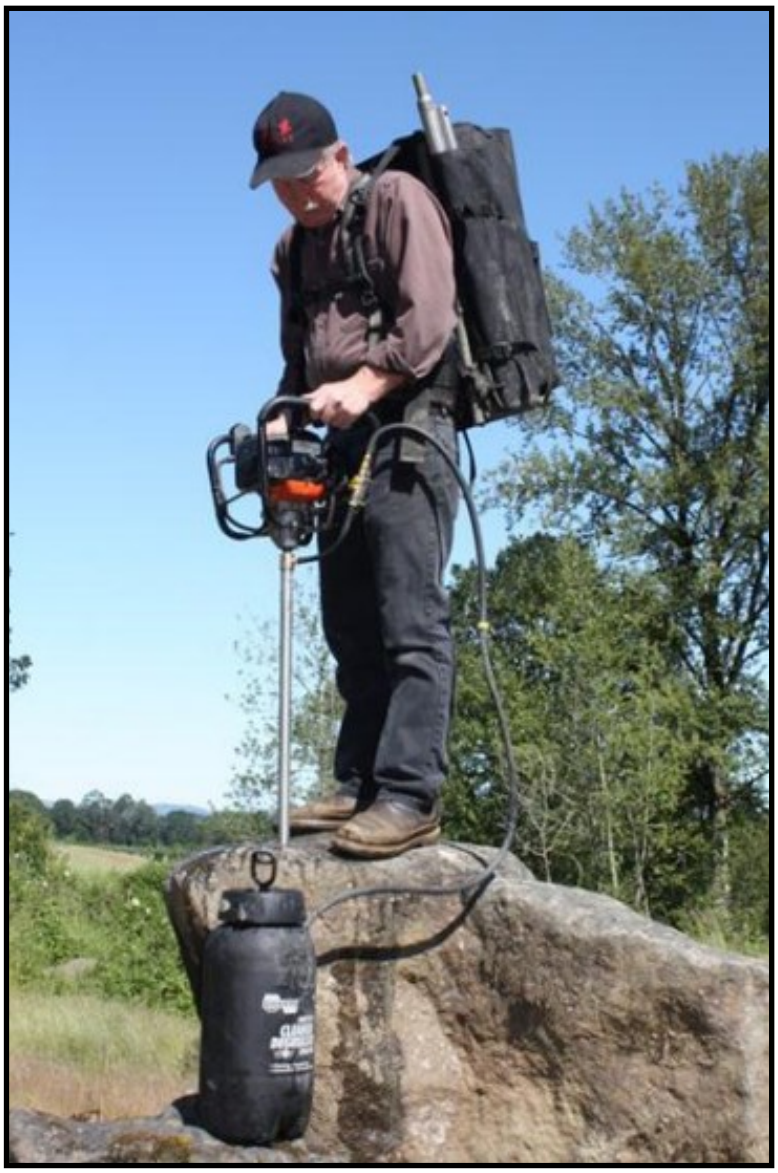
SHAW PORTABLE CORE DRILL
OPERATION & MAINTENANCE



BACKPACK

All components of a basic Shaw portable core drill kit can be carried in its frame backpack as a complete kit weighing about 20 kg (44 lbs). The backpack itself has several main straps which must be adjusted to fit the user: one for adjustment for wearer torso length, two at the sides of the user's chest for snugness to the body and pack positioning, and a hip belt over the wearer's waist.

back lenght adjustment

hip belt

shoulder strap

Adjustments of belts and straps ought to result in a pack which exerts its weight primarily over the wearers hips rather than on his or her shoulders. The pack should be snug to the body, but not uncomfortably tight, and ride as high as possible on the wearers back.

ENGINE DRILL

When the loaded Shaw portable core drill pack is opened the first item to appear is the engine drill.

The Kawasaki TJ53E engine requires two stroke engine oil in regular gasoline in a ratio of 50:1. For example; 20 ml of oil should be added to 1 L of gasoline or 2.6 oz of oil to 1 US gallon of gasoline.

Tables of mixing quantities are sometimes printed on oil container labels. Failure to provide a sufficient amount of oil to the gasoline will cause overheating and destruction of the engine. Oil in the fuel is the only lubrication for the piston. Using too much oil will cause the engine to produce black oily smoke because combustion will be incomplete.

From the many available brands of 2 stroke engine oils available, we strongly recommend using the products of a leading brand because usage of low quality and/or incompatible oils may result in destruction of the engine. Fully-synthetic oils are highly preferable as they are superior as lubricants. Please also note that deliberate, repeated, hard hammering of the Shaw drill string against rock may fracture the Kawasaki engine volant cap.

