ICMJ's PROSPECTING and MINING DUPRNAL



10 KEYS TO PROSPECTING LIKEAPRO

SLUICING AND DETECTING DOWNSTREAM

PRACTICAL ADVICE FOR MILLING HARD ROCK ORES

HARD ROCK 101 MICRO BLASTING

> Melman on Gold & Silver and The BEST Classified Ads!

HARD ROCK 101: MICRO BLASTING

by John Norman

In our first two articles, we covered the basics of rock drilling and mechanical breaking. This month, we are going to introduce a new topic: explosives.

Specifically, we are covering smallscale techniques that can be used by a one- or two-man operation without the need for permits or licenses in most cases. These "micro blasting systems" are sold as a combination of tooling and propellant cartridges that, used together, can break up to a half cubic yard or more of very hard rock in one blast.

We will cover two commerciallyavailable systems—the EZ Break and the Sierra Blaster. There is also a third system called the Boulder Buster on the market. It is a more specialized industry tool that requires the use of a large pneumatic drill, so we won't discuss it here.

(Note: "Micro-Blaster" is a registered trademark of Ezebreak, LLC. In this article, we will be using the term "micro blasting" to mean smallscale blasting generically, and not a specific vendor's system.)

When is This Method a Good Fit?

Micro blasting can be an excellent technique for the small miner. The tools are lightweight and can be packed in. It can be used as a way of getting at placer deposits that were previously untouched due to rock cover. Micro blasting can be used to take down hanging rock, separate minerals from overburden, and collect gemstones and other high-value product with minimal damage.

This technique excels at breaking up free-standing boulders that are too heavy to move by other means. It can be used as a secondary process when expanding grout, heavy equipment or larger explosives generate big rock fragments. It is also used by cave rescue teams to remove obstacles and expand tight passages.

One other advantage to owning a micro blaster is that it offers a way to gain experience in blasting that can be used towards eventually becoming a licensed blaster. States such as California have requirements such as "three years documented experience

with electric or non-electric blasting." The two systems we discuss below have been used successfully in building that book of experience.

Safety All types of blasting can generate dangerous fly rock. While this is minimized in micro blasting, sharp fragments of rock and flying tools can cause injury. All rock that is above ground level contains stored energy from gravity and can crush or kill when suddenly released by a blast.

This type of blasting cartridge is not able to explode if ignited unconfined, but electrical currents, lightning and sparks can cause them to detonate and cause injury during the



This is a size comparison of 500 g emulsion stick (normal blasting) vs. Sierra Blaster cartridges used in micro blasting.



Let them know you saw it in ICMJ's PROSPECTING and MINING JOURNAL • July 2020

loading process if care is not taken. No explosives should ever be handled if a lightning storm is approaching, and your head and other body parts should be never be positioned over a hole during the loading operation. If cartridges must be pushed into a hole, a wooden dowel should be used. Personal protective equipment for this activity includes safety glasses, gloves and steel-toed boots. Fly rock can be controlled with simple canvas tarps or pieces of used conveyor belt.

Legal Status

In the US, all explosives are regulated federally by the Bureau of Alcohol, Tobacco, Firearms and Explosives (ATF). Buying and using explosives generally requires a Federal Explosives License (FEL). The ATF has a number of exceptions, such as smokeless powder used for reloading ammunition and up to 50 lbs/year of black powder for "sporting and cultural purposes." Note that blasting is *not* one of the exempt purposes, so you technically need an FEL and an approved magazine to use and store gunpowder for blasting rock, even though it can be legally purchased for other uses.

The makers of the systems we will be discussing have obtained a specific ATF exemption for their respective products. The cartridges are classified as "Articles Pyrotechnic" (a type of "professional use only" product)



Holes drilled for micro blasting must be cleaned out before any explosives are loaded. This is an air type blower used to clean the hole.

and the manufacturers are allowed to sell them to a non-licensee. In order to purchase the cartridges for either system, the manufacturer's training must be completed online.

In some jurisdictions, such as Massachusetts, you may still be required to obtain a state blaster's license in order to use these systems. And while they can be plausibly referred to as a "powder-actuated tool," some BLM or USFS offices might ask for a "Notice of Intent" or a "Plan of Operation" if you are micro blasting. I believe the intent of the regulations is to cover only operators that could leave behind large-scale surface disturbances or HAZMAT such as abandoned dynamite, but your local office may feel differently.

