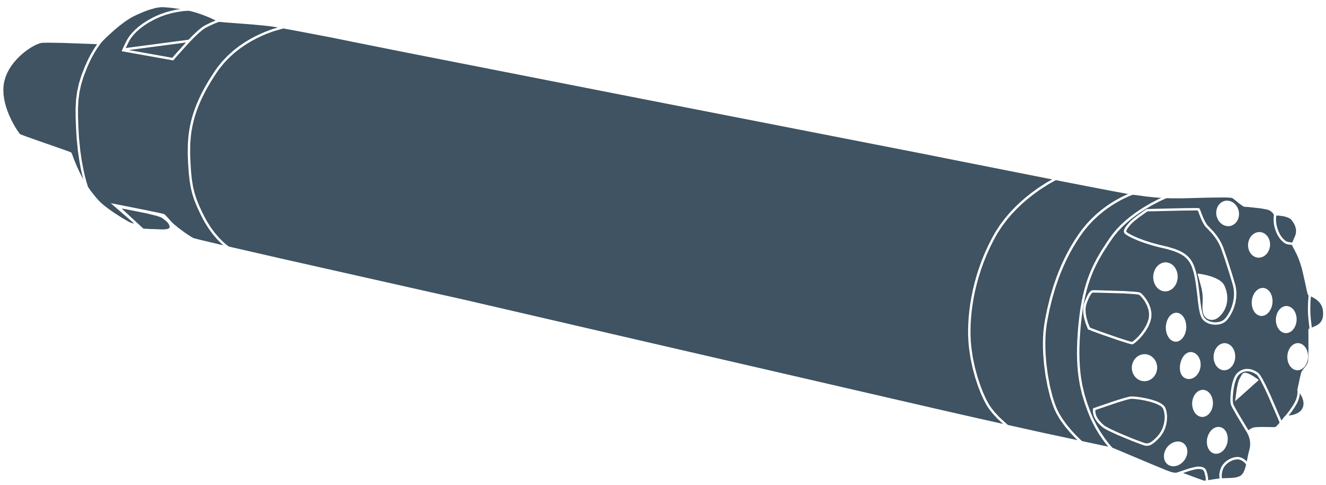
Secoroc QL 340 down-the-hole hammer

Operator's instructions
Spare parts lists



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Epiroc Drilling Tools AB, Fagersta, Sweden

Introduction

Read this manual carefully to learn how to operate and service your DTH correctly. Failure to do so could result in personal injury or equipment damage.

Consult your 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, and should remain with the DTH 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 English and metric units, and are used to provide additional worldwide understanding. Metric units are shown between parentheses "( )". Use only correct replacement parts and fasteners.

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

Abbreviations used throughout this manual.

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

Safety regulations

- Before starting, read these instructions carefully.
- Important safety information is given at various points in these instructions.
- Special attention must be paid to the safety information contained in frames and accompanied by a warning symbol (triangle) and a signal word, as shown below.

⚠ 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.

- Read through the operator's instructions for both the drill rig and the DTH hammer thoroughly before putting the DTH hammer into service. Always follow the advice given in the instructions.
- Use only authorized parts. Any damage or malfunction caused by the use of unauthorized parts is not covered by Warranty or Product Liability.

The following general safety rules must also be observed:

- Make sure that all warning signs on the rig remain in place and are free from dirt and easily legible.
- Make sure there are no personnel inside the working area of the drill rig during drilling, or when moving the rig.
- Always wear a helmet, goggles and ear protectors during drilling. Also observe any local regulations.
- The exhaust air from air driven hammers and grinding machines contains oil. It can be dangerous to inhale oil mist. Adjust the lubricator so that the correct rate of lubrication is obtained.
- Make sure that the place of work is well ventilated.
- Always check that hoses, hose nipples and hose clamps are properly tightened and secured, and that they are not damaged. Hoses that come loose can cause serious injury.
- Local regulations concerning air hoses and connections must always be strictly observed. This is especially the case if the DTH-hammer is to be operated at pressures above 10 bar (145 psi).
- The machine must not be used for purposes other than those prescribed by Secoroc.

Be aware of safety information

Understand signal words

A signal word - **Danger, Warning,** or **Caution** - is used with the safety-alert symbol.

⚠ DANGER

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

⚠ WARNING

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

⚠ CAUTION

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

Safety

Follow instructions

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

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

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

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

Keep DTH in good working condition

Keep your DTH in proper working condition. Unauthorized modifications to the DTH may impair the Function and/or safety and effect DTH life.

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

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

Wear protective clothing

Wear **approved** safety equipment (safety shoes, safety glasses, hearing protection, hard hat, gloves, respirator, etc.) when operating or maintaining the DTH.

Wear close fitting clothing and confine long hair.

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

Check for underground utility lines

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

Avoid electrocution – Stay away

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

- Always contact your local utility company when working in the vicinity of utilities.
- Locate underground utilities by qualified persons.
- Do not raise, lower, or move drill guide or boom near power lines.
- Always wear proper electrically insulated lineman 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 inaccordance with Federal, State, and Local, and appropriate governing agency laws and regulations.

Observe environmental Protection regulations

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

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

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

⚠ WARNING

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

Installation and operation

General information

Follow instructions

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

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

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

Description

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

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

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

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

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

DTH Setup

Bailing velocity requirements

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

Bit installation

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

New bit and chuck

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

Used bit and chuck

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

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

Makeup torque and backhead closure

The Quantum Leap® drills have two forms of locking means for internal components; the QL4, QL120 and QL200 use relatively low-load belleville springs, all others use ''solid clamping" arrangement whereby parts are held in place under very high load.

Rotary head torque is usual y sufficient to close the QL340 backhead. The QL200 uses a special wrench to close the backhead. However, because of the high load used to clamp the parts in place in the QL340, QL50, QL60, QL80, and QL120; a high level of torque is needed to close the backhead gap. Rotary head torque is not sufficient to close the backhead gap. A supplementary wrench is needed to properly tighten the joint. It is extremely important that the backhead gap be closed in these drills.