Before starting the engine, push the flexible rubber priming bulb behind the carburetor several times to pump fuel from the fuel tank to the carburetor. Then push the choke lever forward to the (closed) position. Pull the start cord several times until the engine fires a little. Let the engine warm itself for a moment then push the choke lever to the half choke position. When running smoothly, push the choke lever down. Run the engine for a minute to warm it before drilling. When under load the engine ought to be run at full throttle and at high angular velocity (rpm). Low engine rpm (lugging) causes slippage of the centrifugal clutch and failure of air cooling by the fan blades ahead of the engine.

Maintenance requirements for the engine drill include periodic replacement of spark plug and air filter.

WATER SUPPLY SYSTEMS

Water from a compression bottle (hand) or 12V pump must be supplied to the drill string and diamond bit through a valve, hose and water swivel. The ball valve mounted on the engine drill handle can be nicely adjusted to serve drilling requirements without wasting water. It is often best to open this valve completely when using the loose materials bit for maximum flushing action. Connections with the water hose are made by pulling back the spring loaded fitting behind the valve itself.

The compression bottles of the backpack drilling system sometimes require patience. A head space of air is required over the water surface in a filled bottle which can be compressed to drive out the water to the drill. Sometimes the screw cap must be tightened more than once and forcefully to achieve a seal of the large o-ring under the cap. The hand pump must be used with diligence until real resistance indicates a sufficient compression of air.

The 12V pump requires little maintenance. Batteries of the standard lead acid or lithium ion types may be used.

water swivel

valve

compression bottle

12V pump &
water jug

Inside the swivel sleeve are six Teflon impregnated rotational quad rings. These quad rings are lubricated with silicone/lithium grease. Both quad rings and grease must be replaced at intervals or when water leaks from the swivel. Silt in the water supply can cause quad ring failure. To perform quad ring replacement, remove the water swivel from the engine drill spindle with a pair of wrenches, then disassemble the swivel itself with the use of retaining ring pliers.

dis-assembled water swivel

quad rings in water swivel

quad ring removal with dental tool

Replace the worn rings with new ones, liberally lubricating both the water swivel shaft and sleeve with siliconelithium grease. Re-assemble the swivel and thread it back onto the engine spindle by hand. Remember to apply Teflon tape on the spindle threads.

Larger water tanks with electric on-demand pumps are greatly preferable to compression bottles as they provide much more water volume and a steady, high pressure. Normally these larger tanks must be carried on vehicles of some sort such as ATVs, pickups or boats which can also supply 12V power. Alternatively the pump can be used with a battery and other sources of water such as jerry cans or a body of water itself such as a creek or lake .

SABER TYPE CORE BITS

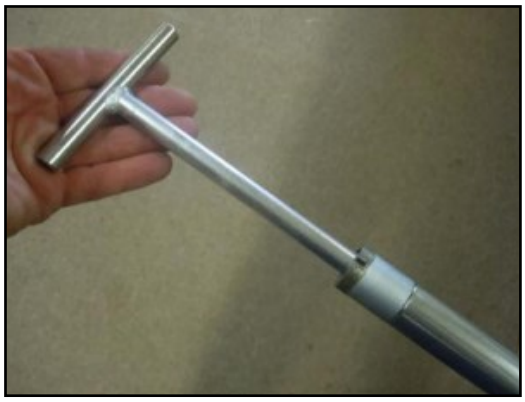
Shaw Tool uses a type of diamond core bit called the “Sabre” in sintered diamond segments are mounted vertically (long axis) in the bit pedestal offer. The many shallow gullets between the segments provide good circulation of water to these limited grinding surfaces. Gullets must be kept open by filing of the metal between the segments with the regular use of a small 4 mm round file.

The sabre bit is much faster cutting than conventional bits but requires religious filing of the gullets.

When a Shaw bit is finally worn out it must be removed and replaced. Bits can become tightly bound in the core barrel thread. The best way of removing a stubbornly bound bit is by turning it out with the use of a pipe wrench and the T handle.

CORE BARREL

As mentioned before the core barrel (threaded lead) holds the diamond bit and receives and holds rock cores. It is made to release cores from the back. Cores in the lead may be dislodged if temporarily stuck by pushing them backward from the bit mouth toward the tail with the use of a knockout rod.



