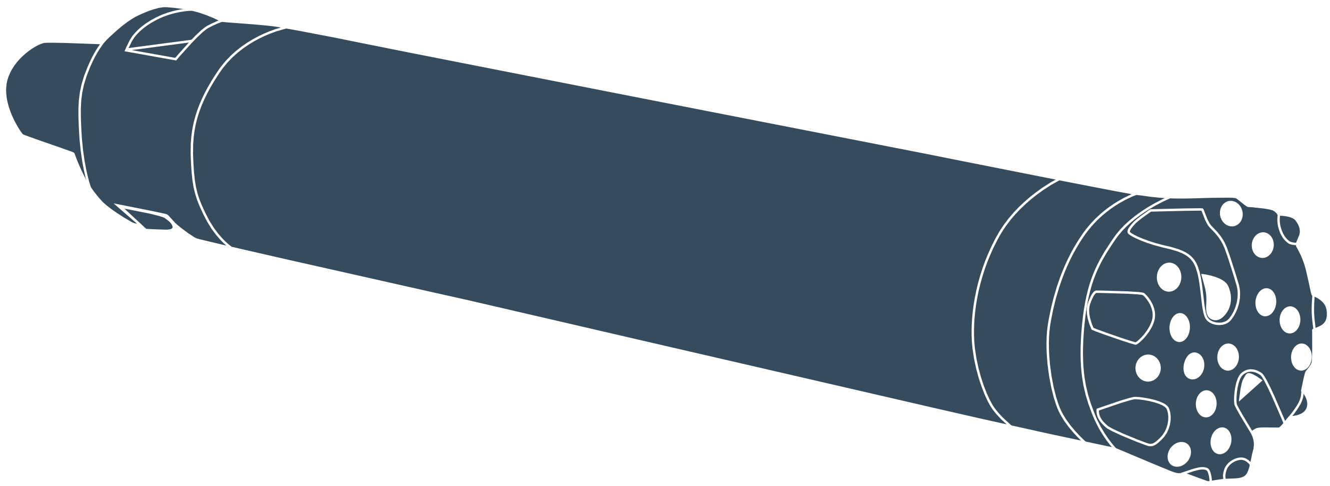
Secoroc QLX down-the-hole hammers

QLX 35/40/50/55/60/60 OG/65/100

Operator's instructions
Spare parts lists

Epiroc



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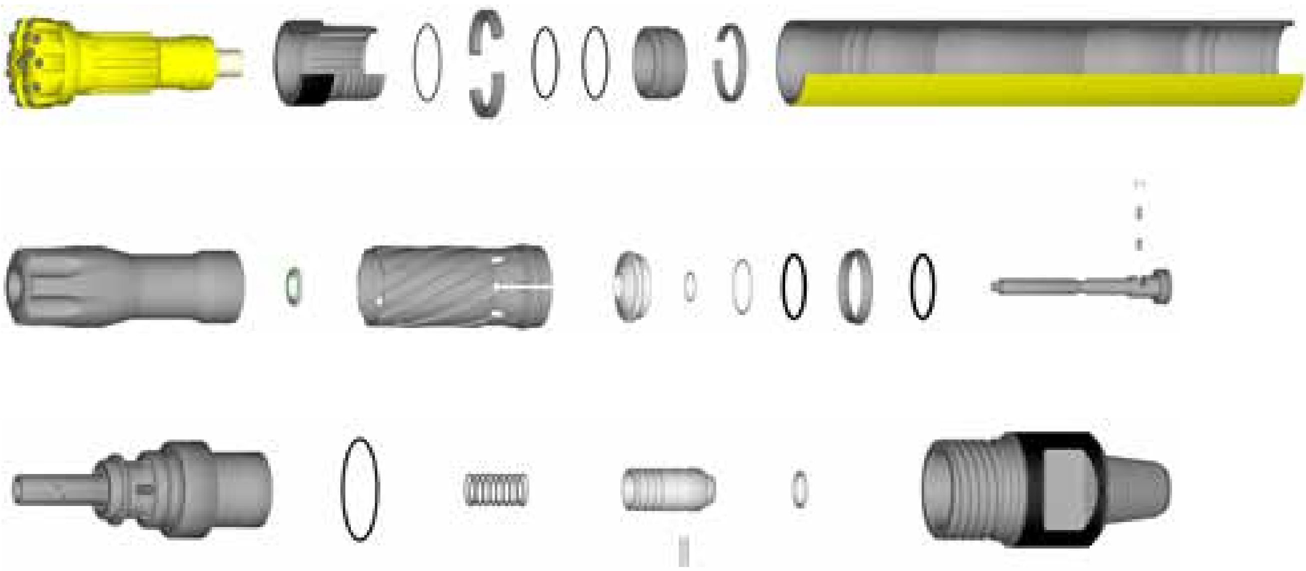
Introduction

The QLX series



READ THIS MANUAL CAREFULLY to learn how to operate and service your DTH hammer correctly. Failure to do so could result in personal injury or equipment damage. Consult your Epiroc Drilling Tools dealer 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 hammer, and should remain with the DTH hammer and available for reference at all times.

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

MEASUREMENTS in this manual are given in both Imperial 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 hammer 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
m/s	Meters per second

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 Epiroc dealer or representative or by contacting the factory.

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

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

Keep the DTH hammer in good working condition

Keep your DTH hammer in proper working condition.

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

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

Visually inspect the DTH hammer daily before using. Do not operate the DTH hammer 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 hammer .

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 hammer.

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.

Warning symbols

Be aware of safety information.

A warning symbol - 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

Indicates hazards or hazardous procedures which COULD result in serious or fatal injury if the warning is not observed.

⚠ CAUTION

Indicates hazards or hazardous procedures which COULD result in injury or damage to equipment if the warning is not observed.

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 linemanís 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 hammer is to be used only for those purposes for which it was intended as explained in this instruction manual.

Installation and operation

Follow instructions

Before operating this down-the-hole hammer for the first time, become familiar with the operation of the machine and the hammer.

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 Epiroc dealer.

Description

The QLX line of down-the-hole hammers is 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 hammers 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.

QLX DTH hammers 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 hammers 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 hammers 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 Epiroc QLX DTH hammer 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 QLX hammer cycle and common DTH hammer cycles.

Installation and setting up the DTH hammer

Before the DTH hammer is used to drill it should be set up for proper air consumption and the joints should be tightened. The selection of choke size 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.

Airselect setup

The best performance of any DTH hammer 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. When more air volume delivery is available than that required to operate the hammer at the rated compressor pressure, an alternative way of utilizing the excess volume is required. If this excess flow is not used the compressor´s unloader will cycle, resulting in a loss of hammer performance.

Traditionally, this excess air has been bypassed through the exhaust passages of the hammer by means of a choke system. These systems, while effectively disposing of the excess air and providing extra hole cleaning capability, will reduce drilling effectiveness by creating back pressure in the exhaust passages of the drill, which reduces power output and drilling rate.

The Airselect system has been designed to eliminate this disadvantage by allowing a QLX hammer to be adjusted to utilize any excess air volume in the operating chambers of the drill, insuring maximum power output without the need for choke plugs, additional valves, or additional valve guides. Unlike conventional bypass choke systems, Airselect adjusts the valving sequence of the hammer to consume more or less air, as required. As the piston drives toward the bit, a sequence of holes in the guide is uncovered. One pair of these holes is aligned with grooves in the guide plug. When that pair of holes is passed by the piston, high pressure air is directed to the top of the valve, forcing it closed. The higher the unconvered pair of holes is in the piston down stroke, the sooner the valve closes, and the less air is consumed.

Note: This system is available in the QLX 5" / QLX 6'" series.

Note:

- Rotate air select counter clockwise for larger position
- QLX 50/55 has 4 AirSelect positions
- QLX 35, QLX 40, QLX 60 OG and QLX 100 are not adjustable

QLX AirSelect is set at position 2 from the factory. DO NOT ATTEMT TO ROTATE BELOW 1 OR ABOVE 5

Airconsumption and Freqency QLX 50/55											
Air consumption / Bpm	**Airselect pos 1**		**Airselect pos 2**		**Airselect pos 3**		**Airselect pos 4**				
363 psi / 25 bar (scfm / l/s)	809	382	871	411	905	427	1055	498			
BPM	1807		1829		1852		1899				
Airconsumption and Freqency QLX 60/65											
Air consumption / Bpm	**Airselect pos 1**		**Airselect pos 2**		**Airselect pos 3**		**Airselect pos 4**		**Airselect pos 5**		
350 psi / 24 bar (scfm / l/s)	865	408	900	425	1000	472	1050	496	1250	590	
BPM	1875		1900		1967		2004		2140		

Note: The QLX hammers use the AirSelect system to properly match the hammer air consumption to the output of the comres-sor. Unlike previous models, the QLX AirSelect can NOT be turned in a full 360 degree range. There are five (5) positions on the AirSelect as shown above. If you attemt to rotate the guide below position one (1) or above position five (5) you will damage the AirSelect.

New airselect guide plug and distributor assembly

Description: Airselect guide plug, #89012271 and Distributor as-sembly, #89012288

Detail: This change in design is to help improve product reliability

The airselect will now have a "pentagon" shape which mates with a "hex bushing" in the distributor.

The detent kit (plunger, spring & retainer plug) will no longer be used.

However, the airselect is still adjustable but hammer will need to be disassembled.

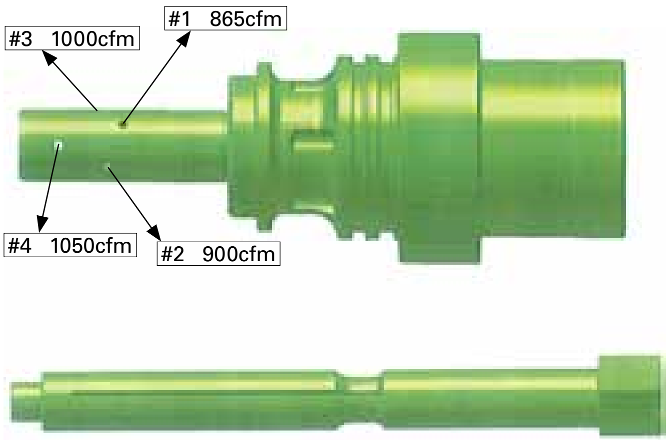
Once disassembled, the airselect guide plug can be removed from distributor and repositioned to desired setting and reassembled into distributor.

Note: There will be a slight inference between guide plug and "hex bushing" in distributor. Use of soft tip hammer or harbor press will be helpful.

Note: Hammers with S/N 1608A200 and higher will have the new design change.

QLX60/65 Distributor assembly #89012288

QLX60/65 Airselect guide plug #89012271



Align slot of guide plug with setting holes in distributor for posi-tion.

Rotate guide plug counter clockwise for higher setting.

Note: Setting #5, all holes are blocked. Signal is picked up from goove in the end of distributor: 1250cfm and higher.

Setup choke plug

Before the DTH hammer is used to drill it should be set up for proper air consumption and the joints should be tightened . The selection of choke size will be dependent on the hole cleaning requirments and the capacity (pressure and flow) of the compressor being used. Hammer air comsumption 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 inpredictable , the proper choke size can only be selected after experience is deleveloped.

The best performance of any DTH hammer 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. QLX hammers* 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. "Solid" choke plugs are installed from factory.

It should be noted that opening choke plug does create a back – pressure on the DTH hammer which reduces performance. Additionally, excess air which is not needed for hole cleaning increases the wear of the DTH hammer.

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.

If additional choke plugs are installed, install as shown.

*Except for QLX 35 and QLX 40.

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 air which is lifting cuttings from the hole.

Bailing velocity is defined as the velocity of the air in the hole annulas at atmospheric pressure. In other words, the effect of bottom hole pressureis 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 hammer in scfm by the annulus area in square feet. The equation following may be used:

VELOCITY [ft./min..] (m/min.) =

AIR CONSUMPTION [scfm] (m^3/min)

ANNULAS AREA [sq.ft.] (sq. m)

Where:

- Air consumption is the rate 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:

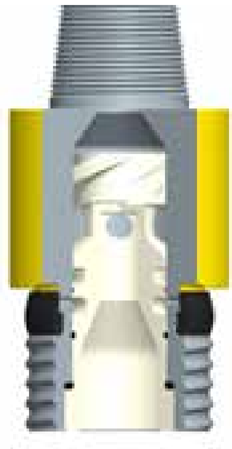
Annulas area:

[sq. ft.] = 0,0055 x (hole dia. [inches] squared - rod dia. [inches] squared)

[sq. m) = 0,785 x (hole dia. [m] squared - rod dia. [m] squared)

Hydrocyclone set up – QLX 100

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.



Maximim fluid removal capacity (gallons per minute)

The hydrocyclone (HC) separator metering orifice size (inch) 0,250 (¼'").

Quantity of meterings ports (one open from factory, one partial from factory).

