displaced as the piston strikes the bit. This form of failure is common in waterwell applications where injection rates are high. This high velocity jet of material actually erodes away the base of the tube and can eventually cause the tube to fail. Tube erosion can be reduced by insuring water is clean and free from particulate matter and that excessive fluid injection is avoided. It's a good idea to monitor tube erosion and make replacements as needed before a hole is started to avoid a costly trip out of the hole.

Exhaust tubes can be removed by cutting off the remaining portion of the tube and prying the remaining piece out with a screwdriver. It may be useful to use a small rotary file to relieve the bore of the tube which remains in the bit. **However, be careful not to touch the bit tube bore with the rotary file or a heat check followed by bit failure may result.** The tube can also be heated slightly to soften the plastic. **Avoid breathing fumes which may come from the heated plastic and also be careful not to overheat the bit.**

A new exhaust tube can be installed by driving the tube into the bit with a rubber faced mallet or with a block of wood between the hammer and tube. Do not hit the tube directly with a metal hammer or the tube may be damaged. Alternatively, the tube can be pressed into the bore using a press or even the table and feed on a drilling rig. Be careful not to over-press the tube.



Bits

TerraRoc manufactures product line of DTH bits in a design specifically for your drilling conditions. Contact your local TerraRoc representative for a complete catalogue.

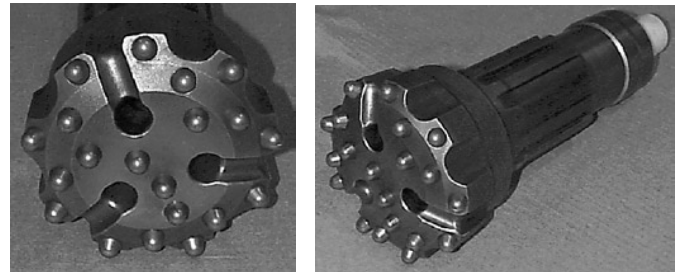
Selection

Proper selection of the correct bit type along with good service practice can reduce operating costs and improve production considerably. The sections following will assist you with the bit selection process and provide instruction for service practice.

Convex head conical tipped

Soft materials which are less than 15,000 psi (1033.5 bar) compressive strength. The material should also be consolidated and homogeneous with a low abrasiveness.

- Soft limestone
- Shale
- Slate



Convex head spherical tipped

Medium soft materials which are 15,000 - 25,000 psi (1033.5 - 1722.5 bar) compressive strength.

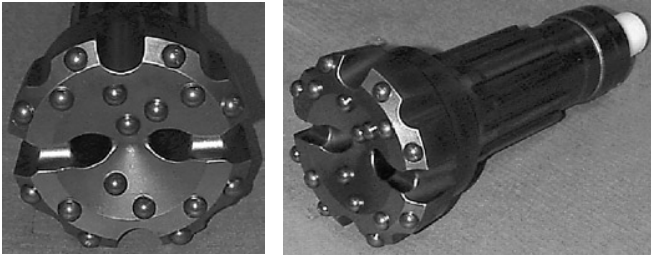
The material should be consolidated and homogenous.

- Hard limestone
- Granite
- Sandstone
- Diorite
- Schist
- Marble

Concave face

Medium-soft to medium-hard materials which are 15,000 - 30,000 psi (1033.5 - 2067 bar) compressive strength. Material can be voided, fractured, unconsolidated and faulted. Face slots provide good hole cleaning in fast drilling applications.

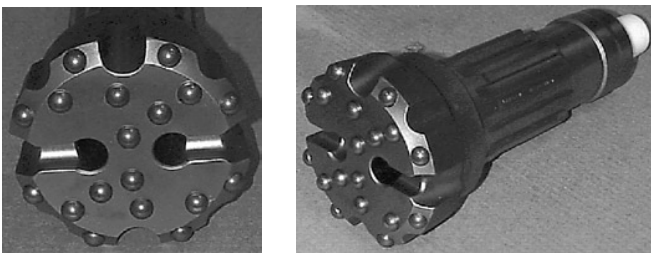
- Hard limestone
- Granite
- Sandstone
- Diorite
- Schist
- Marble



Flat face

Medium-hard to hard materials which are greater than 30,000 psi (2067 bar). Materials should be consolidated but a certain level of voids and fractures are acceptable. The flat face design has the strongest head.

- Granite
- Gabbro



Service

Bits need to be sharpened and serviced just like any other cutting tool would. The following provides tips and suggestions for proper bit maintenance.

Bit sharpening

The sharper a bit insert is the faster you will penetrate and the longer your bit will last. The objective is to penetrate the insert into the rock so that chips can be created. A sharper insert will penetrate deeper and generate larger cuttings. Also, the stresses on a sharp insert are lower those on a dull insert. Lower stresses mean longer insert life and reduced risk of socket bottom failures. The bottom line is

Keep those inserts sharp!!!

TerraRoc offers a complete assortment of bit sharpening tools and equipment. Contact your local TerraRoc sales location for a complete catalogue and sharpening instructions.

Troubleshooting Guide

The majority of DTH operating problems can be traced to improper operation. These troubleshooting charts will help you by suggesting a probable cause and a recommended remedy.

Problem	Cause(s)	Remedy(s)
<p>Rough-erratic operation</p>	<ol style="list-style-type: none"> 1. Too much water injection. 2. Chuck has worn too much. 3. Rotation speed too slow. 4. Feed too hard. 5. Valve lift too large. 6. Worn/leaking valve seal. 7. Worn bit bearing. 8. Worn piston exhaust tube 	<ol style="list-style-type: none"> 1. Reduce level of water injection. Consider installing a Hydrocyclone®. 2. Inspect chuck length for correct body length. A short chuck will restrict air needed to return piston. Note that body length is the distance from the shoulder which contacts the casing to the shoulder that contacts the bit. 3. Increase rotation speed to get at no more than 1/2 in. (12.7 mm) advance per revolution. Watch flat on carbide; if it's on the leading edge of the insert rotation's too slow. 4. Set feed pressure (decrease holddown or increase holdback) just until pulsation in rotation pressure falls and pressure is steady. 5. Inspect valve lift and replace valve assembly if needed. Valve lift should be .045 - .055 in. (1.14 - 1.9 mm) or, .075 - .085 in. (1.9 - 2.16 mm) for high flow QL60/QL65QM valve. 6. Check for axial wear of outside valve seal groove. Replace valve assembly if groove has worn more than .06" (1.5 mm). 7. Replace bit bearing. Leakage past bit bearing may cause piston to lack upstroke force making cycle erratic. 8. Inspect piston bore and exhaust tube vs. bore or exhaust tube. specification. Replace if needed. Leakage past this clearance can reduce piston upstroke force making cycle erratic.
<p>Low penetration/ high pressure</p>	<ol style="list-style-type: none"> 1. Worn/leaking valve seal 2. Chuck has worn too much. 3. Too much water injection. 4. Contamination (rubber hose, etc.) jammed hammer. 5. Exhaust tube projection too long. 6. Valve lift too small. 	<ol style="list-style-type: none"> 1. Check for axial wear of outside valve seal pressure groove. Replace valve assembly if groove has worn more than .06 in. (1.524 mm). 2. Inspect chuck length for correct body length. A short chuck will restrict air needed to return piston. 3. Reduce level of water injection. Consider installing a Hydrocyclone®. 4. Remove obstruction which may be holding the in valve closed or restricting the air flow. 5. Check projection vs. specifications repair tube. 6. Measure valve lift. Replace parts as needed to correct. This problem usually means that standoff has been lost and internal parts are loose. Check standoff of backhead