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

In addition to at least closing the backhead gap, it is also recommended that the backhead and chuck be torqued to approximately 750 – 1000 ft.-lb per inch (40,5 - 54 N-m per mm) of hammer diameter. For example a 5 in. (127 mm) class DTH (QL50) should be torqued to 3750 – 5000 ft.-lb (5143,5 - 6858 N-m). This makeup torque insures against loosening joints in the hole and also preloads the threads sufficiently.

Drill lubrication

Lubrication guidelines and specifications

All DTH ´s require oil lubrication to resist wear, galling and corrosion. Additionally, the film of oil coating all internal parts seals internal clearance paths to reduce power-robbing leakage across sealing clearances. As a general rule of thumb the oil required is proportional to the volume of air being used.

Oil also needs to be of sufficiently high quality. It is recommended that Atlas Copco Supertac rock drill oil be used. If another type of oil is used it must comply with the oil specifications shown in table on page.

For dry drilling (less than 2 gpm (7,6 lpm) of water injection) it is generally recommended that oil be injected into the dril 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 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)), and in particular when using a Hydrocyclone® water separator, 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 caused by the Hydrocyclone®.

Lubricators

There are two primary types of lubricators; a plunger oiler and a venturi oiler:

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

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

Lubrication check

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

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

Water injection

Water injection can cause a DTH to either consume more air (hold a lower pressure) or less air (hold a higher pressure) depending on the volume of fluids injected. For example, if a DTH is lubricated with oil and water is then injected at a low rate (less than 1 gpm (3,8 lpm)), the oil film which is sealing the internal leak paths is washed out and air consumption will increase (pressure will fall).

Conversely, if water is injected at a high rate (more than 3 gpm (11,4 lpm)) the fluid level will be sufficient to seal the leak paths and restrict the flow of air through the DTH. In this case the air consumption will decrease (pressure will increase).

The pressure rise associated with water injection can sometimes exceed the maximum pressure rating of a compressor. In these cases the choke or Hydrocyclone bypass hole must be increased to reduce pressure.

The use of water, while required in most cases, does reduce component life. The following lists some of the problems that water injection can cause:

• Poor quality water can either be corrosive or can carry contamination into the drill. Premature wear or corrosion related failures can result. All water injected into a DTH should be neutral in PH and free from particulate contamination.

• Water injection reduces drill performance considerably. Water restricts the flow and resultant pressure in working chambers of the drill and reduces face cleaning which causes regrinding of cuttings.

• Water present at the impact face causes cavitation of the bit and piston and jetting or cutting of the exhaust tube. In both cases component life is reduced.

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

QL60 Non-lube instructions

The QL60 non-lube does not require injected oil or other lubricants. However, the use of oil will not harm the DTH. The following operational considerations are required.

• A minimum of 1¼ gpm (1 lpm) of water is needed to lubricate and cool the internal seals. It is suggested that at least a ''mist" of water be used even while driving casing.

• Use of the QL60 non-lube for quarry applications is not recommended unless; The minimum water injection rate is observed, and,

• The chances of getting stuck and overheating the drill are minimal. The addition of frictional heat can be sufficient to melt the piston seals and bearings.

• A Hydrocyclone can be used on the QL60 non-lube. Sufficient water bypasses the Hydrocyclone to permit adequate cooling of the seals and bearings.

QL60 Non-lube instructions

• Because there is usually no oil present in the QL60 non-lube to prevent corrosion, it is important to oil the DTH if it will be idle for more than two days. The following process is suggested.

• While the cylinder and casing have been specially heat treated to resist corrosion, other internal parts need the protection of oil when not being used.

• Fill the backhead bore, or last joint, with approximately 1 pint (0,5 Liter) of oil (motor oil is fine),

• Re-connect and cycle the drill on a block of wood at low pressure (50-100 psi) for approx. 15 seconds.

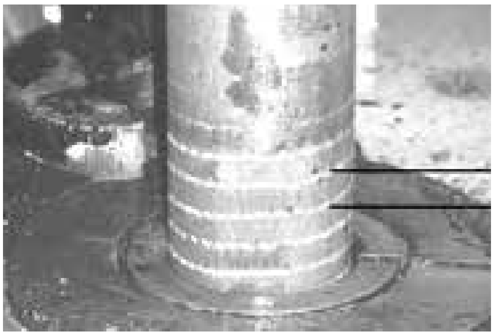
Drill operation

Rotation speed

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

Determining the optimum rotation speed needs to be carried out in the actual application. A good rule-of-thumb is to divide 300 by the bit diameter in inches to determine RPM. This will get the rotation speed in the ''bal park". However, a fine-tuned rotation speed also needs to be correlated with penetration rate. It has been found that a proper rotation speed usually results in a $^3/_8$ in. – $^5/_8$ in. (9,525 mm – 15,875 mm) advance of the bit per revolution of the DTH. This measurement can normally be taken by using chalk or soapstone to scribe a spiral on the drill pipe while the drill is operating. The distance between the spirals (thread pitch) can be measured to determine if rotation speed should be increased or decreased. Obviously, if the pitch is less than $^3/_8$ in. (9,525 mm) the drill RPM should be decreased, if it is more than $^5/_8$ in. (15,875 mm) the drill RPM should be increased.

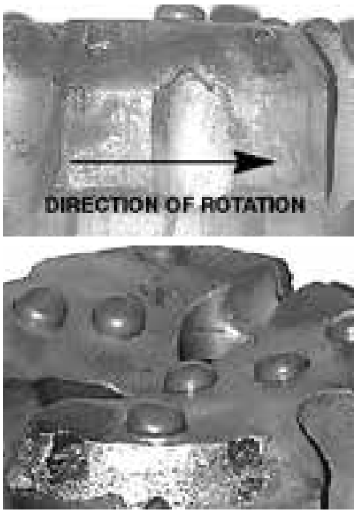
The picture following shows an example of the marks left on a dril pipe when using chalk to mark the advance of the drill.