Operating pressure (psig)

150 psi / 1 port	= 16,0 gpm / 2 ports	= 32,0 gpm
175 psi / 1 port	= 17,3 gpm / 2 ports	= 34,5 gpm
200 psi / 1 port	= 18,5 gpm / 2 ports	= 36,9 gpm
225 psi / 1 port	= 19,6 gpm / 2 ports	= 39,2 gpm
250 psi / 1 port	= 20,6 gpm / 2 ports	= 41,3 gpm
275 psi / 1 port	= 21,7 gpm / 2 ports	= 43,3 gpm
300 psi / 1 port	= 22,6 gpm / 2 ports	= 45,2 gpm
325 psi / 1 port	= 23,5 gpm / 2 ports	= 47,1 gpm
350 psi / 1 port	= 24,4 gpm / 2 ports	= 48,9 gpm
375 psi / 1 port	= 25,3 gpm / 2 ports	= 50,6 gpm
400 psi / 1 port	= 26,1 gpm / 2 ports	= 52,2 gpm

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 DTH hammer performance.

New bit and chuck

The QLX 100 uses plastic drive pins which insure a noNmetallic chuck to bit interface. These pins must be installed prior to operating hammer. If the drive pins are omitted or fail, the chuck/bit spline surface can operate reliably but ONLY for a short period of time.

Chuck threads should be well coated with thread grease before threading into casing. Remembering to install bit retaining rings.

DTH hammer setup

For higher air flow, the Airselect guide is adjusted to uncover holes closer to the end of the guide. This delays the closure of the valve until the piston has travelled further down. The additional 'swept volume´ allows more air to flow into the drive chamber of the hammer, extracting the power of the available air for drilling instead of wasting it by dumping it to exhaust. Since the additional air flows through the operating chambers of the DTH hammer, power-robbing back pressure is also avoided.

Airselect is available in QLX 50/55 and QLX 60/65. This innovation allows the Airselect setting to be changed simply by rotating the guide with a hex socket wrench. Using extensions, the Airselect can be reset from the chuck end of the hammer without disassembly.

Note: QLX hammers with Airselect are shipped from the factory at position 2.

When adjusting the Airselect system, be sure the socket is securely attached to the extension. A few wraps of electrical or similar tape will help secure the socket to the extension. If the socket detaches from the extension, it will be necessary to disassemble the hammer and retrieve it before drilling. For best results, attach the socket permanently to the extension.

	Socket	Ext. Length
QLX 50/55	7 / 16"	24" / 610 mm
QLX 60/65	9 / 16"	24" / 610 mm

Makeup towrque and backhead closure

The QLX drills use a ´compression cone´ arrangement whereby parts are held in place under very high load.

Because of the high load used to clamp the parts in place in the QLX drills; a high level of torque is needed to close the backhead gap. Rotary head torque may be sufficient but in some cases a supplementary wrench may be needed. It is extremely important that the backhead gap be closed in these drills.

The presence of a gap between the casing and the back-head 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 suggested that the backhead and chuck be torqued to approximately 750–1000 ft.-lb per inch (40,5–54 Nm per mm) of hammer diameter. For example a 6 in. (152 mm) class (QLX 60) drill should be torqued to 4500–6000 ft.lb (6156-8208 Nm). This makeup torque insures against loosening joints in the hole and also preloads the threads sufficiently.

Drill lubrication

Lubrication guidelines and specifications

All DTH hammers 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 Epiroc Rock Drill Oil be used. If another type of oil is used it must comply with the oil specifications shown on page 20.

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 m^3/min.) of air. For example a 900 scfm (25,5 m^3/min.) compressor delivering full flow to a DTH hammer would require 900 ÷ 100 x $^1/_3$ = 3 pints per hour (25,5 ÷ 2,8 x 0,16 = 1,6 l per hour). For wet drilling (more than 2 gpm (7,6 lpm) it is suggested that the lubrication rate be doubled to $^2/_3$ pint (0,32 l) of oil per hour for every 100 scfm (2,8 m^3/min.) of air. The additional oil compensates for the wash-out caused by water and the oil losses. Additional lubrication is also required when drilling with soap or foam. See the 'Drilling With Foam´ section for more details (refer to chart below).

OIL INJECTION RATE PINTS/HR (L/HR)		
Air floe scfm	**Dry drilling**	**Wet or hydrocyclone drilling**
150	0.5 (0,2)	1.0 (0,5)
250	0.8 (0,4)	1.7 (0,8)
350	1.2 (,0,6)	2.3 (0,1)
500	1.7 (0,8)	3.3 (10,6)
600	2.0 (1,0)	4.0 (1,9)
750	2.5 (1,2)	5.0 (2,4)
800	2.7 (1,3)	5.3 (2,5)
900	3.0 (1,4)	6.0 (2,8)
1050	3.5 (1,7)	7.0 (3,3)
1250	4.2 (2,0)	8.3 (3,9)
1500	5.0 (2,4)	10.0 (4,7)
2000	6.7 (3,2)	13.3 (6,3)
3000	10.0 (4,7)	20.0 (9,5)

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 reservoir, 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 hammer. Until these surfaces are coated with an oil film very little is actually delivered to the DTH hammer. It´s important to insure that an oil film is established before starting the DTH hammer. It´s recommended that the drill be allowed to blow until a visible film of oil is developed on the bit blow hole.

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 dry drilling (i.e. waterwell and quarry) it's important to redevelop the oil film.

Water injection

Water injection can cause a DTH hammer 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 hammer 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 hammer. 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 Airselect system must be adjusted to a higher flow setting.

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 hammer 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 hammer 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

Drilling with foam

In certain drilling situations, it may be advantageous to use foam to improve hole cleaning and control backpressure. Use of a heavy (shaving cream consistency) foam can suspend drilled cuttings and allow them to be removed from the bore hole at bailing velocities much lower than when depending on air flow alone. Foam can also entrain and suspend formation water in instances of high water inflows, reducing backpressure on the drill.

Epiroc DTH hammers are compatible with all commonly available foaming compounds. Modern drilling foams are non-corrosive, but their effects create an environment suited to rapid corrosion of drill parts. The use of foam with a DTH hammer requires extra care to maximize drill performance and life.

• Foam, being basically soap, breaks down rock drill oil which can cause lubrication problems in the drill. Increase oil injection rates when drilling with foam.

• As foam passes through the drill, bubbles are created and destroyed. This action polishes the steel parts, making them more susceptible to corrosion.

• When drilling activity stops, the oil film normally present has been removed. This leaves the internal parts of the hammer without corrosion protection.

When drilling with foam is completed, all foam residues must be removed from the inside of the drill, and the parts must be coated with oil. Failure to do so will result in rapid corrosion of the internal parts and rapid wear when drilling resumes. The following procedure is recommended if the hammer is down for a day or two:

• With the drill in blow position, shut off foam delivery and blow air with a large quantity of water through the hammer for several minutes.

• Shut off the water and continue to blow lubricated air through the hammer until a good flow of oil is seen at the bit.

• For best results, clean the hammer at the end of each day. If the hammer is to remain unused for an extended period, it is recommended that the DTH hammer be disassembled, cleaned, oiled and reassembled before storage.

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.

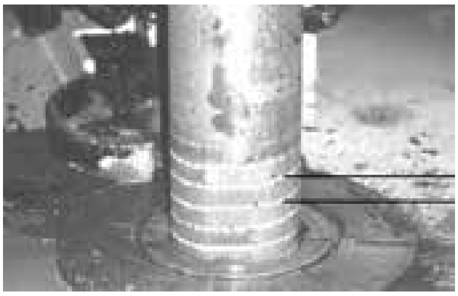
It is suggested that a drill be collared with low pressure and feed until the hole has stabilized. Just as a twist drill needs to be controlled carefully when drilling with an electric hand drill, a DTH hammer needs to be started with care.

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.

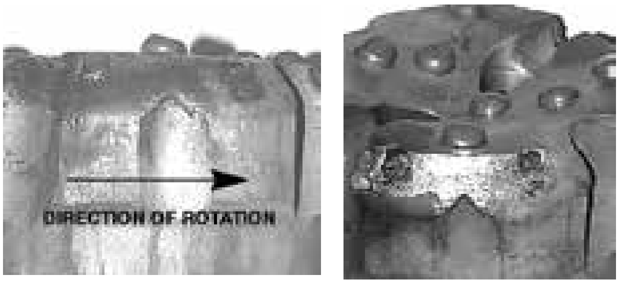
Determining the optimum rotation speed needs to be carried out in the actual application. A good rule-of-thumb is to divide 300 by the bit diameter in inches to determine RPM. This will get the rotation speed in the ´ballpark´. However, a fine-tuned rotation speed also needs to be correlated with penetration rate. It has been found that a proper rotation speed usually results in a $^5/_8$ in. – $^3/_4$ in. (16–19 mm) advance of the bit per revolution of the DTH hammer. 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. If the pitch is less than $^5/_8$ in. (16 mm) the drill RPM should be decreased, if it is more than $^3/_4$ in. (19 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 observing the wear flat developed on the gage (outer) 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: Due to the higher penetration rate of QLX drills over conventional valveless drills, rotation speed will normally need to be increased in proportion to the increase in drilling speed.



View showing wear flat on leading edge - indicates rotation too slow. Note that carbide failure was caused by the leading edge wear flat.

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 hammers 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 hammer can cause damage to the hammer and bit in a short period of time. The feed system of a drilling rig should have a sufficiently fast response so the DTH hammer can ´catch up´ with the bit when a void or soft seam is encountered.

As with rotation speed, QLX drills will typically need to be fed harder due to their higher output power level over valveless drills. Adjust RPM to give ½"' to ¾" (13 to 19 mm).

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

It´s equally important to avoid feeding too hard through voided and fractured material. The piston in a DTH hammer operates within the casing with a clearance of about 0.003 in. (0,076 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 and string in the hole.

Deep Hole drilling requires that you maintain a proper annulus around the casing, to reduce backpressure and maintain performance.

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 (3,8 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.

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 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 hammer parts and components:

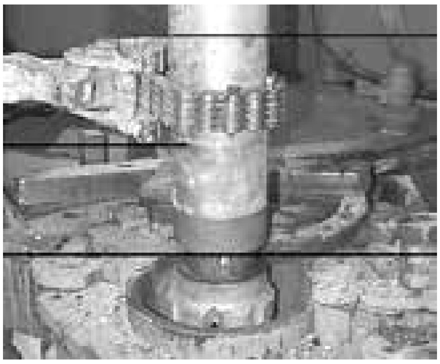
1. Use sharp tong jaws. Worn or rolled over tong jaws increase the jaw pressure and make the wrench more prone to damaging the hammer case. Many Epiroc hammer cases are case hardened which means sharp jaws are needed to grip through the hardened case.

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 onlyincreases 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 following table and figure shows the recommended locations for wrenches.

CHAIN WRENCH POSITIONS		
Hammer model	**Minimum distance from chuck to lower jaw**	**Maximum distance from chuck to upper jaw**
QLX 35	4.7 in. (119 mm)	8.5 in. (216 mm)
QLX 40	5.5 in. (139 mm)	13.5 in. (342 mm)
QLX 50/55	6.5 in. (165 mm)	12.5 in. (318 mm)
QLX 60/65	6.5 in. (165 mm)	13 in. (330 mm)
QLX 100	9 in. (228 mm)	20 in. (508 mm)

Bottom of jaw

Minimum distance



Top of jaw

Maximum distance

QLX 35 minimum distance from bottom of chuck to bottom of jaw / 4.7 in. (119 mm). Maximum distance from bottom of chuck to top of jaw / 8,5 in. (216 mm)

QLX 40 minimum distance from from bottom of chuck to bottom of jaw / 5.5 in. (139 mm) Maximum distance from bottom of chuck to top of jaw / 13.5 in. (342 mm)

QLX 50/55 minimum distance from bottom of chuck to bottom of jaw / 6.5 in. (165 mm). Maximum distance from bottom of chuck to top of jaw / 12.5 in. (318 mm)

QLX 60/65 minimum distance from bottom of chuck to bottom of jaw / 6.5 in. (165 mm). Maximum distance from bottom of chuck to top of jaw / 13 in. (330 mm)

QLX 100 minimum distance from bottom of chuck to bottom of jaw / 9 in. (228 mm). Maximum distance from bottom of chuck to top of jaw / 20 in. (508 mm)

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. Many casings are case hardened for extended service life. The hard casing surface can be cracked by welding or impacting with a sledge hammer. If a chuck or backhead is difficult to loosen, repeatedly tapping the casing at the thread location with a brass bar or hammer while torque is applied may help loosen the joint.

⚠ WARNING

Insure 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´s sometimes helpful to use low-pressure percussion assisted with reverse rotation to free the thread. The following lists the process and cautionary notes:

⚠ 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.

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 hammer 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.

Maintenance and repair

Follow instructions

Along with correct operational technique; proper and timely service and repair of a DTH hammer can extent component life and reduce operational expenses considerably. The sections following describe how to disassemble, inspect, repair and reassemble all QLX hammers.

Depending on the degree to which you plan on servicing a DTH hammer, a number of tools are required. The following lists the tools needed for a complete overhaul of all QLX hammers. A stand is required for holding the DTH hammer 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.

DTH hammer service

In most cases a DTH hammer 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 hammer has lost performance a more detailed inspection will be required.

Disassembly

The following disassembly procedure starts with the presumption that the chuck and backhead threads have been loosened. While the disassembly process is similar for all QLX drills there are slight distinctions from one model to another that will be noted.

Note: The QLX piston can be removed from either end of the drill. QLX 40 piston can ONLY be removed from chuck end.

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.

Note: On QLX 50/55 and QLX 60/65, the casing is reversable.

