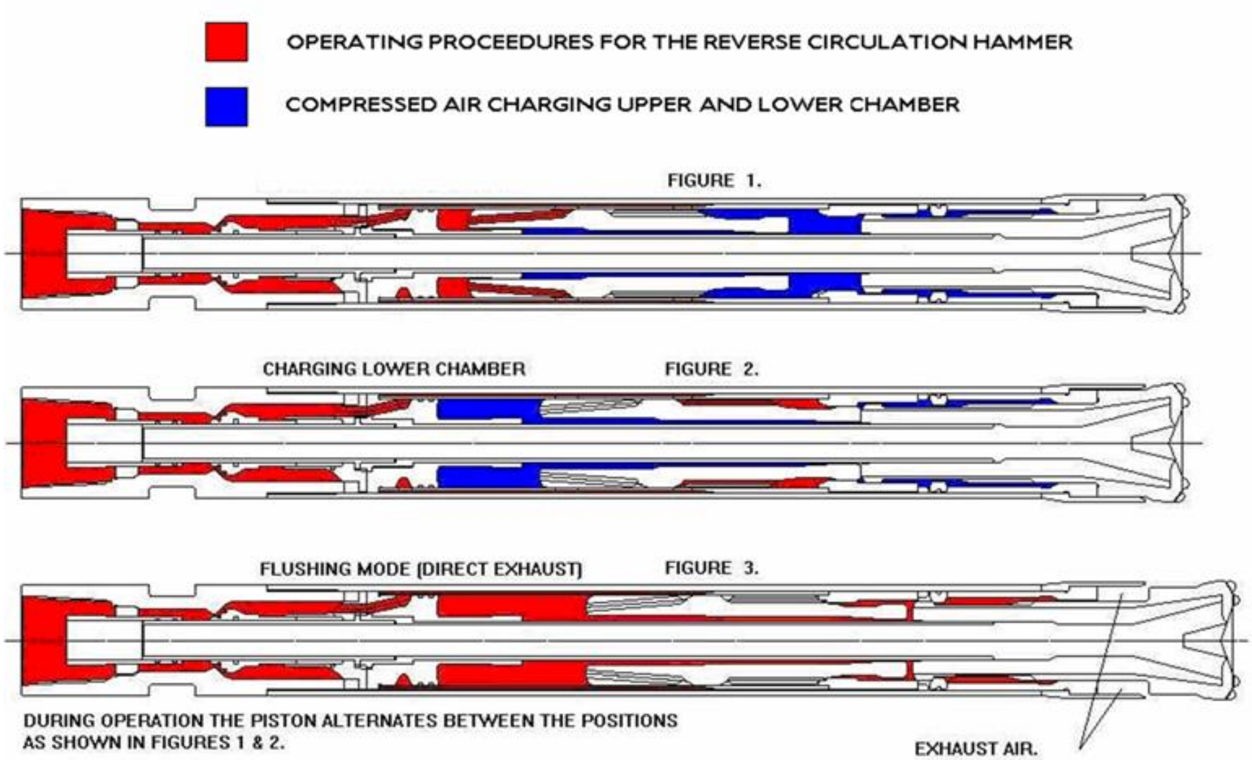
TECHNICAL DATA

Operating Cycle

1. With the piston resting on the percussion bit and the hammer closed up in the drilling position, high pressure air is directed into the bottom chamber of the Hammer and the piston lifts. This commences the piston cycle.
2. As the piston travels upwards it forms the top chamber by forming a seal with the inner tube and the ID the piston. Further movement seals the port that feeds the bottom chamber and also simultaneously releases the seal on the bottom chamber allowing the air to expand and exhaust down the splines of the percussion bit. At the same time the Top chamber port is opened which feeds the high pressure air into the previously formed top chamber thus increasing the pressure above the piston and forcing it back down.
3. During the down cycle or power stroke the piston reseals the bottom chamber on the piston bearing bush thus stopping the exhaust air and creating a chamber of high pressure air below the piston which forces the piston back up the hammer.
4. Lifting the hammer of the bottom of the hole allows the percussion bit to slide down the drive sub also allowing the piston to slide down the hammer and rest on the piston bearing bush. The piston strike face and the strike face of the percussion bit can now not come into contact thus allowing the free flow of high pressure air directly through the hammer without the hammer cycling.