Adjust RPM to give ½ in. - $^3/_8$ 4n. (12,7 mm - 19,05 mm)

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

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



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

Rotation Torque

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

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

Collaring

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

Feed force(hold down and hold back)

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

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

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

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

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

It´s equally important to avoid feeding too hard through voided and fractured material. The piston in a DTH operates within the casing with a clearance of about .003 in. (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 wil occur. Frictional cracks will develop on the surface of the piston if the piston rubs hard enough against the wall of the casing while being distorted. These small frictional cracks can eventually grow and break the piston.

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

Hole cleaning, flushing and dust suppression

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

Dry drilling

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

Wet drilling

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

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

- Water intrusion into the hole can develop mud rings where dry cuttings meet a seam of water entering the hole. Mud rings develop where dry cuttings stick to the wall of the hole when they hit the moist area. Water injection is needed to keep the hole wet enough to prevent these mud rings from developing. Fluid injection rates can vary from 2 - 15 gpm (7,57 - 56,775 lpm) depending of the hole size, rate of penetration and the type of material being drilled.

- Some materials such as those which drill fast or contain clay can sometimes require very heavy levels of water injection. These applications are unique in that they can either be drilled totally dry or totally wet, not in between. Marginal fluid injection results in making a tacky mud which sticks to the drill rods and hole wall and hinders hole cleaning. The correct level of fluid injection thins the paste so it will be cleared from the hole.

Wet drilling with Hydrocyclone®

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

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

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

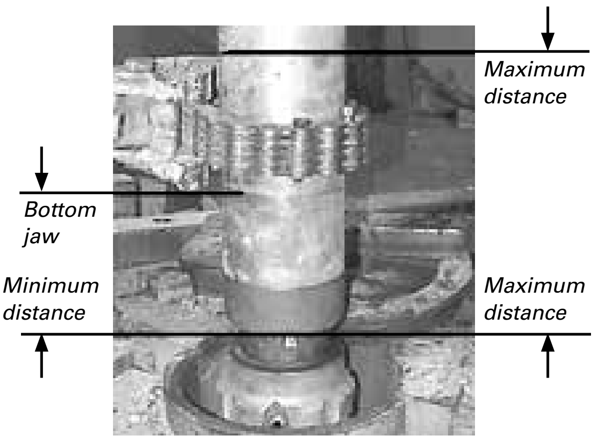
Insure Hydrocyclone® backhead ports are passing air at the end of each hole.

Bit changing

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

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

2. Grip the casing in the proper location. Gripping over the threads can make thread loosening extremely difficult. Example; as the wrench tightens it exerts an inward force which can pinch the threads if they are under the wrench jaw. This only increases the torque needed to uncouple the thread. Also, do not grip the casing in an area where the bore is not supported by either the piston or bearing. Gripping over an unsupported area can distort the bore. The figure and table below shows the recommended locations for wrenches.



Chain Wrench Positions

DTH Model	Minimum distance from chuck to lower jaw	Maximum distance from chuck to upper jaw
QL340/QL40	6.6 in. (167,64 mm)	17 in. (431.8 mm)
QL50/QL55QM	6.5 in. (165,1 mm)	15 in. (381 mm)
QL60/QL65QM	6.5 in. (165,1 mm)	17 in. (431,8 mm)
QL80	8 in. (203,2 mm)	22 in. (558,8 mm)
QL120	12 in. (304,8 mm)	30 in. (762 mm)
QL200	Special Wrench	Special Wrench

3. Insure the bit fits properly within the bit basket. An improper fit may result in the bit slipping from the basket.

4. Never weld or hammer on the casing to loosen it. All casings except the QL200 are case hardened for extended service life. The hard casing surface can be cracked by welding or impacting with a sledge hammer.

⚠ WARNING

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

Process instructions

1. Place a piece of relatively hard polyurethane or conveyor belting in the bit break-out basket to absorb shock.

2. Remove all drill pipe so only the DTH and required adapters are attached to the rotary head.

3. Bring the drill in contact with the bit basket with a relatively light feed.

4. Bring the hammer pressure up to roughly 150 psig (10,3 bar).

5. See if the joint has loosened on its own after about 10 seconds of cycling.

6. If the joint has not loosened, ''Bump" the rotation in reverse at a slow speed while the drill cycles until the joint has loosened.

7. Stop as soon as the chuck loosens, grease and air will be noticed coming from the loosened joint at the time of loosening.

⚠ WARNING

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

Maintenance and repair

General information

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

Tools required for DTH service and repair			
Tool	QL4, QL40	QL50, QL55QM	QL60, QL65QM
Outside Micrometer	3-4", 2-3", 1-2"	4-5", 3-4"	1-2", 5-6", 4-5", 3-4"
Feeler Gauges	Set	Set	Set
Telescopic Bore Gauges	Set up to 3"	Set up to 4"	Set up to 5"
Vernier Caliper	0-6"	0-6"	0-6"
Brass (soft) Bar	3/4" dia. by 48"	1" dia. by 48"	1 – ¼" dia. by 48"
"J" Wrench	2 – ½"	3– ½"	4"
Threaded Rod	None	None	None
Bar Stock	None	None	None
Lifting Eye	None	None	None
Tool	QL80	QL120	QL200
Outside Micrometer	7-8", 5-6", 4-5", 2-3", 1-2"	9-10", 8-9", 7-8", 2-3"	12-13", 10-11", 2-3", 3-4"
Feeler Gauges	Set	Set	Set
Telescopic Bore Gauges	Set up to 6"	Set up to 10"	Set up to 13"
Vernier Caliper	0-6"	0-6"	0-6"
Brass (soft) Bar	1 – 3/4" dia. by 48"	2" dia. by 48"	2– ½" dia. by 48"
"J" Wrench	6"	9 – 1/4"	None
Threaded Rod	None	None	3/4" – 8 by 60"
Bar Stock	None	None	1 – ½" dia. by 18" long bar or tube
Lifting Eye	None	Included	1 ea. 3/4" -8 female, 2 ea. 5/8" -11 male