Problem	Cause(s)	Remedy(s)
Low penetration/ low pressure	<ol style="list-style-type: none"> 1. Lack of oil. 2. Worn drill clearances. 3. Damaged valve seat. 	<ol style="list-style-type: none"> 1. Insure lubricator is working and hammer is pressure getting coated with oil. Check bit blow ports for oil film. 2a. Inspect piston for wear particularly on large diameter just beneath scallops. This is the most sensitive diameter. Check other diameters; tail bore and tail diameter for wear. Compare all to specification. 2b. Inspect guide diameter for wear. Compare with specification and replace if necessary. 2c. Check cylinder bore for wear. Compare to specification and replace if necessary. 2d. Check casing bore for wear. Compare to specification and reverse or replace if necessary. 2e. Check bearing bore for wear. Compare to specification and replace if necessary. 3. Inspect valve seat surface for damage or wear which could cause leakage. Replace valve is suspect.
Drill running off bottom	<ol style="list-style-type: none"> 1. Worn piston. 2. Excessive water injection. 	<ol style="list-style-type: none"> 1. Inspect large diameter of piston for wear. Leakage past the large diameter can cause the piston to cycle when off bottom. 2. Try reducing water injection level. Water inhibits the air venting process which is needed to shut the hammer off.
Component failures	<ol style="list-style-type: none"> 1. Piston cracked through 2. Piston struck end cupping 3. Cracked casing. 	<ol style="list-style-type: none"> 1a. Lack of lubrication could cause frictional cracks. large diameter. Check lubricator and insure oil film is developed on bit blow holes. 1b. Wrenching over wrong location distorts casing and causes frictional rubbing with piston. Apply tong wrench pressure in correct location. 1c. Fighting or getting stuck in hole heats and distorts casing bore causing frictional heat and cracks on piston. Flood tool with water when stuck. 1d. Collaring on an angle or feeding hard through voided, faulted or broken ground can cause casing to distort and rub piston causing cracks. Use light feed when going through tough conditions. 2a. Usually a sign of underfeeding. Increase feed or breaking. until rotation pressure pulses and then back down till smooth. 2b. Cavitation from excess water injection can cause small pits in piston face. These pits turn into cracks. Avoid excessive water injection. 3a. Hammering, welding and wrenching in wrong location can fail casings; avoid these practices & use sharp tong jaws to loosen connections. 3b. Corrosion from internal undercuts and threads; use good quality (neutral pH) water and flush with oil when finished drilling. If possible, coat threaded areas undercuts and bore of casing with corrosion protector such as LPS Hardcoat. 3c. Look for beat in chuck which could allow the piston to stroke far enough to contact air distributor and overstress the casing. Replace chuck if worn more than specification.

Problem	Cause(s)	Remedy(s)
Component failures	4. Rolled over chuck 5. Cracked backhead-body. 6. Cracked backhead	3d. Look for leaking or loose fitting large dia valve seal which could make piston stroke too far and contact distributor. Replace the valve assembly. 3e. Casing has worn beyond discard point. Measure casing OD about 2 in. (50.8 mm) from chuck end. Compare to specification and replace if needed. 4. Underfeeding can cause the bit to rebound into shoulder. the chuck and generate a rolled up edge. Increase feed force. 5. Fighting from hole and pulling backhead through caved-in materials creates frictional heat. Rotate slowly and/or flood with water when stuck. 6. Look for evidence of connection moving on threaded connection. contact shoulder. Connection shoulder may be worn allowing movement. Replace/repair adapter sub or rod.
Breaking exhaust tubes	1. Erosion. 2. Damage. 3. Bit tube bore small.	1a. Water jetting erodes base of bit tube at striking surface. Reduce level of water injection. 1b. Contaminants in water mix and cause abrasive blast at base of exhaust tube. Use clean water. 2a. Damaging tubes when changing bits. Be careful to thread casing onto chuck while vertical and in alignment. 2b. Use care when transporting bits to avoid damage to tube. Keep bit in box until needed. 3. The tube bore of a bit can become deformed and pinch the tube. Look for a rolled over edge or deformation at the top of the bit bore. Remove by grinding away lip.
Chuck loosening in hole	1. Running loose. 2. Improper make up torque.	1a. Refer to proper feed settings 1b. Avoid feathering feed in loose ground or at end of rod. 2a. Tong chuck tight before drilling.
Chuck hard to loosen	1. Gripping poor. 2. Conditions	1a. Don't grip over threads. 1b. Insure tong jaws are sharp. 2a. Try using breakout washer

Specifications

DTH Requirements

Minimum guidelines for mounting specifications

Torque:

Roughly 500 ft-lb per inch (27 N-m per mm) maximum of bit.

Speed:

10 to 90 rpm

Hold down force:

500 lb per inch (9 kg per mm) of hammer maximum (i.e. QL60 needs 3000lb (1360.8 kg))

Hold back force:

Dependent on hole depth and string weight. Must be capable of maintaining 500 lb per inch (226.8 kg per mm) at depth.

Operating pressure:

350 psig (24.1 bar) maximum

Volume:

150 - 200 scfm per inch (.165 - .22 m³/min per mm) of hammer diameter.

Lubrication:

1/3 pint (.16 l) per hour per 100 scfm (2.8 m³/min)

Minimum requirements for compressor capacity and pressure

The pressure and production developed by a DTH will be related to the air flow passing through the drill. The pressure and performance of a DTH is related to the SCFM delivered by the compressor. To determine what pressure a DTH will carry (without fluid injection and well oiled) you need to take into account the actual SCFM (or mass flow) of air delivered by the compressor. Compressors are rated in ACFM which only equals SCFM at standard conditions of sea level and 60°F (16° C) inlet temperature. As the inlet air density either increases or decreases due to temperature and altitude changes, the SCFM delivery of a compressor will change. The pressure and performance of a DTH are related to the SCFM delivered by the compressor.

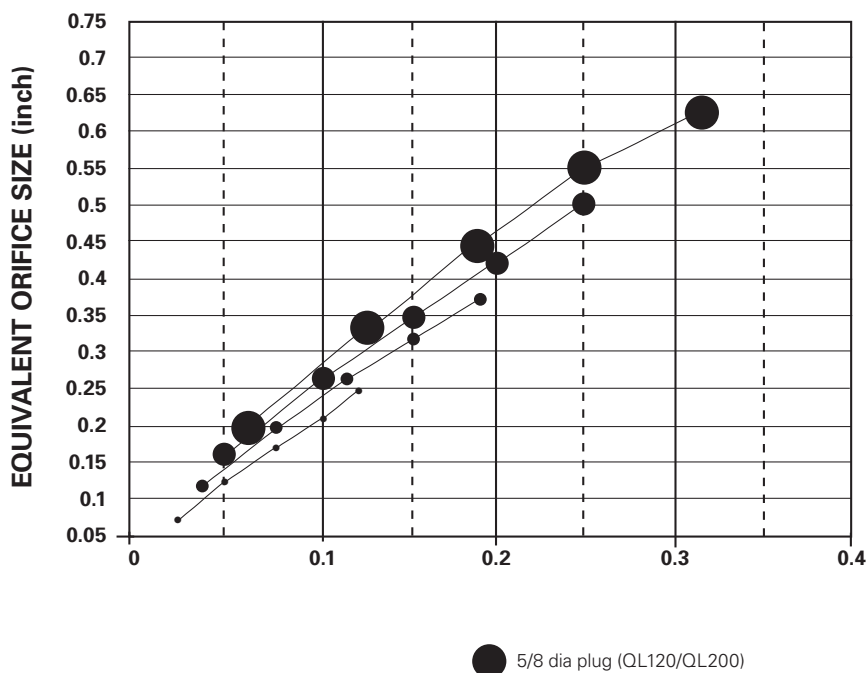
Figures below show the relationship of pressure and flow for all Quantum Leapr DTH 's running oiled with no water injection in a shallow hole.