2. Loosen the chuck along with bit and retaining rings and remove from casing.

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

4. Remove the chuck from the bit.

5. Remove the backhead from the other end of the casing. The compression cone, check seal, guide, and valve assembly will come out with the backhead. If the backhead is removed before unseating the compression cone use one of the following methods for removing the stuck part:

Note: QLX 40 does not have compression cone.

For QLX 50/55 and QLX 60/65 the distributor/compression cone valve assy and guide plug will come out as an assembly. The guide plug in the distributor is held in place by the detent kit.

The air select (guide plug) does not need to be removed unless the air select is not adjusting into select position. In this case remove plunger, spring and plug and replace with new detent kit.

a. Carefully stand the casing on a flat, level surface, backhead end down. Use a soft faced hamer or brass bar to tap the casing lightly at the location of the top of the cylinder. The compression cone will be released.

b. Partially reinstall the backhead or chuck to block the compression cone when it releases with the hammer lying horizontally, use a soft faced hammer or brass bar to tap the casing lightly at the location of the top of the cylinder. The compression cone will be released.

⚠ WARNING

If the compression cone remains in the hammer when the backhead is removed it will be held under very high load by the spring action of the cylinder. when released, the compression cone will be forcefully ejected from the casing. Use caution when removing the cone to avoid personal injury. Do not stand or place any part of the body in front of the casing opening when loosening the compression cone.

If the compression cone is stuck in the cylinder, it will be difficult to unscrew from the casing after the joint is initially broken loose. The check seal is often dislodged from its normal location as well.

If this happens, tap the casing lightly with a soft faced hammer or brass bar about ¼ to ⅓ the casing length from the backhead end of the casing until you hear a loud snap which indicates the cone has unseated.

6. With a brass bar, push the piston upward from chuck end towards backhead end until it contacts the cylinder, then strike the end of the piston firmly with the bar to drive the cylinder out of the retention groove in the casing. Once dislodged from the retention groove, continue to tap the piston until the top end of the cylinder comes out of the casing. The cylinder can now be removed by hand.

Note: QLX 40 cylinder is NOT removable

7. The piston can be removed from the backhead end of the casing by pushing it with a brass bar until it can be extracted by hand.

Note: QLX 40 piston ONLY from chuck end once bearing and bearing O-ring is removed.

8. Remove the bit bearing from the hammer. The bearing can sometimes be removed by hand, but often will require the use of a bearing puller. When using a bearing puller, be sure it is in contact with the bearing and not the bearing retainer. The bearing can also be removed by inserting the piston (small end first) into the backhead end of the casing and tapping the piston with a brass bar to drive the bearing out of the casing.

Note: QLX 40 piston can not be used to remove bearing.

9. Remove the bearing retainer ring from the casing. With the piston in normal position (striking end facing the chuck end of the casing) drive the bearing retainer ring out of its groove using the brass bar. It may be easier to do this with the casing in a vertical position (chuck end down).Be careful to avoid striking the lip at the piston ID to avoid chipping the piston. It may be helpful to place a block of wood or other soft material on top of the piston to cushion against damage.

Assembly

1. Lubricate inside of casing and cylinder. Lubricate outside of cylinder. Place cylinder inside casing and drive into place. Use of cylinder assy tool or old valve will be helpfull or use of brass bar. Cylinder will snap when locked into place. Some movement (¼" – ½") is normal. Push cylinder forward.

Note: QLX 40 cylinder is pre-shrunk into casing.

Assembly tool # 52341229 is available for QLX 50/55 and assembly tool # 52341286 is available for QLX 60/65.

2. Reassemble distributor with new O-rings (compression cone) and valve assy. Guide plug still should be in place. Check for position by rotating clockwise and counter closewise. See previous note for Airselect setting, keeping in mind not to rotate below setting #1 or above #5.

3. Place check valve and spring into distrubtor bore.

4. With backhead lying horizontal, lubricate backhead ID and distrubtor OD. Place distributor assemble inside backhead.

5. Holding on to distrubtor and backhead, place complete assemble into casing and screw together (grease threads).

6. Once backhead O-ring is compressed into casing, there should be a minimul gap. This gap should be close when torquing joints together. SEE PREVIOUS PAGES FOR TORQUE.

7. Moving to chuck end. Lubricate inside casing and piston. Side piston in by hand, should be free.

8. Install bearing retaining ring.

9. Lubricate bit bearing and install.

10. Place chuck over bit splines along with bit retaining rings andscrew into casing, grease threads and splines.

Disassembly QLX 100

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 DTH hammers, there are slight distinctions from one model to another that will be noted. It's important to note that the piston can only be removed from the chuck end of the drill.

1. The QLX100 casing is not reversible. To ensure that the hammer is assembled properly, mark the casing so you can note which end is the backhead side and which is the chuck side.

2. Loosen the chuck along with bit and retaining rings and remove from casing.

3. Remove retaining rings and O-ring from the shank.

4. Remove the chuck from the bit.

5. Using a screwdriver as a tool to free one end, remove the bearing retaining ring.

6. Pull the bit bearing from the hammer casing. Depending on the degree of rust or dryness in this area, a bearing puller may be needed for removal.

7. After removing the bit bearing, the bit bearing stop ring can be removed by hand.

8. Slide the piston out of the drill, being careful to support its weight when it's no longer supported by the casing.

9. Moving to the opposite end of the drill, remove the backhead.

Unscrewing the backhead. Use a lifting device or strap to support the backhead.

10. Remove the check valve and spring.

11. Remove the Belleville spring.

12. Remove the upper end assembly consisting of the valve cap, valve, distributor, and cylinder. This can be accomplished in two ways:

a. Insert a brass bar from the chuck end of the drill and tap or push the complete assembly out of the backhead end.

b. Pull the assembly out using the two provided 5/8-11 UNC threaded holes in the valve cap.

Removing the upper end assembly.

13. Remove the valve cap from the distributor. Use a brass bar to knock the valve cap off of the distributor stem.

14. Separate the distributor and cylinder. A preferred method is to take the cylinder and distributor assembly and fit it over the small diameter end of the piston, resting vertically on a table or the floor. Grasp the outside surface of the cylinder and raise the assembly up, impacting it down onto the piston. This will free the cylinder. Be careful not to get fingers caught in the cylinder while driving it up and down.

15. Also, can be seperated by laying distributor and cylinder on it´s side, from open end of cylinder use brass bar and drive against distributor guide.

Assembly QLX 100

The DTH hammer 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 rock drill oil and preferably thesame 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 equivalent. Make sure the threads are clean and dry and sufficient drying time is allowed.

1. Lubricate the valve seals and install the valve in the valve cap. Ensure that the valve cap/distributor O-ring is installed in the valve cap and that the distributor plugs are installed in the distributor.

Installing the valve in the valve cap.

2. Lower the valve cap/valve assembly over the distributor stem.

Installing the valve cap.

3. Place the valve cap/distributor assembly over the cylinder. Use a brass bar to drive the assembly together until all faces mate together.

Installing the distributor in cylinder.

4. The assembly can then be coated with rock drill oil and installed in the backhead end of the hammer.

Installing the assembly in the hammer.

5. Lubricate and install the Belleville spring, check valve spring, and check valve. Ensure that the spring is installed concave up.

Installing check valve.

6. Install backhead O-ring, apply thread grease, and install backhead.

Installing backhead.

7. Moving to the chuck end of the hammer, install the piston. A lifting device or strap should be used to help support the weight of the part.

Lubrication and installation of the piston.

8. Install the bearing stop ring.

Ring installed.

9. Lubricate and install the bit bearing.

Bit bearing installed.

10. Install the bearing retaining ring. Start at one end of the cord and force it into the groove below the bearing all the way around.

11. Place the chuck, drive pins, and retrieval sleeve (if equipped) over the bit. Install bit retaining rings with O-ring. Lubricate the exhaust tube with rock drill oil and the chuck threads with thread grease. Install the assembly in the hammer.

DTH hammer inspection

When a QLX hammer is disassembled, all parts should be inspected to determine which, if any require replacement, repair, or reversal. Refer to the specifications to find the appropriate discard point clearances. The discard point clearances listed 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 additional wear (performance loss) may be acceptable.

Deterioration in drill performance is caused by the increase in clearance between parts. It is more cost effective to replace the part that decreases clearance the most at the lowest cost. The chart in Section 5 tabulates the new diameters from which the wear on each part can be assessed.

1. Casing outside diameter should be measured roughly 2 to 3 in. (51 to 76 mm) from the end of the chuck end. Refer to the casing reverse and discard dimensions to determine if the asing should be replaced or reversed. Refer to the assembly instructions for the proper casing reversal procedure.

• It is suggested that the chuck be replaced when the casing is reversed.

2. Inspect the chuck.

• Check the overall length of the chuck shoulder against the specifications. A short chuck shoulder can cause cycling problems, difficulty handling water, and rough operation.

• Check the chuck inside diameter. Replace if worn beyond recommended limits.

•The chuck should be replaced if spline wear is heavy or uneven.

•The chuck should be replaced if its minimum outside diameter is less that the casing discard diameter.

3. Inspect the backhead.

• Check the condition of the connection thread. Replace the backhead if the threads are torn,galled or damaged, or if the make-up shoulder is damaged or worn.

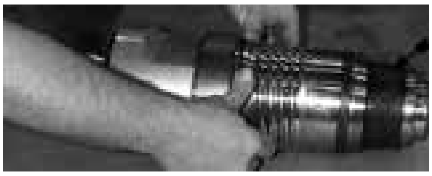
• Check the condition of the internal connection thread. Minor damage can be repaired by filing or lightly grinding the damaged area. Replace the backhead if the threads are badly worn, damaged or cracked.

• Polish or clean valve stem of debris/corrosion.

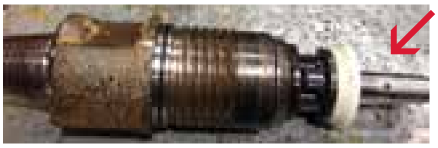
4. Inspect the backhead O-ring and replace if damaged.

THREAD CONDITION	SHOULDER CONDITION	O-ring CONDITION

5. QLX 35: Inspect the check seal. Replace if cracked, torn, or if the seal is brittle. Check valve O-ring for all other.



6. Inspect the guide for wear, scoring, or galling. Replace if worn beyond tabulated limits. A wear pattern on one side of the guide can indicate misalignment in the drill. If this condition is observed, check other parts carefully to identify the source of the misalignment.



Note for QLX 40: If the valve assembly (item7) is replaced with new O-rings, the valve should be installed in the closed position (valve seated against cylinder). This will insure that the hammer will start without incident. New O-rings may require a break-in period of 100 feet (30 meters).

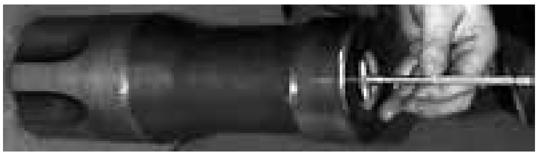
7. Inspect the valve assembly for seal interference and damage. The valve seals should have interference with the distributor guide and backhead, but still move freely. The valve sealing surfaces should be free of nicks, and burrs. Also inspect for valve seal wear on the grooves.

8. Inspect the bearing bore just above the internal flutes for wear using a telescopic bore gauge and micrometer. Replace the bearing if the net clearance between the bit and bearing is beyond the tabulated discard point. Replace the O-ring if it is worn or damaged.

9. Inspect the piston in the locations noted below. The piston usually wears faster than its mating parts, so it is likely piston wear will affect clearances the most. Record the dimensions for comparison to mating parts (cylinder and casing) to determine which part offers the most economical replacement cost.

- Measure the tail outside diameter as shown.

- Measure the tail bore, inspect for seal damage. If the seal requires replacement, remove by prying it out with a screwdriver. Install the replacement seal by working it into the groove by hand as much as possible, then seating it by lightly tapping with a soft-faced hammer.



- Measure the large piston diameter in the location shown.

Note: This is the most critical wear point on the drill, as it has the greatest influence on performance.

Always recommended to change tail seal when servicing hammer.

10. Carefully remove any sharp edges, burrs, or nicks that have developed on the piston using a hand grinder or emery cloth. DO NOT OVERHEAT THE PISTON. IT WILL CRACK IF OVERHEATED! If the piston striking face is heavily cavitated or pitted use a ceramic facing tool or well-cooled grinder to dress the face. A maximum of 0.060 in. (1,52 mm) can be removed from the piston face.

11. If the casing does not require replacement due to outside diameter wear, measure the bore diameter using a telescopic bore gage and micrometer as shown. Record the measurement for later reference. Polish any rough or galled spots in the casing bore with emery cloth. Larger areas of damage can be smoothed out using a hand grinder with flap wheel. Be careful not to remove too much material from the bore to avoid degradation of hammer performance.

Measure at this location (½" past long undercut)

12. Inspect the cylinder for cracks or damage.

Inspect the valve seat for damage and wear.

Measure the diameter of the bore and record for later reference. Scored or galled areas of the bore can be polished with emery cloth.

13. Determine the following clearances from the dimensions recorded.

- Bit to bit bearing
- Piston to casin
- Piston to cylinder
- Piston tail bore seal to guide

14. Referring to the as-new dimensions and recommended replacement clearances in Section 5, determine which parts have suffered the most wear. Replace the part(s) needed to bring the clearances back to specification. The chart below may be useful for recording and determining which clearances require service.

