COP-Series History

- **1905** The first air-powered rock drill made by AB Atlas was introduced - **Atlas No. 16**. It was a heavy tripod-mounted machine equipped with innovations such as rifle bar rotation.
- **1973** Atlas Copco introduced its first hydraulic rock drill, the **COP 1038**. The COP 1032 and COP 1022 were also released during this period. The COP 1038 offered improved penetration rates, longer drill steel life, and lower power consumption. It was produced for 10 years, during which time it was subject to continuous development. It survives today as the much improved **COP 1238**.
- **1986** Atlas Copco's most powerful rock drill, the **COP 4050** was launched.
- **1992** The best-selling **COP 1838** was introduced, featuring an improved damping system that allowed a 50% increase in output without destroying the drill steel.
- **2004** The **COP 3038** was introduced, the fastest rock drill in the world. Used only for face drilling underground.
- **2009** The **COP3060MUX** was introduced as a member of a complete new rock drill platform. This particular Rock Drill is optimized for long hole production drilling. New technology has been implemented to improve performance and extend the service interval.

COP product codes

LE		Low Energy
ME	M	Medium Energy
HE		High Energy
HF		High Frequency
AW		Aggressive water
HD		Heavy duty
U		Underground version of front head
EX	X	Extractor
CR		COPROD short anvil
CRL		COPROD long anvil

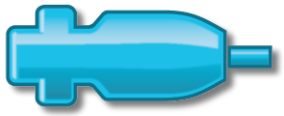
The name of the rock drill is taken from "Copco" standing for **Co**mpagnie **P**neumatique **Co**mmerciale

Output power of the rock drill Diameter of drill steel

Drifting products

- Water flushing
- Horizontal drilling
- Impact energy need varies not so much; adapted to hole size 43-51 mm typically
- As less look-out angle as possible
- Fast and accurate drilling is important in tunnelling, but less in mining
- Higher demands on drilling control system
- The drilling time percentage is high (~70%)

- BOOMER



- COP

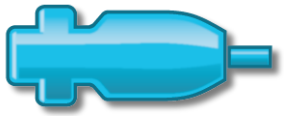
COP 1838

18 kW	60 Hz	330 J	38 – 89 mm	400 h	1008 mm	170 kg	R32(E), TC35E, R38(E) T38(E), T45(E)	MS100, MS160, MS250

Production drilling products

- Water flushing
- Drilling 360º
- Weight of the drill string
- Impact energy need varies: from dia 64 mm to say 115 mm, and the number of joints can be up to 35
- Stroke length adjustment
- The drilling time percentage is high (>55%)
- Hole straightness is important
- Higher demands on drilling control system
- Extractor is frequently used
- Higher rotation torque

- SIMBA

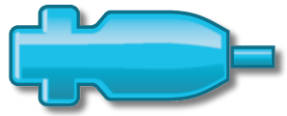


- COP

Bolting products

- Water flushing
- Vertical drilling mainly
- Impact energy need varies not so much; adapted to hole size say 32-38 mm typically
- Drill steel can not take high impact energies
- The drilling time percentage is less (~40%)
- Hole straightness less important (short holes typically)
- Less requirement on drilling control system
- Lower rotation torque

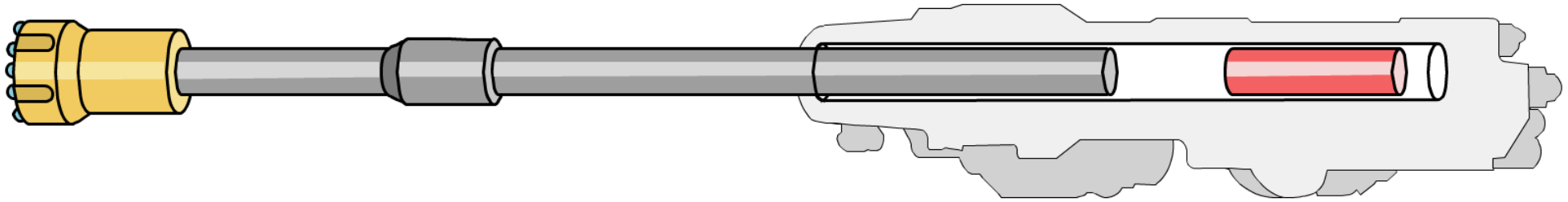
- BOLTEC



- COP

Shockwave

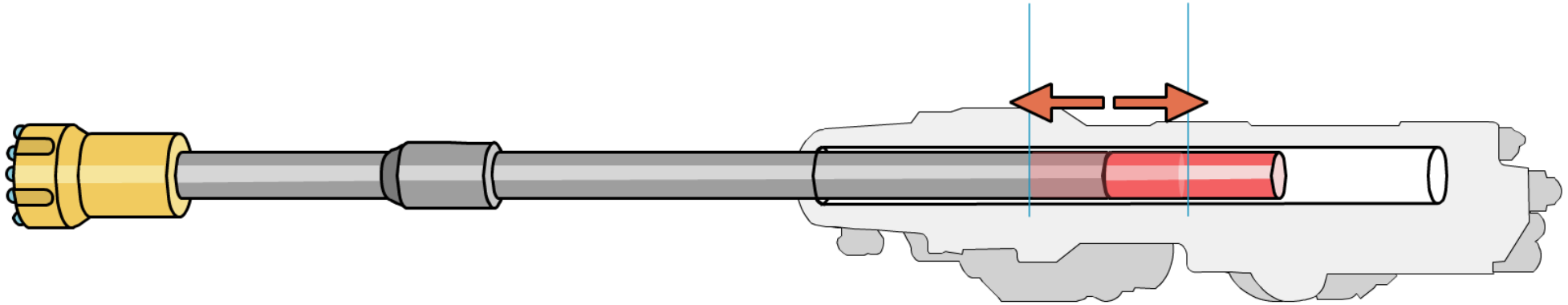
The shockwave length is always twice the length of the piston. The speed of the shockwave is approximately 5.200 m/s (speed of sound is steel) in the drill steel. The speed of sound in air (20°C) is approximately 340 m/s



Shockwave

The shockwave length is always twice the length of the piston. The speed of the shockwave is approximately 5.200 m/s (speed of sound is steel) in the drill steel. The speed of sound in air (20°C) is approximately 340 m/s

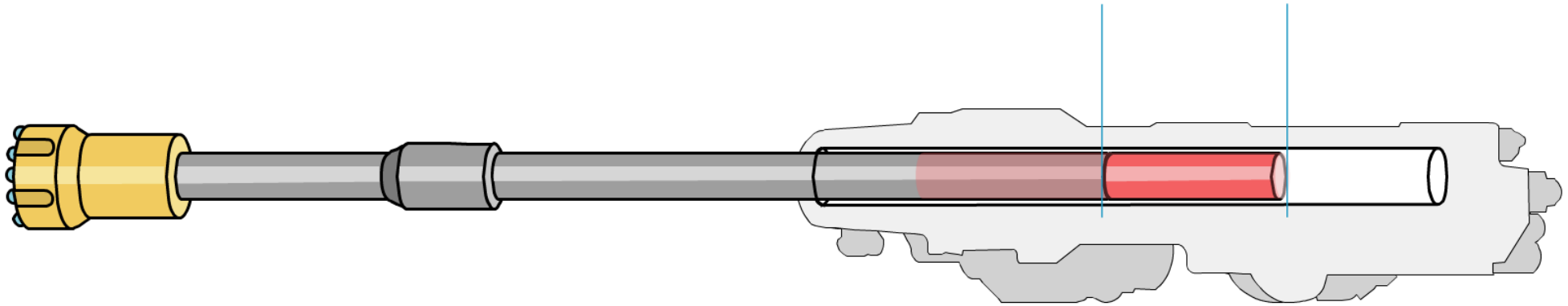
The impact results in two shockwaves: one travels forward through the drill string and the other travels in the opposite direction, through the piston