The Figure 1 shows compressor correction factors for typical oil flooded screw compressors. The rated delivery of a compressor must be multiplied by the correction factor to determine delivery in SCFM. The flow in SCFM should be used for determining the pressure the drill will hold referring to Figure 1.

Figure 1. Altitude Correction Multipliers

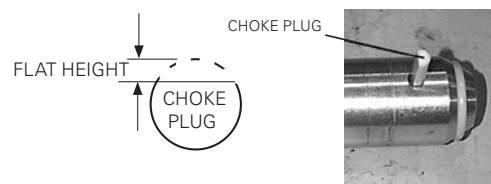
Altitude - feet (meters)	sea level 0 (0)	2,000 (609.6)	4,000 (1219.2)	6,000 (1828)	8,000 (2438.4)	10,000 (3048)
Atmospheric pressure PSIA (mm Hg)	14.70 (760.2)	13.66 (706.4)	12.68 (655.7)	11.77 (608.7)	10.91 (564.2)	10.10 (522.3)
Temperature °F (°C)						
0 (-18)	1.07	0.99	0.92	0.86	0.79	0.74
20 (-7)	1.05	0.97	0.90	0.84	0.78	0.72
40 (4)	1.02	0.95	0.88	.82	0.76	0.70
60 (16)	1.00	0.93	0.86	0.80	0.74	0.69
80 (27)	0.98	0.91	0.85	0.78	0.73	0.67
100 (38)	0.96	0.89	0.83	0.77	0.71	0.66
120 (49)	0.94	0.88	0.81	0.76	0.70	0.65

DIAMETER EQUIVALENT TO FLAT SIZE



1. Diameter is based on flow entering from both sides of the flat (ie. two flats make up hole equivalent).
2. Flat height is thickness removed from round choke plug.
3. Flow can be determined from the expression following where:
D is equivalent hole diameter
Q is flow in scfm
P is pressure in psig
Q = 9.71 x D² x P

Assumptions:
flow coefficient is 0.7 temperature is 120F
gas is air.



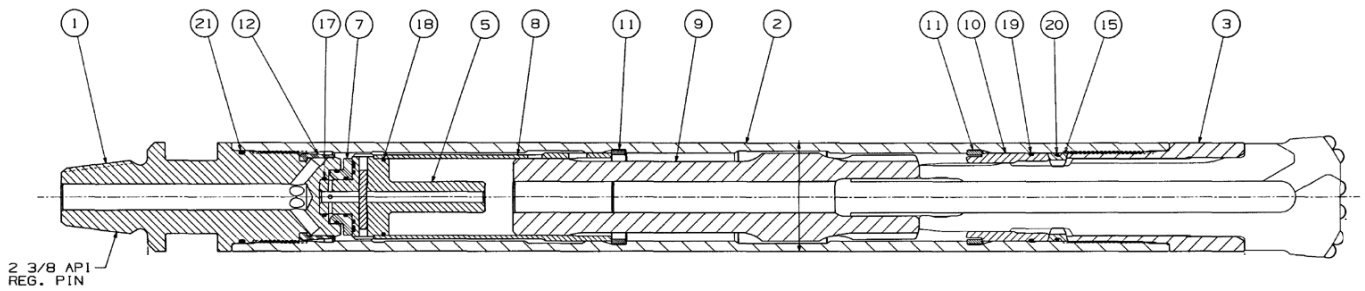
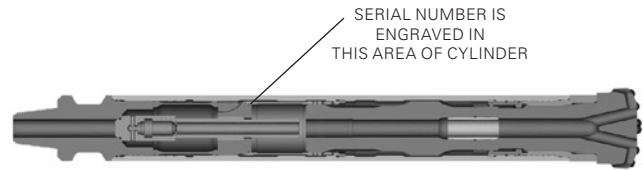
Ordering Instructions

When ordering service parts, please specify:

1. The **NAME** of each part as listed.
2. The **PART NUMBER** as listed or stamped on the part.
3. The **SERIAL NUMBER** of the equipment.

DO NOT use illustration numbers when ordering service parts.

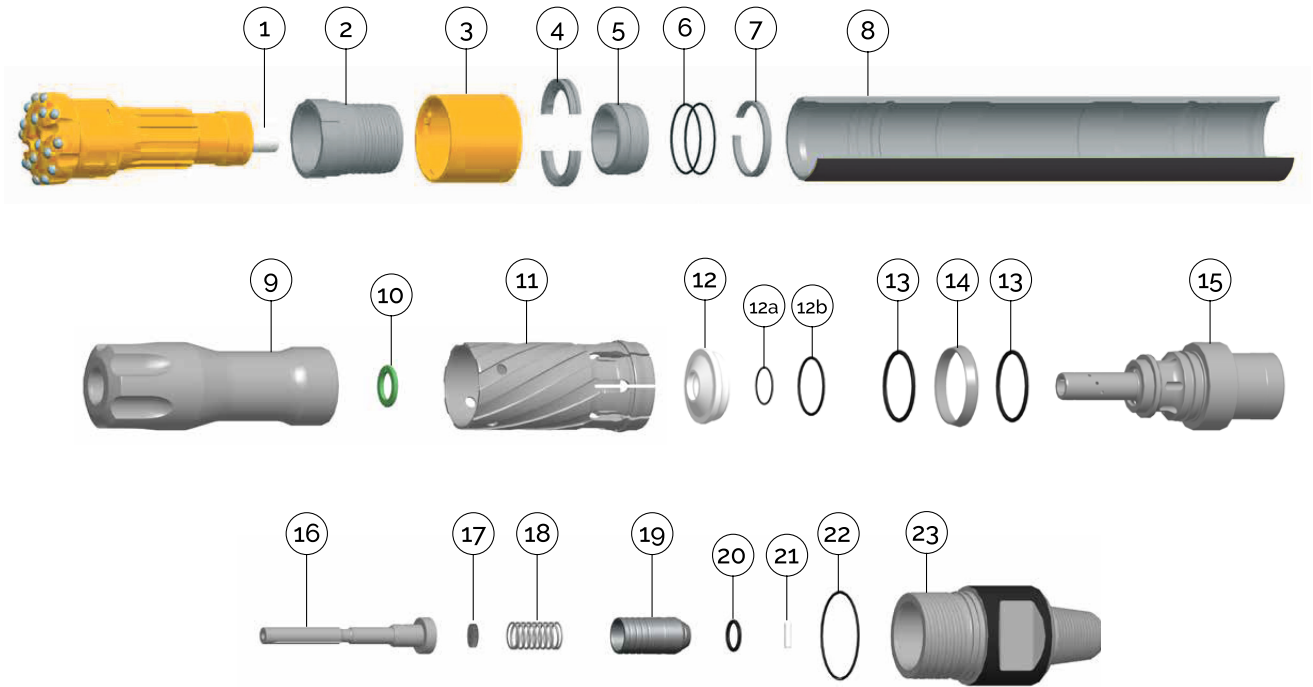
To save time, send all orders for parts to the nearest branch office or agent. **IF IT IS NECESSARY TO SEND ANY PART OF THIS EQUIPMENT TO THE FACTORY, INQUIRE AT OUR NEAREST BRANCH OFFICE OR AGENT FOR SPECIAL INSTRUCTIONS.**



