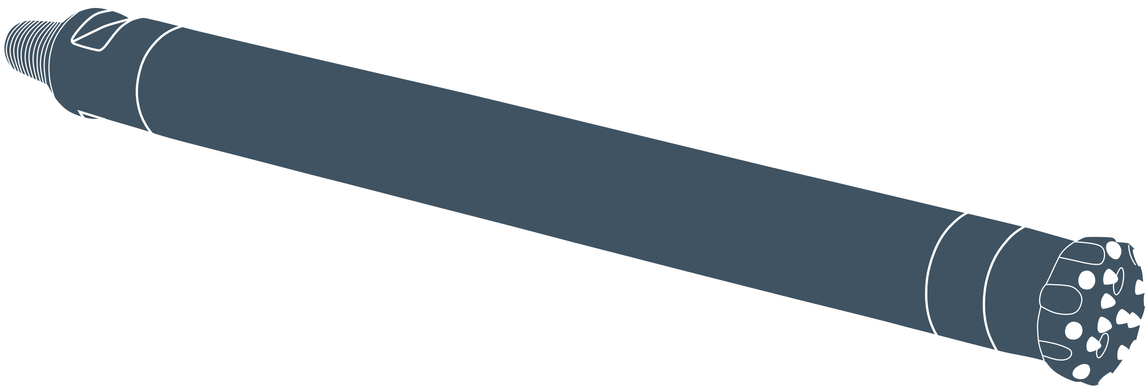
Secoroc COP W4 down-the-hole hammer

Operator's instructions
Spare parts lists



Contents

Introduction

General

The down-the-hole hammer is a percussion hammer drill. As the name implies, the hammer works down the hole at the end of the drill string, where the impact piston strikes the drill bit directly.

Compressed air is led to the hammer via the rotation spindle and drill pipes. Exhaust air from the hammer is discharged through holes in the drill bit and used to flush clean the drill hole. Rotation is provided by a rotation unit on the feed beam and transmitted to the hammer via the drill pipes. The drill pipes are threaded so that the drill string can be extended as drilling progresses and the hole becomes deeper. Feed force is also transmitted to the hammer via the rotation unit and drill pipes. One of the main advantages of DTH hammers is that the drilling rate is not affected very much by the length or depth of the drill hole.

DTH hammers are very productive and have many applications in the mining, quarrying, civil-engineering and water-well drilling industries.

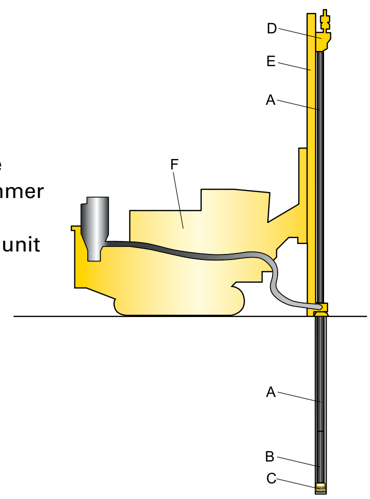
Application (drill rigs)

Secoroc COP W4 down-the-hole hammer is designed for use on DTH or ITH drill rigs. They can also be used on rotary and auger type drill rigs, provided that such rigs meet the specifications for DTH applications. The main demands on the drill rig are as follows:

• It should be equipped with a rotation unit that has a variable rotation speed of 0–120 r/min and a rotation torque of 750–3000 Nm (75–300 kpm). Naturally, the torque demand for a recommended rotation speed will depend on the hammer size and bit diameter.

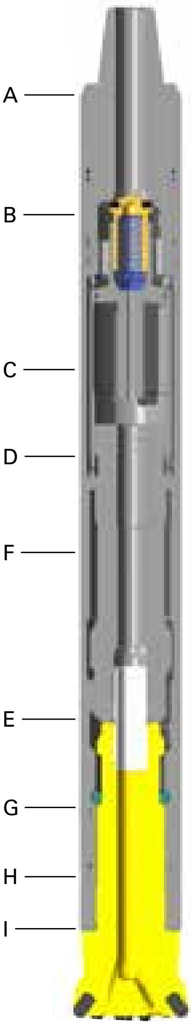
• A variable feed force of 3–43 kN (300–4300 kp) for shallow holes (less for deeper holes, bearing in mind the weight of the drill string). Obviously, the feed must be strong enough to pull the hammer and drill string out of the drill hole. This is an especially important consideration when drilling deep holes. The weight of the drill string varies between 9 and 34 kg/m, depending on the pipe- and bit diameters.

A = Drill pipe
B = DTH hammer
C = Drill bit
D = Rotation unit
E = Feed
F = Drill rig



Technical description

The Secoroc COP W4 hammer and drill bit operate at the bottom of the hole as a unit.



The COP W4 hammer has a long casing **D**, which houses a check valve **B**, impact piston **F**, exhaust tube **E**, retaining ring **G** and drill-bit shank **H**. The back end of the cylinder is closed by a threaded backhead **A**. The backhead has a male thread for connection to the drill pipes, and is provided with wrench flats.

A driver chuck **I** threads into the front end of the cylinder. The splined union between the driver chuck **I** and bit shank **H** transmits rotation to the drill bit. The front end of the driver chuck transmits feed force to the drill bit. The split stop ring **I** limits axial movement of the drill bit. The check valve **B** prevents water from entering the hammer through the driver chuck when the compressed air supply is shut off.

When feed force is applied, the drill bit is pushed into the hammer and pressed against the front of the driver chuck. The impact piston strikes the shank of the drill bit directly. The passage of compressed air through the hammer is directed by the piston and exhaust tube, both of which have regulating ducts.

After the compressed air has imparted most of its pressure energy to the piston, it is led as exhaust air through the exhaust tube **E** into the central gallery in the drill bit. The exhaust air then emerges as flushing air through holes in the drill bit head. This gives efficient transportation of cuttings out of the drill hole.

When the hammer is lifted off the bottom of the hole, the piston drops into the air blowing position. This disengages percussion and gives air blowing only, i.e. a large volume of air flows straight through the hammer and drill bit. During drilling, air blowing starts if the drill bit loses contact with the bottom of the hole. The hammer starts operating again as soon as the bit is pressed back against the driver chuck. Air blowing is used when powerful flushing of the drill hole is required, and in certain difficult drilling conditions.

Technical data

Dimensions and weights		
Length without drill bit, mm (in)	928 mm (3' ½")	
Length excl. thread, mm (in)	851 mm (2' ½")	
Outside diameter,mm (in)	102 mm (4")	
Piston diameter, mm (in)	82 mm (3¼")	
Top sub thread (standard) API Reg	60 mm (2⅜")	
Wrench flat on top sub, mm (in)	65 mm (2½")	
Weight without drill bit, kg (lbs)	37 kg (81 lbs)	
Piston weight, kg (lbs)	8 kg (17 lbs)	
Drilling parameters		
Working pressure, bar (psi) max.	35 (507)	
Rec. Rotation speed and WOB	**Pressure, weight on bit, kg**	**RPM**
15 bar (217 psi)	670 ± 10%	72 ± 10%
20 bar (290 psi)	900 ± 10%	81 ± 10%
25 bar (362 psi)	1100 ± 10%	92 ± 10%
30 bar (435 psi)	1350 ± 10%	102 ± 10%
35 bar (507 psi)	1600 ± 10%	110 ± 10%
Impact rate and air consumption	**Strokes/min**	**l/s**
20 bar (290 psi)	1900	216
25 bar (362 psi)	2100	285
30 bar (435 psi)	2350	365
35 bar (507 psi)	2520	429

Performance figures are average values for new hammers at sea level. Specifications and other data subject to alteration without prior notice.