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

Troubleshooting guide

The majority of DTH hammer 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	Remedy
Rough-erratic operation.	1. Too much water injection.	1. Reduce level of water injection.
	2. Chuck has worn too much.	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. Rotation speed too slow.	3. Increase rotation speed to get no more than ½ 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. Feed too hard.	4. Set feed pressure (decrease holddown or increase holdback) just until pulsation in rotation pressure falls and pressure is steady.
	5. Worn/Broken Tail seal. Bore Seal.	5. Replace seal.
	6. Worn/leaking valve seal.	6. Check for axial wear of outside valve seal groove. Replace valve assembly if groove has worn more than 0.06" (1,5 mm).
	7. Worn bit bearing.	7. Replace bit bearing. Leakage past bit bearing may cause piston to lack upstroke force making cycle erratic.
	8. Worn piston exhaust tube.	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.
	9. Incorrect Airselect setting.	9. Change setting to next higher flow position.
Low penetration/high pressure.	5. Exhaust tube projection too long.	5. Check projection vs. specifications repair tube.
	6. Valve action impeded.	6. Check nose of backhead for corrosion other deposits that can interfere with the smooth cycling of the valve. Remove deposits if present.
	7. Worn tail seal.	7. Replace tail seal.
Low penetration/low pressure.	1. Lack of oil.	1. Insure lubricator is working and hammer is getting coated with oil. Check bit blow ports for oil film.
	2. Worn drill clearances.	2a. Inspect piston for wear particularly on large diameter just beneath scallops. This is the most sensitive diameter. Check other diameters; tail bore seal 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. Damaged valve seat.	3. Inspect valve seat surface for damage or wear which could cause leakage. Replace valve is suspect.
	4. Incorrect airselect setting.	4. Readjust airselect.
Drill running off bottom.	1. Worn piston.	1. Inspect large diameter of piston for wear. Leakage past the large diameter can cause the piston to cycle when off bottom.
	2. Excessive water injection.	2. Try reducing water injection level. Water inhibits the air venting process which is needed to shut the hammer off.
	3. Debris (cuttings, mud) between chuck and bit spline.	3. Clear debris.
Chuck hard to loosen.	1. Poor gripping.	1a. Don´t grip over threads. 1b. Insure tong jaws are sharp.
	2. Conditions.	2. Try using breakout washer.

Problem	Cause	Remedy
Compressor unloading.	1. Incorrect airselect setting.	1. Correct airselect setting.
	2. Excessive water injection.	2. Reduce water injection rate.
	3. Mud rings.	3. Clear mud ring. Increase water injection. Consider adding foam.
Hammer won't start.	1. Mud or dirt in hammer.	1. Disassemble, clean, inspect and repair hammer. Check for proper function of check seal.
	2. Broken exhaust tube.	2. Replace tube. Inspect bearing and chuck.
	3. Broken internal parts.	3. Replace broken parts.
Component failures.	2. Piston struck end cupping.	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.
	3. Cracked casing.	3a. Hammering, welding and wrenching in wrong location can fail casings; avoid these practices and 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. 3d. Look for leaking or loose fitting large diameter 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. 3f. Backhead or chuck thread loose. Be sure threaded joints are tight. Do not reverse rotate or allow hammer to cycle without rotation.
	4. Rolled over chuck.	4. Underfeeding can cause the bit to rebound into chuck shoulder. This will generate a rolled up edge. Increase feed force.
	5. Cracked backhead-body.	5. Fighting from hole and pulling backhead through caved-in materials creates frictional heat. Rotate slowly and/or flood with water when stuck.
	6. Cracked backhead.	6. Look for evidence of connection moving on threaded shoulders. Connection shoulder may be worn allowing movement. Replace/repair adapter sub or rod.
Component failures.	1. Piston cracked through.	1a. Lack of lubrication could cause frictional cracks in 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.
Breaking exhaust tubes.	1. Erosion	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.
	2. Damage.	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. Bit tube bore small	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.	1a. Refer to proper feed settings (section 1). 1b. Avoid feathering feed in loose ground or at end of rod.
	2. Improper make up torque.	2. Tong chuck tight before drilling.

Problem	Cause	Remedy
Cylinder tangs broken.	1. Tail Seal failure.	1. Replace tail seal.
	2. Corrosion.	2a. Be sure hammer parts have a good coating of oil. 2b. Clean and oil hammer after drilling with foam. 2c. Use non-acidic injection water.

Minimum guidelines for mounting specifications

Torque: Roughly 500 ft - lb per inch (27 Nm 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. TD60 needs 3000 lb. (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: 500 psi (34,4 bar) maximum.

Volume: 150–200 scfm per inch (0.165–0,22 m^3/min per mm) of hammer diameter.

Lubrication: $^1/_3$ pint (0,16 l) per hour per 100 scfm. (2,8 m^3/min).

Minimum requirements for compressor capacity and pressure

The pressure and production developed by a DTH hammer will be related to the air flow passing through the drill. The pressure and performance of a DTH hammer is related to the SCFM delivered by the compressor. To determine what pressure a DTH hammer 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 hammer are related to the SCFM delivered by the compressor.

Figures 4 and 5 show the relationship of pressure and flow for all QLX hammers 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

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	0,82	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

Rock drill oil specifications

Characteristic	Test procedure	Below 200F (-70C)	200F to 900F (-70C to 320C)	Above 900F (320C)
Viscosity:				
SUS at 1000F (380C)	ASTM-D2161	175 min.	450 min	750 min.
SUS at 2100F (990C)	ASTM-D2161	46 min.	65 min.	85 min.
cST at 1040F (400C)	ASTM-D445	37 min.	105 min.	160 min.
cST at 2120F (1000C)	ASTM-D445	6 min.	11 min.	16 min.
Pour Point, 0F (0C) max.	ASTM-D97	-100F (-23°C)	-100F (-230C)	00F (-180C)
Flash Point, 0F (0C) min.	ASTM-D92	3700F (1880C)	4000F (2040C)	4500F (2320C)
Viscosity Index, min.	ASTM-D2270	90	90	90
Steam Emulsion No. min.	ASTM-1935-65	1200	1200	1200
Consistency	———	Stringy	Stringy	Stringy
Falex Load Test lbs (kg) [min]	ASTM-D2670	2000 lbs (907 kg)	2000 lbs (907 kg)	2000 lbs (907 kg)
Timken E.P. Test lbs (kg) [min]	ASTM-D2782	30 lbs (14 kg)	30 lbs (14 kg)	30 lbs (14 kg)

Super-tac rock drill oil part numbers

Grade	1 Gallon 3,8 Lit	5 Gallon 18,9 Lit	55 Gallon 207 Lit	300 Gallon 1136 Lit	ISO Grade (reference)	Viscosity (CST@00C)	Viscosity Index (typ)	Pour Point Max 0F (0C)	Flash point Min 0F (0C)	Emulsion Min t 35 ml.
Test reference-ASTM						D2270	D97	D92	D1401	
Test reference - ISO						2909	3104	2592	3488	
Light	52334174	52333192	52333200	52343225	100	90-110	124	-16 (-26)	460 (237)	>60
Medium	52334182	52333218	52333226	52343233	220	198-242	121	0 (17)	457 (236)	>60
Heavy	52334190	52333234	52333242	52323241	460	380-430	94	10 (-12)	455 (235)	>60
Extra heavy	52334208	52333259	52333267	52343258	1000	1078	95	34 (1)	480 (249)	>60

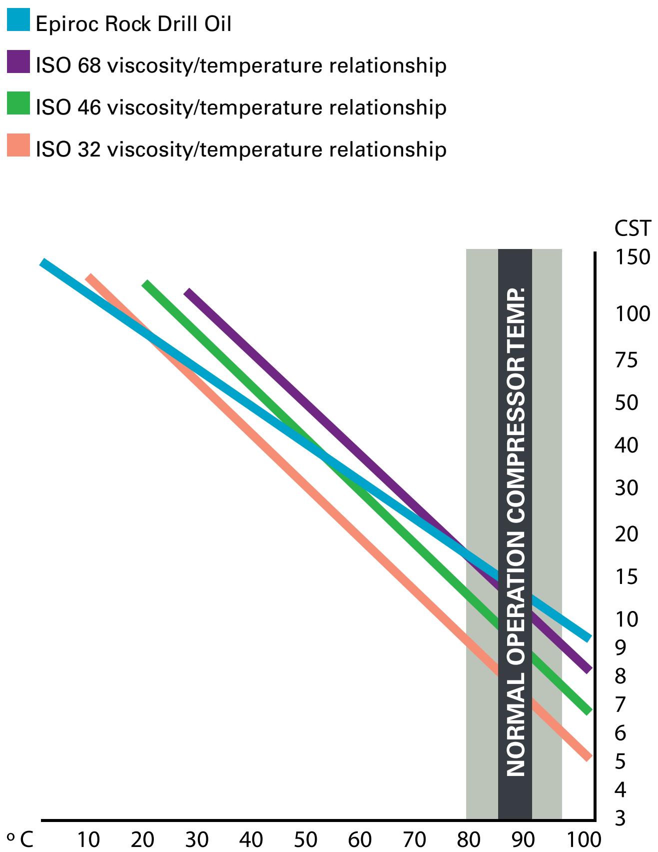
Epiroc Rock Drill Oil

- Reduces the risk of scoring and abrasion.
- Protects against corrosion and oxidation.
- Insensitive to ambient temperature variations.
- Works equally well throughout the temperature range -350C to +450C (-310F to +1130F).
- Provides a lubricant film in excess of 100.000 PSI / 689 MPa.
- Bio Based - 100% renewable raw materials.

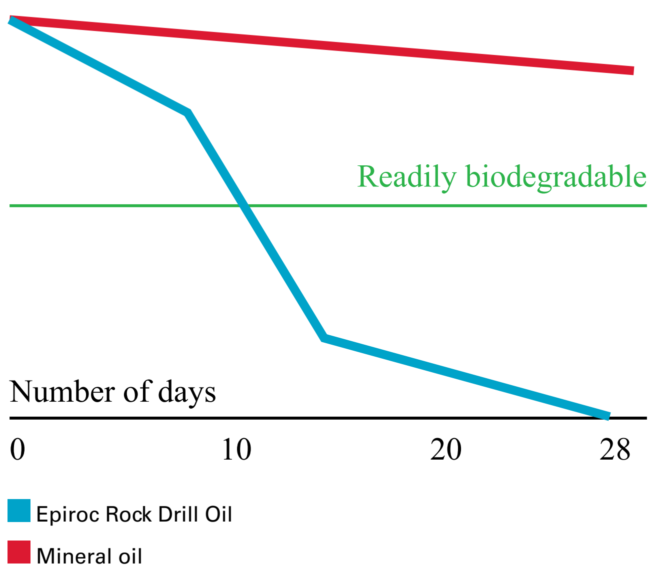
Technical features	
Specific density	907 kg/m³
Boiling point	> 3000C
Freezing point	-300C
pH	7,0 - 7,3
Flashpoint and method of determination	> 2790C C.O.C.

Technical data Comparison					
	BioBlend RDP 100	**Mobil Almo 527**	**Shell Torcula 100**	**Chevron Aries 100**	**Epiroc Rock Drill Oil**
ISO grade	100	not listed	100	100	46
Viscosity @ 400C	100,0	112,9	100,0	95,0	46,0
Viscosity @ 1000C	19,3	11,4	11,6	10,9	8,9
Viscosity index	>220	91	104	98	>214
Pour point 0C	-35	-30	-33	-31	-35
Flash point 0C	>315	204	263	230	>279
Timken OK load	>27 kg	not listed	23 kg	30 kg	35 kg
Falex E.P.	3500	not listed	not listed	3200	>10 000
Biodegradability	>90%	Environmentally persistant	Environmentally persistant	Environmentally persistant	>99%

