

Operating Instructions

16" Multi Helix Spiral
Secondary Concentrator

Version 1.10

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Operating Instructions

16" Reverse Helix Spiral Cleaner

Version 1.10

Assembly:

A stand (frame) is provided to give the Helix Spiral a comfortable operating height. However, you can mount the Spiral in various ways depending on where and how you want to use it. To assemble the stand, just weld the 4 legs to the upper and lower rectangular frames, making sure the leg with the welded jack support is in the correct position.



1. Install the triangular shaped **tailings discharge trough** (photo right) by lifting up the back end of the spiral tube.
2. Slip the belts over the gearbox pulley and align them 90 degrees with the tube. Tighten the belts by adjusting the position of the motor/gearbox. The belts only need to be snug with no slack, do not over tighten the belts.
3. Assemble the one piece **feed bin/feed tube** as shown in the photo below.
4. Install the spray bar assembly.



5. If your Spiral unit has a filter, hook up your water supply to the inlet side. Hook up the outlet side to the manifold using the hose provided. If you don't use a filter, connect your water supply (standard garden hose) direct to the bottom fitting of the spray bar manifold. Connect the hose for the spray head valve to the middle fitting and the wash hose to the top fitting. (note: The Helix disc filter shown here is mounted upside down which makes it easier to disassemble and clean the discs.)

6. Bolt up the concentrate trough and concentrate bin as shown in the photo above. You are now ready to go!



Requirements

Electricity: Your unit was shipped with either a 110v or 220v 1/2 hp. electric motor which runs on normal current. If you use a generator dedicated to run the Spiral, we recommend a minimum of 2.5KW. The electric motor is rated at plus or minus 10% of the rated current, so if you are running on a generator, make sure the voltage output falls within this range.

Water: Depending on the type of ore / concentrate, you may need as much as 40 psi of pressure and 10-20 gpm. If you're using a portable gas or diesel powered water pump, a 1.5" to 2" pump with the output pressure and volume mentioned here is recommended. Most urban water systems will meet these requirements.

The Helix Spiral needs a water source clean enough so as not to plug up the spray heads. Well water or a urban water supply is fine. The water does not have to be crystal clear, just free of particles of 50-100 microns and larger. Clear water does help to observe the ore and concentrate during operation but is not required.

Capacity and Ore Characteristics

Capacity: The production capacity of the Helix Spiral is rated between 1 and 2 tons/hour depending on the matrix of the ore or concentrate you are processing. Heavy ores require a slower feed and therefore, less production capacity. Lighter ores can be fed faster resulting in a higher production capacity. A heavy black sand primary concentrate requires a slower feed to achieve good separation of the heavy contaminants from the gold particles; as opposed to material with a small percentage of heavy particles. Ore with a high percentage of gangue material (host material), or milled ores are examples of light material where contaminants are easily discharged.

Particle size: The capacity rating of the Helix Spiral is based on ¼" minus ore size. However, you can run practically any type of material through the unit, from head ore to finely ground milled ores. Logically, the feed rate and production capacity will vary, but you will achieve a high recovery from most any type of ore or concentrate, even the heaviest types of black sand concentrates.



Basic Functions

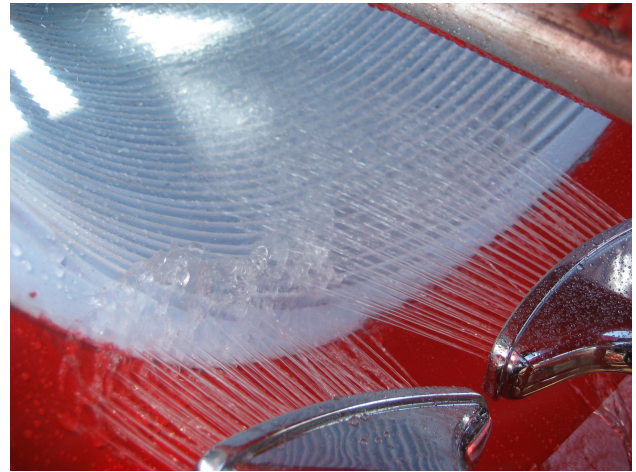


Angle - Adjust the angle of the Spiral tube using the leveling jack leaving a 10 inch gap between the two hinged frames. This is your starting point, and in many cases will be the normal operating setting for most ores and concentrates.