Shockwave

The shockwave length is always twice the length of the piston. The speed of the shockwave is approximately 5.200 m/s (speed of sound is steel) in the drill steel. The speed of sound in air (20°C) is approximately 340 m/s

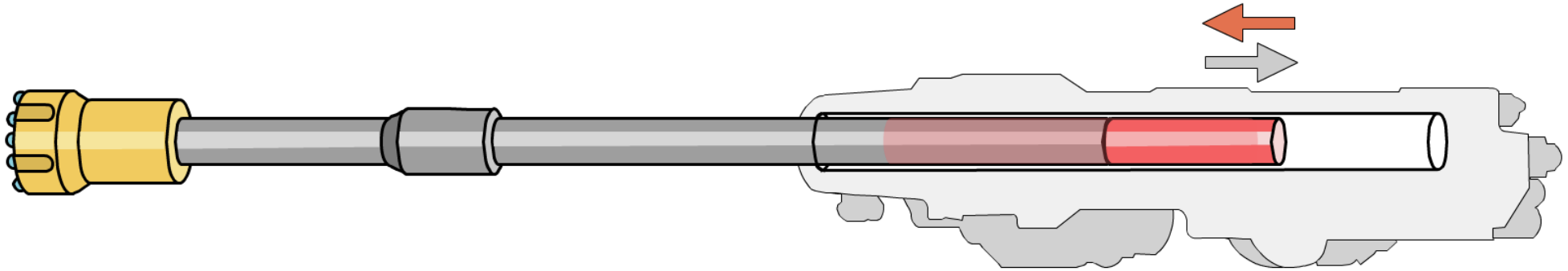
The shockwaves, which travels backward fill the entire piston



Shockwave

The shockwave length is always twice the length of the piston. The speed of the shockwave is approximately 5.200 m/s (speed of sound is steel) in the drill steel. The speed of sound in air (20°C) is approximately 340 m/s

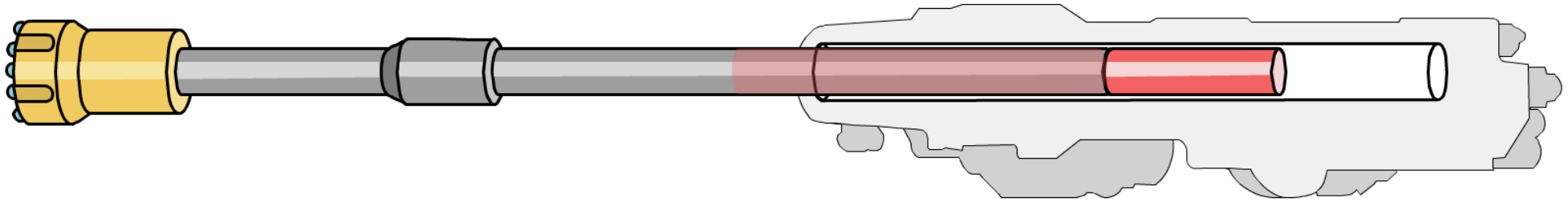
When the shockwaves that is traveling backward reaches the free end of the piston, the shockwave is transformed into a tension wave, which travels in the opposite direction (forward)



Shockwave

The shockwave length is always twice the length of the piston. The speed of the shockwave is approximately 5.200 m/s (speed of sound is steel) in the drill steel. The speed of sound in air (20°C) is approximately 340 m/s

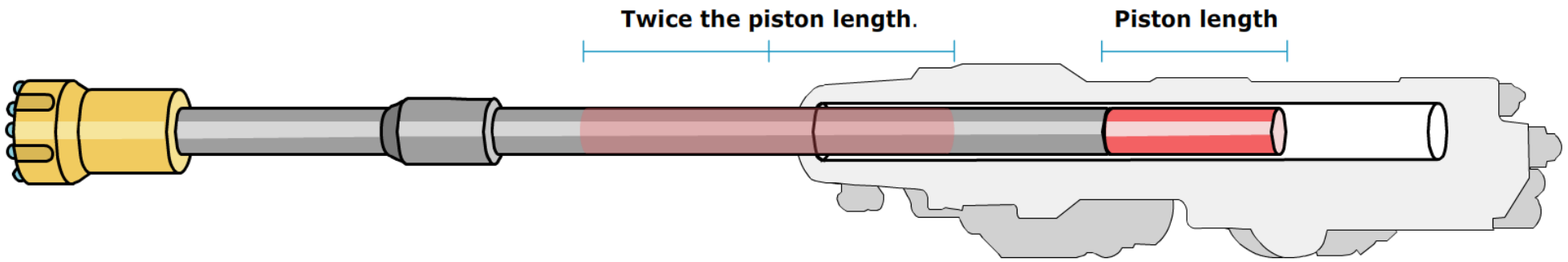
The tension wave passes through the piston and the energy of the piston is neutralized



Shockwave

The shockwave length is always twice the length of the piston. The speed of the shockwave is approximately 5.200 m/s (speed of sound is steel) in the drill steel. The speed of sound in air (20°C) is approximately 340 m/s

The shockwave, which travels forward, is now twice the length of the piston

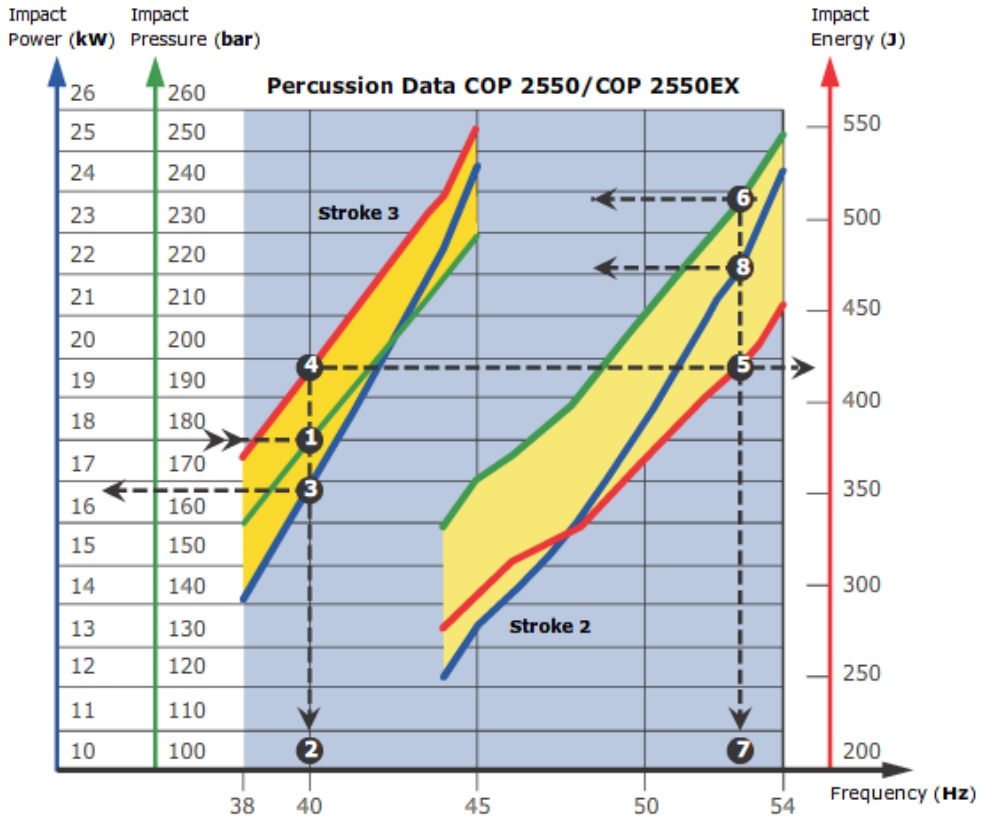


Shockwave properties

- Depending on the rock conditions you may need to change the impact power but you still need the same impact energy. example high coupling temperature you lower the impact power by using longer stroke, still using the same impact energy.