Viscosity vs temperature



Biodegradability



Technical specifications QLX 35 and QLX 40

	Hammers are available with other thread connections			
DTH hammer model	**QLX 35**		**QLX 40**	
Bit shank style	DHD3.5		TD 40	
Product code	9703-QX-00-10P-35-000		9704-QX-00-10P-64-000	
Product number	89001572		89010117	
General specifications	**Imperial**	**Metric**	**Imperial**	**Metric**
Connection Thread	API 2 $^{3}/_{8}$" Reg Pin		API 2 $^{3}/_{8}$" Reg Box/Pin	
Outside diameter	3.1 in	79 mm	4 in	101,6 mm
Length w/o bit shoulder to shoulder	31.4 in	799 mm	35.3 in	897 mm
Weight w/o bit	65 lb	29,5 kg	101.4 lb	46 kg
Backhead across flats	2.5 in	63,5 mm	3 in	76 mm
Min bit size	3.5 in	90 mm	4.5 in	115 mm
Max bit size	4.13 in	105 mm	5.125 in	130 mm
Bore	2.52 in	64 mm	3.13 in	79,5 mm
Piston weight	12 lb	5,5 kg	21.8 lb	9,9 kg
Stroke	4 in	101,6 mm	4 in	101,6 mm
Max pressure differential	435 psig	30 bar	508 psig	35 bar
Make-up torque	3000 ft-lbf	4067 Nm	4000 ft-lbf	5416 Nm
Operational specifications	**QLX 35**		**QLX 40**	
Feed Force	1500–2000 lb	7–9 kN	1500–2000 lb	7–9 kN
Rotation	70-100 rpm		60-90 rpm	
Service specifications	**QLX 35**		**QLX 40**	
Casing discard diameter	2.90 in	73,7 mm	Bkhd end 3.66 in Chuck end 3.58 in	93,0 mm 91,0 mm
Casing reverse diameter	NA	NA	NA	NA
Minimum chuck length	1.85 in	47 mm	1.85 in	47 mm
Max. worn piston to casing clearance	0.011 in	0,27 mm	0.011 in	0,27 mm
Min new piston large OD	2.514 in	63,86 mm	2.514 in	63,86 mm
Max new casing ID	2.521 in	64,03 mm	2.521 in	64,03 mm
Max. worn piston to cylinder clearance	0.011 in	0,27 mm	0.011 in	0,27 mm
Min new piston tail OD	2.270 in	57,66 mm	2.270 in	57,66 mm
Max new cylinder ID	2.277 in	57,84 mm	2.277 in	57,84 mm
Max. worn piston to guide clearance	0.023 in	0,57 mm	0.023 in	0,57 mm
Max new piston tail/seal ID	0.828 in	21,03 mm	0.828 in	21,03 mm
Min new guide OD	0,813 in	20,65 mm	0.813 in	20,65 mm
Max. worn bit to bearing clearance	0.018 in	0,46 mm	0.018 in	0,46 mm
Max new bearing ID	2.068 in	52,53 mm	2.068 in	52,53 mm
Min new bit shank OD	2.056 in	52,22 mm	2.056 in	52,22 mm
Max. worn bit to chuck clearance	0.020 in	0,50 mm	0.020 in	0,50 mm
Max new chuck ID	2.166 in	55,02 mm	2.166 in	55,02 mm
Min new bit shank OD	2.153 in	54,69 mm	2.153 in	54,69 mm
Exhaust tube extension	2.32 in	58,93 mm	2.32 in	58,93 mm
Min. new valve height, low lift valve	NA	NA	NA	NA
Min. new valve height, high lift valve	NA	NA	NA	NA
Valve lift new, low lift valve or w/shim	NA	NA	NA	NA
Valve lift new, high lift valve or w/o shim	NA	NA	NA	NA
Maximum backhead standoff	0.046 in	1,17 mm	0.046 in	1,17 mm
Minimum backhead standoff	0.032 in	0,81 mm	0.032 in	0,81 mm

Air consumption/BPM				
*Estimated values 400–500 psi (27,6-34,5 bar)				
	QLX 35		QLX 40	
	Imperial	Metric	Imperial	Metric
100 psi / 6,9 bar (scfm / l/s) 100 psi (bpm)	142 **1289**	67	111 **1107**	52
150 psi / 10,3 bar (scfm / l/s) 150 psi (bpm)	219 **1509**	103	229 **1252**	108
200 psi / 13,8 bar (scfm / l/s) 200 psi (bpm)	288 **1699**	136	331 **1419**	156
250 psi / 17,2 bar (scfm / l/s) 250 psi (bpm)	348 **1858**	164	441 **1591**	208
300 psi / 20,7 bar (scfm / l/s) 300 psi (bpm)	400 **1987**	189	555 **1759**	262
350 psi / 24,1 bar (scfm / l/s) 350 psi (bpm)	444 **2087**	210	675 **1872**	319
400 psi / 27,6 bar (scfm / l/s)* 400 psi (bpm)	645 **2293**	275	781 **2053**	369
435 psi / 30 bar (scfm / l/s)* 435 psi (bpm)*	847 **2500**	340	859 **2163**	406
450 psi / 31 bar (scfm / l/s)* 450 psi (bpm)*			893 **2211**	421
500 psi / 34,5 bar (scfm / l/s)* 500 psi (bpm)*			1063 **2368**	474

QLX 50/55 and QLX 60/65

DTH hammer model	QLX 50		QLX 55		QLX 60		QLX 65	
Bit shank style	QL 50		QL 50		QL 60		QL 60	
Product code	9705-QX-00-14P-25-000		9705-QX-00-14P-25-HB0		9706-QX-00-14P-26-000		9706-QX-00-14P-25-HB0	
Product number	89010092		89010093		52352465		52352473	
General specifications	**Imperial**	**Metric**	**Imperial**	**Metric**	**Imperial**	**Metric**	**Imperial**	**Metric**
Connection Thread	API 3 1/2″ Reg Pin		API 3 1/2″ Reg Pin		API 3 1/2″ Reg Pin		API 3 ½″ Reg Pin	
Outside diameter	4.8 in	121,9 mm	5.08 in	129 mm	5.6 in	142,2 mm	5.88 in	149,4 mm
Length w/o bit shoulder to shoulder	41.76 in	1060,7 mm	41.76 in	1060,7 mm	41.67 in	1090,7 mm	41.67 in	1090,7 mm
Weight w/o bit	153 lb	69,5 kg	178 lb	80,9 kg	205 lb	93,2 kg	235 lb	106,8 kg
Backhead across flats	3.7 / 4 in	95 / 101,6 mm	3.7 / 4 in	95 / 101,6 mm	4 in	101,6 mm	4 in	102,6 mm
Min bit size	5.25 in	134 mm	5.5 in	140 mm	6.13 in	155,5 mm	6.5 in	165,1 mm
Max bit size	6 in	152 mm	6 in	152 mm	8.5 in	215,9 mm	8.5 in	215,9 mm
Bore	3.95 in	100,25 mm	3.95 in	100,25 mm	4.75 in	120,65 mm	4.75 in	120,7 mm
Piston weight	33 lb	15 kg	33 lb	15 kg	47 lb	21,4 kg	47 lb	21,4 kg
Stroke	3.75 in	95,3 mm	3.75 in	95,3 mm	3.75 in	95,3 mm	3.75 in	95,3 mm
Max pressure differential	500 psig	34,5 bar	500 psig	34,5 bar	500 psig	34,5 bar	500 psig	34,5 bar
Make-up torque	5000 ft-lbf	6770 Nm	5000 ft-lbf	6770 Nm	6000 ft-lbf	8124 Nm	6000 ft-lbf	8124 Nm
Operational specifications	**Imperial**	**Metric**						
Feed Force	1500-2000 lb	7-9 kN	1500-2000 lb	7-9 kN	2000-3000 lb	9-13,3 kN	2000-3000 lb	9-13,3 kN
Rotation	50-80 rpm		50-80 rpm		30-60 rpm		30-60 rpm	
Service specifications	**QLX 50**		**QLX 55**		**QLX 60**		**QLX 65**	
Casing discard diameter	4.38 in	111,3 mm	4.38 in	111,3 mm	5.31 in	134,9 mm	5.31 in	134,9 mm
Casing reverse diameter	4.65 in	118,1 mm	4.84 in	122,9 mm	5.44 in	138,2 mm	5.63 in	142,9 mm
Minimum chuck length	1.85 in	47 mm	1.85 in	47,0 mm	2.15 in	54,6 mm	2.15 in	54,6 mm
Max. worn piston to casing clearance	0.001 in	0,25 mm	0.001 in	0,25 mm	0.009 in	0,23 mm	0.009 in	0,23 mm
Min new piston large OD	3.942 in	100,11 mm	3.942 in	100,11 mm	4.742 in	120,45 mm	4.742 in	120,45 mm
Max new casing ID	3.948 in	100,28 mm	3.948 in	100,28 mm	4.748 in	120,60 mm	4.748 in	120,60 mm
Max. worn piston to cylinder clearance	0.009 in	0,23 mm	0.009 in	0,23 mm	0.009 in	0,23 mm	0.009 in	0,23 mm
Min new piston tail OD	3.519 in	89,38 mm	3.519 in	89,38 mm	4.235 in	107,57 mm	4.235 in	107,57 mm
Max new cylinder ID	3.525 in	89,53 mm	3.525 in	89,53 mm	4.241 in	107,72 mm	4.241 in	107,72 mm
Max. worn piston to guide clearance	0.011 in	0,27 mm	0.011 in	0,27 mm	0.023 in	0,57 mm	0.023 in	0,57 mm
Max new piston tail/seal ID	1.206 in	30,63 mm	1.206 in	30,63 mm	1.505 in	38,23 mm	1.505 in	38,23 mm
Min new guide OD	1.199 in	30,45 mm	1.199 in	30,45 mm	1.490 in	37,85 mm	1.490 in	37,85 mm
Max. worn bit to bearing clearance	0.020 in	0,50 mm	0.020 in	0,50 mm	0,015 in	0,38 mm	0.015 in	0,38 mm
Max new bearing ID	3.019 in	76,68 mm	3.019 in	76,68 mm	3.623 in	92,02 mm	3.623 in	92,02 mm
Min new bit shank OD	3.006 in	76,35 mm	3.006 in	76,35 mm	3.613 in	91,77 mm	3.613 in	91,77 mm
Max. worn bit to chuck clearance	0.017 in	0,42 mm	0.017 in	0,42 mm	0.018 in	0,46 mm	0.018 in	0,46 mm
Max new chuck ID	3.490 in	88,65 mm	3,490 in	88,65 mm	4.187 in	106,35 mm	4.187 in	106,35 mm
Min new bit shank OD	3.479 in	88,37 mm	3.479 in	88,37 mm	4.175 in	106,05 mm	4.175 in	106,05 mm
Exhaust tube extension	2.07 in	52,58 mm	2.07 in	52,58 mm	2.31 in	58,67 mm	2.31 in	58,67 mm
Min. new valve height, low lift valve	NA	NA	NA	NA	NA	NA	NA	NA
Min. new valve height, high lift valve	NA	NA	NA	NA	NA	NA	NA	NA
Valve lift new, low lift valve or w/ shim	NA	NA	NA	NA	NA	NA	NA	NA
Valve lift new, high lift valve or w/o shim	NA	NA	NA	NA	NA	NA	NA	NA
Maximum backhead standoff	0.06 in	1,52 mm	0.06 in	1,52 mm	0.08 in	2,03 mm	0.08 in	2,03 mm
Minimum backhead standoff	0.04 in	1,02 mm	0.04 in	1,02 mm	0.05 in	1,27 mm	0.05 in	1,27 mm

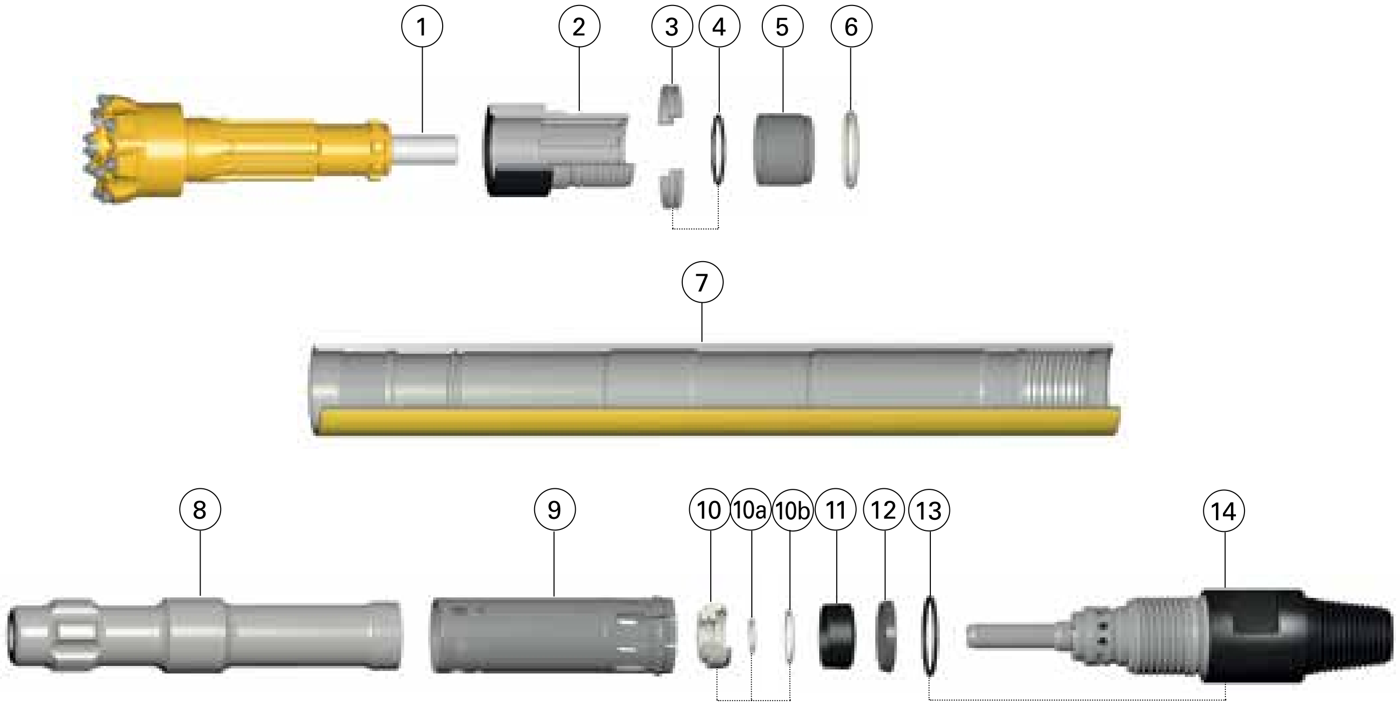
Air consumption/bpm (Airselect position 2)								
***Estimated values 400 - 500 psi (27,6-34,5 bar)**								
	QLX 50		**QLX 55**		**QLX 60**		**QLX 65**	
	Imperial	**Metric**	**Imperial**	**Metric**	**Imperial**	**Metric**	**Imperial**	**Metric**
100 psi / 6,9 bar (scfm / l/s)	155	73	155	73	229	108	229	108
100 psi (bpm)	**1305**		**1305**		**1384**		**1384**	
150 psi / 10,3 bar (scfm / l/s)	257	121	257	121	360	170	360	170
150 psi (bpm)	**1426**		**1426**		**1500**		**1500**	
200 psi / 13,8 bar (scfm / l/s)	374	177	374	177	502	237	502	237
200 psi (bpm)	**1547**		**1547**		**1616**		**1616**	
250 psi / 17,2 bar (scfm / l/s)	508	240	508	240	655	309	655	309
250 psi (bpm)	**1668**		**1668**		**1732**		**1732**	
300 psi / 20,7 bar (scfm / l/s)	657	310	657	310	818	386	818	386
300 psi (bpm)	**1788**		**1788**		**1847**		**1847**	
350 psi / 24,1 bar (scfm / l/s)	822	388	822	388	993	469	993	469
350 psi (bpm)	**1909**		**1909**		**1963**		**1963**	
400 psi / 27,6 bar (scfm / l/s)*	961	453	961	453	1160	548	1160	548
400 psi (bpm)	**2029**		**2029**		**2078**		**2078**	
435 psi / 30 bar (scfm / l/s)*	1065	503	1065	503	1279	604	1279	604
435 psi (bpm)*	**2114**		**2114**		**2194**		**2194**	
450 psi / 31 bar (scfm / l/s)*	1109	524	1109	524	1330	628	1330	628
450 psi (bpm)*	**2150**		**2150**		**2194**		**2194**	
500 psi / 34,5 bar (scfm / Ll/s)*	1258	594	1258	594	1499	708	1499	708
500 psi (bpm)*	**2270**		**2270**		**2309**		**2309**	