Raising the tube will cause a faster discharge of contaminants which allows you to feed the Spiral faster. For example, a higher angle may be desired for simple placer ores with coarse gold where the gangue material easily separates from the heavy coarse gold particles. However, too steep of an angle will cause fine gold particles to float out with the discharge. So if you choose to raise the angle, sample the discharge to see if you are losing gold particles.

An angle setting of less than 10 inches is normally used only for cleaning out the Spiral. However a slightly lower angle can be used with fine, light ores and concentrates with extra fine gold particles (milled ores for example). In this scenario, a slower feed rate is required.

Spray bar - Adjust to maintain the maximum horizontal spray pattern. For the most part, just enough water to wash the material and keep the material from climbing up too high on the side of the tube.



Spray head position - The position of the spray heads is very important and are pre-set here at our shop. For future reference, the photos above show the natural position of the spray heads.

Notice the water stream from the **left spray head** lands on the very front lip of the liner, just touching the first and second riffle. This forces the material to stay in the riffles, not allowing it to discharge.

The water stream from the **right spray head** lands inside the tube covering the first 8-10 riffles. It is the right spray head that does the principal “work” of separating heavy and light particles

Spray head water flow (control) - The twin spray heads are controlled with a single valve. Opening and closing the valve in slight increments has a dramatic effect on how the contaminants separate from the heavy particles.



Feeding - 5 gallon buckets are the most practical method to feed the Helix Spiral. The bucket stays in position and held by the 2 hooks welded inside the feed bin.



Catchment: Using 2 gold pans, one larger than the other is the most practical way to work with the Spiral. The larger pan on the bottom is to catch the overflow of concentrate while you are working with the smaller pan. The smaller “finish pan” is for catching and checking the quality of the concentrate as it flows out, and for sampling the discharge.

Operation

Operation of the Helix Spiral is very simple. With some practice and observing how your particular ore behaves, you will become an expert in no time. Once you understand how the Spiral works you can make it do what you want it to do. Don't be afraid to play with it! There are no factory settings or adjustments that work for all ore types, which is the essential benefit of the Helix Spiral. You can adjust it to a wide range of ores and concentrates. Every ore is different, so again, observing how your ore behaves is the key. With practice, you will achieve very high recovery rates and a quality concentrate product that can be smelted.

Operation and recovery performance are a function of:

- (A) Feed rate (how fast you feed the material)
- (B) Adjustment of the "spray head" water volume
- (C) Adjustment of the "spray bar" water volume
- (D) Adjustment of the position (angle) of the Spiral unit (the tube itself).

Before you start concentrating your first batch of gold bearing ore, it's sometimes a good idea to get a feel for the controls (valves) by practicing with any type of alluvial material. Even better, screen down some of your head ore (or just take out the bigger rocks, and start feeding it through the Spiral. Observe how the water affects the separation of particles by size and weight. How it separates the gangue (host material) from the black sands will be the most obvious. Keep feeding and practicing until you have a basic understanding of the controls and how the ore behaves. If you want to practice on your gold bearing ore, simply place a bucket at the discharge end to capture values that may escape out the end.

Fundamentals

Spray bar - Angle adjustment: For the most part, once you set the spray bar and operating height (tube angle), you will use only the spray heads to control and manipulate the separation of gold particles from the host contaminants. Consider the tube position (angle) and spray bar setting as the base adjustments; and the spray heads as the "fine tuning" adjustment.

Spray head adjustment: By increasing and decreasing the water volume of the 2 spray heads you will "push back" the lighter gangue material and contaminants until they are caught in the water current and discharged out the back - but at the same time, allowing the heavier particles trapped in the riffles to come forward or "screwed in reverse (uphill)" and fall into the concentrate trough down to the concentrate bin. This separation of "lights" and "heavies" using the spray heads is the essence of how the Helix Spiral works.

Gravity separation begins in the middle section of the tube, the moment the material enters. However, it is within the first 8-10 riffles in the upper portion of the tube where heavy particle separation takes place. With practice and careful observation, you will see how the particles separate in the upper section of the tube. Heavy particles (gold and heavy metals and minerals) will immediately start to settle down in the riffles once fed into the middle section of the tube, but once they reach the first 8-10 riffles, they have settled down into the very bottom of the riffles where they are trapped and screwed out against the force of the spray head water. The combination of the incline of the tube, the shape of the riffle groove and the slow screwing motion is what allows the recovery of even extra fine gold particles.