Safety

General 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.

Warning symbols

⚠ **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. See “Application” on page 3.

Preparing to drill

Hose connection

Connecting and securing the air hoses.

For a compressed air system to be efficient, reliable and economic, there must be:

• Sufficient compressed-air capacity (volume and pressure).

• Minimal pressure loss between the compressor and the hammer.

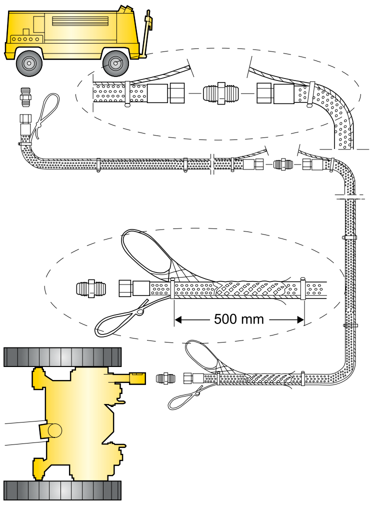
• Minimal air leakage between couplings.

This can be realized by ensuring that:

•The correct size of compressor is selected.

•The correct hose size is used between the compressor and the hammer.

•There is no leakage in hose connections between the compressor and hammer.



DANGER

• Compressed air hoses between the compressor and the drill rig must be secured by means of an external or internal safety wire, which must be fastened safely to the drill rig. If the DTH hammer is to work at pressures above 10 bar (145 psi), any local regulations regarding air hoses and couplings must be strictly observed.

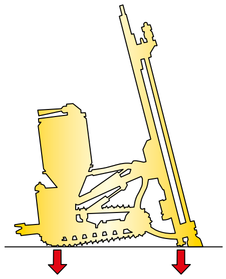
• Always check that hoses, hose nipples and hose clamps are not damaged, and that they are properly tightened and secured.

CAUTION

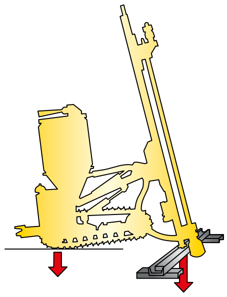
• Always check the condition of drill string components. Bent or worn pipes can cause damage and excessive wear to the hammer and rig.

Setting-up the rig

Before drilling with the DTH hammer, the rig must be set-up correctly in order to give stability and safety. If this is not done, the effects of feed force and rotation torque can cause the rig to move. This will have a negative effect on drilling, especially when drilling deep, straight holes.



When setting up a drill wagon or crawler drill rig, a stable three-point set-up must be obtained, with the weight of the rig distributed between the base of the feed beam and the two rear corners of the rig. It is of the utmost importance that the rear loading points are as far to the rear of the rig as possible, with most of the rig weight being loaded on to the base of the feed.



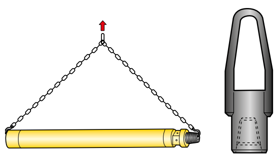
When drilling in soil or other non-consolidated formations, the weight of the rig must not be loaded on to the feed near the mouth of the hole, since this could easily cause the hole to cave-in. Instead, the load should be distributed some distance to either side of the hole. Suitable support can be obtained by placing a sturdy U-beam under the base of the feed beam, and supporting the beam on planks at both ends. A two inch (50 mm) plank should then be placed inside the U-beam to prevent mechanical chatter and damage to the base of the feed beam.

If the rig is wheel-bound, it should be raised off the ground completely using the jacks, so that all wheels are clear of the ground.

DANGER

•The rig must be set-up correctly in order to give stability and safety. If this is not done, the effects of feed force and rotation torque can cause the rig to move or even to overturn. This could result in serious or fatal injury as well as damage to the drill rig and equipment.

WARNING



• **Heavy lift.** Take care when handling the hammer, it is very heavy. The hammer and its internal components are heavy and difficult to handle, especially in the case of the larger hammers.

When lifting using mechanical lifting equipment, sling the hammer as shown in the fig. Alternatively, a lifting-eye coupling can be screwed on to the top sub.

•**Transportation.** Do not let the hammer lie unsecured on a vehicle or drill rig. Always secure the hammer for transportation.

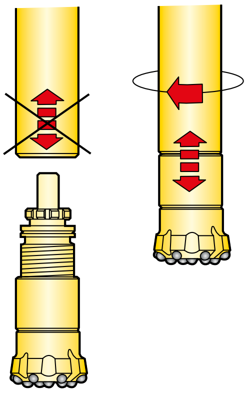
WARNING

• Always wear goggles during drilling!

•The exhaust air from the hammer (and also from the top sub if a unit for extra flushing is fitted) has a very high velocity. Objects such as small stones, drill cuttings, sand, earth and oil residue that are entrained in the flushing air can cause serious injury to unprotected eyes. Pay special attention to this danger during collaring, when a top sub with extra flushing is in use, and when the hammer is fed through the drill steel support or down into the hole.

Drilling

Rotation to the right



DTH hammers must be rotated to the **RIGHT** (clock wise) during drilling, since the driver chuck and top sub are threaded into the cylinder with **RIGHT-HAND THREADS.**

Rotation must always be to the right when the hammer is operating. Left-hand rotation (or no rotation) will cause the driver chuck to loosen, which could mean losing the drill bit (or even the entire hammer) down the hole.

The drill string should be rotated to the right even when the hammer is not operating. For example, this should be done when cleaning the drill hole and when lifting up the drill string. It can be said that rotation to the right should be switched on as long as other operations are in progress with the hammer in the hole. The risk of the drill bit working loose should also be considered when breaking the joints between drill pipes. When adjusting the breaking wrenches, bear in mind that the drill string must not be rotated anti-clockwise any more than is absolutely necessary.

IMPORTANT!

- Always switch on rotation to the right before starting the feed or hammer.
- Let the hammer rotate to the right (clockwise) even during lifting or lowering of the hammer.
- Do not switch off rotation to the right until all other functions have been switched off.

WARNING

- Take great care when jointing drill pipes. Make sure there is no danger of your fingers being pinched or clothing being entagled when the drill string is rotated.
- When a pipe wrench is used during jointing, there is a risk of the wrench flying off and causing injury when rotation is applied.

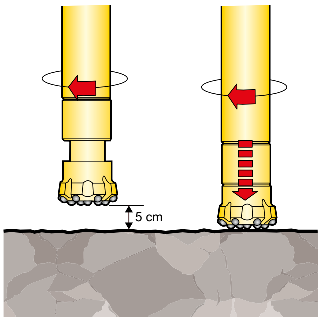
DANGER

- When drilling on soft or unstable ground, great care must be taken because the flushing air from the hammer can erode the material around the drill hole, and so undermine the ground beneath the drill rig. This can pose a great danger to personnel and risk damaging the equipment.