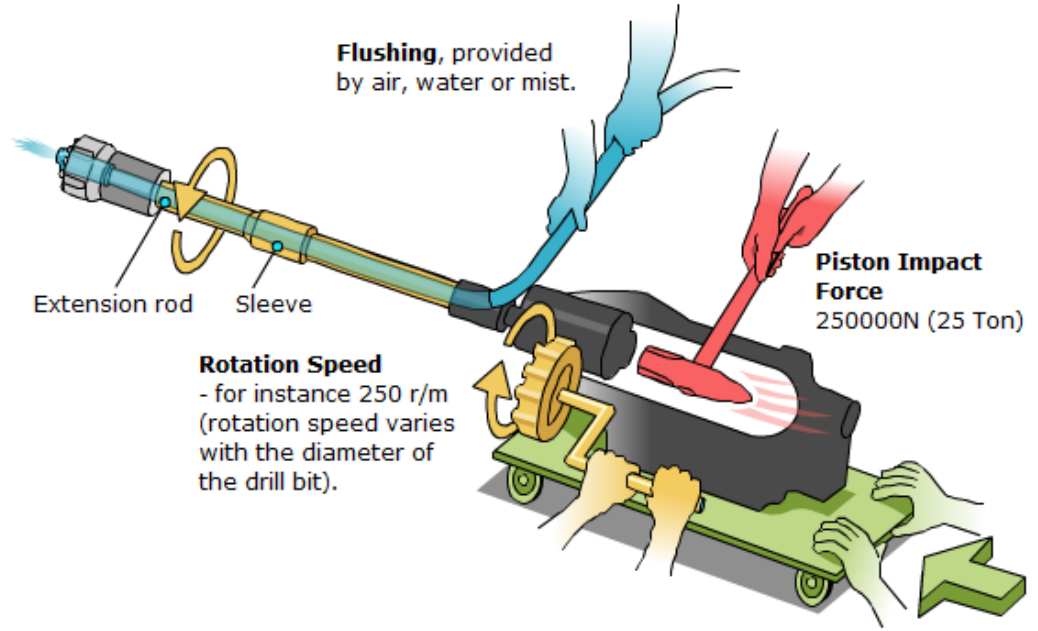
The chart shows indata for impact pressure 180 bar with a long stroke length **(1)**. The frequency is read to 40 Hz **(2)**, the impact power at this frequency is 16,8 kw **(3)** and the impact energy is 420 J **(4)**.

By changing to a shorter stroke length and maintain the impact energy 420 J **(5)** the impact pressure need to be set to 238 bar **(6)**. The frequency achieved is 53 Hz **(7)** and the new impact power is 22,2 kW **(8)**.



Basic functions

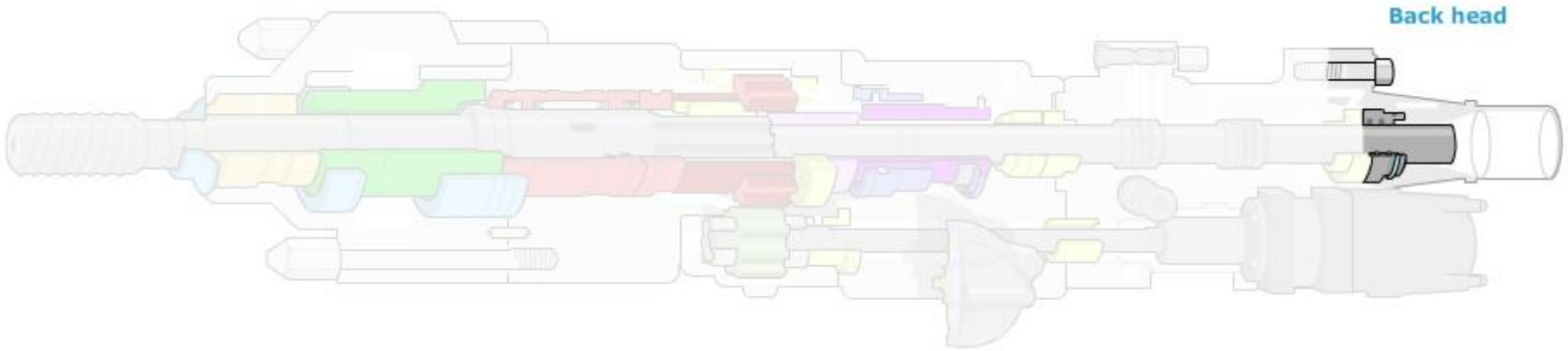
- The rock drill has four different functions - **Feed**, **Impact**, **Rotation** and **Flushing**. All four are vital for drilling in rock.
- **Feed**: keeps the drill bit placed against the rock during drilling and to keep the drill steel joints tightly together.
- **Impact**: sends a shockwave through the drill string in order to crush the rock.
- **Rotation**: turns the drill bit to a suitable new position for the next stroke and to keep the drill steel joints tightly together.
- **Flushing**: cleans rock face for the drill before the impact comes. Drill cuttings are removed from the hole bottom to the surface by water flushing or air blowing, or a combination (water mist).



The figures in the image varies depending on rock drill type, hole dimension, application etc.

Key components

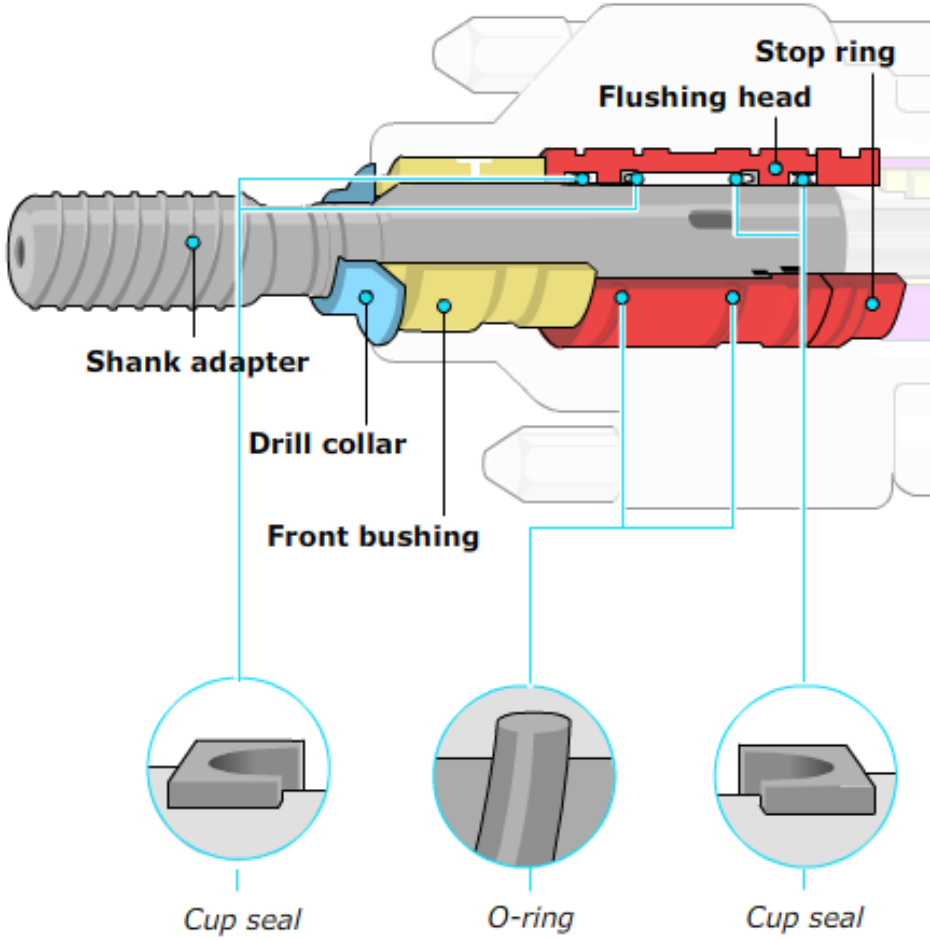
- The COP consists of **five major parts**:
  - front head
  - gears and motors
  - intermediate part
  - cylinder housing
  - back head