There are two dynamics that have a substantial affect on physical separation of particles other than their weight (specific gravity). The first being "particles of similar weight". Particles of similar weight naturally tend to concentrate together. The other dynamic is particle size. Concentrating "like sized particles" increases the separation efficiency (as opposed to concentration and separation of particles of varying sizes). Large particles tend to obstruct small particles in any type of gravity separation. These two dynamics are also the biggest factor in the need for multiple passes. This applies to both natural alluvial and milled ores.

Loose Cut / Tight Cut: We use this term to describe the effect of the spray head water volume, and resulting degree of separation. "Loosening the cut" by lowering the spray head volume allows a more generous amount of host material (gangue) to come forward along with the gold and heavy particles. Loose cuts are generally used when gold particles are very fine and the host ore is not particularly heavy. A loose cut is also called a "rougner cut" or "rougner pass" i.e. an initial pass to create a primary concentrate. Tightening the cut by increasing the spray head volume creates a more dramatic separation effect. Tighter cuts are needed when separating gold particles from heavy contaminants such as black sands for example.

To Start

Step 1. With the leveling jack, adjust the hinged frame to create a 10" gap between the upper and lower frames - Turn on the supply water - Open the spray bar valve until you see the water stream at it's max horizontal level - Now open the valve for the 2 spray heads. Your actual spray head volume depends on your water supply but start with opening the valve 3/4 of the way and make adjustments from there.

Step 2. Start feeding material into the feed bin, mixing it with the supplied water hose. Observe how the ore begins to behave and start to classify in the riffles. It will take a few minutes for the initial quantity of material to settle down in the riffles and start classifying up and down the length of the tube - but in the meantime, do not allow any material to come all the way forward and fall into the cons trough. You need to "hold back" the material by adjusting the spray heads, keeping the material pushed back just past the second or third riffle. The left spray is positioned just for that purpose so observe the left spray head while you are adjusting the volume. Be careful not to set the spray head volume too high as it may cause fine gold particles to discharge out the back. Maintain this temporary spray head setting until the tube is "full" and you start seeing material begin to discharge out the rear. It takes about a half of a 5 gallon bucket to fill the tube. You can also tell if the tube is full by listening for a "pinging sound" of the larger particles falling into the discharge trough.

Note: this initial setting of the spray heads serves as your first reference point. We call it the "hold back" point. Your operational spray head volume will be determined once you start working the ore and observe how your particular ore behaves under continuous feed.

Step 3. Now continue feeding while slowly turning the spray head volume down to allow the heavier particles to come forward and discharge down the concentrate trough. You should see gold and heavier particles that have congregated in the forward riffles. The first 10 riffles or so is where the heavy particles will congregate. Experiment with the spray heads, raising and lowering the volume and observe how your ore behaves. Don't be afraid to experiment. Practice is the key to understanding how the Spiral works with your particular ore. Each time you adjust the spray head volume, observe the gold and heavy particles coming forward and compare with what may be floating out the rear discharge. Sample the discharge with your gold pan each time you increase or decrease the spray head volume until you get to know your settings and ore behavior. If you see an unacceptable amount of gold particles being discharged than your spray head volume is too high. A few gold particles coming out the discharge now and then is normal. In mining, we call this an acceptable loss. Achieving a 98%-99% recovery of particles down to 100 mesh is expected using the Helix Spiral, but not 100%. You will capture particles down to 200 mesh but of a lesser percentage. It all depends on your type of ore.

If you stop or interrupt the feed momentarily just keep in mind that once you resume, you must fill the tube as described in Step 2.

About Feeding: You can feed the Spiral in batches or set it up for continuous feed in a continuous circuit. The feed bin provided is designed for batch feeding with buckets. 5 gallon buckets are the most practical method but you can feed the Spiral using any method you like. For best results, you want a uniform, steady feed of dry material and water (consistent slurry) entering the feed tube. Gold and heavy particles concentrate better if the feed is uniform. Just feed the dry material slowly into the bin, mixing it with water. Once you get to know how the Spiral works, you can increase or decrease the feed accordingly. The most important detail about feeding is to not "over feed". You can judge by looking down the tube at the end, where material is discharged. If the material is climbing up too high on the sidewall then you need to slow down the feed. The material should climb up high enough just to discharge, about an inch above the rim.