Air flow

The Reverse Circulation system requires a continuous Air Flow into the inner tube to maintain continuous suspension of sample flow in the Inner Tube.
Operators must ensure that all the sample is delivered before turning the air off.
Any interruption of Air Flow at or to the bit face holes will result in in sample blockages in the inner tube and return lines. If partial blockage of sample occurs, or if drill pipes commence to stick in the hole, operators should utilize the dual blow down or blow back features of the Blow Down Valve to clean blockages or increase outside circulation to free up the drill pipe.
Failure to monitor Sample flows to the cyclone will interrupt drilling operations.

Effect of elevation

Elevation above sea level affects the compressor output. As elevation increases the compressors volume output decreases. Use the table below to determine the volumetric loss.
Air Pressure, volume and hole cleaning
SH&B Reverse Circulation Hammers require adequate high pressure air to perform correctly. Check the Air pressure chart for your hammer on each Hammer page.

Undoing Threads

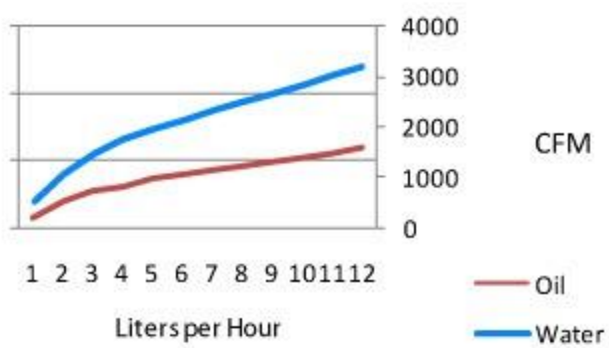
Undoing threads loose to change Percussion Bits
When undoing the Drive Sub loose to change Percussion bits follow these guidelines.

- Keep hands well clear of the bottom of the hammer. Only grip the Drive Sub and the Percussion Bit from the sides as fingers can be jammed if anything falls.
- Always use the hydraulic breakout on the Drill Rig. If this is not available use a wrap around wrench to prevent crushing of the Piston Case.
- Always use good sharp jaws in the breakout as the Piston Case is hardened and only good quality jaws will be able to grip the Piston Case.
- Do not heat the hammer, this may cause cracking of the Piston Case.

Lubrication

Lubrication is the single most important operation to achieve maximum hammer performance and life. Lubrication is vital to minimize part wear, corrosion and premature failure of your DTH Hammer. Schramm Hammers and bits recommends the use of a reputable Rock Drill Oil. The following chart shows different brands and specifications of Rock Drill Oil. Schramm Hammers and Bits recommends the use of environmentally safe Rock Drill oils and greases. Rock Drill Oils are designed to provide extreme pressure capabilities, rust and corrosion protection, antifoam properties, adherence to internal tool surfaces, and good emulsion characteristics.

As with all lubrication too much or not enough lubrication will both affect the operation of your DTH Hammer. The following chart shows the recommended Litres per hour at selected CFM. Pouring oil down the rod line when each new rod is added may cause the hammer to hydraulically lock causing drilling down Time. SH&B recommends the use of a Hammer lubricator.



Effects of incorrect Hammer Lubrication
The major source of damage to DTH hammers (Excluding wear and tear) is incorrect lubrication. DTH hammers operate in some of the worst environmental conditions encountering extreme heat, pH levels, salinity and a wide variety of rock formations containing acidic and basic chemical compositions.
All of the above conditions can lead to pitting and hydrogen embrittlement of the metal components causing premature failure of the hammer components. Correct water injection utilizing clean water and correct oil injection rates will help to minimize the corrosive effects of the chemicals encountered.

To minimize damage and premature wear, it is highly recommended that drillers should service the hammer immediately before reusing or storing the hammer.

Drilling in Water

DTH hammers are equipped with a check valve to assist when drilling under water. The check valve closes when the air supply is turned off, this maintains the air pressure in the hammer and prevents water from entering the hammer. Drilling under water increase the back pressure which decreases the efficiency of the hammer thus slowing the penetration rate. A point can be reached when the up hole velocity of the air is insufficient to overcome the water head and piston will stop, to overcome this extra air must be utilized.

Back pressure in water is determined by the amount of head of water above the hammer. The back pressure can be calculated by using the following.