Key components

Front head

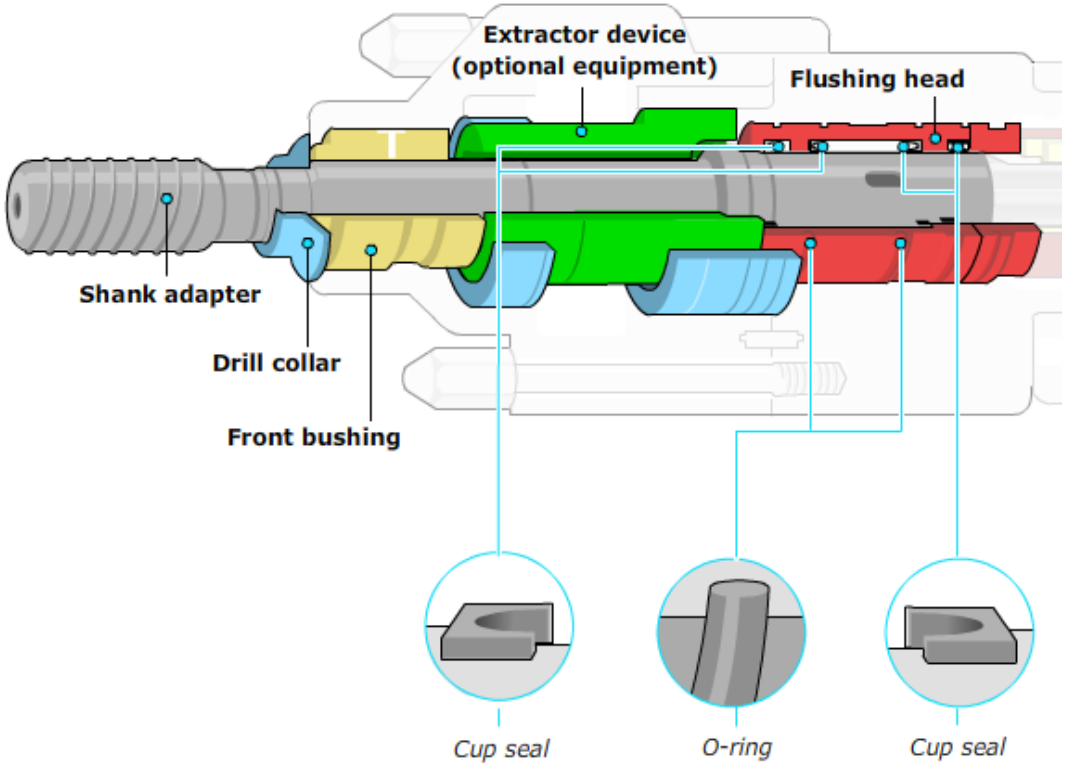
- **Shank adapter** transmits impact energy, rotation, feed force and flushing media to the drill string.
- **Drill collar** is used for drilling upward and prevents dirt from entering the front bushing.
- **Front bushing** guides the shank adapter.
- **Flushing head** it contains cup seals which seal the flushing media between the front head and shank adapter.
- **Stop ring** serves as an end stop for axial movements of the shank adapter. When withdrawing the rock drill, the shank adapter is held by the stop ring.



Key components

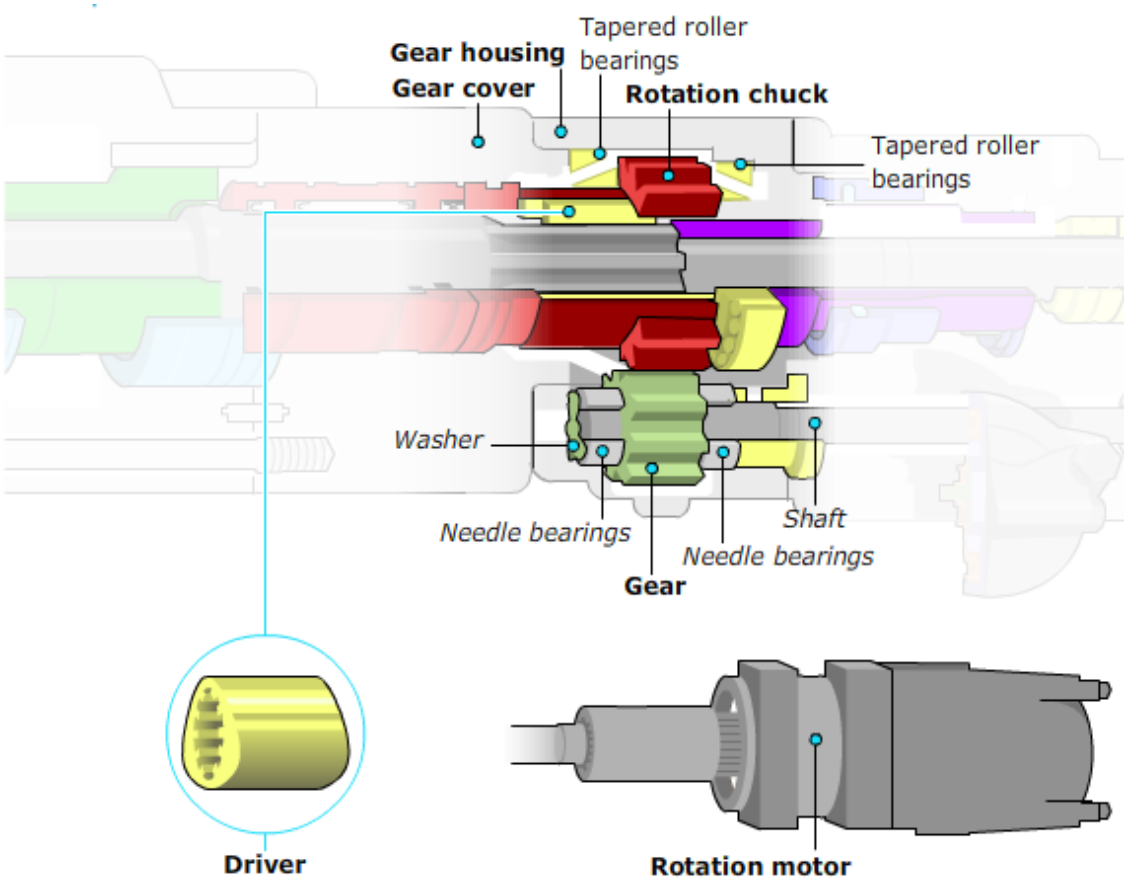
Front head (with extractor device)

- **Extractor device** is optional on some drilling machines. It is used for extracting stuck drill strings.