Cleaning out the Helix Spiral: Between batches, you have the option to clean out the Spiral to get any remaining concentrate and gold left inside the tube. If you are running a series of bulk primary batches, it's not necessary to clean out the tube between batches. However, it is recommended to clean out the tube before you process a "final pass" to produce a final product. To clean out the tube, simply lower the frame using the leveling jack and turn off the spray heads. Leave the spray bar water running to wash out the remaining material. Place a gold pan in the concentrate bin to capture and save the "clean-out concentrate", what we call the middlings or "mids".

Final concentrate - To finish off your product, in preparation for the sale of your concentrate or for smelting, dry your final product on a hot plate and then spread it in a thin layer on a plate or deep bowl with a flat bottom. Demagnetize it by waving a small hand magnet just above the surface (placing the magnet inside a plastic bag helps clean off the contaminants). True "earth magnets" are a bit expensive but worth the investment if you are trying to achieve a top quality smelting grade product and when your ore has a high percentage of magnetics.

Multiple passes (re-concentrating)

Depending on the type of ore concentrate you are processing, multiple passes may be required to achieve a smelting grade product. At times, a single pass will do the job, however, as many as three passes might be required, particularly with fine milled ores. The Helix Spiral concentrates at a very high ratio and you will notice a great reduction in volume on the first pass. In the beginning, as you are getting familiar with how the Spiral works, use a looser cut. With practice, you will become more proficient at using a tighter setting and thus, reduce the number of passes to achieve a final product. As a general rule, you will use a slightly tighter cut for each pass. Whether it requires two or more passes, your final cut should produce a 90% + gold product, ready for smelting.

If you are using multiple passes to achieve the desired product, run the entire batch before re-concentrating.

First pass: Use a loose cut to produce a “primary concentrate”. An example of the type of product you want to achieve as a primary concentrate would be: all the gold, roughly 80% of the heavy minerals and black sands, and roughly 10%-20% of the gangue material (lighter host material). In other words, set the spray head volume just enough to allow a small percentage of gangue material to come forward (and all the heavies will follow). Another indicator is a visual comparison between the percentage of black sands coming forward and percentage of black sands being discharged (use a small finish pan for this so you can sample the discharge).

Second pass: Turn up the spray heads slightly from the previous setting but use the same principal as the first pass by observing how your ore behaves. The second pass, or “secondary concentrate” should achieve separation of: all the gold, a much smaller percentage of the heavy minerals and black sands, and no gangue material.

Third pass: You can decide whether or not to turn up the spray head volume on the third pass. Chances are that you will need to but it depends on the type of ore and the quality of the secondary concentrate you produced in the previous pass. If your secondary concentrate has a large percentage of black sands or heavy minerals, increasing the spray head pressure will be required. For your third pass, you want to separate: all the gold but only a very small percentage of heavy minerals / metals and black sands. You should achieve a “salt and pepper” product, ready for smelting.

Note: If you experience an unacceptable loss of gold particles out the discharge, it is normally due to excessive water volume or from feeding too fast.

Getting to know the matrix of your ore is important. The various particles of minerals and metals that make up your particular ore all have physical characteristics and can be recognized by their size, shape and color. Most of which you can see with the naked eye once they are washed. Recognizing these visual characteristics helps you understand their behavior as you are working with the Spiral.

Note: Our Low-G Horizontal Centrifuge (primary concentrator) concentrates at a very high ratio, just like the Helix Spiral. The Centrifuge will give you a high quality concentrate and usually requires only one pass with the Helix Spiral to achieve a smelting grade product. Both of our concentrators were designed for this purpose, to achieve a high volume reduction.

Ores and Concentrates

As mentioned previously, it is entirely possible to concentrate certain ores with a single pass and achieve a smelting grade product; while more complex ores and concentrates may require re-concentration. Simple ores such as classic river placer ores with coarse gold normally require only a single pass. Stubborn ores with a high percentage of black sands, iron, hematite, heavy minerals; and fine gold liberated from milled ores will require re-concentration. With this in mind, you can still expect to achieve a smelting grade product, even with sulfide ores. There are exceptions however to physical concentration of certain highly mineralized milled ores that do not lend to physical concentration, and in these cases, only chemical recovery will produce worthwhile results.

Specific gravity - refers to the density (weight) of a substance relative to the density of water, with water having a specific gravity of 1. Most milled rock (the host rock) is very light having a specific gravity of 2-3. Natural blond sands and gangue material have a specific gravity in the range of 2-4. The lighter weight black sands have a specific gravity of around 4 and the heavier black sands and magnetite are in the range of 5 to 6. Iron is around 7. Lead is 11. Mercury is around 13. Gold has a specific gravity of 19. Silver is 10 and Platinum is 21.