QLX 100

	Imperial	Metric
Connection API	6 5/8 Reg. pin	65/8 Reg. pin
Outside Diameter	9.00 in	228,6 mm
Length, shoulder to shoulder, less bit	63.8 in	1620,5
Length, bit extended	72.2 in	1833,9 mm
Length, bit retracted	70.4 in	1788,2 mm
Weight, less bit	1007 lb	456,8 kg
Backhead flats	2.5" x 7" AF	63,5 mm x 178 mm AF
Minimum bit size	9.875 in	251 mm
Maximum bit size	11 in	279 mm
Bore	7.5 in	190,5 mm
Piston weight	180 lb	81,6 kg
Stroke	4.75 in	120 mm
Max pressure differential	350 psi	24,1 bar
Make up Torque	10 000 ft-lb	1130 Nm
Operational specifications		
Feed Force	4000- 5000 lb	17,8 - 22,2 kN
Rotation Speed	20-40 rpm	20 -40 rpm
Air consumtion / BPM	**Imperial Pressure/flow**	**Metric Pressure/flow**
100 psi (6.9 bar) 827 BPM	100 psi / 1.097 scfm	6,9 bar / 31,0 m³/min
150 psi (10.3 bar) 910 BPM	150 psi / 1.400 scfm	10,3 bar / 39,6 m³/min
200 psi (13.8 bar) 993 BPM	200 psi / 1.784 scfm	13,8 bar / 50,5 m³/min
250 psi (17.2 bar) 1,075 BPM	250 psi / 2.250 scfm	17,2 bar / 63,7 m³/min
300 psi (20.7 bar) 1,158 BPM	300 psi / 2.797 scfm	20,7 bar / 79,2 m³/min
350 psi (24.1 bar) 1,240 BPM	350 psi / 3.427 scfm	24,1 bar / 97,0 m³/min
Service specifications		
Casing discard diameter	8.450 in	214,630 mm
Casing reverse diameter	NA	NA
Minimum chuck length	3.750 in	95,250 mm
Max. worn piston to casing clearance	0.016 in	0,406 mm
Min new piston large OD	7.490 in	190,246 mm
Max new casing ID	7.501 in	190,525 mm
Max. worn piston to cylinder clearance	0.015 in	0,381 mm
Min new piston tail OD	6.737 in	171,120 mm
Max new cylinder ID	6.747 in	171,374 mm
Max. worn piston to guide clearance	0.014 in	0,356 mm
Max new piston tail/sealID	1.888 in	47,955 mm
Min new guide OD	1.879 in	47,727 mm
Max. worn bit to bearing clearance	0.034 in	0,864 mm
Max new bearing ID	5.941 in	150,901 mm
Min new bit shank OD	5.918 in	150,317 mm
Max. worn bit to chuck clearance	0.070 in	1,778 mm
Max new chuck ID	6.618 in	168,097 mm
Min new bit shank OD	6.571 in	166,903 mm
Exhaust tube extension	2.500 in	63,500 mm
Min. new valve height, low lift valve	NA	NA
Min. new valve height, high lift valve	1.987 in	50,470 mm
Valve lift new, low lift valve or w/shim	NA	NA
Valve lift new, high lift valve or w/o shim	0.072 in	1,829 mm
Maximum backhead standoff	0.102 in	2,591 mm
Minimum backhead standoff	0.036 in	0,914 mm

Secoroc QLX35

Down-the-hole hammer



Ref.	Part	Prod. No.	Product code
1	Exhaust tube	90515375	9091
2	Chuck	89001566	9703-QX-00-000-35-000-001
3	Bit retaining ring assembly incl. O-ring	89001351	9703-QX-00-000-35-000-A02
4	O-ring* for bit retaining ring	–	–
5	Bit bearing	89001349	9703-QX-00-000-35-000-A22
6	Lock ring	89001350	9703-QX-00-000-00-000-006
7	Casing	89001567	9703-QX-00-000-00-000-004
8	Piston	52344843	9703-QX-00-10P-35-000-005
9	Inner cylinder	52312857	9703-QX-00-000-00-000-048
10	QL valve assembly incl. O-rings	89001568	9703-QX-00-000-00-000-A45
10a	O-ring* (small) for valve	–	–
10b	O-ring* (large) for valve	–	–
11	Check seal	52312899	9703-QX-00-000-00-000-017
12	Compression cone	52329588	9703-QX-00-000-00-000-014
13	O-ring* for Backhead		
14	Backhead assembly for 2 3/8" API Reg Pin	89001571	9703-QX-00-10P-00-000-A20
14	Backhead assembly for Cubex#21	89001575	9703-QX-00-47P-00-000-A20

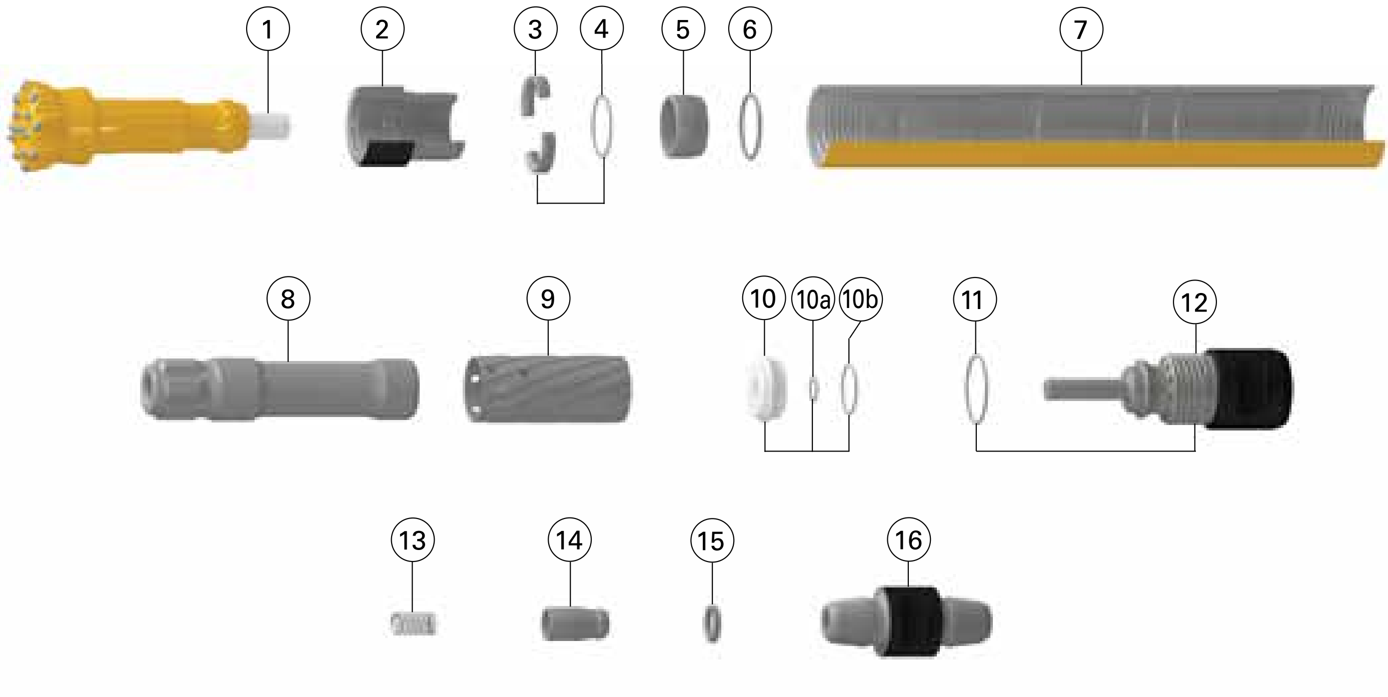
**O-rings not sold separately. Included in different kits, see table.*

Hammers and Kits	Prod. No.	Product code
QLX 35 complete, 2 3/8" API Reg Pin	89001572	9703-QX-00-10P-35-000
QLX 35 complete, Cubex#21	89001574	9703-QX-00-47P-35-000
Economy kit w/o backhead, incl. item 2, 7, 10 and O-ring kit	89001569	9703-QX-00-000-00-000-K39
O-ring kit incl. item 4, 6, 10a, 10b, 13	89001570	9703-QX-00-000-00-000-K47

Wear limits		
Casing	Min. OD	74 mm
Piston / Casing clearance	Max.	0,3 mm
Piston / Cylinder clearance	Max.	0,3 mm
Piston / Guide clearance	Max.	0,6 mm
Exhaust tube protrusion		59 + / – 1 mm

Secoroc QLX40

Down-the-hole hammer



Ref.	Part	Prod. No.	Product code
1	Exhaust tube	90516004	9115
2	Chuck	52339686	9704-QX-00-000-64-000-001
3	Bit retaining ring assembly incl. O-ring	52339694	9704-QX-00-000-64-000-A02
4	O-ring* (bit retaining ring)	–	
5	Bit bearing	52339702	9704-QX-00-000-64-000-A22
6	O-ring* (bit bearing)	–	
7	Casing assembly incl. inner cylinder	52341112	9704-QX-00-000-00-000-004
8	Piston	52341120	9704-QX-00-000-64-000-005
9	Inner cylinder*	–	
10	Valve assembly incl. O-rings	52345402	9704-QX-00-000-00-000-A45
10a	O-ring* (valve)	–	
10b	O-ring* (valve)	–	
11	O-ring*(backhead)	–	
12	Backhead assembly incl. O-ring	89010127	9704-QX-00-000-00-000-A20
13	Check valve spring	89010119	9704-QX-00-000-00-000-016
14	Check valve	89010118	9704-QX-00-000-00-000-017
15	Check valve seal	52344744	9704-QX-00-000-00-000-018
16	Adapter 2 3/8" API Reg pin-pin	89009498	310-3089-10-007-01-D00,41