DTH Service

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

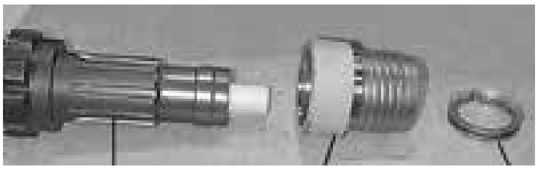
Disassembly

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

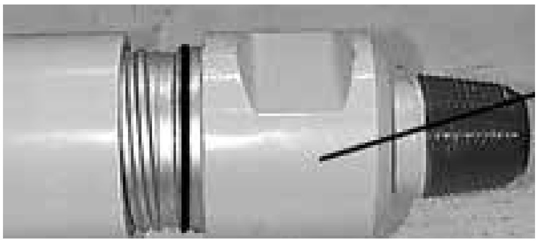
It´s important to note that the QL340 piston can only be removed from the backhead end of the drill. The casing can not be reversed.

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

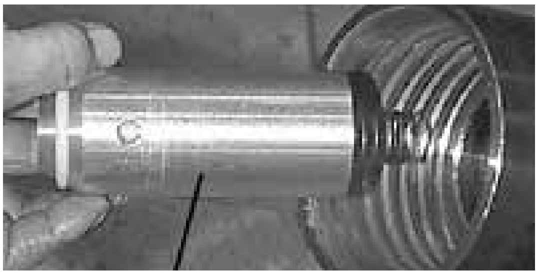
2. **Remove retaining rings and o-ring** from bit shank.



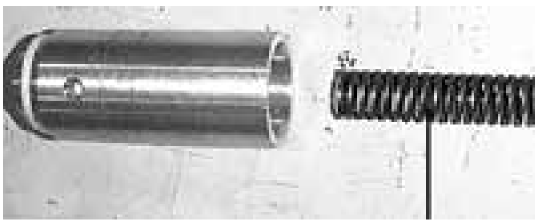
3. **Remove the chuck** from the bit.

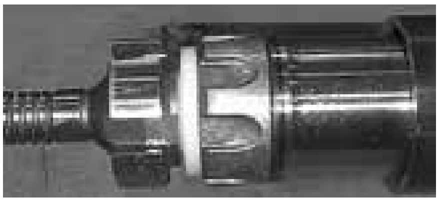


4. **Remove the backhead** from the other end of the casing.



5. **Remove the check valve,** and check valve spring.





Casing

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

7. **Remove the cylinder** retain ring from the casing, it is very Important because if you want to get the piston out, you must get the ring out first,. You can use a special tool to pull it out, or you just need hang the casing then drop it, use the weight of the piston to pull it out.

8. **Slide the piston** out of the drill being careful to carry its weight when it´s no longer supported by the casing.

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

Air distributor

Cylinder

Cylinder

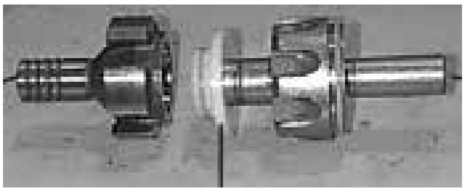
Cylinder *Piston*

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

DTH inspection

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

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



Valve cap *Air distributor*

Valve

1. **Casing** outside diameter should be measured roughly 2 – 3 in.

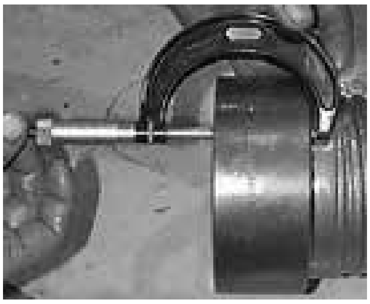
(50,8 – 76,2 mm) from the end of the chuck end. Refer to the casing discard dimensions to determine if the casing should be replaced.

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

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

•The overall length of the chuck should be checked against specification. A short chuck can cause cycling problems, difficulty handling water and a rough drill operation.

•The chuck should be replaced if spline wear is heavy or uneven. The chuck should be replaced if its minimum outside diameter is less than the casing discard point.



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

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

Thread condition

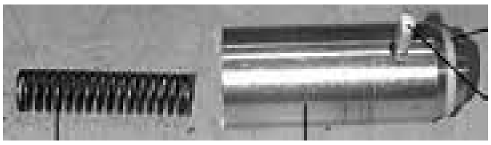
O-ring/Check seal condition

Shoulder condition

4. **The backhead o-ring or check seal** should be replaced if damaged in any way.

5. **The check valve** spring should be checked for cracks and obviously replaced if it is broken. In addition to visual inspection, compress the spring by hand and listen for a faint cracking sound to determine if cracks exist.

6. Inspect the check valve rubber or o-ring for damage on its sealing surface. Replace a damaged check valve. **Remember to replace the check valve choke if a new check valve is required**.



O-ring/ moulded seal

Check valve choke (choke flat must face down)

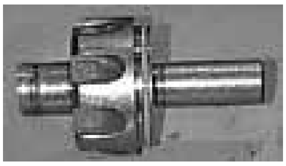
Check valve spring

Check valve

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

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

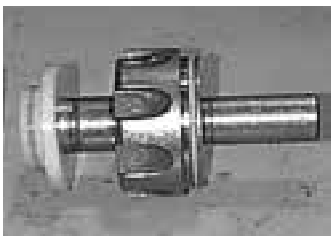
Valve cap side



Side

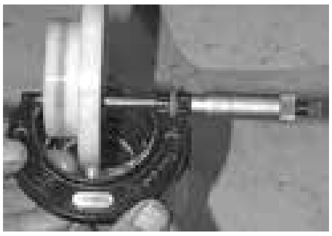
9.**Inspect the valve** for seal interference and damage. The valve seals should have interference with the valve cap bore and distributor guide. The valve sealing surfaces should be free of nicks and burrs.