1 metre Head = 0.1kg/cm2
1 kg/cm2 = 10 metres of Head
1 ft head = 0.434 psi
1 psi = 2.3ft of Head

After a pipe change in a hole with 200m of water the operator will need 200m x 0.1kg/cm2 (20 kg/cm2) of air supply to unload the water from the hole. Once the water starts to flow from the hole the pressure required will drop.

Salt water
During many drilling operations salt water is encountered, this can cause premature corrosion and wear. When drilling in high salinity levels extra oil should be added to the drill string between shifts, with the hammer being left under the water level to avoid exposure to air between shifts.

Drilling Operation

Before commencing drilling ensure all the hammer threads are correctly tightened. Incorrect make up torque can result in thread damage. When threads are not tightened prior to drilling the percussion of the hammer combined with the rotation of the drill string results in over tightening of the DTH hammer. This can damage the threads and also lock the hammer preventing bit change and hammer maintenance.

The Reverse Circulation DTH Hammer will begin to operate as soon as the air supply is turned on and the percussion bit is firmly pressed into the rock face. The weight or thrust required to efficiently operate the hammer can be obtained from the weight on hammer chart. The effect of the drill rods weight on the hammer should also be taken into account when drilling. Insufficient thrust pressure will make the hammer drill erratically resulting in premature wear to the percussion bit and drive sub splines with damage to threads also likely to occur.

Sufficient thrust must be applied to the hammer to achieve optimum drilling rates. SH&B Reverse Circulation hammers produce significant energy which needs to be accommodated for when applying thrust to the hammer. Refer to hammer model data sheet for thread make up torque specifications.

As the hole gets deeper less thrust will be required as the drill string gets heavier. Eventually hold back will be required to prevent excessive weight on the percussion bit.

Hammer Breakout

When breaking a Hammer down, avoid placing breakout tools in the mid section of the cylinder (barrel). Recommended breakout points are 130mm from each end of cylinder. Wrap around chain type breakouts are recommended. (See diagram). When holding bits for breakout, use a secure plate or pot to grab the bit head, but never on the gauge row buttons.
This information is included with every Hammer purchase.

DO NOT APPLY HEAT OR DIRECT IMPACT TO HAMMER WHEN CRACKING JOINTS AS THIS TYPICALLY DAMAGES THE HAMMER.

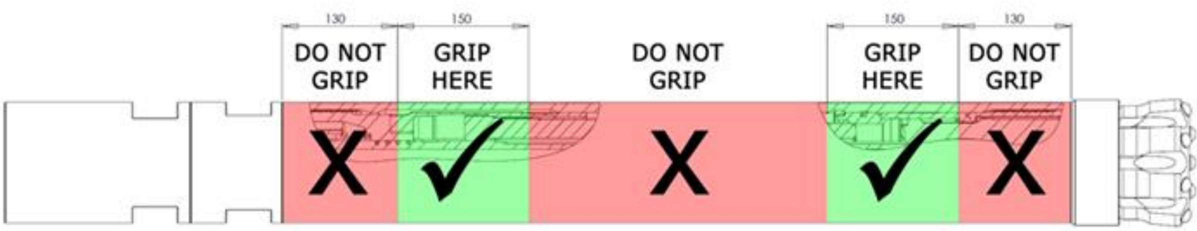


Figure 1: Gripping locations for ADHB Reverse Circulation Hammer.

Working Air Pressure

Maximum working air pressure is dependent on the volume of air supplied to the hammer at a particular pressure. When down feed weight is applied to the hammer the bit closes up on the piston. This moves the piston from flushing position to firing position and the hammer begins to cycle. If weight is removed then the bit drops and the piston returns to the flushing position.

To calculate maximum working air pressure, refer to the air consumption chart on all Airdrill RC Hammer Brochures. These figures apply to the new Hammers with air supply at ground level (sea level).

Factors that affect operating air pressure are:

- Compressor Volume capacity
- Water, foam injection
- Hole Depth
- Drilling below the water table
- Excessive oil injection
- Altitude (metres above sea level)

Weight on Bit

Optimum weight on bit will be the minimum down feed pressure required to maintain actual working air pressure. As this operation is normally performed at the surface with minimal drill string weight, adjustments need to be made for the additional weight of the pipe. The down feed pressures should be noted when obtaining actual working air pressure.