Key components

Gears and motors

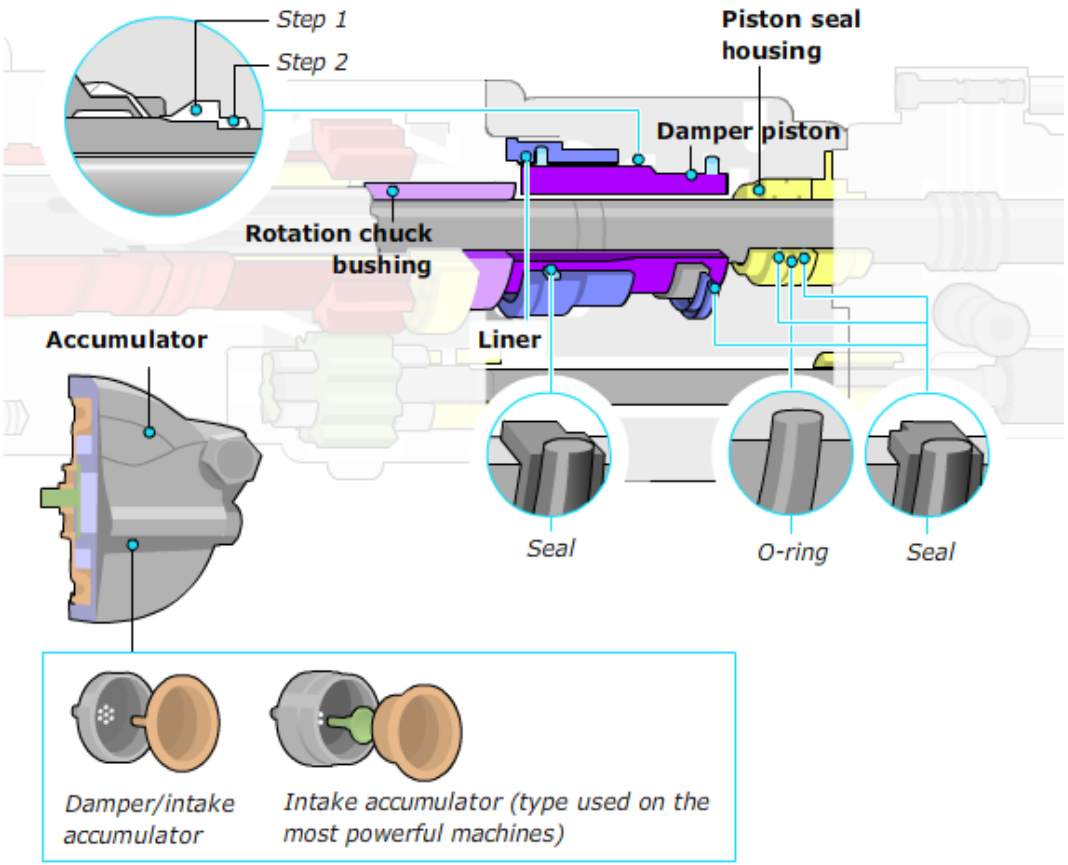


- **Gear** is mounted on a shaft with involute splines.
- **Rotation motor** is an orbit type hydraulic motor. The motor drive shaft drives the gears inside the gear housing.
- **Rotation chuck** are supported by two tapered roller bearings.
- **Driver** is housed inside the rotation chuck, and transfers rotation motion to the shank adapter by means of splines.
- **Gear housing** A linear gear with a gear ratio of 2.19:1 is housed inside the gear housing.
- **Gear cover** preloads the two sets of roller bearings.

Key components

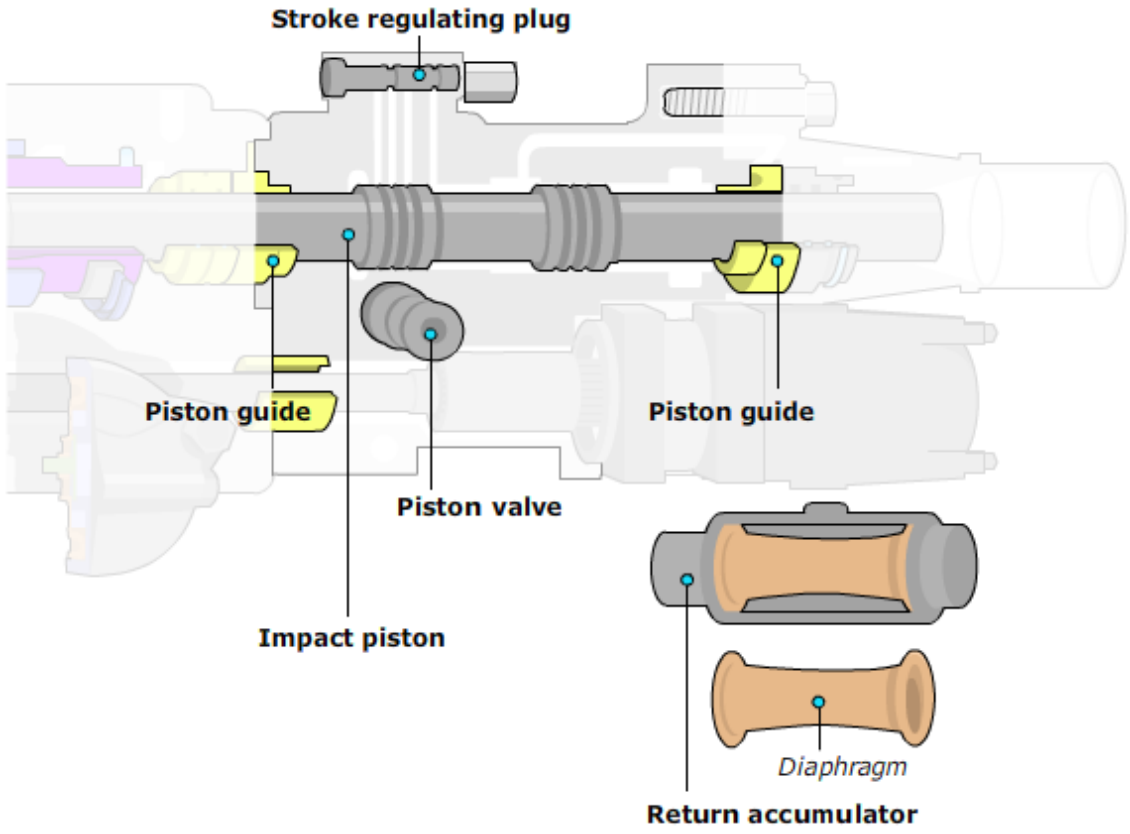
Intermediate part

- **Damper piston** is positioned against the rotation chuck bushing, which in turn is in contact with the shank adapter.
- **Liner** is used to guide the damper piston. The liner contains seal rings and an O-ring.
- **Rotation chuck bushing** links the shank adapter to the damper piston
- **Piston seal housing** contains two seals and is press fitted into the intermediate parts.
- **Damper accumulator** is charged with nitrogen and is mounted externally on the left side of the intermediate part.
- **Intake accumulator** is charged with nitrogen and is mounted externally on the right side of the intermediate part.



Key components

Cylinder housing

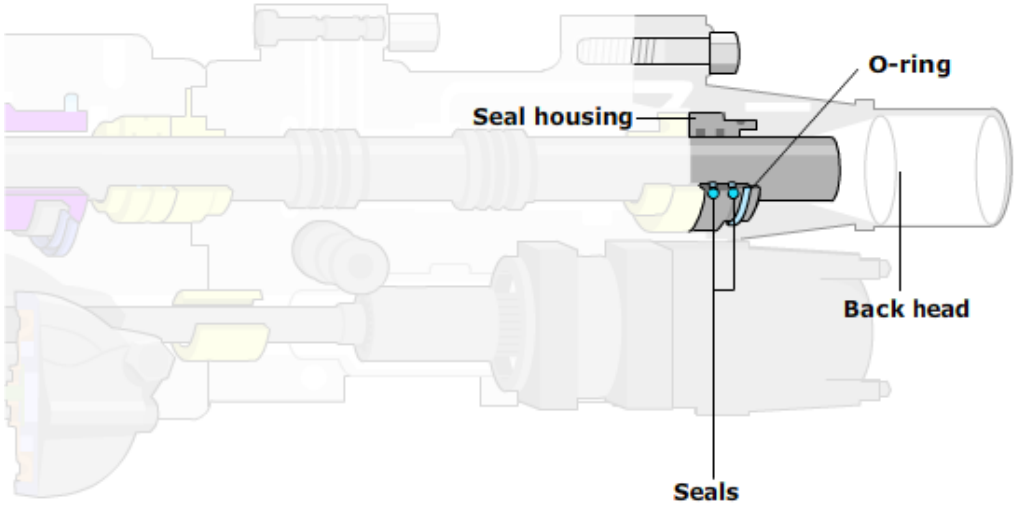


- **Impact piston** is housed in two piston guides, one at each end of the cylinder.
- **Piston guides** prevent the impact piston lands from touching the cylinder walls, and ensure that the piston always strikes the shank adapter squarely.
- **Piston valve plunger** it directs the main hydraulic pressure to the impact piston.
- **Stroke regulating plug** when turned, the plug opens or closes different stroke regulation channels, which directs the hydraulic oil to the opposite side.
- **Return accumulator** this accumulator prevents vibrations of the return hydraulic hose.