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



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

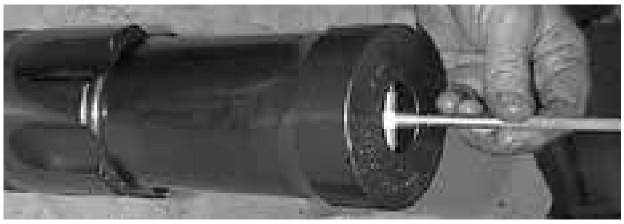
• Measure the height of the valve with calipers and check against the discard specification. Replace the valve if it ís below discard point. A shortened valve may cause a loss in operating pressure.



• Check to see that the outside diameter seal has not worn its groove in the valve by more than.060 in. (1,52 mm) axially. Replace the valve if the seal groove has worn.

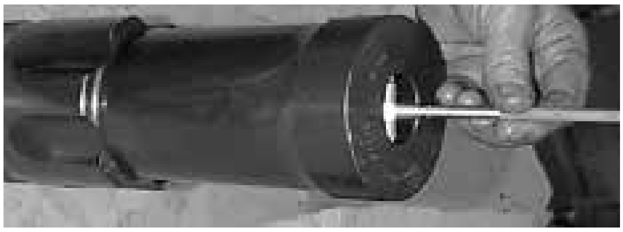
10. **Inspect the piston** for wear using micrometers in the four locations noted below. The piston usually wears more than its mating parts so it ís likely that it will affect clearance the most. Record the dimensions for comparison to mating parts (cylinder, distributor and casing) to determine which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

• Measure the tail bore in the location shown.



• Measure the tail outside diameter in the location shown.

• Measure the piston exhaust tube bore in the location shown.



• Measure the piston large diameter in the location shown.

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

11. Carefully remove any sharp edges, burrs or nicks which have developed on the piston using a hand grinder. **Do not overheat the piston, .it will crack if overheated!** If the piston face is heavily cavitated or pitted either use a ceramic facing tool to dress the face of the piston or use a well cooled grinder. In either case, a maximum of .060 in. (1,52 mm) can be removed from the piston face.

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


Measure at this point (½˝past long undercut)

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

14. **Inspect the air distributor** for excessive wear on the valve seat, replace if wear is deeper than .005 in. (0,127 mm). Measure and record the guide diameter for later reference.

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

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

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

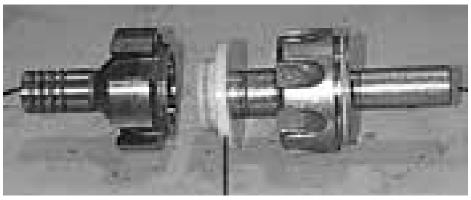
DTH assembly

The DTH assembly process is identical to the disassembly. The following guidelines should be used:

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

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

Valve cap



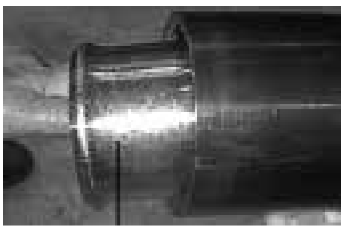
Air distributor

Valve

- Use a mallet or brass bar to overcome the o-ring pressure.
- Insure the valve cap o-ring is installed in the valve cap and that it ís in good condition.
- Install the valve into the valve cap being careful not to fold or tear the valve seal.
- Slide the valve and valve cap onto the distributor stem, again being careful not to damage the valve seal. Tap the top of the valve cap with a mallet to seat the o-ring and lock the parts together.

2. Install the piston through the backhead end of the casing.

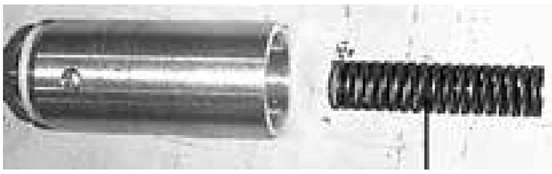
3. Install the cylinder retaining ring into the casing by starting it sideways and when it ís near the undercut turn into the proper orientation until it snaps into the groove. A brass rod may be useful to driving and turning the ring. **Be sure to wear safety glasses as oil and grease in the groove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


Casing

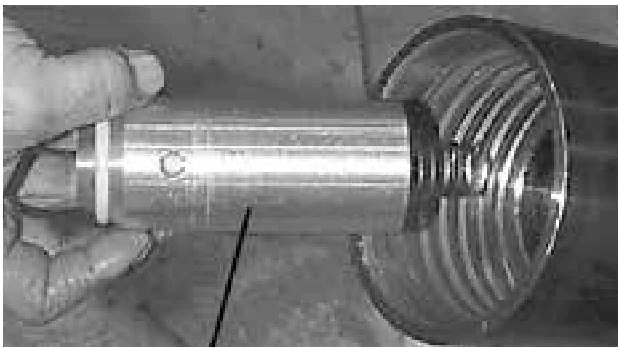
4. Install the assembly valve cap, valve, distributor and cylinder into the casing, make sure all the o ring is ok.

5. Install the shim which against the valve cap.

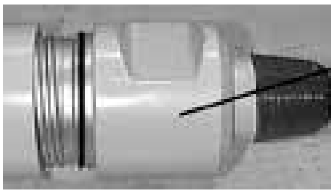
6. Install the check valve spring and check valve.



Check valve spring



Check valve



Back-head

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

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

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

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

Exhaust tube replacement and installation

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

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

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

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

Correct exhaust tube extension

Bits

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

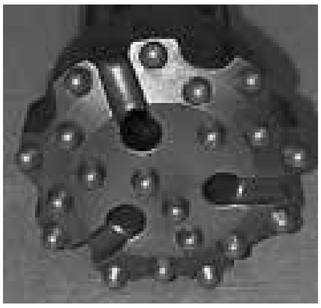
Selection

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

Convex head conical tipped

Soft materials which are less than 15.000 psi (1033,5 bar) compressive strength. The material should also be consolidated and homogeneous with a low abrasiveness.