**O-rings not sold separately. Included in different kits, see table.*

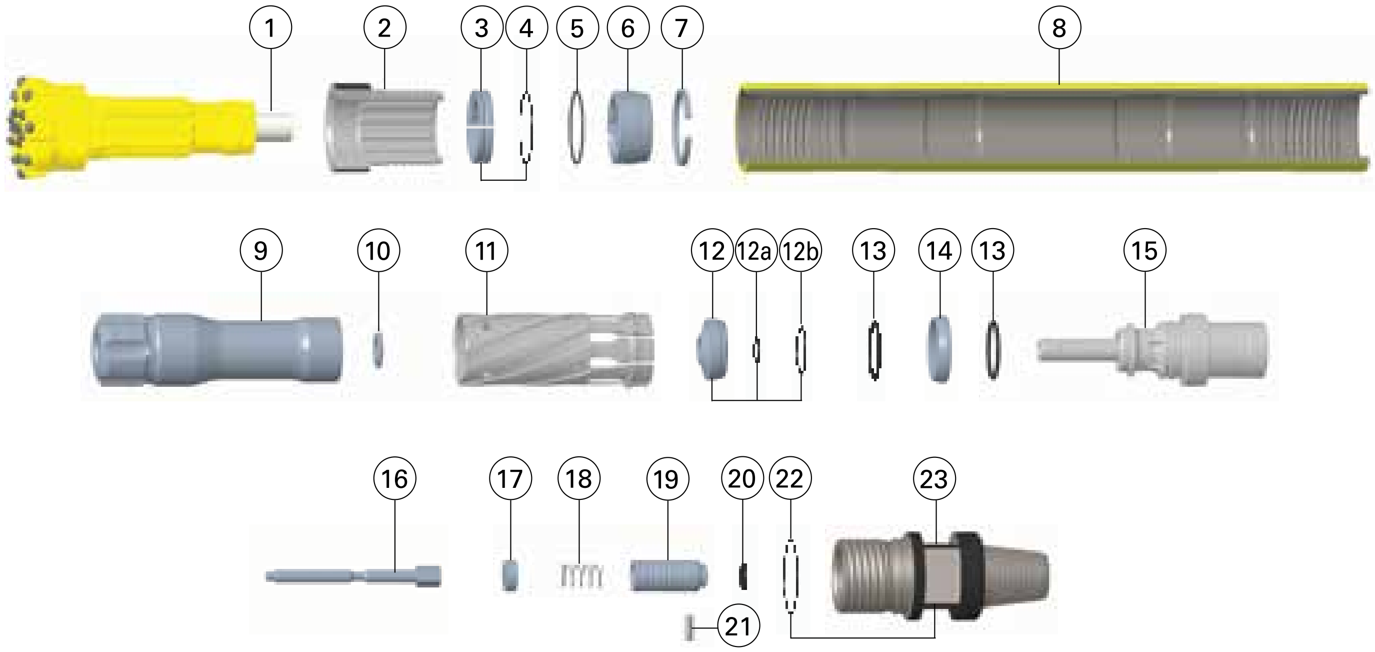
Hammers and kits	Prod. No.	Product code
QLX 40 complete, 2 3/8" API Reg. Box incl. pin-pin adapter	89010117	9704-QX-00-10P-64-000
Economy kit	N/A	N/A
O-ring kit incl. 3x4, 6, 10a, 10b, 11, 15	89010164	9704-QX-00-000-00-000-K47

Accessories	Prod. No.	Product code
Break out washer	89010017	9704-00-60-00-053

Wear limits		
Chuck	Min. length	1.85" / 47 mm
Casing, backhead end	Min. OD	3.66" / 93,0 mm
Casing, chuck end	Min. OD	3.58" / 91,0 mm
Bit bearing	Max. ID	2.068" / 52,53 mm
Piston / casing clearence	Max.	0.011" / 0,27 mm
Piston / inner cylinder clearence	Max.	0.011" / 0,27 mm
Exhaust tube protrusion		2.32" / 58,93 mm

Secoroc QLX 50/55

Down-the-hole hammer



Ref.	Part	Prod. No.	Product code
1	Exhaust tube	90515427	9257
2	Chuck for QLX 50	52335312	9705-QX-00-000-25-000-001
2	Chuck for QLX 55	52334927	9705-QX-00-000-25-H00-001
3	Bit retaing ring assembly	52335569	9705-QX-00-000-25-000-A02
4	O-ring* (bit retainer)	–	–
5	O-ring* (bit bearing)	–	–
6	Bit bearing	89010090	9705-QX-00-000-00-000-A22
7	Lock ring	52335577	9705-QX-00-000-00-000-058
8	Casing for QLX 50	89010067	9705-QX-00-000-00-000-004
8	Casing for QLX 55	89010084	9705-QX-00-000-00-H00-004
9	Piston	52335353	9705-QX-00-000-25-000-005
10	Seal - piston tail bore	52335486	9705-QX-00-000-00-000-054
11	Inner cylinder	52335361	9705-QX-00-000-00-000-048
12	Valve assembly	52338514	9705-QX-00-000-00-000-A45
12a	O-ring* (valve)	–	–
12b	O-ring* (valve)	–	–
13	O-ring* (compression cone)	–	–
14	Compression cone	52335502	9705-QL-00-000-00-000-014
15	Distributor assembly	89012627	9705-QX-00-000-00-000-042
16	Airselect Guide Plug,	89012628	9705-QX-00-000-00-000-052
17	Seat, check valve spring	89012629	9705-QX-00-000-00-000-018
18	Check valve spring	89010065	9705-QX-00-000-00-000-016
19	Check valve	89010066	9705-QX-00-000-00-000-017
20	O-ring* (check valve)	–	–
21	Choke plug solid**	50899137	9706-QL-00-000-00-000-180
21	Choke plug 1/8" **	50899129	9706-QL-00-000-00-000-181

Ref.	Part	Prod. No.	Product code
21	Choke plug 1/4" **	50899111	9706-QL-00-000-00-000-182
22	O-ring* (backhead)	–	–
23	Backhead assembly for QLX 50	89010121	9705-QX-00-14P-00-000-A20
23	Backhead assembly for QLX 55	89010122	9705-QX-00-14P-00-HB0-A20

**O-rings not sold separately. Included in different kits, see table.*

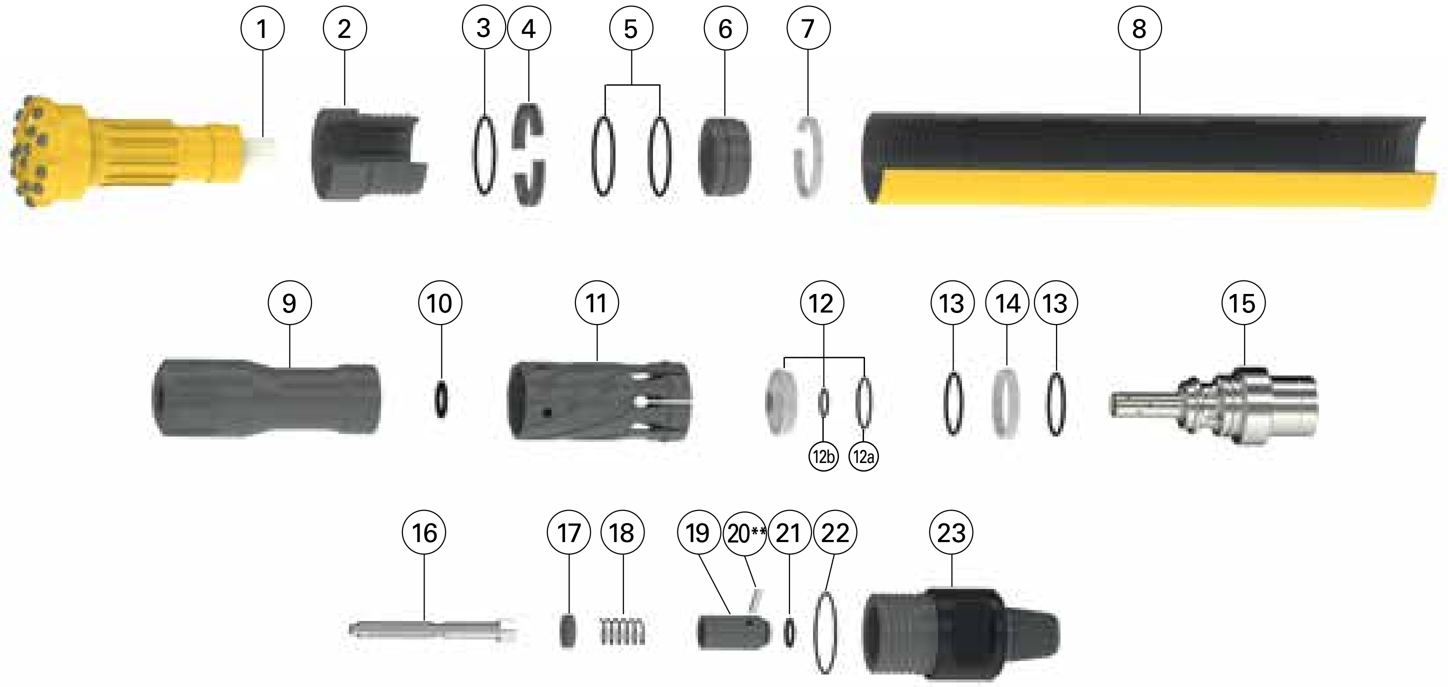
***Item 21 - Choke plug 1/4" and choke plug 1/8" may be used to bypass more air to reduce pressure and/or increase bailing velocity.*

Hammers and kits	Prod. No.	Product code
QLX 50 Complete, API 3 1/2" Reg. Pin	89010092	9705-QX-00-14P-25-000
QLX 55 Complete, API 3 1/2" Reg. Pin	89010093	9705-QX-00-14P-25-HB0
E-kit QLX50, API 3 1/2" Reg Pin incl. item 2, 4, 5, 8, 10, 12, 2x13, 20, 22, 23	89010124	9705-QX-00-14P-25-000-K40
E-kit QLX55, API 3 1/2" Reg Pin incl. item 2, 4, 5, 8, 10, 12, 2x13, 20, 22, 23	89010125	9705-QX-00-14P-25-HB0-K40
O-ring kit incl. items 2x4, 5, 22	89010176	9705-QX-00-000-00-000-K47
Sustainability kit incl. O-ring kit + items 10, 12, 2x13, 20	89010123	9705-QX-00-000-00-000-K70

Wear limits		
Chuck	Min. length	1,85" / 47,0 mm
Casing reverse diam. QLX 50	Min. OD	4,65" / 118,1 mm
Casing reverse diam. QLX 55	Min. OD	4,84" / 122,9 mm
Casing discard diam. QLX 50/55	Min. OD	4,38" / 111,3 mm
Bit bearing	Max I.D	3,019" / 76,68 mm
Piston / casing clearence	Max.	0,01" / 0,25 mm
Piston / inner cylinder clearence	Max.	0,009" / 0,23 mm
Exhaust tube protrusion		2,07" / 52,58 mm

Secoroc QLX 60/65

Down-the-hole hammer



Ref.	Part	Prod. No.	Product code
1	Exhaust tube	90514253	9283
1	Exhaust tube, tapered	52340247	9283-52340247
2	Chuck for QLX 60	52340635	9706-QX-00-000-26-000-001
2	Chuck for QLX 65	52338498	9706-QX-00-000-26-H00-001
3	O-ring* (Chuck)	–	–
4	Bit retaining ring assembly	52327632	9706-QX-00-000-26-000-A02
5	O-ring* (Bit retainer)	–	–
6	Bit bearing	52324506	9706-QX-00-000-26-000-A22
7	Bearing retaining ring	52324514	9706-QX-00-000-00-000-058
8	Casing for QLX 60	52324415	9706-QX-00-000-00-000-004
8	Casing for QLX 65	52324555	9706-QX-00-000-00-H00-004
9	Piston	52324423	9706-QT-00-000-26-000-005
10	Tail seal	52333820	9706-QX-00-000-00-000-054
11	Cylinder	52324480	9706-QX-00-000-00-000-048
12	Valve assembly	52333895	9706-QX-00-000-00-000-K45
12a	Seal*	–	–
12b	O-ring*	–	–
13	O-ring*	–	–
14	Compression cone	52329034	9706-QX-00-000-00-000-014
15	Distributor assembly	89012288	9706-QX-00-000-00-000-042
16	Airselect guide plug	89012271	9706-QX-00-000-00-000-052
17	Seat, check valve spring	89012272	9706-QX-00-000-00-000-018
18	Check valve spring	52349172	9706-QX-00-000-00-000-016
19	Check valve (O-ring incl.)	89010129	9706-QX-00-000-00-000-A17
20	Choke plug Solid**	50899137	9706-QL-00-000-00-000-180
20	Choke plug 1/4" **	50899111	9706-QL-00-000-00-000-181
20	Choke plug 1/8" **	50899129	9706-QL-00-000-00-000-182
21	O-ring* (Check valve)	–	–

Ref.	Part	Prod. No.	Product code
22	O-ring* (Backhead)	–	–
23	Backhead for QLX 60	52351806	9706-QX-00-14P-00-000-020
23	Backhead for QLX 65	52349222	9706-QX-00-14P-00-HB0-020