Model: CPN: Description:	DHDQL120 52107448		DHDQL120-OPT-B 52138385		QL200 52286523		QL200S 52286531	
	Standard QL120. 6-5/8" API reg pin connection.		QL120 with 10-3/4" outside diameter. 6-5/8" API reg pin connection.		Standard QL200 with 8-5/8" API reg pin connection.		Standard QL200 with "SUPER chuck to allow use with up to 36" bits, 8-5/8 API reg pin connection.	
General specifications:	English	Metric	English	Metric	English	Metric	English	Metric
Connection:	6-5/8 API reg pin		6-5/8 API reg pin		8-5/8 API reg pin		8-5/8 API reg pin	
Outside diameter (in & mm)	11,21	284,7	10,75	273,1	15,60	396,2	15,60	396,2
Length w/o bit shoulder to shoulder (in & mm)	72,3	1837,2	72,3	1837,2	65,8	1670,1	72,1	1830,8
Length with bit extended (in & mm)	82,0	2082,8	82,0	2082,8	75,3	1911,4	83,5	2120,1
Length with bit retracted (in & mm)	80,0	2032,0	80,0	2032,0	73,3	1860,6	81,5	2069,3
Weight w/o bit (lb & kg)	1430	650,0	1257	571,4	2579	1172,3	2983	1355,9
Backhead across flats (in)	4 X 1" holes		4 X 1" holes		special wrench/tongs		special wrench/tongs	
Minimum bit size (in & mm)	12,25	311,2	12,25	311,2	17,50	444,5	28,00	711,2
Maximum bit size (in & mm)	22,00	558,8	22,00	558,8	26,00	660,4	36,00	914,4
Bore (in & mm)	9,250	234,95	9,250	234,95	12,250	311,15	12,250	311,15
Piston weight (lb & kg)	350	159,1	350	159,1	610	277,3	610	277,3
Stroke (in & mm)	5,00	127,0	5,00	127,0	4,00	101,6	4,00	101,6
Maximum pressure differential (psig & bar)	250,0	17,2	250,0	17,2	250,0	17,2	250,0	17,2
Maximum choke diameter (in & mm)	0,75	19,05	0,75	19,05	0,88	22,35	0,88	22,35
Make-up torque (ft-lb & N-m)	12000	16248	12000	16248	18000	24372	18000	24372
Air consumption:	QL120 (.050) (12")		QL120 (.050) (12")		QL200 (18")		QL200S (30")	
100 psi/ 6,9 bar (scfm & m ³ /min)	804	22,7	804	22,7	1 584	44,7	1 584	44,7
100 psi (bpm)	585	585	585	585	701	701	701	701
150 psi/ 10,3 bar (scfm & m ³ /min)	1 248	35,3	1 248	35,3	2 470	69,8	2 470	69,8
150 psi (bpm)	695	695	695	695	807	807	807	807
200 psi/ 13,8 bar (scfm & m ³ /min)	1 680	47,5	1 680	47,5	3 389	95,7	3 389	95,7
200 psi (bpm)	805	805	805	805	923	923	923	923
250 psi/ 17,2 bar (scfm & m ³ /min)	2 100	59,3	2 100	59,3	4 341	122,6	4 341	122,6
250 psi (bpm)	915	915	915	915	1 049	1 049	1 049	1 049
300 psi/ 20,7 bar (scfm & m ³ /min)	2 508	70,8	2 508	70,8	5 324	150,4	5 324	150,4
300 psi (bpm)	1 025	1 025	1 025	1 025	1 185	1 185	1 185	1 185
350 psi/ 24,1 bar (scfm & m ³ /min)	2 904	82,0	2 904	82,0	6 340	179,1	6 340	179,1
350 psi (bpm)	1 135	1 135	1 135	1 135	1 331	1 331	1 331	1 331
Operational specifications:								
Feed force (lbs)	4500-6000		4500-6000		10,000-12,000		10,000-12,000	
Rotation speed (rpm)	15-25		15-25		10-15		10-15	
Service specifications:								
Casing discard diameter (in & mm)	10,50	266,7	10,50	266,7	15,00	381,0	15,00	381,0
Casing reverse diameter (in & mm)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Minimum chuck length (in & mm)	4,25	108,0	4,25	108,0	4,87	123,7	11,30	287,0
Max. worn piston to casing clearance (in & mm)	0,013	0,34	0,013	0,34	0,019	0,50	0,019	0,50
Min new piston large OD:	9,242	234,75	9,242	234,75	12,239	310,87	12,239	310,87
Max new casing ID:	9,251	234,98	9,251	234,98	12,252	311,20	12,252	311,20
Max. worn piston to cylinder clearance (in & mm)	0,014	0,34	0,014	0,34	0,019	0,50	0,019	0,50
Min new piston tail OD:	8,302	210,87	8,302	210,87	10,739	272,77	10,739	272,77
Max new cylinder ID:	8,311	211,10	8,311	211,10	10,752	273,10	10,752	273,10
Max. worn piston to guide clearance (in & mm)	0,019	0,50	0,019	0,50	0,039	0,99	0,039	0,99
Max new piston tail/sealID:	2,352	59,74	2,352	59,74	2,875	73,03	2,875	73,03
Min new guide OD:	2,339	59,41	2,339	59,41	2,849	72,36	2,849	72,36
Max. worn bit to bearing clearance (in & mm)	0,031	0,80	0,031	0,80	0,034	0,88	0,034	0,88
Max new bearing ID:	7,396	187,86	7,396	187,86	8,770	222,76	8,770	222,76
Min new bit shank OD:	7,375	187,33	7,375	187,33	8,747	222,17	8,747	222,17
Max. worn bit to chuck clearance (in & mm)								
Max new chuck ID:								
Min new bit shank OD:								
Exhaust tube extension (in & mm):	2,72	69,09	2,72	69,09	2,59	65,79	2,59	65,79
Min. new valve height, low lift valve (in & mm):	2,211	56,16	2,211	56,16	2,236	56,79	2,236	56,79
Min. new valve height, high lift valve (in & mm):	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Valve lift new, low lift valve or w/shim (in & mm):	.045-.055	1,14-1,40	.045-.055	1,14-1,40	.061-.069	1,50-1,75	.061-.069	1,50-1,75
Valve lift new, high lift valve or w/o shim (in & mm):	.075-.085	1,90-2,16	.075-.085	1,90-2,16	n/a	n/a	n/a	n/a
Maximum backhead standoff:	0,105	2,67	0,105	2,67	0,188	4,78	0,188	4,78
Minimum backhead standoff:	0,053	1,35	0,053	1,35	0,125	3,18	0,125	3,18

TerraRoc QLX 60 OG

Down-the-hole hammer



Ref.	Part	Prod. No.
1	Exhaust tube	90514253
1	Exhaust tube, tapered	52340247
2	Retrieval chuck	52353612
3	Retrieval sleeve - comes with bit	-
4	Bit retaining ring, (O-ring not incl.)	52327632
5	Bit bearing	52324506
6	O-ring (bit retainer), not sold separately	-
6	Bit bearing, vented	89010216
7	Bearing retaining ring	52324514
8	Casing	52324415
9	Piston	52324423
10	Tail seal	52333820
11	Inner cylinder	52324480
12	Valve assembly	52333895
12a	Seal, not sold separately	-
12b	Seal, not sold separately	-
13	O-ring, not sold separately	-
14	Compression cone	52329034
15	Air distributor assembly	89012288
16	Airselect guide plug	89012271
17	Seat, check valve spring	89012272
18	Check valve spring	52349172
19	Check valve (O-ring incl.)	89010129
20	Check valve O-ring, not sold separately	-
21	Choke plug Solid**	50899137
21	Choke plug 1/4***	50899129