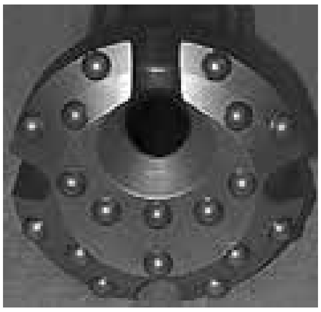
- Soft limestone
- Shale
- Slate




Convex head spherical tipped

Medium soft materials which are 15.000 – 25.000 psi (1033,5 - 1722,5 bar) compressive strength. The material should be consolidated and homogenous.

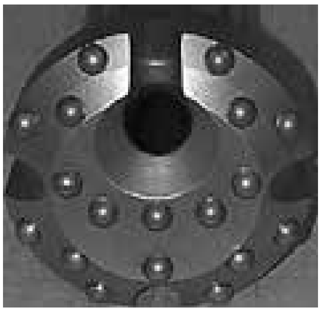
- Hard limestone
- Granite
- Sandstone
- Diorite
- Schist
- Marble




Concave face

Medium-soft to medium-hard materials which are 15.000 – 30.000 psi (1033,5 - 2067 bar) compressive strength. Material can be voided, fractured, unconsolidated and faulted. Face slots provide good hole cleaning in fast drilling applications.

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




Flat face

Medium-hard to hard materials which are greater than 30.000 psi (2067 bar). Materials should be consolidated but a certain level of voids and fractures are acceptable. The flat face design has the strongest head.

- Granite
- Gabbro


Service

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

Bit sharpening

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

The bottom line is Keep those inserts sharp!!!

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

Trouble shooting

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

Problem	Cause(s)	Remedy(s)
Rough-erratic operation	1. Too much water injection	1. Reduce level of water injection. Consider installing a Hydrocyclone®
	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 at 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. Valve lift too large	5. Inspect valve lift and replace valve assembly if needed. Valve lift should be .045 – .055 in. (1,14 - 1,9 mm) or, .075 – .085 in. (1,9 - 2,16 mm) for high flow QL60/QL65QM valve
	6. Worn/leaking valve seal	6. Check for axial wear of outside valve seal groove. Replace valve assembly if groove has worn more than .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. Worn non-lube seals	9. Replace seals and bearings
Low penetration/high pressure	1. Worn/leaking valve seal	1 Check for axial wear of outside valve seal groove. Replace valve assembly if groove has worn more than. 06 in. (1,524 mm)
	2. Chuck has worn too much	2. Inspect chuck length for correct body length. A short chuck will restrict air needed to return piston
	3. Too much water injection	3. Reduce level of water injection. Consider installing a Hydrocyclone®
	4. Contamination (rubber hose, etc.) jammed hammer	4. Remove obstruction which may be holding the in valve closed or restricting the air flow
	5. Exhaust tube projection too long	5. Check projection vs. specifications repair tube
	6. Valve lift too small	6. Measure valve lift. Replace parts as needed to correct. This problem usually means that standoff has been lost and internal parts are loose. Check standoff of backhead

Problem	Cause(s)	Remedy(s)
Low penetration/low pressure	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 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 necessar
	3. Large valve gap	3. Inspect valve lift and replace valve assembly if needed. Valve lift should be .045 – .055 in. (1,14 - 1,9 mm) or, .075 – .085 in. (1,9 - 2,16 mm) for high flow QL60/QL65QM valve
	4. Damaged valve seat	4. Inspect valve seat surface for damage or wear which could cause leakage. Replace valve is suspect
	5. Worn non-lube seals	5. Replace seals
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
Component failures	1. Piston cracked through large diameter	1a. Lack of lubrication could cause frictional cracks. 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
	2. Piston struck end cupping or breaking	2a. Usually a sign of underfeeding. Increase feed 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 & use sharp tong jaws to loosen connections 3b. Corrosion from internal undercuts and threads; use good quality (neutral pH) water and flush with oil when finished drilling. If possible, coat threaded areas undercuts and bore of casing with corrosion protector such as LPS Hardcoat 3c. Look for beat in chuck which could allow the piston to stroke far enough to contact air distributor and overstress the casing. Replace chuck if worn more than specification

Problem	Cause(s)	Remedy(s)
		3d. Look for leaking or loose fitting large dia valve seal which could make piston stroke too far and contact distributor. Replace the valve assembly 3e. Casing has worn beyond discard point. Measure casing OD about 2 in. (50.8 mm) from chuck end. Compare to specification and replace if needed
	4. Rolled over chuck	4. Underfeeding can cause the bit to rebound into shoulder. the chuck and 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 threaded connection	6. Look for evidence of connection moving on contact shoulder. Connection shoulder may be worn allowing movement. Replace/repair adapter sub or rod
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 1b. Avoid feathering feed in loose ground or at end of rod
	2. Improper make up torque	2a. Tong chuck tight before drilling
Chuck hard to loosen	1. Gripping poor	1a. Don´t grip over threads 1b. Insure tong jaws are sharp
	2. Conditions	2a. Try using breakout washer

Specifications

DTH Requirements

Minimum guidelines for mounting specifications

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

Speed: 10 to 90 rpm

Hold down force: 500 lb per inch (9 kg per mm) of hammer maximum (i.e. QL60 needs 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: 350 psig (24,1 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).

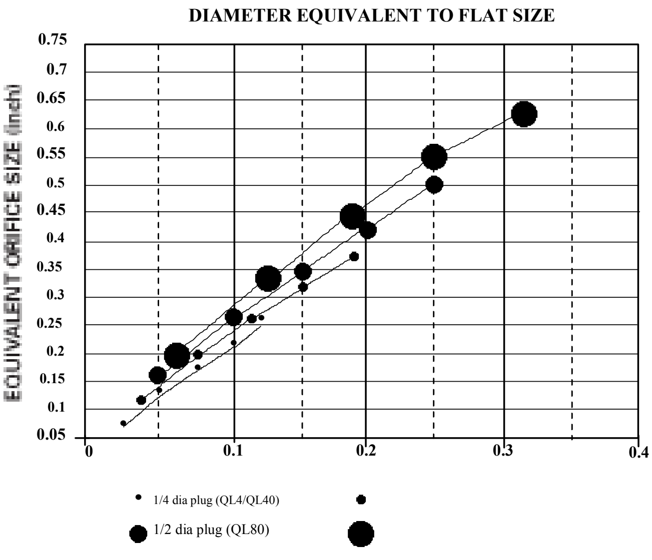
Minimum requirements for compressor capacity and pressure