Key components

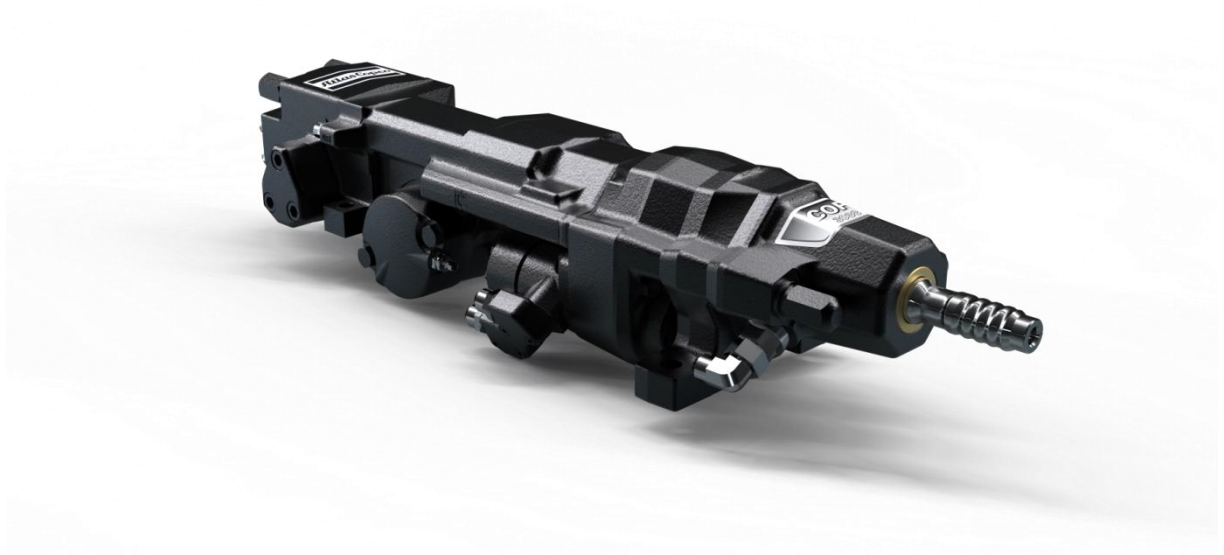
Back head

- **Rear piston seal housing** contains two seals and is press-fitted into the back head. It is held in place between the cylinder and the back head. The seals prevent oil from leaking out of the impact mechanism section.



Impact mechanisms

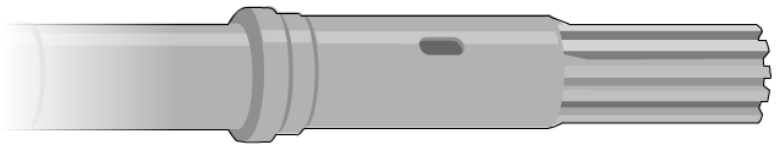
- The COP percussion system can either be:
- **Alternating pressure** type (high pressure alternates piston movement back and forward)
- **Constant pressure** type (always constant pressure in front of piston and one side of valve piston).

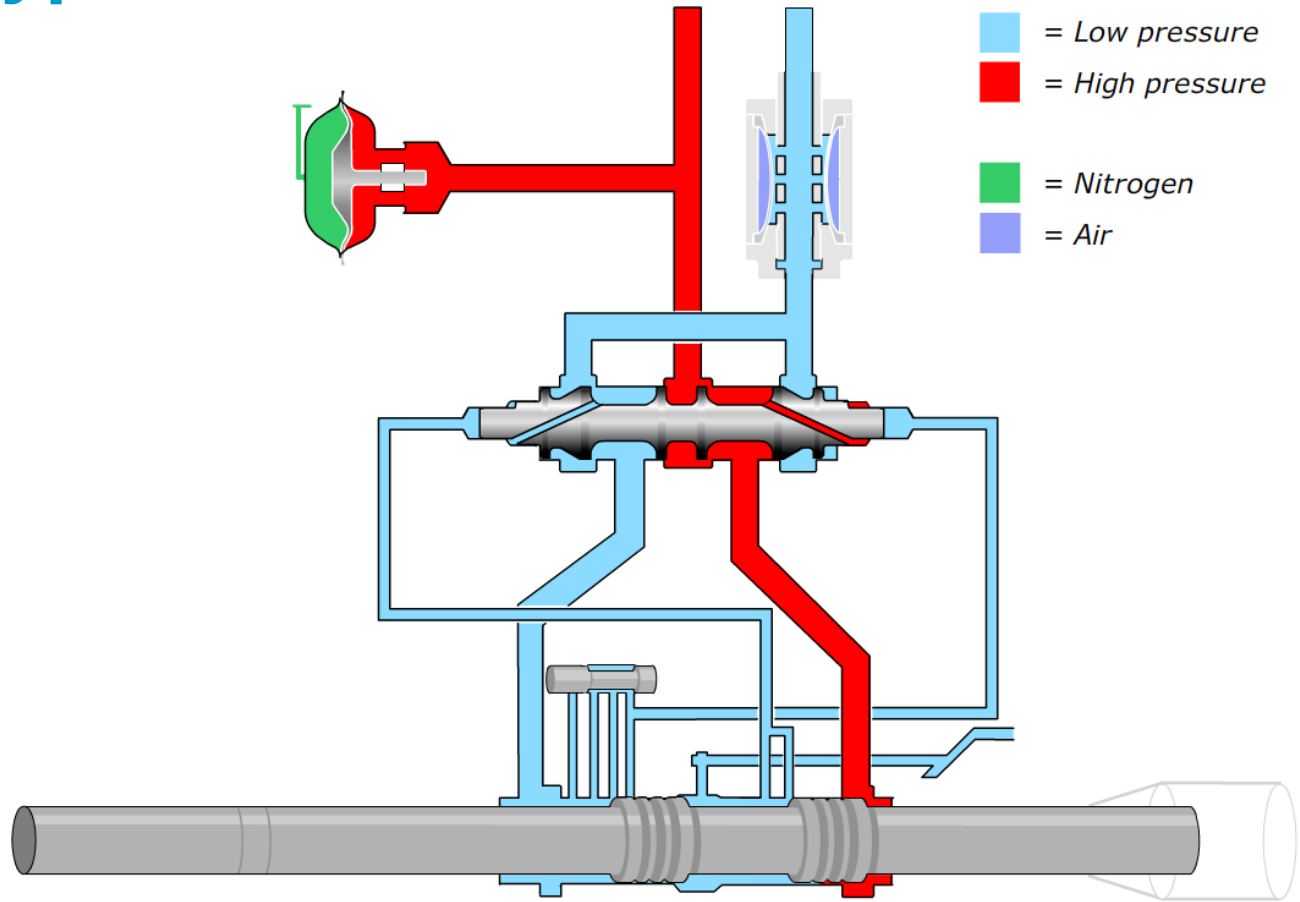


Alternating pressure type

Impact function, alternating pressure type

This is a model which shows the principle of the alternating pressure impact mechanism. When the piston hits the shank adapter, the speed of the piston is approximately 10m/s.