Ref.	Part	Prod. No.
22	Choke plug 1/8**	50899111
23	Backhead	52351806

*O-rings not sold separately. Included in different kits, see table.
**Item 21. Choke plug 1/4" and choke plug 1/8" may be used to bypass more air to reduce pressure and/or increase bailing velocity.*

Hammers and kits	Prod. No.
QLX 60 OG complete, 3 1/2" API Reg Pin, Retrieval chuck	52354180
QLX 60 OG complete, 3 1/2" API Reg Pin, Std. chuck, Vented bearing	89010219
QLX 60 OG complete, 3 1/2" API Reg Pin, Retrieval chuck, Vented bearing	89010220
E-kit (for retrieval options), QLX 60 OG incl. item 2, 2x5, 8, 10, 12, 2x13, 18, 20, 22, 23	89010008
E-kit (for standard chuck), QLX 60 OG incl. item 2, 2x5, 8, 10, 12, 2x13, 18, 20, 22, 23	89010007
O-ring kit, QLX 60 OG incl. item 4x5, 4x13, 20, 22	89010120
Sustainability kit, QLX 60 OG incl. item 2x5, 10, 12, 2x13, 20, 2x22	52354646

Wear limits		
Chuck	Min. length	2.15 in / 54.6 mm
Casing reverse QLX 60 OG	Min. OD	5.44 in / 138.2 mm
Casing discard	Min. OD	5.31 in / 134.9 mm
Bit bushing	Max. ID	3.623 in / 92.02 mm
Piston / Casing clearance	Max.	0.009 in / 0.23 mm
Piston / Cylinder	Max.	0.009 in / 0.23 mm
Exhaust tube protrusion		2.31 in / 58.67 mm

9866 0074 01 2018.03

Finland
Pihitsulunkatu 1 A
33330 Tampere
Finland

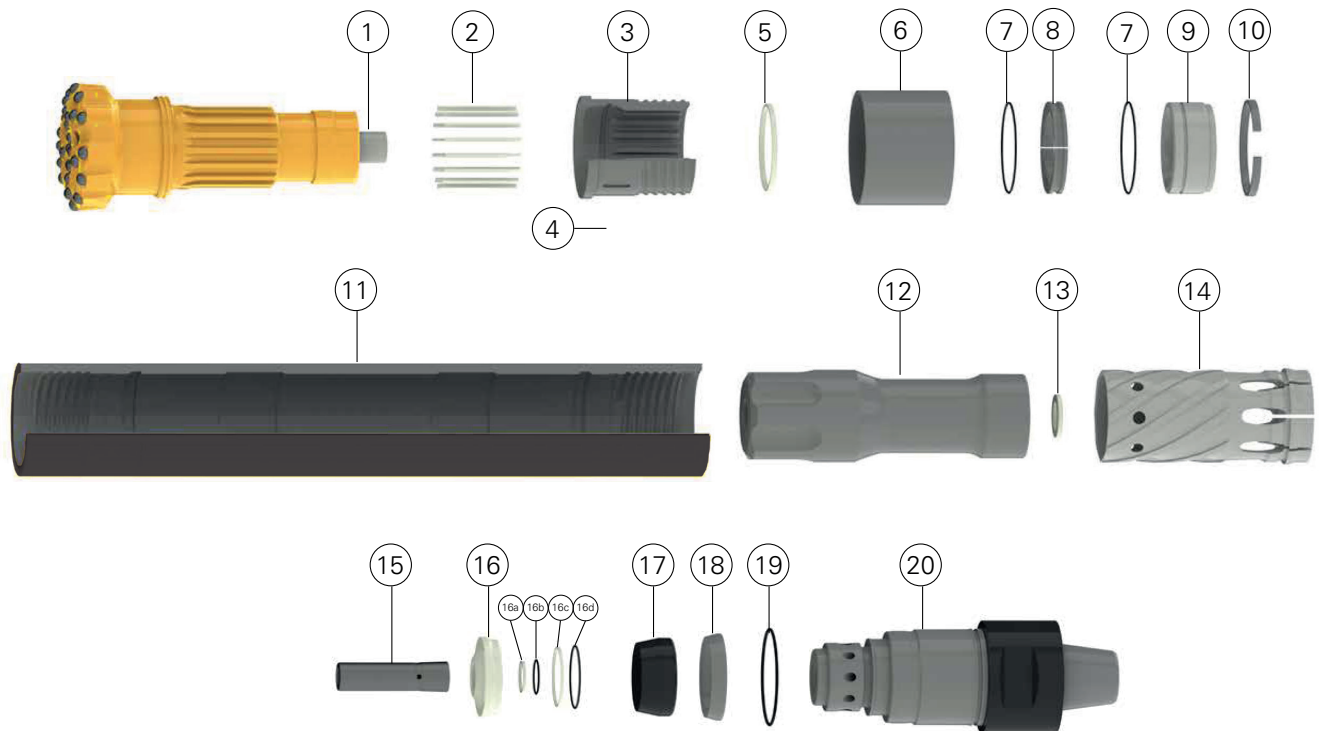
UK
4 - 6 South Lumley Street,
Grangemouth FK3 8BT,
Scotland.

USA
7500 Shadwell Drive,
Roanoke, Virginia, 24019
USA

 **TerraRoc**
terrarcdrilling.com

TerraRoc TD90OG

Down-the-hole hammer



Ref.	Part	Prod. No.
1	Exhaust tube	52341450
2	Drive pin	59000064
3	RS chuck	89012680
3	Std drive pin chuck	89010241
4	RR key	89011551
5	Drive pin support ring	89010515
6	Retainer sleeve	89012681
7	Retaining / Bearing O-ring	95086740
8	Retaining rings	52329455
9	Bearing	52328945
10	Stop ring	52329372
11	Casing	52328846
12	Piston	52328853
13	Tail seal	52328184
14	Cylinder	52328937
14	Cylinder DT	89010383
15	Solid guide	52347283

Ref.	Part	Prod. No.
16	Valve assembly	52337615
16a	Seal*	--
16b	O-ring*	--
16c	Seal*	--
16d	O-ring*	--
17	Check seal	52328929
18	Compression cone	52328879
19	Backhead O-ring	95538104
20	Backhead	52328861

*Not sold separately. Included in different kits below.

Hammers and Kits	Prod. No.
TD 90 RS 4 1/2 API Reg Pin	52348877
TD 90 4 1/2 API Reg Pin DP Chuck	89011506
Sustainability kit TD 90OG, incl. item 2x8, 14, 17, 18, 20	52354650