CAUTION

Always wear ear protectors during drilling.

Collaring



- Feed the hammer downward until the drill bit is about 5 cm from the collaring point.
- Start rotation to the right at low speed (creeping).
- Feed the hammer on to the rock using minimal feed force, so that the bit is pressed into the hammer, and into the impact position.
- Start collaring the hole with reduced impact and feed, until the bit has entered the rock.
- Increase air pressure control fully and adjust the rotation and feed so that the hammer drills smoothly and steadily.

Feed and rotation

With holes of relatively shallow depth, the setting of feed and rotation is usually a simple matter in DTH drilling, since the hammers are comparatively insensitive to small variations in the "normal" flow and pressure settings. The settings can be regarded as correct when the drill string turns evenly without jerks or jamming, and a steady penetration rate is obtained (Se table in page 4 for recommendations).

Feed force

When drilling with the COP W4 hammer, the feed force should be high enough to keep the shank of the drill bit pressed into the hammer during drilling.

- Too low a feed force will give easy rotation, excessive vibration and reduced penetration. The resultant reflex shock waves can damage the rotation unit and feed beam.
- Floating bit avoid, because higher air consumtion.
- Too high a feed force causes the rotation to jam (either erratically or completely) and can subject the drill string to severe bending stresses. It can also damage the rotation unit and feed beam.

The feed force often needs to be corrected during drilling, depending on the rock formation and the weight of the drill string, which obviously varies with the hole depth.

A rough guide to drill pipe weights for different sizes of DTH-hammer are given in the table below:

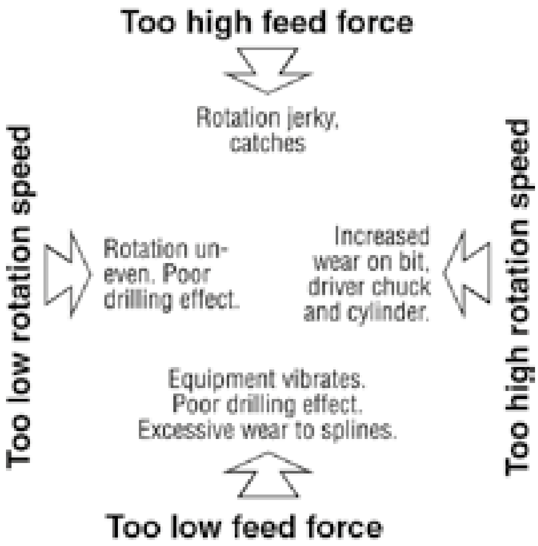
Pipe dimension mm (inch)	Approx. weight per metre, kg (lbs)
76 (2.9)	9 (19.8)
89 (3.5)	15 (33.0)

Bit diameter, water, influx/backpressure, rock formation, hole depth and available rotation torque will have a considerable influence on the setting of the feed force. What is important is that the feed force is adjusted to give steady penetration and a constant, even rotation speed with no jamming. (see table).

N.B. It is important that the feed force be adapted to suit the weight of the drill string. When drilling deep holes, this requires control facilities for negative feeding, a so-called holdback function.

Air

To have proper and efficient hammer function and good penetration rate, make sure to select optimum compressor to be utilized. (See table page 4).



Rotation speed

In hard rock the rotation speed for COP W4 should be set between 20–120 r/min, depending on the hammer size and bit diameter (the larger the bit diameter, the slower the speed). The upper limit generally produces the best penetration rate. In very abrasive rock formations, however, the rotation speed should be reduced to avoid excessive wear of the drill bit. When drilling in softer rock or with high air pressure (above 18 bar) in non-abrasive formations, higher rotation speed may be used. The following should be noted:

Too high a rotation speed will cause increased wear to the drill bit, hammer and drill pipes.

Too low a rotation speed results in a poor drilling output and uneven operation and uneaven wear to the drill bit.

Drilling in wet holes

The inflow of water into the drill hole is expected when drilling water wells, but can also occur when drilling deep holes for other purposes. Water inflow does not normally create problems for drilling, although both “too little” and “too much” can be troublesome.

Too little water tends to bind the drill cuttings into a paste, which sticks to the drill pipes or the hole wall and can easily form collars or plugs. The problem can be lessened by adding water to the flushing air, thus increasing the fluidity of the cuttings. Fluidity can be further improved by adding washing detergent to the water.

N.B. Remember to increase the lubrication dosage when injecting water into the flushing air!

Water injection

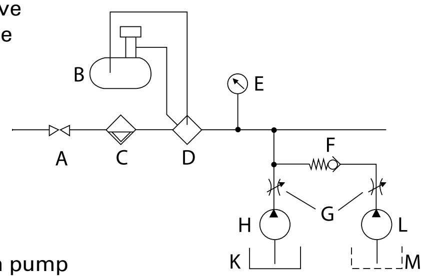
Water injection is normally used to suppress dust when drilling dry holes. The COP W4 down-the-hole hammer is designed to function with a certain amount of water injection. As an example, only 2–6 litres of water per minute (at 18 bar air pressure), injected into the main air line, is sufficient to control the dust when drilling with the COP W4. Too much water injection will have a very negative influence on the penetration rate of the hammer.

Rule of max. thumb: 0,25 l water per m^3 compressed air consumed by the hammer during the drilling sequence.

Flow chart for water flushing

A = Main inlet valve on drill rig
B = Container for air tool oil
C = Filter
D = Lubricator valve
E = Pressure gauge
F = Check valve
G = Valves
H = Water pump
K = Water tank
N = Compressor
O = DTH-hammer

Optional
L = Separate foam pump
M = Separate foam tank



CAUTION

The injection point for water and foaming concentrate should always be located after the main shut-off valve on the rig.
If not, there is a danger of the mixture being pumped back through the main air line and into the compressor. This could seriously damage the compressor.

Foam injection

Foam can be used in DTH drilling to improve the flushing performance (especially in non-consolidated formations). It does this by “lifting up” the cuttings out of the hole, and also has the desirable effect of sealing the hole walls. Foaming concentrate is pumped into the compressed-air line in the form of a concentrate/water mixture. Atlas Copco foaming concentrate has lubricating properties and contains corrosion inhibitors, which prevent seizing in the hammer.

N.B. Before using foaming concentrates not supplied by Atlas Copco, please consult your Epiroc representative for advice.

With Atlas Copco foaming concentrate, a mixture of 0,5–2 per cent concentrate/water is normally recommended. When drilling in water-bearing rock and other difficult formations, it might be necessary to increase the percentage of concentrate, and also to add polymers to the operating air. This will help to stabilize the hole walls and increase the lifting capacity of the foam. The concentrate/water mixture is injected into the main air line by means of a high-pressure pump. Minimum requirements for the water-injection pump are as
follows:

- min. pressure = 30 bar
- min. flow = 20 l/min.