Functions

Rock drill normal lubrication

Functions

Rock drill too much lubrication

- **Erosion damage**: If there is liquid present between piston and adapter during running, erosion groves will occur on the striking face of the piston. The groves may cause fatigue cracks with a break down as a result.

Functions

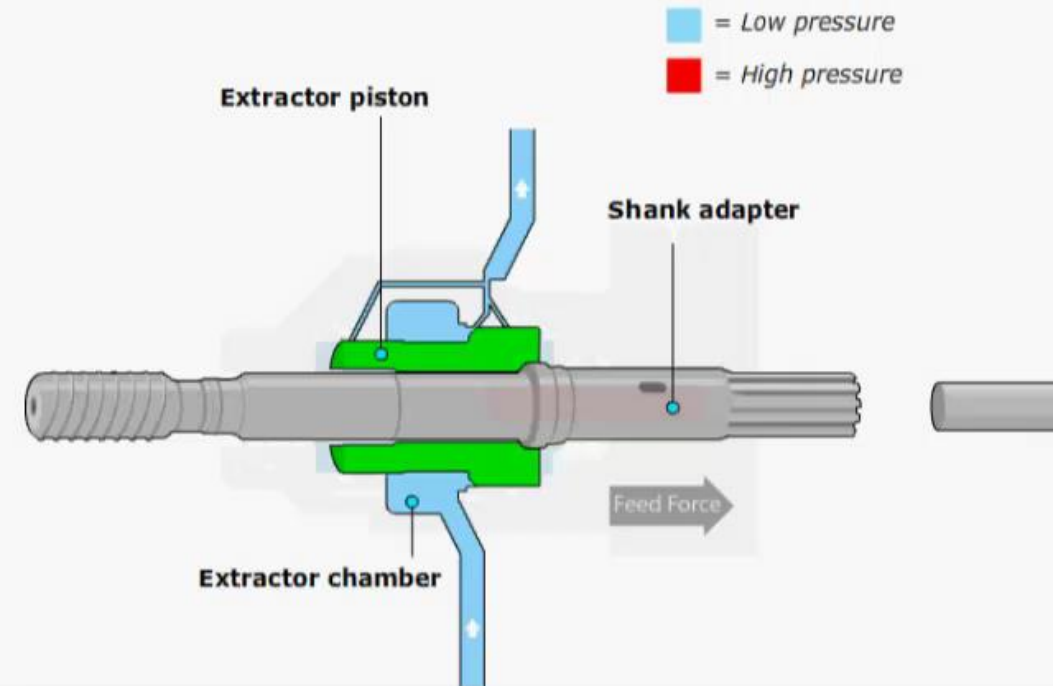
Rock drill too little lubrication

- **Too little lubrication** flow will create heat and extreme wear.
- The rotation shuck bussing will be heated up, also the striking surface of the impact piston. Pore lubrication between the driver and shank adapter will also create heat and wear. Finally, if continued to drill with insufficient lubrication flow, or wrong quality of lubrication oil, there will be premature wear and failure.

Functions

Extractor device

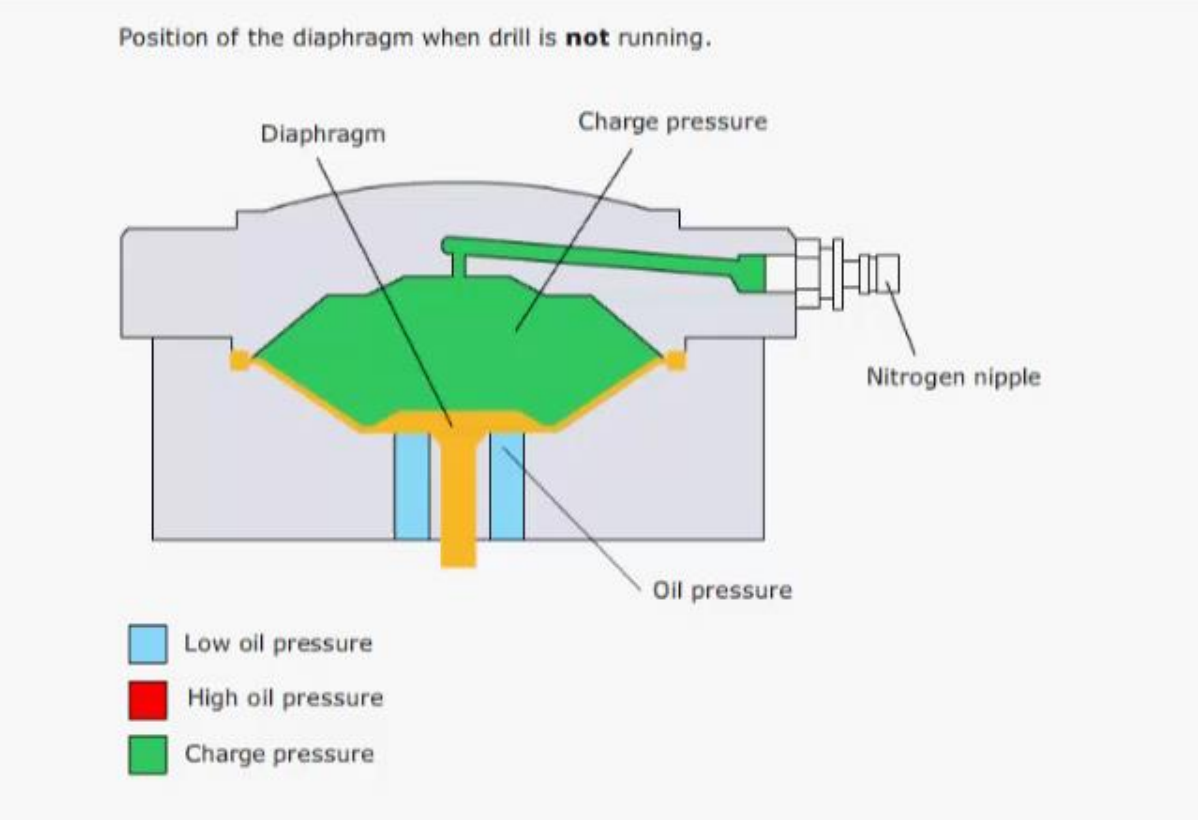
- When the piston strikes, the shank adapter moves forward. The movement builds up pressure in the extractor chamber.
- The high pressure in the extractor chamber will push the extractor and the piston backward
- When the piston and extractor moves backward, there is release of pressure in the extractor chamber.



Functions

Accumulator pressure

- When the **charge pressure** is correct, the diaphragm operates in the correct working position.



5 critical steps of maintenance

- New machine
  - Load accumulator
  - Set / adjust damper idling pressure
- After the first shift
  - Tighten all threaded unions
- Before every shift
  - ECL lubrication
- After every week
  - Tighten all threaded unions
  - Replace the shank adapter
  - Bleeding the return accumulator
  - Grease the gear
- After 400 production hours
  - Dismantle the rock drill from the drill rig. Transport the rock drill to an appropriate workshop for servicing.

5 critical steps of maintenance

New machine

- **Load accumulator** Charge the accumulators when assembled on the rock drill. *Not following these instructions may lead to injury. Using a gas other than nitrogen gas (N2) may cause an explosion*.

✓ Remove the protective cap.

✓ Open the valve nut by 2-3 turns, and connect the gas hose.

✓ Open the gas valve.

✓ Charge the accumulators with nitrogen gas to the correct pressure. Verify the correct pressure; look in the maintenance instruction for the specific rock drill.

✓ Tighten the valve nut and close the gas valve.