Rotation Speed

It is difficult to give a specific rotation speed for any particular bit size, as rotation is dependent on penetration. A guide of 2 rotations to 25 mm of penetration should be considered initially.

Formula for Rotation

RPM/MM per minute x MM/Minute ROP = Recommended RPM x Penetration

Example: Metric

- 2 RPMx300mm25mm of Penetration1 Minute
- 2 RPM x 300mm=600 25 = 24 RPM25

Example: Imperial

- 2 RPMx12 Inch1 Inch of Penetration1 Minute
- 2 RPM x 12 Inch=24 1 = 24 RPM1

This is a general recommendation. Certain ground conditions will require faster rotation, possibly up to 3 Rot/25mm. Rarely would slower rotation than 2 Rot/25mm be required. It is important not to increase rotational torque to achieve faster rotation. A general rule is that the larger diameter bits need slow rotation to protect the outer carbides.

It is best to begin with slow rotation until the hammer has reached maximum working air pressure and weight on bit is stabilised. Rotation should then be adjusted to match the penetration. Too fast will result in excessive wear on the carbides and stress on the splines, while too slow will cause the bit to bog down, stressing the carbides and shank.

Bit Rotation

The "RPM" of the drill string is important to achieve good percussion bit life and good penetration rates, over rotating can cause significant percussion bit damage whilst under rotation will affect the chip size of the sample and also penetration rates. When initially collaring a bit hole a rotation speed of between 40-50 rpm is recommended. Upon reaching the bed rock the following formula can be used as a starting point to determine the rpm required.

- In overburden or soft non-abrasive formations fast rotational speeds up to 40 to 50 rpm are necessary for better bottom hole cleaning and quick drilling rates with small diameter bits.
- In medium rock rotation speeds of 20 to 40 rpm can be used.
- In hard and abrasive formations slower rotation speeds of 10 to 25 rpm are used to fracture the rock and minimise abrasive wear
- Excessive rotational speeds will unduly wear bits and scrub button inserts prematurely. Too slow a rotation or excessive down pressure or weight can bury the buttons and force them to gouge against the rock as the bit rotates.
- Excessive wear and shearing of the buttons then occurs, with probable damage or subsequent failure of the threads, cylinder and drive sub. Buttons sheared due to excessive pull down or too slow rotation, fail in a characteristic way - refer to photograph.
- In both hard and soft ground aim for the hammer to penetrate smoothly at the rate of 10mm per drill pipe revolution.
- Continually adjust the feed and vary the rotational speed up or down as ground formation varies to ensure the hammer runs smoothly at peak air pressure.

Incorrect rotation speed

- Rough rotation can be caused by too much weight, banded rock formation or dull bits binding in the hole.
- If rotation stops and the hammer continues to operate the buttons will bury into the rock formation and the rotary head torque will cause high shear loads on the buttons.
- The hammer must be raised off the bottom quickly to prevent bit damage when this occurs.
- The down pressure and the rotational speed should be adjusted before drilling is resumed.
- Rotate the drill string at all times when the hammer and bit are being moved up or down the hole. Non-rotation can cause loss of a button due to intense local heating.

Rotation Torque Pressure

It is difficult to give a precise torque rating for any specific size drill bit. Minimum torque should be used to maintain working air pressure with correct rotation. This is done by adjusting weight on bit.

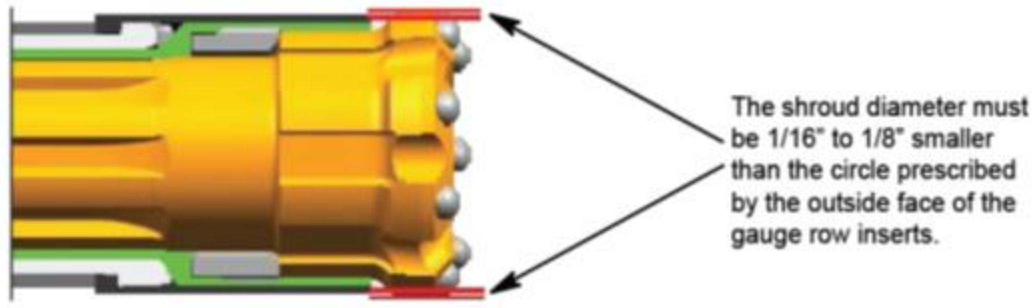
Torque rating can be obtained by monitoring the hydraulic rotation pressure gauge. It is important to monitor the rotation pressure, as an increase will indicate that the hammer is tightening in the hole.