Blasting Basics

Most mining done with explosives involves this basic process:

1. Holes are laid out and drilled to the proper depth (see Part 1, May 2020 issue, for information on rock drilling).

2. Rock dust and chips are cleaned out as necessary.

3. An explosive charge is placed at the bottom of the hole.

4. The rest of the hole is filled with stemming such as sand or gravel to contain the energy of the charge.

5. The charge is detonated, causing a shock wave, followed up quickly by expanding gases that first crack and then heave out the rock burden.

In micro blasting, we are doing the same thing, with a few small differences:

1. The holes are much smaller (typically 5/16" or 10mm vs. 1.5-4").

2. The charges in each hole are smaller (1-5 grams vs. 50-5000+ grams)

3. The explosive material is typically a propellant, which deflagrates (more on this later) and breaks the rock primarily through over-pressure.

4. Instead of sand or other bulk stemming material, micro blasting uses a special tool that seals up the hole and provide the means to initiate the charge.

What Goes on Inside a Blast Hole

To understand how this works, we should take a quick look at what is going on when we blast. With conventional mining explosives, there are three parts to the charge we place down a hole:

1. An electric or non-electric blasting cap that explodes on command, shooting a high-energy shock wave into the booster. This is typically inserted into the booster and placed at the very bottom of the hole.

2. A high explosive booster charge that is "cap-sensitive" and detonates from the blasting cap. Cast boosters and dynamite are typical products used for this.

3. A quantity of bulk blasting agent such as ANFO. This material is not very sensitive and needs the booster to set it off. Smaller blasts may omit this component, relying on a larger, single charge of dynamite or emulsion product.

It's important to note that the explosives used in conventional mining will explode whether or not they are confined inside of a borehole. Setting them of in a pile on the ground will result in a very large air blast, a lot of noise, and dirt/rock being violently thrown.

By contrast, the material used in micro blasting is classified as a "propellant." Typical ingredients are nitrocellulose and similar compounds used in rifle and pistol ammunition. It is set off by a shotgun primer or an electric "hot wire" igniter. Approximately one liter of gas is generated per gram of material used. If materials are ignited outside of a borehole, the cartridge will pop open and the powder will burn with similar intensity to a firework.

If the cartridge is ignited at the bottom of a well-stemmed hole, however, something different happens. As the material burns, pressure and temperature begin to rise quickly. This causes the burning or "deflagration" to proceed faster, generating more heat and more pressure, in a "synergistic" type of reaction that becomes so violent that it is almost indistinguishable from that of a high explosive.

As the pressure inside the hole climbs into the 100's of thousands of pounds per square inch (PSI), the rock begins to come apart at its weak points and split into big fragments. Once this happens, the pressure drops and the reaction fizzles out, with any unburned powder simply burning off. Once key point with micro blasting is that the harder the rock is, the better it works. While conventional explosives will work just fine in rotten rock or even gravel, micro blasting requires sound rock that can contain the expanding gases long enough for pressure to build up.

Rock Dynamics

With conventional or micro blasting, the rock expands and moves in the direction of least resistance. The more "free faces" or areas for the broken rock to expand into, the more work can be done per blast. The results of a single-hole blast can be anything from a "spider web" of cracks to a 2-foot cube of rock being shattered into fragments that one person can easily pick up. Free-standing boulders are all free faces and break very easily. It is realistic to break up and remove a car-sized rock with these tools and a few hours of work.

At the other extreme, a solid wall of granite is much more challenging to blast. The micro blasting heads either need to be placed in a way that



Let them know you saw it in ICMJ's PROSPECTING and MINING JOURNAL • July 2020



Both the Sierra Blaster and EZ Break require a weight to hold in the explosion while the gasses expand. This shows a Sierra Blaster two-hole blast with two heads on top of the cartridges.



This is a photo taken after a successful micro blast, showing a fully shattered boulder broken into large pieces. The worst case in this type of blasting yields just a piece or two blown out or it just cracks in place.

ejects a "wedge" of material, or large holes need to be drilled nearby to provide relief for the rock to move into.

A "dice" pattern of 4 holes in a square is one way to break a very large boulder into pieces, while a 'V' pattern with angled holes can be used to create the wedge cut described above. A line of holes can be drilled and fired to slice a section off a boulder or rock outcrop. For long sections, every other hole can be empty and simple placed to help the rock crack in a line.

Getting Hands-On

Both blasting systems are sold as a kit containing one or more firing heads, a selection of drill bits, tools for cleaning out the bore holes, and a means of firing the charges. With both the EZ Break and Sierra Blaster, multiple blast holes can be set up and fired simultaneously.

A kit with all necessary materials for single-hole blasting weighs around 10 pounds for either system. They are available mail-order from several dealers, and the blasting cartridges can be shipped directly to your door, although there is a HAZMAT charge.