✓ Remove the gas hose and screw the protective cap in the accumulator valve.

5 critical steps of maintenance

After the first shift

- **Tighten all threaded unions** When using a new or newly overhauled rock drill, all threaded unions should be tightened after the first shift.

5 critical steps of maintenance

Before every shift

- **ECL lubrication** Check that air and lubricating oil escape between the shank adapter and front guide.

Driver problems *The most common reported problem with drivers is premature wear. This is normally caused by:*

- *No, or insufficient lubrication.*
- *Wrong type of lubrication oil.*
- *Drilling with a larger diameter than the rock drill is designed for.*

5 critical steps of maintenance

After every week

- **Tighten all threaded unions**

✓ Inspect the side bolts, nuts and washers for cracks, scoring or corrosion. Replace damaged parts.

✓ Smear the threads and the contact surfaces of the side bolt, nuts and washers with Never-Seez regular grade.

✓ Tighten the rear nuts to the correct torque according to the specifications in the maintenance instructions.

✓ Tighten the side bolt to the correct torque according to the specifications in the maintenance instructions.

✓ Tighten the front nuts to the correct torque according to the specifications in the maintenance instructions.

5 critical steps of maintenance

After every week

Never attempt to carry out maintenance while the drill rig is in operation. Ensure that the hydraulic and air systems are depressurized before starting any work. ***Not following instructions may result in injury!***

Replace the shank adapter

- ✓ Remove the flushing hose.
- ✓ Remove the front side-bolt nuts and their washers.
- ✓ Remove the front head by tugging the shank adapter. Then, pull out the shank adapter from the front head.
- ✓ Replace the shank adapter
- ✓ Fit the stop ring and shank adapter into the front head.
- ✓ Apply Never-Seez grease to the threads on the washers and nuts.
- ✓ Fit the washers and nuts.
- ✓ Check the tightening torques on the rear side bolt nuts and the front side bolt.
- ✓ After assembly, check that air and lubricating oil escape out of the hole in the front head and between the shank adapter and front guide.

5 critical steps of maintenance

After every week

- **Bleeding the return accumulator**

✓ Place the rock drill so that it is horizontal.

✓ Remove the plug and O-ring. If oil escapes, then the diaphragm is damaged. Replace the accumulator or diaphragm.

✓ Charge the accumulator by admitting air into it at atmospheric pressure.

✓ Refit the plug and O-ring.

5 critical steps of maintenance

When required

- **Refilling COP-oil**

✓ *Never work on the lubrication system when it is pressurized. Lubricating oil could spray out. Serious injury to eyes and skin may result.*

✓ Use the recommended lubrication air pressure and recommended lubrication oil. Some moving parts in the rock drill are lubricated with oil mixed with compressed air. These parts must be well lubricated.

✓ Check the level in the lubricating oil tank at every shift. Exercise cleanliness and fill the tank with the correct grade oil. The lubrication oil tank holds 5 l

✓ If the lubricating system has been empty of oil, it must be bled after filling.

5 critical steps of maintenance

After 400 production hours

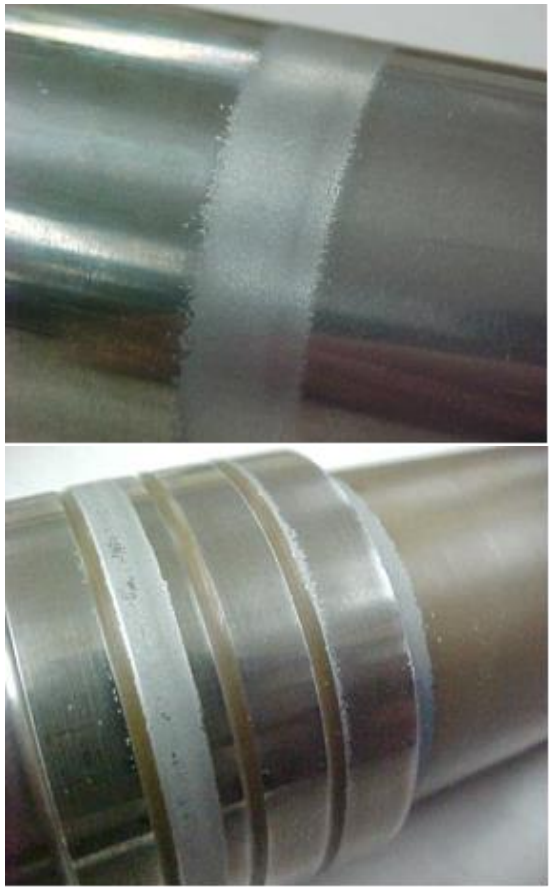
- **Maintenance after 400 production hours**
  Dismantle the rock drill from the drill rig. Transport the rock drill to an appropriate workshop for servicing.
- Servicing should be carried out at appropriate time intervals based on local conditions. Rock conditions greatly affect the amount of wear, which in turn affects the servicing requirements.

Typical errors and troubleshooting

Damaged accumulator diaphragm (high pressure)

With the pulsating operation of rockdrills there are always some cavitations.

On the pistons, some cavitations usually occur on the mantel surface at the front and rear driving areas, and at the switching area between the piston lands.



Typical errors and troubleshooting

Front head middle part flushing seal broken

If there is liquid present between the piston and adapter during running, erosion groves will occur on the striking face of the piston. The groves may cause fatigue cracks with a breakdown as a result.

The piston can be regrind and put in service again if the damage has not gone too far. Instruction for grinding the striking face of the piston can be found in the overhauling instructions.

Typical errors and troubleshooting

Inadequate feed force

- The most common problem with the rockdrill is caused by intense backhammering or drilling with too low or no feed force.
- The impact velocity of the piston will be reduced by a damping device in the cylinder when the piston reaches the front part of the rockdrill. However, to be able to loosen a stuck drill steel the piston must have some residual impact velocity when it reaches the shank in its forward position. The impact forces are then also received by the stop ring.
- In order to resist the impact and wear from the rotation the stop ring is carefully heat treated.

Typical errors and troubleshooting

Piston broken in piston guide area

- The most common case with broken pistons a hard contact with the guide. The piston surface is then locally heated, causing small heat cracks to develop. The crack grows inwards through the piston.
- Reasons for the hard contact can be:
  - Contaminated hydraulic oil
  - Broken side bolt or uneven tightening of side bolts
  - Corroded mating surfaces, or dirt between mating faces causing misalignment
  - Dirt between cylinder and piston guide causing misalignment
  - Dirt between the seal housing and the back head or piston guide causing misalignment
  - Uneven tightening of the back head screws (screws not retightened at specific intervals)

Typical errors and troubleshooting

Driver premature wear

- The most common reported problem with drivers is premature wear, which normally is caused by:
  - No, or insufficient lubrication
  - Wrong type of lubrication oil
  - Drilling with larger diameter than the rock drill is designed for
- In some cases extreme heat may build up in the driver, causing the shank adapter to crack in the splines area, which may lead to serious secondary damages

Typical errors and troubleshooting

Driver broken splines

- Another problem that may occur is broken splines in the driver. This is normally caused by the guide in the front head being too much worn.

Typical errors and troubleshooting

Driver cracked

- If the driver is cracked, this is normally caused by wrong tolerance between driver and rotation chuck i.e. the clearance outside the driver is too big.

Typical errors and troubleshooting

Explain possible problems shown in this movie 1

Typical errors and troubleshooting

Explain possible problems shown in this movie 2

Typical errors and troubleshooting

Explain possible problems shown in this movie 3

Overhauling

Changing flushing seals

- Clean the seal grooves before you install new seals. Fit the O-rings and the seals in the flushing head using a circlip tool and a wooden or plastic stick.
- Note! Turn the seals as specified in the manual.

Use tools without sharp edges to avoid damaging the seals.

Committed to sustainable productivity


Atlas Copco