EXTENSION

Extensions are the main building units of the drill string. They couple and de-couple very easily if male and female mated parts of the bayonet couplings are clean and lubricated with grease. Coupling is done with a simple push-and-turn motion and de-coupling is done with a turn-and-pull one.

Coupling with an initial turning motion - a natural inclination - actually causes o-rings to loop up and be cut. A simple push and turn is all that is wanted. When removing a drill string from a boring, it is best to take it apart in small pieces of two or three extensions each because longer pieces of drill string are unwieldy and can be bent.

LOOSE MATERIALS BIT

The water-injected, loose materials bit included in our standard kits may be used for boring soft materials including rotted rock, clay, soil, muskeg, muck and sand. Soils with clay components often naturally produce sleeved borings but well sorted sand or even heaving sand may be sleeved with commercially available bentonite which is a dry, natural, swelling clay mixture (smectites) which, upon hydration produce an oatmeal-like paste useful for sealing and strengthening boring sidewalls.

The loose materials bit works by disturbing soft materials with its carbide blade, mixing the disturbed cuttings with water to form a dilute mixture of the material (mud) and forcing it under pressure up the boring annulus to the ground surface (or a fracture zone intersecting the boring). The volume of water to use with this bit depends on the drilling circumstances but the usual rule is that more water, and at high pressure is better than too little. Hard clays are often the most difficult of all to deal with; it is best to proceed slowly in drilling this material and to use lots of water in order to keep the bit free of sticky clay buildup.

With skill and patience it has been found that the loose materials bit can also sometimes be used successfully with the addition of dry bentonite to make sleeved borings in wet, flowing (heaving) sand. The way this is done is by pouring dry bentonite chunks into the boring or by smearing largely dry but hydrating dry bentonite powder onto the flights of the loose materials bit. The swelling, gelling material is forced onto the sidewalls by the rotating bit where it mixes with water and sand to form a stiff, relatively stable paste.

“T” HANDLE

The T handle is used to lift, push or turn the drill string by hand. It is needed especially in sampling rock core with the core breaker and core catcher. When a drill bit gets stuck the T handle becomes an important tool for twisting free. Like drill string components this tool must be kept clean and lubricated.

CORE BREAKER

The core breaker is used to snap off rock core which remains intact in a rock boring. Acting as both hammer and a wedge, cores of brittle rock will break at some point in their length when struck a sharp blow with the core breaker. Once broken, the core pieces can be captured with the core catcher. It is important that the breaker vent hole be kept clear to avoid piston effects in the boring.

CORE CATCHER

The Shaw core catcher grips pieces of rock core for retrieval. The spring steel tip of the catcher has three inward bent tabs. Once the catcher has been pushed over the top of the core the tabs grip the core very tightly. All retrieved cores ought to be pushed from the catcher tip backward toward the tail with the knockout rod. It is a natural inclination to pull rock cores forward from the catcher mouth but this will cause the catcher tabs to break.

KNOCKOUT ROD

A small but necessary tool, the knockout rod is needed for punching cores or soil lodged in the bit mouth backward toward the tail of the core barrel (threaded lead). Once cores or soil have been forced out then the knockout rod can be used to scrape out and clean away clay smeared on the inside of the core barrel (threaded lead). Be careful not to cut your hand on the core barrel edge when punching core samples with the knockout rod.

25 mm x 41 mm ADAPTOR

The 25 mm x 41 mm adaptor is used in the rare case where a 25 mm part is coupled to a 41 mm drill string. This is necessary for soil sampling with a 41 mm kit of equipment because the Shaw soil sampler must be small for adequate hand penetration. The adaptor can be used anywhere in the drill string from the handle onward. The o-rings of the male part must be periodically replaced as they dry out and crack.

SOIL SAMPLER

The Shaw soil sampler is very nicely engineered for ease of use and for the exceptional quality of its undisturbed samples. The soil sampler is pushed - not turned - into soft materials. This gentle but forceful method produces long, undisturbed soil samples with stratigraphic orientation, color, moisture content and chemical integrity exceptionally well preserved for analysis or archiving. Cleaning of the sampler after each sampling event is critical.

CONSUMABLES

Other components of Shaw drill kits include an open-end spanner and spark plug wrench, a tube of silicone/lithium grease, Buna-N rubber o-rings, 5/32” (4 mm) round file, air filter, spark plug, and engine manual. Call us if you need more of anything.

DRILLING IN HARD ROCK

To avoid “walking” of the diamond core bit on hard rock begin by cutting a small groove in the rock surface by holding the bit at an angle to the vertical.