After drilling with foam, it is recommended that residual foam should be flushed out of the hammer to prevent corrosion. This is done by injecting water only into the air, and so flushing the foam out the hammer. Oil should then be poured into the drillstring and the hammer operated for a few minutes before the drill string is withdrawn from the hole. If the hammer is then to be stored for a long time, it should be dismantled and all parts cleaned and oiled thoroughly.

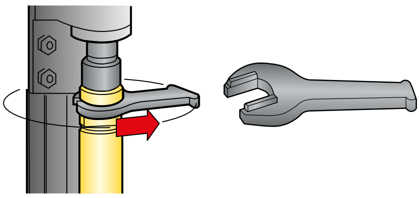
Tools

Tools for removing the drill bit and top sub from the DTH hammer

The threaded connections of the driver-chuck and top sub can become very tightly tensioned during drilling. There are special tools for removing the bit and top sub from the cylinder of the DTH hammer, and these should be used whenever possible.

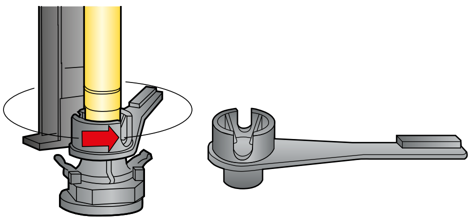
Wrench for pipe-jointing and top sub

Wrench flat	Ordering No.
65 mm	8484-0211-00

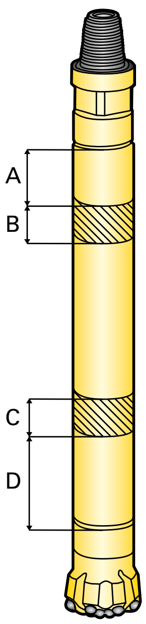


Bit removal tool

(Not available to order).



Loosening the threads of the COP W4 hammer



If special tools like chain wrenches or other types of wrench are used to break the hammer joints, then the tool must be attached around the hammer cylinder as shown in the figure.
Do not attach at other points!

A mm (in)	B mm (in)	C mm (in)	D mm (in)
75 (2.9)	70 (2.8)	70 (2.8)	75 (2.9)

DANGER

- Take great care when breaking the driver-chuck joint using the bit removal tool in combination with reverse rotation. If the shaft of the tool is not locked or touching the edge of the feed beam, the shaft can turn with great force when breaking the driver chuck joint.
- Keep your hands and clothing well clear of the hammer/drill string when it is rotated. Entanglement can result in serious injury.
- Blows against hammer or bit can cause fragments of metal to fly. Always wear goggles when breaking joints.

Breakout bench

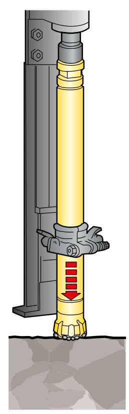
It is always most convenient to break the hammer threads on the rig. For circumstances, when the threads cannot be broken or tend to get stuck, there is a breakout bench available. Ordering No. 9178.

N.B. Failure to attach the wrench as illustrated (B, C) may result in damage to the cylinder. Any such damage will not qualify for compen-sation.

Removing the drill bit

The drill bit can be removed in a number of different ways, depending on the tools available. The following two methods are commonly used:

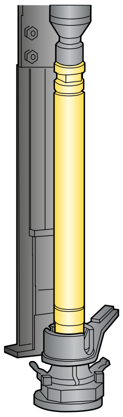
A. Breaking the driver-chuck joint using percussion only



- Run the hammer into the rock or a thick plank.
- Apply light feed force.
- Carefully start the impact mechanism of the hammer.
- Stop the impact mechanism as soon as the driver-chuck joint "cracks".
- Run the hammer up the feed beam to a suit-able working height, and unthread the driver chuck and drill bit.

N.B. Beware of the weight of the drill bit. It could be too heavy to hold.

B. Breaking the driver-chuck joint using the bit removal tool



If the driver-chuck joint is very tight, the special bit-removal tool should be used to break the joint.

Important: Never use a sledge-hammer on down-the-hole hammers.

• Place the bit-removal tool in the drill steel support.

N.B. Looking from behind the feed beam, make sure that the shaft of the bit-removal tool is touching the left-hand edge of the feed beam.

• Carefully run the bit down into the bit removal tool.

• Slowly start up the impact mechanism of the hammer.

• Stop the impact mechanism as soon as the driver-chuck joint "cracks".

• Unscrew the driver chuck by rotating the COP W4 hammer to the **LEFT** (anti-clockwise).

Dirt in the hammer

Stoppages and breakdowns caused by dirt in the percussion mechanism are practically inevitable with all rock drills, and DTH hammers are no exception. However, it should be remembered that, while DTH hammers are no more sensitive to dirt than tophammers, there is obviously a greater risk of dirt ingress in down-the-hole drilling, especially during pipe jointing. Any dirt that enters the drill pipes goes straight into the percussion mechanism. To ensure reliable operation of the hammer, every effort should therefore be made to prevent dirt from entering the drill pipes. The following rules should be observed:

• Always keep drill pipes clean. Always store or stack drill pipes in such a way that the risk of dirt ingress is minimized. Do not let the thread ends rest on grit or mud. Use thread covers wherever practicable.

• Always keep the open thread end of the drill pipe covered during jointing, and remove the cover just before the pipe is coupled up.

• Before coupling up, check that the drill pipe is clean around the threads and on the inside. If in doubt, blow clean the pipe. Remember to cover the pipe end that is already in the hole.

• If threads are dirty, they should be cleaned using a strong bristle brush or a cloth.

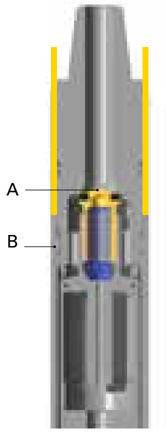
N.B. Always clean **away** from the hole in the pipe. Do NOT let grit fall into the hole in the pipe. After cleaning, always coat the threads with **Atlas Copco thread grease** before jointing.

• Take extra care during jointing operations when drilling in abrasive rock formations, since the ingress of quartz particles into the hammer will cause heavy wear.

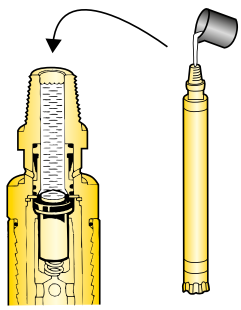
• When drilling holes in water-bearing rock, never leave the hammer at the hole bottom with the air supply switched off. If drilling is to be suspended temporarily, always pull up the hammer by at least two pipe lengths.

• Clean around the driver chuck before changing the drill bit. Make sure the shank of the new drill bit is clean.

• Keep the hammer clean and plug both ends when not in use. Change worn or damaged parts in good time.



The Secoroc COP W4 down-the-hole hammer contains a check valve that is designed to trap a quantity of air inside the hammer when the air supply is switched off. In most conditions, this prevents the ingress of water and dirt into the hammer during jointing operations. The check valve **A** and O-ring **B** must be fault-free when drilling in water-bearing formations. When drilling deep holes in rock with a high water inflow, however, it is possible that some seepage of water into the front of the hammer will take place during jointing. Since only very small particles of dirt would be able to penetrate the hammer in this way, the threat to the hammer is not serious.