Either type will work with a cordless, lightweight, 110V SDS+ hammer drill, and the energy source for firing can be portable. In testing, we found that either system will break rock similarly, but there are key differences such as water-resistance and support equipment needs.

EZ Break. The EZ Break Micro-Blaster uses a single type of powder cartridge, a red paper cylinder with a #209 shotgun primer on one end and approximately one gram of fast, double-base smokeless gunpowder inside.

The firing head consists of a heavy, machined, steel cylinder fitted to a long steel rod that gets placed in the hole. Inside the head is a pneumatic plunger that sends a long firing pin into the cartridge below it when triggered with a blast of compressed air. The firing pin and other parts are user-serviceable. The head is well-made and comes with a nice oxide finish. According to the manufacturer, basic care includes cleaning and light oiling, similar to a firearm.

The kit contains a tough pneumatic hose and a CO_2 -powered "inflator" device that will initiate one head without any external air source. A connector and air fittings are also available to allow 3 or more heads to be fired from the compressed air source of your choice. Also in the kit is a brush and a nice air-blower bulb for cleaning rock dust from the holes.

The drills sold for this application are 5/16" in diameter and available in lengths up to 18" long. With a clean, straight, 18" hole, up to (4) EZ Break cartridges can be loaded in one hole. We found that it takes some practice in order to drill a straight hole this deep, as small diameter drills are not very rigid. Best results are obtained by starting with a short "stub drill" and changing bits in 2-4" increments as the hole progresses. Frequent cleaning of rock dust is also a good idea.

Once the hole is drilled and cleaned to the extent possible, one or more cartridges are dropped into the hole. It's best to insert them one at a time and use a wooden stick to press each one into place. Placing them all at once may result in a jam-up. Cartridges are loaded primer-up and should be placed as far into the hole as possible and touching one another.

Next, the firing head is made ready. The operator double-checks that the air source has been disconnected and resets the firing pin between shots by pushing it all the way inside using a small piece of wire. A magnet inside holds everything in place until firing. The firing head is carefully in-



This shows all the items in a Sierra Blaster three-hole kit, including heads, connector cables and drills.



ready to ship!!!

"One of my best purchases for hard rock mining.... I've owned it for almost a year now and have pushed it beyond it's limits with no problems." —Terry, CA

FOLLOW US ON FACEBOOK OR VISIT OUR WEBSITE FOR EQUIPMENT VIDEOS!! Visit **www.goldbeltglobal.com** to learn why this is the perfect set of machines for prospectors and small-scale miners!

OLESI 8 Orbital Crusher Max feed: 8" Min crush: 3/8" Manganese wear Crush rate: 1tph Weight: 526 lbs Price: \$6200

(Also available: OLESI 4 & OLESI 12)

DC24 Impact Crusher

Max feed: 3" Min crush: 100 mesh Manganese hammers Crush rate: 1000 lbs/hr Weight: 589 lbs Price: \$5800 (Also available: DC36 Impact Crusher) Hopper Feeder Visit us on Facebook for a video of this NEW MACHINE in action!!

OL 4 Reciprocating

Portable, light-weight and reliable option for precise metered feeding of your OLESI 4 Sample Crusher or other small equipment. Only \$649

1-377-502-7/37/2

www.goldbeltglobal.com

Let them know you saw it in ICMJ's PROSPECTING and MINING JOURNAL • July 2020

serted down the hole until it is in close contact with the top cartridge. A light twisting motion can ensure it is fully seated. At least 6" of the rod should be embedded in the rock to ensure proper containment of the blast energy.

When the firing head is ready, the operator retreats back to a safe area, attaches the air source and triggers the firing pin with compressed air. There is no specific limit to the number of heads that may be fired simultaneously, but most operators seem to use from one to three. A larger air source such as an air tank or bulk CO₂ bottle is necessary if using more than one head, and the plumbing does need to be tested for leaks before use.

Sierra Blaster. The Sierra Blaster works similarly to the EZ break Micro-Blaster, but has key differences. First, the system uses electricity instead of compressed air for firing, so the blasting heads have no moving parts. Secondly, the whole system is designed to be water-resistant, so it can be used for tasks such as breaking



A standard blast trigger device like this one can be used to set off the Sierra Blaster; the EZ Break unit uses a CO_2 inflator to trigger.



up rock in a moving creek, and water can be added to holes for better energy transmission. Third, the Sierra Blaster heads come with a "leash" system that allows the heads to be tethered to a hanger screwed into the rock. This helps prevent damage to the head or wiring, especially when blasting into a vertical face.