**O-rings not sold separately. Included in different kits, see table.*

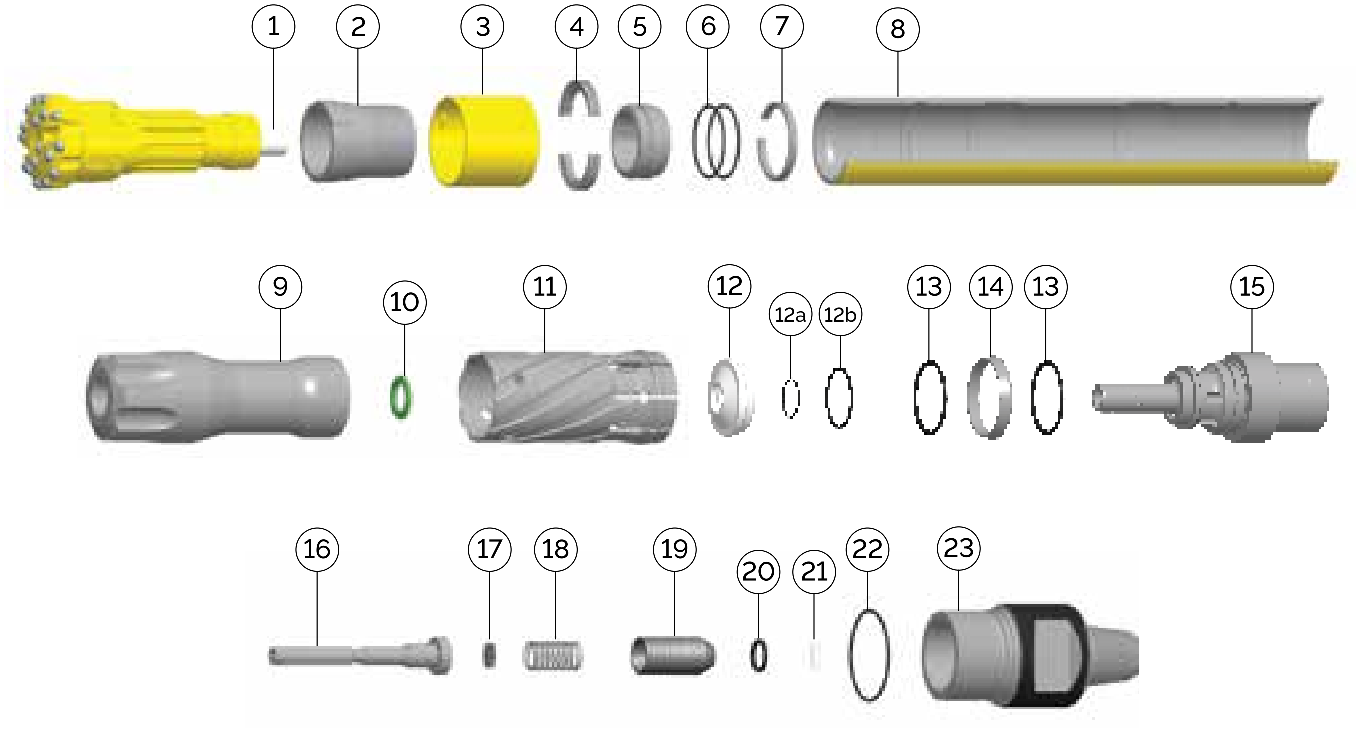
***Item 20: Choke plug 1/4" and choke plug 1/8" may be used to bypass more air to reduce pressure and/or increase bailing velocity.*

Hammers and kits	Prod. No.	Product code
QLX 60 complete, 3 1/2" API Reg Pin	52352465	9706-QX-00-14P-64-000
QLX 65 complete, 3 1/2" API Reg Pin	52352473	9706-QX-00-14P-64-HB0
E-kit, QLX 60 incl. item 2, 3, 2x5, 8, 10, 12, 2x13, 18, 21, 22, 23	89010007	9706-QX-00-14P-64-000-K40
E-kit, QLX 65 incl. item 2, 3, 2x5, 8, 10, 12, 2x13, 18, 21, 22, 23	89010009	9706-QX-00-14P-64-HB0-K40
O-ring kit incl. item 4x3, 4x5, 4x13, 21, 2x22	89010120	9706-QX-00-000-00-000-K47
Sustainability kit incl. item 3, 2x5, 10, 12, 2x13, 21, 22	52354646	9706-QX-00-000-00-000-070

Wear limits		
Chuck	Min. length	2.15 in / 54,6 mm
Casing reverse QLX 60	Min. OD	5.44 in / 138,2 mm
Casing reverse QLX 65	Min. OD	5.63 in / 142,9 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

Secoroc QLX 60 OG

Down-the-hole hammer



Ref.	Part	Prod. No.	Product code
1	Exhaust tube	90514253	9283
1	Exhaust tube, tapered	52340247	9283-52340247
2	Retrieval chuck	52353612	9706-QL-00-000-00-00R-001
3	Retrieval sleeve - comes with bit	–	–
4	Bit retaining ring, (O-ring not incl.)	52327632	9706-QX-00-000-26-000-A02
5	Bit bearing	52324506	9706-QX-00-000-26-000-A22
6	O-ring (bit retainer), not sold separately	–	–
6	Bit bearing, vented	89010216	9706-QX-DH-000-00-00V-059
7	Bearing retaining ring	52324514	9706-QX-00-000-00-000-058
8	Casing	52324415	9706-QX-00-000-00-000-004
9	Piston	52324423	9706-QX-00-000-26-000-005
10	Tail seal	52333820	9706-QX-00-000-00-000-054
11	Inner cylinder	52324480	9706-QX-00-000-00-000-048
12	Valve assembly	52333895	9706-QX-00-000-00-000-A45
12a	Seal, not sold separately	–	–
12b	Seal, not sold separately	–	–
13	O-ring, not sold separately	–	–
14	Compression cone	52329034	9706-QX-00-000-00-000-014
15	Air distributor assembly	89012288	9706-QX-00-000-00-000-042
16	Airselect guide plug	89012271	9706-QX-DH-000-00-000-052
17	Seat, check valve spring	89012272	9706-QX-DH-000-00-000-089
18	Check valve spring	52349172	9706-QX-00-000-00-000-016
19	Check valve (O-ring incl.)	89010129	9706-QX-00-000-00-000-A17
20	Check valve O-ring, not sold separately	–	–
21	Choke plug Solid**	50899137	9706-QL-00-000-00-000-180
21	Choke plug 1/4" **	50899129	9706-QL-00-000-00-000-181

Ref.	Part	Prod. No.	Product code
22	Choke plug 1/8" **	50899111	9706-QL-00-000-00-000-182
23	Backhead	52351806	9706-QX-00-14P-00-000-020

**O-rings not sold separately. Included in different kits, see table.*

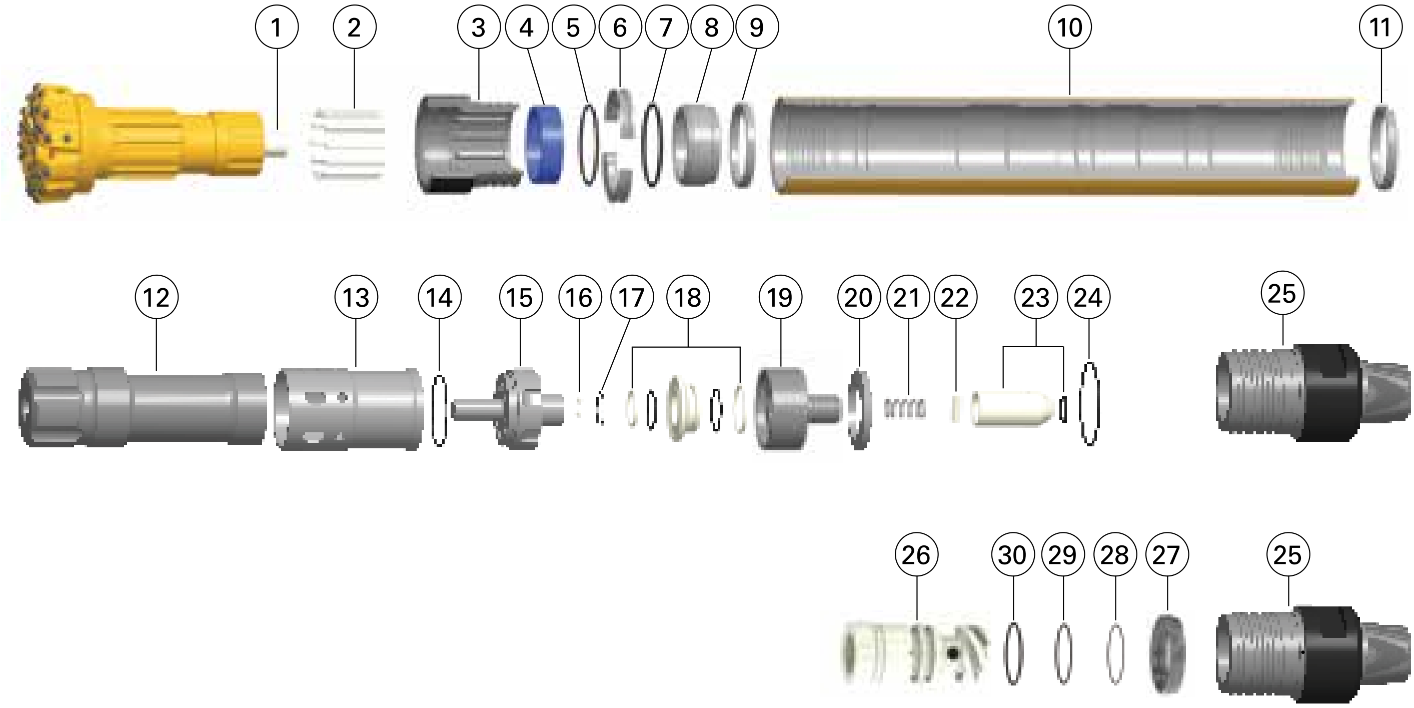
***Item 21: Choke plug 1/4" and choke plug 1/8" may be used to bypass more air to reduce pressure and/or increase bailing velocity.*

Hammers and kits	Prod. No.	Product code
QLX 60 OG complete, 3 1/2" API Reg Pin, Retrieval chuck	52354180	9706-QX-OG-14P-26-00R
QLX 60 OG complete, 3 1/2" API Reg Pin, Std. chuck, Vented bearing	89010219	9706-QX-OG-14P26-00V
QLX 60 OG complete, 3 1/2" API Reg Pin, Retrieval chuck, Vented bearing	89010220	9706-QX-OG-14P-26-00X
E-kit (for retrieval options), QLX 60 OG incl. item 2, 2x5, 8, 10, 12, 2x13, 18, 20, 22, 23	89010008	9706-QX-00-14P-26-00R-K40
E-kit (for standard chuck), QLX 60 OG incl. item 2, 2x5, 8, 10, 12, 2x13, 18, 20, 22, 23	89010007	9706-QX-00-14P-26-000-K40
O-ring kit, QLX 60 OG incl. item 4x5, 4x13, 20, 22	89010120	9706-QX-00-000-00-000-K47
Sustainability kit, QLX 60 OG incl. item 2x5, 10, 12, 2x13, 20, 2x22	52354646	9706-QX-00-000-00-000-070

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

Secoroc QLX 100

Down-the-hole hammer



Ref.	Part	Prod. No.	Product code
1	Exhaust tube	89010443	9710-QX-00-000-00-000-003
1	Drive pins	89010442	9710-QX-00-000-00-000-061
3	Standard chuck	89010455	9710-QX-00-000-00-000-001
3	R4 Retrieval chuck	89010465	9710-QX-OG-000-40-00R-001
4	Chuck bearing	89010448	9710-QX-00-000-00-000-060
5	Bit retainer O-ring	95538104	0663-95538104
6	Bit retainer rings	89010461	9710-QX-00-000-00-000-002
7	Bearing retainer O-ring	89010466	9710-QX-00-000-00-000-035
8	Vented bit bearing	89010457	9710-QX-00-000-00-000-059
8	Bit bearing	89010560	9710-QX-00-000-00-000-022
9	Bearing stop ring	89010456	9710-QX-00-000-00-000-058
10	Casing	89010454	9710-QX-00-000-00-000-004
11	Cylinder stop ring	89010460	9710-QX-00-000-00-000-062
12	Piston	89010463	9710-QX-00-000-00-000-005
13	Cylinder	89010458	9710-QX-00-000-00-000-048
13	DT cylinder	89010478	9710-QX-DT-000-00-000-048
14	Distributor to cylinder O-ring	95538104	0663-95508104
15	Distributor	89010440	9710-QX-00-000-00-000-042
16	Distributor plugs	Not sold separately	
17	Distributor to valve cap O-ring	89010512	9710-QX-00-000-00-000-029
18	Valve assembly	89010438	9710-QX-00-000-00-000-A45
19	Valve cap	89010439	9710-QX-00-000-00-000-074
20	Bellville spring	89010459	9710-QX-00-000-00-000-013
21	Check valve spring	89010464	9710-QX-00-000-00-000-016
22	Solid choke plug	89010467	9710-QX-00-000-00-000-180
22	Choke plug – $^{3}/_{16}$"– 4,83 mm Orifice	89010471	9710-QX-00-000-00-000-181
22	Choke plug – $^{5}/_{16}$" – 7,9 mm Orifice	89010472	9710-QX-00-000-00-000-182

Ref.	Part	Prod. No.	Product code
23	Check valve assembly	89010470	9710-QX-00-000-00-000-A17
23	Check valve O-ring	Not sold separately	
24	Backhead O-ring	95760906	0663-95760906
25	Backhead 6$^{5}/_{8}$" PIN	89010453	9710-QX-00-18P-00-000-020
25	HC backhead	89010530	9710-QX-00-18P-00-0H0-020
26	HC inducer/separator	89010532	9710-QX-00-000-00-0H0-081
27	HC check seal	89010531	9710-QX-00-000-00-0H0-073
28	HC O-ring	89010533	0663-89010533
29	HC O-ring	89011088	0663-89011088
30	HC O-ring	89010475	0663-89010475

Hammers and kits	Prod. No.	Product code
QLX 100,COMP 6$^{5}/_{8}$ API Reg PIN	89010474	9710-QX-OG-18P-40-000
QLX 100,COMP 6$^{5}/_{8}$ API & R4 RET	89010479	9710-QX-OG-18P-40-00R
QLX 100,COMP 6$^{5}/_{8}$ API Pin, HC	89010534	9710-QX-OG-18P-40-0H0
QLX,100,COMP 6$^{5}/_{8}$ API, R4 RET, HC	89010535	9710-QX-OG-18P-40-0HR
QLX,100,COMP 6$^{5}/_{8}$ API Reg PIN	89010561	9710-QX-00-18P-40-000
Sustainability kit (includes items 7, 2 x 14, 17, 18, 21, 24)	89010495	9710-QX-00-000-00-000-K70

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

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