The sealing efficiency of the check valve can be checked by pouring a small quantity of lubricant through the top sub of the hammer, with the hammer held vertical. If the lubricant passes through the checkvalve, then the valve spring and/or valve seal is worn or damaged and should be replaced immediately.

⚠ **WARNING**

• Take great care when jointing the drill pipes and handling the drill bit.

• Mind your fingers!

• Keep your clothing, hair etc. well clear of rotating components! Carelessness can result in serious injury.

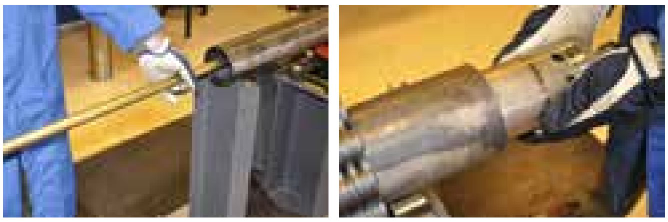
COP W4 service instruction

Disassembly of COP W4 hammer

Remove backhead. Backhead thread connection need to be loosened up with a breakout-bench. Lift out the backhead, weight of the backhead is around 7,4 kg (16,3 lbs).

Remove drive chuck, drill bit and bit retaining ring. Chuck thread connection need to be loosened up either with breakout table on drill rig before hammer is removed or with a breakout bench.

Remove bit retaining ring and chuck from drill bit.



Push the piston out from the chuck side with a long bar, pull out the check valve, spring, distributor, inner cylinder and piston. Weight of piston is 7,7 kg (17l bs)

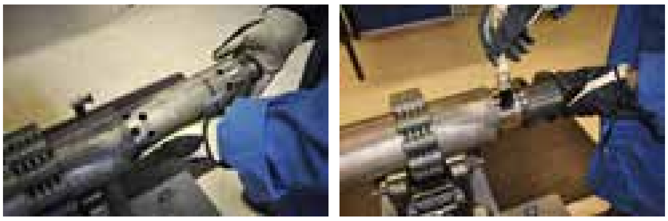
Remove check valve and spring from distributor.

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

Assembly of COP W4 hammer

Inspect the piston for wear or cracks, replace if cracks are found. Lubricate the piston and casing inside with hammer oil and install the piston from the backhead side of the casing with a brass bar.

Place the distributor over the inner cylinder and drive the distributor until all faces mate. Install the check valve and the spring on it.



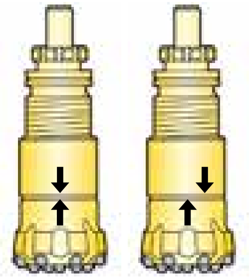
Lubricate the assembly with hammer oil and slide it into the backhead end. Smear the backhead thread with thread grease, tight backhead by hand.

It is most important that the lock halves are fitted properly. The halves are broken to keep exactly the right size and shape. Make sure that the individual marking always stays in the same direction to keep the two ends perfectly matched.

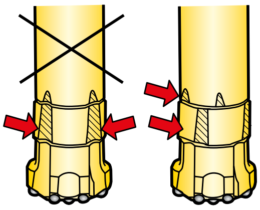
Lubricate the spline on drill bit with thread grease, install the drive chuck and bit retaining ring on to the drill bit. Install the complete unit to the hammer, smear the chuck thread with thread grease and tight by hand.

Other instructions

Wear to the driver chuck and hammer cylinder



Since the driver chuck and hammer cylinder are "sand-blasted" continuously by large volumes of abrasive cuttings during drilling, they eventually become worn out. The areas adjacent to the cuttings grooves in the drill bit will be subjected to the most wear. To prevent uneven wear of the hammer cylinder, therefore, the driver chuck and bit should be marked as shown in figure, before the chuck is lifted off the bit.

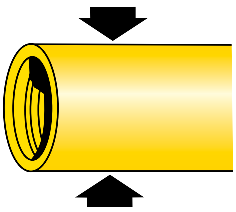


When fitting the driver chuck back on to the drill bit after grinding or replacing a drill bit, its radial location on the bit shank should be advanced by one spline section. This will give a more even distribution of wear on the driver chuck and hammer cylinder.

If the driver chuck is exposed to exceptionnally heavy wear, e.g. when drilling in rock formations with a high quartz content (granite, quartzite etc.), it may be necessary to turn the driver chuck by more than one spline section in order to prevent the driver chuck and hammer cylinder from wearing out too quickly. As a rule, the cuttings grooves in the bit should always be pointing towards the part of the driver chuck that is least worn.

Since the hammer cylinder has three thread inlets, the part of the driver chuck that is worn the most can be located against the part of the hammer that is worn the least.

Checking the wear of the driver chuck and hammer cylinder



Wear to the driver chuck and hammer cylinder should be checked regularly, e.g. every time the bit is reground or changed. Measure the diameter of the hammer cylinder using a sliding calliper. Measure along the full length of the cylinder, with the exception of the outermost 100 mm at each end. At any point between these points, the diameter of the hammer cylinder must not be less than the minimum permissible diameter given for the respective DTH hammer sizes in the table below.

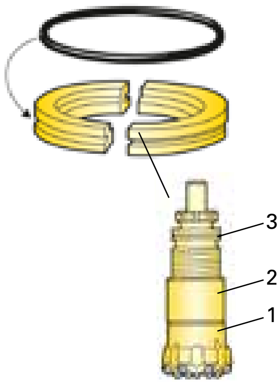
Hammer	Minimum permissible diameter
COP W4	92 mm

The outside diameter of the driver chuck must not be less than that of the hammer cylinder.

N.B. When the hammer cylinder has to be changed, the driver chuck must be replaced at the same time (see the section "Wear limits").

The hammer should be overhauled at suitable intervals, depending on the operating conditions. The abrasiveness of the rock will affect the overhauling intervals, since it has a strong bearing on the rate of wear.

Assembly of the drill bit and driver chuck



- Smear the splines of the bit shank with Atlas Copco thread grease.
- Smear the O-ring of the stop ring with silicone grease.
- Assemble the bit 1, driver chuck 2 and stop ring 3 as shown in figure.

It is most important that the lock halves are fitted properly. The two halves are cracked to keep exact size and shape. The marks on the halves are always at the same correction so that the end surfaces will fit perfect.

IMPORTANT!

Make sure the stop ring is located correctly, and that it faces the right direction. Incorrect fitting will result in severe damage to the hammer. Note that the halves must fit together. See above.

- Smear the thread on the driver chuck with Atlas Copco thread grease.
- Screw in the bit assembly by hand. Note that there should be a clearance of 0,1–0,4 mm between the driver chuck and the cylinder casing. If there is no clearance, the end surface of the cylinder casing should be ground down as necessary. Tighten the driver chuck with the aid of the bit spanner.

Plastic foot valve in the bit shank

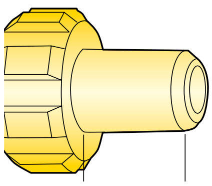
Replacing the foot valve

When the footvalve becomes worn or damaged, it must be replaced. If this is not done, the performance of the hammer will be seriously affected. The signs of wear or damage to the foot valve include excessive air consumption, uneven percussion and difficulty in starting the hammer.