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

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

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

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



1. Diameter is based on flow enetering from both sides of the flat (ie. two flats make up hole equivalent).

2. Flat height is thickness removed from round choke plug.

3. Flow can be determined from the expression following where:

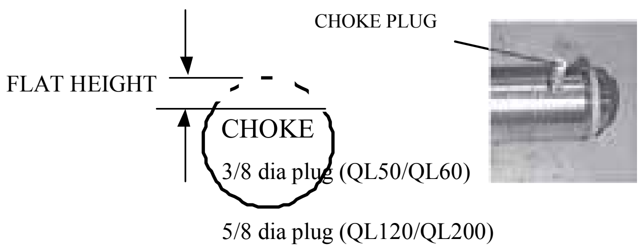
D is equivalent hole diameter

Q is flow in scfm

P is pressure in psig

Q = 9,71 x D^2 x P

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



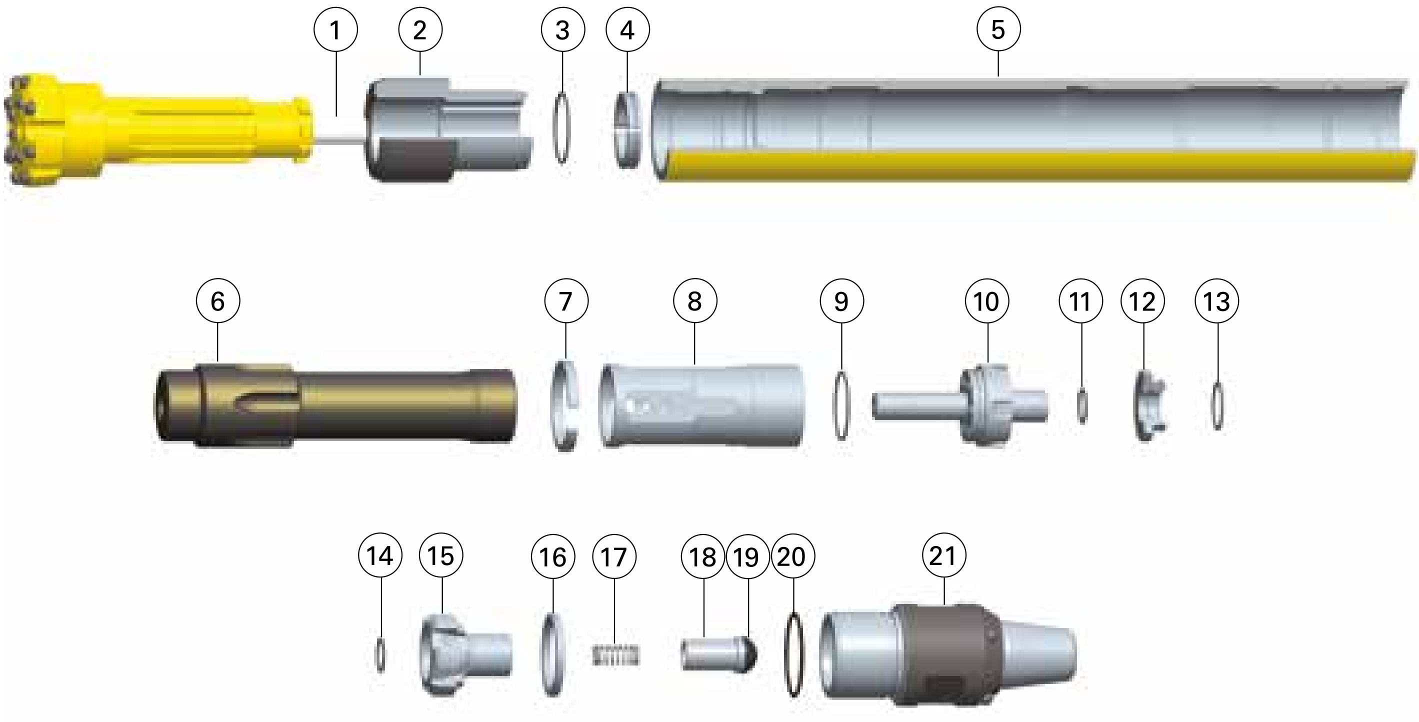
Rock drill oil specifications				
Characteristic	Test procedure	Below 20°F (-7°C)	20°F to 90°F (-7°C to 32°C)	Above 90°F (32°C)
Viscosity: SUS at 100°F (38°C)	ASTM-D2161	175 min.	450 min.	750 min.
SUS at 210°F (99°C)	ASTM-D2161	46 min.	65 min.	85 min.
cST at 104°F (40°C)	ASTM-D445	37 min.	105 min.	160 min.
cST at 202°F (100°C)	ASTM-D445	6 min.	11 min.	16 min.
Pour Point, °F (°C) max.	ASTM-D97	-10°F (-23°C)	-10°F (-23°C)	0°F (-18°C)
Flash Point, °F (°C) min.	ASTM-D92	370°F (188°C)	400°F (204°C)	450°F (232°C)
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 at 40°C)	Viscosity Index (typ)	Pour Point Max °F (°C)	Flash point Min °F (°C)	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