9853 1331 01 2016-05

Finland
Pihtisutunkatu 1 A
33330 Tampere
Finland

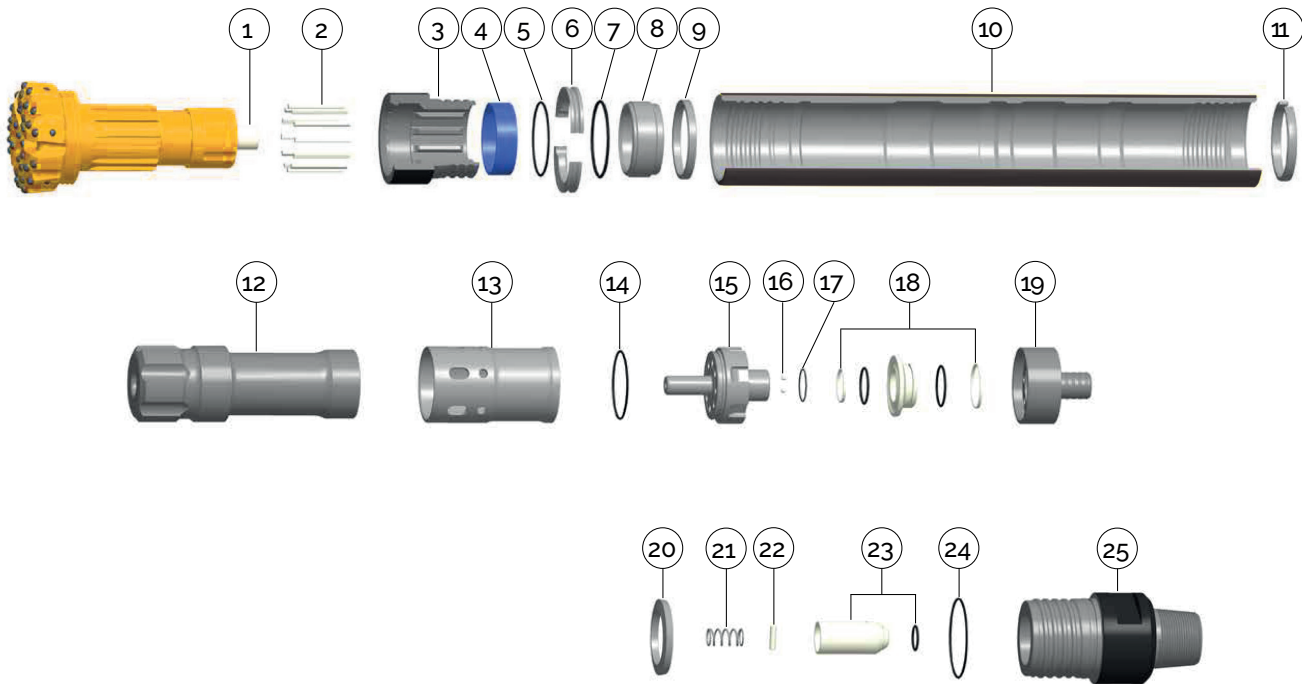
UK
4 - 6 South Lumley Street,
Grangemouth FK3 8BT,
Scotland.

USA
7500 Shadwell Drive,
Roanoke, Virginia, 24019
USA

 **TerraRoc**
terrarcodrilling.com

TerraRoc QLX 100

Down-the-hole hammer



Ref.	Part	Prod. No.
1	Exhaust tube	89010443
1	Drive pins	89010442
3	Standard chuck	89010455
3	Retrievable Sleeve chuck	89010465
4	Chuck bearing	89010448
5	Bit retainer O-ring	95538104
6	Bit retainer rings	89010461
7	Bearing retainer O-ring	89010466
8	Vented bit bearing	89010457
8	Bit bearing *	89010560
9	Bearing stop ring	89010456
10	Casing	89010454
11	Cylinder stop ring	89010460
12	Piston	89010463
13	Cylinder	89010458
13	DT cylinder	89010478
14	Distributor to cylinder O-ring	95538104
15	Distributor	89010440
16	Distributor plugs	<i>Not sold separately</i>
17	Distributor to valve cap O-ring	89010512
18	Valve assembly	89010438
19	Valve cap	89010439
20	Bellville spring	89010459
21	Check valve spring	89010464
22	Solid choke plug	89010467
22	Choke plug - 3/16" - 4.83mm Orifice	89010471

Ref.	Part	Prod. No.
22	Choke plug - 5/16" - 7.9mm Orifice	89010472
23	Check valve assembly	89010470
23	Check valve O-ring	<i>Not sold separately</i>
24	Backhead O-ring	95760906
25	Backhead 6 5/8" Pin	89010453
25	HC backhead *	89010530
26	HC inducer/separator *	89010532
27	HC check seal *	89010531
28	HC O-ring *	89010533
29	HC O-ring *	8901088

*Not shown in illustration

Hammers and Kits	Prod. No.
QLX 100,COMP 6 5/8 API Reg Pin	89010474
QLX 100,COMP 6 5/8 API & RS RET	89010479
QLX 100,COMP 6 5/8 API Pin, HC	89010534
QLX,100,COMP 6 5/8 API, RS RET, HC	89010535
QLX,100,COMP 6 5/8 API Reg Pin	89010561
Sustainability kit (Includes items 7, 2x14, 17, 18, 21, 24)	89010495

Service specifications	in	mm
Casing discard diameter	8.450	214.6
Minimum chuck length	3.750	95.2
Max. worn piston to casing clearance	0.016	0.4
Max. worn piston to cylinder clearance	0.015	0.4
Max. worn piston to guide clearance	0.014	0.4
Max. worn bit to chuck clearance	0.070	1.8

9853 1277 01 - 2014.06

Finland
Pihlisulunkatu 1 A
33330 Tampere
Finland

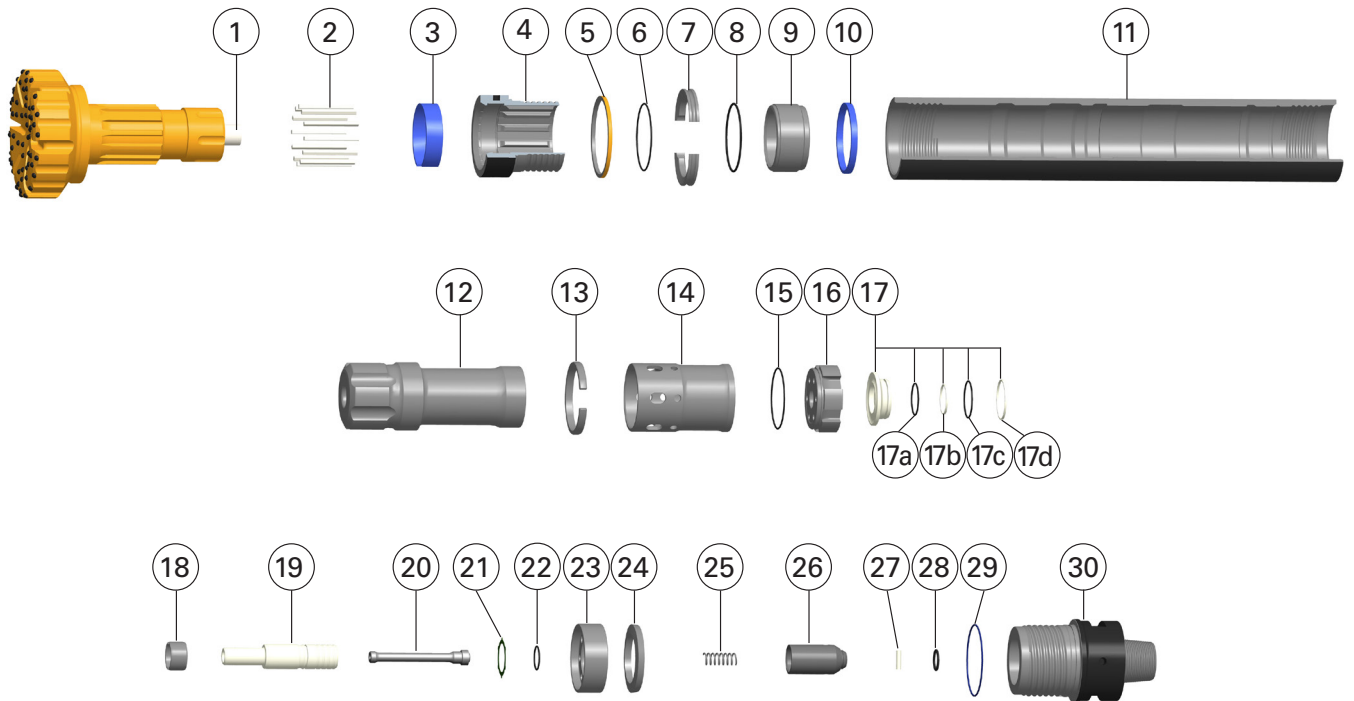
UK
4 - 6 South Lumley Street,
Grangemouth FK3 8BT,
Scotland.