Wear limits and protrusion – foot valves

Diam. new	Diam. worn out	Foot valve Prod. code	Effective protrusion A
32,3 mm	min. 32,1 mm	9115	57,0 mm + – 1mm

Protrusion of the foot valve



After fitting the foot valve into the bit shank, its protrusion from the end of the shank must be checked. Too much or too little protrusion will seriously affect the performance of the hammer.
After the foot valve has been pressed into its seat and protrusion is within the specified limits (see table), do not put more pressure on the foot valve, since this could result in damage.

Removing the foot valve

The worn or damaged foot valve is removed by cutting it with a hacksaw blade or knife, and then prying it out of the bit shank with the aid of a screwdriver. Heating the foot valve to 50–70º C can make removal easier.

⚠ WARNING

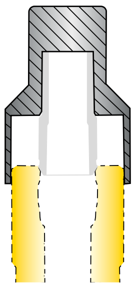
- When removing and fitting foot valves, always wear protective goggles, gloves and appropriate protective clothing. Carelessness can result in injury to the eyes or other body parts.
- Foot valves are brittle. Heavy blows can deform or dislocate the foot valve, with the risk that it would then obstruct the movement of the impact piston.

Fitting a new foot valve

The new foot valve should be pressed into the seat in the flushing hole in the bit shank using a special assembly tool that guarantees guidance of the foot valve into the seat, and ensures that the amount of protrusion is correct. For easier installation, the temperature of the plastic foot valve should be 20–60° C (it can be heated in water, or on the compressor). Before fitting the foot valve into the bit shank, coat the part of the valve that is pressed into the drill bit with rubber glue (or a similar substance). The rubber glue will act as a lubricant during fitting, and as a fixative thereafter. If rubber glue is not available, use silicone grease or some other similar lubricant.

N.B. Do **NOT** use a hammer to seat the foot valve. Heavy blows can damage the foot valve or cause it to locate incorrectly so that it is struck by the impact piston during drilling. Use some kind of hydraulic press to press it gently but firmly on to its seat in the bit shank.

Assembly tool	Product No.
COP W4	90516013



⚠ DANGER

- Before grinding, always check the flushing holes of the drill bit for traces of explosive. Contact with the grinding wheel can cause the explosive to explode causing serious or fatal injury as well as damage to the equipment.
- To clean the flushing hole, use only a wooden rod, copper wire or flushing water.

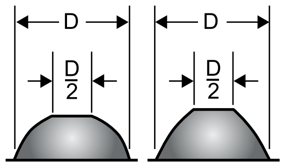
⚠ CAUTION

- Always wear ear protectors, protective clothing, gloves and goggles when grinding.
- Use a dust extraction system or an approved dust mask. This is of special importance when dry grinding indoors.

Regrinding the drill bit

The rate of bit wear depends on the rock formation, and is highest in rocks with a high quartz content. A suitable grinding interval should be determined according to the rate of bit wear. It is more economical to regrind too early rather than to suffer poor penetration rates and risk damaging the drill bit through overdrilling. A few hints about the care of drill bits:

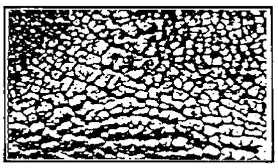
When to regrind



Button bits should be reground when the penetration rate drops, or if any of the cemented carbide buttons are damaged (fractured buttons should be ground flat). It is both practical and economical to redress the buttons when the wear flat reaches about ½ of the diameter of the button.

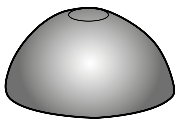
Note: This is a general recommendation.

Look out for "snake skin"



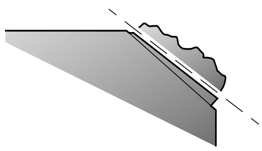
If microscopic fatigue cracks – so-called “snake skin” – begin to appear on the cemented carbide buttons, they must be ground away. In any event, bits should be reground after 300 metres of drilling at the most. This should be done even if there are no visible signs of wear and the penetration rate continues to be good. If snakeskin is not removed, the cracks will deepen and ultimately result in button fracture.

Do not grind away too much cemented carbide



Do not grind too much on the top of the buttons. Let a few millimetres of the wear flat remain on top of the button.

Always grind broken buttons flat

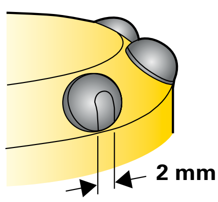


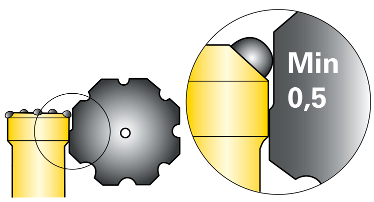
A drill bit can remain in service as long as the gauge buttons maintain the diameter of the bit. Fractured buttons must always be ground flat to prevent chips of cemented carbide from damaging the other buttons.

Avoid grinding the perimeter

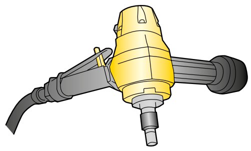
Gauge-button anti-taper has to be removed by grinding, although excessive reduction of the bit diameter should be avoided. Leave about 2 mm of the wear flat.

If necessary, remove some of the bit-body steel below the gauge buttons, so that a clearance (taper) of 0,5 mm is maintained.
If the flushing holes start to deform, open them up with the aid of a rotary burr or steel file.

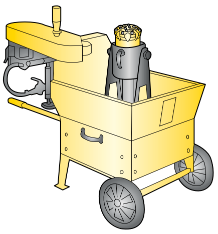




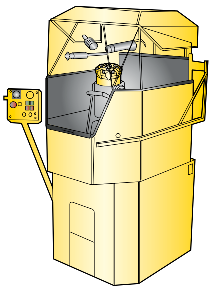
Grinding equipment



The grinding machine HG is a portable, handheld, air-powered grinding machine for button bits, ideal for use at the worksite. It is used with diamond-impregnated grinding cups, which can be used with or without water flushing.



The grinding machnice Manual B-DTH is a mechanized air-powered grinding machine for button bits. It is mounted in a steel box-barrow, which can be wheeled easily around the worksite. The Manual B-DTH uses diamond-impregnated grinding wheels.



For permanent grinding stations, a mechanized stationary grinding machine is available, the BQ3-DTH. It is equipped with automatic feeding devices and grinds both the cemented-carbide buttons and the bit-body steel in one operation. The machine uses diamond-impregnated grinding wheels.

Further information about grinding equipment can be found in the respective product leaflets.

⚠ IMPORTANT!

- Always use water flushing with grinding wheels.
- Use water if possible also with grinding cups and handheld grinders.