Lubricants (Furnished only when spceially ordered)		
Not intended for EU-markets		
51781607	Lubricant, anti-seize	8 Oz.
51857407	Lubricant, Drill pipe	1 Gal
51857415	Lubricant, Drill pipe	2-1/2 Gal
51857423	Lubricant, Drill pipe	5 Gal
52334174	Super-tac rock drill oil (light)	1 Gal
52333192	Super-tac rock drill oil (light)	5 Gal
52333200	Super-tac rock drill oil (light)	55 Gal
52334182	Super-tac rock drill oil (medium)	1 Gal
52333218	Super-tac rock drill oil (medium)	5 Gal
52333226	Super-tac rock drill oil (medium)	55 Gal
52334190	Super-tac rock drill oil (heavy)	1 Gal
52333234	Super-tac rock drill oil (heavy)	5 Gal
52333242	Super-tac rock drill oil (x-heavy)	55 Gal
52334208	Super-tac rock drill oil (x-heavy)	1 Gal
52333259	Super-tac rock drill oil (x-heavy)	5 Gal
52333267	Super-tac rock drill oil (x-heavy)	55 Gal

Secoroc QL 340

Down-the-hole hammer



Ref.	Part	Prod. No.	Product code
1	Exhaust Tube	86002883	9227
2	Chuck	92050398	9704-QL-00-000-34-000-001
3	O-ring (Bit retaining ring)	92050396	9704-QL-00-000-34-000-035
4	Bit retaining ring assembly	92050395	9704-QL-00-000-34-000-A02
5	Casing	92050397	9704-QL-00-000-00-000-004
6	Piston	92050403	9704-QL-00-000-34-000-005
7	Cylinder retain ring	92050400	9704-QL-00-000-00-000-062
8	Cylinder	92050399	9704-QL-00-000-00-000-048
9	O-ring (distributor)	92050402	9704-QL-00-000-00-000-038
10	Distributor	92050401	9704-QL-00-000-00-000-042
11	O-ring (inner valve)	92050409	9704-QL-00-000-00-000-049
12	Valve	92050404	9704-QL-00-000-00-000-044
13	O-ring (outer valve)	92050408	9704-QL-00-000-00-000-050
14	O-ring (valve cap)	92050406	9704-QL-00-000-00-000-029
15	Valve cap	92050405	9704-QL-00-000-00-000-074
16	Shim	92050414	9704-QL-00-000-00-000-026
17	Spring	92050411	9704-QL-00-000-00-000-016
18	Check valve	92050407	9704-QL-00-000-00-000-015
19	Check valve cap	92050238	9703-LD-LP-000-83-000-036
20	O-ring backhead	92050394	9704-QL-00-000-00-000-019
21	Backhead 2 3/8" API Reg Pin	92050393	9704-QL-00-10P-00-000-020

Hammers and Kits	Prod. No.	Product code
QL 340 hammer, complete, 2 3/8" API Reg Pin	92050412	9704-QL-00-10P-34-000
E-kit incl item 2, 5x3, 5, 9, 11, 12, 13, 14, 20, 21	92050440	9704-QL-00-10P-34-000-K40
Valve assembly incl. item 11, 12, 13	92050442	9704-QL-00-000-34-000-K45
O-ring kit incl. item 3, 9, 11, 12, 13, 14, 20	92050441	9704-QL-00-000-00-000-K70

Wear limits		
Casing	Min.OD	92mm
Piston/Casing clearance	Max	0.2mm
Piston/Control tube	Max	0.2mm
Foot valve	Min.OD	26.3mm
Exhaust tube protrusion		57+/- 1mm

Model	QL340-STD	
CPN	92050412	
Description	Standard QL340 with 2 – $^3/_8$" API PIN	
General specification	English	Metric
Connection	2 – $^3/_8$ API reg pin	
outside diameter (in & mm)	3.94	100
length w/o bit shoulder to shoulder (in & mm)	39.15	994,3
length with bit extended (in & mm)	40.65	1032,6
length with bit retracted (in & mm)	39.39	1000,6
weight w/o bit (lb & Kg)	1.93	49
Backhead across flat (in & mm)	2.95	75
Minimun bit size (in & mm)	4.29	109
Maximun bit size (in & mm)	5.04	128
Piston weight (lb & kg)	0.35	9
Stroke (in & mm)	3.94	100
maximun pressure differential (psig & bar)	350	24,1
Maximun choke diameter (in & mm)	-	-
Make-up torque (ft-lb&N-M)	4000	5416
Air consumption		
100 psi / 6,9 bar (scfm &m^3/min)	103	2,9
100psi (bmp)	1120 1	120
150 psi/10.3 bar(scfm &m^3/min)	210	8,3
150psi(bmp)	1258	1258
200 psi / 13,8 bar(scfm &m^3/min)	320	9,1
200psi (bmp)	1475	1475
250 psi / 17,2bar (scfm &m^3/min)	385	11
250psi (bmp)	1583	1583
300 psi / 20,7 bar (scfm &m^3/min)	458	13
300psi (bmp)	1675	1675
350 psi / 24,1 bar (scfm &m^3/min)	598	17
350psi (bmp)	1894	1894
Operational specifications		
Feed force (lbs)	1500-2500	
rotation speed (rpm)	40-60	
Service specification		
Casing discard diameter (in & mm)	3.62	92
Minimun chuck length (in & mm)	2.89	73,4
Max. worn piston to casing clerance (in & mm)	0.01	0,27
Min new piston large OD: (in & mm)	3.20	81,4
Max. new casing (in & mm)	3.21	81,5
Max.worn piston to cylinderclerance (in & mm)	0.01	0,27
Min new pistontail OD: (in & mm)	2.80	71,1
Max new cylinder ID: (in & mm)	2.80	71,2
Max. worn piston to guide clerance (in & mm)	0.01	0,27
Max new piston tail /seal ID: (in & mm)	1.05	26,7
Min new guide OD: (in & mm)	1.05	26,55
max worn bit to chuck clerance (in & mm)	0.02	0,5
Max new chuck ID: (in & mm)	2.17	55
Min new bit shank OD: (in & mm)	2.56	65
Exhaust tube extension (in & mm)	2.25	57,1
Min. new valve height.low lift valve (in & mm)	-	-
Min. new valve height.high lift valve (in & mm)	-	-
Valve lift new low lift valve or w/o shim (in & mm)	-	-
Valve lift new high lift valve or w/o shim (in & mm)	-	-
Maximun backhead standoff	0.03	0,86
Minimun bacfkhead standoff	0.02	0,41

Notes

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