Ores and Concentrates (continued)

Alluvial ores

Primary concentrates: In a commercial mining operation, “washed and classified alluvial ores” are then concentrated in two general phases to work down the material volume into a final product i.e. “primary” and “secondary” concentration. At times, there is even a tertiary phase. The Helix Spiral functions mostly as a “secondary” concentrator (secondary reduction) processing concentrates from a rougher type sluice, primary jig (rougher jig) or any other primary concentration method. However, on a small scale, the Helix Spiral can serve as your one and only concentrating device simply by re-concentrating the ore down until you achieve a smelting grade product. You will not need any other type of concentrator such as finish tables, spiral bowls etc. The Helix Spiral alone will give you a final smelting grade product.

Head ore: The Spiral unit is an excellent tool for bulk testing head ores, a valuable asset for exploration of your ore body. For example, collect 10 buckets of raw head ore and run them through the Spiral as a batch. You can pick out the big rocks or break up chunks of clay by hand, but best results are achieved by screening the sample down to 1/4”. Just make a sturdy screen with a wooden frame.

Milled ores:

You can feed milled ores direct to the Spiral in batches or in continuous fashion just like any other ore. For best results, we recommend 3 passes for milled ores. By nature, milled hard rock ores contain larger percentages of heavier minerals and metals and sometimes categorized as complex ores.

You will work down the ore concentrate as described previously. However, finely milled ores most often contain gold particles in the extra fine range, and therefore require a bit more care in terms of tightening the cuts and water volume. Extra fine gold particles tend to float out if you are not careful. But as always, by observing and adjusting, and sampling your discharge, you can dial in the Spiral and obtain excellent results with milled ores.

Angle adjustment - the normal 10” gap is the recommended operating height for all ores and concentrates. However a slightly lower angle can be used with fine milled ores and with extra fine gold particles. As always, sample the discharge when making any adjustment. In this scenario, you would need to slow down the feed rate.

Another characteristic that differs with milled ores is the fineness of the material i.e. finely ground rock. In one sense, this is an advantage because in most cases, you can achieve a higher reduction in volume (concentration ratio) as compared to alluvial ores due to the fact that the finely ground host rock washes, separates and discharges quite easily. For this reason, you can expect a higher volume output as compared to alluvial ores, up to 2 ½ to 3 tons/hour.

Grind size is another factor in recovery of free gold particles from milled ores. Physical separation methods will have varied results depending on the complexity of the ore, and the output size (grind size) produced by your mill. In general, physical recovery using gravity means is more efficient with a coarser grind size. A grind size of 20-80 mesh is ideal. The coarser the better. However, the other aspect to recovery from milled ores is the grind size, and at what point you achieve complete liberation of the gold particles. Physical recovery (non chemical) is a “free gold recovery. You cannot recovery gold particles that are still locked into the host rock. Best results are a balance of both ideal grind size and complete liberation. In some cases, operators choose to use a coarse grind for an initial recovery. And then regrind the tailings if there are worthwhile values left in the host rock. As opposed to over grinding to a super fine powder where the chances of loss is greater.

Maintenance:

Casters: The unit has 4 support casters and the small guide caster. For heavy use, grease the bearings once a week. For light occasional use, less often. These are standard bearings, and as in all bearings, water and grit will cause wear. The castors are off the shelf and can be replaced. If you can't find a replacement, we can send them to you. With care, they should last for years.

Spray heads and spray bar: Depending on the water quality, you may need to clean them on occasion due to residue buildup which can clog the holes. You can tell if they need cleaning by observing the spray pattern. Cleaning is a matter of disassembling them and using soap and water and any homemade tool, rod or wire.

Filter: If your unit came with a Helix disc filter, keep you eye on the 2 pressure gauges. Static pressure (true pressure) is measured with the control valves closed. During operation, the inlet side will show your source pressure and the outlet side is your actual operating pressure. In operation, the difference between the two pressures will tell you when the filter needs cleaning. The greater the difference, the dirtier the filter. Just remove the canister and take the discs apart, clean and reassemble. This can be done in the field.

Liner: The liner is made from a high quality RTV silicone and requires no maintenance whatsoever. It will last many years. However, the silicone may react to certain chemicals and solvents, or gasoline and diesel. We still have, and use a Spiral with the original liner that is 25 years old.

For additional help, you can call us at 214-736-8554

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