Care & maintenance

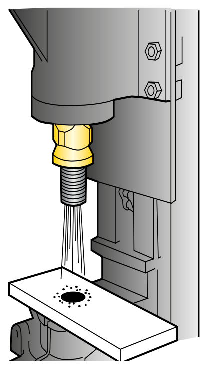
The service life and performance of DTH hammers depends to a large extent on good operating practice and regular maintenance. The following recommendations should be observed:

- Make sure that the compressed air is always clean and dry.
- Always blow clean the air hoses before connecting them to the rig.
- Make sure that the drill pipes are stored properly in the pipe rack, or stacked on trestles in such a way that dirt cannot enter the pipes.
- Fit thread guards to the ends of the drill pipes whenever practicable. Keep the threads and the insides of the pipes clean.
- Always cover the "open" thread end of the drill pipe during pipe-jointing operations. The ingress of dirt into the drill string will cause blockages and/or seizure in the hammer, which can result in breakdown.
- Check regularly that the dosage of lubricating oil into the operating air is sufficient. Check that the lubricating-oil tank on the rig is filled with oil of the correct type and quality. See "Recommended lubricants", page 15.
- Check the wear on the driver chuck and hammer cylinder regularly. The diameter of the driver chuck must never be less than that of the hammer cylinder. The service life of the hammer cylinder can be prolonged by always fitting a driver chuck with a greater outside diameter than that of the hammer cylinder. When the components are approaching their minimum permissible diameters, frequent inspection is necessary. Alternatively, change the components in good time – it makes good economic sense.

N.B. When the hammer cylinder is replaced, the driver chuck should be replaced at the same time (see "Wear limits", page 16).

A general overhaul of the hammer should be carried out at suitable intervals, depending on the operating conditions and empirical statistics. The abrasiveness of the rock will have a considerable effect on the rate of wear, and will affect the overhauling intervals accordingly.

Lubrication



Lubricating oil is vital for the satisfactory operation of DTH hammers. Apart from regular checking of the oil level in the lubricating-oil tank, always make sure that there is oil in the compressed air. This can be checked whenever the rotation unit is free, i.e. disconnected from the drill string.

Simply place a plank over the drill-steel support and blow operating air on to the plank. After a few moments, the surface of the plank should become oily, which confirms that lubricant is being carried to the hammer in the operating air.

The importance of adequate lubrication of the hammer cannot be over-emphasized. Poor lubrication will accelerate wear and ultimately result in breakdown. The effective lubrication of the DTH hammer is not always a straight-forward matter, owing to wide variations in operating conditions, e.g. extreme temperature differentials between the hammer and the lubricator, water or foaming concentrate added to the operating air, etc.

Different lubricants have different properties. Mineral oils have the best lubricating properties and are preferable in most cases. Mineral-base oils have good adhesion properties and are produced in different viscosity and temperature- range grades.

Since mineral oils have good resistance to water, they are suitable for use even when comparatively large volumes of water are injected into the operating air. In this case, however, the dosage must be increased.

Other lubricants worth mentioning are the so-called "edible" oils, which consist of vegetable oils, synthetic lubricants of the ester type, or a mixture between these two. Edible oils can be mixed with mineral oils, have good lubricating properties and are non-toxic.

Please note, use suitable rock drilling tool oil to protect internal parts if the hammer will be stored for a longer period because a non mineral edible oil will hardened and become sticky after a period of time.

Lubricators

Both plunger-pump and nozzle-type lubrication systems are available.

The plunger pump is relatively insensitive to the viscosity of the lubricant and gives a more reliable dosage compared with the nozzle-type lubricator. This is of major importance when the ambient temperature is low.

About 1 ml of oil per m^3 of operating air consumed should be the minimum dosage for bench drilling. As a rule, higher dosages are needed in water-well drilling.

Lubrication at different pressure / flow

Pressure	Flow	Lubrication dosage
25 bar	285 l/sec	0,3–0,5 l/hr
30 bar	365 l/sec	0,5–1,0 l/hr
35 bar	429 l/sec	1,0–1,5 l/hr

In case of water injection, increase dosage by 0,– 0, 2 l/hr.

N.B. The distribution of lubricating oil through the compressed air system generally takes place in the form of so-called "wall flow".

If the air system has been shut off for a long period of time, it can take quite some time for the lubricant to reach the hammer. In such cases, a small amount of oil must be poured directly into the hammer or air hose before drilling.

Choice of lubricating oil

For COP hammers it is recommended to use Atlas Copco Rock drill oil. When choosing between other types of lubricants, the oil should have:

- suitable viscosity
- good adhesion properties
- high film strength
- corrosion inhibitors
- EP additives

Ambient temp.°C(°F)	Viscosity grade
–20 to +15 (–4 to +59)	ISO VG 46-100
+15 to 35 (59 to 95)	ISO VG 100-150
> +35 (95)	ISO VG 150-220

For reasons of water hygiene, lubricating oils used in water-well drilling should be non-toxic.

The temperature limits given above refer to the temperature of the oil in the tank, i.e. the ambient temperature. In cases where the hammer is powered by warm compressed air at high operating pressures, e.g. when connected to a nearby portable compressor, the temperature of the operating air must be taken into consideration. In such cases it may be necessary to choose a thicker oil than what is recommended in the table.

Thicker oils have beneficial characteristics which can be exploited in stable temperature conditions, e.g. underground. In general, thicker oils have a better film strength and better adhesion properties, which leads to lower oil consumption.

Recommended lubricants

Lubricating oil tank	Atlas Copco Rock Drill oil
Threads and splines	Atlas Copco thread grease
O-rings and rubber parts	Silicone grease (temperature limits –20 to +120°C)

Atlas Copco rock drill oil	Ordering No.	Weight
Can 20 litres	89010563	18 kg (40 lbs)
Drum 205 litres	89010564	205 kg (452 lbs)

Wear limits

Component	Wear limit	Action	Comments
Bit (diameter)	Min. 6–10 mm, greater than the max. diameter of the casing.	Fit new bit.	Min. measurement at lower working pressures. Max. measurement at higher working pressure.
Driver chuck (diameter)	Never less than the diameter of the cylinder.		Failure to replace in good time will cause severe wear to hammer cylinder.
Cylinder (diameter)	Lower end 91 mm, upper end 93 mm.	Replace.	Measure the diameter along the full length of the cylinder, with the exception of the outermost 100 mm at each end. Risk of fracture.
Piston / Cylinder	Diametric clearance: max. 0,20 mm.	Replace worn parts.	Outside diameter of piston should be measured at the sealing surface of the piston.
Piston / Control tube	Diametric clearance: max. 0,20 mm.	Replace worn parts.	Inside diam. of the piston against outside diam. of the control tube.
Check valve	Valve seat worn or damaged.	Replace worn or damaged parts.	Tightness of check valve can be tested by pouring a small amount of oil into the valve with the hammer in vertical position.
Exhaust tube	Worn or damaged.	Replace.	