USA
7500 Shadwell Drive,
Roanoke, Virginia, 24019
USA

 **TerraRoc**
terrarocdrilling.com

TerraRoc QL 120

Down-the-hole hammer



Ref.	Part	Prod. No.
1	Exhaust tube	52342094
2	Drive pins 12pc's required (sold as each)	52107604
3	Chuck bearing	52105699
4	Chuck QL120	52105632
4	Chuck QL120 Retrievable Sleeve	52354643
5	Breakout washer solid (used in both ends) ***	52346665
6	O-ring* (Bit retaining ring)	95379350
7	Bit retaining ring	52105640
8	O-ring* (Bit bearing)	52107422
9	Bit bearing	52287562
10	Lock ring (Bit bearing)	52105657
11	Casing QL120	52105616
12	Piston	52105509
13	Lock ring (Cylinder)	52105681
14	Cylinder	52105541
15	O-ring* (Air distributor)	95379350
16	Air distributor	52105525
17	Valve assembly	52116209
17a	O-ring (Valve)	N/A
17b	Seal-ring (Valve)	N/A
17c	O-ring (Valve)	N/A
17d	Seal-ring (Valve)	N/A
18	Sleeve	52105608
19	Distributor guide	89010385
20	Guide liner	52105566
21	Valve shim .025"	52127594
22	O-ring* (Valve cap)	95087086
23	Valve cap	52105533
24	Belleville spring	52105590
25	Spring (Check valve)	51989259
26	Check valve assembly with O-ring	89010386

Ref.	Part	Prod. No.
27	Choke plug solid**	51991305
27	Choke plug 3/8" **	51991313
27	Choke plug 1/2" **	51991321
28	O-ring* (Check valve)	52097896
29	O-ring* (Backhead)	95402913
30	Backhead QL 120 STD 6 5/8" API Reg Pin	52105624
30	Backhead QL 120 BO 6 5/8" API Reg Pin	52346681
30	Backhead QL 120 HC 6 5/8" API Reg Pin	89010524
	Separator O-Ring Part	89011086
	Separator (HC only)	89010525
	Preload O-ring (HC only)	95087250
	Separator O-ring (HC only)	95086781
	Check seal (HC only)	52107257

* O-rings not sold separately. Included in different kits, see table.
 ** Item 27: Choke plug 1/4" and choke plug 1/8" may be used to bypass more air to reduce pressure and/or increase bailing velocity.
 *** Used ONLY on QL120 BO Solid

Hammers and kits	Prod. No.
QL 120 STD, 6 5/8" API Reg Pin	52107448
QL 120 BO Solid both ends, 6 5/8" API Reg Pin	52350725
QL 120 HC, 6 5/8" API Reg Pin	52107455
QL 120 Retrievable Sleeve, 6 5/8" API Reg Pin	52107620
QL 120 Retrievable Sleeve HC, 6 5/8" API Reg Pin	52133501
E-kit QL 120	N/A
Sustainability kit incl. item 6, 8, 15, 17, 22, 28, 29	52354648

Bit retainer sleeves for Oil & Gas	Prod. No.
Retainer Sleeve <14-3/4"	89012683
Retainer Sleeve 14-3/4"+	89012682

9866 0182 01 2018.04

Finland
 Pihlisunkatu 1 A
 33330 Tampere
 Finland

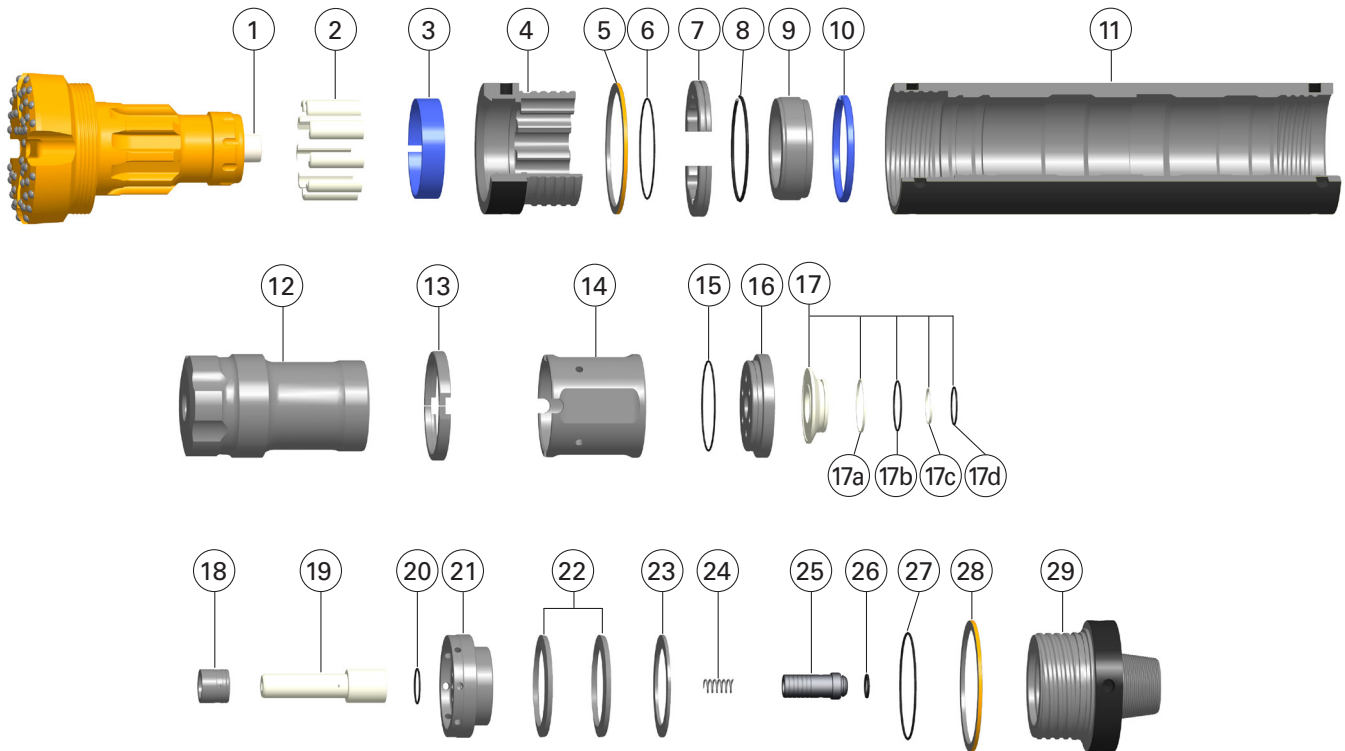
UK
 4 - 6 South Lumley Street,
 Grangemouth FK3 8BT,
 Scotland.