There are two types of cartridges sold with the Sierra Blaster-electric main cartridges and "booster" cartridges that contain only powder and no igniter. Up to two of these can be dropped down a hole, in addition to the main charge. According to the maker, each cartridge contains 1 gram (+/- 5%) of a smokeless gunpowder product. As with the EZ-Break, the rod must be solidly embedded into the rock. According to the directions, the leash system should always be used to prevent the head from being damaged. It can be attached to a nearby boulder or clipped to the rock using the supplied drill bit, concrete screw and hanger.

The Sierra Blaster utilizes a 10mm hole diameter, which is about 25% larger than the EZ-Break. These drills can be hard to find in hardware stores, but Sierra Blaster sells a line of drill bits up to 24" long under the name "Sierra Tuff." The bits are good quality, and are available in two types for various rock conditions.

The hole-cleaning device supplied is a modified air pump, which pushes more air down the hole than a bulb type blower. Various cables, firing line and electrical accessories are supplied with the kit for hooking up a single- or multiple-head shot.

This takes us to one potential disadvantage—the need for electrical power. The recommended firing system is a 110V generator. This is not a problem for a surface mining operation, but is not practical for underground use. We tested a variety of firing methods, and found that the following would work:

• A 400W pure sine-wave inverter unit from Samlex installed in our truck successfully fired 4 heads.

• A 1-joule pocket-sized blasting machine used for firing explosives reliably fired one head.

• The cheap, imported, 800W 2-cycle generators sold under various names will fire a 4 head shot.

The Sierra Blaster heads can be purchased in either lightweight aluninum or heavier stainless-steel nodels. The manufacturer recomnends placing rocks or sandbags over other type to improve performance, and states that it's required for the aluminum type.

The wiring connections and electrial parts are probably the only weak point of this system. It is possible to kink or break the somewhat delicate wires from the electric cartridge, and the electrical cables and connectors, while heavy-duty, can be damaged by rockfall.

Conclusion

Micro blasting is a very useful tool for man-portable, small-scale blasting. The two systems available both to the job. The amount of explosive material used in each one is basically the same due to ATF regulations, and performance on free-standing rock appears to be similar.

Blasting cartridges for either retail for \$1-2.50/each, and the tooling costs are roughly similar, depending on the options purchased. If there is a dealer in your area, you might consider them first, as buying the cartridges n person saves the \$40 HAZMAT fee UPS charges.

Happy mining!

Sources

Aaron Klemenok, President, Sierra Blaster, LLC.

Carroll Bassett, BMS Rescue Equipment

Charles Harrod, Blasters Tool & Supply Co., Inc.

Paul Stovall, SBSD Cave & Technical Rescue Team

Paul Spickler, Sierra Blaster Dealer

Sierra Blaster On-line Certification: https://www.sierrablaster.com/ cartridge-certification/

EZ Break Micro-Blaster Training Videos: https://www.ezebreak.com/ rideos/

John been involved in prospecting, rock hounding and amateur mining for 20+years and is a licensed blaster. He currently serves on a Search & Rescue team that covers abandoned nines and other underground rescue n San Bernardino County, CA. He welcomes questions via email: norman@accxproducts.com

SLUICING AND DETECTING DOWNSTREAM by Matteo Oberto

During the 2019 gold prospecting season, I became part of a bigger detecting team, composed of myself and three good friends. Luca is my best friend and he is very knowledgeable about how to use metal detectors. Giacomo sells army surplus items at his shop in Turin, in northwest Italy. Lorenzo is an amateur and is curious to know all about gold prospecting.

As a geologist specializing in gold and gem prospecting, I try to share my geology and mining knowledge with the team. Mainly, I look for undiscovered gold-bearing alpine veins and gold-rich placers in Italy. We formed this group about a year ago. I explained to them how to look for gold flakes and nuggets using crevicing and panning techniques, and how to set up a sluicing operation properly in order to get the best yield. Above all, we search for gold-rich resources, where a small-scale mining operation could be started.

During our recent prospecting trips, Luca was our detecting instructor. He learned how to use detectors and accessories in Australia years ago thanks to his several journeys in Victoria looking for gold nuggets. Then, he had to move to Italy due to his job, and the "gold fever" followed him. Over the years, he realized that the Italian country is not just rich in touristic attractions, but also in gold nuggets. We purchased several detectors-both VLF (very low frequency) and PI (pulse induction) machinesand then we started looking for gold nuggets in the alpine rivers of Italy.

We soon realized this way of detecting is not so easy. In fact, most Italian watercourses are heavily pol-



et them know you saw it in ICMJ's PROSPECTING and MINING JOURNAL • July 2020