Trouble shooting

Fault	Cause	Remedy
Impact mechanism does not operate, or works with reduced effect.	Air supply throttled or blocked.	Check the air pressure. Check that all air passages leading to the hammer are open.
	Oil is not reaching the impact mechanism of the hammer. Poor or no lubrication, causing increased wear, scoring or seizure.	Let operating air blow through rotation spindle on dry plank or similar. After a few moments, plank surface should become oily. Inspect lubricator. Top-up with oil if necessary or increase lube oil dosage.
	Too large clearance (wear) between the piston and cylinder, or between piston and control tube.	Disassemble the hammer and inspect the wear (see "Wear limits"). Replace worn parts.
	Hammer clogged with dirt.	Disassemble the hammer and wash all components.
	Dirt enters the hammer when drilling in water-bearing formation.	Make sure the check valve seals against the seat in the top sub (see "Dirt in hammer", page 9). Remove the top sub and replace check valve.
Lost drill bit and chuck	Impact mechanism has been operated without rotation to the right.	Fish out the lost equipment using a fishing tool. Remember to always use right-hand rotation, both when drilling and when lifting the drill string.
Excessive air consumption.	Internal parts worn.	Too low feed force / too low WOB (Weight on bit).
	Foot valve worn or damaged.	Replace foot valve.

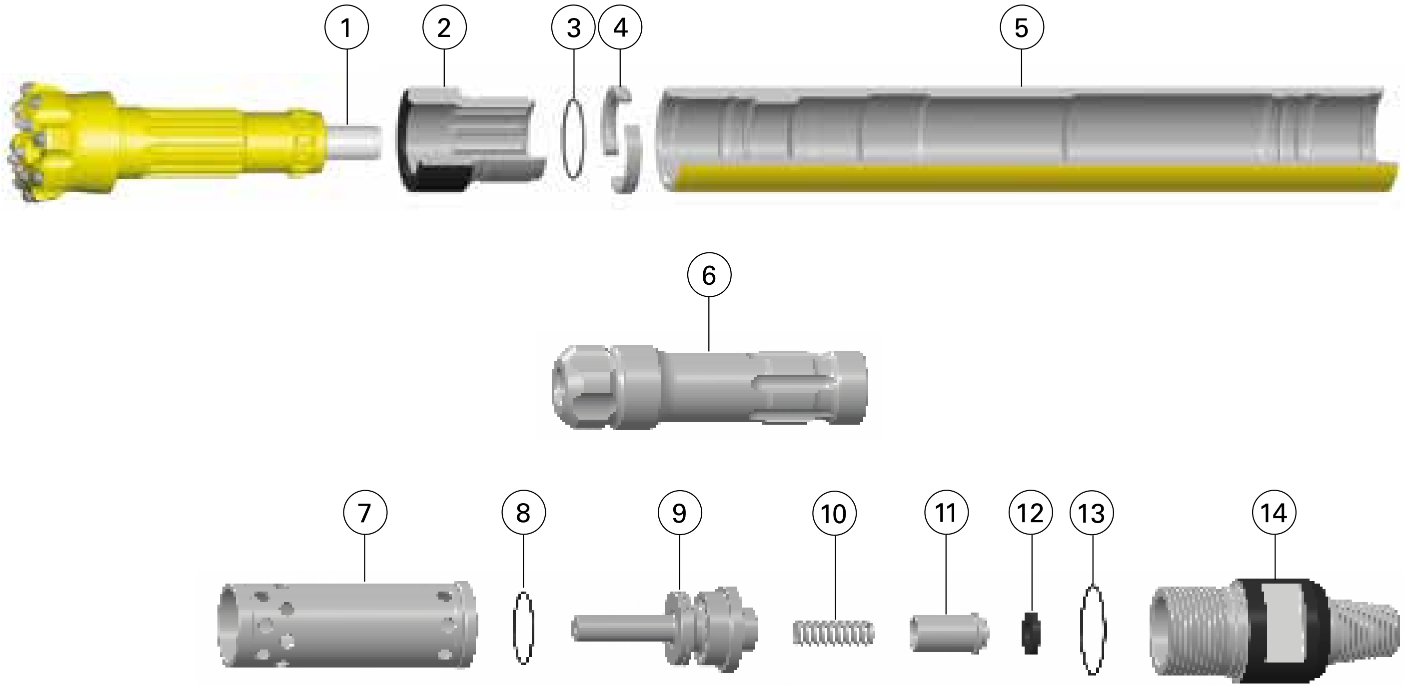
Overhauling

DTH hammers should be overhauled at suitable intervals depending on the drilling conditions and empirical service records. Since the abrasiveness of the rock has a considerable bearing on the rate of wear, it will affect the overhauling intervals accordingly. Before the DTH hammer is sent to an authorized Epiroc service workshop for overhauling, the joints at the top sub and driver chuck should be "cracked" on the rig.

Spare parts list

Secoroc COP W4

Down-the-hole hammer



Ref.	Part	Prod. No.	Product code
1	Exhaust tube	90516004	9115
2	Chuck	89012214	9704-WW-00-000-64-000-001
2	Chuck with guide**	89012313	9704-WW-00-000-64-00G-001
3	O-ring* for bit retaining ring	–	–
4	Bit retaining ring assembly, incl. o-ring	89012206	9704-WW-00-000-64-000-A02
5	Casing	89012205	9704-WW-00-000-00-000-004
5	Casing with guide**	89012314	9704-WW-00-000-00-G00-004
6	Piston	89012213	9704-WW-00-000-64-000-005
7	Cylinder	89012212	9704-WW-00-000-00-000-048
8	O-ring* for air distributor	–	–
9	Air distributor, incl. o-ring	89012217	9704-WW-00-000-00-000-A42
10	Spring check valve	89012216	9704-WW-00-000-00-000-016
11	Check valve	89001020	9704-CO-00-000-00-000-017
12	Seal check valve	89001021	9704-CO-00-000-00-000-018
13	O-ring* for backhead assembly	–	–
14	Backhead assembly, 2$^{3}/_{8}$" API Reg PIN, incl. O-ring	89012211	9704-WW-00-10P-00-000-A20

*O-rings not sold separately. Included in different kits.
**Modified version with OD 114 mm.

Hammers and Kits	Prod. No.	Product code
COP W4 complete, 2$^{3}/_{8}$" API Reg PIN	89012204	9704-WW-00-10P-64-000
COP W4 complete, 2$^{3}/_{8}$" API Reg PIN with guided casing**	89012330	9704-WW-00-10P-64-00G
COP W4 complete, 2$^{3}/_{8}$" API Reg PIN with guided casing and guided chuck**	89012319	9704-WW-00-10P-64-G0G
Economy kit (incl. items 2,5,8,13,14)	89012218	9704-WW-00-10P-64-000-K40
O-ring kit (incl. items 3,8,13)	89012219	9704-WW-00-000-00-000-K47
O-ring kit (incl. items 3,8,13)	89012219	9704-WW-00-000-00-000-K47

Wear limits		
Casing, lower end	Min. OD	91 mm
Casing, upper end	Min. OD	93 mm
Piston / casing clearance	Max.	0,2 mm
Piston / control tube	Max.	0,2 mm
Exhaust tube	Min. OD	32,1 mm
Exhaust tube protrusion		57 + / – 1 mm

Notes

Notes

United in performance.
Inspired by innovation.

Performance unites us, innovation inspires us, and commitment drives us to keep moving forward. Count on Epiroc to deliver the solutions you need to succeed today and the technology to lead tomorrow.
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