Sleeve clearance

When setting sleeve to bit clearances a general rule of thumb is to keep the best seal in the hole as possible and run with at least a 1/16” clearance between the gauge row carbides of the bit and the outside diameter of the sleeve.

The purpose of running this clearance is to create the tightest seal possible whilst not binding in the hole and becoming stuck. This ensures the sample returns through the inner tubes whilst reducing the losses up the outside of the hole.

A tight seal will also help with minimising hole deviation and to keep pressure within the RC circuit thereby holding out water and returning accurate and dry samples



Drilling Techniques

There are many ways of drilling different types of ground conditions. Every driller has their own technique and method to combat adverse drilling conditions. There is no easy way to explain how to drill in certain ground types as conditions vary from hole to hole. It is an old saying that "every hole you drill is different". This is very true; however there are some basic methods to observe.

- The accurate recording and analysis of all drilling data (bit serial numbers, engine hours, metres, oil consumption, etc) is essential to enable the decisions that will give the best cost per drilled metre to be made.
- Learn the basics of your drilling rig. Air pressure, hydraulic pressure, what it is capable of.
- Learn as much as you can about your Reverse Circulation hammer and bits.
- Have a basic understanding of the geology you are likely to encounter in the area you are drilling. If you know the ground and understand the basic stratigraphy it will give you an idea of what to expect whilst drilling at certain depths and the type of materials you are likely to encounter i.e. iron ore, shale, clays, etc.
- Every hole is different, so treat it as such.
- Always watch the air pressure and hydraulic gauges.
- Watch for consistent sample coming through the return circuit.
- Maintain outside return to prevent down hole pressure build up.
- Only use drill additives, drilling foam and polymers when necessary.
- Listen to the hammer working. Once you get used to the way it sounds, you can pick up on ground condition changes and developments.
- Stay alert, it only takes a couple of seconds to get bogged.
- Take your time drilling the hole, as it only takes a couple of minutes to condition the hole at rod change, but a long time to dig out of a bog.
- In most cases an experienced driller will know why they are bogged, as a result of observing the conditions. Knowing why you are bogged will determine your first recovery method.
- Make sure the hammer is well lubricated before starting any attempts at recovery.
- If you had been injecting water, foam or polymers into the hammer, more hammer oil needs to be added to lubricate the internal parts prior to digging out of the hole.
- Always continue to use "AIR ON", "AIR OFF" while you are digging out of the hole as this will help by cooling the hammer and delivering more lubricant to the hammer.

- Having retrieved a bogged hammer, allow it to cool, then flush it with water and hammer oil prior to re-commencement of drilling. If the hammer shows any signs of excessive heating or deformation, it is recommended to break the hammer out for inspection of the internal parts.

DRILL BIT SPECIFICATIONS

Bit Maintenance

- Bit wear and performance is dependent on ground conditions and operating procedure. Bits need regular sharpening to achieve full performance. SH&B recommend sharpening when a 1/3rd of the button profile is flat. The profile should be returned as close as possible to the original shape. In certain conditions the body around the buttons will also need to be addressed. The selection of correct grade of carbide is also important.
- The spline and retention areas should be inspected regularly. Galling on the drive surface will lead to premature bit failure. Excessive rotation torque and down feed weight will cause spline galling.
- The bit head shoulder mushrooms over time. This section may need to be dressed with a light grinder to avoid air restriction.

Bit Selection

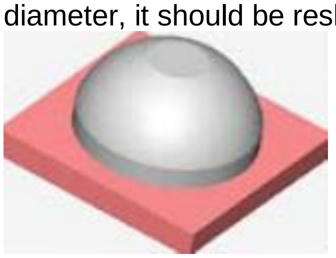
- Incorrect drill bit selection can have a detrimental effect on the bit and also a hammers performance.
- SH&B offer a range of cutting structures to suit most ground conditions.
- Soft to medium ground conditions
  - Drop Centre (DCFE), 4 face flushing grooves
  - Variants
    - Full Ballistic (FB)
    - Semi Ballistic (SB)
- Hard ground conditions
  - Drop Centre (DC), 2 face flushing grooves

Drill bit resharp/reshape guidelines

Carbides must be resharpened when:

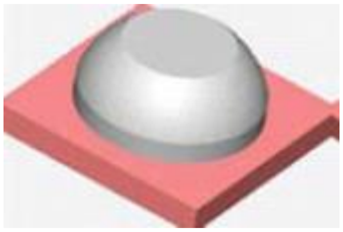
- A drop in penetration is first noticed
- A wear flat one third (1/3) of the carbide diameter develops
- If ‘snake skin’ cracking is observed on the carbide surface

When a wear flat is 1/3 of button
diameter, it should be resharpened.