Once cut, the rock surface groove acts as an anchor point. From this the bit can be slowly rotated to the vertica for the boring. Once the ring cut is made, set the water valve for the minimum amount of water volume needed. The faster the cutting rate the more water will be needed. A lot of water is needed to avoid bit waterway clogging in clay.

One of the greatest problems in rock drilling is loss of water circulation in voids and fractures. With loss of circulation, the boring above the leak will be left without lubrication. Bentonite well mixed in drilling water can be effective in sealing leaks. Baroid Company www.baroididp.com through its many worldwide distributors offers a variety of drilling fluid additives.

DRILLING IN SOFT MATERIALS

Many field investigations require penetration and/or sampling of soil. Simple penetration is best done with the loose materials bit. Undisturbed soil sampling is best done with the Shaw push-type soil sampler. The diamond core bit can be used to penetrate and sample overburden rocks or boulders.

As mentioned above the loose materials bit can easily penetrate soft materials including soft rocks like shale and weathered rock of many types. As this kind of bit grinds away everything in its path in theory it need not be withdrawn as its boring proceeds. In practice, however, the LMB is often fouled by clay and must be withdrawn for cleaning. Use of surfactants in the drilling fluid helps to prevent bit fouling by suspending clay platelets which otherwise accumulate on bit surface. Baroid can help with the bit fouling problem.

Many subsurface materials are heterogeneous including both hard materials and soft materials. By alternate use of the LMB and diamond core bits most materials can be both penetrated and sampled. This alternation is easy to do with Shaw portable equipment as both LMB and diamond core bits of 25 mm or 41 mm OD are of the same outside diameter and thus entirely interchangeable and because the bayonet couplings are very easy to couple and de-couple.

DRILLING IN CONFINED SPACES

For core drilling in confined spaces such as mineshafts without ventilation it is far the safest plan to use an electric drill motor rather than a gasoline engine. Gasoline engine CO2 and CO emissions can be lethal. The recommended electric motor (below) is the High Speed (1750 rpm) Milwaukie Super-Hawg. This electric motor is powerful although heavier than the Kawasaki TJ53E two stroke engine. Shaw Tool provides an adaptor for mating its water swivel to the Milwaukie drill chuck. As the Milwaukie electric drill lacks a centrifugal clutch, it is difficult to control if the working bit or drill string suddenly binds Kawasaki TJ53E during drilling.

DEEP DRILLING

Deeper (>10m) borings can be made with Shaw Tool equipment. The primary limiting factor in this process is the weight of the drill string required. Shaw Tool offers a fairly lightweight (20 lbs., 9 kg.) tripod which can be used with light block and tackle to make lifting heavy drill strings easier. Use the handle to make connection to the female coupling (upper) end of the drill string.

FREQUENTLY ASKED QUESTIONS

Question: Why is my engine hard to start?

Answer: There are several possibilities:

- The on-switch is in the off position.
- The drill is hot (eg. from the sun) which can cause the gasoline in it's fuel lines to vaporize. Use the manual fuel pump (yellow squeeze bulb) to send liquid fuel to the carburetor.
- The gasoline to two-stroke engine oil mixture is too rich, which fouls the spark plug. Discard the bad fuel from the tank and fuel lines and replace it with a good batch. Use fully synthetic two-stroke enine oil in the necessary ratio of 50 parts regular gasoline to 1 part oil: 1 liter gasoline with 20 ml oil or 1 gallon gasoline with 2.6 ounces oil.
- The gasoiline to two-stroke oil mixture is too lean, which has probably caused the engine to be ruined.
- The carburetor is flooded with fuel. Remove the spark plug, pull the start cord several times, replace the plug and try again.

Question: Why does my drill string get stuck?

Answer: Almost always drill string sticking is caused by loss of drilling fluid (water) circulation to the working diamond bit. If the engine speed slows noticeably during drilling or if the drilling fluid fails to emerge from the boring, immediately stop drilling and remove the drill string from the boring and clean the blocked bit.

Question: Why do the drill string male coupling o-rings sometimes fail?

Answer: The o-rings are not sufficiently greased (dry) or they are dirty (clay buildup).

Question: Why does my diamond bit fail to cut rock?

Answer:

- The bit gullets need filing.
- The bit needs dressing by running it fast in dry sand to expose the diamond crystals above the bronze matrix.
- The bit is glazed "slicked" by clay minerals like serpentinite. Dressing is needed.