USA
 7500 Shadwell Drive,
 Roanoke, Virginia, 24019
 USA



TerraRoc QL 200, QL 200S

Down-the-hole hammer



Ref.	Part	Prod. No.
1	Exhaust tube	51989432
2	Drive pins, 9pc's required for QL 200, 12pc's for QL 200 S, Sold as each	51989424
3	Chuck bearing	51989416
3a	Chuck bearing QL 200 S	52124880
4	Chuck QL 200	51989390
4a	Chuck QL 200 S	89010026
5	Breakout washer solid (used in both ends)	52342250
5a	Thrust/Breakout washer (chuck side QL 200 S only)	89010027
6	O-ring (bit retaining ring)	95451233
7	Bit retaining ring	51989382
8	O-ring (bit bearing)	51989481
9	Bit bearing	52133543
10	Lock ring (bit bearing)	52342177
11	Casing	52286507
12	Piston	52286515
13	Lock ring (cylinder)	51989333
14	Cylinder	51989457
15	O-ring (air distributor)	95451233
16	Air distributor	52097045
17a	O-ring (valve)	N/A
17b	Seal-ring (valve)	N/A
17c	O-ring (valve)	N/A
17d	Seal-ring (valve)	N/A
18	Sleeve	52097037
19	Distributor guide	52097029
20	O-ring (valve cap)	95136818
21	Valve cap	52097052

Ref.	Part	Prod. No.
22	Belleville spring, qty required 2 pcs	51989283
23	Belleville spacer	52098860
24	Spring (check valve)	51989259
25*	Check valve assembly with O-ring	51989739
	Choke plug solid, not shown	51991305
	Choke plug 3/8", not shown	51991313
	Choke plug 1/2", not shown	51991321
26	O-ring (check valve)	52097896
27	O-ring (backhead)	95018347
28	Breakout washer solid (used in both ends)	52342250
29	Backhead QL 200 / QL 200 S, 8 5/8" API reg pin	51989218
**	Retrieval sleeve, inner, not shown	89012304
**	Retrieval sleeve, outer, not shown	89012305
**	Key, retainer, not shown (requires 6 per assembly)	89012306
	Solid shim, not shown	51989275

*Item 25: Choke plug 1/4" and choke plug 1/8" may be used to bypass more air to reduce pressure and/or increase bailing velocity.
**For use only with 1 1/2" bits.

Ref.	Hammers and kits	Prod. No.
	QL 200, 8 5/8" API reg pin	52286523
	QL 200 S, 8 5/8" API reg pin	52286531
	E-kit QL 200 / QL 200 S	N/A
	Chuck QL 200 S assembly (incl item 3a, 4a, 5a)	89010028
17	Valve assembly	52098753
	Air distributor and guide assembly (incl item 16, 18, 19)	52098761
	Lifting bail	50780170

9866 0187 01 2018.04.

Finland
Pihlisulunkatu 1 A
33330 Tampere
Finland

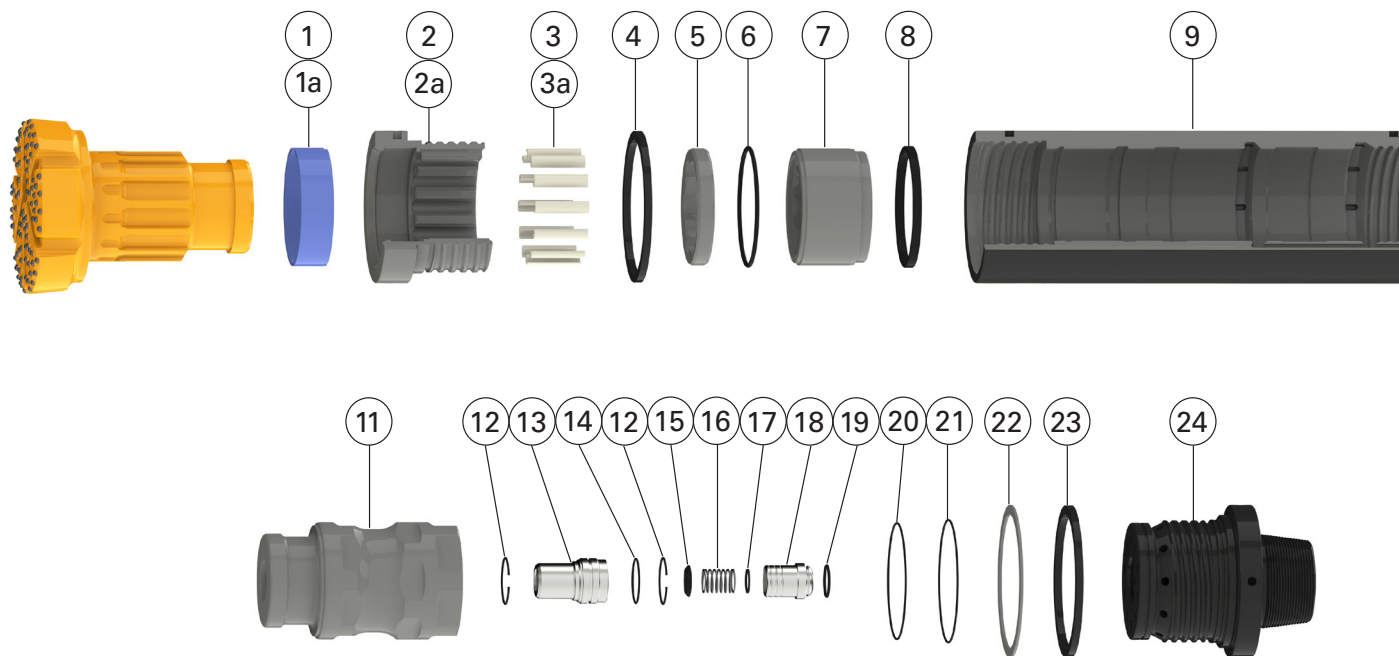
UK
4 - 6 South Lumley Street,
Grangemouth FK3 8BT,
Scotland.

USA
7500 Shadwell Drive,
Roanoke, Virginia, 24019
USA

 **TerraRoc**
terrarocdrilling.com

TerraRoc QL 300, QL 300S

Down-the-hole hammer



Ref.	Part	Prod. No.
1	Chuck bearing, QL 300	52339561
1a	Chuck bearing, QL 300 S	52339538
2	Chuck, QL 300	52339553
2a	Chuck, QL 300 S	52339520
3	Drive pin, QL 300 x12	52338738
3a	Drive pin, QL 300 S x18	52338738
4	Breakout washer	52347861
4a	Thrust washer, QL 300 S only, not shown	52339579
5	Bit retaining ring	52339512
6	Bearing retaining ring	52339884
7	Bearing	52339439
8	Bearing stop ring	52339546
9	Casing	52339397
10	Plug, casing x10	52339470
11	Piston	52339405
12	Guide retaining rings x2	52339082

Ref.	Part	Prod. No.
13	Guide	52339413
14	Guide O-ring	52339876
15	Check valve spring guide	52339454
16	Check valve spring	52339462
17	Check valve spring stop	52339447
18	Check valve	52339421
19	Check valve O-ring	52339868
20	Backhead O-ring front	52339850
21	Backhead O-ring rear	52339843
22	Casing washer	52339504
23	Breakout washer	52347861
24	Backhead	52339389
25	Lifting plug, not shown	52342169

Hammers	Prod. No.
QL 300, 16" Beco pin	52339363
QL 300 S, 16" Beco pin	52339371

9866 0198 01 2018.05

Finland
Pihtisulunkatu 1 A
33330 Tampere
Finland

UK
4 - 6 South Lumley Street,
Grangemouth FK3 8BT,
Scotland.

USA
7500 Shadwell Drive,
Roanoke, Virginia, 24019
USA

 **TerraRoc**
terrarocdrilling.com

Customised Geotechnical Solutions.

Full range of drilling tools and consumables for casing advancement systems, down-the-hole hammers and core drilling, all customised for your needs.

terrarocdrilling.com



Finland
Pihtisulunkatu 1 A
33330 Tampere
Finland

UK
4 - 6 South Lumley Street,
Grangemouth FK3 8BT,
Scotland.

USA
7500 Shadwell Drive,
Roanoke, Virginia, 24019
USA