A wear flat 1/2 of button diameter indicates
too long an interval between sharpening events.

A wear flat of this magnitude indicates the bit has been grossly over-run and failure is likely to occur.



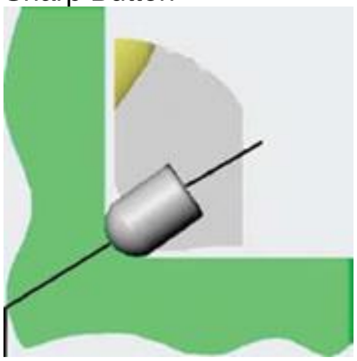
IMPORTANT: When resharpening buttons, make every attempt to restore their original profile. Buttons with a flat profile dramatically reduce the hammer/bit efficiency to fracture rock.

Characteristics of tungsten carbide buttons

- Immensely strong in compression loading;
- Relatively weak in shear (side) loading;

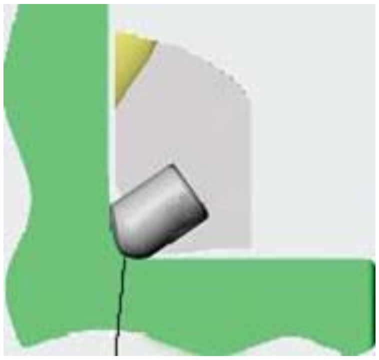
Extremely sensitive to stress concentrators such as grooves & snake skin/heat check surface cracks.

Sharp Button



The design and characteristics of a bit face is such that in operation the gauge buttons are subject, in the main, to compressive loading.

Worn Button



The generation of medium to large wear flats
completely changes the direction of the applied forces from compressive loading to shear loading.

Sheared Button

Shear (side) loading of carbide buttons, under the fluctuating dynamics of drilling, can ultimately result in button breakage.

Button breakage due to shear loading is one of the most common modes of gauge row carbide failure.

Bit insert grinding/reshaping

To assure optimum performance levels from SH&B reverse circulation bits, it is advisable to reshape the tungsten carbide inserts as they wear. After a period of drilling, the buttons tend to develop a flat surface, rather than the original ovoid-rounded shape, and this can slow penetration rates and shorten life. This “flat” enlarges the longer the bit drills. Inspection and experience (noting when penetration rates tend to decrease) can indicate when reshaping should be performed.

When to reshape
Experience has indicated the following as guidelines for resharpening buttons in order to retain drilling efficiency and maximise bit life. Overrun bits will result in high stresses imposed on the bit and may result in button breakages, face “chunking” and excessive spline stress.

When to reshape buttons

- A drop in penetration is first noticed.
- A wear flat one-third (1/3rd) of button diameter develops.
- If snake skin cracking is observed on wear surface.
- If stress chipping occurs, particularly on gauge buttons.

Grinding/reshaping procedure

- To restore the bit to maximum drilling efficiency, the approximate original shape of the button should be restored.
- The use of an automated or manual rotary mounted point grinder is advisable (20,000 – 25,000 RPM) with a shaped vitrified silicon carbide grinding wheel of 60 to 80 grit and J to L hardness. Diamond wheels with coolant application can also be used.
- When using a manual tool grind from the centre of the flat, rolling the wheel down the side of the button to remove the edge. Continue until the button is reshaped to an ovoid or rounded configuration.
- The reshaped button will be somewhat smaller than when new, but drilling efficiency will be restored. Although the gauge buttons are the most important to reshape because they are subject to higher wear, penetration rates will also be helped if the face button configurations are restored.
- It is recommended that face buttons be reshaped each time the gauge buttons are ground, even though the face buttons may not have worn to the same extent as the gauge buttons.

Before Resharpen

After Resharpen